BOX HILL NORTH MASTERPLAN

Species Impact Statement

For:

J. Wyndham Prince

May 2015

Final

PO Box 2474
Carlingford Court 2118

Report No. 15062RP1

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 recommendations 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	7/5/15	AP	
2	8/5/15	KW	

Approved by: David Robertson

Position: Director

Signed: David Robertson

Date: *8 May, 2015*

CUMBERLAND ECOLOGY

DECLARATION:

I, Matthew Scard, of E.J.Cooper & Son Pty Ltd., being the applicant in relation to a Staged Development Application (DA) for a new residential community within the Box Hill North Precinct, being:

- Lots 15-18, Lots, 21, 23, Lots 25-27, Lots 29-31, Lots 40 & 41, and Lots 43-47; in DP 255616;
- Lots 1 -3 in DP 11126;
- Lots 4A & 4B in DP 135304;
- Lot 1 in DP 207750;
- Lots 9 & 10 in DP 593517;
- Lot 5 in DP 658286; and
- Lot 1 in DP 564211.

at Box Hill North in the Hills Local Government Area 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.

Signed:

MATTHEW SCARD.

Date: 10th DECEMBER 2014.

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Glossary of Terms

Abundance	Quantification of the population of the species or community
Affected (C)EECs/species	Subject species, populations and communities likely to be affected by the approved components of the project
APZ	Asset Protection Zone
Box Hill North	389 ha parcel of rezoned land including existing infrastructure that is the study area for the SIS
CEEC	Critically Endangered Ecological Community.
(C)EECs/species	Collective term for Critically Endangered and Endangered Communities and Species
Conservation status	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
CPW	Cumberland Plain Woodland
DA	Development Application
DBH	Diameter at Breast Height
Development	As defined in the EP&A Act
Director-General	The Director-General of the Department of Premier and Cabinet
DoE	Department of the Environment
EEC	Endangered Ecological Community
EP&A Act	NSW *Environmental Planning and Assessment Act 1979*
EPBC Act	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*.
Future Development	The footprint of proposed urban and commercial development of Box Hill North
ILP	Indicative Layout Plan
LGA	Local Government Area
Locality	The area within a 5 km radius of the centre of the study area
MNES	Matters of National Environmental Significance
OEH	The NSW Office of Environment and Heritage. The OEH is a division of the NSW Department of Premier and Cabinet
PCA	Priority Conservation Lands as listed in the Cumberland Plain Woodland

	Recovery Plan
PMST	Protected Matters Search Tool
Proposal	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 Director-General under subsection (4)) to be appropriate for those purposes. In this case, the Bioregion refers to the Sydney Basin Bioregion
RFS	Rural Fire Service
SEPP	State Environmental Planning Policy
SIS	Species Impact Statement
SSTF	Shale Sandstone Transition Forest
Subject species	Threatened species that are known or considered likely to occur in the study area
Study area	The area of land encompassed by the current DA that is likely to be affected, either directly or indirectly, by future development. For the purposes of this SIS, the study area includes land within the Box Hill North Precinct (also referred to as Box Hill North)
The Hills LEP 2012	*The Hills Local Environment Plan 2012*
TSC Act	NSW *Threatened Species Conservation Act 1995*
Threatened species, populations and ecological communities	Has the same meaning as in the TSC Act and/or EPBC Act
VMP	Vegetation Management Plan

Executive Summary

The purpose of this Species Impact Statement (SIS) is to assess the impacts on threatened flora and fauna that could arise from future development within 380 ha of land proposed to be rezoned under an amendment to *The Hills Shire Local Environment Plan 2012* ('The Hills LEP 2012') along Boundary Road, at Box Hill North (the "study area" or "Box Hill North"). The proposed rezoning is currently with the Department of Planning and Environment (DP&E) awaiting gazettal.

This SIS has been prepared to accompany a Staged Development Application (DA) or Master Plan DA for the development of a new residential community at Box Hill North as the staged developments have potential to contribute to a cumulatively significant impact on threatened flora and fauna. The preparation of this SIS provides an opportunity to assess the total cumulative impacts of future development of the study area and to present a suite of conservation and offset measures to address the predicted impacts.

The study area occurs within The Hills Local Government Area (LGA) and is currently used for low density farming, grazing for cattle, horse stables, and small market gardens. Although patches of vegetation occur across the study area, the area is largely cleared as a result of current land uses and contains modified areas, such as a farm dams, storage areas, paths and driveways.

The study area generally bound by Maguires Road to the north, Janpieter Road to the east, Old Pitt Town Road to the south and Boundary Road to the west, and includes the following lots:

- Lots 15-18, Lots, 21, 23, Lots 25-27, Lots 29-31, Lots 40 & 41, and Lots 43-47; in DP 255616;
- Lots 1 -3 in DP 11126;
- Lots 4A & 4B in DP 135304;
- Lot 1 in DP 207750;
- Lots 9 & 10 in DP 593517;
- Lot 5 in DP 658286; and
- Lot 1 in DP 564211.

This SIS has been designed to fulfil two purposes. First it been prepared to address the requirements of Section 109 and 110 of the NSW *Threatened Species Conservation Act 1995* (TSC Act) and the requirements of the Director General of the Department of Premier and

Cabinet, which includes the Office of Environment and Heritage (OEH). Secondly, it concurrently assesses the impacts of future development on matters of national environmental significance that are listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). This SIS includes requirements requested by the Commonwealth Department of the Environment (DoE) for assessment under a process called "preliminary documentation".

Within this document threatened species and endangered ecological communities are as defined within the schedules of the TSC Act and EPBC Act.

S1 Background

The proposal is to rezone a 380 ha parcel of land (including roads and other infrastructure) at Box Hill North to accommodate a new sustainable and high quality residential community comprising 4,100 dwellings, a 5.5 ha town centre, active and passive open space, a primary school site, new roads and infrastructure.

It is proposed to rezone the area known as Box Hill North from RU6 Transition to R1 General Residential, R2 Low Density, R3 Medium Density, R4 High Density, E2 Environmental Conservation, E4 Environmental Living, B2 Local Centre and RE1 Public Recreation under The Hills LEP 2012. It is proposed to apply the RE1 Public Recreation zone to all riparian corridors (existing and proposed), parks and sporting fields within the study area. This land is to be dedicated to Council.

In terms of protecting the vegetation present within the proposed RE1 Public Recreation zone, under the NSW *Local Government Act 1993* (LGA Act) Council must prepare and implement a Plan of Management for this land. Chapter 6, Part 2, Division 2 of the LGA Act sets out a number of elements that must be addressed in a plan of management including requirements for land that includes endangered species and ecological communities.

The Planning Proposal was forwarded to the DP&E in June 2014 for finalisation and gazettal.

Since European settlement, Box Hill North has been used for agriculture and grazing and the vegetation has been extensively cleared and modified. The remaining vegetation exists in relatively isolated patches and has been modified by long-term impacts such as grazing by cattle, urban run-off, weed invasion, nitrification, edge effect and human disturbance, such as storage of agricultural machinery/material and dumping of rubbish and garden clippings. Remnant vegetation in the study area includes some forest and woodland which will be impacted by the current proposal.

Ecological investigations were completed to support the planning proposal and these recognised that rezoning will allow for subdivision and intensification of development across a large proportion of the study area. Such future development will impact on Critically Endangered Ecological Communities (CEECs) and threatened species listed under the TSC Act and EPBC Act that occur within the study area. In particular, development of the study area is likely to have impacts on Cumberland Plain Woodland (CPW) and Shale Sandstone Transition Forest (SSTF), which are both listed as CEECs under the TSC Act and the EPBC Act.

A referral was submitted to DoE and the developments associated with the rezoning have been collectively declared a controlled action under the terms of the EPBC Act due to the predicted impacts on CPW and SSTF. Further assessment of such impacts is therefore required to meet Commonwealth requirements. That assessment is to take the form of what is known as "preliminary documentation". This SIS has been prepared to be used as preliminary documentation for the Commonwealth process, as well as for the NSW assessment process.

After consideration of the current condition of threatened vegetation in the study area, Cumberland Ecology has recommended that the following points are adopted in the rezoning:

- Creeks should be considered as focal points or areas for the future conservation of forest and woodland in the study area;
- The creek linking the western portion of CPW is zoned for conservation and actively regenerated to form a north western patch of CPW;
- The riparian area containing the SSTF with large old trees with hollows is zoned for conservation and actively managed to form a north eastern patch of SSTF;
- The eastern “bulge” of SSTF, which is younger regrowth, should also be considered for retention but could be amenable to retain within larger lots of land, with appropriate mechanisms in place to encourage tree retention; and
- Remaining smaller patches of CPW be either considered for retention (if this can feasibly be done, considering all other factors during the rezoning), or, if cleared, then a suitable offset be provided off site to compensate for the loss due to clearing.

This SIS provides further details of the conservation and offset measures for flora and fauna for Box Hill North.

S2 Proposal

The current proposal involves seeking development consent for a Staged DA (Concept Proposal or Masterplan DA) for a new residential community at Box Hill North, including dwellings, a town centre, a school, parks, pedestrian and cycleway networks, passive open space, roads and associated infrastructure.

Given the likely extent of the impacts from the development of the study area as a whole this SIS considers the impacts of the broader development of the study area and provides an overarching Species Impact Statement that largely addresses ecological issues related to the future development of Box Hill North.

An indicative layout plan is provided within this SIS to show the extent of revegetation and conservation available, as well as indicating the extent of the development footprint.

The planning proposal presents a biodiversity strategy that:

- Secures the conservation of native vegetation on the site that is likely to continue to deteriorate under the existing management regime for the site (i.e. continued rural / farming use or subdivision of the site into 2 hectare parcels and the construction of up to 200 houses) and potential worsening of edge effects;

- Retains the better quality patches of CPW and SSTF on the site (approximately 3.6 hectares of CPW and 7.1 hectares of SSTF), along existing creeks lines and riparian corridors, and where the prospects for the practical long term conservation of vegetation are increased;

- Outlines a commitment to undertake re-vegetation and improvement works of retained areas of native vegetation. This is to be implemented through the preparation and implementation of vegetation management plans and is identified in the voluntary planning agreement; and

- Recognises that additional off site offsets are to be purchased to compensate for the loss of remaining vegetation, namely the purchase BioBanking biodiversity credits, the quantum and type to be determined via a BioBanking assessment.

In this context, the loss of a limited amount of poorer quality vegetation is considered acceptable.

S3 Methods

Detailed flora and fauna investigations have been conducted across the Box Hill North area by NGH Environmental in 2013 and Cumberland Ecology in 2013 and 2014. These studies collectively provide baseline information about the existing flora and fauna across the study area. Methods used in the surveys are explained within the SIS and included database analysis, literature review and field surveys.

S3.1 Database Analyses

EPBC Protected Matters Search Tool (PMST) and a NSW Atlas of NSW Wildlife searches were conducted for the study area and the surrounding locality (5 km radius). These searches identified the threatened ecological communities and flora and fauna species which had potential to occur on site. These searches were used as a basis for later field surveys.

S3.2 Literature Review

Relevant literature was reviewed, including 2013 ecological investigations of the study area by NGH Environmental and Cumberland Ecology. Regional vegetation mapping of the locality and literature about endangered ecological communities and threatened species was also reviewed.

S3.3 Habitat Assessments

Habitat variables were measured within 20 BioBanking plots. These entailed the collection of 10 measurements of habitat quality within 20m x 50 m plots following the BioBanking Assessment Methodology (BBAM).

S3.4 Flora Surveys

Flora surveys were conducted by NGH environmental from 13-15 May 2013. These surveys consisted of 5 random meander transects and 34 inspection points.

Flora surveys were carried out by Cumberland Ecology on four occasions in June and September 2013, and in July 2014. These surveys involved comprehensive surveys of vascular plants, grasses, and forbs utilising a total of 20, 20m x 20m quadrats throughout the main remnant habitats in the north-west and north-east as well as amongst the scattered trees in the southern, central and north-eastern sections of the study area. Additional surveys were conducted during September 2013 to determine the presence of any threatened flora identified as potentially occurring based upon the suitability of habitat in the study area.

During October 2013 random meander transects were conducted in the northern sections of the study area, specifically targeted to determine whether the threatened shrub *Dillwynia tenuifolia* occurs on the study area.

S3.5 Fauna Surveys

Fauna surveys undertaken by NGH Environmental and Cumberland Ecology and included:

- Nocturnal call playback and spotlighting of waterbodies previously identified as suitable habitat for the Green and Golden Bell Frog (*Litorea aurea*);
- Trapping of terrestrial and arboreal mammals using Elliot A and B traps;
- Infra-red camera surveys for nocturnal and diurnal large mammals;
- Microchiropteran bat surveys through ultrasonic detection;
- Extensive random meander transects searching for the Cumberland Plain Land Snail (*Meridolum corneovirens*); and
- Incidental detection of bird species.

S3.6 Mapping

"MapInfo" geographic information systems mapping software was used to prepare vegetation maps, fauna maps and other maps for the SIS. The vegetation of the study area was mapped based on ground and aerial assessments of all remaining native vegetation and after consideration of pre-existing regional vegetation mapping. Vegetation polygons were first drawn from aerial photography, then ground truthed and rectified based upon interpretation of plot based samples, and rapid data assessment points.

S3.7 BioBanking Assessment of Offsets

Biodiversity offsets have been provided as part of a suite of measures to address the predicted ecological impacts of future development. The BioBanking credit calculator was used to objectively assess the impacts of future development across Box Hill North and to

help guide the formulation of an offset package. Offsets were procured via purchase of BioBanking Credits for CPW and SSTF. Areas of the relevant offsets obtained have been quantified using a pro-rata calculation of available credits at offset sites.

Detailed descriptions of the methods are provided within this SIS.

S4 Vegetation of the Study Area

The vegetation within the study area before European settlement would have comprised CPW and SSTF. These communities now exist in various degrees of degradation, and none of the communities are represented in a remnant formation. This report recognises that there are 5 types of vegetation communities as well as non-vegetated areas across Box Hill North. These include:

- Cleared land including driveways, farm dams, houses and associated yards, sheds, and market gardens;
- Exotic Vegetation: Planted and/or heavily degraded vegetation, which includes a mix of natives, exotic garden species and weeds. This area contains no native canopy or mid-storey and only very limited native ground cover, dominated by weeds and/or lawns;
- Scattered Trees: Native trees which have no native shrub layer or understorey and largely exist as single trees scattered across the study area;
- Acacia Regrowth: *Acacia parramattensis* (Parramatta Wattle) regrowth along a man made drainage line with an exotic groundcover;
- Cumberland Plain Woodland: CPW in moderate condition with no mid-storey and a weedy ground-cover with less than 50% native foliage cover; and
- Shale Sandstone Transition Forest: SSTF in moderate condition with a native canopy, no mid-storey and a weedy ground-cover with less than 50% native foliage cover.

All five communities are present within future development areas (ie areas that will be cleared) across Box Hill North. The majority of areas to be cleared occur within land owned by the proponent EJ Cooper Pty Ltd.

S5 Impacts of the Proposed Development

S5.1 Direct Impacts

S5.1.1 Vegetation Communities

The development of the study area will result in the clearance of 20.3 ha of native vegetation comprising 9.8 ha of CPW, 6.2 ha of SSTF, 3.2 ha of Scattered Trees and 1.1 ha of Acacia Regrowth vegetation as well as removal of existing dams.

For the purposes of the impact assessment, it is assumed that all native vegetation within the study area, unless specifically marked for retention, will be cleared under a worst-case scenario. Stands of scattered native vegetation within the study area will be retained where possible during future planning processes. Areas of vegetation to be removed or retained as part of the development of Box Hill North are provided in **Table S.1**.

Table S.1 Comparison of vegetation community areas within Box Hill North

Vegetation Community	Total Vegetation in study area	Vegetation to be retained within the study area (ha)	Vegetation to be removed from the study area (ha)	Vegetation to be removed from the study area (ha) within areas owned or controlled by EJC Pty Ltd
Cumberland Plain Woodland (CEEC)	13.4	3.6	9.8	9.1
Shale Sandstone Transition Forest (CEEC)	13.3	7.1	6.2	6.2
Scattered Trees	3.3	0.1	3.2	2.5
Acacia Regrowth	1.1	0.0	1.1	1.1
Exotic Vegetation	236.2	7.6	228.6	198.2
Total Native Vegetation	31.1	10.8	20.3	18.9
Total Vegetation	267.3	18.5	248.9	217.1

S5.1.2 Threatened (C)EECs/Species

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 occur within the study area and that will potentially 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 minor impacts to habitat, either directly or indirectly.

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

- Cumberland Plain Woodland;
- Shale Sandstone Transition Forest;
- Cumberland Plain Land Snail (*Meridolum corneovirens*);

- Spotted Harrier (*Circus assimilis*);
- Grey-headed Flying-fox (*Pteropus poliocephalus*);
- Eastern Freetail-bat (*Mormopterus norfolkensis*);
- Yellow-bellied Sheathtail-bat (*Saccolaimus flaviventris*);
- Eastern Bentwing-bat (*Miniopterus schreibersii oceanensis*); and
- Southern Myotis (*Myotis macropus*).

Additionally consideration has been given to the following migratory species as listed under the EPBC Act:

- White-bellied Sea-Eagle (*Haliaeetus leucogaster*); and
- Cattle Egret (*Ardea ibis*).

Although these two species are not listed as threatened, impacts to these species have been considered due to their listing as migratory species under the EPBC Act

No threatened flora have been recorded within the study area, but some have been conservatively considered to have potential habitat. These include *Dillwynia tenuifolia* Sieber ex D.C. population in the Baulkham Hills Local Government Area, *Dillwynia tenuifolia*, *Acacia pubescens*, *Grevillea juniperina* subsp. *juniperina* and *Pultenaea parviflora*.

The following fauna species have not been recorded within the study area, but have the potential to use the site as vagrants for foraging or roosting habitat. The habitats within the study area do not provide significant habitat for these species. They will experience a potential loss of foraging habitat to a relatively minor degree. For this reason the following fauna species have been considered to be minor affected species and includes mammals such as Greater Broad-nosed Bat (*Scoteanax rueppellii*), Eastern False Pipistrelle (*Falsistrellus tasmaniensis*), and Yellow-bellied Glider (*Petaurus australis*). Threatened birds with the potential to occur in the study area include Diamond Firetail (*Stagonopleura guttata*), Flame Robin (*Petroica phoenicea*), Scarlet Robin (*Petroica boodang*), Turquoise Parrot (*Neophema pulchella*), Swift Parrot (*Lathamus discolor*), Little Eagle (*Hieraaetus morphnoides*), Little Lorikeet (*Glossopsitta pusilla*), Black Falcon (*Falco subniger*), Varied Sittella (*Daphoenositta chrysoptera*), Brown Treecreeper (eastern subspecies) (*Climacteris picumnus victoriae*), Speckled Warbler (*Chthonicola sagittata*), Glossy Black-Cockatoo (*Calyptorhynchus lathami*), Gang-gang Cockatoo (*Callocephalon fimbriatum*), Regent Honeyeater (*Anthochaera phrygia*), Sooty Owl (*Tyto tenebricosa*), Masked Owl (*Tyto novaehollandiae*), Powerful Owl (*Ninox strenua*) and Barking Owl (*Ninox connivens*).

S5.2 Indirect Impacts

The overall development across the entire Box Hill North area could have substantial indirect impacts to vegetation to be retained on site (e.g. the proposed E4 and RE1 land) and to intact bushland that adjoins to the north, known as Maguires Road Priority Conservation Area.

Indirect impacts will be focused on remaining vegetation communities on the site. Areas around the retained vegetation will be subject to ancillary works and other disturbance such as the creation of interim sediment and detention basins, and battering and retaining walls associated with roads and drainage works. There is also the chance of indirect effects, such as the spread of weeds, to impact on native vegetation in this area.

The quality of SSTF to the north within the Maguires Road Priority Conservation Area (PCA) is much greater than that within the study area. The Maguires Road PCA exists to the north and is separated from the Box Hill North development by Maguires Road. The development has the potential to indirectly impact the Maguires Road PCA, and onsite protected areas, via increases in edge effects from high density living such as tree removal, rubbish dumping, soil compaction, erosion, weed invasion, and altered drainage patterns and nutrient levels resulting from increased runoff. Design of the development has considered this by zoning the fringing areas to this patch with R2 low density, and E4 environmental living.

A suite of measures have been proposed to address this and these will be incorporated into a Vegetation Management Plan for the vegetation and fauna habitats to be retained at Box Hill North. Water flows offsite will be managed under a Water Cycle and Flood Management Strategy for the Box Hill North. Further discussion is provided in the SIS.

S6 Amelioration Measures

The future development of Box Hill North will be ameliorated by the following measures:

- On site retention of approximately 3.6 ha of CPW and approximately 7.1 ha SSTF;
- Future revegetation of open space corridors using CPW (19.5 ha) and SSTF (5 ha) plant species; and
- Acquisition of BioBanking credits to fund off site offsets for CPW (210 credits that provide for conservation and enhancement of 16.7 ha) and SSTF (40 credits that provide for conservation and enhancement of 3.3 ha).

The proponent has already purchased 210 CPW (HN528) and 40 SSTF (HN556) BioBanking credits, which will be formally "retired" if the proposed development is approved. The retirement of BioBanking credits allows for permanent off-site conservation management of CPW and SSTF. It also guarantees the funding of management and active conservation measures in perpetuity.

Additionally, the following ameliorative measures will be applied prior to development of the study area:

- Retention and protection of trees within open spaces where possible;
- Planting of 4.5 ha of Cumberland Plain Woodland species in conservation areas;
- Planting of 15 ha of Cumberland Plain Woodland species in open areas;
- Planting of 5 ha of Shale Sandstone Transition Forest species in open areas;

- Relocation of native fauna where appropriate; and
- Pre-clearance survey of bat habitat to minimise the risk of harm to threatened bats during clearing.

Assessments of Significance (seven part tests) are threshold tests of significance that are prepared as a requirement of Section 5A of the NSW *Environmental Planning and Assessment Act 1979* for impacts arising from development applications. Assessments of significance determine whether there is likely to be a significant impact on any threatened flora and fauna in order to determine whether to proceed to prepare a SIS. Notwithstanding this, the seven part tests can be repeated within an SIS to consider whether a significant negative impact will occur once avoidance, mitigation and compensation measures are considered. This has been done within the SIS for all endangered ecological communities and threatened species known or considered likely to occur on the Box Hill North site.

The seven part tests verify that although the two CEECs and several threatened species would be significantly impacted by future developments on the site, the amelioration measures proposed are likely to address such impacts such that examples of the two CEECs will be conserved on site and preserved within off site offset areas. There will also be substantial replanting of vegetation within open space areas and this is expected to provide opportunities for such fauna as birds and bats in the long term. Thus, when implemented, the suite of ameliorative measures are predicted to address the otherwise significant impacts of the development of the Box Hill North site.

S7 Conclusion

The proposed development of Box Hill North will remove approximately 9.8 ha of CPW and 6.2 ha of SSTF. Without amelioration, this vegetation clearance would have a significant impact. However, when weighed against the conservation benefits that will be derived from on site retention, on site replanting and off site retiring of BioBanking credits and preserving a larger contiguous patch of CPW and SSTF in perpetuity, the long term impacts are sustainable. The proposal is unlikely to result in any threatened species or ecological community becoming locally extinct.

Chapter 1

Introduction

1.1 Purpose

The purpose of this Species Impact Statement (SIS) is to assess the impacts on threatened flora and fauna that could arise from future development within 380 ha of recently rezoned land along Boundary Road, at Box Hill North (the "study area" or "Box Hill North", **Figure 1.1**).

The preparation of this SIS is related to a Staged Development Application (DA) to be lodged with The Hills Shire Council in accordance with Clauses 83A and 83B of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act). The staged DA seeks to develop a new residential community within the study area. The footprint and ecological impacts of the proposed developments have potential to contribute to a cumulatively significant impact on threatened flora and fauna. The preparation of this SIS provides an opportunity to assess the total impact of future development and to present a suite of conservation and offset measures to address the predicted impacts.

This SIS has been prepared in accordance with section 109 and 110 of the NSW *Threatened Species Conservation Act 1995* (TSC Act) and with the requirements of the Director General of the 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 for 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 a development application under Part 4 or request for Part 5 approval under the EP&A Act;
- Assist the Director-General of the OEH in deciding whether or not concurrence should be granted for the purposes of Parts 4 or 5 of the EP&A Act;
- Assist the Director-General of the OEH or the Minister for the Environment when consulted for the purposes of Parts 4 or 5 of the EP&A Act; and

- Assist the Director-General of the OEH in the assessment of the Section 91 Licence application lodged under the TSC Act.

The Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) provides for the protection of the environment, especially Matters of National Environmental Significance (MNES). Under the EPBC Act, a person must not take an action that has, will have, or is likely to have a significant impact on any of these matters without approval from the Australian Government Environment Minister or the Minister's delegate. To obtain approval from the Environment Minister, the proposed action was referred in 2014. The Minister determined that the proposal is a controlled action and further information will be required to assess the impacts by the proposal on MNES. A copy of the decision is provided in **Appendix B**. This SIS therefore also addresses species, populations and communities listed under the EPBC Act. Under the EPBC Act, the proposal is to be assessed via preliminary documentation. A copy of the requirements for the preliminary documentation is provided in **Appendix C**.

This SIS has therefore been designed to fulfil two purposes. First it has been prepared to address the requirements of Section 109 and 110 of the TSC Act and with the requirements of the Director General of the Department of Premier and Cabinet, which includes OEH. Secondly, it concurrently assesses the impacts of future development on matters of national environmental significance that are listed under EPBC Act.

Within this document threatened species and endangered ecological communities are as defined within the schedules of the TSC Act and EPBC Act.

Throughout the SIS the section order and heading titles are replicated from the Director-General's Requirements (DGRs). In order to demonstrate how each SIS section complies with statutory requirements a comprehensive compliance table is included in **Appendix A**.

1.2 Relevant Legislation

Legislation relevant to this impact assessment includes:

- Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*;
- NSW *Environmental Planning and Assessment Act 1979*;
- NSW *Threatened Species Conservation Act 1995*; and
- NSW *Noxious Weeds Act 1993*.

1.2.1 Environment Protection and Biodiversity Conservation Act 1999

The EPBC Act protects the environment, particularly matters of National Environmental Significance. It is managed by the Commonwealth Department of the Environment (DoE). A number of species and communities in Sydney are listed as MNES under the EPBC Act.

1.2.2 Environmental Planning and Assessment Act 1979

The EP&A Act is the principal planning legislation for the State, providing a framework for the overall environmental planning and assessment of development proposals. Various legislation and instruments, such as the TSC Act, are integrated with the EP&A Act and have been reviewed separately.

1.2.3 Threatened Species Conservation Act 1995

Schedule 1 of the TSC Act lists threatened species, populations and ecological communities that are endangered or presumed extinct. Schedule 2 lists vulnerable species and Schedule 3 lists key threatening processes. The TSC Act is administered by OEH, which has issued guidelines for the assessment of threatened flora and fauna.

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 DGRs as listed in ***Section 1.4*** below. The requirements of the Director-General of the OEH were sought pursuant to Section 111 of the TSC Act.

1.2.4 Noxious Weeds Act 1993

The objectives of the NSW *Noxious Weeds Act 1993* are to identify which noxious weeds require control measures, identify control measures suitable to those species and to specify the responsibilities of both public and private landholders for noxious weed control.

1.3 State and Local Government Planning Instruments

Planning Instruments that relate to the development of the area include:

- *State Environmental Planning Policy 19 – Bushland in Urban Areas*; and
- *The Hills Local Environment Plan LEP 2012*.

i. SEPP 19 – Bushland in Urban Areas

State Environmental Planning Policies (SEPPs) deal with issues significant to the state and people of New South Wales. They are made by the Governor on the recommendation of the Minister for Planning and may be exhibited in draft form for public comment before being gazetted as a legal document

SEPP 19 is designed to protect bushland in public open space zones and reservations, and to ensure that bush preservation is given a high priority when local environmental plans for urban development are prepared. This SEPP applies to several areas or part areas, including The Hills Shire Local Government Area (LGA) (listed in Schedule 1 as Baulkham Hills).

ii. The Hills Local Environment Plan

The study area is located within The Hills Shire LGA and falls under The Hills Local Environment Plan 2012 ('The Hills LEP 2012'). The Hills LEP 2012 is prepared by Council and is vetted by the State Government to ensure consistency with the EP&A Act and SEPPs before being gazetted by the Minister for Planning and Environment. The study area is currently zoned as *RU6 - Transitional* under The Hills LEP 2012. Proposed future rezoning of Box Hill North is shown in **Figure 1.2**.

1.4 DGR Matters Which Have Been Limited or Modified

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

1.4.1 Threat Abatement Plans

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

1.4.2 Recovery Plans

The following recovery plans have been nominated to potentially be relevant to this proposal:

- *Acacia pubescens* recovery plan;
- *Pimelea spicata* recovery plan;
- Large Forest Owls recovery plan;
- Koala (*Phascolarctos cinereus*) recovery plan;
- Green and Golden Bell Frog (*Litoria aurea*) recovery plan; and
- Cumberland Plain recovery plan.

Of these recovery plans, only the Cumberland Plain Recovery Plan is of relevance to the current proposal, due to the presence, or potential presence of the species/communities on the study area. The relevance of this recovery plan is addressed in **Chapter 8**.

1.4.3 Key Threatening Processes

The following key threatening processes have been nominated to potentially be relevant to the proposal:

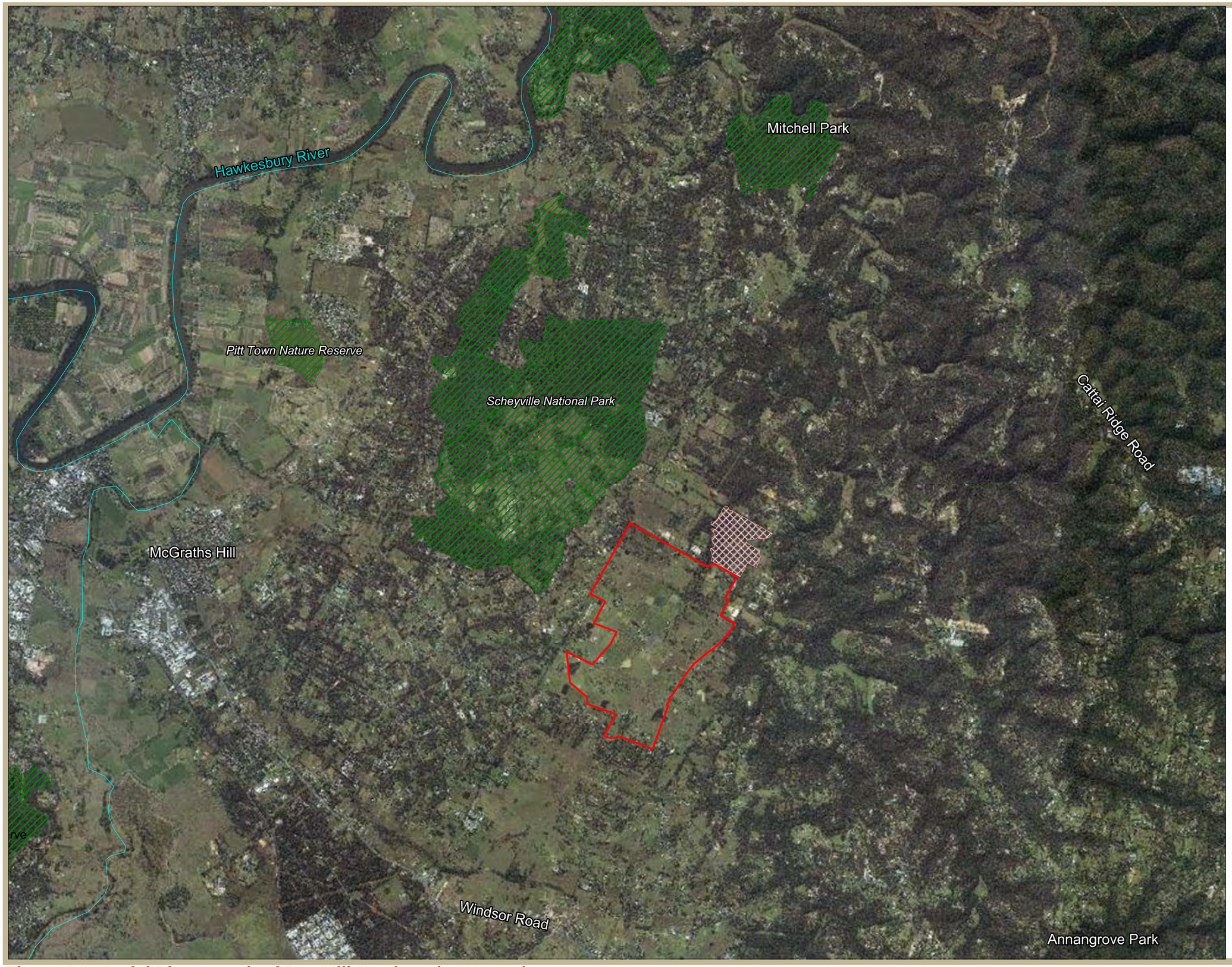
- Aggressive exclusion of birds from woodland and forest habitat by abundant Noisy Miners (*Manorina melanocephala*);
- Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands;

- Anthropogenic climate change;
- Clearing of native vegetation;
- Competition and grazing by the Feral European Rabbit (*Oryctolagus cuniculus* (L.));
- Forest eucalypt dieback associated with overabundant psyllids and bell miners;
- High frequency fires;
- Infection of frogs by amphibian chytrid causing the disease chytridiomycosis;
- Infection of native plants by *Phytophthora cinnamomi*;
- Invasion and establishment of exotic vines and scramblers;
- Invasion of native plant communities by *Olea europaea L. subsp. cuspidata* (African Olive);
- Invasion of native plant communities by exotic perennial grasses;
- Introduction and establishment of Exotic Rust Fungi of the *Pucciniales pathogenic* on plants of the family Myrtaceae;
- Invasion, establishment and spread of *Lantana camara* L. sens. lat (Lantana);
- Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants;
- Loss of hollow-bearing trees;
- Predation by Plague Minnow (*Gambusia holbrooki*);
- Predation by the European Red Fox (*Vulpes vulpes*) (Linnaeus,1758);
- Predation by the Feral Cat (*Felis catus*) (Linnaeus, 1758); and
- Removal of dead wood and dead trees.

1.4.4 Critical Habitat

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

Coordinate System: MGA Zone 56 (GDA 94)



Legend

- Study Area (Box Hill North)
- National Park
- Cumberland Plain Priority Conservation Land
- Waterway

Grid North

Image Source:
SIX Maps (13 04 2011)

Data Source:
© Copyright Commonwealth of Australia (Geoscience Australia) 2006

NPWS (2012).
NPWS Estate Data - Version 2/2012

DECCW (2011). The Cumberland Priority Conservation Lands.

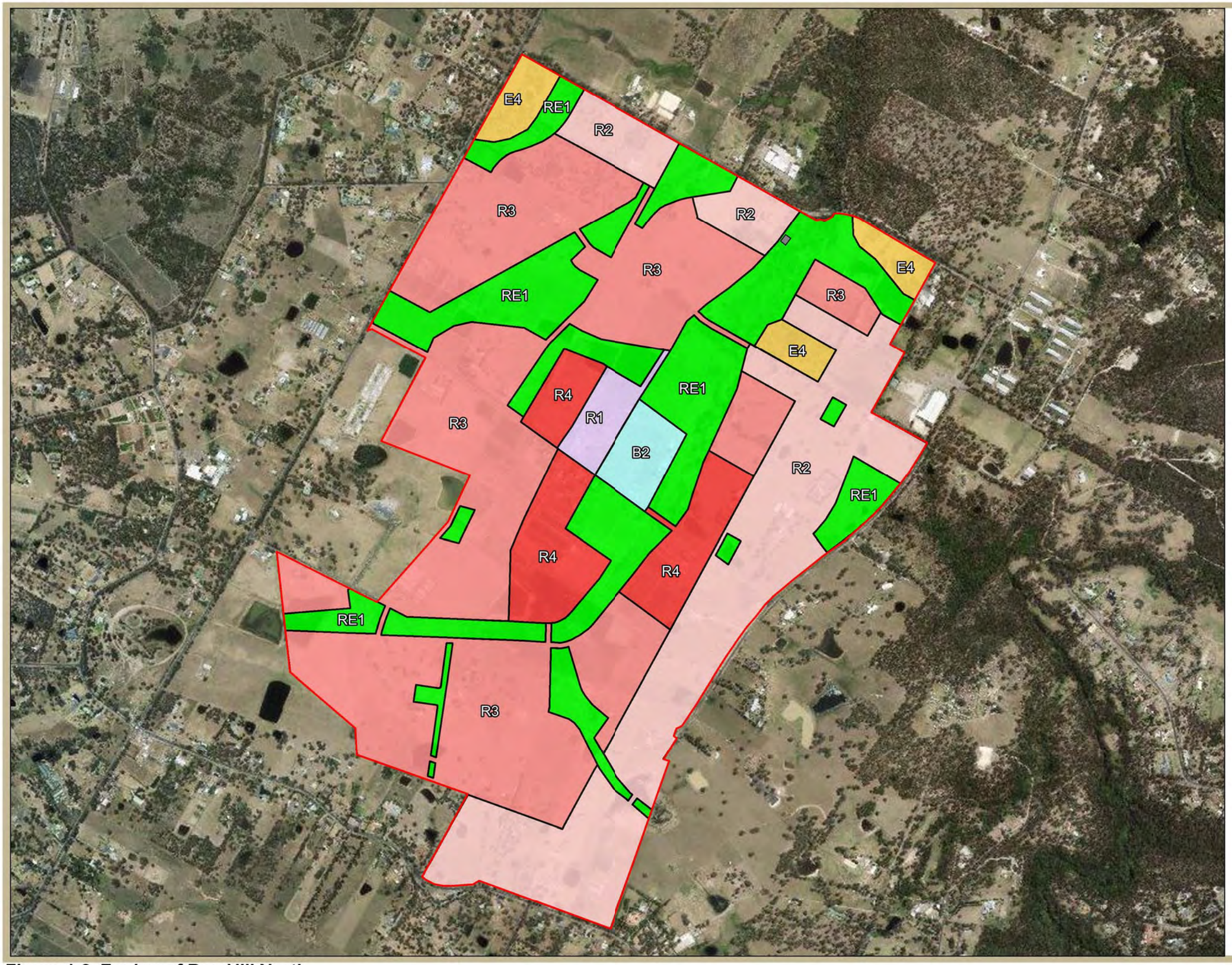
CUMBERLAND ECOLOGY

500 0 500 1000 1500 2000 m

I:\...\15062\Figures\RP1_SIS\20150506\Figure 1.1. Aerial Photograph of Box Hill North

Figure 1.1. Aerial Photograph of Box Hill North and surrounds

Coordinate System: MGA Zone 56 (GDA 94)



Legend

- Study Area (Box Hill North)
- Sewer Site

Zone

- High Density Residential (R4)
- Medium Density Residential (R3)
- Low Density Residential (R2)
- General Residential (R1)
- Local Centre (B2)
- Public Recreation (RE1)
- Environmental Living (E4)

Grid North

Image Source:
Image © SIX Maps
(dated 01-04-2014)

CUMBERLAND ECOLOGY

I:\...\15062\Figures\RP1_SIS\20150506\Figure 1.2. Zoning_Study Area

Figure 1.2. Zoning of Box Hill North

200 0 200 400 600 800 m

Chapter 2

Contextual Information

2.1 Description of the Study Area

2.1.1 Study Area

The study area occurs within The Hills LGA and is located just outside of the North West Growth Centre, directly to the north of the Box Hill and Box Hill Industrial precincts. It is bounded by Maguires Road to the north, Janpieter Road to the east, Old Pitt Town Road to the south and Boundary Road to the west. It is currently accessible from Boundary Road joining the main Windsor Road access to the south.

The study area includes the following lots:

- Lots 15-18, Lots, 21-31, Lots 40 & 41, and Lots 43-47; in DP 255616;
- Lots 1 -3 in DP 11126;
- Lots 4A & 4B in DP 135304;
- Lot 1 in DP 207750;
- Lots 1 & 3 in DP 253552
- Lots 421-425 in DP 1183810;
- Lots 9 & 10 in DP 593517;
- Lot 5 in DP 658286;
- Lot 1 in DP 564211. and
- Lot 1 in DP 782360.

Following European settlement the area was surveyed, settled, cleared and used for farming purposes. Generally, farming within the general area has centred on cattle, but now also supports extensive market gardens.

2.1.2 Current Development Application

The current DA is a Staged DA (Concept Proposal) to accommodate a new residential community at Box Hill North. The staged DA will seek consent for the following:

- 4,100 dwellings;
- 5.5 hectare town centre;
- 10,000m^2 of non-residential floor space;
- Primary school site;
- New roads and infrastructure;
- Open space including sporting fields, parks and passive open space;
- Pedestrian and cycle network;
- Biodiversity strategy which includes land for environmental conservation, replanting of vegetation and vegetation removal; and
- Water cycle and flood management.

The subject of the current DA, is referred to as the 'study area' or 'Box Hill North' within this SIS.

2.1.3 Rezoning of the Study Area

It is proposed to rezone the site from RU6 Transition to R1 General Residential, R2 Low Density, R3 Medium Density, R4 High Density, E2 Environmental Conservation, E4 Environmental Living, B2 Local Centre and RE1 Public Recreation under The Hills LEP 2012. It is proposed to apply the RE1 Public Recreation zone to all riparian corridors (existing and proposed), parks and sporting fields within the site. This land is to be dedicated to Council.

The rezoning will allow for subdivision and subsequent development of a large proportion of the study area. The Indicative Layout Plan (ILP) (**Figure 2.1**) illustrates the manner in which the study area is to be developed. The impacts of the rezoning and subsequent development of the site are considered to impact on threatened communities and species listed under the TSC Act and EPBC Act that occur within the study area.

Given the likely extent of these impacts, this SIS provides an overarching analysis that largely addresses ecological issues related to the future development of the study area as a whole. Amelioration and compensation measures will only apply to lands owned or under the control of EJC Pty Limited.

2.1.4 Biodiversity Values and Land Use in the Locality

Two areas of significant ecological value, Scheyville National Park and Maguires Road Priority Conservation Area (PCA) occur near the study area.

Scheyville National Park is located approximately 500m from the western boundary of the study area. This National Park includes large areas of remnant Cumberland Plain Woodland (CPW) and provides habitat for a range of threatened flora and fauna known from the locality. Threatened fauna known from Scheyville National Park includes:

- Green and Golden Bell Frog (*Litoria aurea*);
- Black Bittern (*Ixobrychus flavicollis*);
- Spotted Harrier (*Circus assimilis*);
- Little eagle (*Hieraaetus morphnoides*);
- Comb-crested Jacana (*Irediparra gallinacea*);
- Gang-gang Cockatoo (*Callocephalon fimbriatum*);
- Glossy Black-cockatoo (*Calyptorhynchus lathami*);
- Little Lorikeet (*Glossopsitta pusilla*);
- Swift Parrot (*Lathamus discolor*);
- Barking Owl (*Ninox connivens*);
- Powerful Owl (*Ninox strenua*);
- Brown Treecreeper (eastern subspecies) (*Climacteris picumnus victoriae*);
- Speckled Warbler (*Chthonicola sagittata*);
- Regent Honeyeater (*Anthochaera phrygia*);
- White-fronted Chat (*Epthianura albifrons*);
- Black-chinned Honeyeater (eastern subspecies) (*Melithreptus gularis gularis*);
- Varied Sittella (*Daphoenositta chrysoptera*);
- Scarlet Robin (*Petroica boodang*);
- Flame Robin (*Petroica phoenicea*);
- Grey-headed Flying-fox (*Pteropus poliocephalus*);
- Eastern Freetail-bat (*Mormopterus norfolkensis*);

- Large-eared Pied Bat (*Chalinolobus dwyeri*);
- Eastern Bentwing-bat (*Miniopterus schreibersii oceanensis*);
- Southern Myotis (*Myotis macropus*);
- Greater Broad-nosed Bat (*Scoteanax rueppellii*); and
- Cumberland Plain Land Snail (*Meridolum corneovirens*).

Threatened flora known from Scheyville National Park includes:

- *Dillwynia tenuifolia*;
- *Pultenaea parviflora*;
- *Acacia pubescens*;
- *Pterostylis saxicola*; and
- *Grevillea juniperina* subsp. *juniperina*.

The Maguires Road PCA is a patch of woodland on private property located across Maguires Road, to the north of the study area. This area has been identified in the Cumberland Plain recovery plan as a PCA as it is broadly contiguous with woodland in the locality, extending along Cataract Creek towards The Long Swamp area and O'Hara's Creek Nature Reserve. This forest patch contains a known population of *Dillwynia tenuifolia*, a species listed as Vulnerable under the TSC Act.

The terrain within the study area is flat to gently undulating (**Figure 2.2**) with well-structured clay soils derived from Wianamatta Shale and Tertiary and Quaternary alluvial soils associated with the Hawkesbury-Nepean River system. Several small tributaries drain into the main stream feature within the study area, Cataract Creek in the north east. This area also supports a different underlying geology with sandstone outcroppings occurring within the stream bank area. A total of 62 dams and water bodies exist on the study area as well as numerous farmhouses, sheds and other infrastructure. These are mainly concentrated along the road accesses bordering and bisecting the study area, Boundary Road, Maguires Road, Janpieter Road, Old Pitt Town Road and Red Gables Road. The study area is currently used for cattle grazing, cropping and hobby farming purposes.

The study area is largely cleared of native vegetation (**Figure 2.3**) and is dominated by exotic grasses. Treed vegetation is mainly represented by a mosaic of regenerating patches of open forest and woodland at various stages of canopy regeneration. These comprise patches of CPW and Shale Sandstone Transition Forest (SSTF).

CPW and SSTF are listed as a Critically Endangered Ecological Communities (CEECs) under both the TSC Act and EPBC Act. The most intact and mature patches of woodland are found in the north-west (extending south-east from the corner of Boundary Road and Maguires Road) and north-east (bordering the riparian zone of Cataract Creek) of the study

area. In the south, centre and north-east corner of the study area scattered paddock trees also occur. Whilst they are comprised of canopy species indicative of CPW (*Eucalyptus crebra* (Narrow-leaved Ironbark), *E. moluccana* (Grey Box) and *E. tereticornis* (Forest Red Gum) they lack understorey and ground cover vegetation and do not comprise CPW.

2.2 Description of the Current Development Application

The current proposal is for the development of a new residential community within Box Hill North.

The development will involve construction of approximately 4100 residential dwellings and associated infrastructure including commercial areas.

The ILP (**Figure 2.1**) illustrates the manner in which the study area is to be developed.

As illustrated in the ILP, the proposed development of the study area entails:

- A Village Centre, comprising a mix of retail, commercial, community, open space and residential uses, in the central part of the precinct;
- Predominantly residential development in the remainder of the precinct;
- Construction of roads, including external connections to Boundary Road; and
- Provision of local open space, riparian corridors and stormwater basins.

2.2.1 Nature

It is proposed to rezone the study area from RU6 Transition to R1 General Residential, R2 Low Density, R3 Medium Density, R4 High Density, E2 Environmental Conservation, E4 Environmental Living, B2 Local Centre and RE1 Public Recreation under The Hills LEP 2012.

It is proposed to apply the RE1 Public Recreation zone will be applied to all riparian corridors (existing and proposed), parks and sporting fields within the site.

The new zoning plan for the study area is shown in **Figure 1.2**.

i. Buildings and other structures

Future development will include land subdivision and construction of approximately 4,100 dwellings, along with a primary school, retail buildings, a town centre, parks, pedestrian and cycleway networks, passive open space, roads and associated infrastructure.

Final building plans for the study area have not been prepared to date. A sewage pumping station will be located within the RE1 lands in the north of the study area. The location of this structure is not shown in **Figure 2.1**. An indicative location for the sewer pump station is shown in **Figure 6.1** of this SIS. The footprint of the sewage pumping station is

approximately 29m x 20m plus an additional 200 m^2 for associated pad works (total works approximately 775 m^2).

ii. Installation and maintenance of utilities

All necessary utilities required to service a residential subdivision will be installed and maintained in the appropriate manner, in accordance with accepted standards.

iii. Access routes

New access routes across the study area will be created under the proposal. The final access route plan has not yet been made available.

iv. Waste and water management

Specific waste and water management requirements, including the establishment of stormwater and sediment detention basins, are detailed in the Water Cycle & Flood Management Strategy Report (J Wyndham Prince Pty Ltd 2013). Waste management during construction is in accordance with all relevant Council regulations and is specified in the Water Cycle & Flood Management Strategy Report.

v. Changes in surface water flows

Changes in surface water flows will be managed according to the Water Cycle and Flood Management Strategy Report (J Wyndham Prince Pty Ltd 2013).

vi. 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), it is proposed to construct APZs between the areas of proposed works and the areas of hazard. The temporary APZs will be managed by the landowner, in accordance with the NSW RFS guidelines until such time as permanent APZs have been put in place. The permanent APZs will be established through future stages of subdivision in accordance with the provisions of the RFS.

The details of the specific APZ requirements are outlined in the Preliminary Bushfire Constraints Report (Australian Bushfire Protection Planners Pty Ltd 2013). A more detailed Bushfire Report will be produced at a later date.

vii. Landscaping

Landscaping will include street tree planting, and planting along the central riparian area in accordance with the Vegetation Management Plan (VMP). Landscaping will also include parks and areas of open passive space within the riparian corridor. All species used in planting are selected in accordance with Council requirements and avoid the use of species that may invade bushland. Please refer to the VMP for detailed descriptions.

2.2.2 Extent

As described above, for the purposes of this SIS, the current proposal includes development of the study area. The total area of the proposed works within the DA comprises approximately 368 ha of urban development. The remaining lands will comprise of public recreation areas or maintained native vegetation.

2.2.3 Location

The study area occurs within The Hills LGA, NSW 2765. It is bounded by Maguires Road to the north, Janpieter Road to the east, Old Pitt Town Road to the south and Boundary Road to the west and is currently accessible from Boundary Road joining the main Windsor Road access to the south. The study area includes the following lots:

- Lots 15-18, Lots, 21, 23, Lots 25-27, Lots 29-31, Lots 40 & 41, and Lots 43-47; in DP 255616;
- Lots 1 -3 in DP 11126;
- Lots 4A & 4B in DP 135304;
- Lot 1 in DP 207750;
- Lots 9 & 10 in DP 593517;
- Lot 5 in DP 658286; and
- Lot 1 in DP 564211.

2.2.4 Timing

Anticipated start- of- works to implement the future development of the study area is subject to planning consent being issued.

2.2.5 Layout

The layout of the DA, identifying the study area, is set out above and the extent of works is shown on the attached plan (refer **Figure 2.1**).

2.2.6 Short-term and Long-term Social and Economic Implications and/or Impacts of the Project

The proposal is anticipated to result in the following social benefits:

- Delivery of additional residential and employment land in north west Sydney;
- Provision of housing diversity for a full range of household types and lifestyle preferences;

- Creation of an environment that provides access to public and private spaces and promotes healthy lifestyles, facilitating a vibrant, robust, sustainable community;
- Additional open space, sporting grounds, and community centres; and
- Provision of physical and social infrastructure to the site.

Economic benefits of the project will include:

- Provision of retail floor space including supermarket and retail specialty;
- Provision of non-retail specialty, commercial/offices, medical centres, childcare centres, taverns, petrol stations, and gyms;
- Retail activity centre will be positioned in close proximity to higher density residential;
- Based on population projections and take-up rate, a supermarket based centre would be supportable at Box Hill North by 2021, of potentially up to 10,000 m^2; and
- Existing larger facilities in the region would continue to provide the major retail destination for the future Box Hill North residential population.

2.2.7 Capital Investment and Ongoing Employment/Economic Value

The capital investment in the development of Box Hill North is approximately $500M.

The proposal will provide employment opportunities on the site by providing up to 10,000m^2 of non-residential floor space, increase employment opportunities during the roll out and construction, increase the demand for local employment opportunities from the 4,100 households located at Box Hill North and generate economic activity both locally and outside of the area

2.3 Land Tenure Information

The registered proprietor of the study area is EJ Cooper Pty Ltd. (EJC Limited) with the exception of the following lots:

- Lots 24 & 28, in DP 255616;
- Lot 1 in DP 782360;
- Lots 421-425 in DP 1183810; and
- Lots 1 & 3 in DP 253552.

These lots constitute private properties for which land tenure information was not readily available.

2.4 Vegetation

The vegetation communities in the locality have been mapped by The Hills Shire Council (**Figure 2.4**) and OEH as part of the broad-scale mapping for the South Coast Illawarra Vegetation Integration (SCIVI) Project (**Figure 2.5**) and broad-scale mapping for the Cumberland Plain (as the Department of Environment, Climate Change and Water (DECCW)) (DECCW 2007b, a), The DECCW maps are based on various existing vegetation maps, including Hills Shire Council mapping, as well as aerial photograph interpretation.

The three mapping programs utilised for this SIS report overlap over large areas of the locality and have equivalent vegetation units. For the purposes of this report, the DECCW (2007) map unit names have been utilised to describe the vegetation communities in the locality with additional map unit names from the SCIVI mapping, as required, for vegetation units that do not have equivalent communities in the DECCW (2007) mapping.

The DECCW (2007) map units within the study area have been verified and refined by ground-truthing the vegetation communities in the study area. The Hills Shire Council mapping has also been ground truthed.

The following CEECs are known to occur within the study area:

- Cumberland Plain Woodland (CPW) in the form of Shale Plains Woodland, as mapped by DECCW 2007; and
- Shale Sandstone Transition Forest (SSTF) in the form of High Sandstone Influence and Low Sandstone Influence variants.

Within the locality, a much broader range of communities, as mapped by DECCW (2007), are known to occur. These include:

- Shale Hills Woodland (CEEC);
- Alluvial Woodland (Endangered Ecological Community (EEC));
- Freshwater Wetlands (EEC);
- Shale-Gravel Transition Forest (EEC);
- Castlereagh Scribbly Gum Woodland (Vulnerable Ecological Community (VEC));
- Upper Georges River Sandstone Woodland; and
- Western Sandstone Gully Forest.

Additional Vegetation communities mapped in the locality by the SCIVI mapping include:

- Coastal Sandstone Plateau Heath;
- Lower Blue Mountains Wet Forest;

- Sandstone Riparian Scrub;
- Sydney Hinterland Transition Woodland; and
- Sydney Swamp Forest.

The distribution of these communities in the locality is shown in **Figure 2.4** and **2.5**.

As specified in the DGRs, the vegetation communities present within the locality have been described with reference to Council vegetation mapping, SCIVI mapping (Tozer *et al* 2010) and relevant Scientific Committee determinations for Endangered Ecological Communities as well as the Cumberland Plain vegetation mapping (NSW NPWS 2002a, DECCW 2007b)

All vegetation communities mapped by NPWS (NSW NPWS 2002a, b) were described by Tozer (2003), some of which were subsequently updated in Tozer et al (2010). Consultation with Tozer (2010) has been undertaken during the preparation of the relevant ecological community descriptions below:

2.4.1 Cumberland Plain Woodland – Shale Plains Woodland

The Native Vegetation of the Cumberland Plain mapping (NSW NPWS 2002a, b), 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 (NSW Scientific Committee 2009a).

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* and *E. tereticornis*, in association with *E. crebra* and *Acacia implexa* (Hickory Wattle). Mid-storey dominants include; *Bursaria spinosa subsp. 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 var. 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.

2.4.2 Shale Sandstone Transition Forest

The Native Vegetation of the Cumberland Plain mapping (NSW NPWS 2002a, b), SCIVI mapping unit GW p2 and descriptions by Tozer (2003) for Map Units 1 and 2: Shale Sandstone Transition Forest (Low Sandstone and High Sandstone influence) correspond to

the CEEC 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 and is described as 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* (Broad-leaved Ironbark) and *E. punctata* (Grey Gum), generally also in association with; *E. globoidea* (White Stringybark) and *E. eugenioides* (Thin-leaved Stringybark). Dominant understorey species include; *Allocasuarina littoralis* (Black She-oak), *Persoonia linearis*, *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* (Three-awned Speargrass), *Pratia purpurascens* (Whiteroot), *Microlaena stipoides var. stipoides*, *Entolasia stricta* (Wiry Panic), *Lomandra multiflora* (Many-flowered Mat-rush), *Themeda australis*, *Panicum simile* (Two-colour Panic), E*chinopogon caespitosus* (Hedgehog Grass), *Pomax umbellata, Dichondra repens*, *Glycine clandestina*, *Billardiera scandens* (Hairy Apple Berry*)* and *Opercularia diphylla* (Tozer et al. 2010).

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

2.4.3 Cumberland Plain Woodland - Shale Hills Woodland

The Native Vegetation of the Cumberland Plain mapping (NSW 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 (NSW Scientific Committee 2009a).

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.s tereticornis* and is associated with *E. crebra* and *E. eugenioides*. The mid-storey is dominated by Blackthorn (*Bursaria spinosa*). The groundcover dominants are *Dichondra repens*, *Cheilanthes sieberi* (Poison Rock Fern), *Aristida vagans*, *Microlaena stipoides* (Weeping Meadow Grass), *Themeda australis*, *Brunoniella australis*, Slender Tick-trefoil (*Desmodium gunnii*), *Opercularia diphylla*, Sprawling Bluebell (*Wahlenbergia gracilis*), *Dichelachne micrantha*, *Paspalidium distans*,

Eragrostis leptostachya (Paddock Lovegrass) and *Lomandra filiformis* (Wattle Mat-rush) (Tozer et al. 2006).

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

2.4.4 Alluvial Woodland

The Native Vegetation of the Cumberland Plain mapping (NSW 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 (NSW Scientific Committee 2004g).

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; *Eucalyptus tereticornis*, *Angophora floribunda* (Rough-barked Apple), *E. amplifolia* (Cabbage Gum), associated with; *E. eugenioides* and *Eucalyptus elata* (River Peppermint). Dominant mid-storey species include; *Acacia parramattensis*, *Bursaria spinosa subsp. spinosa* and *Sigesbeckia orientalis*. Dominant groundcover species are; *Microlaena stipoides var. stipoides*, *Oplismenus aemulus* (Basket Grass), *Dichondra repens*, *Entolasia marginata* (Bordered Panic), *Solanum prinophyllum* (Forest Nightshade), *Pratia purpurascens*, *Echinopogon ovatus* (Forest Hedgehog Grass), *Desmodium varians*, *Commelina cyanea* (Native Wandering Jew) and *Veronica plebeia* (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.

2.4.5 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 2004d).

This community is not described by any mapping projects for the Cumberland Plain or SCIVI project.

Descriptions by Tozer et al (2010) for Map Unit FrW p313: Coastal Freshwater Lagoons corresponds to the EEC listing for Freshwater Wetlands. This community is described as a mosaic of tall reeds, dense patches of taller shrubs, herbfields and open water. It has a scattered distribution along the coastline and is generally found in areas below 10m ASL

where shallow sandy alluvium is inundated by freshwater or slightly brackish water. The mapping of this Coastal Freshwater Lagoons is likely to be underestimated as the available modelling variables had insufficient precision to delineate the specific habitat of this community.

2.4.6 Shale Gravel Transition Forest

The Native Vegetation of the Cumberland Plain mapping (NSW NPWS 2002a, b) and descriptions by Tozer (2003) for Map Unit 103: Shale Gravel Transition Forest 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 2002).

Shale Gravel Transition Forest (SGTF) 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* but *E. moluccana* and *E. tereticornis* may also occur. *Melaleuca decora* (Paperbark) dominates the understorey, with *Bursaria spinosa*, *Daviesia ulicifolia* (Gorse Bitter Pea) and *Lissanthe strigosa* occurring 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.

2.4.7 Castlereagh Scribbly Gum Woodland

The Native Vegetation of the Cumberland Plain mapping (NSW NPWS 2002a, b) and descriptions by Tozer (2003) for Map Unit 6: Castlereagh Scribbly Gum Woodland along with descriptions by Tozer et al (2010) for Map Unit DSF p7 corresponds to the Vulnerable Ecological Community (VEC) listing for Castlereagh Scribbly Gum Woodland in the Sydney Basin Bioregion.

This community occurs almost exclusively on soils derived from Tertiary alluvium, with occasional occurrences on adjoining shale or Holocene alluvium where, presumably, the influence of Tertiary alluvium is strong. It is most often found on sandy soils and tends to occur on slightly higher ground (> 27 m).

The canopy is dominated by *Eucalyptus parramattensis, subsp. parramattensis, Angophora bakeri* and *E. sclerophylla* (Hard-leaved Scribbly Gum) 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, M. nodosa, Hakea sericea* and *H. dactyloides*. The ground stratum contains a diverse range of forbs including *Themeda australis, Entolasia stricta, Cyathochaeta diandra, Dianella revoluta subsp revoluta, Stylidium graminifolium, Platysace ericoides, Laxmannia gracilis* and *Aristida warburgii*.

2.4.8 Sandstone Ridgetop Woodland

The Native Vegetation of the Cumberland Plain mapping (NSW NPWS 2002a, b) and Tozer (2003) have described Map Unit 31: Sandstone Ridgetop Woodland as occurring predominantly on sandstone ridgetops and plateau, with extensions to the floor of shallow gullies. This community does not correspond to a State or Commonwealth listed threatened ecological community. The SCIVI map unit DSF p131 – Coastal Sandstone Ridgetop Woodland corresponds to this community.

The canopy is dominated by *Corymbia gummifera* (Red Bloodwood) and *Eucalyptus sclerophylla* with frequent occurrences of *Banksia serrata*. The shrub layer is diverse and is frequently dominated by *Banksia spinulosa var. spinulosa, Isopogon anemonifolius, Leptospermum trinervium, Phyllanthus hirtellus, Dillwynia retorta* and *Eriostemon australasius subsp. australasius*. The ground stratum is also diverse and consists of species such as *Lomandra obliqua, Entolasia stricta, Cyathochaeta diandra, Dampiera stricta* and *Stipa pubescens*.

2.4.9 Upper Georges River Sandstone Woodland

The Native Vegetation of the Cumberland Plain mapping (NSW NPWS 2002a, b) and Tozer (2003) have described Map Unit 32: Upper Georges River Sandstone Woodland as occurring predominantly on the Mittagong Formations and typically found 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 Red Bloodwood, with Narrow-leaved Stringybark and Black She-oak (*Allocasuarina littoralis)*. Shrub species include Prickly Moses (*Acacia ulicifolia*), Sunshine Wattle (*Acacia terminalis*), Narrow-leaved Wattle (*Acacia linifolia*), Narrow-leaved Geebung (*Persoonia linearis),* Slender Teatree and Dwarf Cherry (*Exocarpos strictus)*. The ground stratum is often dominated by grass species such as Wiry Panic, Kangaroo Grass, *Austrostipa pubescens,* Three-awn Speargrass and *Austrodanthonia fluva*.

2.4.10 Western Sandstone Gully Forest

The Native Vegetation of the Cumberland Plain mapping (NSW 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 *Eucalyptus pilularis*, with occasional occurrences of *E. punctata*. A sparse layer of smaller trees is dominated by *Ceratopetalum gummiferum* (Christmas Bush) and Black She-oak. Shrub species include *Acacia terminalis, Leptospermum trinervium, Persoonia linearis* and *Banksia spinulosa var. spinulosa*.. In the ground stratum, the fern species *Pteridium esculentum* (Bracken) is invariably present, along with the climber *Smilax glyciphylla* (Sweet

Sarsaparilla). The SCIVI map unit DSF p142 – Hinterland Sandstone Gully Forest corresponds to this community.

2.4.11 Coastal Sandstone Plateau Heath

The SCIVI mapping (Tozer et al 2010) has described Map Unit HL p117: Coastal Sandstone Plateau Heath as occurring in restricted areas of shallow damp sandy loams on coastal and near-coastal areas of the Hornsby and Woronora plateaux. This community does not correspond to a State or Commonwealth listed threatened ecological community.

The community is characterised by an open to dense shrub canopy with emergent mallees and groundcover of sedges and forbs. The most common tree species is *Corymbia gummifera*. Shrub species include *Banksia ericifolia, Lambertia formosa, Epacris microphylla, Leptospermum trinervium, Pimelea linifolia, Hakea laevipes, Pultenaea elliptica* and *Petrophile pulchella*. Common groundcover species include: *Dampiera stricta, Actinotus minor, Cyathochaeta diandra* and *Lindsaea linearis*.

2.4.12 Hinterland Sandstone Gully Forest

The SCIVI mapping (Tozer et al 2010) has described Map Unit DSF p142: Hinterland Sandstone Gully Forest as occurring along the western portion of the Hornsby and Woronora plateaux and in the lower Blue Mountains, in areas surrounding the Cumberland Plain. This community does not correspond to a State or Commonwealth listed threatened ecological community.

The community is an open eucalypt forest with an abundant sclerophyll shrub stratum and a groundcover dominated by sedges. Dominant tree species include *Angophora costata, Corymbia gummifera, Banksia serrata* and *Eucalyptus piperita*. Shrub species include *Persoonia linearis, Phyllanthus hirtellus, Ceratopetalum gummiferum, Leptospermum trinervium, Banksia spinulosa* and *Platysace linearifolia,* Common groundcover species include herbs and monocots such as *Entolasia stricta, Pteridium esculentum, Dianella caerulea, Xanthosia pilosa, Lomandra longifolia* and *Lepidosperma laterale* as well as climbers such as *Billardiera scandens.*

2.4.13 Lower Blue Mountains Wet Forest

The SCIVI mapping (Tozer et al 2010) has described Map Unit WSF p102: Lower Blue Mountains Wet Forest as occurring predominantly in the sheltered sandstone slopes and gullies of the Greater Blue Mountains, with localised occurrences in tributaries of the Hawkesbury River north of Sydney and the upper Georges River. This community does not correspond to a State or Commonwealth listed threatened ecological community.

The community is a tall eucalypt forest with a moist open understorey of shrubs, climbers and ferns. The canopy is dominated by *Syncarpia glomulifera* (Turpentine)*, Angophora costata, Acacia elata* and *Eucalyptus deanei* (Mountain Blue Gum). Shrub species include *Elaeocarpus reticulatus, Leucopogon lanceolatus* and *Persoonia linearis*. Common groundcover species include: *Lomandra longifolia, Blechnum cartilagineum, Dianella caerulea, Pteridium esculentum* and *Viola hederacea.*

2.4.14 Sandstone Riparian Scrub

The SCIVI mapping (Tozer et al 2010) has described Map Unit FoW p58: Sandstone Riparian Scrub as occurring around the edges of the Sydney basin on streams draining from Triassic Hawkesbury and Narrabeen sandstone, in the Blue Mountains, Hornsby, Woronora and Nattai Plateaux. It is generally restricted to shallow sand and gravel alluvium over rock on the bed and banks of streams subjected to occasional high-velocity floods. This community does not correspond to a State or Commonwealth listed threatened ecological community.

The community is a scrub or low forest with clumped shrubs and a clumped groundcover dominated by sedges and ferns. The tree layer is small and generally consists of species such as *Tristaniopsis laurina* and *Ceratopetalum apetalum.* Shrub species include *Lomatia myricoides, Tristania neriifolia* and *Leptospermum morrisonii*. Common groundcover species include: *Entolasia stricta, Schoenus melanostachys, Lomandra fluviatilis* and *Sticherus flabellatus*.

2.4.15 Sydney Hinterland Transition Woodland

The SCIVI mapping (Tozer et al 2010) has described Map Unit DSF p146: Sydney Hinterland Transition Woodland as occurring on loamy soils typically derived from sediments belonging to the Hawkesbury or Mittagong formations in the Cumberland Plain rainshadow. This community does not correspond to a State or Commonwealth listed threatened ecological community.

The community is a eucalypt woodland with an open understorey of sclerophyll shrubs, sedges, forbs and grasses. The canopy is dominated by *Corymbia gummifera, Eucalyptus punctata, Angophora costata* and *Syncarpia glomulifera*. Shrub species include *Phyllanthus hirtellus, Persoonia linearis, Leptospermum trinervium, Persoonia levis, Acacia linifolia, Banksia spinulosa* and *Pimelea linifolia*. Common groundcover species include: *Entolasia stricta, Lomandra obliqua, Pomax umbellata, Themeda australis, Lomandra multiflora, Lepidosperma laterale, Dianella revoluta* and *Goodenia hederacea*.

2.4.16 Sydney Swamp Forest

The SCIVI mapping (Tozer et al 2010) has described Map Unit FoW p44: Sydney Swamp Forest as occurring in narrow strips of sandy clay alluvium along drainage lines below 50m around the margins of Cumberland plain. This community corresponds to the EEC listing for Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions.

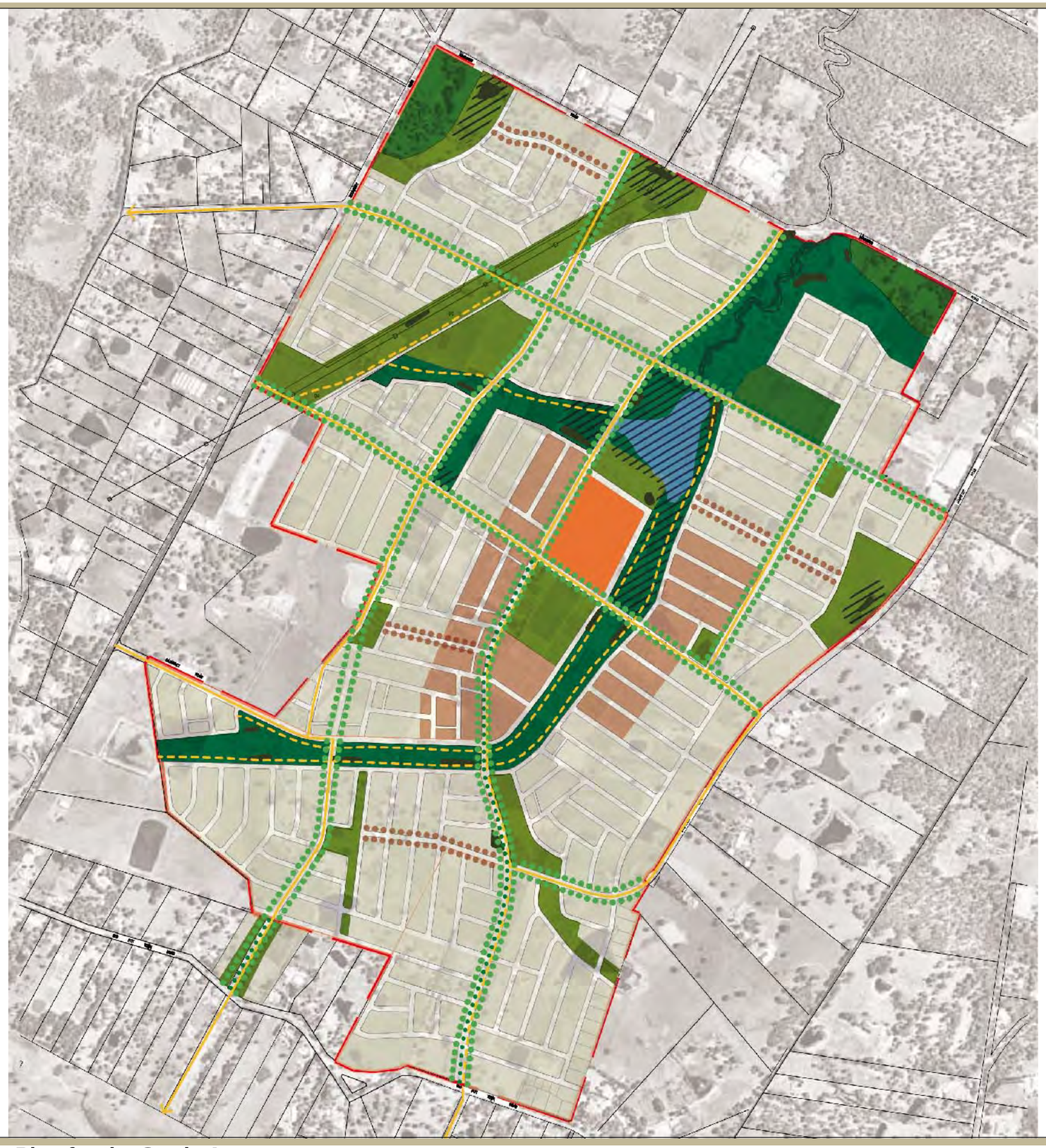
The community is described as a dense scrub with emergent trees and a sparse groundcover of sedges and forbs. The canopy is dominated by *Eucalyptus robusta* while the shrub layer is dominated by *Melaleuca linariifolia* and *Leptospermum polygalifolium*. Common groundcover species include: *Pteridium esculentum, Pratia purpurascens, Gahnia sieberiana, Entolasia marginata, Adiantum aethiopicum, Calochlaena dubia* and *Viola hederacea*.

2.4.17 Listed Ecological Communities of the Cumberland Plain

Other C/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 (CEEC);
- Agnes Banks Woodland (EEC);
- Castlereagh Swamp Woodland (EEC);
- Cooks River/Castlereagh Ironbark Forest (EEC);
- Elderslie Banksia Scrub Forest Community (EEC);
- Moist Shale Woodland (EEC).
- Riparian Forest (EEC);
- Turpentine – Ironbark Margin Forest (EEC); and
- Western Sydney Dry Rainforest (EEC).

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



I:\...\15062\Figures\RP1_SIS\20150506\Figure 2.1. Indicative Layout

Figure 2.1. Indicative Layout Plan for the Study Area

Coordinate System: MGA Zone 56 (GDA 94)

Legend

- Study Area (Box Hill North)
- Contours

Grid North

Image Source:
Image © SIX Maps
(dated 01-04-2014)

Date Source:
© Copyright Commonwealth of Australia
(Geoscience Australia) 2006

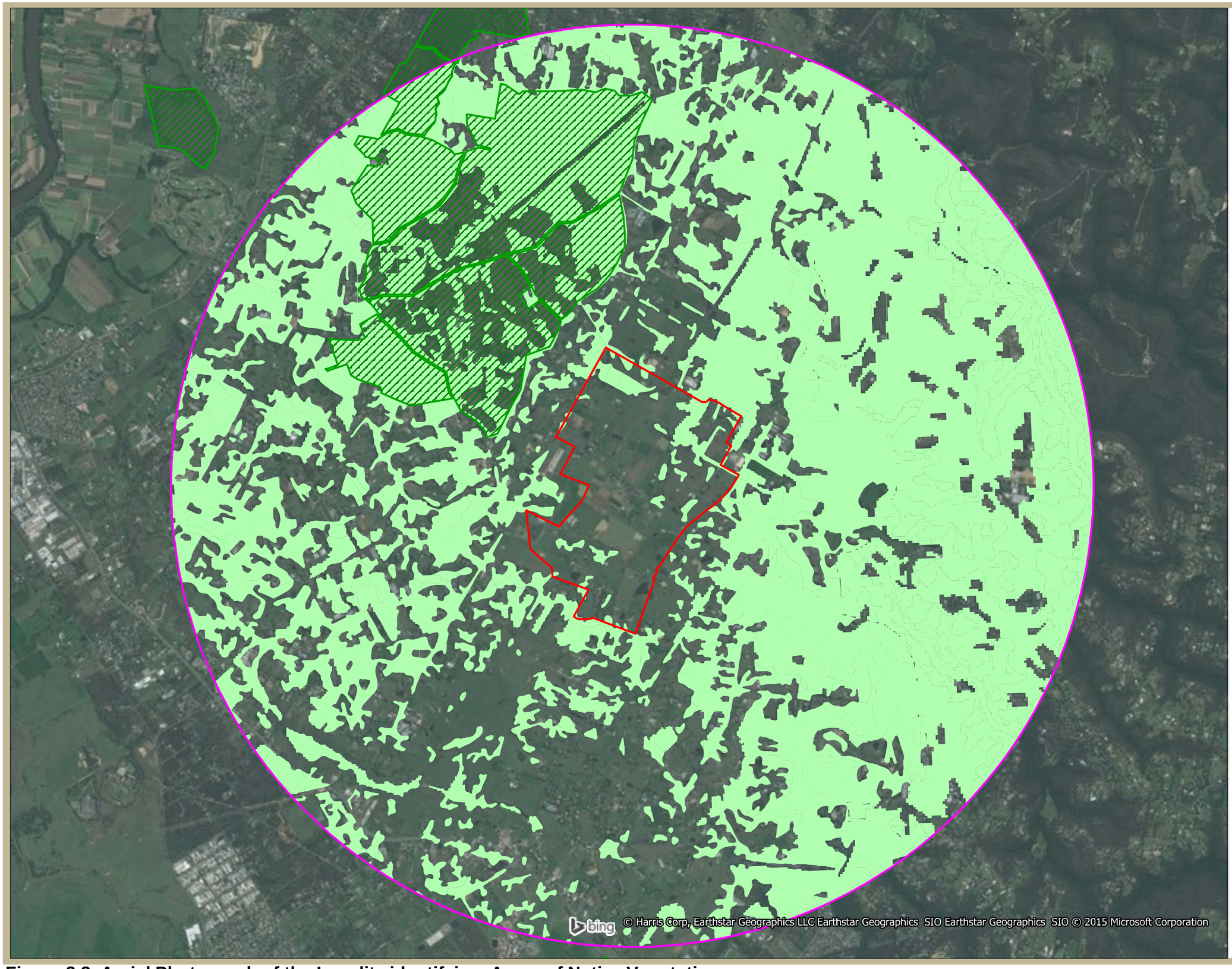
CUMBERLAND ECOLOGY

I:\...\15062\Figures\RP1_SIS\20150506\Figure 2.2. Topography_Study Area

Figure 2.2. Topography of the Study Area

200 0 200 400 600 800 m

Coordinate System: MGA Zone 56 (GDA 94)



Data Source:
DECCW NSW(2008). Change in the Distribution of Cumberland Plain Woodland.

DECCW NSW (2011). Southeast NSW Native Vegetation Classification and Mapping

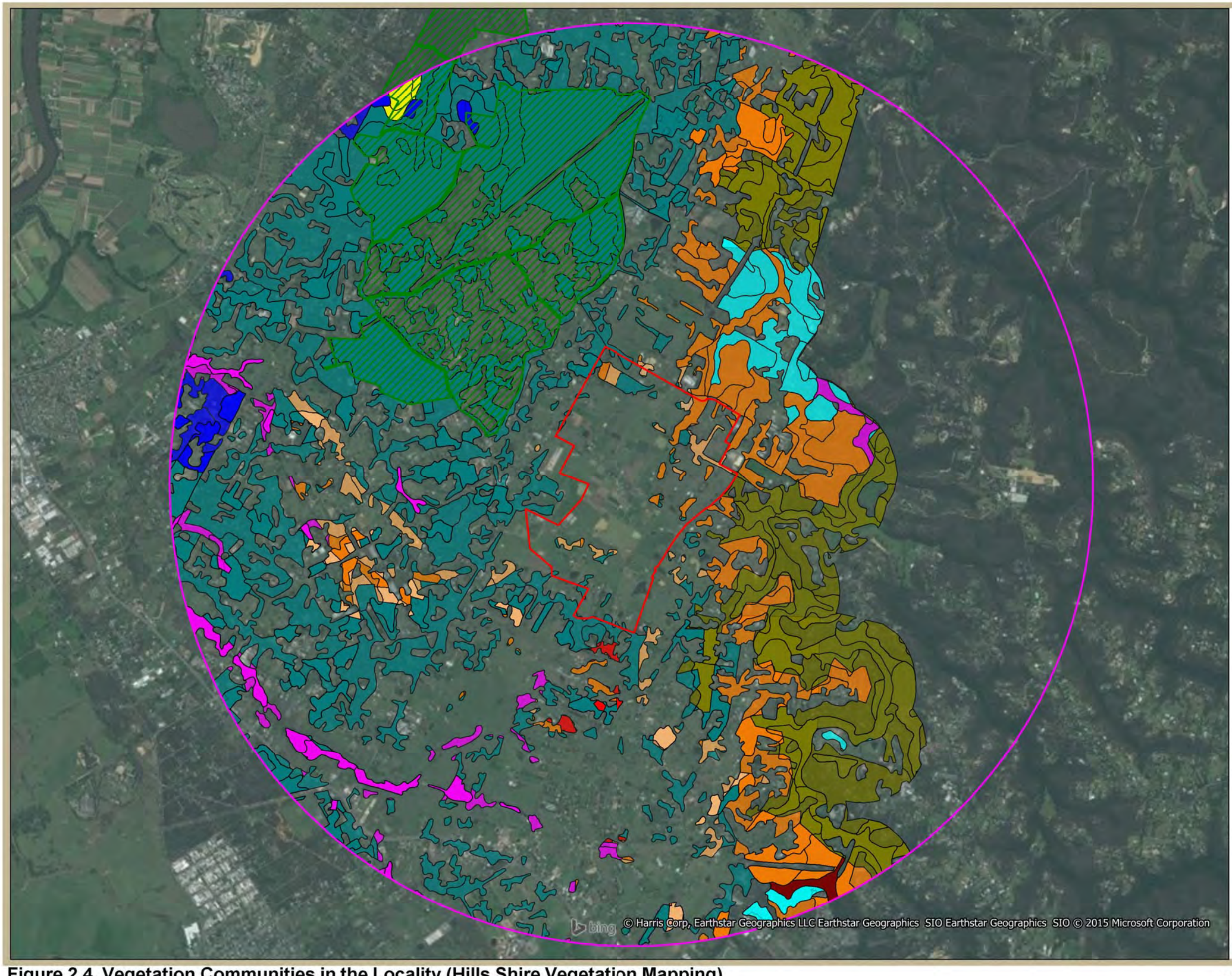
CUMBERLAND ECOLOGY

I:\...\15062\Figures\RP1_SIS\20150506\Figure 2.3. Locality_Native Vegetation

Figure 2.3. Aerial Photograph of the Locality identifying Areas of Native Vegetation

500 0 500 1000 1500 2000 m

Coordinate System: MGA Zone 56 (GDA 94)



Legend

- Study Area (Box Hills North)
- Locality
- National Park

Vegetation Community

- Shale Sandstone Transition Forest (High Sandstone Influence)
- Shale Sandstone Transition Forest (Low Sandstone Influence)
- Shale Hills Woodland
- Shale Plains Woodland
- Shale/Gravel Transition Forest
- Alluvial Woodland
- Upper Georges River Sandstone Woodland
- Western Sandstone Gully Forest
- Freshwater Wetlands
- Castlereagh Scribbly Gum Woodland
- Unclassified Vegetation

Data Source:
DECCW NSW(2008). Change in the Distribution of Cumberland Plain Woodland.

NPWS (2012).
NPWS Estate Data - Version 2/2012.

CUMBERLAND ECOLOGY

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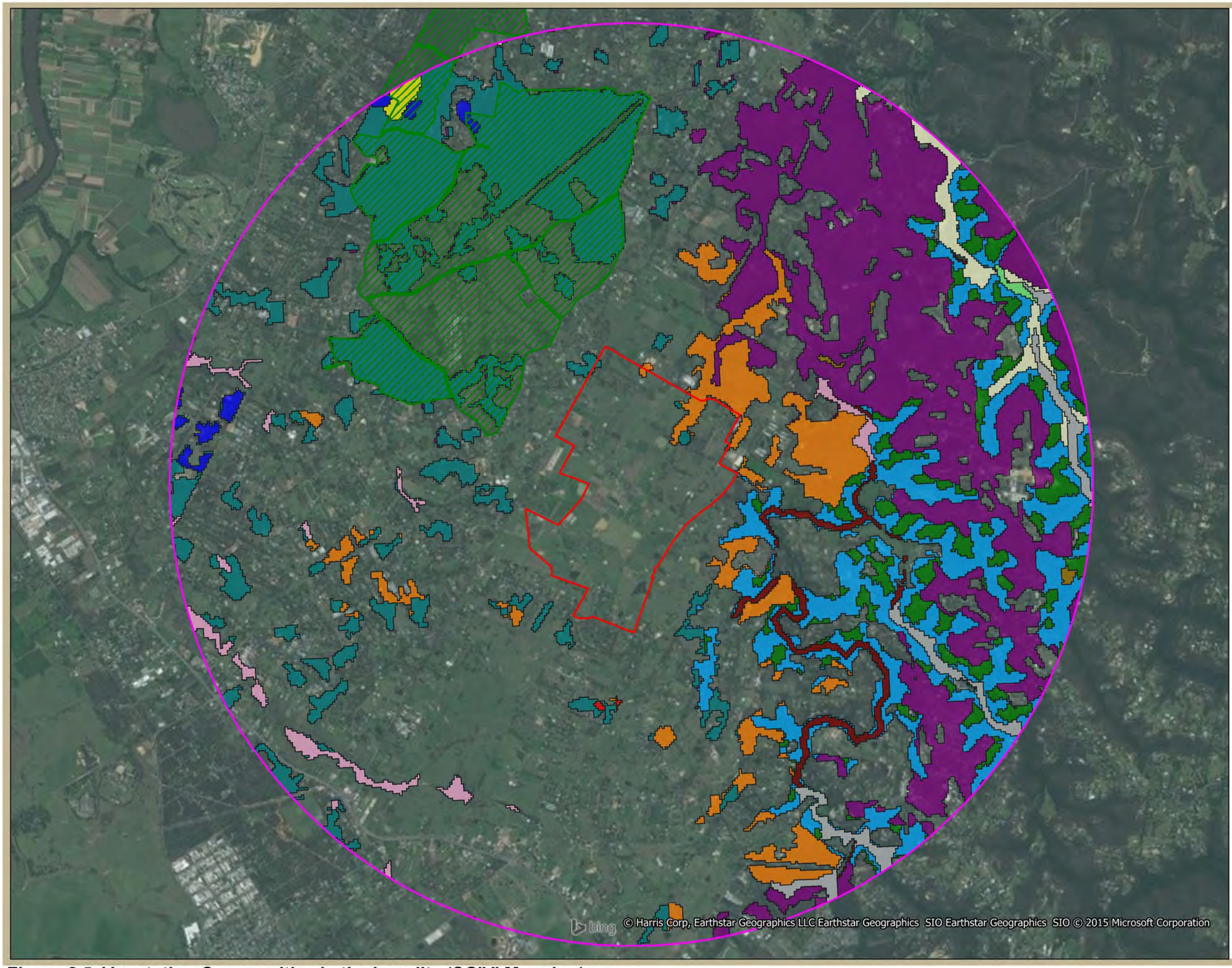
Grid North

I:\...\15062\Figures\RP1_SIS\20150506\Figure 2.4. Vegetation Communities_Locality_Hills Shire

Figure 2.4. Vegetation Communities in the Locality (Hills Shire Vegetation Mapping)

500 0 500 1000 1500 2000 m

Coordinate System: MGA Zone 56 (GDA 94)



Legend

- Study Area (Box Hill North)
- Locality
- National Park

Vegetation Community

- Cumberland Shale Sandstone Transition Forest
- Cumberland Shale Hills Woodland
- Cumberland Shale Plains Woodland
- Castlereagh Shale-Gravel Transition Forest
- Castlereagh Scribbly Gum Woodland
- Cumberland River Flat Forest
- Coastal Sandstone Ridgetop Woodland
- Hinterland Sandstone Gully Forest
- Lower Blue Mountains Wet Forest
- Sydney Hinterland Transition Woodland
- Sydney Swamp Forest
- Sandstone Riparian Scrub
- Coastal Sandstone Plateau Heath
- Coastal Freshwater Lagoon

Data Source:
DECCW NSW(2011). Southeast NSW Native Vegetation Classification and Mapping.

NPWS (2012).
NPWS Estate Data - Version 2/2012.

CUMBERLAND ECOLOGY

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Grid North

I:\...\15062\Figures\RP1_SIS\20150506\Figure 2.5. Vegetation Communities_Locality_SCIVI

500 0 500 1000 1500 2000 m

Figure 2.5. Vegetation Communities in the Locality (SCIVI Mapping)

Chapter 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. Subject species defines those threatened species, populations and ecological communities listed in the DGRs that required consideration.

As a minimum, all subject species have been considered in the Likelihood of Occurrence assessment for the study area. Impacts to subject species and communities further classified as affected (C)EECs/species have been assessed in detail within this SIS.

3.1 Endangered and Critically Endangered Ecological Communities

The following CEEC are known to occur within the study area:

- Cumberland Plain Woodland; and
- Shale Sandstone Transition Forest.

This SIS considers these CEECs as subject communities.

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 databases, including the Atlas of NSW Wildlife (OEH 2014a), Bird Data (Birds Australia 2011), EPBC Protected Matters Saerch Tool (DoE 2014b) and the BioBanking Credit Calculator Tool (DECC 2009). The search area was defined as within a

10 km radius of the study area. A 10 km radius search area was adopted for the Birds Australia database. These records are shown in **Figure 3.1** and **Figure 3.2**.

The number and age of records of threatened species recorded within a 10 km radius of the study area 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

There have been three flora and fauna assessments conducted at the study area from 2013. These assessments involved literature reviews, database assessments, vegetation mapping, general census of flora and fauna, and targeted threatened species searches. The reports include:

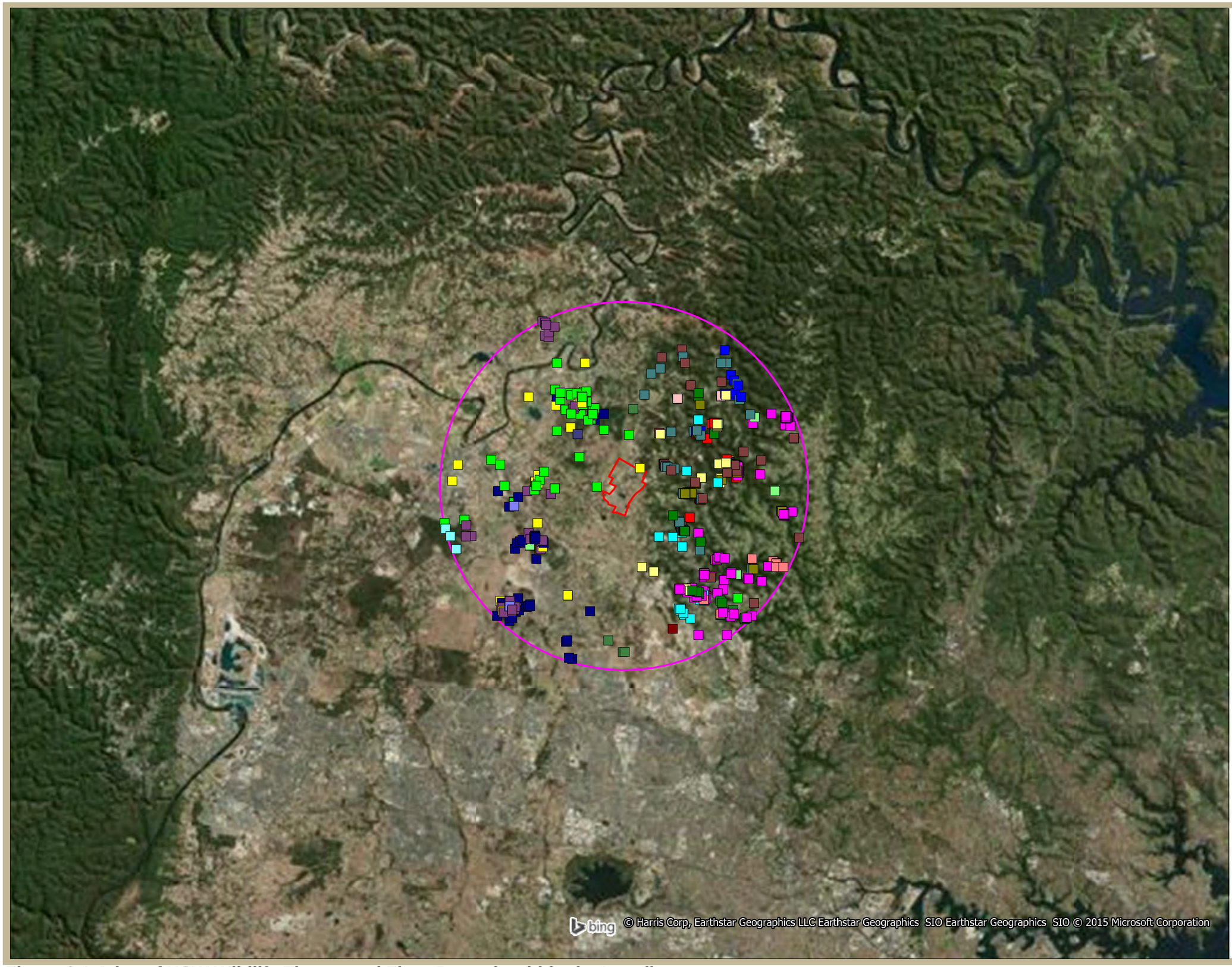
- NGH Environmental (June 2013) Biodiversity Assessment – Box Hill North;
- Cumberland Ecology (July 2013) Ecological Assessment: Box Hill North Rezoning Proposal; and
- Cumberland Ecology (November 2013) Box Hill North Rezoning Proposal – Flora and Fauna Assessment.

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 in the study area. The results of this assessment are found in **Chapter 4**. Habitat searches were based on OEH threatened species survey guidelines (DEC (NSW) 2004).

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”).

Coordinate System: MGA Zone 56 (GDA 94)



Legend

Study Area (Box Hill North)

10km search area

Threatened Flora

- *Acacia bynoeana*
- *Acacia gordonii*
- *Acacia pubescens*
- *Darwinia biflora*
- *Dillwynia tenuifolia*
- *Epacris purpurascens var. purpurascens*
- *Eucalyptus nicholii*
- *Eucalyptus sp. Cattai*
- *Grevillea juniperina subsp. juniperina*
- *Grevillea parviflora subsp. supplicans*
- *Hibbertia superans*
- *Lasiopetalum joyceae*
- *Leucopogon fletcheri subsp. fletcheri*
- *Melaleuca deanei*
- *Micromyrtus minutiflora*
- *Olearia cordata*
- *Persoonia hirsuta*
- *Persoonia nutans*
- *Pimelea curviflora var. curviflora*
- *Pimelea spicata*
- *Pterostylis saxicola*
- *Pultenaea parviflora*
- *Syzygium paniculatum*
- *Tetratheca glandulosa*
- *Zieria involucrata*

Grid North

Data Source:
BioNet Atlas of NSW Wildlife
© NSW Office of Environment and Heritage dated 27/03/2015

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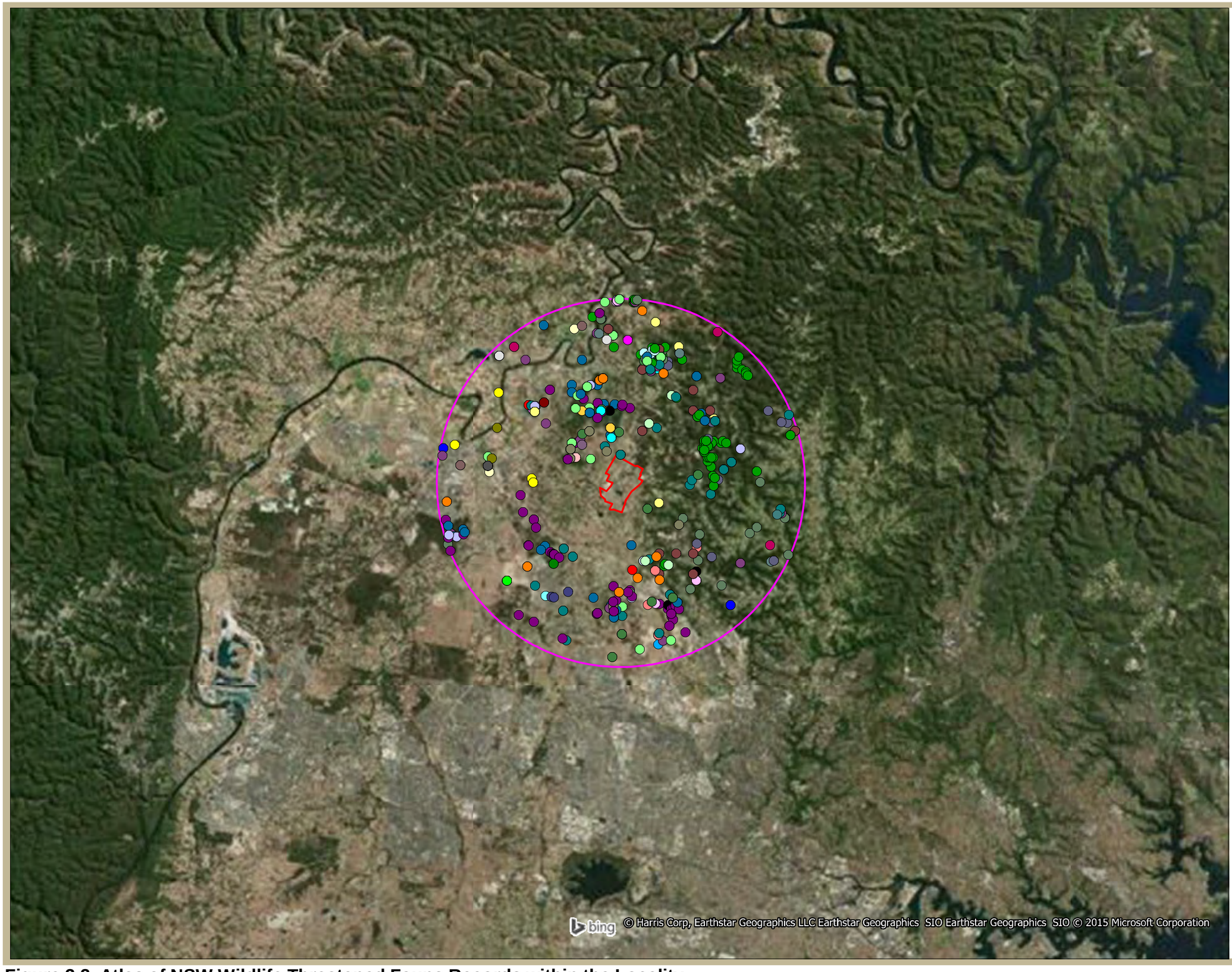
2.5 0 2.5 5 7.5 10 km

I:\...\15062\Figures\RP1_SIS\20150506\Figure 3.1. Threatened Flora Records_Locality

Figure 3.1.Atlas of NSW Wildlife Threatened Flora Records within the Locality

Coordinate System: MGA Zone 56 (GDA 94)



Legend

Study Area (Box Hill North)

10km search area

Threatened Fauna

- Australasian Bittern
- Australian Painted Snipe
- Barking Owl
- Black Bittern
- Black Falcon
- Black-chinned Honeyeater (eastern subspecies)
- Black-tailed Godwit
- Blue-billed Duck
- Brown Treecreeper (eastern subspecies)
- Cumberland Plain Land Snail
- Curlew Sandpiper
- Eastern Bentwing-bat
- Eastern False Pipistrelle
- Eastern Freetail-bat
- Flame Robin
- Freckled Duck
- Gang-gang Cockatoo
- Giant Burrowing Frog
- Glossy Black-Cockatoo
- Greater Broad-nosed Bat
- Green and Golden Bell Frog
- Grey-headed Flying-fox
- Hooded Robin (south-eastern form)
- Koala
- Large-eared Pied Bat
- Little Bentwing-bat
- Little Eagle
- Little Lorikeet
- Major Mitchell's Cockatoo
- Masked Owl
- Painted Honeyeater
- Powerful Owl
- Red-crowned Toadlet
- Regent Honeyeater
- Scarlet Robin
- Sooty Owl
- Southern Myotis
- Speckled Warbler
- Spotted Harrier
- Spotted-tailed Quoll
- Square-tailed Kite
- Squirrel Glider
- Superb Parrot
- Swift Parrot
- Turquoise Parrot
- Varied Sittella
- White-fronted Chat
- Yellow-bellied Glider
- Yellow-bellied Sheathtail-bat

Data Source:
BioNet Atlas of NSW Wildlife © NSW Office of Environment and Heritage dated 27/03/2015

CUMBERLAND ECOLOGY

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Grid North

2.5 0 2.5 5 7.5 10 km

I:\..\15062\Figures\RP1_SIS\20150506\Figure 3.2. Threatened Fauna_Locality

Figure 3.2. Atlas of NSW Wildlife Threatened Fauna Records within the Locality

Chapter 4

Survey

This chapter presents the background of ecological studies in the study 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 DGRs 4.1; Requirement to Survey and 4.2; Documentation.

4.1 Survey Background

4.1.1 Past Surveys of the Study Area

Recent ecological information that is suitable for inclusion in the SIS is available from two recent investigations in 2013. These have been utilised to inform this SIS and include:

- NGH (2013) Biodiversity Assessment – Box Hill North;
- Cumberland Ecology (2013) Ecological Assessment: Box Hill North Rezoning Proposal; and
- Cumberland Ecology (2013) Box Hill North Rezoning Proposal – Flora and Fauna Assessment.

Both of these investigations considered the occurrence of endangered ecological communities and threatened species habitats within the study area.

4.1.2 Surveys Specifically for the SIS

The contemporary ecological study was intended to upgrade existing knowledge of the biodiversity values of Box Hill North. Detailed surveys were completed in 2013 to provide flora and fauna data for the study area in compliance with OEH guidelines for flora and fauna survey (DEC NSW, 2004). Additional flora surveys were conducted in July 2014 to supplement data collected in the previous year.

i. Vegetation surveys

The vegetation of the study area has been covered by regional vegetation mapping by OEH (2008; 2011). The regional mapping is useful to help provide a context for the occurrences of vegetation in both the study area and the locality. However, as these maps are of a

regional scale, they are at a relatively coarse scale and have not been based on field verification of the study area.

On a local scale, vegetation mapping has previously been undertaken across the study area by NGH (2013) and Cumberland Ecology (2013).

ii. Targeted threatened species surveys

Based on the identification of subject species from assessment of species records and the habitats present (**Chapter 3**), targeted surveys were conducted for the following threatened species groups:

- Shrubs and herbs associated with Cumberland Plain Woodland (in particular *Dillwynia tenuifolia*, *Pimelea spicata* and *Grevillea juniperina subsp. juniperina*);
- Cumberland Plain Land Snail;
- Green and Golden Bell Frog;
- Microchiropteran bats; and
- Diurnal birds.

4.2 Survey Methods

4.2.1 Terrestrial Survey

i. Dates of survey

As for the vegetation communities, there is now information available about the fauna and fauna habitats of the study area based upon recent work by NGH (2013) and Cumberland Ecology (2013).

The most recent surveys built upon an existing database of flora and fauna information. Recent surveys are also available from nearby areas of the study area, being those undertaken to inform flora and fauna assessments in the Box Hill Precinct of the North West Growth Centre.

The detailed field surveys within the study area took place over the 2013 winter/spring period, and are summarised below in **Table 4.1**. Floristic surveys were conducted in June and September, whereas fauna surveys were undertaken in September and October 2013.

Table 4.1 Dates of Field Surveys

Dates of Survey	Tasks Completed
26th June 2013	Flora Quadrats, targeted threatened flora searches, diurnal bird census
9-10th September	Targeted Green and Golden Bell Frog surveys, ultrasonic microbat surveys, diurnal bird census
26-27th September 2013	Flora Quadrats, targeted threatened flora searches, diurnal bird census
30th September – 4th October 2013	Fauna trapping surveys, diurnal bird census
3rd and 8th October	Green and Golden Bell Frog targeted surveys
8th October 2013	*Dillwynia tenuifolia* targeted searches
11th October 2013	Cumberland Plain Land Snail targeted searches
18th July 2014	Site inspection
24th July 2014	Flora Quadrats

ii. Flora survey

a. Vegetation mapping of Box Hill North

Vegetation maps provided by OEH in the Mapping of the Cumberland Plain (DECCW 2011), The Hills Shire Council Vegetation Classification Mapping, and ground-truthing that was undertaken by Cumberland Ecology in 2013 were used in the first instance to map the vegetation of Box Hill North. This survey data formed a basis of the current investigation.

Additional flora surveys were conducted specifically for the purposes of SIS reports related to the study area through quadrat sampling (20m x 20m) conducted on 26th June 2013, 26-27th September 2013, and 24th July 2014. The quadrats were located within all classes of the vegetation communities present in the study area. Analysis of the data was used to characterise vegetation map units by their species composition and community structure. Quadrat data methodologies were conducted using the BioBanking Assessment Methodology (DECC 2009).

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 study area. Mapping was completed using MapInfo Version 12.0.1 (Pitney Bowes Software Inc. 2010) on a Windows 7 platform.

b. 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 study area areas were traversed extensively during the 2013 surveys with additional inspections conducted, as required, within the study area in 2014 to determine conditions of vegetation.

A total of 20 BioBanking quadrats were sampled across the study area from 2013 - 2014 survey periods in 20 x 20 metre plots. Sampling methods followed the BioBanking assessment methodology (DECC 2009) In addition to the complete floristic census within the 20m x 20m plot, a meander of the 50m x 20m plot was also undertaken to record any species that were not detected in the smaller plot.

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 4.1**. Flora quadrat data is provided in **Appendix D**. In each quadrat, the following information was recorded as a minimum:

- All vascular flora species present within 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);
- Number of hollows in canopy trees;
- The diameter at breast height of canopy trees containing hollows;
- Number of logs (and total length);
- The ground cover composition (exotic groundcover, native grasses, native shrubs, every meter along a 50 m transect;
- Quantum and species of regenerating trees;
- A waypoint to mark the location of the quadrat, using a handheld Global Positioning System (GPS); and
- Photographs of the quadrat.

Targeted searches for threatened plants from the locality such as *Dillwynia tenuifolia* were undertaken by extensive traverses of areas of suitable habitat. This included traverses of the woodland areas across the northern portions of the study area for two days in September 2013 (Cumberland Ecology Pty Ltd 2013). This time of year was selected to enhance the chance of detection for the species as it is most visible at this time (OEH 2013).

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**.

Table 4.2 Modified Braun-Blanquet scores used in Quadrat surveys

Class	Cover-abundance	Notes
1	<5% cover	Rare (up to one plant per plot)
2	<5% cover	Uncommon (more than one plant per plot)
3	<5% cover	Common (several plants per plot)
4	< 5 % cover	Very Common (lots of plants per plot but <5% cover)
5	5-25% cover	
6	26-50% cover	
7	51-75% cover	
8	76-100% cover	

iii. Fauna survey

Fauna surveys were conducted during spring 2013 in accordance with OEH guidelines for ecological assessment (DEC (NSW) 2004), and Guidelines for detecting frogs listed as threatened under the EPBC Act 1999.

Table 4.3 Fauna Survey Methods and Effort (Cumberland Ecology 2013)

Survey Method	CE Survey Effort in Box Hill North
Amphibians	
Call playback and spotlighting	4 nights per Green and Golden Bell Frog habitat (20 person hours)
Reptiles	
Opportunistic sightings	Throughout survey period
Diurnal Birds	
Walking transects	Throughout survey period
Opportunistic sightings	Throughout survey period
Nocturnal Birds	
Day habitat search	Throughout survey period
Ground and Arboreal Mammals	
Trapping	4 Nights

Table 4.3 Fauna Survey Methods and Effort (Cumberland Ecology 2013)

Survey Method	CE Survey Effort in Box Hill North
Bats	
Ultrasonic call recording	2 nights
Snails	
Active habitat searches (spot assessment method)	63 sites

a. Bat surveys

Microchiropteran bats (microbats) were surveyed through the use of Anabat Z-caim and SongMeter2BAT+ units to record ultrasonic bat recordings.

Units were employed during the survey to record calls of microbats and were left at each survey location for two nights. Units were set before dusk each evening and set to automatically switch off after dawn. Calls recorded on each anabat were analysed to determine which species were present within the site.

b. Ground and arboreal mammal surveys

Trapping was used to detect arboreal and terrestrial fauna occurring within the study area boundary, utilising a trap line of 25 terrestrial Elliot A traps and 10 arboreal Elliot B traps. Surveys were conducted on the nights of the 30 September to the 4 October.

Terrestrial trap lines were established with Elliott (A) traps and set approximately 10 m apart depending on available habitat. Arboreal trap lines were established with Elliott (B) traps and set approximately 20 m apart, in association with each second terrestrial Elliot A trap. The arboreal traps were placed on platforms attached to habitat trees at a height of approximately two metres. Each tree was sprayed with a honey and water mixture to act as an attractant.

Both the terrestrial and arboreal Elliot traps were baited with a mixture of peanut butter, honey and rolled oats and left for a period of four nights. Traps were checked early each morning, and any fauna captured were identified and released. Baits were replaced following captures and the honey water mixture was re-applied before each night of trapping.

A total of 40 arboreal trap nights and 100 terrestrial trap nights were completed over the survey period.

c. Infra-red cameras

Two infra-red (IR) cameras were set up at two locations in the study area to identify fauna species. The cameras were attached to trees and focused on nearby buried bait (chicken

necks). The cameras begin recording when nearby fauna movement activates the motion sensor. The bait was replenished as necessary. The cameras were left for four nights, resulting in a total of eight IR recording nights. Recorded footage was collected and analysed to identify the detected fauna species.

d. Diurnal bird surveys

Visual observation and call identification of diurnal birds was carried out during each survey period. Surveys were conducted opportunistically throughout the study area, in concurrence with other surveys whilst on site. Stops were made throughout transects to positively identify birds, and detect cryptic species in the vegetation adjacent to transect. Diurnal birds were also identified and recorded as they were encountered throughout the study area during the survey periods. GPS readings were taken near sightings of any threatened bird species.

e. Incidental observations

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

f. Green and Golden Bell Frog surveys

Surveys were conducted in accordance with the recommended survey effort for the species (DEC (NSW) 2005b). Surveys involved:

- Initial silent period listening for frogs (5 minutes)
- Broadcasting the Green and Golden Bell Frog call using a megaphone (5 minutes)
- Second period of silence listening for responding Green and Golden Bell Frogs (5 minutes)
- A search of the area with a spotlight for individuals that did not call (10 minutes)

This was conducted at all locations of possible habitat for Green and Golden Bell Frogs, for a period of four nights during October 2013.

g. 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 at relevant habitat locations for the Cumberland Plain Land Snail.

A total of 63 sampling points were taken across the study area. Searches of five minutes in duration were made within the one metre of each tree for either live snails, or snail shells. Trees that were targeted were those which provided suitable habitat for the species,

predominantly those with a diameter at breast height (DBH) of over 10cm and having a layer of bark around their base. Typical species included *Eucalyptus moluccana* and to a lesser extent *Eucalyptus tereticornis*.

iv. 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 CPW woodland and open forest;
- Riparian SSTF vegetation associated with minor tributaries and drainage lines;
- Young regenerating CPW and SSTF woodland; and
- Exotic Grassland.

Fauna habitat assessment was conducted primarily within 50m x 20m BioBanking plots following the BioBanking Assessment Methodology (DECC 2009). Along a 50m transect the following features were measured at a 1 m interval:

- Native Canopy Cover;
- Native mid-storey cover;
- Native ground cover (grasses, shrubs, other); and
- Exotic vegetation.

Within the 50m x 20m plot, the following information was recorded:

- Number and length of fallen logs; and
- Number of trees with hollows (and metadata for each tree with a hollow).

Throughout the study area, habitat condition was assessed by noting ground, shrub/understorey and canopy cover, the number and size of hollows present, habitat features such as rocky outcrops and coarse woody debris, and signs of fauna usage such as scats and scratches, through extensive traverses of the study area.

Fauna habitat assessments across the study area also included consideration of important indicators of habitat condition and complexity including the occurrence of microhabitats such as tree hollows, coarse woody debris, rocky outcrops and wetland areas such as creeks and soaks.

Hollows were used as a general indication of habitat quality for arboreal fauna, and hollow-dependent birds and microbats. Hollows observed during surveys were recorded and the general vegetation condition and tree maturity throughout the site were used to predict

whether trees were likely to contain hollows. Indirect indicators of fauna such as droppings, diggings, footprints, scratches, nests, burrows, paths and runways were also noted.

Previous studies of the study area have recorded GPS coordinates for trees that contain hollows across the study area, and are shown on **Figures 4.1** and **Figure 4.2** within this SIS (NGH Environmental Pty Ltd 2013).

4.2.2 Weather Conditions During Surveys

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

A summary of weather conditions in the locality of the study area during the 2013 and 2014 surveys is provided in **Table 4.4**. Weather conditions during the survey period stayed predominantly cool to mild, with the daily maximum temperature varying from 19.4°C to 33.2°C. One day saw rainfall, with most other days being overcast but remaining dry, or clear. Temperature, and rainfall observations are from Richmond RAAF (station 067105), and was obtained from Bureau of Meteorology.

Table 4.4 Summary of weather conditions during surveys by Cumberland Ecology

Date	°C min	°C max	Rain (mm)	cloud cover	wind direction	wind speed km/h
26th June 2013	10.3	19.4	15.4	0	No data	No data
9th September 2013	5.2	27	0	0	NNE	26
10th September 2013	15.2	32.2	0	0	NW	78
26th September 2013	9	32.4	0	0	WNW	72
27th September 2013	3.7	25	0	0	E	35
30th September 2013	No data	31.7	No data	0	no data	no data
1st October 2013	3.4	33.2	No data	0	WNW	78
2nd October 2013	4.3	27.5	0	0	NW	50
3rd October 2013	12.8	20.7	0	0	SSE	57
4th October 2013	4.1	21.9	0	0	ENE	28
8th October 2013	8.5	23.1	0	0	SE	50
11th October 2013	13.8	26.9	0	0	SE	44
18th July 2014	2.3	16.5	0.2	0	W	50
24th July 2014	3.1	16.1	0	80	NE	24

4.2.3 Survey Limitations

Lots that are not owned by or under the control of EJ Cooper Pty Ltd were not surveyed (**Figure 4.3**). Assumptions about the vegetation on these lots have been made given the presence of other vegetation communities on the site. Though we cannot absolutely rule out the presence of other threatened fauna that may be present on these sites, the sites for which access were limited are extensively cleared with little native vegetation remaining.

Rainfall patterns leading up to the spring surveys in 2013 were not ideal for plant growth as they had below average rainfall. This may have limited the detectability of some species of plants and animals.

Notwithstanding such relatively minor limitations, the simplicity of the habitats on the study area, the three surveys by NGH Environmental and Cumberland Ecology, and the availability of information about flora and fauna in adjacent areas has meant that the flora and fauna of the study area has been adequately described.

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 this SIS. Emphasis has been placed on threatened flora and vegetation communities that have been recorded from the study area or that could potentially occur.

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

4.3.1 Vegetation Communities of the Study Area

The study area has been extensively cleared due to a history of agricultural use. The majority of the study area has also likely to have undergone pasture improvement in the past for stock grazing. Historically, the vegetation of the study area would have comprised native woodland communities and would have included CPW and SSTF, which are both now largely restricted to the northern portions of the study area (**Figure 4.4**)

The widespread vegetation communities now consist of exotic grasslands dominated by such exotic species as *Pennisetum clandestinum* (Kikuyu), *Paspalum dilatatum* (Paspalum), *Eragrostis curvula* (African Love Grass) and *Chloris gayana* (Rhodes Grass), almost to the exclusion of any other understorey species. A small number of native grass and forb species are present but these species occur in very low abundances. A list of the biometric data and flora survey quadrat results is provided in **Appendix D** and the plant species recorded is presented in **Appendix E**, respectively.

Woodlands and open forests occur within the study area in remnant patches, varying widely in their size and quality. The largest and highest quality patches occur in the north of the study area. Five patches of low and moderate quality CPW occur in the north-west corner of

the study area. These patches are characterised by a variable shrub and ground layer with invasive species common in most patches. Additionally a single patch of low and moderate quality SSTF occurs in the north-east of the study area, along Cataract Creek. This patch represents the most intact habitat on the study area, with many hollow-bearing trees (27 hollows present) and a more intact understorey than the CPW remnants.

Scattered paddock trees also occur in the south, centre and north-east corner of the study area. The ground layer beneath these trees is dominated by invasive grass and forb species and the shrub layer is largely absent. Although the tree species include trees such as *Eucalyptus crebra*, which are characteristic of CPW, these areas are highly degraded habitat which do not constitute viable CPW.

i. Cumberland Plain Woodland

Approximately 13.4 ha of CPW occurs as five patches in the north-west corner of the study area, and two smaller degraded patches in the middle and south of the study area (**Figure 4.4**). The dominant canopy species present in this community are *Eucalyptus moluccana* with *E. tereticornis* and *E. crebra* also common.

The patches in the north west corner of the study area represent woodland which has recovered since the initial clearing of the study area and although they contain many tall trees, hollow bearing trees are almost absent (see **Photograph 3.1**). The ground stratum of the more intact north-western CPW patches displays a variable mixture of native and exotic grass and forb species depending on the condition of the remnant patch. Common native species include *Microlaena stipoides* (Weeping Grass), *Aristida vagans*, *Eragrostis leptostachya* and *Chloris ventricosa* (Plump Windmill Grass). Common invasive grasses include *Setaria pumilo* (Whorled Pigeon Grass) and *Paspalum dilatatum*. Native forbs were also present in all remnant patches, with common species including *Dichondra repens* and *Desmodium varians*. More disturbance sensitive species are also present such as *Asperula conferta* and *Gonocarpus teucrioides* (Raspwort).

The understorey in the north-west remnant patches is similarly varied, being either absent or dominated by exotics such as *Rubus fruticosus* (Blackberry). Other patches support some native understorey in places, dominated by native *Bursaria spinosa*.

Photograph 4.1 Cumberland Plain Woodland, dominated by young *Eucalyptus moluccana* and *E. tereticornis*.

ii. Shale Sandstone Transition Forest

One large patch (approximately 13 ha) of SSTF exists in the study area and represents the most intact, remnant vegetation in the study area (**Figure 4.4**). This community extends either side of the base of Cataract Creek and has a total length of approximately 600m from Maguires Road to the north (**Photograph 4.2**).

Dominant tree species vary through the patch from north to south. Eucalyptus tereticornis with *Angophora floribunda* (Rough-barked Apple) closer to the creek line are common in the north. Other species present include *Eucalyptus sclerophylla* (Hard-leaved Scribbly Gum), and *Eucalyptus fibrosa* (Broad-leaved Ironbark). Further south *Eucalyptus tereticornis* (Forest Red Gum), *Eucalyptus moluccana* (Grey Box) and *Eucalyptus crebra* (Narrow-leaved Ironbark) become increasingly common as the community grades towards CPW. However diagnostic SSTF tree species are co-dominant throughout this section, therefore the entire vegetation community has been classified as SSTF.

The understorey is dominated by a similar grass and forb assemblage as the CPW patches described above. Common native grasses include *Aristida vagans* (Threeawn Speargrass), *Dichelachne micrantha* (Plume Grass) and *Eragrostis leptostachya*. *Paspalum dilatatum* (Paspalum) and *Setaria pumila* (Whorled Pigeon Grass) are common invasive grasses in this area, particularly in the southern section of this community.

The understorey is similarly variable with *Bursaria spinosa* (Blackthorn) common in the southern portion of the community grading into *Ozothamnus diosmifolius* (White Dogwood)

and *Kunzea ambigua* (Tick Bush) further north. At the northern extremity this community appears to be grading into the moister forest present on the other side of Maguires Road with species such as *Daviesia ulicifolia* (Gorse Bitter Pea) occurring.

A distinct 'bulge' exists low on the eastern edge of the main patch. This area is dominated by younger, smaller tree communities with tree hollows absent, representing lower habitat value than the main adjacent patch (**Figure 4.4**, **Photograph 4.3**). This area is considered to represent recent regrowth and the most intact portions of this community are centred on the creek line base.

Smaller remnant patches of SSTF exist in the north-eastern corner of the study area and south of the larger patch.

Vegetation in the north eastern corner of the study area is indicative of SSTF (**Photograph 4.4**). Canopy species include *Eucalyptus amplifolia* (Cabbage Gum), *Eucalyptus punctata* (Grey Gum) and *Eucalyptus tereticornis* (Forest Red Gum). The ground cover is dominated throughout by Pennisetum clandestinum, but there are also areas where *Cynodon dactylon* (Couch) and *Microlaena stipoides* (Weeping Grass) are present. The shrub layer is absent in these patches and there are no fallen logs. There are no hollow-bearing trees in the patch as the majority of the trees are regrowth with a DBH of < 80cm.

Photograph 4.2 Shale Sandstone Transition Forest showing exposed sandstone outcropping on the edge of Cataract Creek

Photograph 4.3 Shale Sandstone Transition Forest regrowth (Flora Plot 11)

Photograph 4.4 Shale Sandstone Transition Forest remnant (Flora Plot 19)

iii. Wetland/Dams

The Box Hill North site has been used for intensive cropping requiring irrigation, and in other places grazing of livestock. It is well supplied with artificial water storages of variable sizes and shapes. Sixty-two (62) dams or water bodies exist across the study area.

The majority of dams within the study area are devoid of fringing wetland vegetation. The ongoing disturbance from cattle and steep bathymetry of the edges of these man made dams are not suitable for growth of emergent macrophytes and other wetland vegetation. These dams have been identified as 'farm dams' on **Figure 4.4**, and are shown in **Photograph 4.5** and **Photograph 4.6**. Sixteen (16) dams within the study area have marginal fringing vegetation such as *Typha spp*. the occurrence of the fringing vegetation is sporadic and limited to small patches, even within a dam (**Photograph 4.6**).

Photograph 4.5 Dam on study area lacking fringing aquatic vegetation

Photograph 4.6 Dam in the northern area of the Study Area with fringing vegetation dominated by *Typha orientalis* (Broad-leaved Cumbungi)

iv. Exotic Vegetation

Exotic grasslands and cultivated lands comprise the majority of the study area. Cultivated lands are used for market gardens for growing broccoli and lettuce variants. Crops requiring irrigation are shown in **Photograph 4.7**.

Exotic grasslands are dominated by pasture grasses. Canopy trees, shrubs, fallen logs and stumps have been entirely removed from this community on the study area. Six flora quadrates were undertaken across the study area to confirm the assemblage of flora species. Exotic grasslands have been cleared of native vegetation, and are unlikely to regenerate. These areas do not form the community of Derived Native Grasslands of either CPW or SSTF, as the ground cover composition is dominated by exotic species. The only native species present in exotic grassland plots was *Microlaena stipoides* which occurs as only one or two individuals per 20m x 20m quadrat.

In the south of the study area there are scattered *E. crebra* within the exotic grasslands. These areas are considered to form the community of exotic grassland for this SIS, however the justification for assigning this vegetation type is expanded in the section below (**Photograph 4.8** and **Photograph 4.9**).

Photograph 4.7 Cultivated lands used for horticulture at Photopoint 10

Photograph 4.8 Exotic grassland at Flora Quadrat 20

Photograph 4.9 Exotic grassland at Rapid Assessment 4

a. Scattered Trees

Scattered *E. crebra* trees exist across the study area, which are likely remnant trees from formerly existing native vegetation communities from the locality (**Photograph 4.10-4.13**).

The scattered paddock trees in the south and centre of the study area (marked as scattered paddock trees in **Figure 4.4**) lack a native understorey and have a stratum dominated by exotic pasture grass and forb species *Setaria pumilo* and *Paspalum dilatatum*. Due to the lack of shrub layer, ground cover and connectivity characteristics, these scattered trees do not comply with the NSW or Commonwealth listing for Cumberland Plain Woodland or Shale Sandstone Transition Forest. The reasons are expanded below:

Photograph 4.10 ***Eucalyptus crebra*** **stag with exotic grassland at flora quadrat 14**

Photograph 4.11 **Scattered** ***Eucalyptus crebra*** **with exotic understorey in southern portion of the study area**

Photograph 4.12 Scattered *Eucalyptus crebra* with exotic grassland nearby Cataract Road

b. TSC Act Cumberland Plain Woodland

Under the TSC Act, the areas of scattered paddock trees do not qualify as Cumberland Plain Woodland. Whilst *E. crebra* is a canopy species of the Cumberland Plain Woodland, in the southern areas:

- The shrub layer is absent; and
- The ground cover is highly modified and dominated by exotic pasture grasses.

Under section 5 of the Final Determination of the Scientific Committee for Cumberland Plain Woodland:

"The ground cover is dominated by a diverse range of grasses including Aristida ramosa (Purple Wiregrass), A. vagans (Threeawn Speargrass), Cymbopogon refractus (Barbed Wire Grass), Dichelachne micrantha (Plumegrass), Echinopogon caespitosus (Forest Hedgehog Grass), Eragrostis leptostachya (Paddock Lovegrass), Microlaena stipoides (Weeping Grass), Paspalidium distans and Themeda australis (Kangaroo Grass), and with graminoids Carex inversa (Knob Sedge), Cyperus gracilis, Lomandra filiformis subsp. filiformis (Wattle Mat-rush) and L. multiflorus subsp. multiflorus (Many-flowered Mat-rush). The ground cover also includes a diversity of forbs such as Asperula conferta (Common Woodruff), Brunoniella australis (Blue Trumpet), Desmodium varians (Slender Tick Trefoil), Dianella longifolia (Blue Flax Lily), Dichondra repens (Kidney Weed), Opercularia diphylla, Oxalis perennans and Wahlenbergia gracilis (Australian Bluebell), as well as scramblers, Glycine spp. and

Hardenbergia violacea (Native Sarsaparilla) and the fern Cheilanthes sieberi (Poison Rock Fern)."

The patches in the south are lacking all species that have been listed under the final determination, except for scattered individuals of *Microlaena stipoides*. The presence of this grass is indicative that the area was once Cumberland Plain Woodland, but these areas do not qualify in their current form, and the determination is made that this area of vegetation does not constitute CPW.

The final determination does allow for the provision of Derived Native Grasslands of CPW, whereby:

"Either or both of the upper-storey and mid-storey may be absent from the community. Native grasslands derived from clearing of the woodland and forest are also part of this community if they contain characteristic non-woody species"

The areas in the south do not contain the characteristic non-woody species as described in the final determination for CPW and therefore do not conform to the definition of Derived Native Grasslands of CPW

c. EPBC Act Cumberland Plain Woodland

Under the EPBC Act, the areas in the south do not classify as CPW, as they are:

- Lacking in native perennial understorey species;
- Patch size;
- Are isolated from other patches of CPW; and
- Are lacking in large trees with hollows.

Table 4.5 below outlines the threshold flowchart for determining the presence of the listed (C)EECs at the study area. All questions within the flowchart have been addressed, although the decision paths can determine the absence of the listed community early within the EPBC listed community flowchart.

Table 4.5 Flowchart rationale for EPBC determination of Cumberland Plain Woodland

	Threshold	Scattered Trees in South
1	Are native tree species present with a minimum projected foliage cover of 10%?	Yes. The area contains several large *E. crebra* that have projected foliage cover >10%
2	Is the patch of the ecological community 0.5 ha or greater	No, the area exists as scattered trees that are up to 100m apart.

Table 4.5 Flowchart rationale for EPBC determination of Cumberland Plain Woodland

	Threshold	Scattered Trees in South
	in size?	
3	Of the perennial understorey vegetative cover present, is 50% made up of native species?	No, the understorey is comprised almost entirely by exotic vegetative cover. The perennial understory vegetation does contain M. stipoides, and indicative species for the listed communities, however this exists as scattered individuals with less than 5% ground cover. The ground has been ploughed historically and is highly modified in its current form.
4	Is the patch 5 ha or greater in size?	No, the patch size exists as scattered trees and is < 5 ha.
5	Is the patch contiguous with a native vegetation patch 5 ha or greater in size?	No, the patch is isolated from other forms of the community. The patch is within a larger area of cleared pastures with exotic grasslands, dams, and cultivated lands.
6	Does the patch contain at least one tree per ha that is large (≥ 80cm DBH) or has a hollow?	Yes, there are isolated trees that have dbh > 80 cm.
7	Of the perennial understorey vegetative cover present, is 30% made up of native species?	No, the perennial understorey comprises exotic pasture grasses. See plot data quadrat 14 and 15. There are scattered native dicots, however they comprise less than 20% of the species abundance, and less than 5% of the ground cover throughout the community
8	The listed Ecological Community is present?	No.

Photograph 4.13 Exotic grassland

4.3.2 Threatened Flora Species

No threatened flora species have been found on site by any of the vegetation investigations.

Flora surveys have been undertaken at the study area by NGH and Cumberland Ecology and have recorded a wide diversity of plants; however no threatened species were recorded in the study area. Based on desktop assessments as listed in **Section 3.2.1**, the following threatened flora species are considered to have potential to occur within the study area:

- *Acacia pubescens* (Downy Wattle) – Vulnerable, TSC Act, Vulnerable EPBC Act;
- *Dillwynia tenuifolia* – Vulnerable, TSC Act;
- *Epacris purpurascens* var. *purpurascens*– Vulnerable, TSC Act;
- *Grevillia juniperina* subsp. *juniperina* (Juniper-leaved Grevillia) – Vulnerable, TSC Act;
- *Pimelea curviflora* var. *curviflora* – Vulnerable, TSC Act; Vulnerable, EPBC Act;
- *Pimelea spicata* – Endangered, TSC Act; Endangered, EPBC Act; and
- *Pultenaea parviflora* (Sydney Bush-pea) – Endangered, TSC Act; Vulnerable, EPBC Act.

Acacia pubescens, Dillwynia tenuifolia, Grevillea juniperina subsp. juniperina and *Pultenaea parviflora* were considered to have the greatest likelihood of occurring on the study area, as

individuals of these species occur on nearby properties and the forest patch to the north-east.

i. Recent surveys of the study area

Recent surveys by Cumberland Ecology (2013) targeted threatened flora species likely to occur in the study area. Surveys were focused within remnant CPW and SSTF in the north of the study area, as these areas had the highest likelihood for these species to occur.

Targeted surveys in the most suitable habitat (within and around the SSTF community) failed to detect either these or any other threatened floral species. A single individual of *Dillwynia tenuifolia* was found in 2007, in the patch of woodland to the north of the study area. No individuals of *D. tenuifolia* were observed during the targeted surveys of similar vegetation community within the study area immediately adjacent to the location of the observed individual.

Details of the methodologies for the flora searches are shown in **Section 4.2.1.ii**.

4.3.3 Fauna Habitats within the Study Area

Habitats of value to native fauna in the study area are generally associated with the woodland that occurs in the north along the creek line that drains to Cataract Creek. The value of this vegetation to hollow-dwelling native fauna is significant as the trees are mostly mature and offer roosting or nesting habitat.

The extent of disturbance and land management activities in the central and southern areas of the subject site has significantly limited the suitability of the study area to provide habitat for native species. Disturbed habitats generally support populations of native and exotic species that are common in urban/rural environments. Therefore the patches of scattered trees in the central and southern areas of the subject site are not likely to support a wide range of species compared with the nearby Scheyville NP, which contains larger areas of woodland that is not subject to ongoing disturbance.

i. Woodland habitat

The dominant fauna habitat is woodland, and this occurs throughout the northern portions of the study area.

The patches of CPW in the north west of the study area offer feeding habitat for woodland birds. The canopy is relatively young and the trees lack hollows for nesting. This area is regrowth and has not formed mature trees. Tree species such as *E. tereticornis* and *E. moluccana* are present as habitat for Cumberland Plain Land Snails. The existing CPW within the study area (**Figure 4.5**) provides foraging and refuge resources for a variety of species at the study area such the Yellow-faced Honeyeater *Lichenostomus chrysops* and Noisy Friarbird *Philemon corniculatus*. Additionally, a Koala feed tree species *Eucalyptus tereticornis* occurs in this community. However as mature, hollow bearing trees are rare these recovering patches, they are considered to represent only marginal foraging habitat for most species.

Within the Shale Sandstone Transition Forest the fauna habitat occurs in two distinct growth forms:

- Mature woodland; and
- Regenerating woodland.

The vegetation along the creekline occurs as mature woodland. Along this area there are large mature trees and there are more than 27 hollows along the creekline. The shrub layer is partially cleared by cattle grazing, but still provides suitable habitat for passerine birds. The canopy trees provide foraging, nesting and breeding habitat for a variety of fauna that exist at the study area. Other areas of SSTF across the study area are regenerating woodlands which provide foraging habitat for woodland birds, but lack hollows for nesting habitat. Regenerating *Acacia parramattensis* along the creekline provides nesting habitat for fairy-wrens and finches. Sandstone outcropping in the stream bed provides habitat for a range of species including the Brown Antechinus (*Antechinus stuartii)* as well as potential roosting sites for microchiropteran bats. Several bird species have been observed making use of the available tree hollows in this community, including Red-rumped Parrots *Psephotus haematonotus*. Within a large *E. tereticornis* in the SSTF along the creek, there is an eyrie used by a pair of White-bellied Sea Eagles *Haliaeetus leucogaster*.

The stream running through the centre of this community supports a range of avifauna including the Purple Swamphen (*Porphyrio porphyrio*), and Azure Kingfisher (*Alcedo azurea*).

Photograph 4.14 Eagle eyrie within SSTF woodland

ii. Grassland habitat

Grassland areas that occur across the majority of the site represent little value to native fauna, as there is little structural complexity that is necessary to provide roosting or nesting habitat for most species. 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 Australian Raven (*Corvus coronoides*), Crested Pigeon (*Geophaps lophotes*), Galah (*Cacatua roseicapillus*), and mammals such as the Eastern Grey Kangaroo *Macropus giganteus*). Introduced species such as Red Fox (*Vulpes vulpes*), and European Rabbit (*Oryctolagus cuniculus*) are common within the grassland habitats.

Grassland areas across the study area are unlikely to regenerate to form additional woodland.

iii. Artificial waterbodies

A total of 62 waterbodies occur on the study area of varying sizes and aquatic floral assemblages (**Photographs 4.14-4.15**). The value of the majority of these dams for fauna is limited as they provide little refuge or habitat complexity.

Photograph 4.15. Waterbody with Typha spp. reeds.

Photograph 4.16. Large water storage in the centre of the southern half of the study area, south of Red Gables Road.

These waterbodies provide refuge and foraging habitat for a range of fauna species including two EPBC listed migratory species, the Cattle Egret and White-bellied Sea Eagle.

Seven of these waterbodies support communities of *Typha spp*. which is potential (low quality) habitat for the Green and Golden Bell Frogs. Targeted searches according to EPBC guidelines (DoE 2010) were undertaken in October 2013 and failed to detect this species.

4.3.4 Fauna Species

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

i. Mammals

The study area contains fragmented habitat for mammals that has been degraded by livestock grazing and other agricultural pursuits. This has greatly limited the diversity of mammal species present, particularly threatened mammals. Species frequently encountered on the study area included microbats and exotic species such as Deer (*Cervus sp.*), Feral Cats and the Red Fox.

Two threatened microchiropteran bat species listed as Vulnerable under the TSC Act were recorded by Cumberland Ecology; the Eastern Bentwing-bat and Eastern Freetail-bat. Two other threatened species, the Eastern False Pipistrelle and the Southern Myotis are

considered to probably occur within the study area; however their calls were not able to conclusively differentiated from those of similar species. In addition Cumberland Ecology detected the presence of Grey-headed Flying-fox during nocturnal frog surveys on the 19 September 2013.

Although not recorded by Cumberland Ecology, NGH Environmental (2013) also recorded the Yellow-bellied Sheathtail-bat from the study area, which is listed as Vulnerable under the TSC Act.

Targeted surveys were conducted to search for the Squirrel Glider (*Petaurus norfolcensis*) but no gliders or other tree-dwelling threatened mammal species were found. The only species of native mammal captured during the field survey was a single Brown Antechinus detected through Elliot trapping in the patch of SSTF.

No Koalas have been recorded on the study area by NGH Environmental or Cumberland Ecology, and although some habitat is present, the species is not considered likely to occur. Although one species of feed tree is known to occur on the study area *Eucalyptus tereticornis*, only widely scattered patches of woodland occur and such woodland is degraded and fragmented. The available habitat is considered to be of only marginal value for this species. More intact habitat for this species exists in Scheyville National Park, approximately 5km to the west of the study area.

Table 4.6 Results from bat surveys

	TSC Act	EPBC Act	Anabat 1		Anabat 2
			9/09/2013	10/09/2013	10/09/2013
Number of sequence files			410	593	230
Number of calls identified			83	66	35
Chalinolobus gouldii			Definite	Definite	Definite
Chalinolobus morio			Definite	Definite	Definite
Falsistrellus tasmaniensis	Vulnerable		Probable		
Myotis macropus	Vulnerable		Probable	Probable	Probable
Nyctophilus species			Probable	Probable	Probable
Scotorepens orion			Probable	Definite	
Vespadelus pumilus			Probable	Probable	Probable
Vespadelus regulus				Probable	
Vespadelus vulturnus			Probable	Probable	Probable
Miniopterus schreibersii oceanensis	Vulnerable		Definite	Definite	Probable
Austronomus australis			Definite	Definite	
Mormopterus norfolkensis	Vulnerable		Definite	Probable	Probable
Mormopterus species 2			Definite	Definite	Probable

ii. Birds

Overall bird diversity within the study area was low, with a total of 63 species detected. A complete fauna list can be found in **Appendix F**. The remnant woodland habitat and large number of waterbodies present supported a high diversity of woodland and aquatic bird species. Common species included the Sulphur-crested Cockatoo (*Cacatua galerita*), Australian Magpie (*Cracticus tibicen*), and Rainbow Lorikeet (*Trichoglossus haematodus*), as well as a range of honeyeaters such as the Yellow-faced Honeyeater and White-naped Honeyeater (*Melithreptus lunatus*).

Small woodland birds were also common in the CPW and SSTF remnant patches, with species such as the Yellow Thornbill (*Acanthiza nana*) and Superb Fairy-wren (*Malurus cyaneus*) frequently encountered.

The waterbodies and Cataract Creek creekline supported a range of aquatic species such as the Pacific Black Duck (*Anas superciliosa*), Little Black Cormorant (*Phalacrocorax sulcirostris*) and Purple Swamphen.

One threatened bird species under the TSC Act was detected on site, the Spotted Harrier. Two species listed as migratory under the EPBC Act was also detected, the Cattle Egret and the White-bellied Sea-Eagle. The locations for all threatened species sightings are available in **Figure 4.6**.

iii. Reptiles

No reptile species were detected within the study area by NGH Environmental or Cumberland Ecology. The PMST search conducted for the study area identified the Broad-headed Snake (*Hoplocephalus bungaroides*) as having potential to occur on the study area. However due to the lack of habitat the occurrence of this species is considered unlikely. In order to support a breeding population of this species large areas of exposed sandstone are required, and these features are absent on the study area.

The Atlas of NSW Wildlife search conducted for the study area identified a range of common reptile species that have potential to be making use of available habitat (woodland, creeks and dams) on the study area. These species include:

- Eastern Snake-necked Turtle (*Chelodina longicollis*);
- Red-throated Skink (*Acritoscincus platynota*);
- Copper-tailed Skink (*Ctenotus taeniolatus*);
- Eastern Blue-tongue (*Tiliqua scincoides*);
- Eastern Water Dragon (Intellagama *lesueurii*);
- Bearded Dragon (*Pogona barbata*);
- Red-bellied Black Snake (*Pseudechis porphyriacus*); and

- Brown Snake (*Pseudonaja textilis*).

iv. Amphibians

Six common amphibian species were recorded from the study area by Cumberland Ecology, including the Common Eastern Froglet (*Crinia signifera*), Spotted Grass Frog (*Limnodynastes tasmaniensis*), Verreaux's Tree Frog (*Litoria verreauxii*) and Peron's Tree Frog (*Litoria peronii*), the Eastern Dwarf Tree Frog (*Litoria fallax*) and the Leaf Green Tree Frog (*Litoria phyllochroa*).

No threatened amphibian species were recorded despite targeted Green and Golden Bell Frog surveys. This species has not been recorded from the study area by Cumberland Ecology or NGH Environmental, and is considered unlikely to occur.

v. Invertebrates

No live specimens of the Cumberland Plain Land Snail have been recorded from the study area, however a single empty shell was found along the northern boundary during surveys by Cumberland Ecology on the 10 October 2013.

The species is small, cryptic and hard to find, particularly during dry weather, and the protracted dry weather prior to the commencement of this survey may have made the species difficult to find. For this reason, the CPW patches on the study area are considered to be potential habitat for this species and this species is included in the assessments of significance.

4.4 Habitat Corridors

The study area forms a void within locally broad vegetation coverage. The vegetation within the study area forms a brief corridor that extends from Maguires Road south for approximately 500 m. The majority of the study area is cleared or comprises of exotic grasslands.

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 experience a measureable loss of habitat and are known from the Study Area. 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 DGRs, 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 study area.

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 study area that will experience a loss of individuals from the population in the study area 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:

- Spotted Harrier;
- Grey-headed Flying-fox;
- Eastern Freetail-bat;
- Yellow-bellied Sheathtail-bat*;*
- Eastern Bentwing-bat;
- Southern Myotis;
- Cumberland Plain Land Snail;
- White-bellied Sea-Eagle;
- Cattle Egret;
- Cumberland Plain Woodland; and
- Shale Sandstone Transition Forest.

All of these (C)EECS/species occur within the study area and will have habitat removed as a result of the development.

i. Spotted Harrier

The species has been recorded within the study area. A single individual was seen during surveys conducted by NGH Environmental in May 2013. Spotted Harrier is listed as Vulnerable under the TSC Act, and is not listed under the EPBC Act.

The species is known sporadically in the locality as the species forages over a wide area. Given the widespread nature of the species there are no known local populations of the species. The species occurs throughout the mainland of Australia, except in densely forested habitats of the coast, escarpments and ranges. The relative significance of the observation in the study area is low, given the transient nature of the species.

ii. Grey-headed Flying-fox

The species has been recorded within the study area. Individuals were observed flying over the site during nocturnal surveys in September 2013 by Cumberland Ecology. This species is listed as Vulnerable under the TSC Act and Vulnerable under the EPBC Act. The species is known to coastal south-eastern Australia, and roosts in camps of up to ten thousand individuals, where they have high site fidelity. Camps can exist for up to one hundred years. The species can travel up to 50km from the camp to forage and the observation at the study area is likely individuals in transit and not using the study area to forage. There are no camps within the study area.

iii. Eastern Freetail-bat

The species has been recorded by NGH Environmental in 2013 and Cumberland Ecology in 2013, in the remnant corridor of SSTF along the creekline. The Eastern Freetail-bat is listed as Vulnerable under the TSC Act. The species utilises the SSTF corridor as roosting and foraging habitat. Numbers of species in the locality are unknown, primarily likely due to low survey effort in surrounding areas. The species is likely to exist throughout the Maguires Road PCA to the north where better quality habitat exists, as well as within the study area. The significance of the population in the study area is unknown as little is known about this species.

iv. Yellow-bellied Sheathtail-bat

The species was recorded in May 2013 by NGH Environmental within the patch of CPW along Maguires Road, using an ultrasonic detector. The species was not recorded by Cumberland Ecology. The Yellow-bellied Sheathtail-bat is listed as Vulnerable under the TSC Act. The species is a wide ranging species that is found over all of NSW except the alpine regions. It roosts in groups of up to six in tree hollows and buildings. An estimate of the number of individuals utilising the site is difficult to determine. The species utilises a wide variety of habitats, and would use both open and forested areas within the study area.

v. Eastern Bentwing-bat

The species has been recorded by NGH Environmental in 2013 and Cumberland Ecology in 2013, in the remnant corridor of SSTF along the creekline. The Eastern Bentwing-bat is listed as Vulnerable under the TSC Act. The species primarily roosts in caves, culverts and buildings. The species forages in forested areas catching moths and other flying insects for prey. Numbers of species utilising the site are difficult to determine using contemporary survey techniques. There are seven records of the species within the locality. within the study area

vi. Southern Myotis

The species was recorded by Cumberland Ecology using an ultrasonic detector. An entire call sequence was not recorded, but given the availability of suitable habitat at the Study area, the species is assumed to be present. Southern Myotis is listed as Vulnerable under the TSC Act. The species generally roost in groups of 10 - 15 close to water in caves, mine shafts, hollow-bearing trees, storm water channels, buildings, under bridges and in dense foliage. The species forages over streams and pools catching insects and small fish by raking their feet across the water surface. The species is widespread across coastal NSW and is also prevalent in the Riverina. The significance of the population in the study area is low, although the study area may provide forage habitat for individuals that live outside the study area.

vii. Cumberland Plain Land Snail

No live specimens of the species have been recorded from the study area, however a single empty shell was found during surveys by Cumberland Ecology on the 10 October 2013. Cumberland Plain Land Snail is listed as Endangered under the TSC Act. Thorough searches for the species only detected the single dead individual; therefore the local population is considered no longer present or small if present. The species is known from other areas throughout the Cumberland Plain. Given the highly degraded condition of the study area, and the lack of fallen bark at the base of feed species, it is not expected that the population within the study area is significant.

viii. White-bellied Sea-Eagle

The species has been recorded by NGH Environmental in 2013 and Cumberland Ecology in 2013, in the remnant corridor of SSTF along the creekline. There is a pair of White-bellied Sea-Eagles and an eyrie in the southern section within the remnant SSTF. The species is listed as Migratory under the EPBC Act. The species is widespread throughout coastal Australia. The local population is estimated at two as a breeding pair was observed. The significance of the population within the study area is low as the species is not threatened within NSW.

ix. Cattle Egret

A single individual was recorded by Cumberland Ecology in 2013. The species is listed as Migratory under the EPBC Act. The species is widespread throughout Australia and is a vagrant throughout NSW. The observation at the site is likely an individual opportunistically foraging at the study area, and is not a resident.

x. Cumberland Plain Woodland

CPW within the study area occurs exclusively as remnant woodland and regrowth woodland. There are several patches in the north western corner of the study area, as well as satellite patches in the centre and south of the site. CPW within the study area does not exist in the form of Derived Native Grassland. The community is listed as a CEEC under the TSC Act and EPBC Act. The community exists throughout the Cumberland Plain in the form of locally

patchy remnants. The occurrence within the study area is likely regenerated CPW that has been historically cleared. The relative significance of the community within the study area is low, given the current degraded form.

xi. Shale Sandstone Transition Forest

SSTF within the study area exists in a relatively intact corridor along the creekline in the north. There are more extensively degraded patches within the north-eastern corner of the study area. The community is listed as a CEEC under the TSC Act and EPBC Act. The community exists within the locality extensively to the north of the study area.

4.5.2 Minor Affected (C)EECs/Species

The following flora species have not been recorded within the study area, but have the potential to occur on the site due to suitable habitat (**Table 4.7**). Targeted searches have failed to detect these species; however records exist nearby (< 5 km) to the Study area. For this reason the following flora species have been considered to be minor affected species.

i. Flora population

- *Dillwynia tenuifolia* Sieber ex D.C. in the Baulkham Hills LGA

ii. Flora species

- *Dillwynia tenuifolia;*
- *Acacia pubescens;*
- *Grevillea juniperina* subsp. *juniperina;* and
- *Pultenaea parviflora.*

iii. Fauna species

The following fauna species have not been recorded within the study area, but have the potential to use the site as vagrants for foraging or roosting habitat. The habitats within the study area do not provide significant habitat for these species. They will experience a loss of foraging habitat to a relatively minor degree. For this reason the following fauna species have been considered to be minor affected species.

a. Mammals

- Greater Broad-nosed Bat*;*
- Eastern False Pipistrelle*;* and
- Yellow-bellied Glider*;*

b. Birds

- Diamond Firetail*;*
- Flame Robin;
- Scarlet Robin;
- Turquoise Parrot;
- Swift Parrot;
- Little Eagle;
- Little Lorikeet;
- Black Falcon;
- Varied Sittella;
- Brown Treecreeper (eastern subsp.);
- Speckled Warbler;
- Glossy Black-Cockatoo;
- Gang-gang Cockatoo;
- Regent Honeyeater;
- Sooty Owl;
- Masked Owl;
- Powerful Owl; and
- Barking Owl.

4.5.3 (C)EECs/Species that are not affected

Targeted searches failed to detect any threatened flora species. With the exception of those mentioned above as minor affected species, all other threatened flora are considered to be species that are not affected by the proposal.

Very few of the birds listed as subject species have been detected within the study area, and many only occur within the locality at the extremities of the 10 km desktop search. Targeted searches for the Green and Golden Bell Frog failed to detect any individuals. Although habitat exists within the study area, no records of the species have been recorded within the

locality. For these reasons, all fauna species listed as subject species in the DGRs, other than those listed above, are considered to be species that are not affected.

Table 4.7 Likelihood of Occurrence Table for Flora in the Study Area

Scientific Name	Common Name	TSC Act Status	EPBC Act Status	Habitat Description	Habitat Present within the study area	Likelihood of Occurrence	OEH Subject Species	Impacted Species
Acacia bynoeana	Bynoe's Wattle	E	V	This species is confined to the northern portion of the Sydney Basin Bioregion and the southern portion of the north coast Bioregion. Occurs in heath or dry sclerophyll forest on sandy clay soils, often containing ironstone gravels. Prefers open, slightly disturbed sites such as trail margins, edges of roadside spoil mounds and in recently burnt patches. It occurs in association with Corymbia gummifera, Eucalyptus sclerophylla, Banksia serrata & Angophora bakeri, none of which occur in Cumberland Plain Woodland. It has been recorded in Castlereagh Nature Reserve.	Habitat features are absent	Unlikely	Yes	No
Acacia gordonii		E	E	Restricted to the north-west of Sydney, it has a disjunct distribution and is known from only a few locations. Less than 1500 plants are known from the Bilpin/Faulconbridge/Maroota/Hornsby Heights areas in the east, with some plants within the Blue Mountains National Park in the west. Occurs within the Hawkesbury, Blue Mountains, Hornsby and Baulkham Hills LGAs. Grows in dry sclerophyll forest and heathlands amongst or within rock platforms on sandstone outcrops.	Habitat features are absent	Unlikely	No	No
Acacia pubescens	Downy Wattle	V	V	Occurrences are concentrated around the Bankstown-Fairfield-Rookwood area and the Pitt Town area, with outliers occurring at Barden Ridge, Oakdale and Mountain Lagoon. Occurs on alluviums, shales and at the intergrade between shales and sandstones. The	Suitable habitat is present and there are proximate records.	Possible.	Yes	Yes

Table 4.7 Likelihood of Occurrence Table for Flora in the Study Area

Scientific Name	Common Name	TSC Act Status	EPBC Act Status	Habitat Description	Habitat Present within the study area	Likelihood of Occurrence	OEH Subject Species	Impacted Species
				soils are characteristically gravely soils, often with ironstone. Occurs in open woodland and forest, in a variety of plant communities, including Cooks River/ Castlereagh Ironbark Forest, Shale/ Gravel Transition Forest and Cumberland Plain Woodland. The topography of the habitat of the species is flat to gently undulating, a characteristic of the Cumberland Plain region.				
Darwinia biflora		V	V	Occurs at 129 sites in the northern and north-western suburbs of Sydney, in the Ryde, Baulkham Hills, Hornsby and Ku-Ring-Gai LGAs. The northern, southern, eastern and western limits of the range are at Maroota, North Ryde, Cowan and Kellyville, respectively. Occurs on sheet rock which often contains moss beds on the edges of weathered shale-capped ridges, where these intergrade with Hawkesbury Sandstone. The species occurs in Sandstone Ridgetop Woodland, which is equivalent to Sydney Sandstone Ridge-top Woodland/ Open Forest and Sydney Sandstone Scrub-heath complex.	Habitat features are absent	Unlikely	No	No
Dillwynia tenuifolia		V		The core distribution is the Cumberland Plain from Windsor to Penrith east to Deans Park. In western Sydney, this species is locally abundant within scrubby/dry heath areas within Castlereagh Ironbark Forest and Shale Gravel Transition Forest on tertiary alluvium or laterised clays.	Suitable habitat is present. Offsite record from 2007 at the northern end of the vegetated creek line. Not detected during survey.	Possible.	Yes	Yes

Table 4.7 Likelihood of Occurrence Table for Flora in the Study Area

Scientific Name	Common Name	TSC Act Status	EPBC Act Status	Habitat Description	Habitat Present within the study area	Likelihood of Occurrence	OEH Subject Species	Impacted Species
Epacris purpurascens var. purpurascens		V		Recorded from Gosford in the north, to Narrabeen in the east, Silverdale in the west and Avon Dam vicinity in the South. Found in a range of habitat types, most of which have a strong shale soil influence. These include ridgetop drainage depressions supporting wet heath within or adjoining shale cap communities eg. Stringybark and Ironbark woodlands, various shale/sandstone transition forest associations including Turpentine Ironbark Margin Forest, Stringybark/Scribbly Gum Woodland and Scribbly Gum/ Grey Gum/ Red Bloodwood Woodland.	Marginal habitat present but no records in proximity to site. Not detected during survey.	Possible.	Yes	No
Eucalyptus nicholii	Narrow-leaved Black Peppermint	V	V	This species is sparsely distributed but widespread on the New England Tablelands from Nundle to north of Tenterfield, being most common in central portions of its range. Typically grows in dry grassy woodland, on shallow soils of slopes and ridges. Found primarily on infertile soils derived from granite or metasedimentary rock. Seedling recruitment is common, even in disturbed soils, if protected from grazing and fire. Tends to grow on lower slopes in the landscape.	Marginal habitat. Not detected during survey.	Possible.	No	No
Eucalyptus sp. Cattai		E		A small, often mallee-form tree to 4.5 m with thick, somewhat fibrous, furrowed bark. Occurs in the area between Colo Heights and Castle Hill, northwestern Sydney. Occurs as a rare emergent tree in scrub, heath and low woodland on sandy soils, usually as	Habitat features are absent.	Unlikely	Yes	No

Table 4.7 Likelihood of Occurrence Table for Flora in the Study Area

Scientific Name	Common Name	TSC Act Status	EPBC Act Status	Habitat Description	Habitat Present within the study area	Likelihood of Occurrence	OEH Subject Species	Impacted Species
				isolated individuals or occasionally in small clustered groups. The sites at which it occurs are flat and on ridge tops. Associated soils are laterised clays overlying sandstone.				
Grevillea juniperina ssp. Juniperina	Juniper-leaved Grevillea	V		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. Habitat comprises woodland areas on reddish clay to sandy soils derived from Wianamatta Shale and Tertiary alluvium (often close to the boundary between the two geologies), associated with lateritic gravels. Populations are found in relatively open and/or disturbed sites and wetter areas.	Suitable habitat present, and there are recent records within locality. Not recorded during surveys	Possible	Yes	Yes
Hibbertia superans		E		Occurs from Baulkham Hills to South Maroota in the northern outskirts of Sydney, where there are currently 16 known sites, and at one locality at Mount Boss, inland from Kempsey. The species occurs on sandstone ridgetops often near the shale/sandstone boundary. Occurs in both open woodland and heathland, and prefers open disturbed areas, such as tracksides.	Limited suitable habitat. The nearest records are represent the western limit of this species distribution. No sandstone ridgetops at the site.	Unlikely.	Yes	No
Lasiopetalum joyceae		V	V	Has a restricted range occurring on lateritic to shaley ridgetops on the Hornsby Plateau south of the Hawkesbury River. Grows in heath on sandstone.	Limited suitable habitat. Not recorded during surveys.	Unlikely.	No	No
Leucopogon		E		Found in the LGAs of Hawkesbury, Baulkham Hills and Blue	Habitat features are	Unlikely.	Yes	No

Table 4.7 Likelihood of Occurrence Table for Flora in the Study Area

Scientific Name	Common Name	TSC Act Status	EPBC Act Status	Habitat Description	Habitat Present within the study area	Likelihood of Occurrence	OEH Subject Species	Impacted Species
fletcheri subsp. fletcheri				Mountains. Occurs on flat to gently sloping ground along ridges and spurs in dry eucalypt woodland or shrubland. Grows on soils which are clayey lateritic.	absent			
Melaleuca deanei		V	V	Deane's Paperbark occurs in two distinct areas, in the Ku-ring-gai/Berowra and Holsworthy/Wedderburn areas respectively. The species occurs mostly in ridgetop woodland, with only 5% of sites in heath on sandstone. Flowers appear in summer but seed production appears to be small and consequently the species exhibits a limited capacity to regenerate.	Habitat features are absent	Unlikely.	No	No
Micromyrtus minutiflora		E	V	Grows in Castlereagh Scribbly Gum Woodland, Ironbark Forest, Shale/Gravel Transition Forest, open forest on tertiary alluvium and consolidated river sediments.	Suitable habitat present, recent records within locality. Not recorded during surveys.	Possible.	Yes	No
Olearia cordata		V	V	A NSW endemic with a scattered distribution generally restricted to the south-western Hunter Plateau, eastern Colo Plateau, and the far north-west of the Hornsby Plateau near Wisemans Ferry east of Maroota. Populations are typically small and scattered. Grows in dry open sclerophyll forest and open shrubland, on sandstone ridges. Flowers November to May, with seed released from February to May, depending on environmental factors.	Habitat features are absent.	Unlikely	No	No
Persoonia	Hairy	E	E	The species is distributed from Singleton in the north, along the east	Habitat features are	Unlikely.	Yes	No

Table 4.7 Likelihood of Occurrence Table for Flora in the Study Area

Scientific Name	Common Name	TSC Act Status	EPBC Act Status	Habitat Description	Habitat Present within the study area	Likelihood of Occurrence	OEH Subject Species	Impacted Species
hirsuta	Geebung			coast to Bargo in the south and the Blue Mountains to the west. Occurs in small populations, increasing the species fragmentation in the landscape. Found in sandy soils in dry sclerophyll open forest, woodland and heath on sandstone from near sea level to 600m altitude.	absent. Nearest records on sandstone dominated geology which is absent from the site.			
Persoonia nutans		E	E	Restricted to the Cumberland Plain in western Sydney, between Richmond in the north and Macquarie Fields in the south. Northern populations are confined to aeolian and alluvial sediments and occur in a range of sclerophyll forest and woodland vegetation communities, with the majority of individuals occurring within Agnes Banks Woodland or Castlereagh Scribbly Gum Woodland and some in Cooks River / Castlereagh Ironbark Forests. Southern populations also occupy tertiary alluvium, but extend onto shale sandstone transition communities and into Cooks River / Castlereagh Ironbark Forest.	Suitable habitat present. Not recorded during surveys.	Possible.	No	No
Pimelea curviflora var. curviflora		V	V	Confined to the coastal area of Sydney between northern Sydney in the south and Maroota in the north-west. Found in the Baulkham Hills, Blacktown, Hornsby, Parramatta, and Warringah LGAs. Occurs on shaley/lateritic soils over sandstone and shale/sandstone transition soils on ridgetops and upper slopes amongst woodlands.	Suitable habitat present. Recorded 1km north-east of the site however, ridge tops and upper slopes are not present on the site.	Possible.	Yes	No
Pimelea		E	E	Occurs on well-structured clay soils in two disjunct areas, the	Suitable habitat present.	Possible.	Yes	No

Table 4.7 Likelihood of Occurrence Table for Flora in the Study Area

Scientific Name	Common Name	TSC Act Status	EPBC Act Status	Habitat Description	Habitat Present within the study area	Likelihood of Occurrence	OEH Subject Species	Impacted Species
spicata				Cumberland Plain (Narellan, Marayong, Prospect Reservoir, Freemans Reach, Georges Hall areas) and the Illawarra (Landsdowne to Shellharbour to northern Kiama). On the inland Cumberland Plain sites it is associated with Grey Box and Ironbark. In the coastal Illawarra it occurs commonly in Coast Banksia open woodland with a more well developed shrub and grass understorey. Has been recorded from both shale hills and shale plains woodland.	Recorded 2km north of the site. Not recorded during the survey however, cryptic species.			
Pterostylis saxicola	Sydney Plains Greenhood		E	Restricted to western Sydney between Freemans Reach in the north and Picton in the south. Grows in small pockets of shallow soil in depressions on sandstone rock shelves above cliff lines. The vegetation communities above the shelves where Pterostylis saxicola occurs are sclerophyll forest or woodland on shale/sandstone transition soils or shale soils.	Habitat features are absent	Unlikely	Yes	No
Pultenaea parviflora		E	V	Endemic to the Cumberland Plain. Core distribution is from Windsor to Penrith and east to Dean Park. Found in scrubby/dry heath areas within Castlereagh Ironbark Forest and Shale Gravel Transition Forest on tertiary alluvium or laterised clays and in transitional areas where these communities adjoin Castlereagh Scribbly Gum Woodland.	Suitable habitat present. Nearest records 3km west of the site. Not detected during the survey.	Possible.	Yes	Yes
Syzygium paniculatum	Magenta Lilly Pilly	V	E	The Magenta Lilly Pilly is found only in NSW, in a narrow, linear coastal strip from Upper Lansdowne to Conjola State Forest. On the	Habitat features are absent.	Unlikely	No	No

Table 4.7 Likelihood of Occurrence Table for Flora in the Study Area

Scientific Name	Common Name	TSC Act Status	EPBC Act Status	Habitat Description	Habitat Present within the study area	Likelihood of Occurrence	OEH Subject Species	Impacted Species
				south coast the Magenta Lilly Pilly occurs on grey soils over sandstone, restricted mainly to remnant stands of littoral (coastal) rainforest. On the central coast Magenta Lilly Pilly occurs on gravels, sands, silts and clays in riverside gallery rainforests and remnant littoral rainforest communities.				
Tetratheca glandulosa	Glandular Pink-bell	V	V	Restricted to the following LGAs: Baulkham Hills, Gosford, Hawkesbury, Hornsby, Ku-ring-gai, Pittwater, Ryde, Warringah, and Wyong. Found in various communities from heaths and scrub to woodlands/open woodlands, and open forest. Soils are generally shallow, consisting of a yellow, clayey/sandy loam.	Suitable habitat present. Nearest records 1km east of the site. Not detected during the survey.	Possible.	Yes	No
Zieria involucrata		E	V	Has a disjunct distribution north and west of Sydney, in the Baulkham Hills, Hawkesbury, Hornsby and Blue Mountains LGAs. Occurs primarily on Hawkesbury sandstone. Also occurs on Narrabeen Group sandstone and on Quaternary alluvium. Found primarily in sheltered forests on mid- to lower slopes and valleys, e.g. in or adjacent to gullies which support sheltered forest, although some populations extend upslope into drier vegetation. Also known from at least two atypical ridgetop locations. The canopy typically includes Syncarpia glomulifera subsp. glomulifera (Turpentine), Angophora costata (Smooth-barked Apple), Eucalyptus agglomerata (Blue-leaved Stringybark) and Allocasuarina torulosa (Forest Oak).	Habitat features are absent.	Unlikely	No	No

Table 4.7 Likelihood of Occurrence Table for Flora in the Study Area

Scientific Name	Common Name	TSC Act Status	EPBC Act Status	Habitat Description	Habitat Present within the study area	Likelihood of Occurrence	OEH Subject Species	Impacted Species
Endangered populations								
Dilwynia tenuifolia Sieber ex D.C. in the Baulkham Hills local government area		E		Occurs in vegetation similar to Cumberland Plain Woodland, on Wianamatta Shale soils. Flowering occurs sporadically from August to March depending on environmental conditions . Pollinators are unknown.	Suitable habitat present, recent records within locality. Not recorded during surveys	Possible.	Yes	No

Table 4.8 Likelihood of Occurrence Table for Fauna Species in the Study Area

Scientific Name	Common Name	TSC Act Status	EPBC Act Status	Habitat Description	Habitat Present within the study area	Likelihood of Occurrence	OEH Subject Species	Impacted Species
Amphibians								
Litoria aurea	Green and Golden Bell Frog	E	E	Green and Golden Bell Frogs have been found in differing habitat in NSW and Victoria. In NSW, the species commonly occupies disturbed habitats, and breeds largely in ephemeral ponds. In NSW, the Green and Golden Bell Frog has been found in a wide range of water bodies except fast flowing streams. It inhabits many disturbed sites, including abandoned mines and quarries. Breeding habitat in NSW includes water bodies that are still, shallow, ephemeral, unpolluted (but the frog can be found in polluted habitats), unshaded, with aquatic plants and free of Mosquito Fish (Gambusia holbrooki) and other predatory fish. Terrestrial habitats consist of grassy areas and vegetation no higher than woodlands, and a range of diurnal shelter sites.	Habitat features are present	Low	Yes	No
Heleioporus australiacus	Giant Burrowing Frog	V	V	Found in heath, woodland and open dry sclerophyll forest on a variety of soil types except those that are clay based. The species is not generally found in heavily cleared landscapes. It spends more than 95% of its time in non-breeding habitat, in areas up to 300 m from breeding sites. Whilst in non-breeding habitat it burrows below the soil surface or in the leaf litter. Individual frogs occupy a series of burrow sites, some of which	Preferential habitat features are absent and the landscape has been highly cleared.	Low	No	No

Table 4.8 Likelihood of Occurrence Table for Fauna Species in the Study Area

Scientific Name	Common Name	TSC Act Status	EPBC Act Status	Habitat Description	Habitat Present within the study area	Likelihood of Occurrence	OEH Subject Species	Impacted Species
				are used repeatedly.				
Pseudophryne australis	Red-crowned Toadlet	V,P		Confined to the Sydney Basin, from Pokolbin in the north, the Nowra area to the south, and west to Mt Victoria in the Blue Mountains. Occurs in open forests, mostly on Hawkesbury and Narrabeen Sandstones. Inhabits periodically wet drainage lines below sandstone ridges that often have shale lenses or cappings. Shelters under rocks and amongst masses of dense vegetation or thick piles of leaf litter. Breeding congregations occur in dense vegetation and debris beside ephemeral creeks and gutters.	Habitat is absent. Limited sandstone occurs on site and there is low water quality in damp areas.	Unlikely	No	No
Birds								
Anthochaera phrygia	Regent Honeyeater	CE	E	Inhabits temperate woodlands and open forests of the inland slopes of south-east Australia. The species inhabits dry open forest and woodland, particularly Box-Ironbark woodland, and riparian forests of River She-oak. These woodlands have large numbers of mature trees, high canopy cover and abundance of mistletoes. The species usually nest in tall mature eucalypts and sheoaks.	Marginal foraging habitat is present, although there is a lack of mistletoe and high canopy cover at site. A low density of hollows are available for nesting.	Possible	No	Yes
Apus pacificus	Fork-tailed Swift		Migratory	This species breeds in the north-east and mid-east Asia and spends winters in Australia and southern New Guinea. It is common in the Kimberley, uncommon to moderately common	Broad habitat preferences are available, but the species is mostly aerial.	Possible	No	No

Table 4.8 Likelihood of Occurrence Table for Fauna Species in the Study Area

Scientific Name	Common Name	TSC Act Status	EPBC Act Status	Habitat Description	Habitat Present within the study area	Likelihood of Occurrence	OEH Subject Species	Impacted Species
				near north-west, west and southeast coasts and rare to scarce elsewhere. They never settle voluntarily on the ground and spend most of their lives in the air, living on the insects they catch in their beaks.				
Ardea ibis	Cattle Egret		Migratory	The Cattle Egret is found in grasslands, woodlands and wetlands, and is not common in arid areas. It also uses pastures and croplands, especially where drainage is poor. Will also forage at garbage dumps, and is often seen with cattle and other stock. The Cattle Egret is partially migratory, moving during winter. They breed in colonies, usually with other waterbirds and their shallow platform nests are made in wetland areas in trees and bushes.	Habitat features are present	Present	No	Yes. Occurs onsite
Botaurus poiciloptilus	Australasian Bittern	E	E	In NSW, this species occurs along the coast and is frequently recorded in the Murray-Darling Basin, notably in floodplain wetlands of the Murrumbidgee, Lachlan, Macquarie and Gwydir Rivers. Occurs in permanent freshwater wetlands with tall, dense vegetation. Favours permanent and seasonal freshwater habitats, particularly those dominated by sedges, rushes and/or reeds (e.g. Phragmites, Cyperus, Eleocharis, Juncus, Typha, Baumea, Bolboschoenus) or cutting grass (Gahnia) growing over muddy or peaty substrate. Nests in secluded places in densely-vegetated wetlands on a platform	Some suitable habitat present on site, recent records within 5km of site.	Unlikely	Yes	No

Table 4.8 Likelihood of Occurrence Table for Fauna Species in the Study Area

Scientific Name	Common Name	TSC Act Status	EPBC Act Status	Habitat Description	Habitat Present within the study area	Likelihood of Occurrence	OEH Subject Species	Impacted Species
				of reeds.				
Callocephalon fimbriatum	Gang-gang Cockatoo	V		In New South Wales, the Gang-gang Cockatoo is distributed from the south-east coast to the Hunter region, and inland to the Central Tablelands and south-west slopes. In summer, generally found in tall mountain forests and woodlands, particularly in heavily timbered and mature wet sclerophyll forests. In winter, may occur at lower altitudes in drier more open eucalypt forests and woodlands, and often found in urban areas. Favours old growth attributes for nesting and roosting.	Some suitable foraging habitat exists on the site, limited breeding habitat. May utilise the site occasionally. Limited occurrence records in locality	Likely	Yes	Yes
Lophochroa leadbeateri	Major Mitchell's Cockatoo	V		Inhabits a wide range of treed and treeless inland habitats, always within easy reach of water. Feeds mostly on the ground, especially on the seeds of native and exotic melons and on the seeds of species of saltbush, wattles and cypress pines. Pairs nest in tree hollows that are located at least 1 km apart, with no more than one pair every 30 square kilometres. Found across the arid and semi-arid inland, from south-western Queensland south to north-west Victoria,	Some suitable foraging habitat exists on the site but limited breeding habitat. May utilise the site occasionally. Limited occurrence records in locality	Unlikely	No	No
Calyptorhynchus lathami	Glossy Black-Cockatoo	V		Inhabits open forest and woodlands of the coast and the Great Dividing Range up to 1000 m in which stands of she-oak species occur. Dependent on large hollow-bearing eucalypts	Some suitable foraging habitat exists on the site, limited breeding habitat.	Likely	Yes	Yes

Table 4.8 Likelihood of Occurrence Table for Fauna Species in the Study Area

Scientific Name	Common Name	TSC Act Status	EPBC Act Status	Habitat Description	Habitat Present within the study area	Likelihood of Occurrence	OEH Subject Species	Impacted Species
				for nest sites. Feeds almost exclusively on the seeds of several species of she-oak (Casuarina and Allocasuarina species).	May utilise the site occasionally. Limited occurrence records in locality			
Chthonicola sagittata	Speckled Warbler	V		In NSW, Speckled Warblers occupy eucalypt and cypress woodlands on the slopes west of the Great Dividing Range, with an extension of range into the cypress woodlands of the northern Riverina. Populations also occur in drier coastal areas such as the Cumberland Plain, Western Sydney and the Hunter and Snowy River valleys. Speckled Warblers inhabit woodlands with a grassy understorey, often on ridges or gullies. Large, relatively undisturbed remnants are required for the species to persist in an area.	Some suitable habitat exists on the site. May utilise the site occasionally.	Likely	Yes	Yes
Circus assimilis	Spotted Harrier	V		The Spotted Harrier occurs throughout the Australian mainland, except in densely forested or wooded habitats of the coast, escarpment and ranges, and rarely in Tasmania. Occurs in grassy open woodland including Acacia and mallee remnants, inland riparian woodland, grassland and shrub steppe. It is found most commonly in native grassland, but also occurs in agricultural land, foraging over open habitats including edges of inland wetlands.	Some suitable foraging habitat exists on the site. Observed on the site.	Present. Occurs on site	Yes	Onsite

Table 4.8 Likelihood of Occurrence Table for Fauna Species in the Study Area

Scientific Name	Common Name	TSC Act Status	EPBC Act Status	Habitat Description	Habitat Present within the study area	Likelihood of Occurrence	OEH Subject Species	Impacted Species
Oxyura australis	Blue-billed Duck	V		The Blue-billed Duck is endemic to south-eastern and south-western Australia. The Blue-billed Duck prefers deep water in large permanent wetlands and swamps with dense aquatic vegetation. Blue-billed Ducks usually nest solitarily in Cumbungi over deep water between September and February. They will also nest in trampled vegetation in Lignum, sedges or Spike-rushes, where a bowl-shaped nest is constructed. Young birds disperse in April-May from their breeding swamps in inland NSW to non-breeding areas on the Murray River system and coastal lakes.	Some suitable foraging habitat exists on the site but limited breeding habitat. May utilise the site occasionally. Limited occurrence records in locality	Possible.	No	No
Stictonetta naevosa	Freckled Duck	V		Prefer permanent freshwater swamps and creeks with heavy growth of Cumbungi, Lignum or Tea-tree. During drier times they move from ephemeral breeding swamps to more permanent waters such as lakes, reservoirs, farm dams and sewage ponds. Nests are usually located in dense vegetation at or near water level.	Some suitable foraging habitat exists on the site but limited breeding habitat. May utilise the site occasionally. Limited occurrence records in locality	Possible.	No	No
Climacteris picumnus	Brown Treecreeper (eastern ssp.)	V		The eastern subspecies lives in eastern NSW in eucalypt woodlands through central NSW and in coastal areas with drier open woodlands such as the Snowy River Valley, Cumberland Plains, Hunter Valley and parts of the Richmond	Suitable foraging habitat present, but limited recent records in proximity to site.	Possible	Yes	Yes

Table 4.8 Likelihood of Occurrence Table for Fauna Species in the Study Area

Scientific Name	Common Name	TSC Act Status	EPBC Act Status	Habitat Description	Habitat Present within the study area	Likelihood of Occurrence	OEH Subject Species	Impacted Species
				and Clarence Valleys. Found in eucalypt woodlands (including Box-Gum Woodland) and dry open forest of the inland slopes and plains inland of the Great Dividing Range; mainly inhabits woodlands dominated by stringybarks or other rough-barked eucalypts, usually with an open grassy understorey, sometimes with one or more shrub species.				
Daphoenositta chrysoptera	Varied Sittella	V		Inhabits eucalypt forests and woodlands, especially rough-barked species and mature smooth-barked gums with dead branches, mallee and Acacia woodland. It builds a cup-shaped nest of plant fibres and cobweb in an upright tree fork high in the living tree canopy.	Some foraging and breeding habitat present, may utilise the site irregularly.	Possible.	Yes	Yes
Epthianura albifrons	White-fronted Chat	V		Found in damp open habitats, particularly wetlands containing saltmarsh areas that are bordered by open grasslands or lightly timbered lands. Along the coastline, found in estuarine and marshy grounds with vegetation less than 1 m tall, also found in open grasslands and sometimes in low shrubs bordering wetland areas. Inland, the White-fronted Chat is often observed in open grassy plains, saltlakes and saltpans that are along the margins of rivers and waterways.	Preferential habitats are not available. The site has no saltmarsh and is disturbed.	Unlikely	No	No
Falco subniger	Black Falcon	V		In New South Wales there is assumed to be a single population that is continuous with a broader continental	Suitable habitat present, recent records in	Possible	Yes	Yes

Table 4.8 Likelihood of Occurrence Table for Fauna Species in the Study Area

Scientific Name	Common Name	TSC Act Status	EPBC Act Status	Habitat Description	Habitat Present within the study area	Likelihood of Occurrence	OEH Subject Species	Impacted Species
				population, given that falcons are highly mobile, commonly travelling hundreds of kilometres. Inhabits woodland, shrubland and grassland in the arid and semi-arid zones, especially wooded watercourses and agricultural land with scattered remnant trees. Usually associated with streams or wetlands. Nests in healthy, riparian woodland remnants with a diverse avifauna.	proximity to site.			
Gallinago hardwickii	Latham's Snipe, Japanese Snipe		Migratory	In Australia, Latham's Snipe occurs in permanent and ephemeral wetlands up to 2000 m above sea-level. They usually inhabit open, freshwater wetlands with low, dense vegetation (e.g. swamps, flooded grasslands or heathlands, around bogs and other water bodies). However, they can also occur in habitats with saline or brackish water, in modified or artificial habitats, and in habitats located close to humans or human activity. Latham's Snipe does not breed within Australian jurisdiction.	Marginally suitable wetland habitat is present. The migratory species may occur occasionally.	Possible	No	No
Rostratula australis	Australian Painted Snipe	E	E	Prefers fringes of swamps, dams and nearby marshy areas where there is a cover of grasses, lignum, low scrub or open timber. Nests on the ground amongst tall vegetation, such as grasses, tussocks or reeds.	Marginally suitable wetland habitat is present. Few records in proximity to the site.	Unlikely	No	No
Glossopsitta	Little	V		Forages primarily in the canopy of open eucalypt forest and	Suitable habitat present,	Possible.	No	Yes

Table 4.8 Likelihood of Occurrence Table for Fauna Species in the Study Area

Scientific Name	Common Name	TSC Act Status	EPBC Act Status	Habitat Description	Habitat Present within the study area	Likelihood of Occurrence	OEH Subject Species	Impacted Species
pusilla	Lorikeet			woodland, yet also finds food in Angophoras, Melaleucas and other tree species. Riparian habitats are particularly used, due to higher soil fertility and hence greater productivity. Also utilises isolated flowering trees in open country, e.g. paddocks, roadside remnants and urban trees. Roosts in treetops, often distant from feeding areas. Nests in proximity to feeding areas if possible, most typically selecting hollows in the limb or trunk of smooth-barked Eucalypts.	recent records in proximity to site.			
Haliaeetus leucogaster	White-bellied Sea-Eagle		Migratory	Common in coastal and near coastal areas of Australia. They breed near water and nest in trees in open forest or woodland.	Suitable habitat is present	Present. Occurs on site.	No	Onsite
Hieraaetus morphnoides	Little Eagle	V		Occupies open eucalypt forest, woodland or open woodland. Sheoak or Acacia woodlands and riparian woodlands of interior NSW are also used. Nests in tall living rees within a remnant patch, where pairs build a large stick nest in winter.	Both breeding and foraging habitat is present.	Possible	Yes	Yes
Hirundapus caudacutus	White-throated Needletail		Migratory	Often occur in large numbers over eastern and northern Australia. White-throated Needletails are non-breeding migrants in Australia. Aerial species which can roost in trees.	Broad habitat preferences are available	Possible	No	No
Ixobrychus flavicollis	Black Bittern	V		Inhabits both terrestrial and estuarine wetlands, generally in areas of permanent water and dense vegetation. Where	Some suitable habitat present on site, recent	Possible	Yes	No

Table 4.8 Likelihood of Occurrence Table for Fauna Species in the Study Area

Scientific Name	Common Name	TSC Act Status	EPBC Act Status	Habitat Description	Habitat Present within the study area	Likelihood of Occurrence	OEH Subject Species	Impacted Species
				permanent water is present, the species may occur in flooded grassland, forest, woodland, rainforest and mangroves. Nests are located on a branch overhanging water and consist of a bed of sticks and reeds on a base of larger sticks.	records within 5km of site.			
Lathamus discolor	Swift Parrot	E	E	In NSW mostly occurs on the coast and south west slopes. On the mainland they occur in areas where eucalypts are flowering profusely or where there are abundant lerp (from sap-sucking bugs) infestations. Favoured feed trees include winter flowering species such as Eucalyptus robusta, Corymbia maculata, C. gummifera, E. sideroxylon, and E. albens. Breeds in Tasmania in spring and summer.	Suitable foraging habitat occurs on site, may utilise the site infrequently	Possible.	Yes	Yes
Polytelis swainsonii	Superb Parrot	V	V	Inhabit Box-Gum, Box-Cypress-pine and Boree Woodlands and River Red Gum Forest. In the Riverina the birds nest in the hollows of large trees (dead or alive) mainly in tall riparian River Red Gum Forest or Woodland. On the South West Slopes nest trees can be in open Box-Gum Woodland or isolated paddock trees. May forage up to 10 km from nesting sites, primarily in grassy box woodland.	Some suitable habitat present on site, recent records within 5km of site.	Possible	Yes	No
Neophema pulchella	Turquoise Parrot	V		Lives on the edges of eucalypt woodland adjoining clearings, timbered ridges and creeks in farmland. Forages quietly and may be quite tolerant of disturbance. Nests in tree hollows,	Moderate foraging and breeding habitat present. Recent records within	Possible	Yes	Yes

Table 4.8 Likelihood of Occurrence Table for Fauna Species in the Study Area

Scientific Name	Common Name	TSC Act Status	EPBC Act Status	Habitat Description	Habitat Present within the study area	Likelihood of Occurrence	OEH Subject Species	Impacted Species
				logs or posts, from August to December. It lays four or five white, rounded eggs on a nest of decayed wood dust.	5km of site.			
Lophoictinia isura	Square-tailed Kite	V		Found in a variety of timbered habitats including dry woodlands and open forests. Shows a particular preference for timbered watercourses. In arid north-western NSW, has been observed in stony country with a ground cover of chenopods and grasses, open acacia scrub and patches of low open eucalypt woodland.	Some suitable habitat present on site. Out of typical distribution.	Unlikely	Yes	No
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. The nest is a small, neat cup of bark and grasses bound with webs, in a tree fork or crevice, from less than 1 m to 5 m above the ground.	Marginal foraging and breeding habitat present, although vegetation is not structurally diverse. Limited recent records in proximity to the site.	Unlikely	Yes	No
Limosa limosa	Black-tailed Godwit	V		Primarily a coastal species. Usually found in sheltered bays, estuaries and lagoons with large intertidal mudflats and/or sandflats. Further inland, it can also be found on mudflats and in water less than 10 cm deep, around muddy lakes and swamps. Individuals have been recorded in wet fields and sewerage treatment works. Roosts and loafs on low banks of	Marginal foraging habitat present.	Unlikely	No	No

Table 4.8 Likelihood of Occurrence Table for Fauna Species in the Study Area

Scientific Name	Common Name	TSC Act Status	EPBC Act Status	Habitat Description	Habitat Present within the study area	Likelihood of Occurrence	OEH Subject Species	Impacted Species
				mud, sand and shell bars.				
Melithreptus gularis gularis	Black-chinned Honeyeater (eastern ssp.)	V		Occupies mostly upper levels of drier open forests or woodlands dominated by box and ironbark eucalypts. Also inhabits open forests of smooth-barked gums, stringybarks, ironbarks and tea-trees. The nest is placed high in the crown of a tree, in the uppermost lateral branches, hidden by foliage.	Some foraging and breeding habitat present. Limited recent records in proximity to the site.	Unlikely	Yes	No
Grantiella picta	Painted Honeyeater	V		Inhabits Boree, Brigalow and Box-Gum Woodlands and Box-Ironbark Forests. A specialist feeder on the fruits of mistletoes growing on woodland eucalypts and acacias. Prefers mistletoes of the genus Amyema. Insects and nectar from mistletoe or eucalypts are occasionally eaten.	Marginal foraging habitat present. There is a lack of mistletoe, but it may utilise site on occasion. Limited recent records in proximity to the site.	Unlikely	Yes	No
Merops ornatus	Rainbow Bee-eater		Migratory	In Australia it is widespread, except in desert areas, and breeds throughout most of its range, although southern birds move north to breed. The Rainbow Bee-eater is most often found in open forests, woodlands and shrublands, and cleared areas, usually near water. It will be found on farmland with remnant vegetation and in orchards and vineyards. It will use disturbed sites such as quarries, cuttings and mines to build its nesting tunnels.	Marginal foraging habitat is present.	Possible	No	No
Monarcha	Black-faced		Migratory	The Black-faced Monarch is found along the coast of eastern	Marginal foraging habitat	Possible	No	No

Table 4.8 Likelihood of Occurrence Table for Fauna Species in the Study Area

Scientific Name	Common Name	TSC Act Status	EPBC Act Status	Habitat Description	Habitat Present within the study area	Likelihood of Occurrence	OEH Subject Species	Impacted Species
melanopsis	Monarch			Australia, becoming less common further south. The Black-faced Monarch is found in rainforests, eucalypt woodlands, coastal scrub and damp gullies. It may be found in more open woodland when migrating.	is present.			
Monarcha trivirgatus	Spectacled Monarch		Migratory	The Spectacled Monarch is found in coastal north-eastern and eastern Australia, including coastal islands, from Cape York, Queensland to Port Stephens, New South Wales. It is much less common in the south. It prefers thick understorey in rainforests, wet gullies and waterside vegetation, as well as mangroves.	Preferential habitat features are absent and the landscape has been highly cleared.	Unlikely	No	No
Myiagra cyanoleuca	Satin Flycatcher		Migratory	Found along the east coast of Australia in tall forests, preferring wetter habitats such as heavily forested gullies, but not rainforests.	and the landscape has been highly cleared.	Unlikely	No	No
Calidris ferruginea	Curlew Sandpiper	E		The Curlew Sandpiper is distributed around most of the Australian coastline (including Tasmania). It occurs along the entire coast of NSW, particularly in the Hunter Estuary, and sometimes in freshwater wetlands in the Murray-Darling Basin. It generally occupies littoral and estuarine habitats, and in New South Wales is mainly found in intertidal mudflats of sheltered coasts. It also occurs in non-tidal swamps, lakes and lagoons on the	Preferential habitat features are absent and the landscape has been highly cleared.	Unlikely	No	No

Table 4.8 Likelihood of Occurrence Table for Fauna Species in the Study Area

Scientific Name	Common Name	TSC Act Status	EPBC Act Status	Habitat Description	Habitat Present within the study area	Likelihood of Occurrence	OEH Subject Species	Impacted Species
				coast and sometimes inland. It forages in or at the edge of shallow water, occasionally on exposed algal mats or waterweed, or on banks of beach-cast seagrass or seaweed.				
Ninox connivens	Barking Owl	V		Inhabits eucalypt woodland, open forest, swamp woodlands and, especially in inland areas, timber along watercourses. Denser vegetation is used occasionally for roosting. During the day they roost along creek lines, usually in tall understorey trees with dense foliage such as Acacia and Casuarina species, or the dense clumps of canopy leaves in large Eucalypts. Nests in hollows of large, old eucalypts.	Some suitable foraging habitat present on site, as part of a large home range	Possible.	Yes	Yes
Ninox strenua	Powerful Owl	V		In NSW the Powerful Owl lives in forests and woodlands occurring in the coastal, escarpment, tablelands and western slopes environments. Specific habitat requirements include eucalypt forests and woodlands on productive sites on gentle terrain; a mosaic of moist and dry types, with mesic gullies and permanent streams; presence of leafy subcanopy trees or tall shrubs for roosting; presence of large old trees to provide nest hollows. Optimal habitat includes a tall shrub layer and abundant hollows supporting high densities of arboreal marsupials.	Some foraging habitat present	Possible.	Yes	Yes
Petroica	Scarlet	V		Occurs in dry eucalypt forests and woodlands. The	Some foraging or	Possible	Yes	Yes

Table 4.8 Likelihood of Occurrence Table for Fauna Species in the Study Area

Scientific Name	Common Name	TSC Act Status	EPBC Act Status	Habitat Description	Habitat Present within the study area	Likelihood of Occurrence	OEH Subject Species	Impacted Species
boodang	Robin			understorey is usually open and grassy with few scattered shrubs. This species lives in both mature and regrowth vegetation. It occasionally occurs in mallee or wet forest communities, or in wetlands and tea-tree swamps. Scarlet Robin habitat usually contains abundant logs and fallen timber: these are important components of its habitat. Nests are often found in a dead branch in a live tree, or in a dead tree or shrub.	breeding habitat present. Limited recent records in proximity to the site.			
Petroica phoenicea	Flame Robin	V		In NSW, it breeds in upland areas and in winter, many birds move to the inland slopes and plains. It is likely that there are two separate populations in NSW, one in the Northern Tablelands, and another ranging from the Central to Southern Tablelands. Breeds in upland tall moist eucalypt forests and woodlands, often on ridges and slopes. Prefers clearings or areas with open understoreys. The groundlayer of the breeding habitat is dominated by native grasses and the shrub layer may be either sparse or dense. Nests are often near the ground and are built in sheltered sites, such as shallow cavities in trees, stumps or banks.	Some suitable habitat present on site, limited recent records in proximity to the site.	Possible	Yes	Yes
Rhipidura rufifrons	Rufous Fantail		Migratory	Found in rainforest, dense wet forests, swamp woodlands and mangroves, preferring deep shade, and is often seen close to the ground.	Preferential habitat features are absent.	Unlikely	No	No

Table 4.8 Likelihood of Occurrence Table for Fauna Species in the Study Area

Scientific Name	Common Name	TSC Act Status	EPBC Act Status	Habitat Description	Habitat Present within the study area	Likelihood of Occurrence	OEH Subject Species	Impacted Species
Stagonopleura guttata	Diamond Firetail	V		Found in grassy eucalypt woodlands, including Box-Gum Woodlands and Snow Gum Woodlands. Often found in riparian areas (rivers and creeks), and sometimes in lightly wooded farmland.	Both breeding and foraging habitat present.	Likely	Yes	Yes
Tyto novaehollandiae	Masked Owl	V		Occurs in dry eucalypt forests and woodlands. This species is a forest dweller known to hunt along forest edges such as roadsides. Requires moist eucalypt forested gullies to breed, utilising large tree hollows and occasionally caves to nest in.	Some foraging habitat present, but large hollow-bearing trees suitable for nesting are absent.	Possible	No	Yes
Tyto tenebricosa	Sooty Owl	V		Occurs in rainforest, including dry rainforest, subtropical and warm temperate rainforest, as well as moist eucalypt forests. Roosts by day in the hollow of a tall forest tree or in heavy vegetation.	Some suitable foraging habitat present on site.	Possible.	Yes	Yes
Mammals								
Chalinolobus dwyeri	Large-eared Pied Bat	V	V	Generally rare with a very patchy distribution in NSW. Roosts in caves (near their entrances), crevices in cliffs, old mine workings and in the disused, bottle-shaped mud nests of the Fairy Martin (Hirundo ariel), frequenting low to midelevation dry open forest and woodland close to these features. Found in well-timbered areas containing gullies. This species probably forages for small, flying insects below the forest canopy.	Some suitable foraging habitat present on site.	Possible	Yes	No

Table 4.8 Likelihood of Occurrence Table for Fauna Species in the Study Area

Scientific Name	Common Name	TSC Act Status	EPBC Act Status	Habitat Description	Habitat Present within the study area	Likelihood of Occurrence	OEH Subject Species	Impacted Species
Falsistrellus tasmaniensis	Eastern False Pipistrelle	V		Prefers moist habitats, with trees taller than 20 m. Generally roosts in eucalypt hollows, but has also been found under loose bark on trees or in buildings.	Some foraging habitat present	Likely. Possibly detected during Anabat surveys	Yes	Yes
Miniopterus australis	Little Bentwing-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.	Some suitable foraging habitat present on site.	Possible.	Yes	No
Miniopterus schreibersii oceanensis	Eastern Bentwing bat	V		Caves are the primary roosting habitat, but also use derelict mines, storm-water tunnels, buildings and other man-made structures. Hunt in forested areas, catching moths and other flying insects above the tree tops.	Some suitable foraging habitat present on site.	Present.	Yes	Yes
Mormopterus norfolkensis	Eastern Freetail-bat	V		Occur in dry sclerophyll forest and woodland east of the Great Dividing Range. Roost mainly in tree hollows but will also roost under bark or in man-made structures.	Some foraging and breeding habitat present	Present	Yes	Onsite
Myotis macropus	Southern Myotis	V		Generally roost in groups of 10 - 15 close to water in caves, mine shafts, hollow-bearing trees, storm water channels, buildings, under bridges and in dense foliage. Forage over streams and pools catching insects and small fish by raking their feet across the water surface.	Some foraging habitat present	Likely. Possibly detected during Anabat surveys	Yes	Onsite
Petaurus	Yellow-	V		Found in tall mature eucalypt forest mostly where there is high	Marginal foraging habitat	Possible.	No	Yes

Table 4.8 Likelihood of Occurrence Table for Fauna Species in the Study Area

Scientific Name	Common Name	TSC Act Status	EPBC Act Status	Habitat Description	Habitat Present within the study area	Likelihood of Occurrence	OEH Subject Species	Impacted Species
australis	bellied Glider			rainfall and high nutrient soils. Dens in hollows of large trees often in family groups.	present, although it prefer wet forests.			
Petaurus norfolcensis	Squirrel Glider	V		Inhabits mature or old growth Box, Box-Ironbark woodlands and River Red Gum forest west of the Great Dividing Range and Blackbutt-Bloodwood forest with heath understorey in coastal areas. Prefers mixed species stands with a shrub or Acacia midstorey.	Suitable habitat present.	Unlikely.	Yes	No
Phascolarctos cinereus	Koala	V	V	Inhabit eucalypt woodlands and forests. Feed on the foliage of more than 70 eucalypt species and 30 non-eucalypt species, but in any one area will select preferred browse species. The Koala has a fragmented distribution throughout eastern Australia from north-east Queensland to the Eyre Peninsula in South Australia. In NSW it mainly occurs on the central and north coasts with some populations in the west of the Great Dividing Range.	Some foraging habitat present. However, there are no recent records in the locality.	Unlikely	Yes	No
Pteropus poliocephalus	Grey-headed Flying-fox	V	V	Occur in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops. Roosting camps are generally located within 20 km of a regular food source and are commonly found in gullies, close to water, in vegetation with a dense canopy.	Suitable forage habitat present.	Present	Yes	Onsite

Table 4.8 Likelihood of Occurrence Table for Fauna Species in the Study Area

Scientific Name	Common Name	TSC Act Status	EPBC Act Status	Habitat Description	Habitat Present within the study area	Likelihood of Occurrence	OEH Subject Species	Impacted Species
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	V		Roosts singly or in groups of up to six, in tree hollows and buildings. In treeless areas they are known to utilise mammal burrows. When foraging for insects, flies high and fast over the forest canopy, but lower in more open country. Forages in most habitats across its very wide range, with and without trees. It appears to defend an aerial territory.	Suitable habitat present.	Present	Yes	Yes
Dasyurus maculatus	Spotted - tailed Quoll	V	E	Recorded across a range of habitat types, including rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline. Individual animals use hollow-bearing trees, fallen logs, small caves, rock outcrops and rocky-cliff faces as den sites.	Some suitable foraging habitat present on site.	Unlikely	No	No
Scoteanax rueppellii	Greater Broad-nosed Bat	V		More commonly found in tall wet forest but also occurs in dry eucalypt forest. Roosts in tree hollows and buildings. Forages along creek and river corridors.	Suitable habitat present	Likely	Yes	Yes
Invertebrates								
Meridolum corneovirens	Cumberland Plain Land Snail	E		Primarily inhabits Cumberland Plain Woodland (an endangered ecological community). This community is a grassy, open woodland with occasional dense patches of shrubs. Lives under litter of bark, leaves and logs, or shelters in loose soil around grass clumps. Occasionally shelters under rubbish.	Recent records of species close to site, marginal habitat present. Empty shell detected during surveys. Areas of CPW available	Present	Yes	Onsite

Coordinate System: MGA Zone 56 (GDA 94)

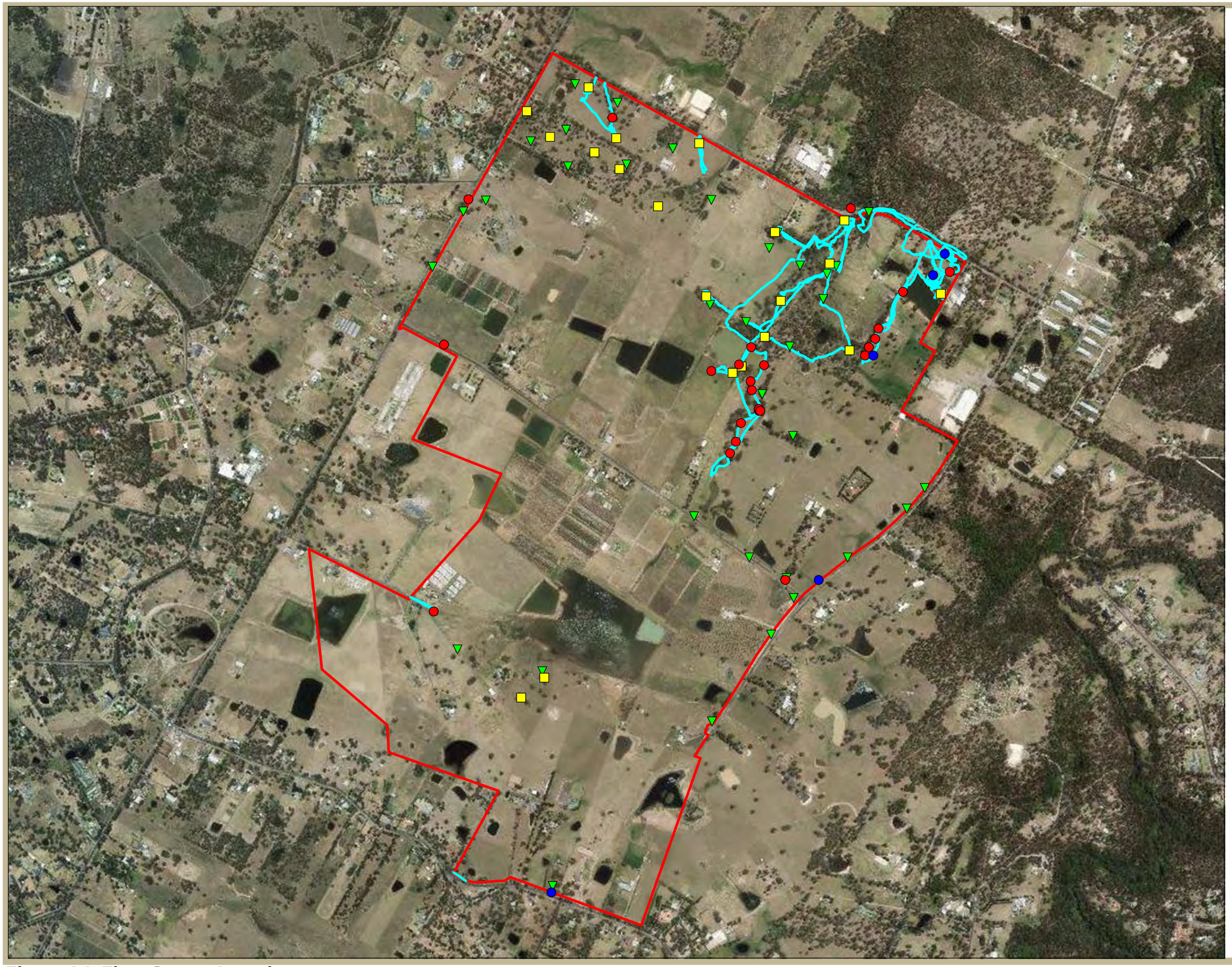


Image Source:
Image © SIX Maps
(dated 01-04-2014)

Data Source:
NGH Environmental (2013).
Biodiversity Assessment Box Hill North.

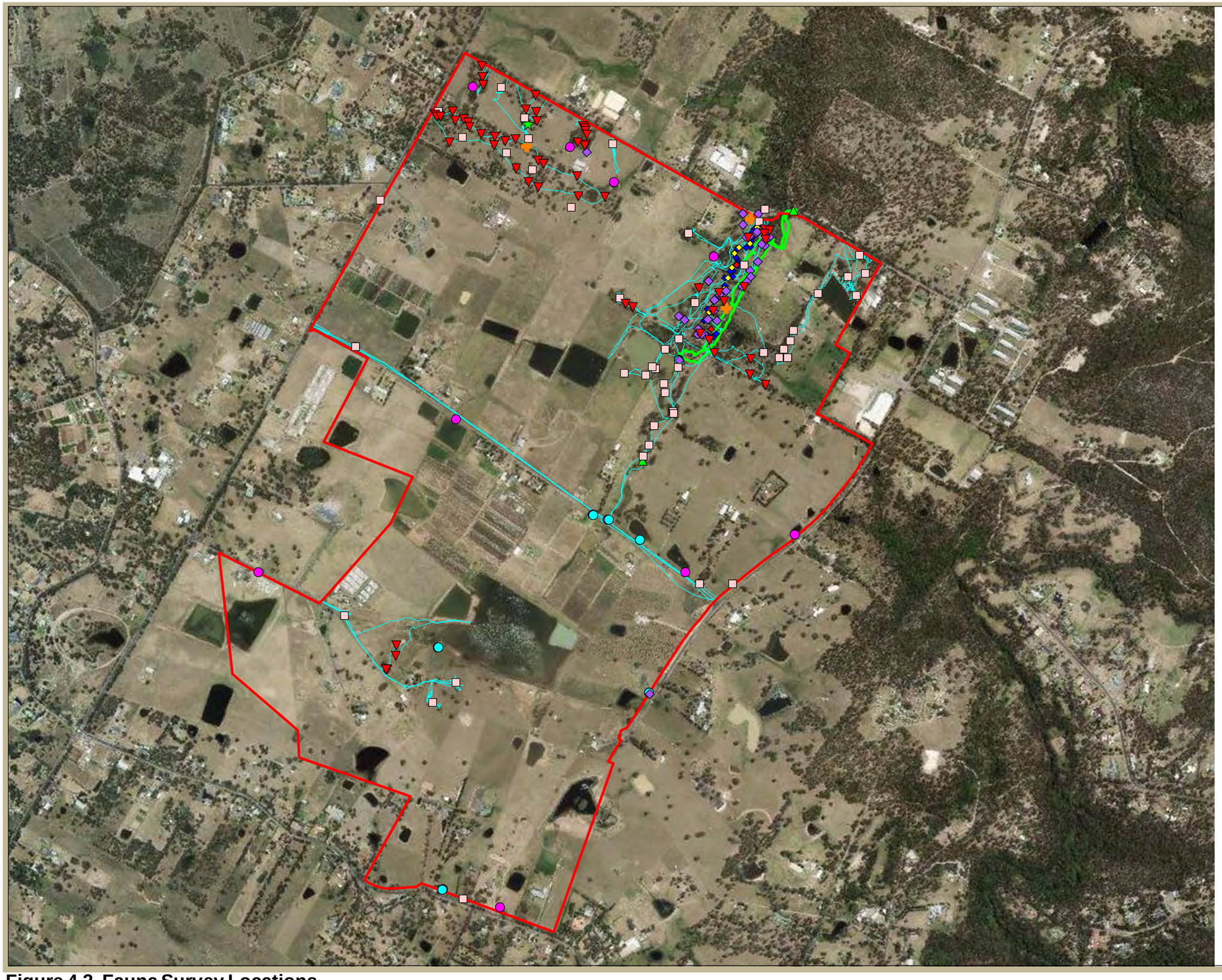
CUMBERLAND ECOLOGY

I:\...\15062\Figures\RP1_SIS\20150506\Figure 4.1. Flora Survey Locations

Figure 4.1. Flora Survey Locations

200 0 200 400 600 800 m

Coordinate System: MGA Zone 56 (GDA 94)



Legend

- Study Area (Box Hill North)

Cumberland Ecology Fauna Surveys

- Elliot 1 Traps
- Elliot B Traps
- IR Cameras
- Green and Golden Bell Frog searches
- Quadrat (20 x 50)
- Anabat Survey static points
- Snail Search
- Anabat Survey transect
- Cumberland Plain Land Snail meander

NGH Fauna Surveys

- Bird Survey
- Anabat
- Hollow-bearing Tree Register
- Dam Assessment

Grid North

Image Source:
Image © SIX Maps
(dated 01-04-2014)

Data Source:
NGH Environmental (2013).
Biodiversity Assessment Box Hill North.

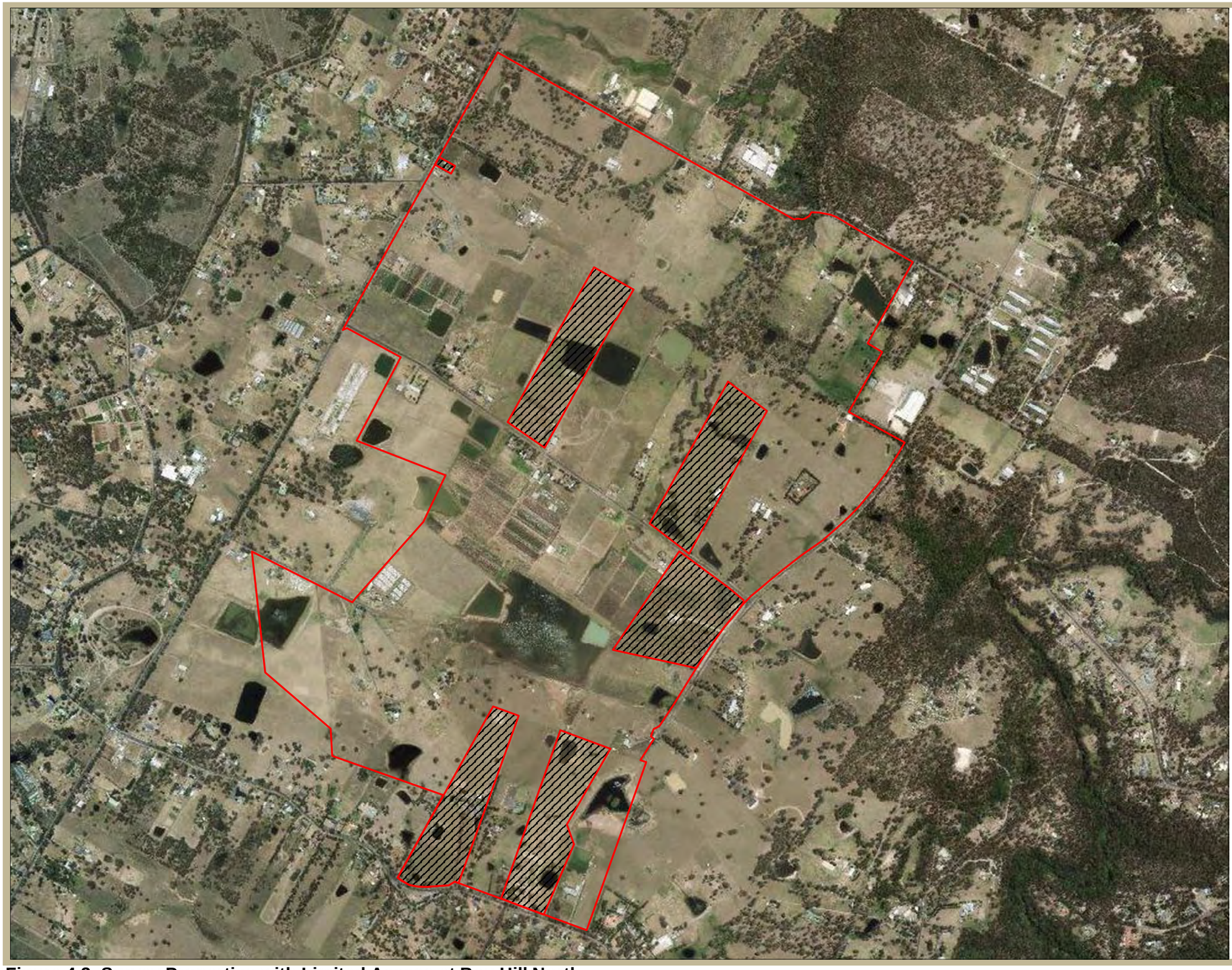
CUMBERLAND ECOLOGY

I:\...\15062\Figures\RP1_SIS\20150506\Figure 4.2. Fauna Survey Locations

Figure 4.2. Fauna Survey Locations

200 0 200 400 600 800 m

Coordinate System: MGA Zone 56 (GDA 94)



I:\...\15062\Figures\RP1_SIS\20150506\Figure 4.3. Survey Properties with Limited Access

Figure 4.3. Survey Properties with Limited Access at Box Hill North

Coordinate System: MGA Zone 56 (GDA 94)

N
Grid North

Legend

Study Area (Box Hill North)

Vegetation Community

- Cumberland Plain Woodland
- Acacia Regrowth
- Shale Sandstone Transition Forest
- Scattered Trees
- Exotic Vegetation

Image Source:
Image © SIX Maps (1-04-2014)

CUMBERLAND ECOLOGY

I:\...\15062\Figures\RP1_SIS\20150506\Figure 4.4. Native Vegetation_Box Hill North

Figure 4.4. Native Vegetation of Box Hill North

100 0 100 200 300 400 m

Coordinate System: MGA Zone 56 (GDA 94)

N
Grid North

Legend

Study Area (Box Hill North)

Fauna Habitat

Woodland

Exotic Grassland

Waterbody

Image Source:
Image © SIX Maps (1-04-2014)

CUMBERLAND ECOLOGY

I:\...\15062\Figures\RP1_SIS\20150506\Figure 4.5. Fauna Habitat_Box Hill North

Figure 4.5. Fauna Habitat within Box Hill North

100 0 100 200 300 400 m

Coordinate System: MGA Zone 56 (GDA94)

N
Grid North

Legend

Study Area (Box Hill North)

Migratory Fauna (EPBC Act)

White Bellied Sea Eagle

Cattle Egret

Threatened Fauna (TSC Act and/or EPBC Act)

Microbats (Myotis macropus, Miniopterus schreibersii, Mormopterus norfolkensis)

Microbats (Miniopterus schreibersii, Mormopterus norfolkensis, Falsistrellus tasmaniensis and Myotis macropus)

Grey-headed Flying Fox

Cumberland Plain Land Snail (shell)

Image Source: SIX maps (01-04-2014)

CUMBERLAND ECOLOGY

I:\...\15062\Figures\RP1_SIS\20150506\Figure 4.6. Threatened Fauna Records_Study Area

Figure 4.6. Threatened Fauna recorded within the Study Area

100 0 100 200 300 400 m

Chapter 5

Assessment of Likely Impacts on Threatened Species

This chapter addresses the impacts to species in order to address DGR Sections 5. The following summary of impact provides an indication of general impacts of the proposal and future proposals within the study area.

Assessments of impacts have considered 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 and 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
- Landscaping.

Impacts on threatened species and populations from the proposed rezoning that have been considered include:

- Fragmentation and isolation of habitat and incremental decline in its quality and extent;
- Loss of locally significant vegetation;
- Loss of foraging and roosting habitat for threatened fauna and a reduction in their local abundance and distribution, including loss of hollow bearing trees;
- Changes in hydrological regime resulting from altered surface flows and groundwater levels;
- Deterioration in water quality;

- Increased susceptibility, on site and on adjacent and downstream areas, to competition, disease, predation, insect attack and other disturbances due to increased access and a reduction in vegetation cover;
- Indirect effects of urbanisation e.g. tree removal, rubbish dumping, soil compaction, erosion, weed invasion as well as altered drainage patterns and nutrient levels resulting from increased runoff; and
- Clearing, modification and long term degradation of habitat associated with the provision of asset protection zones.

5.1 Assessment of Species likely to be affected

5.1.1 Spotted Harrier (Circus assimilis)

i. Description

The Spotted Harrier is a medium sized bird of prey with an owl-like facial ruff that creates the appearance of a short broad head. The underparts are blue-grey with dark barring, the wingtips are black, and the legs yellow. Juveniles are mottled and streaked ginger and brown, with ginger shoulders, fawn rump, and banded tail (OEH 2012l).

ii. Discussion of local and regional abundance and distribution

There is only one record of the Spotted Harrier in The Hills LGA and 63 records in the Sydney Basin Bioregion. Spotted Harriers are found throughout the Australian mainland, except in densely forested or wooded habitats of the coast, escarpment and ranges, and rarely in Tasmania (OEH 2012l).

iii. Discussion of other known local populations

The species has only been recorded once within The Hills LGA. Sightings in the locality are concentrated along the Nepean River, where the species is likely foraging. There is one record from Scheyville National Park approximately 500m to the west. Remaining sightings across the Sydney bioregion are near waterways.

Populations occurring across NSW are highly mobile and will travel to reach suitable foraging habitat. Records within the locality are likely sporadic occurrences.

The species was recorded once within the study area, and as such the significance of individuals or populations that may occur within the study area is unknown.

iv. Assessment of habitat

a. Description of habitat values

Occurs in grassy open woodland including Acacia and mallee remnants, inland riparian woodland, grassland and shrub steppe. It is found most commonly in native grassland, but

also occurs in agricultural land, foraging over open habitats including edges of inland wetlands (OEH 2012l). Builds a stick nest in a tree and lays eggs in spring (or sometimes autumn), with young remaining in the nest for several months.

The condition of the habitat varies across the study area. There are extensive foraging habitats across the study area, and in the locality. Some remnant woodland exists in the SSTF corridor that would be suitable for breeding. There is foraging and breeding habitat of better quality within the Maguires Road PCA and Scheyville National Park.

b. Description of habitat utilisation

The study area is likely used for foraging by Spotted Harriers as part of a much wider foraging area. The species predominately occurs along the Nepean River and associated riparian zone. No evidence of roosting was found within the study area. The species will remain viable within the locality because the study area comprises a very small amount of potential foraging habitat in the locality, and the species would be utilising other areas of habitat in the locality.

v. Discussion of conservation status

a. Local, regional and statewide status

The Spotted Harrier is listed as Vulnerable under Schedule 2 of the TSC Act. It is not listed under the EPBC Act. Due to the sporadic occurrence in the locality, the importance of the population that uses the study area is unknown.

b. Threatening processes

The following threatening processes may affect the Spotted Harrier within the study area:

- Secondary poisoning from rabbit baiting;
- Secondary poisoning from rodenticides; and
- Clearing and degradation of foraging and breeding habitat, particularly that which affects prey densities.

c. Habitat requirements

The Spotted Harrier inhabits a range of vegetation types, from woodland and open forest to open grassland and agriculture lands. The species requires open areas of grassland to forage. The species breeds by building a stick nest in a tree, known as an eyrie.

d. Other documentation

No recovery plan has been prepared for this species. No Threat Abatement Plan is relevant to this species. No critical habitat for this species has currently been identified by the Director-General of the OEH. A targeted strategy for managing the species has been developed under the Saving our Species program. The Spotted Harrier is listed as a

landscape managed species, as it is widely occurring and subject to threatening processes that act at the landscape scale.

e. Assessment of adequacy of reservation

Given the wide variety of habitats the species occurs in, the habitat for this species is distributed between rural, and conservation areas. The Spotted Harrier has been observed within Scheyville National Park, where better quality habitat exists. In the locality, the Spotted Harrier is reserved within Scheyville National park, and along the foreshores of the Nepean River.

f. Limit of known distribution

The Spotted Harrier is distributed across Australia, excepting densely vegetated coastal forests. The study area is not on the edge of the species distribution.

vi. Discussion of the likely effect of the proposal at local and regional scales

a. Significance within a local context

The proposal will remove an area of existing cleared land. The clearing of this habitat from the study area is not considered significant in the local context as potential foraging habitat exists widely in the locality. Breeding habitat that exists at the study area will be conserved under the current proposal. Significant habitat for the species will be conserved within Maguires Road PCA and Scheyville National Park.

b. Discussion of connectivity

The habitat to be removed as part of the proposal will not affect habitat availability in the locality. The species uses a wide variety of habitats and does not frequent the study area. The removal of habitat within the study area will not fragment or affect connectivity of habitat in the locality as much larger areas of both rural and woodland habitats exist in the locality. Due to the loss of only a small proportion of habitat in the locality and the high mobility of this species, the proposal will not decrease the ability of movement of individuals and gene flow between habitats or populations.

c. Consideration of threatening processes

- Secondary poisoning from rabbit baiting;
- Secondary poisoning from rodenticides; and
- Clearing and degradation of foraging and breeding habitat, particularly that which affects prey densities.

The proposal will not significantly increase the use of poisons for rabbit baiting or rodenticides in the locality.

The proposal will remove some foraging habitat in the study area. It is not expected that the proposal will impact on breeding habitat.

5.1.2 Grey-headed Flying-fox (Pteropus poliocephalus)

i. Description

The Grey-headed Flying-fox is the largest Australian bat, with a head and body length of 23-29 cm, and black wing membranes with a wingspan up to 1m (NSW Scientific Committee 2004e, OEH 2012g). The fur on the back is dark grey, although some individuals have a pronounced silver frosting to the hairs and the belly is grey, often with flecks of white and ginger (Churchill, 2008). It has a mantle of rusty brown fur fully encircling the neck, and its head is covered with light grey fur (Churchill, 2008). The fur also extends down the legs to the toes (Churchill 2008).

ii. Discussion of local and regional abundance and distribution

There are 36 records of the Grey-headed Flying-fox in The Hills LGA and 5199 records in the Sydney Basin Bioregion. Grey-headed Flying-foxes are found within 200 km of the eastern coast of Australia, from Bundaberg in Queensland to Melbourne in Victoria (OEH 2012).

iii. Discussion of other known local populations

There are a few records of the Grey-headed Flying-fox in the locality, including within Scheyville National Park (see **Figure 3.2**). Records outside of this area occur in the suburbs of Baulkham Hills, Dural and Kellyville. Grey-headed Flying-foxes roost in colonies known as ‘camps’. Camps have a strong site fidelity and there are three camps that occur around the Sydney metropolitan area: Ku-ring-gai Flying-fox Reserve at Gordon, the Royal Botanic Gardens and Cabramatta Creek Flying-fox Reserve.

The study area provides a very small area of potential foraging habitat for the species as part of a much larger foraging range. No animals use the study area for roosting.

iv. Assessment of habitat

a. Description of habitat values

The Grey-headed Flying-fox occurs in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps (OEH 2012g), as well as urban gardens and forages in cultivated fruit crops (OEH 2012g).

Grey-headed Flying-foxes congregate in large numbers at roosting sites (camps) that may also be found in rainforest patches, Melaleuca stands, mangroves, riparian woodland or modified vegetation in urban areas (NSW Scientific Committee, 2004). Roosting camps are generally located within 20 km of a regular food source and are commonly found in gullies, close to water, in vegetation with a dense canopy (OEH 2012g).

The condition of habitat varies across the study area. The study area contains remnant indigenous tree cover although this is not continuous over the whole site. The majority of remnant habitat is confined to the patches of SSTF and CPW in the north of the study area. There is significant trampling or grazing currently evident; and the study area is likely to have been used for grazing historically. The study area is adjacent to the Maguires Road PCA, and surrounded by rural lands as well as the recently approved Box Hill Precinct within the North West Growth Centre. Eucalypt trees within the study area present potential foraging habitat within the study area for the species.

b. Description of habitat utilisation

Grey-headed Flying-foxes live in specific roost camps, the locations of which are well known within the Sydney region. The study area only affords potential foraging habitat to the species as no camps are known from the study area or the locality.

v. Discussion of conservation status

a. Local, regional and statewide status

The Grey-headed Flying-fox is listed as Vulnerable under Schedule 2 of the TSC Act. It is also listed as vulnerable under the EPBC Act. It is not considered as locally or regionally significant in The Hills LGA because no camps occur in there.

b. Threatening processes

The following threatening processes may affect the Grey-headed Flying-fox within the study area:

- Loss of foraging habitat;
- Unregulated shooting;
- Electrocution on powerlines, entanglement in netting and on barbed-wire;
- Negative public attitudes and conflict with humans;
- Impacts from climate change; and
- Disease.

c. Habitat requirements

The Grey-headed Flying-fox occurs in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps (OEH 2012g), as well as urban gardens and cultivated fruit crops (OEH 2012g). Grey-headed Flying-foxes congregate in large numbers at roosting sites (camps) that may also be found in rainforest patches, Melaleuca stands, mangroves, riparian woodland or modified vegetation in urban areas (OEH 2012g). Roosting camps are generally located within 20km of a regular food source and are commonly found in gullies, close to water, in vegetation with a dense canopy (OEH 2012g). They forage

opportunistically, often at distances up to 30km from camps, and occasionally up to 60-70 km per night, in response to patchy food resources (NSW Scientific Committee, 2004).

d. Other documentation

No recovery plan has been prepared for this species. No Threat Abatement Plan is relevant to this species. No critical habitat for this species has currently been identified by the Director-General of the OEH.

e. Assessment of adequacy of reservation

In NSW, Grey-headed Flying-foxes have been recorded in numerous conservation reserves along the east coast, and the tablelands and eastern slopes of the Great Dividing Range (OEH 2012g).

f. Limit of known distribution

It occurs along the east coast of Australia from Bundaberg in Queensland to Melbourne, Victoria (OEH 2012g). This species may range to the western slopes of the Great Dividing Range in northern NSW (OEH 2012g). The study area falls within this distribution and is neither at its eastern or western limit.

The species is listed under the Save our Species conservation program as a Landscape Managed Species.

vi. Discussion of the likely effect of the proposal at local and regional scales

a. Significance within a local context

The proposal will remove only a small area of potential foraging habitat for the species in relation to the habitat within the study area. Areas of potential habitat conserved within Maguires Road PCA, and Scheyville National Park are more significant and are not threatened by development or other impacts. The habitat occurring in these reserves is more secure than habitat occurring on private property close to development. The highest quality habitat for the species is in the SSTF corridor, and will be conserved under the current proposal.

b. Discussion of connectivity

The habitat to be removed as part of the proposal represents a small portion of available habitat in the locality. Nearby bushland to the north and west of the study area is connected to a large system of remnant bushland associated with creek lines throughout The Hills LGA. Due to the loss of only a small proportion of habitat in the locality and the high mobility of this species, the proposal will not decrease the ability of movement of individuals and gene flow between habitats or populations.

c. Consideration of threatening processes

The habitat proposed for removal is a small proportion of the total foraging habitat available to the species in the locality and not considered a significant loss for the species.

The proposal is not in the vicinity of any roosting sites and so will not cause disturbance to roosting.

The proposal is not for an activity that would cause conflict with Grey-headed Flying-foxes, and would not incite a need to shoot them.

There is an increased risk of electrocution on powerlines if above-ground powerlines are installed for the development. These will be a small extension from the adjacent development of an insignificant length compared with the length of powerlines in the proposed North West Growth Centre.

5.1.3 Eastern Freetail-bat (Mormopterus norfolkensis)

i. Description

The Eastern Freetail-bat weighs up to 10 grams, has a forearm length of 36-40mm and a skull which is sinuate in profile (Churchill, 1998). Its fur is dark brown to reddish brown on the back and slightly paler on the belly (NSW Scientific Committee 2004c, OEH 2012e). Like other freetail-bats, its face is hairless with wrinkled lips and triangular ears and it has a long (3 - 4 cm) bare tail protruding from the tail membrane (Churchill 2008).

ii. Discussion of local and regional abundance and distribution

There are 31 records of the Eastern Freetail-bat in The Hills LGA and 785 records in the Sydney Basin Bioregion. The Eastern Freetail-bat is found along the east coast from South Queensland to southern NSW (OEH 2012g).

iii. Discussion of other known local populations

There are several records of the Eastern Freetail-bat in the locality (**Figure 3.2**). The species has been recorded within five kilometres of the study area in suburban habitats in Castle Hill, Kellyville, Dural and Annangrove. Due to the scattered nature of the records in the locality it is not known definitively if the records of the Eastern Freetail-bat are from the same population. There are several records from Scheyville National Park. As the populations or individual records on private property close to development are not protected, their security is likely to be low.

A recent survey detected calls that could be conclusively attributed this species, thus it is likely that individuals or populations of this species inhabit the study area. The significance of the individuals or populations in the study area to the local population unknown but the individuals are likely to be part of a population ranging over a larger area.

iv. Assessment of habitat

a. Description of habitat values

The Eastern Freetail-bat primarily roosts in tree hollows, but also roost under bark or in man-made structures (OEH 2012g). This species has been recorded in a wide variety of habitats including tall open forest, River Red Gum and Yellow Box woodlands, riparian open forest and dry sclerophyll forest (Churchill, 2008). The Eastern Freetail-bat is considered to be solitary (OEH 2012g).

Potential roosting habitat exists within the study area, including the study area, in the form of tree hollows and stags. The condition of foraging habitat varies across the study area. The study area contains remnant indigenous tree cover although this is not continuous over the whole site. There are also some remnant canopy trees and several dead stags occur within the study area.

b. Description of habitat utilisation

It is likely that the study area is mainly used by the species for foraging, and is probably used for roosting by some individuals. The study area does not provide significant habitat in the locality as large areas of more intact potential habitat are conserved within Scheyville National Park, and Maguires Road PCA to the west and north of the study area respectively, and other areas of potential habitat occur within the locality through the Cattai Creek catchment.

v. Discussion of conservation status

a. Local, regional and statewide status

The Eastern Freetail-bat is listed as Vulnerable under Schedule 2 of the TSC Act. It is not listed under the EPBC Act. It is not considered as locally or regionally significant in The Hills LGA because of its state listing.

b. Threatening processes

The following key threatening processes generally affect the species:

- Loss of hollow-bearing trees;
- Loss of foraging habitat; and
- Application of pesticides in or adjacent to foraging areas.

c. Habitat requirements

The Eastern Freetail-bat primarily roosts in tree hollows, but also roosts under bark or in man-made structures (OEH 2012g). This species has been recorded in a wide variety of habitats including tall open forest, River Red Gum and Yellow Box woodlands, riparian open forest and dry sclerophyll forest (Churchill, 2008).

d. Other documentation

No recovery plan has been prepared for this species. No Threat Abatement Plan is relevant to this species. No critical habitat for this species has currently been identified by the Director-General of the OEH. The Species is listed under a Save our Species conservation project, as a data deficient species.

e. Assessment of adequacy of reservation

Records of the Eastern Freetail-bat in the locality are scattered in suburban sites on private property close to development, and also within Scheyville National Park to the west of the study area. Urban areas are not protected therefore security is likely to be low, but suitable, more secure habitat occurs in Scheyville National Park.

f. Limit of known distribution

The Eastern Freetail-bat is distributed along the east coast from South Queensland to southern NSW. The study area falls within this distribution (OEH 2012g).

vi. Discussion of the likely effect of the proposal at local and regional scales

a. Significance within a local context

The proposal will remove only a small area of habitat for the species in relation to the habitat within the study area. Areas of suitable habitat conserved within Scheyville National Park, and Maguires Road PCA, are more significant and are not threatened by development or other impacts. The habitat occurring in Scheyville National Park and Maguires Road PCA is more secure than habitat occurring on private property close to development.

b. Discussion of connectivity

The habitat to be removed as part of the proposal represents a small portion of foraging habitat available in the locality. Bushland to the north of the study area forms part of the Maguires Road PCA. Loss of vegetation within the study area is not considered to affect connectivity along this corridor. This species is highly mobile and does not require continuous vegetation cover to disperse. The loss of only a very small proportion of habitat in the locality the proposal will not decrease the ability of movement of individuals and gene flow between habitats or populations.

c. Consideration of threatening processes

The proposed development will remove potential roosting habitat for this species. Suitable habitat will be retained in the conservation area in the north eastern corner of the study area.

The proposal will result in the loss of a very small proportion of foraging habitat in comparison with the amount of foraging habitat available in the locality.

The proposal will not result in an activity that will use pesticides, therefore this threat is not relevant to the proposal.

5.1.4 Yellow-bellied Sheathtail-bat (Saccolaimus flaviventris)

i. Description

The Yellow-bellied Sheathtail-bat is a distinctive large insectivorous bat up to 87mm long. It has long narrow wings, jet black back, and a white to yellow belly. It has a characteristic flattened head and sharply jointed muzzle (OEH 2012o). The females do not have a wing pouch. The species weighs approximately 44 g (Churchill, 2008).

ii. Discussion of local and regional abundance and distribution

There are 5 records from The Hills LGA, and 109 records from the Sydney Bioregion. Yellow-bellied Sheathtail-bats are found across eastern and northern Australia, excluding Tasmania (Churchill, 2008).

iii. Discussion of other known local populations

There are few records within the locality, including within the Scheyville National Park. Records also occur along Windsor Road, and in urban areas of Schofields, and Rouse Hill. The individuals known from Scheyville National Park are the most secure individuals in the locality, with populations and individuals on private property less secure. Yellow-bellied Sheathtail-bats records occur throughout the locality, however it is unknown if they are the same population.

iv. Assessment of habitat

a. Description of habitat values

The Yellow-bellied Sheathtail-bat roosts in tree hollows and under roofs of buildings alone or in groups of up to six. The species forages for insects above the canopy high and fast hunting insects, but lower in more open country (OEH 2012o).

The condition of habitat within the study area is suited to the Yellow-bellied Sheathtail-bat. The canopy and hollows in the SSTF corridor are suited to roosting habitat, as are the abundance of sheds and buildings across the site. The study area contains many hollows in the SSTF, however this will be conserved as part of the current proposal.

b. Description of habitat utilisation

Within the study area, the species would use the SSTF corridor as a roosting and breeding location, and forage above the canopy or in the grassland. The species also occurs in Scheyville National Park, and is likely widespread in the locality given its broad preference for habitats. The species will remain viable because the study area comprises a small amount of potential foraging habitat, and the species would be utilising other areas of habitat in the locality.

v. Discussion of conservation status

The Yellow-bellied Sheathtail-bat is listed as Vulnerable under Schedule 2 of the TSC Act. It is not listed under the EPBC Act. The Yellow-bellied Sheathtail-bat is not considered locally or regionally significant in The Hills LGA because of its state listing.

a. Local, regional and statewide status

The Yellow-bellied Sheathtail-bat is listed as Vulnerable under Schedule 2 of the TSC Act. It is not listed under the EPBC Act. It is not considered as locally or regionally significant in The Hills LGA because of its state listing.

b. Threatening processes

The following threatening processes are listed for the species:

- Disturbance to roosting and summer breeding sites.
- Foraging habitats are being cleared for residential and agricultural developments, including clearing by residents within rural subdivisions.
- Loss of hollow-bearing trees; clearing and fragmentation of forest and woodland habitat.
- Pesticides and herbicides may reduce the availability of insects, or result in the accumulation of toxic residues in individuals' fat stores.

c. Habitat requirements

Yellow-bellied Sheathtail-bats roost in large tree hollows. They can occur in a variety of habitats including wet and dry sclerophyll forest, open woodland, grasslands, urban and desert (Churchill 2008).

d. Other documentation

No recovery plan has been prepared for this species. No Threat Abatement Plan is relevant to this species. No critical habitat for this species has currently been identified by the Director-General of the OEH. The species is listed under a Save our Species conservation project, as a landscape managed species.

e. Assessment of adequacy of reservation

Records of the Yellow-bellied Sheathtail-bat in the locality are scattered in suburban sites on private property close to development, and also within Scheyville National Park to the west of the study area. Urban areas are not protected therefore security is likely to be low, but suitable, more secure habitat occurs in Scheyville National Park.

f. Limit of known distribution

The species occurs across Australia, except Tasmania and southern Western Australia (OEH 2012o). The species is within its distribution.

vi. Discussion of the likely effect of the proposal at local and regional scales

a. Significance within a local context

The proposal will remove only a small area of habitat for the species in relation to the habitat within the study area. Areas of suitable habitat conserved within Scheyville National Park are more significant and are not threatened by development or other impacts. The habitat occurring in Scheyville National Park and Maguires Road PCA is more secure than habitat occurring on private property close to development.

b. Discussion of connectivity

The habitat to be removed as part of the proposal represents a small portion of potential foraging habitat available in the locality. Bushland to the north of the study area forms part of a riparian corridor along Cataract Creek. Loss of vegetation within the study area is not considered to affect connectivity along this corridor. This species is highly mobile and does not require continuous vegetation cover to disperse. The loss of only a very small proportion of habitat in the locality the proposal will not decrease the ability of movement of individuals and gene flow between habitats or populations.

c. Consideration of threatening processes

The proposal will not involve disturbance to roosting sites as the area of suitable habitat along the SSTF corridor will be conserved.

Foraging habitats in open grassland will be cleared as a result of the development, but extensive foraging habitat exists to the north in Maguires Road PCA, and to the west in Scheyville National Park.

Hollow bearing trees are to be conserved along the SSTF corridor. The areas of CPW to be cleared do not have an abundance of hollows.

The use of pesticides is not likely to be exacerbated by the proposal.

5.1.5 Eastern Bentwing-bat (Miniopterus schreibersii oceanensis)

i. Description

The Eastern Bentwing-bat weighs up to 20 grams, has a head and body length of about 6 cm and a wingspan of 30 - 35 cm. Its fur is chocolate to reddish-brown on its back and slightly lighter on the belly. It has a short snout and a high 'domed' head with short round ears. The wing membranes attach to the ankle, not to the base of the toe. The last bone of the third finger is much longer than the other finger-bones giving the "bent wing" appearance (NSW Scientific Committee 2004b, OEH 2012c).

ii. Discussion of local and regional abundance and distribution

There are 63 records of the Eastern Bentwing-bat in The Hills LGA and 1763 records in the Sydney Basin Bioregion. The Eastern Bentwing-bat is found along the east coast of Australia (OEH 2012).

iii. Discussion of other known local populations

There are several records of the Eastern Bentwing-bat in the locality (**Figure 3.2**). The species has been recorded within five kilometres of the study area in suburban habitats in Castle Hill, Kellyville, Bella Vista, Dural and Glenhaven. Due to the scattered nature of the records in the locality it is not known if the records of the Eastern Bentwing-bat are from the same population. As the populations or individual records on private property close to development are not protected, their security is likely to be quite low.

Recent surveys have detected the presence of individuals within the study area. The significance of the individuals or populations recorded within the study area to the local population is unknown but the individuals are likely to form a part of a larger population from the locality.

iv. Assessment of habitat

a. Description of habitat values

The Eastern Bentwing-bat primarily roosts in caves, but also utilises derelict mines, stormwater tunnels, buildings and other man-made structures (OEH 2012c). It forages above the canopy in forested areas. This species also can potentially roost in some of the rock crevices and overhangs (OEH 2012c). The Eastern Bentwing-bat forms maternity colonies in caves and populations usually centre on such caves (OEH 2012c).

The study area does not provide suitable breeding habitat for the species as the species congregates in maternity caves. The study area may provide suitable roosting habitat as the species typically roosts in caves or man-made structures such as culverts or disused mines. The condition of foraging habitat varies across the study area. The study area contains remnant indigenous tree cover although this is not continuous over the whole site. There are remnant canopy trees and several dead stags occur within the study area, especially in the SSTF corridor.

b. Description of habitat utilisation

It is likely that the study area is mainly used by the species for foraging and that the species roosts in caves in the locality. The study area does not provide significant habitat in the locality as limited suitable roosting habitat is present. Large areas of potential habitat are conserved in within Maguires Road PCA to the north of the study area, and Scheyville National Park to the west of the study area.

v. Discussion of conservation status

a. Local, regional and statewide status

The Eastern Bentwing-bat is listed as Vulnerable under Schedule 2 of the TSC Act. It is not listed under the EPBC Act. It is not considered as locally or regionally significant in The Hills LGA because of its state listing.

b. Threatening processes

The following key threatening processes generally affect the species:

- Disturbance by recreational cave climbers and general public accessing the cave and adjacent areas particularly during winter or breeding.
- Loss of foraging habitat.
- Loss of food resources and indirect poisoning of individuals from nearby use of herbicides / insecticides.
- Predation by Feral Cats and Red Foxes.
- Introduction of exotic pathogens, specifically known White-nosed fungus.
- Threat of cave entrances being blocked for human safety reasons. Also, vegetation encroaching and blocking cave entrances.
- Potential for large scale wildfire to impact on resource availability in surrounding habitat. Direct threats at caves from fire.
- Weeds (*Rubus fruticosus*) encroaching over cave entrances restrict access; need to ensure correct control techniques for *R. fruticosus*.

c. Habitat requirements

The Eastern Bentwing-bat primarily roosts in caves, but also utilise derelict mines, stormwater tunnels, buildings and other man-made structures (OEH 2012c). It forages above the canopy in forested areas. This species also can potentially roost in some of the rock crevices and overhangs (OEH 2012c). The Eastern Bentwing-bat forms maternity colonies in caves and populations usually centre on such caves (OEH 2012c).

d. Other documentation

No recovery plan has been prepared for this species. No Threat Abatement Plan is relevant to this species. No critical habitat for this species has currently been identified by the Director-General of the OEH. The Species is listed under a Save our Species conservation project, as a site managed species.

Saving our Species aims to conserve as many threatened species as possible. This conservation project aims to conserve the Little Bentwing-bat in the long-term. The project

was developed by experts who identified the minimum number of necessary management sites and conservation actions required to conserve the species. Four sites have been identified in NSW (ordered north south). They are: Willi Willi, Drum Cave, Church Cave, and Hibernacular Sites. None of these sites occur within the study area.

e. Assessment of adequacy of reservation

Records of the Eastern Bentwing-bat in the locality are scattered in suburban sites on private property close to development. These areas are not protected therefore security is likely to be low. Suitable, secure habitat occurs in Scheyville National Park.

f. Limit of known distribution

The Eastern Bentwing-bat is distributed along the NSW coast and 250km inland. The study area falls within this distribution.

vi. Discussion of the likely effect of the proposal at local and regional scales

a. Significance within a local context

The proposal will remove only a small area of habitat for the species in relation to the habitat within the study area. Areas of suitable habitat conserved within Scheyville National Park are more significant and are not threatened by development or other impacts. The habitat occurring in Scheyville National Park and Maguires Road PCA is more secure than habitat occurring on private property close to development.

b. Discussion of connectivity

The habitat to be removed as part of the proposal represents a small portion of potential foraging habitat available in the locality. Bushland to the north of the study area forms part of a riparian corridor along Cataract Creek. Loss of vegetation within the study area is not considered to affect connectivity along this corridor. This species is highly mobile and does not require continuous vegetation cover to disperse. The loss of only a very small proportion of habitat in the locality the proposal will not decrease the ability of movement of individuals and gene flow between habitats or populations.

c. Consideration of threatening processes

The study area does not provide suitable roosting habitat in the form of caves. The proposal is not likely to disturb significant habitat such as maternity caves as they do not occur within the study area.

The proposal will result in the loss of a small area of foraging habitat, although this is considered to be a very small portion of foraging habitat in comparison with the amount of foraging habitat available in the locality.

The proposal will not result in an activity that will use pesticides; therefore this threat is not relevant to the proposal.

The proposal is not likely to exacerbate the impacts of cats and foxes in the study area.

5.1.6 Southern Myotis (Myotis macropus)

i. Description

Southern Myotis is a fishing bat with disproportionately large feet. It has dark grey fur which is reddish above and paler below. the Southern Myotis are up to 15 grams and has a wingspan of about 28cm (NSW Scientific Committee 2004f, OEH 2012i). The species lives near water in caves and tree hollows. It also utilises old mines, tunnels and culverts to roost. The species has a strong association for waterways where they catch prawns and fish with their large feet (Churchill 2008).

ii. Discussion of local and regional abundance and distribution

There are ten records within the locality and 1271 records within the Sydney Bioregion. The species is found near waterways along the coast throughout Victoria, New South Wales, Queensland, Northern Territory, and Kimberley regions of Western Australia.

iii. Discussion of other known local populations

Most records from the locality are from Scheyville National Park, the Long Swamp area to the north of the study area, and along the Nepean River.

Due to the scattered nature of the records in the locality it is not known for sure if the records of the Southern Myotis are from the same population. As the populations or individual records on conserved lands, their security is likely to be quite high.

Recent surveys have detected the presence of individuals within the study area. The significance of the individuals or populations recorded within the study area to the local population is unknown but the individuals are likely to form a part of a larger population from the locality.

iv. Assessment of habitat

a. Description of habitat values

The species roosts in tree hollows, and also uses man made structures, such as disused mines, culverts and tunnels. The species forages over waterways nearby to roosting sites, where it catches prawns and fish from the surface.

The study area provides suitable breeding habitat for the species as the roosts in hollows and man made structures. The study area may also provide suitable roosting habitat as the species typically roosts in caves or man-made structures such as culverts or disused mines. The condition of foraging habitat varies across the study area. The abundance of dams on the site provides a large area of foraging habitat, although the majority of the dams are a great distance from roost habitat.

The study area contains remnant indigenous tree cover although this is not continuous over the whole study area. There are remnant canopy trees and several dead stags occur within the study area, especially in the SSTF corridor.

b. Description of habitat utilisation

The species is likely to utilise both roosting and feeding habitat across the study area. The areas most likely used will be waterways proximal to roosting sites (<300m). Ample roosting habitat exists in the SSTF corridor in the north, and is proximal to waterways suitable for feeding.

v. Discussion of conservation status

a. Local, regional and statewide status

The Southern Myotis is listed as Vulnerable under Schedule 2 of the TSC Act. It is not listed under the EPBC Act. It is not considered as locally or regionally significant in The Hills LGA because of its state listing.

b. Threatening processes

The following threatening processes have been identified for the Southern Myotis:

- Loss or disturbance of roosting sites.
- Clearing adjacent to foraging areas.
- Application of pesticides in or adjacent to foraging areas.
- Reduction in stream water quality affecting food resources

c. Habitat requirements

The species roosts in tree hollows, and also man made structures such as derelict mines, caves, culverts and tunnels. The species forages over waterways nearby to roosting sites (Churchill 1998).

d. Other documentation

No recovery plan has been prepared for this species. No Threat Abatement Plan is relevant to this species. No critical habitat for this species has currently been identified by the Director-General of the OEH. The Species is listed under a Save our Species conservation project, as a landscape managed species.

e. Assessment of adequacy of reservation

Records of the Southern Myotis in the locality are scattered in suburban sites on private property close to development. These areas are not protected therefore security is likely to be low. Suitable, secure habitat occurs in Scheyville National Park where the species is also

known to occur. Suitable habitat occurs in Scheyville National Park which is protected which allows for security for the species in the locality.

f. Limit of known distribution

The species is found near waterways along the coast throughout Victoria, New South Wales, Queensland, Northern Territory, and Kimberley regions of Western Australia.

vi. Discussion of the likely effect of the proposal at local and regional scales.

a. Significance within a local context

The proposal will remove only a small area of habitat for the species in relation to the habitat within the study area. Areas of suitable habitat conserved within Scheyville National Park are more significant and are not threatened by development or other impacts. The habitat occurring in Scheyville National Park and Maguires Road PCA is more secure than habitat occurring on private property close to development.

b. Discussion of connectivity

The habitat to be removed as part of the proposal represents a small portion of potential foraging habitat available in the locality. Bushland to the north of the study area forms part of a riparian corridor along Cataract Creek. Loss of vegetation within the study area is not considered to affect connectivity along this corridor. This species is highly mobile and does not require continuous vegetation cover to disperse. The loss of habitat from the study area resulting from the proposal will not decrease the ability of movement of individuals and gene flow between habitats or populations.

c. Consideration of threatening processes

The proposal will not reduce significantly the availability of roosting sites in the locality. Suitable habitat exists within the SSTF corridor which will be retained. There is also suitable habitat in the locality in Maguires Road PCA, and Scheyville National Park.

The proposal will not clear additional land near roosting sites as the land is already cleared.

The application of pesticides should not be exacerbated under the current proposal more than current levels. The reduction of market farms in the locality may reduce the use of pesticides.

The quality of stream water in the locality due to the development onsite will not be reduced as a result of the development (J Wyndham Prince Pty Ltd 2013).

5.1.7 Cumberland Plain Land Snail (Meridolum corneovirens)

i. Description

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 2013b)

ii. Discussion of local and regional abundance and distribution

There are 21 occurrences of the species in The Hills LGA, and 855 records from the Sydney Bioregion.

Recent surveys have detected the presence of no live individuals within the study area. The significance of the individuals or populations recorded within the study area to the local population is unknown but the individuals are likely to form a part of a larger population from the locality.

iii. Discussion of other known local populations

Records in the locality are focussed on Scheyville National Park, and Windsor Downs Nature Reserve. There are also records from vegetated areas in Rouse Hill and Vineyard.

This species has been recorded within the study area only as a single empty shell, and is estimated to be absent from the study area, or occur in a low density, likely due to the heavy grazing, and regenerating form of CPW present which generally lacks significant leaf litter and debris due to the young age of most trees present.

iv. Assessment of habitat

a. Description of habitat values

The Cumberland Plain Land Snail lives within the leaf litter at the base of trees within the Cumberland Plain Woodland. It is highly dependent on the presence of bark, leaves, logs, and occasionally rubbish. The species is a fungus specialist and does not eat green plants.

Habitat in the study area is limited to the patches of CPW in the north, and is highly degraded. The study area does not provide adequate habitat for the species given the fragmented, highly grazed nature of the woodland on the site.

b. Description of habitat utilisation

The species is a specialist and can only utilise habitats within the CPW in the north. The species cannot forage over wide areas, and therefore is restricted to a very small area to forage. There are few fallen logs across the study area, and even secondary habitat such as rubbish and litter is infrequent.

v. Discussion of conservation status

a. Local, regional and statewide status

The Cumberland Plain Land Snail is listed as Endangered under Schedule 2 of the TSC Act. It is not listed under the EPBC Act. It is not considered as locally or regionally significant in The Hills LGA because of its state listing.

b. Threatening processes

The following threating processes have been identified for the species:

- Clearing and degradation of Cumberland Plain Woodland remnants.
- Weeds are considered a threat to the species, altering the composition of the litter that grows the fungi on which the species feeds.
- Fires at inappropriate times, or too frequently, will destroy the habitat required by the species, or burn the groundcover in which it can be sheltering, leading to direct loss of individuals.
- Heavy grazing by domestic stock in areas the species occupies will reduce the amount of cover available and lead to loss by trampling and habitat change.
- As the species shelters under fallen logs, removal of this material for firewood or in 'clearing up' can result in loss of ground habitat at sites occupied by the species.
- There is generally a poor understanding of other threats to this species

c. Habitat requirements

The species inhabits Cumberland Plain Woodland and lives under litter of bark, leaves, logs, and shelters in loose soil and around grass clumps (NSW Scientific Committee 1997a, OEH 2013b). The species can dig into the soil during drought conditions. Little other is known of its biology.

d. Other documentation

No recovery plan has been prepared for this species. No Threat Abatement Plan is relevant to this species. No critical habitat for this species has currently been identified by the Director-General of the OEH. The Species is listed under a Save our Species conservation project, as a landscape managed species. The species is listed within the Cumberland Plain Recovery Plan.

e. Assessment of adequacy of reservation

The majority of records in the locality are from Windsor Downs Nature Reserve, and in Scheyville National Park which is a protected area. Given the habitat requirements of the

species, there are few records in unprotected urban areas, as such the reservation of the species is adequate.

f. Limit of known distribution

The species is known from the Cumberland Plain in western Sydney. The species is within its distribution.

vi. Discussion of the likely effect of the proposal at local and regional scales

a. Significance within a local context

The proposal will remove a small area of low quality, degraded habitat for the species in relation to the habitat within the study area. Areas of suitable habitat conserved within Scheyville National Park are more significant and are not threatened by development or other impacts. The habitat occurring in Scheyville National Park and Maguires Road PCA is more secure than habitat occurring on private property close to development.

b. Discussion of connectivity

The proposal will not reduce the connectivity of the species in the locality. The habitat within the study area does not form a corridor, and given the lack of live individuals, does not support a viable population. There is better quality habitat and greater populations in nearby Scheyville National Park.

c. Consideration of threatening processes

The proposal will clear a small area of degraded Cumberland Plain Woodland. In its current form the area does not provide significant habitat for the species.

Weeds are already affecting the species at the site and inhibiting the abundance of habitat. The proposal will not further exacerbate any impacts of weeds and altering of composition of litter than current levels.

The frequency of fires is not likely to be affected by the proposal.

Heavy grazing by domestic stock is currently affecting the potential habitat in the study area. The proposal will reduce the level of grazing by stock.

The effect of 'cleaning up' and removing logs for firewood will not be exacerbated by the proposal. The areas of CPW within the study area is already void of fallen logs.

5.1.8 White-bellied Sea-Eagle (Haliaeetus leucogaster)

i. Description

White-bellied Sea-Eagles are a large, distinct raptor that has long, broad wings and a short wedge shaped tail. The species is recognisable by a brilliant white underbelly and head, and

it has grey wings. The wings have black tips. The species is generally seen as a single individual or in pairs.

The species is distributed along the coastline where it forages over natural and artificial waterbodies. The species can occur throughout Australia except the most arid deserts. The species uses waterways and rivers as corridors. the species can grow up to 4.2 kg and has a wingspan up to 2.2 meters. The species is long lived and can live for up to 30 years.

ii. Discussion of local and regional abundance and distribution

There are 9 records from The Hills LGA, and 1142 records from the Sydney Bioregion. The species is found near waterways across Australia.

iii. Discussion of other known local populations

There are scattered observations across the locality, generally focussed on waterways. There are numerous records from Sydney Harbour, Parramatta River, and the Nepean River. The occurrence of sightings interfaces at the base of the Blue Mountains, where the topography rises and observations decrease.

The presence of individuals in the study area is part of a wider population. The pair of individuals observed near a large eyrie, suggests the pair may be breeding at the study area.

iv. Assessment of habitat

a. Description of habitat values

The species is found in coastal and inland habitats and is characterised by the presence of large areas of water. The species has been recorded in the vicinity of rivers, waterways, bays, coastlines, swamps, sewage ponds, billabongs and saltmarshes. The species builds a large eyrie on cliffs or in large trees during breeding.

White-bellied Sea-Eagles forage over water and catch fish, but the species will also feed on birds, reptiles, mammals and crustaceans.

b. Description of habitat utilisation

The species has been observed using a large tree for an eyrie in the SSTF corridor. The two individuals observed are likely a breeding pair, and the species are monogamous and mate for life.

Given the presence of 62 dams and waterbodies within the study area, the species likely uses the area for foraging. The species does forage over a large area, so this most likely extends throughout the locality, including areas such as the Nepean River.

v. Discussion of conservation status

a. Local, regional and statewide status

The species is not listed under the TSC Act. The species is listed as Migratory under the EPBC Act. It is not considered as locally or regionally significant in The Hills LGA because of its federal listing.

b. Threatening processes

The main threats to the White-bellied Sea-Eagle are the loss of habitat due to land development, and the disturbance of breeding pairs by human activity (Birds Australia 2011, DoE 2014c).

Potential threats to the species include:

- Poisoning;
- Shooting;
- Competition with Wedge-tailed Eagles (*Aquila audax*); and
- Deterioration of inland water resources.

c. Habitat requirements

The species forages over waterbodies, but will also opportunistically feed on carion, mammals, and reptiles. The species requires cliffs or large trees for nesting. The species will nest in a variety of areas and has been observed nesting inland, near the coast, and on offshore islands.

d. Other documentation

There are threat abatement and recovery recommendations available (DoE 2014c). The following management actions are suggested for the species:

- The protection of suitable habitat (especially known breeding sites) on public land;
- Monitoring known nest sites and locating new nest sites;
- Increase of public awareness;
- Completion of a population viability assessment; and
- Encourage further research on the species.

e. Assessment of adequacy of reservation

The species is widely occurring across Australia and the locality. There are records from the locality which include within Scheyville National Park. The location of the species within the

study area is broad, but the nesting location is within the SSTF corridor, which will be conserved under the current proposal. The adequacy of reservation under the current proposal for the breeding pair is uncertain.

f. Limit of known distribution

The species occurs across Australia wherever water bodies occur. The species is within its known distribution.

vi. Discussion of the likely effect of the proposal at local and regional scales

a. Significance within a local context

The future development of the site will remove areas of foraging habitat for the species. The presence of Carp (*Cyprinus carpio*) in the farm dams within the study area are suitable for sustaining the species within the study area. The species forages over a wide area and the individuals at the site likely use areas of the Nepean River as forage areas as well.

The future development may impact the breeding habitat in the study area. The species is known to abandon nests if disturbed, especially during the early breeding season. The disturbance of nesting pairs by human activity can lower breeding success, and has been associated with some local population declines, for example, abandoned territories on the Eyre Peninsula and far west coast of South Australia were located in areas that had been developed for tourism or that contained recreational sites accessible by vehicles (Clunie 1994)

b. Discussion of connectivity

The habitat to be removed as part of the future development will not affect habitat availability in the locality. The species uses a wide variety of habitats but does not frequent the study area. The removal of habitat within the study area will not fragment or affect connectivity of habitat in the locality as much larger areas of both waterways and woodland habitats exist in the locality. Due to the loss of only a small proportion of habitat in the locality and the high mobility of this species, the proposal will not decrease the ability of movement of individuals and gene flow between habitats or populations.

c. Consideration of threatening processes

The proposal should not increase the occurrence of poisoning or shooting of the species. The effect of competition by Wedge-tailed Eagles will not be exacerbated by the proposal.

The condition of inland water resources will not be affected by the future development of the site.

5.1.9 Cattle Egret (Ardea ibis)

i. Description

The Cattle Egret is a small, stocky, mostly white member of the Ardeidae family. In south-east Australia it is found from Bundaberg, inland to Roma, Thargominda, and then down through Inverell, Walgett, Nyngan, Cobar, Ivanhoe, Balranald to Swan Hill, and then west to Pinnaroo and Port Augusta. The species grows to a weight of 390 g and a length of approximately 70 cm (DoE 2014a). The species feeds off ticks off the backs of cattle, whereby the name is derived.

ii. Discussion of local and regional abundance and distribution

There are 15 records of the species with The Hills LGA and 1540 records within the Sydney Bioregion.

iii. Discussion of other known local populations

There are scattered observations across the locality, generally focussed on waterways. There are numerous records from Sydney Harbour, Parramatta River, and the Nepean River. The occurrence of sightings interfaces at the base of the Blue Mountains, where the topography rises and observations decrease.

The presence of individuals in the study area is part of a wider population.

iv. Assessment of habitat

a. Description of habitat values

The species occurs in tropical and temperate grasslands, wooded lands, and terrestrial wetlands. The species forages away from water in low lying grasslands and is commonly found in farm areas that contain livestock (DoE 2014a). The species has also been observed feeding in rubbish tips. The roosting habitat is typified by trees, amongst ground vegetation near swamps, and has also been recorded roosting in industrial areas.

b. Description of habitat utilisation

The study area provides a variety of suitable habitats for the species. The presence of large open fields is suitable for foraging, whereas the remnant native vegetation serves as suitable roosting habitat. The species breeds in Melaleuca and Acacia swamps of the Murray-Darling Basin, and so the study area does not provide breeding habitat.

v. Discussion of conservation status

a. Local, regional and statewide status

The species is listed as Marine and Migratory (CAMBA) under the EPBC Act. The species is not listed under Section 2 of the TSC Act. The species is not listed at the local level.

b. Threatening processes

Threatening processes that have been identified for the species include:

- Persecution of large colonies in urban areas; and
- Loss of breeding habitats through wetland degradation and destruction.

c. Habitat requirements

The species utilises a broad range of habitat types including inland wetlands, grassland, and riparian zones. The species requires open spaces to forage. The species can utilise a variety of habitats for roosting at night, including trees, and dense ground vegetation.

d. Other documentation

No threat abatement plan has been developed for the species.

e. Assessment of adequacy of reservation

The species occurs across a wide variety of habitats within the locality. The species occurs to the west of the study area in Scheyville National Park, where suitable habitat is protected. The species also occurs frequently along riparian zones of waterways including the Nepean River. The species is also represented extensively in urban and private owned lands.

f. Limit of known distribution

The species occurs throughout Australia. The species is not at the limit of its known distribution.

vi. Discussion of the likely effect of the proposal at local and regional scales

a. Significance within a local context

The future development of the site will remove areas of foraging habitat for the species. The farm dams and grasslands within the study are suitable for sustaining the species within the study area. The species forages over a wide area and the individuals at the site likely use areas of the Nepean River as forage areas as well. There is no evidence of a roosting colony in the study area.

The future development may impact the foraging habitat in the study area. The species is widespread and forages over a large area. The future development of the study area will reduce foraging habitat (grasslands) in the locality, but will not significantly reduce the foraging habitat in the locality.

b. Discussion of connectivity

The habitat to be removed as part of the future development will not affect habitat availability in the locality. The species uses a wide variety of habitats but does not frequent the study area. The removal of habitat within the study area will not fragment or affect connectivity of

habitat in the locality as much larger areas of both waterways and woodland habitats exist in the locality. Due to the loss of only a small proportion of habitat in the locality and the high mobility of this species, the proposal will not decrease the ability of movement of individuals and gene flow between habitats or populations

c. Consideration of threatening processes

- Persecution of large colonies in urban areas
- Loss of breeding habitats through wetland degradation and destruction

There are no large roosting colonies in the study area. The future development will not affect breeding habitats for the species as there are no wetlands in the study area.

5.2 Impacts within the locality to threatened (C)EECs/Species

Directs impacts to threatened fauna within the locality will result primarily from increased urbanisation of the area. The area to the south of the study area is part of the North West Growth Centre, in particular the Box Hill Precinct. The Box Hill Precinct was rezoned in April 2013, and will allow across a 974 ha area for the construction of 9,600 residential dwellings housing up to 29,700 people. Within the adjacent Box Hill Industrial Precinct (to the south east of the study area), there will be 133 ha of commercial zoning to accommodate up to 16,000 new jobs in the area. The locality will be subject to a major increase in human traffic and associated impacts of urbanisation, irrespective of the impacts of the future development of Box Hill North.

Likely direct impacts to threatened fauna and flora in the locality will be minimal as a result of the future development of the study area. The impacts of the future development will be largely contained within the study area. Impacts that may permeate beyond the study area such as increased runoff of stormwater; sediment and dust will be minimised under the following management plans:

- Wyndham Prince Pty Ltd (2013). Box Hill North Precinct - Water Cycle & Flood Management Strategy Report; and
- An Erosion and sediment management plan.

Likely indirect impacts offsite to threatened flora and fauna will result from increased urbanisation of the locality, and will be linked directly to the impacts of higher density living. The following threatening processes have the potential to create indirect impacts on native flora and fauna within the locality, as a result of development of the study area:

- Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants;
- Predation on native fauna by feral cats;
- Removal of dead wood and dead trees;

- Dumping of rubbish in bushland areas;
- Animal strike from increased traffic in the locality;
- Increased lighting from houses and street lights; and
- Increased noise from urban development.

Chapter 6

Assessment of Likely Impacts on Endangered Ecological Communities

This chapter addresses the impacts to species in order to address DGR Sections 6. The following summary of impact provides an indication of general impacts of the proposal and future proposals within the study area.

Assessments of impacts have considered 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 and 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
- Landscaping.

6.1.1 Direct Impacts of Development

The proposed development will occur within a landscape that has been extensively altered since European settlement took place. The study area is predominately vegetated by exotic grasslands, or cleared for cropping with patches of remnant CPW and SSTF vegetation in the north of the study area.

The development of the sales offices will remove a small quantity of CPW. The future development of the study area however will remove larger tracts of CPW, and some areas of SSTF. The total quantum of vegetation to be removed is shown in **Figure 6.1** and **Table 6.1** below:

Table 6.1 Comparison of vegetation community areas within Box Hill North

Vegetation Community	Total Vegetation in study area	Vegetation to be retained within the study area (ha)	Vegetation to be removed from the study area (ha)	Vegetation to be removed from the study area (ha) within areas owned or controlled by EJC Pty Ltd
Cumberland Plain Woodland (CEEC)	13.4	3.6	9.8	9.1
Shale Sandstone Transition Forest (CEEC)	13.3	7.1	6.2	6.2
Scattered Trees	3.3	0.1	3.2	2.5
Acacia Regrowth	1.1	0.0	1.1	1.1
Exotic Vegetation	236.2	7.6	228.6	198.2
Total Native Vegetation	*31.1*	*10.8*	*20.3*	*18.9*
Total Vegetation	*267.3*	*18.5*	*248.9*	*217.1*

6.2 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 study area that will experience a loss of individuals from the population and are assessed in detail in the sections below. These are:

- Cumberland Plain Woodland; and
- Shale Sandstone Transition Forest.

6.3 Description of Habitat

6.3.1 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 2009a). 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 Box Hill North 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.

i. Habitat in the study area

a. Type

In the study area CPW occurs in the Shale Plains Woodland (SPW) 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 1990b). It occurs on Wianamatta shales, some Holocene alluvium and occasionally Mittagong formation, Tertiary alluvium, Hawkesbury sandstone and Aeolian deposits (Tozer 2003).

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

b. Size

The total area of CPW within the study area includes 8.8 ha of moderate quality CPW. A total of approximately 4.6 ha of CPW exists in the undeveloped areas of Box Hill North, and will be conserved within E4 lands.

Other areas of CPW have been mapped as occurring widely to the west of the study area (**Figure 2.4** and **2.5**). Of these areas, a large area of CPW is conserved within Scheyville National Park, which contains large remnants of the community.

c. Condition

The survey and detailed assessment of floristic data prepared specifically for this SIS has involved the comparison of quadrats to ascertain information on condition. Although CPW can take the form of Derived Native Grassland, this form is not present within the study area.

The form of CPW on the site is a degraded form that lacks large canopy trees with hollows. The shrub layer is absent through the majority of CPW within the study area due to heavy grazing by cattle, and historic land clearing. The remnant areas of CPW within the study area are patchy and have a ground layer that is generally dominated by exotic grasses. There is little evidence of regeneration of canopy species, no hollow logs on the ground, and large stumps have been completely removed from the area, suggesting it has been completely cleared at some stage.

ii. Habitat in the locality

Mature and regenerating CPW exists extensively within the locality, as the study area is 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. CPW habitat exists to the west of the study area. Historically, the majority of the study area would have been vegetated with CPW; however the areas have been cleared extensively for agriculture. As a result, habitat for CPW within the study area is confined to the areas where it currently exists.

iii. 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 1997).

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 1997).

iv. 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 1997b, 2009a).

v. Disturbance history and recovery capacity

The study area has been highly modified for agriculture and horticulture. Given the persistent impacts within the study area historically, the community likely exists as soil stored seed only within the areas that it currently exists as the above ground community. Areas where cattle have been removed across the study area form a thick ground cover of Kikuyu that blankets the ground cover.

vi. Conservation status

a. Local, regional, and state-wide conservation status

The community is listed under Section 2 of the TSC Act as Critically Endangered, and is listed under the EPBC Act as Critically Endangered as CPW and SSTF. The location of Commonwealth listed CPW within the study area is shown in **Figure 6.2**. The ecological community is not listed at the local scale due to its state and federal listing.

b. Threatening processes

The following threatening processes are considered for the community:

- The main threat is further clearing for urban or rural development, and the subsequent impacts from fragmentation;
- Grazing and mowing, which stops regrowth of the community;
- Inappropriate water run-off entering the site, which leads to increased nutrients and sedimentation;
- Weed invasion; and
- Inappropriate fire regimes, which have altered the appropriate floristic and structural diversity.

c. Recovery plans

This community is addressed in the Recovery Plan for the Cumberland Plain.

d. Representation in the conservation reserves

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 2001) 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 LGA, such as Prospect Reservoir, Nurragingy Reserve and intergrading with Sydney Coastal River Flat Forest at Bells and Eastern Creek (NSW NPWS 1997).

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

- Report on the methodology for identifying priority conservation lands on the Cumberland Plain (DECCW, 2010); and
- Cumberland Plain Recovery Plan (DECCW 2011).

Importantly, the two of the studies listed above identify Scheyville National Park and bushland to the north of Maguires Road as a Priority Area/Priority Conservation Lands for the management and recovery of the Cumberland Plain.

vii. Effect of the proposal at local and regional scales

The future development of the study area will reduce the population of the community within the locality by 9.8 ha. The effect of the proposal will reduce the occurrence of the community within the locality and region.

Cumulative in region

a. Significance in the locality

Within the locality, the removal of the community will form a significant impact. The community is represented well in the locality within conservation reserves, but the future development of the site will reduce the occurrence of the community within the locality.

b. Extent of habitat removal or modification

The proposed development will entail the removal of approximately 9.8 ha of regenerating CPW woodland within the Study area. The remaining area (approximately 3.6 ha) will be retained on site and will be restored and managed through the implementation of a Vegetation Management Plan (VMP). Additionally an area of passive open space will serve to buffer the remnant CPW patch from nearby development, further reducing the impact on the retained portion of the community. The proposed development is not likely place the local occurrence of this community at risk of extinction. A portion of CPW will be retained within the study area, and significant areas of the community occur within the locality.

c. Connectivity

The study area exists as a void of vegetation within the locality. The small areas of CPW within the study area do not provide connectivity within the locality, and exists as fragments on the margin of a wider area of habitat for the community. The future development of the study area will not reduce connectivity within the locality. Through the implementation of a VMP, the connectivity of the community will increase within the locality.

d. Consideration of threatening processes

The future development of the site will further clear areas of CPW for urban development. The impacts of this are mitigated through offsetting using the BioBanking system, and the establishment of planted habitat corridors within the development.

Grazing and mowing is currently undertaken heavily within the study area, and the future development will not exacerbate the effects.

The study area forms a distinct basin and is bounded by four roadways along elevated lands. The future development will not increase run off entering/exiting the study area. The installation of bioretention basins will capture excess water resultant from urbanisation of the study area (J Wyndham Prince Pty Ltd 2013).

6.3.2 Shale Sandstone Transition Forest

The NSW Scientific Committee made a final determination on the 28th November 2014 to list Shale Sandstone Transition Forest as Critically Endangered under the TSC Act (NSW Scientific Commitee 2014). The state listing includes derived native grasslands where they contain characteristic native non-woody species (NSW Scientific Committee 2009a). It does not state minimum condition thresholds, patch size or project foliage cover requirements for SSTF or derived native grasslands.

SSTF is listed as a CEEC) under the TSC Act and EPBC Act. SSTF occurs at the edges of the Cumberland Plain, where clay soils from the shale rock intergrades with earthy and sandy soils from sandstone, or where shale caps overlay sandstone. The boundaries are indistinct, and the species composition varies depending on the soil influences. The main tree species include *Eucalyptus tereticornis*, *E. punctata, E. globoidea*, *E. eugenioides* , *E. fibrosa* and *E. crebra*. Areas of low sandstone influence (more clay-loam soil texture) have an understorey that is closer to Cumberland Plain Woodland.

SSTF would have existed historically in the area it currently exists. The area has been reduced to an extent, however its occurrence on the interface of soil types limits its distribution. Grazing and land clearing has reduced the area of this community to an extent, but it naturally occurs in narrow bands between soil types.

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.

i. Habitat in the study area

a. Type

Its habitat is the interface between open shale plains, and sandstone influenced soils. The habitat is generally indistinct and it exists only along transition zones between soil types.

b. Size

The total area of SSTF within the study area includes 13.3 ha of the community. A total of approximately 7.1 ha of SSTF exists in areas where vegetation will be retained after development within the study area.

Other areas of SSTF have been mapped as occurring widely to the north of the study area (**Figure 2.4** and **Figure 2.5**). Of these areas, a large area of SSTF is conserved within Maguires Road PCA, which contains large remnants of the community.

c. Condition

The survey and detailed assessment of floristic data prepared specifically for this SIS has involved the comparison of quadrats to ascertain information on condition. Although SSTF can take the form of Derived Native Grassland, this form is not present within the study area.

The SSTF within the study area is a degraded form that retains large canopy trees with hollows. The shrub layer is present through some of the SSTF in the study area, but it is sparse due to heavy grazing by cattle, and historic land clearing. The remnant areas of SSTF within the study area have a ground layer that is generally dominated by exotic grasses. There is evidence of regeneration of canopy species, hollow logs on the ground, and large stumps still present within the creek line.

ii. Habitat in the locality

Mature and regenerating SSTF exists extensively within the locality, as the study area is 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. SSTF habitat exists to the north of the study area. The community only exists in narrow bands along sedimentary interfaces. As a result, habitat for SSTF in the study area is confined to the areas where it currently exists. It occurs in the Hawkesbury, Baulkham Hills, Liverpool, Parramatta, Penrith, Campbelltown and Wollondilly LGAs.

iii. Condition of similar habitat in the region

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

Maguires Road PCA (10m from the study area) and Gulguer Nature Reserve (43km from the study area) both contain SSTF and are assumed to be managed to provide good condition habitat for SSTF. Maguires Road PCA has been identified in the recovery plan as a location where good quality remnant examples still exist.

iv. National distribution

Shale Sandstone Transition Forest is only found in the Cumberland Plain of Western Sydney, (NSW Scientific Committee 1997b, 2009a)

v. Disturbance history and recovery capacity

The study area has been highly modified for agriculture and horticulture. Areas of SSTF within the study area have however remained relatively intact. Given the dependency on soil types and highly specialised habitat preference, the community likely exists as soil stored seed only within the areas that it currently exists as the above ground community.

vi. Conservation status

a. Local, regional, and state-wide conservation status

The community is listed under Section 2 of the TSC Act as Critically Endangered, and is listed under the EPBC Act as Critically Endangered. The location of Commonwealth listed SSTF within the study area is shown in **Figure 6.2**.The ecological community is not listed at the local scale due to its state and federal listing.

b. Threatening processes

The following threatening processes are considered for the community:

- The main threat is further clearing for urban or rural development, and the subsequent impacts from fragmentation;

- Inappropriate water run-off entering the site, which leads to increased nutrients and sedimentation;
- Weed invasion; and
- Inappropriate fire regimes, which have altered the appropriate floristic and structural diversity.

c. Recovery plans

A recovery plan has been developed for this ecological community under the Cumberland Plain Recovery Plan.

d. Representation in the conservation reserves

The community is only protected within three conservation reserves:

- Blue Mountains National Park;
- Cattai National Park; and
- Gulguer Nature Reserve.

Known areas of SSTF within the region also occur in proximate sites to the study area, and is best represented to the north of the site in Maguires Road PCA. There are (NSW NPWS 1997).

vii. Effect of the proposal at local and regional scales

The future development of the study area will reduce the extent of the community within the locality by 6.2 hectares without mitigation.

a. Significance in the locality

Within the locality, the removal of the community will form a significant impact. The community is represented well in the locality but not in conservation reserves. The future development of the site will reduce the occurrence of the community within the locality, but under the direction of the VMP, areas will be planted out to connect remnant patches within the study area.

b. Extent of habitat removal or modification

The proposed development will entail the removal of approximately 6.2 ha of regenerating SSTF within the study area. The remaining area (approximately 7.1 ha) will be retained on site and will be restored and managed through the implementation of a Vegetation Management Plan (VMP). Additionally an area of passive open space will serve to buffer the remnant SSTF patch from nearby development, further reducing the impact on the retained portion of the community. The proposed development is not likely place the local occurrence

of this community at risk of extinction as a sizable portion of SSTF will be retained within the study area, and significant areas of the community occur within the locality.

c. Connectivity

The study area exists as a void of vegetation within the locality. The small areas of SSTF within the study area provide connectivity within the locality, and exists as a corridor from the study area on the margin of a wider area of habitat for the community. The future development of the study area will not reduce connectivity within the locality. Through the implementation of a VMP, the connectivity of the community will increase within the locality.

d. Consideration of threatening processes

The future development of the site will further clear small areas of SSTF for urban development. The impacts of this are mitigated through offsetting using the BioBanking system, and the establishment of planted habitat corridors within the development.

The study area forms a distinct basin and is bounded by four roadways along elevated lands. The future development will not increase run off entering the study area. The installation of bioretention basins will capture excess water resultant from urbanisation of the study area (J Wyndham Prince Pty Ltd 2013).

The understorey is currently dominated by pasture grass species. the future development will not increase the effects of weeds on the community in the study area.

Changes in fire regimes are not expected to be exacerbated by the future development of the study area.

Coordinate System: MGA Zone 56 (GDA 94)

N
Grid North

Legend

- Study Area (Box Hill North)
- Area to be impacted

Vegetation Community

- Cumberland Plain Woodland
- Shale Sandstone Transition Forest
- Acacia Regrowth
- Exotic Vegetation

Image Source:
Image © SIX Maps (1-04-2014)

CUMBERLAND ECOLOGY

100 0 100 200 300 400 m

I:\...\15062\Figures\RP1_SIS\20150506\Figure 6.1. Development Footprint

Figure 6.1. Development Footprint of the Study Area showing Impacted Native Vegetation

Coordinate System: MGA Zone 56 (GDA 94)

Legend

- Study Area (Box Hill North)

Commonwealth Listed CEECs

- Cumberland Plain Woodland
- Shale Sandstone Transition Forest

Grid North

Image Source:
Image © SIX Maps
(dated 01-04-2014)

CUMBERLAND ECOLOGY

200 0 200 400 600 800 m

I:\...\15062\Figures\RP1_SIS\20150506\Figure 6.2. Commonwealth Listed EECs

Figure 6.2. Commonwealth Listed CEECs within Box Hill North

Chapter 7

Description of Feasible Alternatives

There existed a number of options for varying the mix of development and conservation at Box Hill North. Key examples are compared and contrasted below:

7.1 The Current Proposal

The rezoning of Box Hill North had regard to information in the earlier flora and fauna assessment by Cumberland Ecology (2013), which discussed the feasibility of retention of various patches of woodland and open forest amid future urban areas. The patches of CPW in the north west corner of the study area were considered to have limited value for retention owing to their lack of connectivity and their future vulnerability to edge effects.

Given such discussions the rezoning has foreshadowed the following conservation measures:

- On site retention of CPW and SSTF;
- Future revegetation of passive open space and riparian corridors using CPW and SSTF plant species; and
- Acquisition of BioBanking credits to fund off site offsets for CPW and SSTF.

The current proposal allows for some *in situ* retention of vegetation, focused on the largest, most intact area of vegetation in the north east of the site, and to a lesser extent the north west corner. It also provides for forming increased vegetative cover along open space and riparian corridors on site, which are likely to have a number of ecological, water quality and aesthetic benefits.

It also funds a significant conservation outcome off site by purchase of BioBanking credits for CPW and SSTF. Such conservation measures will be part of larger conservation areas with a greater potential to remain viable in the long term.

The current proposal entails a mixture of on and off site measures that are likely to remain viable in the long term.

7.2 Do Nothing Option

The vegetation within the study area and surrounding land has suffered sustained impacts by agricultural and rural residential use of the land which leaves the study area more susceptible to degradation such as:

- Fragmentation of habitats;
- Isolation of habitat patches; and
- Reduction in habitat values and supports fewer species.

During the surveys in 2013, the patches of CPW on this site were already considered to be highly modified. Areas of SSTF are currently in better condition, but ground cover is still dominated in many places by exotic grasses. The fauna recorded in 2013 are dominated by common species and feral animals, such as rabbits, foxes and mynas indicating habitat disturbance.

Additional flora and fauna investigations undertaken for this SIS tend to show that the remaining vegetation is declining in condition in many places. There is no evidence that scattered trees in some paddocks within the study area are being replaced as no regeneration is occurring.

The “do nothing” option of retaining the study area in its current state is likely to lead to ongoing degradation of the vegetation, unless actively managed for conservation. As history has proven, there is little incentive for agricultural land owners to manage weeds and control feral animals on their properties.

The do nothing option is not likely to lead to viable long term retention and management of native flora and fauna.

7.3 Partial Development and Retention of Additional Vegetation, with Offsetting of Impacts

It is possible to conserve additional vegetation on site and, concurrently to have less development. In order to achieve that, choices are limited and would entail conservation of more of the young CPW patches in the north western corner of the study area.

If more land were to be conserved in this area, the CPW retained would still lack connectivity to other native vegetation and would be "enclosed" by future urban development on the south and eastern margins. There is also a probability that the future upgrading of the road to the west would further isolate such this area of CPW.

Retention of less CPW in this area, and opting for a larger acquisition of offsite offsets means that a larger, more intact remnant of such vegetation is to be funded in a more viable location in the long term.

7.4 Development of the Whole Site and Offsetting of all Impacts

In theory, all native vegetation on site could be cleared and offset off site. If that were to occur, no local conservation outcomes would ensure. Also, the larger trees present within the SSTF that contain hollows would be cleared. The clearing of the entire study area would result in a significant loss of fauna habitat within the locality.

No vegetation would be retained along the creek in the north eastern portion of the study areas and there would be no native vegetation remaining to buffer the bushland offsite to the north from edge effects of the future developments in Box Hill.

The absence of native tree cover would also detract from the visual amenity of the Box Hill North area.

7.5 Conclusion

It is contended that the current proposal of land uses via the recently approved rezoning of land will achieve a balanced mixture of in situ and ex situ conservation. Conservation measures proposed will both be funded recurrently under the terms of the proposed VMP (*in situ*) and via BioBanking (*ex situ*). The alternatives are not as feasible and would not lead to such a conservation outcome.

Chapter 8

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

8.1 Introduction

A Final Recovery Plan (the Recovery Plan) for the communities and associated threatened species of the Cumberland Plain has been prepared and adopted by the OEH in January 2011 (DECCW 2011). The Draft Recovery Plan (DECCW (NSW) 2009) was in force between 2009 and 2011. The purpose of this chapter is to examine the consistency of the future development of Box Hill North 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 future development of the study area under section 79C of the *Environmental Planning and Assessment Act* 1979 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.

8.2 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 6.1.

Table 8.1 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* subsp. *juniperina*)	Vulnerable	-
Micromyrtus minutiflora	Endangered	Vulnerable
Sydney Plains Greenhood (*Pterostylis saxicola*)	Endangered	Endangered

Table 8.1 Threatened Biodiversity addressed in the Recovery Plan		
Threatened Biodiversity	**TSC Act Status**	**EPBC Act Status**
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 subsp. *viridiflora* population in the Bankstown, Blacktown, Camden, Fairfield, Holroyd, Liverpool and Penrith LGAs	Endangered	-
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	Critically Endangered	Critically 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 none occur within the study area.

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 Chapters 4 and 5.

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

- CPW; 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. OEH considers these lands to be the highest priority for future efforts to conserve the threatened biodiversity in the region.

While the study area is not priority conservation lands, the Recovery Plan nevertheless identifies as a responsibility of, the proponent, 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 8.3 below. 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 study area are also discussed in Section 8.3 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 study area will directly remove habitat for a small number of threatened species including; the Cumberland Plain Land Snail. *Dillwynia tenuifolia* plants occur nearby (to the north of) the study area, but not within the study area. Notwithstanding this, the potential impacts of the proposed development on this species have been considered.

Further to this, a total area of 9.8 ha of CPW and 6.2 ha of SSTF will be removed as part of the proposal. The removal of this vegetation will remove degraded habitat for the Cumberland Plain Land Snail within the study area. Significant and higher quality habitat for the threatened species will remain in the locality. Such impacts have been assessed in detail in Chapter 5 and **Appendix H** of this SIS.

8.3 Compliance 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. Likewise, 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.

8.3.1 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 OEH (Formerly DECCW). However, the proposed future development in general is consistent with these objectives by:

- Protecting an area of CPW in the north western corner and enhancing this area by planting of additional CPW species within exotic grasslands;
- Delivering appropriate management for the maintenance of CPW within the study area as stipulated in the VMP; and
- Featuring the existing stands of CPW within the study area as assets of the development.

The community awareness of the Cumberland Plain's threatened biodiversity is enhanced through the retention of the SSTF corridor, replanting of CPW species along a major riparian corridor through the study area; and the creation of E4 lands in the north western corner of the study area.

8.3.2 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.
- 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 within the study area is overcome by the offset measures proposed by the proposed future development, as discussed in detail in Chapter 9 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 of the recovery plan) on public and private lands within the Cumberland Plain.

8.3.3 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 retained riparian corridor in the study area falls under the first two categories above.

Within the study area, some areas of bushland will be retained after residential development is complete. These areas will predominantly include Asset Protection Zones (APZ), and open space, including some pocket parks. Open Space and pocket parks will be dedicated to The Hills Shire Council as Public Reserves.

According to Appendix 2 of the recovery plan, 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 OEH 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 OEH 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* ("the OEH Guidelines") (DEC (NSW) 2005d) is referred to in Appendix 2, which 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, 8.3.4.

8.3.4 Management Plans Regulating Development of the Study Area

Several management plans will be developed and adopted for the bushland within the study area. These areas will be managed in accordance with these management plans to the extent required. These management plans will be consistent with the objectives and requirements of the Recovery Plan, as outlined above.

Management plans to be adopted for the study area includes the following which will require approval by Council as part of the statutory planning framework:

- A plan of management for reserves and parks;
- Fauna Management protocol;
- Bushfire Hazard Reduction Plan; and
- Vegetation Management Plan for Box Hill North.

The management plans listed above will be prepared as part of future DAs and will need to be adopted by Council. The plans will be consistent with relevant best practice guidelines for the management of bushland and were prepared in consultation with relevant government departments.

The recommended fire regimes in Appendix 3 of the Recovery Plan are not considered relevant to bushland in the study area, as the remnants of bushland are not suitable for this kind of management.

8.3.5 Assessment of Threatened Species, Populations and Ecological Communities within this SIS

Several threatened species, populations and ecological communities recorded from the study area 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 in Chapters 4 and 5.

The management and recovery objectives for the flora and fauna species, populations and ecological communities listed in this SIS 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.

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 future development is consistent with these actions because the largest and best areas of biodiversity in the study area will be conserved within the passive open space network and riparian corridor, 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 retained vegetation in the study area.

8.4 Application of Recovery Plan to Proposal

As discussed above, when considering whether to grant development consent to the future development of the study area, 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 1995 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:
  - Building the protected area network;
  - Delivering best practice management;
  - Promoting awareness, education and engagement; and
  - Enhancing information, monitoring and enforcement.

The future development of Box Hill North is consistent with these actions because:

1. The largest and best areas biodiversity in the study area will be conserved within the proposed passive open space and riparian corridor, 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 small and is of lower biodiversity value compared to that of the riparian corridor; and
3. Management plans regulating the development of the study area (to be developed and will require approval), will be consistent with the objectives and requirements of the Recovery Plan (e.g. the VMP).

The acquisition of BioBanking credits for CPW and for SSTF will fund the conservation management of 16.7 ha of CPW and 3.3 ha of SSTF off site, as explained in the following chapter. These off site offsets will be managed according to best practice and following an

OEH-approved management strategy. Thus the offsite offsets will also be consistent with the Recovery Plan.

CUMBERLAND ECOLOGY

Chapter 9

Ameliorative Measures

9.1 Introduction

The purpose of this chapter is to outline the measures proposed to ameliorate the impacts of the future development of Box Hill North on flora and fauna as required in DGR Section 7 Ameliorative Measures.

As demonstrated in previous chapters, the area zoned for urban development contains some habitat for native flora and fauna, including species and ecological communities listed under State and Commonwealth threatened species legislation.

Ameliorative measures for Box Hill North were developed according to the following hierarchy of measures:

- Avoid – to the extent possible, developments should be designed to avoid or minimize ecological impacts;
- Mitigate – where certain impacts are unavoidable through design changes, mitigation measures should be introduced to ameliorate the ecological impacts of the project; and
- Compensate – the residual impacts of the project, following the implementation of mitigation measures, should be compensated to offset what would otherwise be a net loss of habitat.

Box Hill North includes the following amelioration measures:

- on site retention of some CPW and SSTF (avoidance);
- future revegetation of open space corridors using CPW and SSTF plant species (mitigation); and
- acquisition of BioBanking credits to fund off site offsets for CPW and SSTF (compensation).

The package of measures is explained below.

9.2 Avoidance Strategies

The ecological investigation by Cumberland Ecology (2013) to support the planning proposal mapped the vegetation and other fauna habitats of Box Hill North and discussed potential for avoidance of some of the major patches of vegetation. In particular, consideration was given to avoidance of the largest patches of CPW and SSTF.

The rezoning has provided for retention of vegetation, including 7.1 ha of SSTF and 3.6 ha of CPW (zoned RE1 and E4 respectively). These will be actively managed in perpetuity by implementing a Vegetation Management Plan, which is has been prepared (see below).

The area of SSTF will be part of an open space corridor and the existing SSTF will be linked in future to other areas that are to be replanted with CPW and SSTF plant species. Scattered remnant trees will be retained where possible and incorporated into future replanting of CPW and SSTF within the study area.

9.3 Mitigating Measures

The ecological investigation by Cumberland Ecology (2013) for the rezoning application recognised the need for ongoing management of retained and replanted vegetation to ensure that such vegetation could be sustainably managed. Mitigation measures are also required to manage native fauna species, not only threatened species, and to guide the overall management of the open space corridors, and other landscape elements.

The following mitigation measures are required to minimize any adverse effects of the proposal on any native species and communities within Box Hill North:

- Preparation of a Vegetation Management Plan (VMP);
- Fauna Management Protocols;
- Planned and staged decommissioning of dams; and
- Preparation of a Landscape Management Plan.

These measures are discussed in more detail below.

Mitigation measures are also to minimise adverse effects on native species, not only threatened species, are recommended for the development of Box Hill North.

9.3.1 The VMP

The VMP will be provided based on the relevant areas to be conserved and rehabilitated as set out in the recommendations of the ecological assessment by Cumberland Ecology (2013), in accordance with all relevant policy and guidelines. The VMP will include a description of the type, extent and current conditions of existing vegetation including:

- Details on total plant species and threatened flora and fauna;

- A description of the broader context of the vegetation within the site, including details of environmental constraints:
- A review and referral to legislation and other plans that relate to the site;
- Identification of management zones within the study area which will be categorized within each stage of development (thus allowing for flexibility should changes be required as the development application for each stage of development is produced), including:
    - a description of each management zone;
    - management issues within each management zone;
    - the aims, objectives, activities and performance criteria of the VMP within each management zone;
    - the target condition of vegetation within each management zone following implementation of the VMP, with the target condition comprising the aims of the project;
    - the activities that will be undertaken to achieve the objectives of each proposed management zone; and
    - criteria that will enable the assessment of success of the proposed activities;

It is anticipated that the VMP will form a master document, which is referred to within each DA for each stage of development. Over time, changes in the development layout or legislative changes may necessitate that the VMP be updated.

9.3.2 Fauna Management

The VMP will also prescribe measures for the active management of fauna within Box Hill North. Fauna management procedures include:

- Active management of native fauna habitat;
- Relocation of native fauna where appropriate;
- Euthanizing of introduced fauna where appropriate; and
- Pre-clearance surveys.

These measures are discussed in more detail below.

i. Re-location of Cumberland Plain Land Snails

Prior to any disturbance to the study area, a targeted search for Cumberland Plain Land Snails will be conducted. Any snails found during this process are to be relocated to a

nearby site containing CPW. The details of this process and the receiver site will be determined at a later stage, prior to works commencing.

ii. Pre-clearance Surveys of Roosting Bat Habitat

It is recommended that pre-clearance surveys of all buildings are undertaken to determine presence of roosting bats, particularly microchiropteran bats (microbats). Pre-clearance surveys for microbats should include an assessment of the building for potential roosting habitat and microbat echolocation surveys (Anabat and ZCAIM). In the event that potential roosting habitat is present within the buildings, an appropriate Bat Management Plan outlining staged demolition works for the building and appropriate relocation of microbats is to be prepared.

iii. Pre-clearance Surveys of Arboreal Habitat

It is recommended that pre-clearance surveys be undertaken to ensure that any fauna ethics issues are managed appropriately. The clearing of vegetation will be conducted in the following stages:

- Prior to the clearing of any trees, a pre-clearing fauna survey will be conducted by a qualified ecologist to identify and minimise impacts to resident fauna. Any fauna utilising the area will be recorded, and where possible, these will be encouraged to leave the area. Tree hollows have potential to contain native species such as bats, gliders, possums, reptiles and birds. All trees containing hollows will be flagged with fluorescent marking tape and have a large “H” (habitat) spray painted with white line marking paint on four sides of the tree. The ground around each tree will be inspected for scats, and the trees for scratch marks;

- The clearing will be conducted using a two-stage clearing process. Trees or habitat features marked as habitat will not be cleared during the first stage; however all vegetation around the tree will be so that the habitat features are isolated;

- The following day, identified habitat trees will be cleared using the following protocols:

    - If possible, trees marked as containing hollows will be shaken by machinery prior to clearing to encourage any animals remaining to leave the hollows and move on;

    - The recommended methodology is to use a cherry picker and/or arborist to then remove the crown of the tree;

    - Branches bearing hollows are to be removed individually and hoisted gently to the ground;

    - The trunk is to be removed in sections; and

    - Sections of trunk and branches with hollows are to be moved to an area of nearby vegetation and placed near the base of a large tree.

The two-stage clearing process enables fauna to feel secure whilst clearing occurs around their tree, and allows them a chance to self-relocate upon nightfall, when foraging typically occurs. Fauna are not likely to re-inhabit trees, as they are not likely to feel secure in their tree with all trees around it cleared. An ecologist will be present while clearing to rescue animals injured during the clearance operation.

Any fauna found will be captured and relocated to nearby remnant vegetation and released after nightfall to minimise the risk of predation by diurnal predators. Any animals that are inadvertently injured will be taken to the nearest veterinary clinic for treatment, or if the animal is unlikely to survive, it will be humanely euthanized. All persons working on the vegetation clearing will be briefed about the possible fauna present at the time of construction, and what procedures should be undertaken in the event of an animal being injured or disturbed. A qualified fauna ecologist will be present on-site at all times during clearing.

9.3.3 Landscape Management

The proposed layout of the development of the study area is shown in **Figure 2.6** and forms part of the DA submission. Street trees are an important element of the streetscape and individual CPW and SSTF trees will be retained where possible.

Details of the layout of revegetation areas and species use for planting will be provided in a Landscape Management Plan.

9.3.4 Decommissioning Procedure for Farm Dams

The proponent will prepare a decommissioning procedure for farm dams, which if the future development is approved, will form part of the DA conditions of consent. As part of this process, sediment and water quality testing should be undertaken and assessed against ANZECC guidelines. This will establish if the water can be used for irrigation or if it has to be removed by other means.

The timing and method of de-watering the dam will be managed by engineers, while a qualified ecologist will be present during the process. Any native aquatic fauna species will be captured and relocated to a predetermined location. Any alien fauna species will be destroyed according to current standards. It is assumed that eels and turtles may be present within the dams.

9.3.5 Other Relevant Measures

The following control measures will need to be in place before and during construction:

- Erosion and sediment control measures;
- Prevention of dust and noise where possible;
- Storm-water management around and on the site;

- Identification and eradication of weeds before and during construction to prevent contamination of adjacent sites;
- Eradication of rabbits prior to development to prevent further spread; and
- Protection of trees to be retained.

Details of these measures will be outlined in relevant management plans such as the storm-water management plans and sediment management plan.

9.4 Compensatory Strategies

The OEH 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.

9.4.1 Future Regeneration of Open Space Corridors using Cumberland Plain Woodland and Shale Sandstone Transition Forest Species

In addition to retention of existing vegetation within the study area, the proponent will commit to revegetating areas of the study area with species typified by the CPW and SSTF communities. The proponent intends on replanting:

- 15 ha of CPW canopy and shrub species within open space areas across the study area;
- 4.5 ha of CPW canopy and shrub species within E4 lands to revegetate the entire E4 area onsite; and
- 5 ha of SSTF canopy and shrub species within suitable open space areas across the study area.

The final location and extent of replanting onsite will be directed by the following documents:

- A Vegetation Management Plan;
- A Bushfire Hazard Management Plan; and
- A Landscape Plan.

9.4.2 Acquisition of BioBanking Credits to Fund Offsite Offsets

In addition to retention of onsite vegetation, and the replanting of 24.5 ha of native vegetation in open and environmental spaces, the proponent has purchased a significant quantum of BioBanking Credits to facilitate management of a nearby BioBank site, Fernhill East (Agreement 112). A total of 250 ecosystem credits have been purchased under the BioBanking scheme (DECC 2007) for the following vegetation communities:

- 210 credits of HN528 - Grey Box – Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin; and
- 40 credits of HN556 – Narrow-leaved Ironbark – Broad-leaved Ironbark – Grey Gum open forest of the edges of the Cumberland Plain, Sydney basin.

HN528 credits were purchased at a rate of $13,000/credit while HN556 credits were purchased at a rate of $10,000/credit which equates to a financial investment of approximately $3.13 million to fund offsite offsets.

Based on a credit per hectare ratio, the credits purchased equate to a pro-rata area of:

- 16.7 ha of HN528 - Grey Box – Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin; and
- 3.3 ha of HN556 – Narrow-leaved Ironbark – Broad-leaved Ironbark – Grey Gum open forest of the edges of the Cumberland Plain, Sydney basin.

Details of the BioBank Site are discussed below

i. Fernhill East BioBank Site

Fernhill East is a BioBank Site in Mulgoa, NSW. It has been gazetted under BioBank Agreement 112.

a. Cumberland Plain Woodland at Fernhill East

CPW occurs as remnant patches on an agricultural property that is situated in the rural area of Mulgoa in enriched sandstone and shale habitats at the margin of the Cumberland Plain. Immediately to the west, the CPW patches are directly connected to the bushland vegetation within the Blue Mountains National Park and to the Hawkesbury River via other vegetated areas onsite. To the east, and generally to the north and south, lies the urban/rural landscape of the Greater Western Sydney region, containing scattered mosaics of native remnant vegetation in various stages of disturbance and regeneration around major urban centres such as Penrith, Glenmore Park and St Marys.

CPW occurs on a property that has been managed for farming for a long time (including grazing) and exists as discrete patches on the lower relief areas of the property, namely to the east, and as a belt of trees along the Mulgoa Road frontage. The understorey is predominantly native and includes grazing sensitive species such as Kangaroo Grass;

however, common pasture weeds such as thistles, fleabane, Cobbler's Pegs, and Paddy's Lucerne are also present.

The canopy varies from moderately dense to diffuse. Many of these trees appear to be young but mature. The occurrence of old growth trees with abundant hollows is also likely to be rare because of historical clearing but future hollow-bearing trees are present and very young regeneration of canopy species is also evident.

Major infestations of problematic woody weeds, such as Lantana, Blackberry, Tree of Heaven and African Boxthorn occur within CPW patches and moderate incursions of perennial exotic grasses, namely African Lovegrass and Rhodes Grass, have been noted. Overabundant feral populations of the European Rabbit have also been noted for the site.

b. Shale Sandstone Transition Forest at Fernhill East

The onsite occurrence of SSTF is represented by one large patch located in the north eastern corner of the site in association with Cataract Creek. This patch is contiguous with a larger offsite occurrence of SSTF situated to the north east of the site. However, the areas that will be cleared comprise one to two lobes of thickly regenerating canopy trees extending out to the east and west from the core patch of SSTF. The core of the patch is not within the developable footprint and will not affect the connectivity of the larger patch to offsite vegetation.

On a wider scale, the proximity of the study area to areas such as the Scheyville National Park and Mitchell National Park is counterbalanced by the planned intensification of urban development in the surrounding areas and potentially by the proposed future M9 Outer Sydney Orbital that may run through the Hills Shire LGA.

The lobes of thickly regenerating canopy trees that extend from the core patch of SSTF to the east and west are comprised of very young, regenerating eucalypt trees and lack mature, hollow-bearing trees. As these areas have regenerated from seed after clearing (presumably to create pasture for grazing), the community lacks a developed understorey. Much of the understorey is at risk of competition from perennial exotic grasses such as Kikuyu and Paspalum that were sown in the past across the majority of the site to create pasture for grazing stock.

9.4.3 Quantum of Offsets

The quantum of compensatory offsets has been calculated for the study area and is shown in **Table 9.1**.

Scattered trees across the southern portion of the study area have been included in the area of CPW to be cleared as a measure of canopy cover. These trees do not qualify for the community under NSW or Commonwealth descriptions (Chapter 4), but a conservative approach has been taken when quantifying the total disturbance with respect to offsetting.

The offsetting ratios for State Assessments have included the replanting across the study area. However offsetting ratios for Commonwealth Assessments have excluded replanting

within the calculation due to the differences in the definition of the (C)EEC under the EPBC Act. While the replanting does not contribute to the offsets for CPW and SSTF under the EPBC Act, the increased area of habitat available does contribute to the offsets for threatened species via increased availability of foraging and nesting habitat.

9.5 Conservation and Compensation Area Summary

The overall offset strategy for the development of Box Hill North involves a combination of retention of on-site vegetation (avoidance), revegetation and replanting of CPW and SSTF (mitigation) and purchase of off-site offsets via BioBanking credits (compensation).

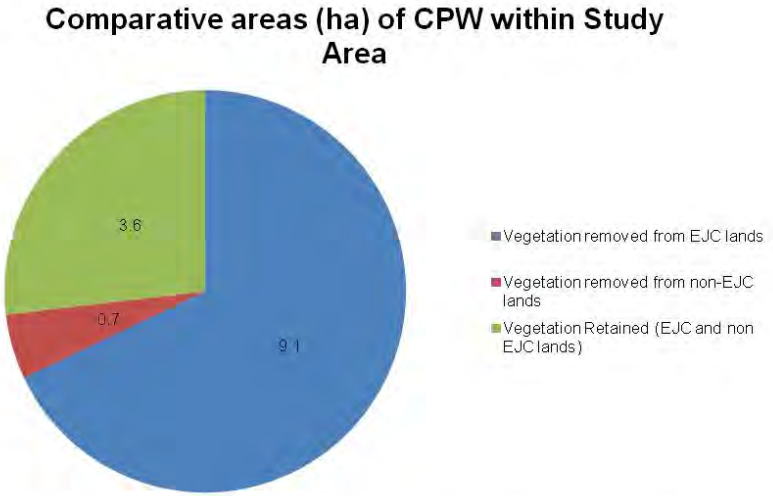
These strategies conform to the offset requirements under NSW Legislation, providing an overall offset ratio of approximately 4.1:1 for CPW and 2.5:1 for SSTF.

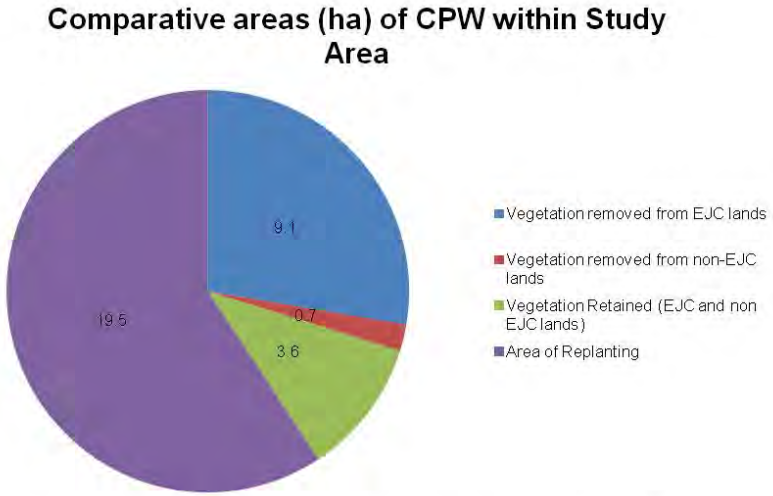
The revegetation and replanting of CPW and SSTF are excluded from the Commonwealth offset package. However the retention of on-site vegetation and purchase off site offsets via BioBanking also provide an appropriate offset, as required under Commonwealth legislation, of approximately 2.1:1 for CPW and 1.7:1 for SSTF.

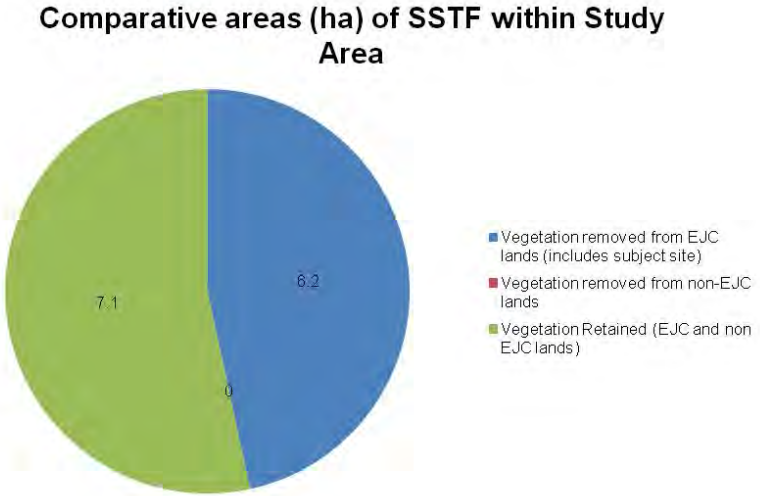
A summary indicating the percentage of offset lands to impact areas for the State and Commonwealth offsets is provided in **Figure 9.1** below.

Table 9.1 Quantum of offsets proposed to compensate for losses of native vegetation from urban development at Box Hill North

					BioBanking Credits							OFFSET RATIOS	
				Impact		Impact EJC Lands		Purchased		In-Situ Areas			
	Common Name	Vegetation Description	Code	Area (ha)	BioBanking Credits	Area (ha)	BioBanking Credits	Area (ha)	BioBanking Credits	Retained (ha)	Replanted (ha)	**Total Offset (including replanting)**	**Total Offset (excluding replanting)**
NSW Assessment	Cumberland Plain Woodland	Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin	HN528	9.8	428	9.1	399	16.7	210	3.6	19.5	**4.1**	
	Shale Sandstone Transition Forest	Narrow-leaved Ironbark - Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin	HN556	6.2	305	6.2	305	3.3	40	7.1	5	**2.5**	
	Total			**16.0**	**733**	**15.3**	**704**	**20**	**250**	**30.7**	**24.5**		
Commonwealth Assessment	Cumberland Plain Woodland	Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin	HN528	9.8	428	9.1	399	16.7	210	3.6			**2.1**
	Shale Sandstone Transition Forest	Narrow-leaved Ironbark - Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin	HN556	6.2	305	6.2	305	3.3	40	7.1			**1.7**
	Grand Total			**16.0**	**504**	**15.3**	**450**	**20**	**250**	**30.7**			







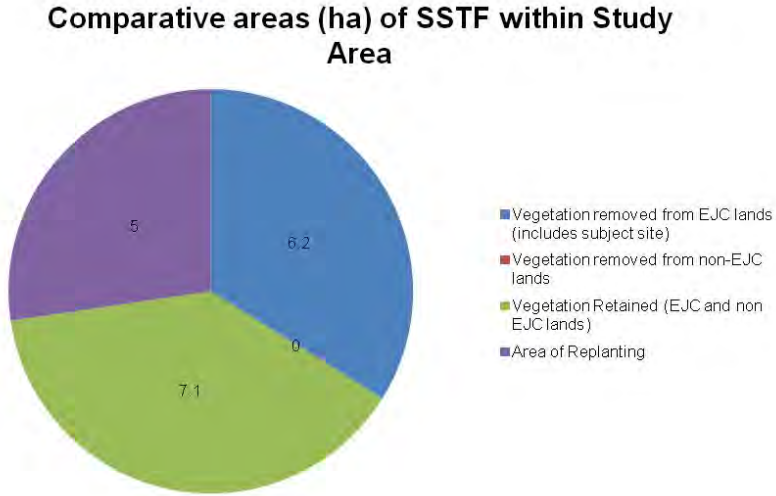


Figure 9.1 Percentage of Impact and Offset areas for CPW and SSTF under Commonwealth and State Legislation

9.6 Impacts When Amelioration is Considered

Assessments of Significance (seven part tests) are threshold tests of significance that are prepared as a requirement of Section 5A of the EP&A Act for impacts arising from development applications. Assessments of significance determine whether there is likely to be a significant impact on any threatened flora and fauna in order to determine whether to proceed to prepare a SIS. Notwithstanding this, the seven part tests can be repeated within an SIS to consider whether a significant negative impact will occur once avoidance, mitigation and compensation measures are considered. This has been done within Appendix I for all endangered ecological communities and threatened species known or considered likely to occur on the Box Hill North site.

The seven part tests verify that although the two CEECs and several threatened species would be significantly impacted by future developments on the site, the amelioration measure proposed are likely to address such impacts such that examples of the two CEECs will be conserved on site, and preserved within off site offset areas. There will also be substantial replanting of vegetation within open space areas and this is expected to provide opportunities for such fauna as birds and bats in the long term. Thus, when implemented, the suite of ameliorative measures are predicted to address the otherwise significant impacts of the development of the Box Hill North site.

CUMBERLAND ECOLOGY

Chapter **10**

Conclusion

The proposed future development of Box Hill North will remove 20.3 ha of native vegetation of which approximately 9.8 ha of CPW, 6.2 ha of SSTF, 3.2 ha of Scattered Trees, 1.1 ha of Acacia Regrowth, as well as the removal of existing dams across the study area. Without amelioration, this vegetation clearance would have a significant impact. However, when weighed against the conservation benefits that will be derived from on site retention, on site replanting and off site retiring of BioBanking credits and preserving a larger contiguous patch of CPW and SSTF in perpetuity, the long term impacts are sustainable.

The proposal is unlikely to result in any threatened species or ecological community becoming locally extinct. Threatened species recorded from the Study Area are all mobile species (except Cumberland Plain Land Snail) which utilise areas outside of the study area. These mobile threatened species would use the study area intermittently, however better quality habitat is situated within the locality, and has protected tenure in areas such as Scheyville National Park. Foraging habitat will be reduced within the locality for Spotted Harrier, Grey-headed Flying-fox, Eastern Freetail-bat, Yellow-bellied Sheathtail-bat, Eastern Bentwing-bat, Southern Myotis, Cattle Egret, and White-bellied Sea-eagle. Foraging and breeding habitat will be removed for Cumberland Plain Land Snail, although the size of the population is small if not currently absent from the Study Area. Therefore, the loss of this habitat in the subject site is not considered to be significant.

The impact of the proposal will be more than balanced by the major conservation outcome resulting from the proposed biodiversity offset strategy. When weighed against the conservation benefits, both direct and indirect, that will be derived from the offset package, together with the various mitigation measures afforded by the management strategies for weeds and feral, the areas of degraded vegetation to be cleared as a result of the proposal are considered to be of minor consequence. The proposal is unlikely to result in any threatened species or ecological community becoming extinct. Known occurrences of threatened flora and fauna are predicted to be secure in the long term as a result of the proposed biodiversity offset strategy and supporting mitigation measures that will be enshrined in the legal, statutory planning framework.

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Appendix A

Director General's Requirements

Table A.1 DGR Compliance Table

Main Section	Sub-Sections		Comments
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:	The SIS is signed by the principal author at the beginning of the document.
	a.	the applicant for the licence, or	N/A
	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 SIS is signed at the beginning of the document by the applicant for development consent / proponent of the activity proposed to be carried out.
	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."		The declaration is provided at the beginning of the document.

Table A.1 DGR Compliance Table

Main Section	Sub-Sections	Comments
2. CONTEXTUAL INFORMATION	The description must include information of the following forms and types:	-
	2.1 Description of proposal 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 on and off the study area as a result of the proposal. These actions described must include but are not to be restricted to construction, provision or ongoing use and maintenance of proposed: • buildings or other structures; • associated infrastructure such as for sewage, electricity, gas or water; • routes for access and egress; drainage infrastructure and changes made to surface water flows; • bush fire asset protection zones; and • landscaping.	Ref to Section 2.1 – 2.2
	2.2 Land tenure information Information must be provided about the land tenure across the study area.	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. Vegetation descriptions should match (or at least refer to) those in the Vegetation Types Database	Ref to Section 2.4.

Table A.1 DGR Compliance Table

Main Section	Sub-Sections	Comments
	(available at www.environmenl.nsw.gov.au/resources/nature/BioMetric Vegetation Type CMA.xls). Reference should also be made to Council vegetation mapping, SCIVI mapping (Tozer et al., 2011) as well as the descriptions of endangered or critically endangered ecological communities as determined by the Scientific Committee. Classifications must have regard to both structural and floristic elements.	
	2.4 Plans and maps An aerial photograph (or reproduction of such a photograph) (preferably colour), of the locality must be provided, indicating scale, and clearly delineating the study area. A map or maps must be provided, showing: • in the locality, → land tenures and uses including parks and reserves, and areas of high human activity such as townships, regional centres and major roads. → any locally significant areas for threatened biodiversity. → the locations of any previously known threatened species or endangered populations. → the locations and types of vegetation and cleared areas (with reference to the description required in section 2.3). • 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. → topography of the site and immediate surrounds at a scale of not less than 1:3000. → 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.	Plans and maps are identified on Page xiii and ix within the Table of Contents

Table A.1 DGR Compliance Table

Main Section	Sub-Sections	Comments
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.* 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	-
	3.1.1 Assessment of available information	Ref to Chapter 3.
	In determining the subject threatened species, populations and ecological communities likely to be present (the subject species), a full list of threatened species, populations and ecological communities within a 10 km x 10 km radius of the subject site must first be compiled. Contact the OEH Wildlife Data Unit to obtain a full Atlas report under licence for a 10 km x 10 km area around the study site. Use of the BioBanking Credit Calculator is also recommended to supplement the list of threatened species that possibly occur on the site (see guidelines at www.environment.nsw.gov.aulthreatenedspecies/surveymethodsfauna.htm#4). Flora and fauna databases such as the OEH Atlas of NSW Wildlife, and those held by local government, the Australian Museum, the CSIRO, Forests NSW and the Botanic Gardens Trust Sydney must also be consulted to assist in compiling the list. The SIS must include the compiled list of threatened species, populations and ecological communities likely to be present at the site or in the locality. Note that the OEH Atlas only holds records for which the OEH is the custodian and does not include records held in other databases, where the conditions of data licences or data exchange agreements prevent the OEH from distributing such information. In many cases, the OEH Atlas may only contain a small subset of the available data. Hence, other databases must also be consulted to assist in making an adequate determination of subject species.	

Table A.1 DGR Compliance Table

Main Section		Sub-Sections	Comments
		A list of subject threatened species, populations and ecological communities likely to be present (the subject species) must then be developed from recent records obtained from the data sources above, as well as any other species likely to be present that may not have been recorded. In developing the list of subject species, populations and ecological communities, consideration must be given to the habitat types present within the study area and the known distribution of threatened species, populations and ecological communities in the locality. The guidelines at www.environment.nsw.gov.aulthreatenedspecies/surveymethodsfauna.htm#3 for habitat assessment must be followed. Threatened species, Endangered Populations and Endangered or critically endangered ecological communities The threatened species, endangered populations and endangered or critically endangered ecological communities listed in the DGRs (not listed here) should be considered as a subject species. 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. The proponent should 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.	The list of subject species is provided in Table 4.7 and Table 4.8
4	SURVEY	**4.1 Requirement to survey** A fauna and flora survey is to be conducted in the study area. Targeted surveys must be conducted for all subject threatened species, populations and ecological communities determined in accordance with section 3 and for species, populations and ecological communities identified in section 4.3. 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. It is noted that previous flora surveys of the site by NGH and Cumberland Ecology were undertaken in late autumn and winter respectively, which is not a suitable time for locating threatened flora species.	Ref to Chapter 4, Sections 4.1 – 4.2.

Table A.1 DGR Compliance Table

Main Section	Sub-Sections	Comments
	Survey requirements for certain species are identified in section 4.3. Guidance on appropriate methodologies and level and timing of survey efforts for some other species can be obtained from environmental impact assessment guidelines (see section 9.4), draft or approved recovery plans, scientific or environmental management journals, previous 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. Appropriate justification for reducing otherwise recommended levels of survey effort is required to show that impacts are not likely to be significant. Previous surveys and assessments may contribute to addressing this requirement if they have been conducted and documented in accordance with the following provisions. 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	Refer to Section 4.2 and figures 4.1 and 4.2
	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 quadrats or length of transects 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, which indicate scale and have an explanatory legend of any information showing symbols used.	
	4.2.2 Documenting survey effort and results	Chapter 4, Appendix G
	Attachment 1 contains survey proformas for a range of standard fauna survey techniques. Digital copies of these proformas are available by electronic mail and should be obtained from the nominated contact officer. These proformas should be used by field staff when undertaking fauna surveys and completed data sheets are to be included as an appendix to the SIS.	

Table A.1 DGR Compliance Table

Main Section	Sub-Sections	Comments
	Name(s) and contact phone number(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.	Appendix H
	The date and time and environmental conditions experienced during each survey must be documented.	Refer to Table 4.1 and Table 4.4 for date and environment conditions during survey.
	The time invested for each survey technique must be summarised in the SIS, based on completed proformas. e.g. - number of person hours/transect, duration of call playback, number of nights traps set. **It is not sufficient to aggregate all time spent on all survey techniques. Effort must be expressed each time a survey technique is applied.**	Refer to Table 4.3.
	Any limitations (e.g. denied access to private land) to sampling across the study area are to be documented.	Refer to Section 4.2.3.
	4.2.3 Description and mapping of results of vegetation, flora and fauna surveys	Refer to Section 4.3 and Figures 4.4 - 4.6.
	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.	
	4.3 Specific survey requirements	Refer to Section 4.1 and 4.2.
	In addition to any surveys carried out to assess the subject species, the following targeted surveys must be undertaken:	
	Native vegetation	Native vegetation has been mapped – refer to Figure 4.4.
	Areas of native vegetation on site should be accurately mapped. These areas should include any areas with the potential to regenerate, either naturally or with assistance, to native vegetation. Regeneration potential should be based on presence of	

Table A.1 DGR Compliance Table

Main Section	Sub-Sections	Comments
	native species and knowledge of site history. These areas of native vegetation should be stratified, if required, taking into account any variation in condition and disturbance, and these stratification units should then be adequately sampled. Any areas of exotic vegetation should also be mapped and data on any native species present (and their percent cover) should be collected and provided in the SIS. The ecological community on site should be described (including information on dominant species in each stratum) and compared to the description of ecological communities in the SCIVI mapping (Tozer et al., 2011) and the descriptions of the NSW Scientific Committee, in accordance with section 5.1 of these requirements. Maps of native vegetation on site should also include areas of 'derived' native grassland (DNG) of Cumberland Plain Woodland, if present. The definition of DNG should take into account the definition provided in the NSW Scientific Committee's determination for Cumberland Plain Woodland. OEH notes that the Cumberland Ecology report (2013) is incorrect in stating that the determination requires that DNG must be comprised predominantly of native species.	For detailed discussion of DNG, refer to Section 4.3
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 • landscaping. Assessment must include the **direct and indirect** impacts of these activities which may occur both **on or off** the study	For all requirements in relation to Section 5 of the DGRs, refer to Chapter 5.

Table A.1 DGR Compliance Table

Main Section	Sub-Sections	Comments
	area. To assess the impacts from the provision of 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 locating access roads around the perimeter of the site as an option to meet those requirements but reduce impacts on retained bushland. The impacts on threatened species and populations from the proposed rezoning are likely to arise from: • fragmentation and isolation of habitat and an incremental decline in its quality and extent; • loss of locally significant vegetation; • loss of foraging and roosting habitat for threatened fauna and a reduction in their local abundance and distribution, including loss of hollow bearing trees; • changes in the hydrological regime resulting from altered surface flows and groundwater levels; • deterioration in water quality; • increased susceptibility, on site and on adjacent and downstream areas, to competition, disease, predation, insect attack and other disturbances due to increased access and a reduction in vegetative cover; • indirect effects of urbanisation eg tree removal, rubbish dumping, soil compaction, erosion, weed invasion as well as altered drainage patterns and nutrient levels resulting from increased runoff; and • clearing, modification and long term degradation of habitat associated with the provision of asset protection zones.	
	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 Chapter 5

Table A.1 DGR Compliance Table

Main Section	Sub-Sections	Comments
	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 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*	For all requirements in relation to Section 5 of the DGRs, refer to Chapter 5.
	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.	For all requirements in relation to Section 5 of the

Table A.1 DGR Compliance Table

Main Section	Sub-Sections	Comments
		DGRs, refer to Chapter 5.
	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)).*	For all requirements in relation to Section 5 of the DGRs, refer to Chapter 5.
	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, history of resource extraction or logging and proximity to roads. Details of the study area's fire history (eg frequency, time since last fire, intensity) and the source of fire history (eg observation, local records), must be provided.	For all requirements in relation to Section 5 of the DGRs, refer to Chapter 5.
	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.	For all requirements in relation to Section 5 of the DGRs, refer to

Table A.1 DGR Compliance Table

Main Section	Sub-Sections	Comments
		Chapter 5.
	5.4 Discussion of conservation status The following are further requirements related to your obligation under Section 110(2)(c) to address the following: *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 6.4.4) 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.	For all requirements in relation to Section 5 of the DGRs, refer to Chapter 5.
	5.5 Discussion of the likely effect of the proposal at local and regional scales	For all requirements in

Table A.1 DGR Compliance Table

Main Section	Sub-Sections	Comments
		relation to Section 5 of the DGRs, refer to Chapter 5.
	5.5.1 Significance within a local context Provision of information to allow adequate determination of the significance of the effects of the proposal in accordance with Section 5A of the EP&A Act is required. 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 tenure and long-term security, of other areas of known habitats in the locality with those in the study area.	For all requirements in relation to Section 5 of the DGRs, refer to Chapter 5.
	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.	For all requirements in relation to Section 5 of the DGRs, refer to Chapter 5.
	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.	For all requirements in relation to Section 5 of the DGRs, refer to Chapter 5.
	5.5 Description of feasible alternatives	Refer to Section

Table A.1 DGR Compliance Table

Main Section	Sub-Sections	Comments
	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 study area and why these can or cannot be considered as feasible alternatives.	5.5
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 • landscaping. Assessment must include the **direct and indirect** impacts of these activities which may occur both **on or off** the study area.	For all requirements in relation to Section 6 of the DGRs, refer to Chapter 6.

Table A.1 DGR Compliance Table

Main Section	Sub-Sections	Comments
	To assess the impacts from the provision of 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 development as an option to meet those requirements but reduce impacts on retained bushland. The impacts to endangered or critically endangered ecological communities (C)EECs from the proposed rezoning are likely to arise from: • fragmentation and isolation of habitat and an incremental decline in its quality and extent; • loss of locally significant vegetation; • loss of foraging habitat for threatened fauna and a reduction in their local abundance and distribution. • changes in the hydrological regime resulting from altered surface flows and groundwater levels (particularly from the proposed realignment on the creek), which will potentially impact on areas of Shale/Sandstone Transition Forest and identified Priority Conservation Lands; • deterioration in water quality; • increased susceptibility, on site and on adjacent and downstream areas, to competition, disease, predation, insect attack and other disturbances due to increased access and a reduction in vegetative cover; • indirect effects of urbanisation eg tree removal, rubbish dumping, soil compaction, erosion, weed invasion, etc; and • clearing, modification and long term degradation of habitat associated with the provision of asset protection zones and gross pollutant traps.	
	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: *a general description of the ecological community present in the area that is the subject of the action and in any area that*	For all requirements in relation to Section 6 of the

Table A.1 DGR Compliance Table

Main Section	Sub-Sections	Comments
	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 (C)EECs may be affected, directly or indirectly (including cumulatively), by the proposal. This must include reference to the (C)EECs as described by the NSW Scientific Committee, and to the requirements outlined previously in section 4, and take into account information in any relevant recovery plans or draft recovery plans 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. Subsequently this information should be utilised in an Assessment of Significance (as required in section 8) for each of those (C)EECs.	DGRs, refer to Chapter 6.
	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.*	For all requirements in relation to Section 6 of the DGRs, refer to Chapter 6.
	6.2.1 Study area An assessment of habitat in the study area is required and must include: • a description of each (C)EEC, including: → a description of those areas where the community may only be represented by soil stored seed with no or few above-	For all requirements in relation to Section 6 of the

Table A.1 DGR Compliance Table

Main Section	Sub-Sections	Comments
	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 (C)EECs 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 (C)EECs across the site. Consideration should be given to the results (preliminary or otherwise) of restoration projects being undertaken at other sites that contain the (C)EECs when assessing its recovery capacity. • comparison of the affected community with the (C)EECs 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 the extent and condition of the (C)EEC.	DGRs, refer to Chapter 6.
	6.2.2 Locality A discussion of other occurrences of each (C)EECs 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 their habitat. • the relative significance of the subject site for each (C)EEC in the locality and region.	For all requirements in relation to Section 6 of the DGRs, refer to Chapter 6.
	6.3 Discussion of conservation status 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*	For all requirements in relation to Section 6 of the DGRs, refer to

Table A.1 DGR Compliance Table

Main Section	Sub-Sections	Comments
	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. Known occurrences in the locality and region of fragmentation, decrease in extent or degradation of each (C)EEC or its habitat should be documented.	Chapter 6.
	6.4 Discussion of the likely effect of the proposal at local and regional scales	For all requirements in relation to Section 6 of the DGRs, refer to Chapter 6.
	6.4.1 Significance within a local context Provision of information to allow adequate determination of the significance of the effects of the proposal in accordance with Section 5A of the EP&A Act (see section 8 of these requirements below) is required. The significance of impacts in the study area for conservation of affected (C)EECs in the locality must be discussed. An assessment of the significance of	For all requirements in relation to Section 6 of the

Table A.1 DGR Compliance Table

Main Section	Sub-Sections	Comments
	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.	DGRs, refer to Chapter 6.
	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 study 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. The proposed zoning of any habitats to be retained should also be taken into account. It is considered that RE1 Public Recreation, E3 Environmental Management, E4 Environmental Living and other zonings that do not have biodiversity conservation as a primary objective, will not adequately protect biodiversity values on site in the long term.	For all requirements in relation to Section 6 of the DGRs, refer to Chapter 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 adjacent habitats, including identified Priority Conservation Lands to the north of the site, 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.	For all requirements in relation to Section 6 of the DGRs, refer to Chapter 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	For all requirements in relation to Section 6 of the

Table A.1 DGR Compliance Table

Main Section	Sub-Sections	Comments
	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.	DGRs, refer to Chapter 6.
	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 study area and why these can or cannot be considered as feasible alternatives.	For all requirements in relation to Section 6 of the DGRs, refer to Chapter 6.
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.* Ameliorative or compensatory measures proposed to reduce or offset the level of impact should only be considered where it can be shown that they have been successfully applied elsewhere. The likely efficacy of such measures with respect to the current proposal should be assessed in detail.	Refer to Section 9.1-9.3
	7.1.1 Long term management strategies	Refer to Section

Table A.1 DGR Compliance Table

Main Section	Sub-Sections	Comments
	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.	9.3
	7.1.2 Compensatory strategies	Refer to Section 9.4
	Where significant modification of the proposal to minimise impacts on threatened species or endangered communities is not possible then compensatory strategies should be considered. These may include other offsite or local area proposals that contribute to long term conservation of the threatened species, population or ecological community.	
	Any proposed offsetting measures should be developed in accordance with the "Principles for the Use of Biodiversity Offsets in NSW" (www.environment.nsw.gov.aulbiodivoffsels/oehoffselprincip.hlm). The BioBanking Assessment Methodology (www.environment.nsw.gov.au/biobanking/assessmelhodology.him) could also be used to assess the adequacy of any proposed offsetting measures.	
	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 relevant land managers.	
	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.	
	7.1.4 Ongoing monitoring	Refer to Section 9.4.1
	Any proposed pre-construction monitoring plans or on-going monitoring of the effectiveness of the mitigation 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	
	7.1.3 Translocation	-

Table A.1 DGR Compliance Table

Main Section	Sub-Sections	Comments
	The OEH does not consider that translocation of threatened species, populations and ecological communities is an appropriate ameliorative strategy for the purposes of considering impacts of a particular development/activity. The OEH strongly supports the view that development proposals which may impact on a significant local population of threatened species, populations or ecological communities as determined by the SIS should aim to: i. minimise the impacts by considering all possible alternatives to the development, such that a significant impact is not likely; and ii. manage the remaining habitat (if any) to ensure that the local population continues to exist in the long term. The translocation of threatened species, populations and ecological communities is only supported by the OEH in specific conservation programs (eg. recovery planning) but only as a last resort, and only when in-situ conservation options have been exhausted. Such programs should only be considered following extensive investigation of a demonstrated long term financial commitment on behalf of the applicant.	
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 conclusion must be drawn as to whether the proposal is still considered likely to have a significant effect.	Refer to Appendix I
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 Appendix J and Appendix K

Table A.1 DGR Compliance Table

Main Section	Sub-Sections	Comments
	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* 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) An action will require referral to, and may require the approval of, the Commonwealth 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. Information regarding matters of national environmental significance may be obtained from www.environment.gov.au/epbclmatters/index.html on the website of the Commonwealth Department of the Environment or by contacting the Department on 1800 803 772. Further information regarding the operation of the EPBC Act in NSW can be found on the NSW Department of Planning's website at EPBC Act Guide to Implementation in NSW (available at www.planning.nsw.gov.au/assessingdev/environmentalassessment.asp) and on their website at www.environment.gov.au/epbc/aboutlindex.html	Refer to Appendix B

Table A.1 DGR Compliance Table

Main Section	Sub-Sections	Comments
	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: *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. *Threatened Species Conservation Act 1995:* • 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.	Refer to Appendix J
	9.4 Section 110 (5) reports Section 11 0(5} of the Threatened Species Conservation Act 1995 has the effect of requiring OEH to provide that information regarding the State-wide conservation status of the subject species as it has available, in order to satisfy ss.11 0(2} & (3) of the Act. To this end, a number of publications have been produced: i. OEH has produced a set of profiles for a number of threatened species, populations and ecological communities and these are available on the OEH website (www.threatenedspecies.environment.nsw.gov.au). Some of these may be relevant to the subject species for this development. ii. The Metropolitan Branch Biodiversity Conservation Section has produced a number of profiles and environmental	Refer to References Section and Appendix J

Table A.1 DGR Compliance Table

Main Section	Sub-Sections	Comments
	impact assessment guidelines for species, populations and ecological communities. These are also on the OEH Threatened Species website. Proponents and consultants should note that OEH has no further published information available to satisfy s.11 0(5} of the Act and that 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.	

Appendix B

EPBC Referral Notice

Australian Government
Department of the Environment

EPBC Ref: 2014/7119

Ms Elise Crameri
Associate Planner
APP Corporation Pty Limited
PO Box 1573
NORTH SYDNEY NSW 2060

Dear Ms Crameri

Decision on referral
Residential and commercial development, Box Hill North, NSW (EPBC 2014/7119)

Thank you for submitting a referral under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). This is to advise you of my decision about the proposed action, to develop a 380ha parcel of land at Box Hill North to accommodate a 4100 dwelling residential community, town centre, school, roads and infrastructure.

As a delegate of the Minister for the Environment, I have decided that the proposed action is a controlled action and, as such, requires assessment and a decision on approval under the EPBC Act before it can proceed.

It appears that the proposed action is likely to have a significant impact on the following matters protected by the EPBC Act:

- Listed threatened species and communities (sections 18 & 18A)

For example, based on the information available in the referral, the proposed action is likely to have a significant impact because it involves clearing approximately 8 ha of the critically endangered Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest ecological community.

Please note that this decision only relates to the potential for significant impacts on matters protected by the Australian Government under Chapter 2 of the EPBC Act.

I have also decided that the project will need to be assessed through preliminary documentation. Each assessment approach requires different levels of information and involves different steps. All levels of assessment include a public consultation phase, *in which any third parties can comment on the proposed action.*

A copy of the document recording this decision is enclosed.

Details on the assessment process for the project and the responsibilities of the proponent are set out in the enclosed fact sheet. Further information is available from the Department's website at http://www.environment.gov.au/epbc.

While I have determined that your project will be assessed by preliminary documentation, some further information will be required to be able to assess the relevant impacts of the action.

Therefore, under section 95A of the EPBC Act, I am also writing to ask you to provide further information as detailed in **Attachment A**. The preliminary documentation should contain sufficient information to take into consideration all relevant EPBC Act policies for the all matters of NES. Once this information is provided and if the documentation is suitable for exhibition further advice will be provided by the Department as to the procedures for public exhibition.

Please also note that once a proposal to take an action has been referred under the EPBC Act, it is an offence under Section 74AA to take the action while the decision making process is on-going (unless that action is specifically excluded from the referral or other exemptions apply). This provision of the EPBC Act carries a maximum penalty of $425,000. The EPBC Act is available on line at: http://www.environment.gov.au/epbc/about/index.html

The Department has recently published an *Environmental Impact Assessment Client Service Charter* (the Charter) which outlines the Department's commitments when undertaking environmental impact assessments under the EPBC Act. A copy of the Charter can be found at: http://www.environment.gov.au/epbc/publications/index.html.

If you have any questions about the referral process or this decision, please contact the project manager, Zarni Bear, by email to zarni.bear@environment.gov.au, or telephone (02) 6274 1404 and quote the EPBC reference number shown at the beginning of this letter.

Yours sincerely

James Tregurtha
Assistant Secretary
South-Eastern Australia Assessment Branch
10 March 2014

cc Dr David Robertson, Cumberland Ecology

Attachment A – Additional information required for assessment

Acronymns

CPW – Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest (Critically Endangered)

SSTF - Shale-Sandstone Transition Forest (Endangered)

EPBC Act - *Environment Protection and Biodiversity Conservation Act 1999*

EC – ecological community

Details of the proposed action

1) Please provide maps indicating the proximity of the site to the
   a) North West Growth Centre and
   b) Maguire's Road Priority Conservation Land under the Cumberland Plain Recovery Plan, 2011.

Flora and fauna surveys

2) The Department considers the field survey effort and methodology used to date is not sufficient to adequately estimate the extent of CPW and SSTF on site. In addition, vegetation mapping by The Hills Shire Council suggests that additional patches of CPW or SSTF may occur on site. These maps also identify several patches for which the vegetation type is not identified and should be confirmed by survey. Please see: http://www.thehills.nsw.gov.au/Vegetation-Classification-Mapping.html#.UvrpUn9kys- Map sheets 7 and 10.

   In order to resolve this matter, we request
   a) additional vegetation surveys are conducted, in a manner that is consistent with methodologies described in *Policy Statement 3.31 Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest: A guide to identifying and protecting the nationally threatened ecological community* (http://www.environment.gov.au/system/files/resources/3c01d3d1-c135-4d91-a605-f5730975d78c/files/cumberland-plain-shale-woodlands.pdf).
   It is preferred that surveys are conducted in spring to maximise detection of species present. The density and location of plots should be suitable to confirm species composition, condition and patch boundaries with greater certainty. If surveys cannot be carried out during spring then any measure of condition of the patch should be considered to be an underestimate and thus patches should not be excluded on the basis of condition.

   b) The results from the quadrat surveys be presented and analysed against the structure, characteristic species (in all 3 vegetative layers), condition and size criteria of the EPBC Act listing advice for CPW and SSTF. Patches that do not meet the condition thresholds may still retain important natural values and the potential for restoration of spontaneous regrowth vegetation should also be discussed.;

c) Should this analysis determine that additional CPW and/or SSTF (as listed under the EPBC Act) is present on site:

i) the extent (in hectares) must be accurately estimated;

ii) the distribution on site and occurrence relative to the development footprint, must be shown on maps; and

iii) an analysis of the likely direct and indirect impacts of the proposed development must be presented, in relation to the Department's *EPBC Act Policy Statement – Significant Impact Guidelines* (available at: http://www.environment.gov.au/epbc/publications/nes-guidelines.html).

Areas requiring further investigation are illustrated in yellow on the map below. In particular:

i. The area between patches 1 and 4 should be investigated to confirm whether this should be defined as one contiguous patch.
ii. The southern boundary of patch 4 should be investigated as it appears woody vegetation has been excluded from the defined patch
iii. The area between patches 4 and 5 should be investigated as it appears woody vegetation has been excluded, also, to confirm whether this is a contiguous patch.
iv. The boundary of patch 6 should be investigated as it appears woody vegetation has been excluded
v. The vegetation of patch 6 should be checked for community definition- the Hills Shire map identifies some of this as Cumberland Plain Woodland (fitting in to the EPBC Act CPW listing) rather than SSTF. This area is likely to be an integrading zone between the two ECs, so may best fit the CPW definition, particularly when considered in conjunction with areas to the south and west (see next point).
vi. The area to the south and west of patch 6 (as far as Red Gables Rd) should be investigated. The Hills Shire map identifies a substantial area as Cumberland Plain Woodland. This has been excluded from the current referral.
vii. The area of scattered trees towards the southern boundary. The Hills Shire map identifies a patch of Cumberland Plain Woodland in this area, as well as patches of unidentified vegetation.
viii. The southern margin on Old Pitt Town Rd - The Hills Shire map identifies a patch of Cumberland Plain Woodland in this area, as well as patches of unidentified vegetation.

Figure 2: Location and Condition of CPW and SSTF on the Box Hill North Subject Site

Figure 1: Areas requiring further investigation

3) The Department considers the referral does not adequately address the likely impacts to areas of CPW and/or SSTF adjacent to the site of the proposed action (for example, the area highlighted in pink in the above figure, Scheyville National Park and the forested area to the north of Maguire's Road). Please provide a discussion on the landscape context of the ECs occurring on site, the extent of potential direct (by clearing or disturbance) and indirect (by, for example, changes in hydrology, nutrient pollution, increased traffic, increased interaction with humans and pets and fragmentation or reduced connectivity of habitat) impacts of the proposed action at a landscape scale.

4) It is noted that a number of farm dams may provide habitat for the vulnerable Green and Golden Bell Frog (*Litoria aurea*). However, the Department considers that documentation presented to date has not adequately addressed its likely occurrence and scale of potential impacts of the proposed action on this species.

   In order to resolve this matter, we request you;

   a) Undertake and report results of additional targeted surveys consistent with the methodologies described in *EPBC Act Policy Statement 3.19: Significant impact guidelines for the vulnerable green and golden bell frog (Litoria aurea)* (http://www.environment.gov.au/system/files/resources/e882f6c7-a511-4fba-9116-2f2f7ef941aa/files/litoria-aurea-policy.pdf). Alternatively, you may wish to provide an independent review, by a duly qualified expert[1] on this species, as to the likely presence of this species.
   b) If recorded on site (or considered likely to occur), report on the estimated size, density and location of the population;
   c) Report on the extent of suitable foraging and/or breeding habitat, both on-site and within adjacent land, as described for this species. Please provide a map displaying potential habitat overlaid with the proposed development footprint;
   d) Provide a description of all direct and indirect impacts that the action will have, or is likely to have, during both the construction and operational phases of the development. Information must include:
      i) a detailed assessment of the nature and extent of the likely short-term and long-term relevant impacts;
      ii) an account of the impact to each habitat type (breeding, foraging etc) and/or habitat connectivity/corridors, should more than one habitat type occur for a particular species;
      iii) any estimates must clearly identify not only the extent of occurrence of habitat being directly cleared as a result of the action, but also retained habitat that is likely to be indirectly impacted by the residential development once operational;
      iv) maps to support the above information, clearly identifying habitat/s occurring within the development footprint; and
      v) an analysis as to the scale of the impacts relative to the local and regional occurrences of the species, with reference to the *EPBC Act Policy Statement 3.19 Significant impact guidelines for the vulnerable green and golden bell frog (Litoria aurea).*

[1] Please provide appropriate evidence documenting their suitability as an expert

Mitigation Measures

5) If developed, please provide copies of all relevant proposed Management Plans that will outline the measures taken to reduce or avoid ongoing impacts on CPW, SSTF and the Green and Golden Bell Frog[2] (both on and off site) as a result of this development.

   If Management Plans are not yet developed, a summary document which includes a description of feasible mitigation measures which have been proposed by the proponent or suggested in public submissions, and which are intended to prevent or minimise relevant impacts including:

   a) a description and an assessment of the expected or predicted effectiveness of the mitigation measures;
   b) any statutory or policy basis for the mitigation measures;
   c) the cost of the mitigation measures;
   d) an outline of an environmental management plan that sets out the framework for continuing management, mitigation and monitoring programs for the relevant impacts of the action, including any provisions for independent environmental auditing;
   e) the name of the agency responsible for endorsing or approving each mitigation measure or monitoring program; and
   f) a consolidated list of mitigation measures proposed to be undertaken to prevent, minimise or compensate for the relevant impacts of the action, including mitigation measures proposed to be taken by State governments, local governments or the proponent.

Offsets

6) Please provide details of an offset package to compensate for the residual impacts to matters of national environmental significance (NES) [in particular, CPW, SSTF and potentially the Green and Golden Bell Frog]. The package should include:

   a) a description of the proposed offset measure/s, including how, when and where the offset will be delivered and managed;
   b) detail of how the offset/s compensate for the impact on each relevant matter of NES, resulting from the action;
   c) a description of how the offset/s will ensure the protection, conservation and management of the relevant matter of NES, in perpetuity;
   d) description of how the offset/s are consistent with the Department's Environmental Offsets Policy (October 2012), available at http://www.environment.gov.au/epbc/publications/environmental-offsets-policy.html ; and
   e) The cost (financial and other) of the offsets.

   Refer to the attached schedule for further information on offsets.

[2] Dependent on the outcome of Request #4

Please note the Department does not consider land zoning as providing an adequate level of surety that the CPW and SSTF retained on site will be protected and managed for environmental outcomes in perpetuity. Particularly as the SSTF to be retained onsite is zoned as Open Space or Environmental Living, which allows clearing for building envelopes, asset protection and public safety. In this case, the Department considers that all SSTF occurring onsite will be directly impacted as a result of the proposed action, with offsets commensurate with this level of impact.

Legal mechanisms (ie conservation covenants, biobanking) may ensure open space areas are protected in perpetuity (against future development), in conjunction with ongoing funding and management arrangements to ensure their long-term viability, could (provided they are adequate) allow those areas to be considered as offsets. However, note that their size, fragmentation and exposure to edge effects would fall considerably short of compensating for the residual impacts of the project on the ecological communities of concern.

Other information

7) A description of the short-term and long-term social and economic implications and/or impacts of the project; including capital investment and ongoing employment/ economic value.

Information requirements for EPBC Act offset proposals

- Details in relation to the proposed offsets package, including:
  - the location and size, in hectares, of any offset site(s);
  - maps clearly showing for each offset site:
    - the relevant ecological features;
    - the landscape context; and
    - the cadastre boundary.
  - the current tenure arrangements (including zoning and ownership) of any proposed offset sites;
  - confirmed records of presence (or otherwise) of relevant protected matter(s) on the offset site(s); and
  - detailed information regarding the presence and quality of habitat for relevant protected matter(s) on the offset site. The quality of habitat should be assessed in a manner consistent with the approach outlined in the document titled *How to use the offset assessment guide* available at: http://www.environment.gov.au/epbc/publications/environmental-offsets-policy.html.
- Provide information and justification regarding how the offsets package will deliver a conservation outcome that will maintain or improve the viability of the protected matter(s) consistent with the *EPBC Act environmental offsets policy* (October 2012) including:
  - management actions that will be undertaken that improve or maintain the quality of the proposed offset site(s) for the relevant protected matter(s). Management actions must be clearly described, planned and resourced as to justify any proposed improvements in quality for the protected matter(s) over time;
  - the time over which management actions will deliver any proposed improvement or maintenance of habitat quality for the relevant protected matter(s);
  - the risk of damage, degradation or destruction to any proposed offset site(s) in the absence of any formal protection and/or management over a foreseeable time period (20 years). Such risk assessments may be based on:
    - presence of pending development applications, mining leases or other activities on or near the proposed offset site(s) that indicate development intent;
    - average risk of loss for similar sites; and
    - presence and strength of formal protection mechanisms currently in place.
  - the legal mechanism(s) that are proposed to protect offset site(s) into the future and avert any risk of damage, degradation or destruction.
- Provide information regarding how the proposed offsets package is additional to what is already required, as determined by law or planning regulations, agreed to under other schemes or programs or required under an existing duty-of-care.
- The overall cost of the proposed offsets package; including costs associated with, but not limited to:
  - acquisition and transfer of lands/property;
  - implementation of all related management actions; and
  - monitoring, reporting and auditing of offset performance.

Appendix C

Preliminary Documentation Requirements

Table C.1 Preliminary Documentation Compliance Table

Main heading	Subsections	Response
Details of the proposed action	**1)** Please provide maps indicating the proximity of the site to the **a)** North West Growth Centre; and **b)** Maguire's Road Priority Conservation Land under the Cumberland Plain Recovery Plan, 2011.	Figure 1.1
Flora and fauna surveys	**2**) The Department considers the field survey effort and methodology used to date is not sufficient to adequately estimate the extent of CPW and SSTF on site. In addition, vegetation mapping by The Hills Shire Council suggests that additional patches of CPW or SSTF may occur on site. These maps also identify several patches for which the vegetation type is not identified and should be confirmed by survey. In order to resolve this matter, we request: a) additional vegetation surveys are conducted, in a manner that is consistent with methodologies described in Policy Statement 3.31 Cumber/and Plain Shale Woodlands and Shale-Gravel Transition Forest: A guide to identifying and protecting the nationally threatened ecological community It is preferred that surveys are conducted in spring to maximise detection of species present. The density and location of plots should be suitable to confirm species composition, condition and patch boundaries with greater certainty. If surveys cannot be carried out during spring then any measure of condition of the patch should be considered to be an underestimate and thus patches should not be excluded on the basis of condition. b) The results from the quadrat surveys be presented and analysed against the structure, characteristic species (in all 3 vegetative layers), condition and size criteria of the EPBC Act listing advice for CPW and SSTF. Patches that do not meet the condition thresholds may still retain important natural values and the potential for restoration of spontaneous regrowth vegetation should also be discussed. c) Should this analysis determine that additional CPW and/or SSTF (as listed under the EPBC Act) is present on site:	Refer to Section 4.1 and 4.2 for survey methodology. Refer to Section 4.3.1 for results and to Appendix B for quadrat data. Refer to Section 4.3.1 for assessment of vegetation against the EPBC Act listing advice The extent, distribution and assessment of likely impacts are

Table C.1 Preliminary Documentation Compliance Table

Main heading	Subsections	Response
	i) the extent (in hectares) must be accurately estimated; ii) the distribution on site and occurrence relative to the development footprint, must be shown on maps; and iii) an analysis of the likely direct and indirect impacts of the proposed development must be presented, in relation to the Department's EPBC Act Policy Statement - Significant Impact Guidelines d) Areas requiring further investigation are illustrated in yellow on the map below. In particular: i. The area between patches 1 and 4 should be investigated to confirm whether this should be defined as one contiguous patch. ii. The southern boundary of patch 4 should be investigated as it appears woody vegetation has been excluded from the defined patch iii. The area between patches 4 and 5 should be investigated as it appears woody vegetation has been excluded, also, to confirm whether this is a contiguous patch. iv. The boundary of patch 6 should be investigated as it appears woody vegetation has been excluded v. The vegetation of patch 6 should be checked for community definition- the Hills Shire map identifies some of this as Cumberland Plain Woodland (fitting in to the EPBC Act CPW listing) rather than SSTF. This area is likely to be an intergrading zone between the two ECs, so may best fit the CPW definition, particularly when considered in conjunction with areas to the south and west (see next point). vi. The area to the south and west of patch 6 (as far as Red Gables Road) should be investigated. The Hills Shire map identifies a substantial area as Cumberland Plain Woodland. This has been excluded from the current referral. vii. The area of scattered trees towards the southern boundary. The Hills Shire map identifies a patch of	shown in Table 6.1 The areas that required further investigation are discussed in Section 64.3 and shown in Figure 4.4.

Table C.1 Preliminary Documentation Compliance Table

Main heading	Subsections	Response
	Cumberland Plain Woodland in this area, as well as patches of unidentified vegetation. viii. The southern margin on Old Pitt Town Road - The Hills Shire map identifies a patch of Cumberland Plain Woodland in this area, as well as patches of unidentified vegetation.	
	3) The Department considers the referral does not adequately address the likely impacts to areas of CPW and/or SSTF adjacent to the site of the proposed action (for example, the area highlighted in pink in the above figure, Scheyville National Park and the forested area to the north of Maguire's Road). Please provide a discussion on the landscape context of the EECs occurring on site, the extent of potential direct (by clearing or disturbance) and indirect (by, for example, changes in hydrology, nutrient pollution, increased traffic, increased interaction with humans and pets and fragmentation or reduced connectivity of habitat) impacts of the proposed action at a landscape scale.	Refer to Chapter 6
	4) It is noted that a number of farm dams may provide habitat for the vulnerable Green and Golden Bell Frog (*Litoria aurea*). However, the Department considers that documentation presented to date has not adequately addressed its likely occurrence and scale of potential impacts of the proposed action on this species. In order to resolve this matter, we request you; **a)** Undertake and report results of additional targeted surveys consistent with the methodologies described in EPBC Act Policy Statement 3. 19: Significant impact guidelines for the vulnerable green and golden bell frog (*Litoria aurea*) Alternatively, you may wish to provide an independent review, by a duly qualified expert on this species, as to the likely presence of this species. **b)** If recorded on site (or considered likely to occur), report on the estimated size, density and location of the population; **c)** Report on the extent of suitable foraging and/or breeding habitat, both on-site and within adjacent land, as described for this species. Please provide a map displaying potential habitat overlaid with the proposed	Refer to section 4.2.1(e), Table 3.2 and section 4.5.3.

Table C.1 Preliminary Documentation Compliance Table

Main heading	Subsections	Response
	development footprint; **d)** Provide a description of all direct and indirect impacts that the action will have, or is likely to have, during both the construction and operational phases of the development. Information must include: **i)** a detailed assessment of the nature and extent of the likely short-term and long-term relevant impacts; **ii)** an account of the impact to each habitat type (breeding. foraging etc) and/or habitat connectivity/corridors, should more than one habitat type occur for a particular species; **iii)** any estimates must clearly identify not only the extent of occurrence of habitat being directly cleared as a result of the action, but also retained habitat that is likely to be indirectly impacted by the residential development once operational; **iv)** maps to support the above information, clearly identifying habitats occurring within the development footprint; and **v)** an analysis as to the scale of the impacts relative to the local and regional occurrences of the species, with reference to the EPBC Act *Policy Statement 3. 19 Significant impact guidelines for the vulnerable green and golden bell frog* (*Litoria aurea*).	
Mitigation Measures	**5)** If developed, please provide copies of all relevant proposed Management Plans that will outline the measures taken to reduce or avoid ongoing impacts on CPW, SSTF and the Green and Golden Bell Frog (both on and off site) as a result of this development. If Management Plans are not yet developed, a summary document which includes a description of feasible mitigation measures which have been proposed by the proponent or suggested in public submissions, and which are intended to prevent or minimise relevant impacts including: **a)** a description and an assessment of the expected or predicted effectiveness of the mitigation measures; **b)** any statutory or policy basis for the mitigation measures;	Refer to Chapter 9

Table C.1 Preliminary Documentation Compliance Table

Main heading	Subsections	Response
	c) the cost of the mitigation measures; **d)** an outline of an environmental management plan that sets out the framework for continuing management, mitigation and monitoring programs for the relevant impacts of the action, including any provisions for independent environmental auditing; **e)** the name of the agency responsible for endorsing or approving each mitigation measure or monitoring program; and **f)** a consolidated list of mitigation measures proposed to be undertaken to prevent, minimise or compensate for the relevant impacts of the action, including mitigation measures proposed to be taken by State governments, local governments or the proponent.	
Offsets	**6)** Please provide details of an offset package to compensate for the residual impacts to matters of national environmental significance (NES) [in particular, CPW, SSTF and potentially the Green and Golden Bell Frog]. The package should include: **a)** a description of the proposed offset measure/s, including how, when and where the offset will be delivered and managed; **b)** detail of how the offsets compensate for the impact on each relevant matter of NES, resulting from the action; **c)** a description of how the offsets will ensure the protection, conservation and management of the relevant matter of NES, in perpetuity; **d)** description of how the offsets are consistent with the Department's Environmental Offsets Policy (October 2012), and **e)** The cost (financial and other) of the offsets. Refer to the attached schedule for further information on offsets.	Refer to Section 9.4.
Other information	**7)** A description of the short-term and long-term social and economic implications and/or impacts of the project;	Refer to Section 2.2.6

Table C.1 Preliminary Documentation Compliance Table

Main heading	Subsections	Response
	including capital investment and ongoing employment economic value	

Appendix D

BioBanking Quadrat Data, Plot Data, and Rapid Assessment Data

Table D.1 Flora Plot Data from 20m x 20m survey plots

Form	Native/ Exotic	Family	Species	Common Name	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	R1	R2	R3	R4	R5
	native	Myrtaceae	*Angophora bakeri*	Narrow-leaved Apple																					X				
	native	Myrtaceae	*Eucalyptus amplifolia*	Cabbage Gum																			5			X			
Trees	native	Myrtaceae	*Eucalyptus crebra*	Narrow Leaved Ironbark	5		1	1										6	5							X			X
Trees	native	Myrtaceae	*Eucalyptus eugenioides*	Thin-leaved Stringybark																									
	native	Myrtaceae	*Eucalyptus fibrosa*	Red Ironbark																					X				
Trees	native	Myrtaceae	*Eucalyptus moluccana*	Grey Box	2		1	5						5															
	native	Myrtaceae	*Eucalyptus parramattensis subsp. parramattensis*	Parramatta Red Gum																					X				
	native	Myrtaceae	*Eucalyptus punctata*	Grey Gum																			6		X				
	native	Myrtaceae	*Eucalyptus racemosa*	Snappy Gum																						X			
Trees	native	Myrtaceae	*Eucalyptus resinifera*	Red Mahogany						5			5																
Trees	native	Myrtaceae	*Eucalyptus tereticornis*	Forest Red Gum	1		1	5		5	6	5	6	5		6	5						5		X	X			
Small Trees	native	Fabaceae (Mimosoideae)	*Acacia parramattensis*	Parramatta wattle											5		5												
Small	native	Myrtaceae	*Eucalyptus crebra*	Narrow Leaved														X											

Table D.1 Flora Plot Data from 20m x 20m survey plots

Form	Native/ Exotic	Family	Species	Common Name	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	R1	R2	R3	R4	R5
Trees				Ironbark																									
Small Trees	native	Myrtaceae	*Eucalyptus tereticornis*	Forest Red Gum							5		5	5	6	5	5												
Small Trees	native	Myrtaceae	*Eucalyptus resinifera*	Red Mahogany						5																			
Small Trees	native	Myrtaceae	*Melaleuca decora*									5																	
	native	Myrtaceae	*Melaleuca nodosa*																							X			
	native	Myrtaceae	*Melaleuca thymifolia*																						X				
Shrubs	native	Asteraceae	*Ozothamnus diosmifolius*	Rice Flower						3		2	X	4			5						1						
Shrubs	exotic	Cactaceae	*Opuntia stricta*	Common Prickly Pear										1															
Shrubs	native	Fabaceae (Faboideae)	*Daviesia ulicifolia subsp. ulicifolia*	Gorse Bitter Pea						1																			
Shrubs	native	Fabaceae (Mimosoideae)	*Acacia sp.*										X	4			5												
Shrubs	native	Fabaceae (Mimosoideae)	*Acacia parramattensis*	Parramatta wattle							1				4		5												
Shrubs	native	Fabaceae	*Daviesia ulicifolia*	Gorse Bitter Pea	1							X					5									X			
Shrubs	exotic	Malvaceae	*Sida rhombifolia*	Paddy's Lucerne	2		2	2																					

Table D.1 Flora Plot Data from 20m x 20m survey plots

Form	Native/ Exotic	Family	Species	Common Name	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	R1	R2	R3	R4	R5
Shrubs	native/exotic	Meliaceae	*Melia azedarach*	White Cedar						1																			
Shrubs	native	Myrtaceae	*Eucalyptus moluccana*	Grey Box	2																								
Shrubs	native	Myrtaceae	*Eucalyptus tereticornis*	Forest Red Gum	2		3								5														
Shrubs	native	Myrtaceae	*Melaleuca decora*	Flax-leaved Paperbark								5	1																
Shrubs	native	Myrtaceae	*Melaleuca linariifolia*									1	1																
Shrubs	native	Phyllanthaceae	*Breynia oblongifolia*	Coffee Bush						2																			
Shrubs	native	Pittosporaceae	*Bursaria spinosa*	Blackthorn	2		1			3	2	2	X	5		2													
Shrubs	native	Proteaceae	*Persoonia linearis*	Narrow-leaved Geebung						1																			
Shrubs	exotic	Rosaceae	*Rubus fruticosus*	Blackberry						2		1		5		1	4								X				
Shrubs	native	Santalaceae	*Exocarpos cupressiformis*	Cherry Ballart						1					1														
Shrubs	exotic	Solanaceae	*Solanum mauritianum*	Tobacco Bush				1																					
Dicots	exotic	Caryophyllaceae	*Paronychia brasiliana*	Chilean Whitlow Wort							1	2																	
Dicots	native	Acanthaceae	*Brunoniella australis*	Blue Trumpet	1			2		2																			X
Dicots	native	Amaranthaceae	*Alternanthera denticulata*	Lesser Joyweed						1																			
Dicots	native	Apiaceae	*Centella asiatica*	Indian	2	4	2		3				3				3					2							

Table D.1 Flora Plot Data from 20m x 20m survey plots

Form	Native/ Exotic	Family	Species	Common Name	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	R1	R2	R3	R4	R5
				Pennywort																									
Dicots	native	Apiaceae	*Cyclospermum leptophyllum*	Slender Celery						2										2									
	exotic	Apiaceae	*Foeniculum vulgare*																					3					
Dicots	exotic	Apocynaceae	*Araujia sericifera*	Moth Vine						2																			
	exotic	Asteraceae	*Bidens pilosa*	Cobblers Pegs																2									X
Dicots	exotic	Asteraceae	*Cirsium vulgare*	Spear Thistle	2	1	2			2	3	3	3	3	2	1			2		X	2		2					
Dicots	exotic	Asteraceae	*Conyza bonariensis*	Flax-leaf Fleabane	2	2		1	1												7								
Dicots	exotic	Asteraceae	*Conyza sp.*							3			3		3														
Dicots	native	Asteraceae	*Cotula australis*	Common Cotula																									
Dicots	exotic	Asteraceae	*Gnaphalium sp.*	-					2																				
Dicots	exotic	Asteraceae	*Hypochaeris microcephala*	White Flat Weed												3		3	4	2	X								
Dicots	exotic	Asteraceae	*Hypochaeris radicata*	Catsear		1														3	X	4						X	
Dicots	exotic	Asteraceae	*Lactuca saligna*	Willow-leaved Lettuce						2																			
Dicots	exotic	Asteraceae	*Senecio madagascariensis*	Fireweed	2	3	2		2	3	4	4	3	3	3	4		4	4	4	X	3	3	3	X		X	X	

Table D.1 Flora Plot Data from 20m x 20m survey plots

Form	Native/ Exotic	Family	Species	Common Name	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	R1	R2	R3	R4	R5
Dicots	exotic	Asteraceae	*Senecio sp*			3				1																			
Dicots	native	Asteraceae	*Sigesbeckia orientalis*		2	2	1		2	2																			
Dicots	exotic	Asteraceae	*Sonchus oleraceus*	Common Sowthistle						2				2								2							
Dicots	exotic	Asteraceae	*Tagetes minuta*	Stinking Roger												1													
Dicots	exotic	Asteraceae	*Taraxacum officionale*	Dandelion												2								3					
	exotic	Boraginaceae	*Echium plantagineum*	Paterson's Curse																	X								
Dicots	exotic	Brassicaceae	*Lepidium africanum*															2											
Dicots	exotic	Brassicaceae	*Cardamine hirsuta*	Common Bittercress						2				3						2	X								
Dicots	native	Campanulaceae	*Wahlenbergia gracilis*	Sprawling Bluebell							X																		
Dicots	exotic	Caryophyllaceae	*Cerastium glomeratum*	Mouse-ear Chickweed																3				2					
Dicots	exotic	Caryophyllaceae	*Silene gallica var. gallica*																1										
Dicots	exotic	Caryophyllaceae	*Stellaria media*	Common Chickweed						2		3								2									
	native	Casuarinaceae	*Allocasuarina littoralis*	black she-oak																					X				

Table D.1 Flora Plot Data from 20m x 20m survey plots

Form	Native/ Exotic	Family	Species	Common Name	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	R1	R2	R3	R4	R5
	native	Chenopodiaceae	*Atriplex semibaccata*																										X
Dicots	native	Chenopodiaceae	*Einadia hastata*	Berry Saltbush									X	4			4												X
Dicots	native	Chenopodiaceae	*Einadia nutans*	Climbing Saltbush									1																
Dicots	native	Chenopodiaceae	*Einadia polygonoides*											3															
Dicots	native	Chenopodiaceae	*Einadia sp.*							1																			
Dicots	native	Chenopodiaceae	*Einadia trigonos*	Fish Weed							3					4							2						
Dicots	exotic	Clusiaceae	*Hypericum perforatum*	St. Johns Wort													2												
Dicots	native	Clusiaceae	*Hypericum gramineum*	Small St John's Wort	2	2	1		2													2							
Dicots	native	Commelinaceae	*Commelina cyanea*	Native Wandering Jew						2						3													
Dicots	native	Convolvulaceae	*Dichondra repens*	Kidney Weed	2		3	3	3	3	3	4	3			3	2		X		X								X
Dicots	native	Convolvulaceae	*Dichondra sp. A*									2																	
Dicots	native	Dilleniaceae	*Hibbertia sp.*										2																
Dicots	exotic	Fabaceae - Faboideae	*Medicago minima*	Woolly Burr Medic								4			3		3	4	4		X	4							
	exotic	Fabaceae - Faboideae	*Medicago polymorpha*	Burr Medic																2				2					

Table D.1 Flora Plot Data from 20m x 20m survey plots

Form	Native/ Exotic	Family	Species	Common Name	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	R1	R2	R3	R4	R5
Dicots	exotic	Fabaceae - Faboideae	*Trifolium repens*	White Clover														3		3									
Dicots	exotic	Fabaceae - Faboideae	*Vicia hirsuta*	Tiny Vetch					1																				
Dicots	exotic	Gentianaceae	*Centaurium erythraea*	Common Centaury																									
	exotic	Gentianaceae	*Centaurium tenuiflorum*																	2	X								
Dicots	native	Geraniaceae	*Erodium crinitum*	Blue Storksbill												2													
	native	Geraniaceae	*Geranium homeanum*																	2									
Dicots	native	Geraniaceae	*Geranium solanderi*	Native Geranium									1	3		1								2					
	native	Goodeniaceae	*Goodenia hederacea*																							X			
Dicots	exotic	Asteraceae	*Solvia sessilis*	Jo-jo															2		X								
Dicots	native	Lobeliaceae	*Pratia purpurascens*	Whiteroot	3					3		3	3	3	4								2			X			
	exotic	Malvaceae	*Malva parviflora*	Small-flowered Mallow																									X
Dicots	exotic	Malvaceae	*Modiola caroliniana*	Red-flowered Mallow							3					3			2		X								X
Dicots	exotic	Malvaceae	*Sida rhombifolia*	Paddy's Lucerne						3	4	3	2	4	3	4	3	3	4	2			2						X
Dicots	exotic	Myrsinaceae	*Anagallis arvensis*	Scarlet/Blue	2	1	1	2	2	2	3				3	2		3	2	3	X	2		3					

Table D.1 Flora Plot Data from 20m x 20m survey plots

Form	Native/ Exotic	Family	Species	Common Name	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	R1	R2	R3	R4	R5
				Pimpernel																									
Dicots	native	Oxalidaceae	*Oxalis perennans*	-	1	2	1	2	2	X										4	X								
Dicots	native	Phyllanthaceae	*Poranthera microphylla*							1																			
Dicots	exotic	Phytolaccaceae	*Phytolacca octandra*	Inkweed										3															
Dicots	exotic	Plantaginaceae	*Plantago lanceolata*	Lamb's Tongues	3	2	4	3	4								3	4	4	4	X	4		2	X				X
Dicots	exotic	Plantaginaceae	*Veronica arvensis*	Wall Speedwell															2	2									
Dicots	native	Plantaginaceae	*Veronica plebeia*	Creeping Speedwell				2		2																			
Dicots	exotic	Poaceae	*Sporobolus africanus*	Parramatta Grass						2																			
Dicots	native	Polygonaceae	*Persicaria lapathifolia*	Pale Knotweed										2															
Dicots	native	Polygonaceae	*Rumex brownii*	Swamp Dock			1			2	X		2	3		2	2			1									
Dicots	native	Polygonaceae	*Rumex brownii?*	Swamp Dock																									
Dicots	exotic	Ranunculaceae	*Ranunculus sp.*							2																			
	native	Ranunculaceae	*Ranunculus sessiliflorus*	Small-flowered Buttercup																2	X	2							
Dicots	native	Rubiaceae	*Opercularia aspera*	Coarse Stinkweed						X																			
Dicots	native	Solanaceae	*Solanum americanum*	Glossy							2																		

Table D.1 Flora Plot Data from 20m x 20m survey plots

Form	Native/ Exotic	Family	Species	Common Name	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	R1	R2	R3	R4	R5
				Nightshade																									
Dicots	exotic	Solanaceae	*Solanum mauritianum*	Wild Tobacco Bush						1																			
Dicots	exotic	Solanaceae	*Solanum nigrum*	Black-berry Nightshade						2		1		2		2													
Dicots	native	Solanaceae	*Solanum prinophyllum*	Forest Nightshade				2		1			2	2															
Dicots	exotic	Solanaceae	*Solanum pseudocapsicum*	Madeira Winter							3																		
Dicots	exotic	Solanaceae	*Solanum sp.*									1																	
	exotic	Solanaceae	*Solanum sisymbriifolium*																				3		X				
Dicots	exotic	Verbenaceae	*Verbena bonariensis*	Purpletop						2	2			3	3	2				3	X			4					
Dicots	exotic	Verbenaceae	*Verbena rigida*	Veined Verbena	1	1		2												3		3							
Dicots	exotic	Fabaceae	*Lotus uliginosus*	Greater Bird's Foot trefoil			4	2	4											4	X	4		3					
Monocot-grasses	Unknown	Poaceae	*Paspalum distans*									1																	
Monocot-	native	Poaceae	*Andropogon virginicus*	Whisky Grass											1														

Table D.1 Flora Plot Data from 20m x 20m survey plots

Form	Native/ Exotic	Family	Species	Common Name	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	R1	R2	R3	R4	R5
grasses																													
Monocot-grasses	native	Poaceae	*Aristida ramosa*	Purple Wiregrass			2	3	3																	X			
Monocot-grasses	native	Poaceae	*Aristida vagans*	Threeawn Speargrass	3			5		2												3							
	native	Poaceae	*Aristida sp.*																										X
Monocot-grasses	native	Poaceae	*Austrodanthonia sp.*							2																			
Monocot-grasses	exotic	Poaceae	*Axonopus fissifolius*	Narrow-leaf Carpet Grass		5	7		7			1					2				3	3					X	
Monocot-grasses	native	Poaceae	*Bothriochloa decipiens*	Pitted Bluegrass					3												5	4							
Monocot-grasses	native	Poaceae	*Bothriochloa macra*	Red-leg grass		2	2													5	3								
	exotic	Poaceae	*Briza maxima*																					2					

Table D.1 Flora Plot Data from 20m x 20m survey plots

Form	Native/ Exotic	Family	Species	Common Name	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	R1	R2	R3	R4	R5
Monocot-grasses	native	Poaceae	*Briza minor*	Shivery Grass									2																
Monocot-grasses	exotic	Poaceae	*Briza subaristata*																			2							
Monocot-grasses	native	Poaceae	*Bromus catharticus*	Prairie Grass										3	1	3	2	2	5								X		
Monocot-grasses	exotic	Poaceae	*Chloris gayana*	Rhodes Grass										4	2		7												X
Monocot-grasses	native	Poaceae	*Chloris ventricosa*	Tall Chloris			4	4													2								X
Monocot-grasses	native	Poaceae	*Cymbopogon refractus*	Barbwire Grass	5			4							1														
Monocot-grasses	native	Poaceae	*Cynodon dactylon*	Couch Grass	5	5		5	5	6	6	6	6	6	6	7		7	7	7		5	6	5	X	X	X	X	X

Table D.1 Flora Plot Data from 20m x 20m survey plots

Form	Native/ Exotic	Family	Species	Common Name	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	R1	R2	R3	R4	R5
Monocot-grasses	native	Poaceae	*Dichelachne micrantha*	Shorthair Plumegrass		1	2															3		2					
Monocot-grasses	native	Poaceae	*Dichelachne parva*	Plumegrass	4				5																				
Monocot-grasses	native	Poaceae	*Dichelachne sp.*							1							1												
Monocot-grasses	native	Poaceae	*Echinopogon caespitosus*	Bushy Hedgehog-grass	2																		3						
Monocot-grasses	native	Poaceae	*Entolasia stricta*	Wiry Panic						2				2															
Monocot-grasses	exotic	Poaceae	*Ehrharta erecta*	Panic Veldtgrass						3	2																		
Monocot-grasses	native	Poaceae	*Eragrostis brownii*	Brown's Lovegrass								6	4		6				2										

Table D.1 Flora Plot Data from 20m x 20m survey plots

Form	Native/ Exotic	Family	Species	Common Name	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	R1	R2	R3	R4	R5
Monocot-grasses	exotic	Poaceae	*Eragrostis curvula*	African Lovegrass	2															4	5								
Monocot-grasses	native	Poaceae	*Eragrostis leptostachya*	Paddock Lovegrass	3			4	2			4	2	2						2	3		2						
Monocot-grasses	native	Poaceae	*Imperata cylindrica*	Blady Grass		1																							
Monocot-grasses	native	Poaceae	*Lachnagrostis filiformis*												1														
Monocot-grasses	exotic	Poaceae	*Lolium perenne*	Perennial Ryegrass												3		6	7	3									
Monocot-grasses	native	Poaceae	*Microlaena stipoides*	Weeping Meadow Grass	3	3		7		6	6	6	7	7	6	5	5	4	3	4		5	5		X	X		X	X
Monocot-grasses	native	Poaceae	*Oplismenus aemulus*	Australian Basket Grass						3																			

Table D.1 Flora Plot Data from 20m x 20m survey plots

Form	Native/ Exotic	Family	Species	Common Name	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	R1	R2	R3	R4	R5
Monocot-grasses	native	Poaceae	*Panicum sp.*							1																			
	native	Poaceae	*Paspalidium distans*																				2						
Monocot-grasses	exotic	Poaceae	*Paspalum dilatatum*	Paspalum	5	7	7		7											6	6	7		3	X		X	X	X
Monocot-grasses	exotic	Poaceae	*Paspalum sp.*								2		3		3	3	2	5	4										
Monocot-grasses	exotic	Poaceae	*Pennisetum clandestinum*	Kikuyu Grass							4		2	4		6	3	6	5				5	7					X
	exotic	Poaceae	*Poa annua*	Winter Grass																3									
Monocot-grasses	exotic	Poaceae	*Setaria parviflora*	Slender Pigeon Grass		4	2	4	4			1			4				2	3	2			3					
Monocot-grasses	exotic	Poaceae	*Sporobolus africanus*	Parramatta Grass						2		1							2	2	3	2							
Monoco	native	Poaceae	*Sporobolus creber*	Slender Rat's	2	1	2		5			3			X					2	2	3						X	

Table D.1 Flora Plot Data from 20m x 20m survey plots

Form	Native/ Exotic	Family	Species	Common Name	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	R1	R2	R3	R4	R5
t-grasses				Tail Grass																									
	native	Poaceae	*Sporobolus elongatus*	Slender Rat's Tail Grass																X									
Monocot-grasses	exotic	Poaceae	*Stenotaphrum secundatum*	Baffalo Grass										1															
Monocot-grasses	native	Poaceae	*Vulpia myuros*	Rat's Tail Fescue	2																								
Monocot-other	native	Cyperaceae	*Carex appressa*	Tall Sedge									3	3			1												
Monocot-other	native	Cyperaceae	*Carex inversa*	-	1															4	4	3		3					
Monocot-other	exotic	Cyperaceae	*Cyperus gracilis*	Slender Flat-sedge														2	2		2								
Monocot-other	exotic	Cyperaceae	*Cyperus sesquiflorus*																1										
Monocot-other	exotic	Cyperaceae	*Cyperus tenellus*																										
Monoco	native	Cyperaceae	*Gahnia sp.*	Rough Saw-						2		1			4														

Table D.1 Flora Plot Data from 20m x 20m survey plots

Form	Native/ Exotic	Family	Species	Common Name	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	R1	R2	R3	R4	R5
t-other				sedge																									
	native	Cyperaceae	*Gahnia aspera*	Rough Saw-sedge																						X			
	native	Juncaceae	*Juncus homalocaulis*																	2									
Monocot-other	native	Juncaceae	*Juncus sp.2*							2		1																	
Monocot-other	native	Juncaceae	*Juncus sp.*							2		1	2	2			1												
Monocot-other	native	Juncaceae	*Juncus planifolius*																										
Monocot-other	native	Juncaceae	*Juncus usitatus*	Common Rush	1	2														4	4	2		3	X			X	
Monocot-other	native	Lomandraceae	*Lomandra filiformis*	Wattle Mat-rush						3	1					3		3											
Monocot-other	native	Lomandraceae	*Lomandra longifolia*	Spiny-headed Mat-rush						2			1																
Monocot-other	native	Lomandraceae	*Lomandra multiflora subsp. Multiflora*	Many-flowered Mat-rush														1											
Ferns and	native	Pteridaceae	*Adiantum aethiopicum*	Common Maidenhair						3																			

Table D.1 Flora Plot Data from 20m x 20m survey plots

Form	Native/ Exotic	Family	Species	Common Name	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	R1	R2	R3	R4	R5
Allies																													
Ferns and Allies	native	Adiantaceae	*Cheilanthes sieberi*	Poison Rock Fern	2					X					1														
Climbers and Vines	exotic	Apocynaceae	*Araujia sericifera*	Moth Vine						2	1		2			1													
Climbers and Vines	exotic	Asparagaceae	*Asparagus asparagoides*	Bridal Creeper	1					2			1				2												
Climbers and Vines	native	Fabaceae - Faboideae	*Glycine clandestina*	Love Creeper	3																								
Climbers and Vines	native	Fabaceae - Faboideae	*Glycine microphylla*	Small-leaf glycine				2		3	X	1	4	3	3	3	3												
Climbers and Vines	native	Fabaceae - Faboideae	*Glycine tabacina*	Love Creeper	3	2	2	3	2								2					3							X
Climbers and	exotic	Fabaceae - Faboideae	*Vicia sativa*												2														

Table D.1 Flora Plot Data from 20m x 20m survey plots

Form	Native/ Exotic	Family	Species	Common Name	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	R1	R2	R3	R4	R5
Vines																													
Climbers and Vines	exotic	Rosaceae	*Rubus fruticosus*	Blackberry complex		2																							
	native	Thymelaeaceae	*Pimelea linifolia*	Slender Rice Flower																						X			

Table D.2 Flora survey metadata

Quadrat Number	Date	Vegetation Code	Easting	Northing	Surveyors	Map Name	Map Number	AMG Zone
Q1	28-Jun-13	HN528 CPW	305494	6278695	Bryan Furchett, David Robertson	Wilberforce	9030-1N	56
Q2	28-Jun-13	HN528 CPW	305580	6278605	Bryan Furchett, David Robertson	Wilberforce	9030-1N	56
Q3	28-Jun-13	HN528 CPW	305739	6278555	Bryan Furchett, David Robertson	Wilberforce	9030-1N	56
Q4	28-Jun-13	HN528 CPW	305831	6278496	Bryan Furchett, David Robertson	Wilberforce	9030-1N	56
Q5	28-Jun-13	HN528 CPW	305972	6278367	Bryan Furchett, David Robertson	Wilberforce	9030-1N	56
Q6	26-Sep-13	HN556 SSTF	306641	6278328	David Roberts, Bryan	Wilberforce	9030-1N	56

Table D.2 Flora survey metadata

Quadrat Number	Date	Vegetation Code	Easting	Northing	Surveyors	Map Name	Map Number	AMG Zone
					Furchett, Cecelia Phu			
Q7	26-Sep-13	HN556 SSTF	306393	6278282	David Robertson, Bryan Furchett, Cecelia Phu	Wilberforce	9030-1N	56
Q8	26-Sep-13	HN556 SSTF	306592	6278175	David Roberts, Bryan Furchett, Cecelia Phu	Wilberforce	9030-1N	56
Q9	26-Sep-13	HN556 SSTF	306420	6278038	David Robertson, Bryan Furchett, Cecelia Phu	Wilberforce	9030-1N	56
Q10	26-Sep-13	HN556 SSTF	306365	6277907	David Robertson, Bryan Furchett, Cecelia Phu	Wilberforce	9030-1N	56

Table D.2 Flora survey metadata

Quadrat Number	Date	Vegetation Code	Easting	Northing	Surveyors	Map Name	Map Number	AMG Zone
Q11	26-Sep-13	HN556 SSTF	306669	6277866	David Robertson, Bryan Furchett, Cecelia Phu	Wilberforce	9030-1N	56
Q12	27-Sep-13	HN528 CPW	306152	6278049	Bryan Furchett, Mikael Peck	Riverstone	9030-1S	56
Q13	27-Sep-13	HN556 SSTF	306284	6277801	Bryan Furchett, Mikael Peck	Wilberforce	9030-1N	56
Q14	27-Sep-13	Scattered Trees	305600	6276678	Bryan Furchett, Mikael Peck	Wilberforce	9030-1N	56
Q15	27-Sep-13	Scattered Trees	305519	6276605	Bryan Furchett, Mikael Peck	Riverstone	9030-1S	56
Q16	24/07/2014	Exotic Grassland	305714	6278786	Bryan Furchett, Alex Pursche	Riverstone	9030-1S	56
Q17	24/07/2014	Exotic Grassland	305816	6278605	Bryan Furchett, Alex	Wilberforce	9030-1N	56

Table D.2 Flora survey metadata

Quadrat Number	Date	Vegetation Code	Easting	Northing	Surveyors	Map Name	Map Number	AMG Zone
					Pursche			
Q18	24/07/2014	Exotic Grassland	306115	6278594	Bryan Furchett, Alex Pursche	Wilberforce	9030-1N	56
Q19	24/07/2014	HN556 SSTF	306993	6278073	Bryan Furchett, Alex Pursche	Wilberforce	9030-1N	56
Q20	24/07/2014	Exotic Grassland	306252	6277777	Bryan Furchett, Alex Pursche	Riverstone	9030-1S	56

Table D.3 BioBanking Plot Data recorded at Box Hill North

Description for Figure	Item	Easting	Northing	Native Species	Native Canopy Cover %	Native Mid-storey Cover	Native ground Cover (Grasses)	Native Ground Cover (Shrubs)	Native Ground Cover (Other)	Exotic Groundcover	Trees with Hollows	Regenerating Canopy Species	Fallen Log Length
Q1	HN528 CPW	305494	6278695	25	18	0	60	0	28	15.33	0	1	15
Q2	HN528 CPW	305580	6278605	11	7	0	2	0	12	28.67	0	0	0
Q3	HN528 CPW	305739	6278555	15	6.5	0	12	0	0	25.33	0	1	0
Q4	HN528 CPW	305831	6278496	17	14.5	0	68	0	8	6.67	0	0.33	7
Q5	HN528 CPW	305972	6278367	11	0	0	12	0	0	29.33	0	1	0
Q6	HN556 SSTF	306641	6278328	40	9	19.5	82	0	30	14	2	1	11
Q7	HN556 SSTF	306393	6278282	7	27.5	9	52	0	16	27.33	0	1	13
Q8	HN556 SSTF	306592	6278175	18	9	0.5	72	8	20	8	1	1	5
Q9	HN556 SSTF	306420	6278038	18	10	0	92	2	12	24	0	1	0
Q10	HN556 SSTF	306365	6277907	19	25	1.5	56	0	26	21.33	0	1	1
Q11	HN556 SSTF	306669	6277866	10	0	9.5	78	0	2	20	0	1	1.5
Q12	HN528 CPW	306152	6278049	11	33.5	7	44	0	4	32.67	2	1	1
Q13	HN556 SSTF	306284	6277801	15	9.5	27.5	8	6	22	29.33	0	1	16
Q14	Scattered Trees	305600	6276678	5	35.5	0	26	0	46	32.67	0	1	2
Q15	Scattered Trees	305519	6276605	4	37	0	0	0	0	32.67	0	0	0

Table D.3 BioBanking Plot Data recorded at Box Hill North

Description for Figure	Item	Easting	Northing	Native Species	Native Canopy Cover %	Native Mid-storey Cover	Native ground Cover (Grasses)	Native Ground Cover (Shrubs)	Native Ground Cover (Other)	Exotic Groundcover	Trees with Hollows	Regenerating Canopy Species	Fallen Log Length
Q16	Exotic Grassland	305714	6278786	12	0	0	12	0	0	32	0	0	0
Q17	Exotic Grassland	305816	6278605	12	0	0	8	0	0	33.3	0	0	0
Q18	Exotic Grassland	306115	6278594	10	0	0	0	0	0	32.6	0	0	0
Q19	HN556 SSTF	306993	6278073	11	37	0	4	0	0	21.33	0	0	0
Q20	Exotic Grassland	306252	6277777	5	0	0	0	0	0	33.3	0	0	0

Appendix E

Flora Species Lists

Table E.1 Flora Species Recorded From the Study area

Form	Family	Exotic	Scientific Name	Common Name
Trees	Myrtaceae		*Acacia bakeri*	Narrow-leaved Apple
Trees	Fabaceae		*Acacia falcata*	
Trees	Fabaceae		*Acacia parramattensis*	Parramatta Wattle
Trees	Casuarinaceae		*Allocasuarina littoralis*	Black She-oak
Trees	Myrtaceae		*Angophora floribunda*	Rough-barked Apple
Trees	Myrtaceae		*Corymbia maculata*	Spotted Gum
Trees	Myrtaceace		*Eucalyptus amplifolia*	Cabbage Gum
Trees	Myrtaceae		*Eucalyptus crebra*	Narrow-leaved Ironbark
Trees	Myrtaceae		*Eucalyptus eugenioides*	Narrow-leaved Stringybark
Trees	Myrtaceae		*Eucalyptus fibrosa*	Broad-leaved Ironbark
Trees	Myrtaceae		*Eucalyptus moluccana*	Grey Box
Tress	Myrtaceae		*Eucalyptus parramattensis subsp. parramattensis*	Parramatta Red Gum
Trees	Mytraceae		*Eucalyptus punctata*	Grey Gum
Trees	Myrtaceae		*Eucalyptus racemosa*	Snappy Gum
Trees	Myrtaceae		*Eucalyptus resinifera*	Red Mahogany
Trees	Myrtaceae		*Eucalyptus sclerophylla*	Hard-leaved Scribbly Gum
Trees	Myrtaceae		*Eucalyptus tereticornis*	Forest Red Gum
Trees	Santalaceae		*Exocarpus cupressiformis*	Native Cherry
Trees	Myrtaceae		*Melaleuca decora*	
Trees	Myrtaceae		*Melaleuca linariifolia*	Flax-leaved Paperbark
Trees	Oleaceae		*Notelaea longifolia*	Large Mock-olive
Trees	Proteaceae		*Persoonia linearis*	Narrow-leaved Geebung
Trees	Pinaceae		*Pinus sp.*	Pine
Trees	Araliaceae		*Polyscias elegans*	Celery Wood
Small Trees	Myrtaceae		*Melaleuca nodosa*	
Small Trees	Myrtaceae		*Melaleuca thymifolia*	
Shrubs	Fabaceae		*Acacia floribunda*	White Sally Wattle
Shrubs	Fabaceae		*Acacia sp.*	
Shrubs	Asteraceae	*	*Bidens pilosa*	Cobblers Pegs

Table E.1 Flora Species Recorded From the Study area

Form	Family	Exotic	Scientific Name	Common Name
Shrubs	Phyllanthaceae		*Breynia oblongifolia*	Coffee Bush
Shrubs	Pittosporaceae		*Bursaria spinosa subsp. Spinosa*	Blackthorn
Shrubs	Fabaceae		*Daviesia ulicifolia*	Gorse Bitter Pea
Shrubs	Santalaceae		*Exocarpus strictus*	Dwarf Cherry
Shrubs	Myrtaceae		*Kunzea ambigua*	Tick Bush
Shrubs	Oleaceae	*	*Ligustrum sinense*	Narrow-leafed Privet
Shrubs	Meliaceae		*Melia azerdarach*	White Cedar
Shrubs	Myrsinaceae		*Myrsine variabilis*	
Shrubs	Cactaceae	*	*Opuntia sp.*	Prickly Pear
Shrubs	Asteraceae		*Ozothamnus diosmifolius*	Dogwood
Shrubs	Thymelaeaceae		*Pimelea linifolia*	Slender Rice Flower
Shrubs	Rosaceae	*	*Rubus fruticosus*	Blackberry
Shrubs	Rosaceae		*Rubus parvifolius*	Native Raspberry
Shrubs	Malvaceae	*	*Sida rhombifolia*	Paddy's Lucerne
Shrubs	Solanaceae	*	*Solanum linnaeanum*	Apple of Sodom
Vines and Twiners	Apocynaceae	*	*Araujia sericifera*	Moth Vine
Vines and Twiners	Apocynaceae	*	*Asparagus asparagoides*	Bridal Creeper
Vines and Twiners	Ranunculaceae		*Clematis aristata*	Old Man's Beard
Vines and Twiners	Ranunculaceae		*Clematis glycinoides*	Headache Vine
Vines and Twiners	Luzuriagaceae		*Eustrephus latifolius*	Wombat Berry
Vines and Twiners	Fabaceae		*Glycine clandestina*	Twining Glycine
Vines and Twiners	Fabaceae		*Glycine microphylla*	Small-leaf glycine
Vines and Twiners	Fabaceae	*	*Glycine tabacina*	Love Creeper
Vines and	Fabaceae		*Hardenbergia violacea*	Purple Coral Pea

Table E.1 Flora Species Recorded From the Study area

Form	Family	Exotic	Scientific Name	Common Name
Twiners				
Vines and Twiners	Apocynaceae		*Marsdenia rostrata*	Milk Vine
Vines and Twiners	Passifloraceae	*	*Passiflora edulis*	Passionfruit
Vines and Twiners	Fabaceae	*	*Vicia sativa*	
Forbs	Polygonaceae	*	*Acetosella vulgaris*	Sheep Sorrel
Forbs	Amaranthaceae		*Alternanthera denticulata*	Lesser Joyweed
Forbs	Amaranthaceae	*	*Amaranthus caudatus*	Love-lies Bleeding
Forbs	Myrsinaceae	*	*Anagallis arvensis*	Scarlet Pimpernel
Forbs	Asparagaceae	*	*Asparagus officinalis*	Asparagus
Forbs	Rubiaceae		*Asperula conferta*	Common Woodruff
Forbs	Chenopodiaceae		*Atriplex semibaccata*	
Forbs	Asteraceae		*Brunoniella australis*	Blue Trumpet
Forbs	Brassicaceae	*	*Cardamine hirsuta*	Common Bittercress
Forbs	Gentianaceae	*	*Centaurium erythraea*	Common Centaury
Forbs	Gentianaceae	*	*Centaurium tenuiflorum*	
Forbs	Apiaceae		*Centella asiatica*	Indian Pennywort
Forbs	Caryophyllaceae	*	*Cerastium glomeratum*	Mouse-ear Chickweed
Forbs	Asteraceae	*	*Cirsium vulgare*	Spear Thistle
Forbs	Commelinaceae		*Commelina cyanea*	Native Wandering Jew
Forbs	Asteraceae	*	*Conyza bonariensis*	Fleabane
Forbs	Asteraceae	*	*Conyza sp.*	
Forbs	Asteraceae		*Cotula australis*	Common Cotula
Forbs	Apiaceae		*Cyclospermum leptophyllum*	Slender Celery
Forbs	Fabaceae		*Desmodium varians*	Slender Tick-trefoil
Forbs	Phormiaceae		*Dianella longifolia*	Blueberry Lily
Forbs	Convolvulaceae		*Dichondra repens*	Kidney Weed
Forbs	Convolvulaceae		*Dichondra sp A.*	

Table E.1 Flora Species Recorded From the Study area

Form	Family	Exotic	Scientific Name	Common Name
Forbs	Boraginaceae	*	*Echium plantagineum*	Paterson's Curse
Forbs	Boraginaceae		*Einadia hastata*	Berry Saltbush
Forbs	Boraginaceae		*Einadia nutans*	Climbing Saltbush
Forbs	Boraginaceae		*Einadia polygonoides*	
Forbs	Boraginaceae		*Einadia sp.*	
Forbs	Boraginaceae		*Einadia trigonos*	Fish Weed
Forbs	Geraniaceae		*Erodium crinitum*	Blue Storksbill
Forbs	Apiaceae	*	*Foeniculum vulgare*	Aniseed
Forbs	Geraniaceae		*Geranium homeanum*	
Forbs	Geraniaceae		*Geranium solanderi*	Native Geranium
Forbs	Asteraceae	*	*Gnaphalium sp.*	Native Geranium
Forbs	Goodeniaceae		*Goodenia hederacea*	
Forbs	Haloragaceae		*Gonocarpus tetragynus*	Raspwort
Forbs	Haloragaceae		*Gonocarpus teucrioides*	Raspwort
Forbs	Dilleniaceae		*Hibbertia sp.*	Stinking Pennywort
Forbs	Apiaceae		*Hydrocotyle laxiflora*	Stinking Pennywort
Forbs	Clusiaceae		*Hypericum gramineum*	Small St Johns Wort
Forbs	Asteraceae	*	*Hypericum perforatum*	St. Johns Wort
Forbs	Asteraceae	*	*Hypochaeris microcephala*	White Flat Weed
Forbs	Asteraceae	*	*Hypochaeris radicata*	Cats Ear
Forbs	Asteraceae	*	*Lactuca saligna*	Willow-leaved Lettuce
Forbs	Brassicaceae	*	*Lepidium africanum*	Native oxalis
Forbs	Fabaceae	*	*Lotus uliginosus*	Greater Bird's Foot trefoil
Forbs	Malvaceae	*	*Malva parviflora*	Small-flowered Mallow
Forbs	Fabaceae	*	*Medicago minima*	Woolly Burr Medic
Forbs	Fabaceae	*	*Medicago polymorpha*	Burr Medic
Forbs	Malvaceae	*	*Modiola caroliniana*	Red-flowered Mallow
Forbs	Rubiaceae		*Opercularia aspera*	Coarse Stinkweed
Forbs	Oxalidaceae		*Oxalis perennans*	Native oxalis
Forbs	Caryophyllaceae	*	*Paronychia brasiliana*	Chilean Whitlow Wort

Table E.1 Flora Species Recorded From the Study area

Form	Family	Exotic	Scientific Name	Common Name
Forbs	Polygonaceae		*Persicaria decipiens*	Slender Knotweed
Forbs	Polygonaceae		*Persicaria lapathifolia*	Pale Knotweed
Forbs	Caryophyllaceae	*	*Petrorhagia nanteuilii*	Proliferous Pink
Forbs	Phytolaccaceae	*	*Phytolacca octandra*	Inkweed
Forbs	Plantaginaceae	*	*Plantago lanceolata*	Plantain
Forbs	Phyllanthaceae		*Poranthera microphylla*	Small-leaved Poranthera
Forbs	Lobeliaceae		*Pratia purpurascens*	Whiteroot
Forbs	Ranunculaceae	*	*Ranunculus repens*	Creeping Buttercup
Forbs	Ranunculaceae		*Ranunculus sessiliflorus*	Small-flowered Buttercup
Forbs	Ranunculaceae	*	*Ranunculus sp.*	
Forbs	Polygonaceae		*Rumex brownii*	Swamp Dock
Forbs	Asteraceae		*Senecio linearifolius*	Fireweed Groundsel
Forbs	Asteraceae	*	*Senecio madagascariensis*	Fireweed
Forbs	Asteraceae	*	*Senecio sp.*	
Forbs	Asteraceae		*Sigesbeckia orientalis subsp. Orientalis*	Indian Weed
Forbs	Caryophyllaceae	*	*Silene gallica var. gallica*	
Forbs	Solanaceae		*Solanum americanum*	Glossy Nightshade
Forbs	Solanaceae	*	*Solanum mauritianum*	Tobacco Bush
Forbs	Solanaceae	*	*Solanum nigrum*	Black Nightshade
Forbs	Solanaceae		*Solanum prinophyllum*	Forest Nightshade
Forbs	Solanaceae	*	*Solanum pseudocapsicum*	Madeira Winter
Forbs	Solanaceae	*	*Solanum sisymbriifolium*	
Forbs	Solanaceae	*	*Solanum sp.*	
Forbs	Asteraceae	*	*Soliva sessilis*	Jo-jo
Forbs	Asteraceae	*	*Sonchus oleraceus*	Common Sow Thistle
Forbs	Caryophyllaceae	*	*Stellaria media*	Common Chickweed
Forbs	Asteraceae	*	*Tagetes minuta*	Stinking Roger

Table E.1 Flora Species Recorded From the Study area

Form	Family	Exotic	Scientific Name	Common Name
Forbs	Asteraceae	*	*Taraxacum officinale*	Dandelion
Forbs	Fabaceae	*	*Trifolium dubium*	Yellow Suckling Clover
Forbs	Fabaceae	*	*Trifolium repens*	White Clover
Forbs	Verbenaceae	*	*Verbena bonariensis*	Purple Top
Forbs	Verbenaceae	*	*Verbena rigida*	Veined Verbena
Forbs	Plantaginaceae	*	*Veronica arvensis*	Wall Speedwell
Forbs	Plantaginaceae		*Veronica plebeia*	Creeping Speedwell
Forbs	Fabaceae	*	*Vicia hirsuta*	Tiny Vetch
Forbs	Violaceae		*Viola hederacea*	Ivy-leaved Violet
Forbs	Campanulaceae		*Wahlenbergia gracilis*	Small Bluebell
Forbs	Asteraceae	*	*Xanthium occidentale*	Noogoora Burr
Ferns	Adiantaceae		*Adiantum aethiopicum*	Common Maidenhair
Ferns	Aspleniaceae		*Asplenium flabellifolium*	Necklace Fern
Ferns	Pteridaceae		*Cheilanthes sieberi*	Rock Fern
Ferns	Dennstaedtiaceae		*Pteridium esculentum*	Bracken Fern
Grasses	Poaceae	*	*Andropogon virginicus*	Whisky Grass
Grasses	Poaceae		*Aristrida ramosa*	Purple Wiregrass
Grasses	Poaceae		*Aristida vagans*	Three awned Speargrass
Grasses	Poaceae		*Austrodanthonia sp.*	
Grasses	Poaceae	*	*Axonopus fissifolius*	Narrow-leafed Carpet Grass
Grasses	Poaceae		*Bothriochloa decipiens*	Pitted Bluegrass
Grasses	Poaceae		*Bothriochloa macra*	Red-leg Grass
Grasses	Poaceae	*	*Briza maxima*	
Grasses	Poaceae		*Briza minor*	Shivery Grass
Grasses	Poaceae	*	*Briza subaristata*	
Grasses	Poaceae		*Bromus cartharticus*	Prairie Grass
Grasses	Poaceae	*	*Chloris gayana*	Rhodes grass
Grasses	Poaceae		*Chloris ventricosa*	Plump Windmill Grass
Grasses	Poaceae		*Cymbopogon refractus*	Barbed Wire Grass

Table E.1 Flora Species Recorded From the Study area

Form	Family	Exotic	Scientific Name	Common Name
Grasses	Poaceae		*Cynodon dactylon*	Couch
Grasses	Poaceae		*Dichelachne micrantha*	Shorthair Plume Grass
Grasses	Poaceae		*Dichelachne parva*	Plume Grass
Grasses	Poaceae		*Echinopogon caespitosus*	Tufted Hedgehog Grass
Grasses	Poaceae		*Echinopogon ovatus*	Forest Hedgehog Grass
Grasses	Poaceae	*	*Ehrharta erecta*	Panic Veldtgrass
Grasses	Poaceae		*Elymus scaber*	Common Wheatgrass
Grasses	Poaceae		*Entolasia marginata*	Bordered Panic
Grasses	Poaceae		*Entolasia stricta*	Wiry Panic
Grasses	Poaceae		*Eragrostis brownii*	Brown's Lovegrass
Grasses	Poaceae	*	*Eragrostis cilianensis*	Stinking Lovegrass
Grasses	Poaceae	*	*Eragrostis curvula*	African Lovegrass
Grasses	Poaceae		*Eragrostis leptostachya*	Paddock lovegrass
Grasses	Poaceae	*	*Holcus lanatus*	Yorkshire Fog
Grasses	Poaceae	*	*Imperata cylindrica*	Blady Grass
Grasses	Poaceae		*Lachnagrostis filiformis*	
Grasses	Poaceae	*	*Lolium perenne*	Perennial Ryegrass
Grasses	Poaceae		*Microlaena stipoides*	Weeping Grass
Grasses	Poaceae		*Oplismenus aemulus*	Australian Basket Grass
Grasses	Poaceae		*Panicum effusum*	Hairy Panic
Grasses	Poaceae		*Panicum simile*	Two-colour Panic
Grasses	Poaceae		*Paspalidium distans*	
Grasses	Poaceae	*	*Paspalum dilatatum*	Paspalum
Grasses	Poaceae	*	*Paspalum sp.*	
Grasses	Poaceae	*	*Pennisetum clandestinum*	Kikuyu
Grasses	Poaceae	*	*Phalaris aquatica*	Phalaris
Grasses	Poaceae		*Phragmites australis*	Phragmites
Grasses	Poaceae	*	*Poa annua*	Winter Grass
Grasses	Poaceae		*Rytidosperma sp.*	Wallaby grass
Grasses	Poaceae	*	*Setaria parviflora*	Slender Pigeon Grass

Table E.1 Flora Species Recorded From the Study area

Form	Family	Exotic	Scientific Name	Common Name
Grasses	Poaceae	*	*Setaria pumilo*	Whorled Pigeon Grass
Grasses	Poaceae	*	*Sporobolus africanus*	Parramatta Grass
Grasses	Poaceae		*Sporobolus creber*	Slender Rat's Tail Grass
Grasses	Poaceae		*Sporobolus elongatus*	Slender Rat's Tail Grass
Grasses	Poaceae		*Stenotaphrum secundatum*	Buffalo Grass
Grasses	Poaceae		*Themeda australis*	Kangaroo Grass
Grasses	Poaceae		*Vulpia myuros*	Rat's Tail Fescue
Sedges and Rushes	Cyperaceae		*Carex appressa*	Tall Sedge
Sedges and Rushes	Cyperaceae		*Carex inversa*	
Sedges and Rushes	Cyperaceae		*Cyperus difformis*	Dirty Dora
Sedges and Rushes	Cyperaceae	*	*Cyperus eragrostis*	Umbrella Sedge
Sedges and Rushes	Cyperaceae	*	*Cyperus gracilis*	Slender Flat-sedge
Sedges and Rushes	Cyperaceae	*	*Cyperus rotundus*	Nutgrass
Sedges and Rushes	Cyperaceae		*Cyperus sesquiflorus*	
Sedges and Rushes	Cyperaceae	*	*Cyperus tenellus*	
Sedges and Rushes	Cyperaceae		*Gahnia aspera*	Rough Saw-sedge
Sedges and Rushes	Juncaceae		*Juncus filicaulis*	
Sedges and Rushes	Juncaceae		*Juncus homalocaulis*	
Sedges and Rushes	Juncaceae		*Juncus planifolius*	Common Rush
Sedges and Rushes	Juncaceae		*Juncus usitatus*	Common Rush

Table E.1 Flora Species Recorded From the Study area

Form	Family	Exotic	Scientific Name	Common Name
Sedges and Rushes	Juncaceae		*Juncus sp*	
Sedges and Rushes	Juncaceae		*Juncus sp. 2*	
Sedges and Rushes	Cyperaceae		*Lepidosperma laterale*	
Sedges and Rushes	Cyperaceae		*Lomandra filiformis*	Wattle Mat-rush
Sedges and Rushes	Lomandraceae		*Lomandra longifolia*	Spiny-headed Mat-rush
Sedges and Rushes	Lomandraceae		*Lomandra multiflora*	Many-flowered Mat-rush
Sedges and Rushes	Cyperaceae		*Schoenus apogon*	Common Bog-rush
Sedges and Rushes	Typhaceae		*Typha orientalis*	Broad-leafed Cumbungi

Appendix F

Fauna Species List

Table F.1 Fauna Species Recorded From the Study area

Type	Exotic	Scientific Name	Common Name
Amphibian		*Crinia signifera*	Common Eastern Froglet
Amphibian		*Limnodynastes tasmaniensis*	Spotted Grass Frog
Amphibian		*Litoria fallax*	Eastern Dwarf Tree Frog
Amphibian		*Litoria verreauxii*	Verreaux's Frog
Amphibian		*Litoria peronii*	Peron's Tree Frog
Amphibian		*Litoria phyllochroa*	Leaf Green Tree Frog
Birds		*Acanthiza nana*	Yellow Thornbill
Birds		*Acanthiza sp.*	Unidentified Thornbill
Birds		*Alceda azurea*	Azure Kingfisher
Birds		*Anas castanea*	Chestnut Teal
Birds		*Anas gracilis*	Grey Teal
Birds		*Anas rhynchotis*	Australasian Shoveler
Birds		*Anas superciliosa*	Pacific Black Duck
Birds		*Anhinga novaehollandiae*	Australasian Darter
Birds	*	*Anser sp.*	Domestic Goose
Birds		*Ardea ibis*	Cattle Egret
Birds		*Ardea intermedia*	Intermediate Egret
Birds		*Ardea pacifica*	White-necked Heron
Birds		*Aythya australis*	Hardhead
Birds		*Cacatua galerita*	Sulphur-crested Cockatoo
Birds		*Cacatua sanguinea*	Little Corella
Birds		*Cacatua tenuirostris*	Long-billed Corella
Birds		*Cacomantis variolosus*	Brush Cuckoo
Birds		*Chenonetta jubata*	Australian Wood Duck
Birds		*Circus assimilis*	Spotted Harrier
Birds	*	*Columba livia*	Rock Dove
Birds		*Coracina novaehollandiae*	Black-faced Cuckoo-shrike
Birds		*Cormobates leucophaea*	White-throated Treecreeper
Birds		*Corvus coronoides*	Australian Raven
Birds		*Cracticus tibicen*	Australian Magpie
Birds		*Cygnus atratus*	Black Swan
Birds		*Dacelo novaeguineae*	Laughing Kookaburra

Table F.1 Fauna Species Recorded From the Study area

Type	Exotic	Scientific Name	Common Name
Birds		*Egretta novaehollandiae*	White-faced Heron
Birds		*Elseyornis melanops*	Black-fronted Dotterel
Birds		*Eolophus roseicapillus*	Galah
Birds		*Falcunculus frontatus frontatus*	Eastern Shrike-tit
Birds		*Fulica atra*	Eurasian Coot
Birds		*Gallinula tenebrosa*	Dusky Moorhen
Birds		*Grallina cyanoleuca*	Magpie-lark
Birds		*Haliaeetus leucogaster*	White-bellied Sea-Eagle
Birds		*Haliastur sphenurus*	Whistling Kite
Birds		*Himantopus himantopus*	Black-winged Stilt
Birds		*Hirundo neoxena*	Welcome Swallow
Birds		*Lichenostomus chrysops*	Yellow-faced Honeyeater
Birds		*Malurus cyaneus*	Superb Fairy-wren
Birds		*Manorina melanocephala*	Noisy Miner
Birds		*Melithreptus lunatus*	White-naped Honeyeater
Birds		*Microcarbo melanoleucos*	Little Pied Cormorant
Birds		*Neochmia temporalis*	Red-browed Finch
Birds		*Oriolus sagittatus*	Olive-backed Oriole
Birds		*Pardalotus punctatus*	Spotted Pardalote
Birds		*Pelecanus conspicillatus*	Australian Pelican
Birds		*Phalacrocorax sulcirostris*	Little Black Cormorant
Birds		*Philemon corniculatus*	Noisy Friarbird
Birds		*Platalea flavipes*	Yellow-billed Spoonbill
Birds		*Platycercus elegans*	Crimson Rosella
Birds		*Platycercus eximius*	Eastern Rosella
Birds		*Pteropus poliocephalus*	Hoary-headed Grebe
Birds		*Porphyrio porphyrio*	Purple Swamphen
Birds		*Psephotus haematonotus*	Red-rumped Parrot
Birds		*Rhipidura albiscapa*	Grey Fantail
Birds		*Rhipidura leucophrys*	Willie Wagtail
Birds	*	*Sturnus tristis*	Common Myna
Birds	*	*Sturnus vulgaris*	Common Starling

Table F.1 Fauna Species Recorded From the Study area

Type	Exotic	Scientific Name	Common Name
Birds		*Tachybaptus novaehollandiae*	Australasian Grebe
Birds		*Threskiornis molucca*	Australian White Ibis
Birds		*Threskiornis spinicollis*	Straw-necked Ibis
Birds		*Trichoglossus haematodus*	Rainbow Lorikeet
Birds		*Vanellus miles*	Masked Lapwing
Mammal		*Antechinus stuartii*	Brown Antechinus
Mammal	*	*Cervus spp.*	Deer
Mammal		*Chalinolobus gouldii*	Gould's Wattled Bat
Mammal		*Chalinolobus morio*	Chocolate Wattled Bat
Mammal	*	*Felis catus*	Cat
Mammal		*Falsistrellus tasmaniensis*	Eastern False Pipistrelle
Mammal		*Miniopterus schreibersii oceanensis*	Eastern Bentwing-bat
Mammal		*Mormopterus norfolkensis*	Eastern Freetail-bat
Mammal		*Mormopterus "Species 2"*	Undescribed Freetail Bat
Mammal		*Myotis macropus*	Southern Myotis
Mammal		*Nyctophilus sp.*	Long-eared bat
Mammal		*Pteropus poliocephalus*	Grey-headed Flying-fox
Mammal		*Rhinolophus megaphyllus*	Eastern Horseshoe-bat
Mammal		*Saccolaimus flaviventris*	Yellow-bellied Sheathtail-bat
Mammal		*Scotorepens balstoni*	Inland Broad-nosed Bat
Mammal		*Scotorepens orion*	Eastern Broad-nosed Bat
Mammal		*Scotorepens sp.*	Unidentified Broad-nosed Bat
Mammal		*Austronomus australis*	White-striped Freetail-bat
Mammal		*Vespadelus darlingtoni*	Large Forest Bat
Mammal		*Vespadelus regulus*	Southern Forest Bat
Mammal		*Vespadelus vulturnus*	Little Forest Bat
Mammal	*	*Vulpes vulpes*	Red Fox
Fish	*	*Cyprinus carpio*	Carp

Appendix G

Survey Effort

Table G.1 Fauna Survey Methods and Effort (Cumberland Ecology 2013)

Survey Method	CE Survey Effort in Box Hill North
Amphibians	
Call playback and spotlighting	4 nights per *L. aurea* habitat (20 person hours)
Reptiles	
Opportunistic sightings	Throughout survey period
Diurnal Birds	
Walking transects	Throughout survey period
Opportunistic sightings	Throughout survey period
Nocturnal Birds	
Day habitat search	Throughout survey period
Ground and Arboreal Mammals	
Trapping	4 Nights
Bats	
Ultrasonic call recording	2 nights
Snails	
Active habitat searches (spot assessment method)	63 sites

Appendix H

Survey Datasheets

Table H.1 Cumberland Plain Land Snail searches at Box Hill North metadata

Survey Details	
Name of Surveyor	Alex Graham, Emily Cave
Contact Number	02 9868 1933
Date of Survey	11/10/2013
Number of Locations Searched	62
Location Details	
Location	Box Hill North
AMG Zone	56
Survey Start or Grid Corner Easting	306663
Survey Start or Grid Corner Northing	6278302
Survey End or Grid Corner Easting	305650
Survey End or Grid Corner Northing	6278794
Weather Details (at start of survey)	
Cloud Cover	0
Moon	
Wind Direction and Speed	SE 44 km/h
Rain	0
Minumum and maximum Temperature	13.8 and 26.9

Table H.2 Cumberland Plain Land Snail searches at Box Hill North Survey Results

Way Point	Coordinates of Tree Surveyed	Live Snails Present Y/N	Shells Present Y/N
066		N	N
067	E: 306663 N: 6278302	N	N
068	E: 306679 N: 6278297	N	N
069	E: 306662 N: 6278286	N	N
070	E: 306666 N: 6278264	N	N
071	Data file corrupted	N	N
072	E: 306595 N: 6278097	N	N
073	E: 306523 N: 6278045	N	N
074	E: 306505 N: 6278073	N	N
076	E: 306485 N: 6278008	N	N
077	E: 306512 N: 6217994	N	N
078	E: 306442 N: 6277929	N	N
079	E: 306473 N: 6277906	N	N
080	E: 306493 N: 6277859	N	N
081	E: 306624 N: 6277842	N	N
082	E: 306679 N: 6277751	N	N
083	E: 306623 N: 6277786	N	N
084	E: 306173 N: 6278027	N	N
085	E: 306199 N: 6278018	N	N
086	E: 306434 N: 6278089	N	N
087	E: 306605 N: 6278271	N	N
088	E: 305481 N: 6278685	N	N
089	E: 305487 N: 6278677	N	N
090	E: 305501 N: 6278677	N	N
091	E: 305544 N: 6278696	N	N
092	E: 305554 N: 6278665	N	N
093	E: 305584 N: 6278671	N	N
094	E: 305601 N: 6278659	N	N
095	E: 305606 N: 6278643	N	N
096	E: 305648 N: 6278618	N	N
097	E: 305695 N: 6278610	N	N

Table H.2 Cumberland Plain Land Snail searches at Box Hill North Survey Results

Way Point	Coordinates of Tree Surveyed	Live Snails Present Y/N	Shells Present Y/N
098	E: 305733 N: 6278595	N	N
099	E: 305770 N: 6278603	N	N
100	E: 305852 N: 6278529	N	N
101	E: 305871 N: 6278517	N	N
102	E: 305992 N: 6278476	N	N
103	E: 306091 N: 6278404	N	N
104	E: 305998 N: 6278406	N	N
105	E: 305854 N: 6278434	N	N
106	E: 305818 N: 6278452	N	N
107	E: 305791 N: 627488	N	N
108	E: 305774 N: 6278500	N	N
109	E: 305695 N: 6278581	N	N
110	E: 305535 N: 6278586	N	N
111	E: 305385 N: 6276766	N	N
112	E: 305385 N: 6276803	N	N
113	E: 305356 N: 6276719	N	N
114	E: 305350 N: 6276717	N	N
115	Possible Cumberland Plain Land Snail shell incidental		
116	E: 306009 N: 6278653	N	N
117	E: 306016 N: 6278647	N	N
118	E: 306018 N: 6278638	N	N
119	E: 306023 N: 6278623	N	N
120	E: 306022 N: 6278589	N	N
121	E: 306016 N: 6278585	N	N
122	E: 305992 N: 6278595	N	N
123	E: 305837 N: 6278760	N	N
124	E: 305841 N: 6278700	N	N
125	E: 305845 N: 6278669	N	N
126	E: 305805 N: 6278710	N	N
127	E: 305643 N: 6278860	N	N
128	E: 305647 N: 6278821	N	N

Table H.2 Cumberland Plain Land Snail searches at Box Hill North Survey Results

Way Point	Coordinates of Tree Surveyed	Live Snails Present Y/N	Shells Present Y/N
129	E: 305650 N: 6278794	N	N

Table H.3 Green and Golden Bell Frog targeted searches Metadata

Survey Details	Night 1	Night 2	Night 3	Night 4
Name of Surveyor	Aleksei Atkin, Bo Davidson	Aleksei Atkin, Bo Davidson	Alex Pursche, Alex Graham	Aleksei Atkin, Bo Davidson
Contact Number	02 9868 1933	02 9868 1933	02 9868 1933	02 9868 1933
Date of Survey	9/09/2013	10/09/2013	3/10/2013	8/10/2013
Type of Amplification	Megaphone	Megaphone	Megaphone	Megaphone
Duration of Call Playback	10 min	10 min	10 min	10 min
Duration of Listening	15 min	15 min	15 min	15 min
Location Details				
Locaton Desription	Dams 2, 5, 6, 7, 10, 11, 13	Dams 2, 5, 6, 7, 10, 11, 13	Dams 2, 5, 6, 7, 10, 11, 13	Dams 2, 5, 6, 7, 10, 11, 13
Map Name	Wilberforce & Riverstone	Wilberforce & Riverstone	Wilberforce & Riverstone	Wilberforce & Riverstone
Map Number	90301N & 9030-1S	90301N & 9030-1S	90301N & 9030-1S	90301N & 9030-1S
Full AMG References for Survey Site				
AMG Zone	56	56	56	56
Easting	Dam 2: 305569 , 5: 306075, 6: 306130, 7: 306243, 10: 306288, 11: 305534, 13: 306367	Dam 2: 305569 , 5: 306075, 6: 306130, 7: 306243, 10: 306288, 11: 305534, 13: 306367	Dam 2: 305569 , 5: 306075, 6: 306130, 7: 306243, 10: 306288, 11: 305534, 13: 306367	Dam 2: 305569 , 5: 306075, 6: 306130, 7: 306243, 10: 306288, 11: 305534, 13: 306367
Northing	Dam 2: 6275941, 5: 6277278, 6: 6277263, 7: 6277195, 10: 6276652, 11: 6276798, 13:	Dam 2: 6275941, 5: 6277278, 6: 6277263, 7: 6277195, 10: 6276652, 11: 6276798, 13:	Dam 2: 6275941, 5: 6277278, 6: 6277263, 7: 6277195, 10: 6276652, 11: 6276798, 13:	Dam 2: 6275941, 5: 6277278, 6: 6277263, 7: 6277195, 10: 6276652, 11: 6276798, 13:

Table H.3 Green and Golden Bell Frog targeted searches Metadata

Survey Details	Night 1	Night 2	Night 3	Night 4
	6277832	6277832	6277832	6277832
Start Time	19:00	19:00	19:00	19:00
End Time	23:00	23:00	23:00	23:00
Weather Details (at start of survey)				
Cloud Cover	0	0	0	0
Moon				
Wind Direction and Speed	NNE 26 km/h	NW 78 km/h	SSE 57 km/h	SE 50 km/h
Rain	0	0	0	0
Minumum and Maximum Temperature	5.2 and 27	15.2 and 32.2	12.8 and 20.7	8.5 and 23.1

Table H.4 Green and Golden Bell Frog targeted survey results

			Litoria fallax	*Litoria verreauxi*	*Litoria phyllochroa*	*Litoria peronii*	*Crinia signifera*	*Limnodynastes tasmaniensis*	*Limnodynastes peronii*
	Night	**Date**	**Eastern Dwarf Tree Frog**	**Verreaux's Tree Frog**	**Leaf Green Tree Frog**	**Peron's Tree Frog**	**Common Eastern Froglet**	**Spotted Marsh Frog**	**Striped Marsh Frog**
Dam 13	1	9/09/2013				Heard	Heard		
Easting	2	10/09/2013				Heard			Heard
Northing	3	3/10/2013		Heard		Heard	Heard		
	4	8/10/2013							
Dam 7	1	9/09/2013		Heard			Heard		
Easting	2	10/09/2013	Heard	Heard			Heard		
Northing	3	3/10/2013							
	4	8/10/2013					Heard		
Dam 6	1	9/09/2013					Heard		Heard
Easting	2	10/09/2013							Heard
Northing	3	3/10/2013							
	4	8/10/2013							
Dam 5	1	9/09/2013	Heard						Heard
Easting	2	10/09/2013	Heard		Heard				Heard
Northing	3	3/10/2013							
	4	8/10/2013							

Table H.4 Green and Golden Bell Frog targeted survey results

			Litoria fallax	*Litoria verreauxi*	*Litoria phyllochroa*	*Litoria peronii*	*Crinia signifera*	*Limnodynastes tasmaniensis*	*Limnodynastes peronii*
	Night	**Date**	**Eastern Dwarf Tree Frog**	**Verreaux's Tree Frog**	**Leaf Green Tree Frog**	**Peron's Tree Frog**	**Common Eastern Froglet**	**Spotted Marsh Frog**	**Striped Marsh Frog**
Dam 10	1	9/09/2013	Heard	Heard					
Easting	2	10/09/2013							
Northing	3	3/10/2013		Heard			Heard		
	4	8/10/2013					Heard		
Dam 11	1	9/09/2013						Heard	
Easting	2	10/09/2013	Heard	Heard		Heard	Heard	Heard	
Northing	3	3/10/2013							
	4	8/10/2013					Heard		
Dam 2	1	9/09/2013	Heard						
Easting	2	10/09/2013	Heard	Heard			Heard		
Northing	3	3/10/2013		Heard			Heard		
	4	8/10/2013							

Table H.5 Small mammal survey metadata

Survey Details	
Name of Surveyor	Bo Davidson and Mikael Peck
Contact Number	02 9868 1933
Date Traps Set	1-Oct-13
Date Traps Collected	4-Oct-13
Type of Trap	25 Elliot A Terrestrial; 10 Elliot B Arboreal
Dimensions of Trap	Elliot A: Elliot B:
Number of Traps	35
Intervals Between Traps	10 m
Length of Transect	250m
Bait Used	Peanut Butter and Oats
Location Details	
Location	Box Hill North
AMG Zone	56
Transect Start or Grid Corner Easting	306646
Transect Start or Grid Corner Northing	6278322
Transect End or Grid Corner Easting	306490
Transect End or Grid Corner Northing	6278050

Table H.6 Small Mammal survey results

						1 October 13			2 October 13			3 October 13			4 October 2013	
Trap Type	Trap No.	Easting	Northing	Waypoint	Photo	O/C: Trap open/closed	P/A: Bait present/absent	Species	O/C: Trap open/closed	P/A: Bait present/absent	Species	O/C: Trap open/closed	P/A: Bait present/absent	Species	O/C: Trap open/closed	P/A: Bait present/absent
Elliot A Terrestrial	1	0306646	6278322	017	206	O	P	N/A	O	P	N/A	C	P	*Antechinus stuartii*	#219-22/ Pregnant female	O
Elliot A Terrestrial	2	0306637	6278313	018		O	P	N/A	O	P	N/A	O	P			O
Elliot A Terrestrial	3	0306625	6278302	020		O	P	N/A	O	P	N/A	O	P			O
Elliot A Terrestrial	4	0306619	6278292	022		O	P	N/A	O	P	N/A	O	P			O
Elliot A Terrestrial	5	0306624	6278275	023		O	P	N/A	O	P	N/A	O	P			O
Elliot A Terrestrial	6	0306616	6278258	024		O	P	N/A	O	P	N/A	O	P			O
Elliot A Terrestrial	7	0306613	6278239	026		O	P	N/A	O	P	N/A	O	P			O
Elliot A Terrestrial	8	0306598	6278236	027		O	P	N/A	O	P	N/A	O	P			O
Elliot A	9	0306567	627823	029		O	P	N/A	O	P	N/A	O	P			O

Table H.6 Small Mammal survey results

						1 October 13			2 October 13			3 October 13			4 October 2013	
Trap Type	Trap No.	Easting	Northing	Waypoint	Photo	O/C: Trap open/closed	P/A: Bait present/absent	Species	O/C: Trap open/closed	P/A: Bait present/absent	Species	O/C: Trap open/closed	P/A: Bait present/absent	Species	O/C: Trap open/closed	P/A: Bait present/absent
Terrestrial			2													
Elliot A Terrestrial	10	0306561	6278201	031		O	P	N/A	O	P	N/A	O	P			O
Elliot A Terrestrial	11	0306567	6278195	032		O	P	N/A	O	P	N/A	O	P			O
Elliot A Terrestrial	12	0306569	6278181	033		O	P	N/A	O	P	N/A	O	P			O
Elliot A Terrestrial	13	0306572	6278171	034		O	P	N/A	O	P	N/A	O	P			O
Elliot A Terrestrial	14	0306553	6278153	036		O	P	N/A	O	P	N/A	O	P			O
Elliot A Terrestrial	15	0306542	6278149	037		O	P	N/A	O	P	N/A	O	P			O
Elliot A Terrestrial	16	0306551	6278132	038		C	P	N/A	O	P	N/A	O	P			O
Elliot A Terrestrial	17	0306524	6278126	040		O	P	N/A	O	P	N/A	O	P			O
Elliot A	18	0306525	627810	042		O	P	N/A	O	P	N/A	O	P			O

Table H.6 Small Mammal survey results

						1 October 13			2 October 13			3 October 13			4 October 2013	
Trap Type	Trap No.	Easting	Northing	Waypoint	Photo	O/C: Trap open/closed	P/A: Bait present/absent	Species	O/C: Trap open/closed	P/A: Bait present/absent	Species	O/C: Trap open/closed	P/A: Bait present/absent	Species	O/C: Trap open/closed	P/A: Bait present/absent
Terrestrial			0													
Elliot A Terrestrial	19	0306505	6278067	044		O	P	N/A	O	P	N/A	O	P			O
Elliot A Terrestrial	20	0306485	6278045	046		O	P	N/A	O	P	N/A	O	P			O
Elliot A Terrestrial	21	0306464	6278015	047		O	P	N/A	O	P	N/A	O	P			O
Elliot A Terrestrial	22	0306453	6277974	049		O	P	N/A	O	P	N/A	O	P			O
Elliot A Terrestrial	23	0306498	6277928	050		O	P	N/A	O	P	N/A	O	P			O
Elliot A Terrestrial	24	0306469	6277921	052		O	P	N/A	O	P	N/A	O	P			O
Elliot A Terrestrial	25	0306487	6277918	053		O	P	N/A	O	P	N/A	O	P			O
Elliot B Arboreal	1	0306636	6278307	019		O	P	N/A	O	P	N/A	O	P			O
Elliot B	2	0306625	627828	021		O	P	N/A	C	P	N/A	O	P			O

Table H.6 Small Mammal survey results

						1 October 13			2 October 13			3 October 13			4 October 2013	
Trap Type	Trap No.	Easting	Northing	Waypoint	Photo	O/C: Trap open/closed	P/A: Bait present/absent	Species	O/C: Trap open/closed	P/A: Bait present/absent	Species	O/C: Trap open/closed	P/A: Bait present/absent	Species	O/C: Trap open/closed	P/A: Bait present/absent
Arboreal			5													
Elliot B Arboreal	3	0306612	6278250	025		O	P	N/A	O	P	N/A	O	P			O
Elliot B Arboreal	4	0306572	6278235	028		O	P	N/A	O	P	N/A	O	P			O
Elliot B Arboreal	5	0306557	6278214	030	207	O	P	N/A	O	P	N/A	O	P			O
Elliot B Arboreal	6	0306549	6278165	039		O	P	N/A	O	P	N/A	O	P			O
Elliot B Arboreal	7	0306535	6278126	041	218	O	P	N/A	O	P	N/A	O	P			O
Elliot B Arboreal	8	0306523	6278088	043		O	P	N/A	O	P	N/A	O	P			O
Elliot B Arboreal	9	0306471	6278004	048		O	P	N/A	O	P	N/A	O	P			O
Elliot B Arboreal	10	0306490	6278050	045	217	O	P	N/A	O	P	N/A	O	P			O

Appendix I

Assessments of Significance

I.1 Introduction

Assessments of Significance (seven part tests) are threshold tests of significance that are prepared as a requirement of Section 5A of the EP&A Act for impacts arising from development applications. Assessments of significance determine whether there is likely to be a significant impact on any threatened flora and fauna in order to determine whether to proceed to prepare a SIS. Notwithstanding this, the seven part tests can be repeated within an SIS to consider whether a significant negative impact will occur once avoidance, mitigation and compensation measures are considered. This has been done within Appendix I for all endangered ecological communities and threatened species known or considered likely to occur within the study area.

The seven part tests verify that although the two CEECs and several threatened species would be significantly impacted by future developments on the site, the amelioration measure proposed are likely to address such impacts such that examples of the two CEECs will be conserved on site, and preserved within off site offset areas. There will also be substantial replanting of vegetation within open space areas and this is expected to provide opportunities for such fauna as birds and bats in the long term. Thus, when implemented, the suite of ameliorative measures are predicted to address the otherwise significant impacts of the future development of the study area.

As stated in Chapters 5 & 6, the future development will impact on (C)EECs/Species across the study area. The following table reiterates the impact onsite to vegetation communities (and subsequently fauna habitat):

Table I.1 Comparison of vegetation community areas within Box Hill North

Vegetation Community	Total Vegetation in study area	Vegetation to be retained within the study area (ha)	Vegetation to be removed from the study area (ha)	Vegetation to be removed from the study area (ha) within areas owned or controlled by EJC Pty Ltd
Cumberland Plain Woodland (CEEC)	13.4	3.6	9.8	9.1
Shale/Sandstone Transition Forest (CEEC)	13.3	7.1	6.2	6.2
Scattered Trees	3.3	0.1	3.2	2.5
Acacia Regrowth	1.1	0.0	1.1	1.1
Exotic Vegetation	236.2	7.6	228.6	198.2
Total Native Vegetation	*31.1*	*10.8*	*20.3*	*18.9*
Total Vegetation	*267.3*	*18.5*	*248.9*	*217.1*

I.2 Critically Endangered Ecological Communities

I.2.1 Cumberland Plain Woodland (CPW)

Cumberland Plain Woodland (CPW) is listed as a CEEC under the TSC Act and the EPBC Act. It 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 (SPW) is more widely distributed, occurring throughout the drier areas of the Cumberland Plain (NSW NPWS 2001). Dominant canopy species include *Eucalyptus moluccana* (Coastal Grey Box), *E. tereticornis* (Forest Red Gum), *E. crebra* (Narrow-leaved Ironbark), *Corymbia maculata* (Spotted Gum) and *E. eugenoides* (Thin-leaved Stringybark). The shrub layer is dominated by *Bursaria spinosa* (Blackthorn). Grasses dominate the ground layer (Benson and Howell 1990a). 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 (NSW NPWS, 2001a).

In December 2009, Cumberland Plain Woodland was listed as a critically endangered ecological community. The definition of the community in the 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.

Low to moderate condition CPW occurs in the north-west of the Study area in five recognisable patches (see Figure 4.4). These areas comprise regenerating CPW following prior clearing and contain few mature, hollow-bearing trees or other significant habitat for fauna. The understorey of these patches is similarly disturbed with a variety of invasive grasses and forbs present in the grassland community. *Bursaria spinosa* is present amongst the understorey in some patches; however the invasive exotic species *Rubus fruticosis* (Blackberry) is also widespread. The south, centre and north-east corner of the Study area also contains scattered occurrences of indicative CPW trees species (e.g. *Eucalyptus moluccana*). However the regenerating trees are too widely scattered and contain a too highly disturbed understorey to qualify as a woodland community.

(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 will entail the removal of regenerating CPW woodland within the study area. The remaining area will be retained on site and will be restored and managed through the implementation of a Vegetation Management Plan (VMP). Additionally an area of passive open space will serve to buffer the remnant CPW patch from nearby development, further reducing the impact on the retained portion of the community. The proposed development is not likely place the local occurrence of this community at risk of extinction as a sizable portion of CPW will be retained within the Study area, and significant areas of the community occur within the Locality.

The proposed development has the potential to modify the composition of the ecological community through soil disturbance events during the construction phase and through edge effects following the completion of the development. However, the proposed development entails the use of variety of soil retention and WSUD features to minimise the impact of these events and they will not place the local occurrence of this community at risk of extinction. Furthermore, the retained vegetation will be managed through the implementation of a VMP and plantings occurring within the proposed development will utilise locally endemic species diagnostic of the community.

(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

The proposed development will involve the removal of regenerating CPW. CPW will be retained, and no adverse modifications of this area will occur due to the implementation of appropriate mitigation measures and a VMP.

No area of habitat will become fragmented or isolated from other areas of habitat in the locality as a result of the proposed development. The CPW present on the site is not contiguous with other nearby areas of the same habitat. Boundary Road to the west and Maguires Road to the north separate vegetation within the site from other patches within the locality. A portion of this community is bounded by modified grassland to the south and east and is not contiguous with other areas of the community either on or adjacent to the Study area.

The CPW to be removed within the study area represents low to moderate quality habitat with few tree hollows or other habitat features. It also displays inconsistent grass and understorey communities with several invasive grass, forb and shrub species present in many areas. The area of this habitat to be removed within the study area is not considered to be of high importance to the long-term survival of this ecological community in the locality.

(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 Director-General of the OEH.

(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

The Draft Recovery Plan for the Cumberland Plain has been placed on public exhibition. 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 a significant portion of this community is to be retained within the study area and a VMP will be prepared which will manage and enhance the recovery of this area. Further, this area represents the highest quality habitat present amongst the existing CPW patches, with a small drainage line providing an additional buffer to the proposed development area. This drainage will be developed into a vegetated sediment retention basin which will provide additional habitat value. Additionally, locally endemic native species will be planted throughout the proposed development, ensuring the genetic diversity of the community within the Study area is retained and enhanced. The portions of this community to be cleared within the study area represent low to moderate quality habitat, based on the variable shrub and ground strata present and their removal will be offset through the purchase of BioBanking credits.

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 following KTP:

- Clearing of native vegetation; and.

The vegetation to be cleared consists predominantly of degraded and sparsely regenerating CPW and a significant portion will be retained and enhanced within the study area with the cleared remainder offset through the purchase of BioBanking credits.

The VMP will include measures to be implemented to reduce the impacts of exotic perennial grasses.

Conclusion

The proposed development will involve the removal of CPW from the Study area. The current condition of the patches of CPW to be removed is currently relatively low, and they occur in a highly degraded agricultural landscape. In the absence of management measures they would be expected to continue to degrade. However; CPW will be retained and a range of mitigation measures will be implemented to improve the integrity of this area. Most significantly, a VMP will be prepared and implemented to manage the regeneration of this area, including weed and feral animal management, and ongoing monitoring. Additionally, locally endemic species diagnostic of the community will be planted throughout the proposed development ensuring that the community remains viable within the site.

A BioBanking assessment has been completed for the vegetation to be removed, and an informal BioBanking agreement is proposed, with the purchase of ecosystem credits considered to adequately offset the removal of areas of the community. .The purchase of BioBanking credits will ensure that an area of the community is conserved offsite and is managed in the future. Without the implementation of these mitigation and offsetting measures, the impact to CPW would be considered significant; however with the implementation of the proposed mitigation measures, and the purchase of these ecosystem credits, no significant impact is predicted to occur to CPW as a result of the Future development.

I.2.2 Shale Sandstone Transition Forest (SSTF)

Shale-Sandstone Transition Forest (SSTF) is listed as a Critically Endangered Ecological Community (CEEC) under the TSC Act and EPBC Act. SSTF occurs at the edges of the Cumberland Plain, where clay soils from the shale rock intergrades with earthy and sandy soils from sandstone, or where shale caps overlay sandstone. The boundaries are indistinct, and the species composition varies depending on the soil influences. The main tree species include *Eucalyptus tereticornis*, *E. punctata*, *E. globoidea*, *E. eugenioides*, *E. fibrosa* and *E. crebra*. Areas of low sandstone influence (more clay-loam soil texture) have an understorey that is closer to Cumberland Plain Woodland.

Prior to European settlement, this community was extensive around the edges of the Cumberland Plain, western Sydney, most particularly in the southern half. Today, only 9,950 ha remains intact (22.6% of its original extent) and the bulk of this occurs in the Hawkesbury, Baulkham Hills, Liverpool, Parramatta, Penrith, Campbelltown and Wollondilly LGAs.

SSTFs occur in the Study area and represents the most intact remaining habitat occurring within the study area (Figure 4.4). This community supports a variety of fauna habitat

features including tree hollows, sandstone outcrops, crevices and overhangs and shallow ponds.

The proposed development will retain this community within the riparian corridor and adjacent area of passive open space. The remaining SSTF will be impacted through development for low density residential housing and environmental living, although this will allow some retention of individual trees and understorey species.

(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 will retain areas of this community within the study area within the riparian corridor and an area of passive open space extending from the base of Cataract Creek. The remaining area will be impacted by the proposed development; however this area is listed as low density residential lots. This will allow some retention of fauna habitat in these areas (some mature trees), however the understorey is likely to be impacted through clearing and weed colonisation. As the majority of this community is to be retained in its current state and will be subject to a vegetation management plan (VMP) it is unlikely that the proposed development will put the local occurrence of this species at risk of extinction.

The proposed development entails the implementation of a variety of techniques and technologies designed to minimise the impact of the development, both during the construction phase and the later management of the development following the completion of works. These measures include soil traps and other WSUD features designed to minimise urban stormwater discharge into the riparian area. In addition the VMP will contain provisions for weed management, tree planting and ongoing monitoring of this community. The proposed development is considered unlikely to substantially and adversely affect this community to the extent that its local occurrence is put at risk of occurrence.

(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

The majority of this community will be retained within the study area, and the remainder to be cleared represents regenerating areas lacking the mature, hollow bearing trees of the more established area to be retained. The development proposed for these areas is listed as low density residential which will allow for the retention of some habitat functionality.

The community is currently largely isolated within the study area with its western, southern and eastern boundaries abutting cleared farmland. The northern boundary is separated from an adjoining forest patch by Maguires Road by approximately 20 to 40 m. The proposed development is unlikely to lead to any further fragmentation of this community either on or adjacent to the Study area.

The community present within the study area is considered to be of mostly moderate quality. The majority of this community within the study area will be retained, and only a small area will be removed. This area is not considered to be important to the ongoing survival of the local population of this ecological community.

(e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)

No critical habitat for this community has currently been identified by the Director-General of the OEH.

(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

SSTF is currently being addressed as part of the draft Cumberland Plain Endangered Ecological Communities Recovery Plan which has been placed on public exhibition. 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 objectives as the majority of SSTF present within the study area will be retained and a VMP will be drafted and enacted to facilitate the ongoing management of the community within the study area. The VMP will also encourage awareness, education, monitoring and enforcement through active management of the community (replanting, weed management and the placement of nesting boxes).

There are no threat abatement plans relevant to SSTF

(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 following KTP:

- Clearing of native vegetation

The vegetation to be cleared consists predominantly of degraded and sparsely regenerating SSTF and the majority will be retained within the study area with the cleared remainder offset through the purchase of BioBanking credits. In addition higher quality examples of this community exist in the forest reserve to the north-east of the Study area and also in the nearby Scheyville National Park. A VMP will be enacted to manage the ongoing rehabilitation of this community.

Conclusion

The proposed development will result in the removal of SSTF from the Study area. However, SSTF in the study area will be retained and managed through the implementation of a VMP. It is considered that due to the nearby presence of larger and more intact examples of this community as well as the retention of the majority of this community within the study area, the proposed development will have a minimal impact on the long-term survival of this ecological community.

A BioBanking assessment has been completed on the vegetation to be removed. An informal BioBanking agreement is proposed to purchase ecosystem credits to act as an offset for a portion of the vegetation to be removed. Without effective mitigation and offsetting, the future development would constitute a significant impact to the SSTF community, however with the implementation of the proposed mitigation measures, and the purchase of these ecosystem credits, no significant impact is predicted to occur to SSTF as a result of the Future development.

I.3 Threatened Flora

I.3.1 Dillwynia tenuifolia

Dillwynia tenuifolia is listed as Vulnerable under the TSC Act. The species has not been detected within the Study area, however is known from six records in the locality. The species is considered to have potential to occur based on the proximity of records and similarity of soil type.

Dillwynia tenuifolia is a low shrub, to 1m, occurring on Tertiary alluvium in Castlereagh Woodlands. Its range covers the Richmond – Windsor – Blacktown area, with outlying populations at Kemps Creek, Voyager Point and South Maroota. It is conserved within Agnes Banks, Windsor Downs, Castlereagh and Mulgoa Nature Reserves, and Blue Mountains, Yengo and Scheyville National Parks. The species is threatened by clearing, disturbance along tracks, rubbish dumping and slashing.

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

No individuals of the species are known from the Study area, despite extensive searches for the species. Were the species to occur within the site, the numbers are considered likely to be low, and the species is known to occur in local conservation reserves. As a result, the viable local population of the species is not likely to be placed 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

Individuals within the The Hills LGA form part of an endangered population. No individuals of the species are known from the Study area, despite extensive searches for the species. Were the species to occur within the site, the numbers are considered likely to be low, and the species is known to occur in local conservation reserves. As a result, the viable local population of the species is not likely to be placed at risk of extinction.

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.

An area of vegetation constituting potential habitat for the species will be removed by the proposed action. However, potential habitat will be conserved and managed on the site.

Potential habitat for the species is currently largely isolated within the study area with its western, southern and eastern boundaries abutting cleared farmland. The northern boundary is separated from an adjoining forest patch by Maguires Road by approximately 20 to 40 m. The proposed development is unlikely to lead to any further fragmentation of this community either on or adjacent to the Study area

The importance of the area of potential habitat to be removed is considered low, as the potential habitat exists as moderate to low quality woodland, with high levels of weed invasion. The areas of most suitable habitat within the Study area will be retained and managed in the long-term. This area is not considered to be important to the ongoing survival of the species in the locality.

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 listed in the critical habitat registry by the Director-General of the OEH.

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 finalised or drafted for this species.

No threat abatement plans are relevant to this species.

g) Whether the action proposed constitutes or is part of a key threatening process or likely to result in the operation of, or increases the impact of, a key threatening process.

The proposed development will result in the following KTP:

- Clearing of native vegetation

The vegetation to be cleared consists predominantly of degraded and sparsely regenerating Cumberland Plain Woodland and Shale-Sandstone Transition Forest. The highest quality areas of these communities will be retained and managed within the Study area. In addition higher quality areas of habitat exist in the forest reserve to the north-east of the Study area and also in the nearby Scheyville National Park. A VMP will be enacted to manage the ongoing rehabilitation of this potential habitat for the species.

Conclusion

The Future development will result in the loss of potential habitat for the species; however it is unlikely that the species would occur in high numbers within the Study area

A range of impact avoidance, mitigation and compensation measures have been developed for the Future development, some of which are relevant to this species. The measures will

assist in addressing the impacts to these species, including the conservation of vegetation on the site, the implementation of locally endemic flowering species in landscape plantings, and the offsetting of areas through an informal BioBanking agreement. As a result of these mitigation and offsetting measures, the Future development is not considered likely to significantly impact the species.

I.3.2 Acacia pubescens

Acacia pubescens is listed as Vulnerable under both the TSC Act and EPBC Act. The species has not been detected within the Study area, however is known from 44 records in the locality. The species is considered to have potential to occur based on the proximity of records and similarity of soil type.

Acacia pubescens is a spreading shrub, 1 - 5 m high with brilliant yellow flowers, bipinnate leaves (divided twice pinnately) and conspicuously hairy branchlets. The species occurs on alluviums, shales and at the intergrade between shales and sandstones. The soils are characteristically gravely soils, often with ironstone. The species occurs in open woodland and forest, in a variety of plant communities, including Cooks River/Castlereagh Ironbark Forest, Shale/Gravel Transition Forest and Cumberland Plain Woodland (REF).

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,

No individuals of the species are known from the Study area, despite extensive searches for the species. Were the species to occur within the site, the numbers are considered likely to be low, and the species is known to occur in local conservation reserves. As a result, the viable local population of the species is not likely to be placed 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,

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.

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.

An area vegetation constituting potential habitat for the species will be removed by the proposed action. However, other areas potential habitat will be conserved and managed on the site.

Potential habitat for the species is currently largely isolated within the study area with its western, southern and eastern boundaries abutting cleared farmland. The northern boundary is separated from an adjoining forest patch by Maguires Road by approximately 20 to 40 m. The proposed development is unlikely to lead to any further fragmentation of this community either on or adjacent to the study area

The importance of the area of potential habitat to be removed is considered low, as the potential habitat exists as moderate to low quality woodland, with high levels of weed invasion. The areas of most suitable habitat within the Study area will be retained and managed in the long-term. This area is not considered to be important to the ongoing survival of the species in the locality.

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 listed in the critical habitat registry by the Director-General of the OEH.

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 finalised or drafted for this species.

No threat abatement plans are relevant to this species.

g) Whether the action proposed constitutes or is part of a key threatening process or likely to result in the operation of, or increases the impact of, a key threatening process.

The proposed development will result in the following KTP:

- Clearing of native vegetation

The vegetation to be cleared consists predominantly of degraded and sparsely regenerating Cumberland Plain Woodland and Shale-Sandstone Transition Forest. The highest quality areas of these communities will be retained and managed within the Study area. In addition higher quality areas of habitat exist in the forest reserve to the north-east of the Study area

and also in the nearby Scheyville National Park. A VMP will be enacted to manage the ongoing rehabilitation of this potential habitat for the species.

Conclusion

The Future development will result in the loss of potential habitat for the species; however it is unlikely that the species would occur in high numbers within the Study area

A range of impact avoidance, mitigation and compensation measures have been developed for the Future development, some of which are relevant to this species. The measures will assist in addressing the impacts to these species, including the conservation of vegetation on the site, the implementation of locally endemic flowering species in landscape plantings, and the offsetting of areas through an informal BioBanking agreement. As a result of these mitigation and offsetting measures, the Future development is not considered likely to significantly impact the species.

I.3.3 Grevillea juniperina subsp juniperina

Grevillea juniperina subsp. juniperina is listed as Vulnerable under the TSC Act. The species is not known from the Study area, but has been detected five times within the locality. As suitable habitat for the species is present, the species is considered to have potential to occur within the study area.

Grevillea juniperina subsp. juniperina is a dense shrub, 0.5-1.5m tall, found only in Western Sydney. The distribution of this species is bounded by St Mary's, Londonderry and Prospect. It occurs on red sandy to clay soils in Cumberland Plain Woodland and Castlereagh Woodland. It is found in localised and small populations. Grevillea juniperina subsp. juniperina is threatened by habitat clearance, altered fire regimes, weed invasion, rubbish dumping, trampling and vehicular damage. The species is conserved within the nearby Scheyville Nature Reserve.

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,

No individuals of the species are known from the Study area, despite extensive searches for the species. Were the species to occur within the site, the numbers are considered likely to be low, and the species is known to occur in local conservation reserves. As a result, the viable local population of the species is not likely to be placed 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,

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.

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.

An area of vegetation constituting potential habitat for the species will be removed by the proposed action. However, potential habitat will be conserved and managed on the site.

Potential habitat for the species is currently largely isolated within the study area with its western, southern and eastern boundaries abutting cleared farmland. The northern boundary is separated from an adjoining forest patch by Maguires Road by approximately 20 to 40 m. The proposed development is unlikely to lead to any further fragmentation of this community either on or adjacent to the Study area

The importance of the area of potential habitat to be removed is considered low, as the potential habitat exists as moderate to low quality woodland, with high levels of weed invasion. The areas of most suitable habitat within the Study area will be retained and managed in the long-term. This area is not considered to be important to the ongoing survival of the species in the locality.

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 listed in the critical habitat registry by the Director-General of the OEH.

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 finalised or drafted for this species.

No threat abatement plans are relevant to this species.

g) Whether the action proposed constitutes or is part of a key threatening process or likely to result in the operation of, or increases the impact of, a key threatening process.

The proposed development will result in the following KTP:

- Clearing of native vegetation

The vegetation to be cleared consists predominantly of degraded and sparsely regenerating Cumberland Plain Woodland and Shale-Sandstone Transition Forest. The highest quality areas of these communities will be retained and managed within the Study area. In addition higher quality areas of habitat exist in the forest reserve to the north-east of the Study area and also in the nearby Scheyville National Park. A VMP will be enacted to manage the ongoing rehabilitation of this potential habitat for the species.

Conclusion

The Future development will result in the loss of potential habitat for the species; however it is unlikely that the species would occur in high numbers within the Study area

A range of impact avoidance, mitigation and compensation measures have been developed for the Future development, some of which are relevant to this species. The measures will assist in addressing the impacts to these species, including the conservation of vegetation on the site, the implementation of locally endemic flowering species in landscape plantings, and the offsetting of areas through an informal BioBanking agreement. As a result of these mitigation and offsetting measures, the Future development is not considered likely to significantly impact the species.

I.3.4 Pultenaea parviflora

Pultenaea parviflora is listed as Endangered under the TSC Act and Vulnerable under the EPBC Act. The species is not known from the Study area, but has been detected 10 times within the locality. As suitable habitat for the species is present, the species is considered to have potential to occur within the Study area.

Pultenaea parviflora is a small shrub to 1m endemic to the Cumberland Plain. It occurs in the Windsor – Penrith – Dean Park area, with outlying populations at Kemps Creek and Wilberforce. It is conserved within Scheyville National Park, Windsor Downs Nature Reserve and Castlereagh Nature Reserve. It occurs in dry heath areas within Castlereagh Ironbark Forest on Tertiary alluvium and laterised clays. The abundance of the species depends on the extent of past disturbance; with clearing, altered fire regimes, vehicle access, rubbish dumping and weed invasion being a threat to P. parviflora. Disturbance that leads to competition with taller colonising species also threatens this species.

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,

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,

No individuals of the species are known from the Study area, despite extensive searches for the species. Were the species to occur within the site, the numbers are considered likely to be low, and the species is known to occur in local conservation reserves. As a result, the viable local population of the species is not likely to be placed 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,

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.

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.

An area of vegetation constituting potential habitat for the species will be removed by the proposed action. However, potential habitat will be conserved and managed on the site.

Potential habitat for the species is currently largely isolated within the study area with its western, southern and eastern boundaries abutting cleared farmland. The northern boundary is separated from an adjoining forest patch by Maguires Road by approximately 20 to 40 m. The proposed development is unlikely to lead to any further fragmentation of this community either on or adjacent to the Study area

The importance of the area of potential habitat to be removed is considered low, as the potential habitat exists as moderate to low quality woodland, with high levels of weed invasion. The areas of most suitable habitat within the Study area will be retained and managed in the long-term. This area is not considered to be important to the ongoing survival of the species in the locality.

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 listed in the critical habitat registry by the Director-General of the OEH.

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 finalised or drafted for this species.

No threat abatement plans are relevant to this species.

g) Whether the action proposed constitutes or is part of a key threatening process or likely to result in the operation of, or increases the impact of, a key threatening process.

The proposed development will result in the following KTP:

- Clearing of native vegetation

The vegetation to be cleared consists predominantly of degraded and sparsely regenerating Cumberland Plain Woodland and Shale-Sandstone Transition Forest. The highest quality areas of these communities will be retained and managed within the Study area. In addition higher quality areas of habitat exist in the forest reserve to the north-east of the Study area and also in the nearby Scheyville National Park. A VMP will be enacted to manage the ongoing rehabilitation of this potential habitat for the species.

Conclusion

The Future development will result in the loss of potential habitat for the species; however it is unlikely that the species would occur in high numbers within the Study area

A range of impact avoidance, mitigation and compensation measures have been developed for the Future development, some of which are relevant to this species. The measures will assist in addressing the impacts to these species, including the conservation of vegetation on the site, the implementation of locally endemic flowering species in landscape plantings, and the offsetting of areas through an informal BioBanking agreement. As a result of these mitigation and offsetting measures, the Future development is not considered likely to significantly impact the species.

I.4 Threatened Fauna

I.4.1 Birds

i. Blossom-dependent Birds

The following Assessment of Significance has been prepared as a composite test for nectarivorous bird species listed under the TSC Act that are known to or are likely to occur within the Study area. These include the following:

- Regent Honeyeater (Potential to occur);
- Little Lorikeet (Potential to occur);and
- Swift Parrot (Potential to occur).

Regent Honeyeater

The Regent Honeyeater *Anthochaera phrygia* is listed as Critically Endangered under the TSC Act. There are 5 records of the species within the locality. The species was recorded once within the Study area.

The Regent Honeyeater is a nomadic species that inhabits eucalypt open forests and woodlands, particularly box-ironbark vegetation as well as River Oak gallery forest (NSW Scientific Committee 2011b). This species feeds on the nectar of eucalypts and key species include *Eucalyptus sideroxylon* (Mugga Ironbark), *Eucalyptus albens* (White Box) and *Eucalyptus melliodora* (Yellow Box) as well as the mistletoe *Amyema cambagei* which grows on *Casuarina cunninghamiana* (River Oak) (Menkhorst et al. 1999). Additionally insects and other arthropods form a component of the diet of this species (Menkhorst et al. 1999). There are only three known key breeding regions including the Chiltern-Albury area in Victoria and in the Capertee Valley and Bundarra-Barraba area in NSW (OEH 2012h). In NSW the distribution is very patchy and mainly confined to the two main breeding areas and surrounding fragmented woodlands (OEH 2012h).

Little Lorikeet

The Little Lorikeet is listed as Vulnerable under the TSC Act. There are 48 records of the species within the locality. This species has been recorded 9 times within the Locality.

The Little Lorikeet is considered to be a nomadic species mostly occurring in dry, open eucalypt forests and woodlands (NSW Scientific Committee 2009b). Isolated flowering trees in open country are also utilised by this species (OEH 2014d). The Little Lorikeet feeds primarily on nectar and pollen in the tree canopy, particularly on profusely-flowering eucalypts, but also on a variety of other species including melaleucas and mistletoes (OEH 2014d). In some parts of its range, *Eucalyptus albens* and *Eucalyptus melliodora* are particularly important food sources for pollen and nectar respectively (OEH 2014d). This species nests in hollow-bearing trees, particularly those within smooth-barked eucalypts, including *Eucalyptus viminalis* (Manna Gum), *Eucalyptus blakelyi* (Blakely's Red Gum) and *Eucalyptus dealbata* (Tumbledown Red Gum) (NSW Scientific Committee 2009b). Hollows

utilised by the Little Lorikeet are very small, with an approximate diameter of 3 cm (NSW Scientific Committee 2009b). This species is widely distributed across the coastal and Great Divide regions of eastern Australia from Cape York to South Australia, with NSW providing a large portion of the species' core habitat (OEH 2014d). The nomadic movement of the species is influenced by season and food availability, although some areas retain residents for much of the year (OEH 2014d).

Swift Parrot

The Swift Parrot is listed as Endangered under the TSC Act. There are two records of the species in the locality. This species has not been recorded during field surveys of the Study area but is considered to have potential to occur due to the availability of suitable forage habitat and proximity of the records in the locality (within several kilometres).

The Swift Parrot is semi nomadic during winter, foraging in dry woodlands, primarily in Victoria and NSW (DoE 2013). The Swift Parrot migrates from its Tasmanian breeding grounds to overwinter in the box-ironbark forests and woodlands of Victoria, NSW and southern Queensland (DoE 2013). The principal wintering grounds are the inland slopes of the Great Dividing Range and along the eastern coastal plains (DoE 2013). They occur in areas where eucalypts are flowering profusely or where there are abundant lerp infestations (OEH 2012m). Favoured feed trees include *Eucalyptus robusta* (Swamp Mahogany), *Corymbia maculata* (Spotted Gum), *Corymbia gummifera* (Red Bloodwood), *Eucalyptus sideroxylon* (Mugga Ironbark) and *Eucalyptus albens* (White Box) (OEH 2012m).

Assessment of Significance

(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

The Future development will remove potential foraging habitat for the Regent Honeyeater, Little Lorikeet and Swift Parrot. These species are highly mobile and are considered likely to utilise habitat resources throughout the locality, within conserved areas of the Study area and within adjacent conservation reserves. These areas will continue to provide foraging habitat for these species. Accordingly, the Future development is considered unlikely to result in the extinction of a viable local population of these species.

(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

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

The Future development is not considered to significantly increase fragmentation of habitat for these species within the Study area. The majority of the Study area has previously been cleared of treed vegetation through agricultural practices. Some fragmentation will occur between isolated patches of treed vegetation. Although the Future development will increase the amount of overall fragmentation, it will not result in the isolation of important areas of habitat. Habitat connectivity will be maintained within the Study area and with adjacent conservation reserves through the implementation of corridor plantings, creating habitat links across the site.

The habitat to be removed or indirectly impacted by the Future development is not considered important for these species as areas of suitable habitat occur within other areas of the Study area and the locality. Areas of suitable habitat will remain and connect to adjacent conserved habitat, and vegetation on the site will be managed through a VMP which will ensure the long-term viability of the vegetation on the site.

(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 been identified by OEH.

(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan

The *Regent Honeyeater Recovery Plan 1999-2003* (Menkhorst et al. 1999) contains a number of objectives including those relating to the maintenance and enhancement of the value of habitat at key sites, monitoring and research.

The *National Recovery Plan for the Swift Parrot Lathamus discolor* (Saunders and Tzaros 2011) aims to address knowledge gaps and ongoing conservation issues to ensure the Swift

Parrot population is self-sustainable in the long term. Although potential habitat for this species will be removed within the Study area, the consideration of impacts to this species is consistent with the plan.

A recovery plan has not been developed for the Little Lorikeet, and no threat abatement plans are relevant to 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

The following KTPs are relevant to these species within the Study area:

- 'Clearing of native vegetation' as this reduces the area of forage and nesting habitat available for the species;
- 'Loss of hollow-bearing trees' as this reduces the abundance of nesting habitat for some species;
- 'Removal of dead wood and dead trees' as this reduces the abundance of important ground foraging and nesting habitat;
- 'Invasion of native plant communities by exotic perennial grasses' as this results in the loss of key food plants and habitat and encourages flock-foraging species;
- 'Predation, habitat degradation, competition and disease transmission by Feral Pigs, Sus scrofa' as wallowing and rooting causes direct disturbance to habitats and may increase erosion;
- 'Competition and grazing by the feral European rabbit, *Oryctolagus cuniculus*' as they compete with native fauna for resources, alter the structure and composition of vegetation, and degrade the land; and
- 'Competition from feral honey bees (*Apis mellifera*)' as they compete with native fauna for tree hollows and floral resources.

Conclusion

The Future development will result in the loss of potential foraging habitat for the Regent Honeyeater, Little Lorikeet and Swift Parrot. Given that the species are highly mobile and are likely to utilise numerous habitat resources within the locality, the species are considered to remain viable within the locality and their ranges.

A range of impact avoidance, mitigation and compensation measures have been developed for the Future development, some of which are relevant to these species. The measures will assist in addressing the impacts to these species, including the conservation of vegetation on the site, the implementation of locally endemic flowering species in landscape plantings, and the offsetting of areas through an informal BioBanking agreement. As a result of these mitigation and offsetting measures, the Future development is not considered likely to significantly impact these species.

ii. Woodland Birds

The following Assessment of Significance has been prepared as a composite test for woodland bird species listed under the TSC Act that are known to or are likely to occur within the Study area. These include the following:

- Turquoise Parrot (potential to occur);
- Speckled Warbler (potential to occur);
- Brown Treecreeper (eastern subspecies) (potential to occur);
- Diamond Firetail (potential to occur);
- Varied Sittella (potential to occur);
- Scarlet Robin (potential to occur); and
- Flame Robin (potential to occur).

Turquoise Parrot

The Turquoise Parrot is listed as Vulnerable under the TSC Act. There are no records of the species within the locality, however woodlands and forests within the Study area are considered to constitute potential suitable habitat for the species.

The Turquoise Parrot inhabits eucalypt and cypress-pine open forests and woodlands, particularly box or box-ironbark woodlands, often in undulating or rugged country (NSW Scientific Committee 2009c). It also occurs in open woodland or riparian gum woodland, and often near ecotones between woodland and grassland, or coastal forest and heath (NSW Scientific Committee 2009c). Feeding occurs on the ground where the species feeds on seeds of grasses, forbs and native shrubs, as well as some flowers, nectar, fruits, leaves and scale-insects (OEH 2014f) (NSW Scientific Committee 2009c). The Turquoise Parrot nests in tree hollows, logs or posts (OEH 2014f). Hollows are often located within 1-2 m of the ground and, on average, have an entrance 10 x 7 m in size (NSW Scientific Committee 2009c). The Turquoise Parrot occurs from southern Queensland through to northern Victoria (OEH 2014f). Within NSW, the species occurs mainly on the western side of the tablelands, inland slopes and adjoining plains in the eastern half of NSW, and in some dry coastal valleys (NSW Scientific Committee 2009c).

Speckled Warbler (*Chthonicola sagittata*)

The Speckled Warbler is listed as Vulnerable under the TSC Act. There are 188 records of the species within the locality. There are no records of the species within the Study area, however woodlands and forests within the Study area are considered to constitute potential suitable habitat for the species.

The Speckled Warbler inhabits a wide range of *Eucalyptus* dominated communities that have a grassy understorey, often on rocky ridges or in gullies (OEH 2012j). Typical habitat

for this species would include scattered native tussock grasses, a sparse shrub layer, some eucalypt regrowth and an open canopy (OEH 2012j). This species forages on the ground and in the understorey for arthropods and seeds (NSW Scientific Committee 2001b). Preferred areas of foraging habitat contain a combination of open grassy patches, leaf litter and shrub cover (NSW Scientific Committee 2001b). Nests of this species are built using dry grass and strips of bark and are located in a slight hollow in the ground or at the base of a low dense plant, such as grass tussocks, often among fallen branches and other litter (OEH 2012j) (NSW Scientific Committee 2001b). The Speckled Warbler occurs from south-eastern Queensland, through central and eastern NSW to Victoria (NSW Scientific Committee 2001b). In NSW, the Speckled Warbler occurs on the slopes west of the Great Dividing Range, with populations also occurring in drier coastal areas such as the Cumberland Plain, Western Sydney and the Hunter and Snowy River valleys (NSW Scientific Committee 2001b).

Brown Treecreeper (eastern subspecies)

The Brown Treecreeper (eastern subspecies) is listed as Vulnerable under the TSC Act. There are two records of the species within the locality. There are no records of the species within the Study area, however woodlands and forests within the Study area are considered to constitute potential suitable habitat for the species.

The Brown Treecreeper inhabits eucalypt woodlands (including box-gum woodland) and dry open forest (OEH 2012a). The woodlands and forests are usually dominated by stringybarks or other rough-barked eucalypts, typically with an open grassy understorey and sometimes with one or more shrub species (OEH 2012a). This species forages on tree trunks and on the ground amongst leaf litter and on fallen logs for ants, beetles and larvae (NSW Scientific Committee 2004a). Fallen timber is considered to be an important habitat component for foraging (OEH 2012a). The Brown Treecreeper nests in hollows in standing dead or live trees and tree stumps are essential for nesting (OEH 2012a). The Brown Treecreeper occurs through central NSW on the western side of the Great Dividing Range and sparsely scattered to the east of the Divide in drier areas such as the Cumberland Plain of Western Sydney, and in parts of the Hunter, Clarence, Richmond and Snowy River valleys (NSW Scientific Committee 2004a).

Diamond Firetail

The Diamond Firetail is listed as Vulnerable under the TSC Act. There are no records of the species within the locality, however woodlands and forests within the Study area are considered to constitute potential suitable habitat for the species.

The Diamond Firetail inhabits eucalypt woodlands, forests and mallee where there is a grassy understorey (NSW Scientific Committee 2001a). This species has been recorded within box-gum woodlands and *Eucalyptus pauciflora* (Snow Gum) woodlands, as well as open forest, mallee, riparian areas (rivers and creeks), lightly wooded farmland natural temperate grassland, and in secondary grassland derived from other communities (OEH 2012b). This species feeds exclusively on the ground, on ripe and partly-ripe grass and herb seeds and green leaves, and on insects (especially in breeding season) (OEH 2012b). Nests are built in the shrubby understorey, or higher up, particularly under nests of hawks or

ravens (OEH 2012b). The Diamond Firetail also roosts in dense shrubs or in smaller nests built especially for roosting (DEC (NSW) 2005a). In NSW, the species occurs predominantly west of the Great Dividing Range, although populations are known from drier coastal areas such as the Cumberland Plain of western Sydney and the Hunter, Clarence, Richmond and Snowy River valleys (NSW Scientific Committee 2001a).

Varied Sittella

The Varied Sittella is listed as Vulnerable under the TSC Act. There are 20 records of the species within the locality. The species has not been recorded in surveys, but is considered likely to occur due to proximity of records (within several kilometres) and the availability of suitable habitat.

The Varied Sittella inhabits eucalypt forests and woodlands, especially where rough-barked species and mature smooth-barked gums with dead branches are present, as well as mallee and *Acacia* woodland (NSW Scientific Committee 2010c). This species feeds on arthropods gleaned from crevices in rough or decorticating bark, dead branches, standing dead trees and small branches and twigs in the tree canopy (OEH 2012n). Nests are built from plant fibres and cobwebs in an upright tree fork high in the living tree canopy (OEH 2012n). The Varied Sittella is distributed throughout NSW with a nearly continuous extent from the coast to the far west (NSW Scientific Committee 2010c).

Scarlet Robin

The Scarlet Robin is listed as Vulnerable under the TSC Act. There are two records of the species within the locality. This species has not been recorded during current surveys. Suitable forage, nesting and breeding habitat is available within the Study area. This species may occur within the Study area as a vagrant.

The Scarlet Robin inhabits dry eucalypt forests and woodlands, usually in areas where the understorey is open and grassy with few scattered shrubs (OEH 2013e). It is known to occur in both mature and regrowth vegetation and occasionally in mallee and west forest communities, wetlands and tea-tree swamps (OEH 2013e). Important structural components of its habitat include abundant logs and fallen timber (OEH 2013e). It forages from low perches, feeding on invertebrates taken from the ground, tree trunks, logs and other coarse woody debris (NSW Scientific Committee 2010a). Nests are built from plant fibres and cobwebs and are located in the fork of a tree, usually at least 2 m above the ground (NSW Scientific Committee 2010a). The Scarlet Robin is found from south east Queensland to south east South Australia and also in Tasmania and south west Western Australia (OEH 2013e). In NSW, it occurs from the coast to the inland slopes, and can disperse to the lower valleys and plains of the tablelands and slopes after breeding (OEH 2013e).

Flame Robin

The Flame Robin (*Petroica phoenicea*) is listed as Vulnerable under the TSC Act. There is one record of the species in the locality. The species has not been recorded during field surveys of the Study area but is considered to have potential to occur due to the availability

of suitable grassy woodland habitat. This species is expected to occur within the Study area as a vagrant.

The Flame Robin inhabits upland tall moist eucalypt forests and woodlands, often on ridges and slopes during breeding season and migrate to drier more open habitats in the lowlands (i.e. valleys below the ranges, and to the western slopes and plains) (OEH 2013c). This species forages from low perches, from which they sally or pounce onto small invertebrates which they take from the ground or off tree trunks, logs and other coarse woody debris (OEH 2013c). Flying insects are often taken in the air and sometimes gleans for invertebrates from foliage and bark (OEH 2013c). Nests are built from plant materials and spider webs, occurring in sheltered sites such as shallow cavities in trees, stumps or banks (OEH 2013c). The Flame Robin is endemic to south eastern Australia, and ranges from near the Queensland border to south east South Australia and also in Tasmania (OEH 2013c). In NSW, it breeds in upland areas and in winter, many birds move to the inland slopes and plains (OEH 2013c).

Assessment of Significance

(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

The Future development will remove potential habitat for the Turquoise Parrot, Speckled Warbler, Brown Treecreeper, Diamond Firetail, Varied Sittella, Scarlet Robin and Flame Robin. These species are highly mobile and are considered likely to utilise habitat resources throughout the locality and within adjacent conservation reserves. These areas will continue to provide breeding habitat for these species. Accordingly, the Future development is considered unlikely to result in the extinction of a viable local population of these species.

(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

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

The Future development is not considered to significantly increase fragmentation of habitat for these species within the Study area. The majority of the Study area has previously been cleared of treed vegetation through agricultural practices. Some fragmentation will occur between isolated patches of treed vegetation. The Future development will also result in the loss of some ecotonal habitat. Although the Future development will increase the amount of overall fragmentation, it will not result in the isolation of important areas of habitat. Habitat connectivity will be maintained within the Study area and with adjacent conservation reserves.

The habitat to be removed or indirectly impacted by the Future development is not considered important for these species as extensive areas of suitable habitat occur within other areas of the Study area and the locality. Extensive areas of suitable habitat will remain and connect to adjacent conserved habitat.

(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 been identified by OEH.

(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan

Recovery plans have not been developed for these species. The threat abatement plan for the KTP of 'Predation by the European Red Fox Vulpes vulpes' is relevant to some assessed 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 following KTPs are relevant to these species within the Study area:

- 'Clearing of native vegetation' as this reduces the area of forage and nesting habitat available for the species;
- 'Loss of hollow-bearing trees' as this reduces the abundance of nesting habitat for some species;
- 'Removal of dead wood and dead trees' as this reduces the abundance of important ground foraging and nesting habitat;

- 'Invasion of native plant communities by exotic perennial grasses' as this results in the loss of key food plants and habitat and encourages flock-foraging species;
- Predation by the European Red Fox, Vulpes vulpes as they pose a major threat to the survival of native Australian fauna, with non-flying mammals and ground-nesting birds at greatest risk;
- 'Predation, habitat degradation, competition and disease transmission by Feral Pigs, Sus scrofa' as wallowing and rooting causes direct disturbance to habitats and may increase erosion;
- 'Competition and grazing by the feral European rabbit, Oryctolagus cuniculus' as they compete with native fauna for resources, alter the structure and composition of vegetation, and degrade the land; and
- 'Competition from feral honey bees Apis mellifera' as they compete with native fauna for tree hollows and floral resources.

Conclusion

The Future development will result in the direct loss of potential habitat for Turquoise Parrot, Speckled Warbler, Brown Treecreeper, Diamond Firetail, Varied Sittella, Scarlet Robin and Flame Robin. Given that these species are highly mobile and are likely to utilise numerous habitat resources within the locality, the species are considered to remain viable within the locality and their ranges.

A range of impact avoidance, mitigation and compensation measures have been developed for the Future development, some of which are relevant to these species. These include the conservation and management of areas of vegetation within the Study area, the use of locally endemic species in plantings across the site, and the implementation of an informal BioBanking agreement to offset vegetation losses. These measures will assist in addressing the impacts to these species, including addressing the loss of woodland and forest habitat. As a result of these mitigation and offsetting measures, the Future development is not considered likely to significantly impact these species.

iii. Cockatoos

The following Assessment of Significance has been prepared as a composite test for Cockatoos listed under the TSC Act that are known to or are likely to occur within the study area. These include the following:

- Glossy Black-cockatoo; and
- Gang-gang Cockatoo.

Glossy Black-cockatoo

The Glossy Black-Cockatoo is listed as Vulnerable under the TSC Act. There are seven records of the species within the locality. The species has not been detected within the

Study area, but is considered to have potential to occur based on the proximity of records and the availability of suitable foraging habitat.

The Glossy Black-cockatoo inhabits open forest and woodlands of the coast and the Great Dividing Range where stands of She-oak occur (OEH 2014c). This species feeds almost exclusively on the seeds of several species of She-oak (*Casuarina* and *Allocasuarina* species), shredding the cones with their large bill (OEH 2014c). Key food species on the coast and tablelands are *Allocasuarina torulosa* (Forest Oak) and *Allocasuarina littoralis* (Black She-oak), with some *Allocasuarina distyla* taken (Scrub She-oak) (NSW Scientific Commitee 2008). Inland, its key food species include *Allocasuarina verticillata* (Drooping Sheoak) and *Casuarina cristata* (Belah), as well as *Allocasuarina inophloia* (Stringybark She-oak), *Allocasuarina diminuta*, *Allocasuarina gymnanthera*, and sometimes *Allocasuarina leuhmannii* (Buloke) (NSW Scientific Commitee 2008). Nesting occurs in large hollows (26 cm wide and up to 1.4 m deep) within live or dead eucalypts, commonly in a dead spout in a living tree (NSW Scientific Commitee 2008). The Glossy Black-cockatoo occurs from the central Queensland coast to East Gippsland in Victoria, and inland to the southern tablelands and central western plains of NSW, with a small population in the Riverina (OEH 2014c).

Gang-gang Cockatoo

The Gang-gang Cockatoo Callocephalon fimbriatum is listed as Vulnerable under the TSC Act. There are sixrecords of the species within the locality. The species has not been detected within the Study area, but is considered to have potential to occur based on the proximity of records and the availability of suitable foraging habitat.

The Gang-gang Cockatoo inhabits eucalypt open forests and woodlands with an Acacia understorey (NSW Scientific Committee 2008). In summer, generally found in tall mountain forests and woodlands, particularly in heavily timbered and mature wet sclerophyll forests (OEH 2015). In winter, may occur at lower altitudes in drier more open eucalypt forests and woodlands, particularly in box-ironbark assemblages, or in dry forest in coastal areas, and often found in urban areas (OEH 2015) (NSW Scientific Committee 2005). It feeds on seeds obtained in trees and shrubs, particularly eucalypts and acacias, and is also known to feed on seeds of introduced trees and shrubs as well as insect larvae (NSW Scientific Committee 2008). This species nests in hollows in the trunks, limbs or dead spouts of tall living trees, especially eucalypts, often near water (NSW Scientific Committee 2008). The Gang-gang Cockatoo is distributed from southern Victoria through south- and central-eastern NSW (OEH 2015). In NSW the Gang-gang Cockatoo is restricted to the south-eastern coast and highlands, from the lower Hunter and northern Blue Mountains to the south-western slopes (NSW Scientific Committee 2008).

Assessment of Significance

(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

The Future development will remove an area of potential habitat for the Glossy Black-cockatoo and Gang-gang Cockatoo. Large hollow-bearing trees within the Study area may provide breeding habitat for the Glossy Black-cockatoo, however these will be retained within the conserved vegetation. These species are highly mobile and are considered likely to utilise habitat resources throughout the locality and within adjacent conservation reserves. These areas will continue to provide breeding habitat for the Glossy Black-cockatoo species. Accordingly, the Future development is considered unlikely to result in the extinction of a viable local population of these species.

(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

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

The Future development is not considered to significantly increase fragmentation of habitat for these species within the Study area. The majority of the Study area has previously been cleared of treed vegetation through agricultural practices. Some fragmentation will occur between isolated patches of treed vegetation. Although the Future development will increase the amount of overall fragmentation, it will not result in the isolation of important areas of habitat. Habitat connectivity will be maintained within the Study area and with adjacent conservation reserves.

The habitat to be removed by the Future development is not considered important for these species as extensive areas of suitable habitat occur within other areas of the Study area and

the locality. Extensive areas of suitable habitat will remain and connect to adjacent conserved habitat.

(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 been identified by OEH.

(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan

Recovery plans have not been developed for these species, and no threat abatement plans are relevant.

(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 following KTPs are relevant to these species within the Study area:

- 'Clearing of native vegetation' as this reduces the area of forage and nesting habitat available for the species;
- 'Loss of hollow-bearing trees' as this reduces the abundance of nesting habitat;
- 'Removal of dead wood and dead trees' as this reduces the abundance of important nesting habitat; and
- 'Competition from feral honey bees (Apis mellifera)' as they compete with native fauna for tree hollows and floral resources.

Conclusion

The Future development will result in the loss of potential habitat for the Glossy Black-cockatoo and Gang-gang Cockatoo. Given that the species are highly mobile and are likely to utilise numerous habitat resources within the locality, the species are considered to remain viable within the locality and their ranges.

A range of impact avoidance, mitigation and compensation measures have been developed for the Future development, some of which are relevant to these species. Measures include the conservation of areas of vegetation within the Study area, the use of locally endemic species in plantings on the site, and the implementation of an informal BioBanking agreement to offset vegetation removal. The measures will assist in addressing the impacts to these species, including addressing the loss of woodland and forest habitat. As a result of these mitigation and offsetting measures, the Future development is not considered likely to significantly impact the species.

iv. Raptors

The following Assessment of Significance has been prepared as a composite test for raptor bird species (birds of prey) listed under the TSC Act that are known to or are likely to occur within the Study area. These include the following:

- Spotted Harrier (known to occur);
- Little Eagle (potential to occur); and
- Black Falcon (potential to occur).

Spotted Harrier

The Spotted Harrier is listed as Vulnerable under the TSC Act. There are no records of the species within the locality, however the species has been recorded once within the Study area during surveys by NGH Environmental (NGH Environmental, 2013) in 2013.

The Spotted Harrier inhabits grassy open woodland including *Acacia* and mallee remnants, inland riparian woodland, grassland and shrub steppe (NSW Scientific Committee 2010b). It is found most commonly in native grassland, but also occurs in agricultural land, foraging over open habitats including edges of inland wetlands (NSW Scientific Committee 2010b). The diet of the Spotted Harrier includes terrestrial mammals, such as bandicoots, bettongs and rodents, birds and reptiles, occasionally large insects and rarely carrion (NSW Scientific Committee 2010b). Nests are located in trees and built from sticks (OEH 2012k). The Spotted Harrier occurs throughout the Australian mainland, except in densely forested or wooded habitats of the coast, escarpment and ranges, and individuals disperse widely in NSW (NSW Scientific Committee 2010b).

Little Eagle

The Little Eagle (*Hieraaetus morphinoides*) is listed as Vulnerable under the TSC Act. There are no records of the species within the locality, however the species is considered to have potential to occur due to the availability of suitable foraging habitat.

The Little Eagle inhabits open eucalypt forest, woodland or open woodland, she-oak woodlands, acacia woodlands, and riparian woodland within interior NSW, which have an abundance of prey (NSW Scientific Committee 2011a). It feeds on birds, reptiles and mammals, occasionally consuming large insects and carrion. Nests are built using large sticks in tall living trees within remnant patches of vegetation (NSW Scientific Committee 2011a). The Little Eagle is distributed throughout the mainland of Australia, except for the most densely forested parts of the Dividing Range escarpment (NSW Scientific Committee 2011a).

Black Falcon

The Black Falcon is listed as Vulnerable under the TSC Act. There are five records of the species within the locality, and there is considered to be suitable potential habitat for the

species within the Study area based on the presence of woodland and grassland communities.

The Black Falcon inhabits woodland, shrubland and grassland in the arid and semi-arid zones, especially wooded watercourses and agricultural land with scattered remnant trees. The species is usually associated with streams or wetlands. The species nests in healthy, riparian woodland remnants with diverse avifauna (OEH 2013a).

Assessment of Significance

(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

The Future development will remove an area of known habitat for the Spotted Harrier, as well as potential habitat for the Little Eagle and Black Falcon. Large remnant trees within the Study area may provide breeding habitat for these species, and will be retained within the conserved vegetation. These species are highly mobile and are considered likely to utilise habitat resources throughout the locality and within adjacent conservation reserves. These areas will continue to provide breeding habitat for the Spotted Harrier, Little Eagle and Black Falcon. Accordingly, the future development is considered unlikely to result in the extinction of a viable local population of these species.

(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

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

The Future development is not considered to significantly increase fragmentation of habitat for these species within the Study area. The majority of the Study area has previously been cleared of treed vegetation through agricultural practices. Some fragmentation will occur between isolated patches of treed vegetation as well as between grassland patches. Although the Future development will increase the amount of overall fragmentation, it will not result in the isolation of important areas of habitat. Habitat connectivity will be maintained within the Study area and with adjacent conservation reserves.

The habitat to be removed or indirectly impacted by the Future development is not considered important for these species as extensive areas of suitable habitat occur within other areas of the Study area and the locality. Extensive areas of suitable habitat will remain and connect to adjacent conserved habitat.

(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 been identified by OEH.

(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan

Recovery plans have not been developed for these species, and no threat abatement plans are relevant.

(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 following KTPs are relevant to these species within the Study area:

- 'Clearing of native vegetation' as this reduces the area of forage and nesting habitat available for the species; and
- 'Removal of dead wood and dead trees' as this reduces the abundance of important nesting habitat.

Conclusion

The Future development will result in the direct loss of known habitat for the Spotted Harrier and potential habitat for the Little Eagle and Black Falcon. Given that the species are highly mobile and are likely to utilise numerous habitat resources within the locality, the species are considered to remain viable within the locality and their ranges.

Without appropriate mitigation, the impacts to the Spotted Harrier would be considered significant. However, a range of impact avoidance, mitigation and compensation measures have been developed for the Future development which are relevant to these species. These measures include the conservation of vegetation on the site, the use of locally

endemic species in plantings and the implementation of an informal BioBanking agreement to offset the removal of vegetation. The measures will assist in addressing the impacts to these species, including addressing the loss of woodland and forest habitat. As a result of these mitigation and offsetting measures, the Future development is not considered likely to significantly impact these species.

v. Forest Owls

The following Assessment of Significance has been prepared as a composite test for owls listed under the TSC Act that are known to or are likely to occur within the study area. These include the following:

- Barking Owl (potential to occur);
- Powerful Owl (potential to occur);
- Masked Owl (potential to occur); and
- Sooty Owl (potential to occur).

Barking Owl

The Barking Owl is listed as Vulnerable under the TSC Act. There is one record of the species within the locality. This species has not been recorded during field surveys, however suitable foraging habitat exists within the Study area.

The Barking Owl inhabits forests and woodlands of tropical, temperate and semi arid zones that are typically dominated by eucalypts, often red gum species (NSW NPWS 2003). It is flexible in its habitat use, and hunting can extend in to closed forest and more open areas (OEH 2014b). The diet of this species preferentially includes small arboreal mammals such as the Squirrel Glider and Common Ringtail Possum; however they are also known to feed on birds, invertebrates and terrestrial mammals such as rodents and rabbits (OEH 2014b). This species roosts in or under dense foliage in large trees including rainforest species of streamside gallery forests, *Casuarina cunninghamiana* (River Oak), other Casuarina and Allocasuarina species, Eucalypt, Angophora or Acacia species (NSW NPWS 2003). For breeding, this species required hollows in large eucalypts or paperbarks, usually near watercourses or wetlands (NSW NPWS 2003). In NSW, the occurrence of the Barking Owl is widespread on the coastal plain and foothills and the inland slopes and plains (NSW NPWS 2003).

Powerful Owl

The Powerful Owl is listed as Vulnerable under the TSC Act. There are six records of the species within the locality. This species has not been recorded during field surveys, however suitable foraging habitat exists within the Study area.

The Powerful Owl inhabits a range of vegetation types, from woodland and open sclerophyll forest to tall open wet forest and rainforest (OEH 2013d). Optimal habitat includes a tall shrub layer and abundant hollows supporting high densities of arboreal marsupials (DEC

(NSW) 2006). The main prey items of this species are medium-sized arboreal marsupials, particularly the Greater Glider, Common Ringtail Possum and Sugar Glider, with birds and flying foxes occasionally being consumed (OEH 2013d). Roosting occurs in groves of dense mid-canopy trees or tall shrubs in sheltered gullies, typically on wide creek flats and at the heads of minor drainage lines, but also adjacent to cliff faces and below dry waterfalls (DEC (NSW) 2006). This species nests in old hollow eucalypts in unlogged, unburnt gullies and lower slopes within 100 m of streams or minor drainage lines, with hollows greater than 45 cm diameter and greater than 100 cm deep; surrounded by canopy trees and subcanopy or understorey trees or tall shrubs (DEC (NSW) 2006). In NSW, the Powerful Owl is widely distributed throughout the eastern forests from the coast inland to tablelands, with scattered, mostly historical records on the western slopes and plains (OEH 2013d).

Masked Owl

The Masked Owl is listed as Vulnerable under the TSC Act. There is one record of the species within the locality. This species has not been recorded during field surveys of the Study area but is considered to have the potential to occur due to the availability of suitable forage, roosting and breeding habitat and proximity of records (within several kilometres).

The Masked Owl inhabits dry eucalypt forests of the tablelands, western slopes and the undulating wet-dry forests of the coast (DEC (NSW) 2006). Optimal habitat includes an open understorey and a mosaic of sparse (grassy) and dense (shrubby) ground cover on gentle terrain (DEC (NSW) 2006). This species hunts within forests and well as along their edges (OEH 2014e), and is a specialist predator of terrestrial mammals, particularly native rodents (DEC (NSW) 2006). The diet is supplemented by bandicoots, arboreal mammals (Sugar Glider, Common Ringtail Possum), and some birds (DEC (NSW) 2006). Roosting occurs in hollows in live or occasionally dead eucalypts; dense foliage in gullies; and caves or recesses in cliffs (DEC (NSW) 2006). This species nests in old hollow eucalypts, live or dead but commonly live, in a variety of topographic positions from gully to upper slope, with hollows greater than 40 cm wide and greater than 100 cm deep; there is no relationship with distance to streams (DEC (NSW) 2006). The Masked Owl occurs from the coast to the western plains, with records of this species throughout much of NSW, excluding the most arid north-western corner (DEC (NSW) 2006).

Sooty Owl

The Sooty Owl is listed as Vulnerable under the TSC Act. There are no records of the species within the locality. This species has not been recorded during field surveys of the Study area but is considered to have the potential to occur due to the availability of suitable forage, roosting and breeding habitat and proximity of records (within several kilometres).

The Sooty Owl Occurs in rainforest, including dry rainforest, subtropical and warm temperate rainforest, as well as moist eucalypt forests. The species roosts by day in the hollow of a tall forest tree or in heavy vegetation; hunts by night for small ground mammals or tree-dwelling mammals such as the Common Ringtail Possum (Pseudocheirus peregrinus) or Sugar Glider (Petaurus breviceps). The Sooty Owl nests in very large tree-hollows.

Assessment of Significance

(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

The Future development will remove an area of potential habitat for the Barking Owl, Powerful Owl, Masked Owl and Sooty Owl. Large hollow-bearing trees within the Study area may provide breeding habitat for these species, however it is expected that breeding habitat is primarily located outside of the Study area, and that suitable breeding habitat within the site will be retained within the conserved vegetation. These species are highly mobile and are considered likely to utilise habitat resources throughout the locality and within adjacent conservation reserves. These areas will continue to provide breeding habitat for the Barking Owl, Powerful Owl, Masked Owl and Sooty Owl. Accordingly, the Future development is considered unlikely to result in the extinction of a viable local population of these species.

(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

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

The Future development is not considered to significantly increase fragmentation of habitat for these species within the Study area. The majority of the Study area has previously been cleared of treed vegetation through agricultural practices. Although the Future development will increase the amount of overall fragmentation, it will not result in the isolation of important

areas of habitat. Habitat connectivity will be maintained within the Study area and with adjacent conservation reserves.

The habitat to be removed by the Future development is not considered important for these species as extensive areas of suitable habitat occur within other areas of the Study area and the locality. Extensive areas of suitable habitat will remain and connect to adjacent conserved habitat.

(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 been identified by OEH.

(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan

The Draft Recovery Plan for the Barking Owl Ninox connivens (NSW NPWS 2003) contains a number of objectives with the overall aim to recover the species to a position of viability in nature in NSW. The consideration of impacts is consistent with this plan..

The Recovery Plan for Large Forest Owls (DEC (NSW) 2006), which include the Powerful Owl and Masked Owl, contains a number of objectives with the overall aim to ensure that viable populations of the large forest owls continue in the wild in NSW in each region where they presently occur. Although potential habitat for this species will be removed within the Study area, the consideration of impacts to this species is consistent with the plan.

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

The following KTPs are relevant to these species within the Study area:

- Clearing of native vegetation as this reduces the area of forage and nesting habitat available for this species;
- Loss of hollow-bearing trees as this reduces the abundance of nesting habitat;
- Removal of dead wood and dead trees as this reduces the abundance of important ground foraging and nesting habitat;
- Competition and grazing by the feral European rabbit, Oryctolagus cuniculus as they compete with native fauna for resources, alter the structure and composition of vegetation, and degrade the land; and
- Competition from feral honey bees (Apis mellifera) as they compete with native fauna for tree hollows and floral resources.

Conclusion

The Future development will result in the direct loss of potential habitat for the Barking Owl, Powerful Owl, Masked Owl and Sooty Owl. Given that the species are highly mobile and are likely to utilise numerous habitat resources within the locality, the species are considered to remain viable within the locality and their ranges.

A range of impact avoidance, mitigation and compensation measures have been developed for the Future development, some of which are relevant to these species. Measures include the retention of large hollow-bearing trees which constitute suitable breeding habitat for the species, as well as the planting of locally endemic native species which are likely to support the owls' prey species. Additionally, an informal BioBanking agreement is proposed to offset impacts to vegetation. The measures will assist in addressing the impacts to these species, including addressing the loss of woodland and forest habitat. As a result of these mitigation and offsetting measures, the Future development is not considered likely to significantly impact these species.

I.4.2 Invertebrates

i. Cumberland Plain Land Snail (Meridolum corneovirens)

The Cumberland Plain Land Snail is listed as Endangered on Schedule 2 of the TSC Act. One empty shell from this species was detected on site and based on the precautionary approach taken in this assessment it is therefore considered to occur within the study area.

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 (DEC 2005). It primarily occurs in Cumberland Plain Woodland, which is a grassy open woodland with occasional dense patches of shrubs (DEC 2005). It lives under litter or bark, leaves and logs or shelters in loose soil around grass clumps (DEC 2005).

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.*

It is unknown whether a viable local population of the Cumberland Plain Land Snail is present in the Study area, as the habitat within the study area is sparse and suitable CPW patches are small and infrequent, with the exception of the moderate condition CPW in the north-west corner. Some potential habitat for this species will be removed from the Study area; however significant portions of CPW are to be retained on site which will be managed for conservation in the long term. Considering the degraded nature of the Study area and the poor quality of the habitat available, the removal of some areas of degraded habitat is not likely to place a viable local population 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 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:

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

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:

the extent to which habitat is likely to be removed or modified as a result of the action proposed, and

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

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.

An area of moderate and marginal CPW habitat will be removed within the study area. An area will be retained on site and subject to a VMP for its ongoing restoration and management. This represents retainment of relatively higher suitable habitat for this species within the study area. The majority of the area to be cleared under the proposed development comprises regenerating, disturbed CPW not considered high quality habitat for this species.

The potential habitat for this species occurs in the north-west corner of the Study area. This habitat is already partially fragmented from nearby patches of CPW by Boundary and Maguires Roads to the west and north of the Study area, respectively. The proposed development will not increase the existing fragmentation of this community in the immediate area.

The habitat to be removed, modified or fragmented as a result of the proposed development is not considered important to the long-term survival of the species within the locality. The existing habitat is of low to moderate quality and better examples occur nearby in forest to the north-east and Scheyville National Park.

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 Director-General of the OEH.

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.

The proposed development will result in the following KTP;

- Clearing of native vegetation

Small, degraded patches of potential habitat will be cleared for the proposed development. Potential habitat will be preserved and managed within the study area.

No other key threatening process that may be exacerbated by the proposed development will affect this species.

Conclusion

Without mitigation and offsetting, the Future development has the potential to significantly impact the species as the development of the Study area will remove an area of habitat. However, the proposed development is not likely to have a significant impact on Cumberland Plain Land Snail such that the local population would be placed at risk of extinction, as a significant portion of potential habitat will be retained and managed within the study area, and an informal BioBanking agreement is proposed to offset vegetation impacts. As a result of these mitigation and offsetting measures, the Future development is not considered likely to significantly impact the species.

I.4.3 Mammals

i. Arboreal mammals

a. Grey-headed Flying-fox (*Pteropus poliocephalus*)

The Grey-headed Flying-fox is listed as vulnerable under the TSC Act and the EPBC Act. The species has not been detected within the Study area, however is known from six records in the locality. Suitable foraging habitat for the species occurs within the Study area.

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 (DEC (NSW) 2005c). (NSW Scientific Committee 2004e).

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 or breeding habitat occur within the study area. 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. Larger areas of habitat will remain in the locality that will be unaffected by the development.

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:

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

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:

the extent to which habitat is likely to be removed or modified as a result of the action proposed, and

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

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 portion of suitable woodland habitat for this species within the study area will be removed or modified as a result of the Future development. However; significant portions of suitable habitat will be retained.

The most suitable habitat for this species in the study area occurs in the northern part of the Study area and the proposed development will not significantly increase the fragmentation of

these habitat patches. This species has a very large foraging range and covers large areas each night. Accordingly, no area of habitat is likely to become isolated from other areas of habitat for this species.

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 nearby forest patch to the north-east and the nearby Scheyville National Park.

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 Director-General of the OEH.

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.

The proposed development will result in the following KTP;

- Clearing of native vegetation

Several patches of CPW and SSTF woodland occur within the study area, which provide potential foraging habitat. An area will be removed for the proposed development. However; the most suitable habitat for this species will be conserved within the study area. A VMP will be drafted to manage the ongoing rehabilitation and monitoring of these habitat remnants. The extent of clearing proposed is therefore not considered to be a threat to the Grey-headed Flying-fox in the local area.

No other key threatening process that may be exacerbated by the proposed development will affect this species.

Conclusion

The Future development will result in the direct loss of potential habitat for the Grey-headed Flying-fox. Given that the species are highly mobile and are likely to utilise numerous habitat resources within the locality, the species are considered to remain viable within the locality and their ranges.

A range of impact avoidance, mitigation and compensation measures have been developed for the Future development, some of which are relevant to these species. Measures include the retention areas of blossoming trees, as well as the planting of locally endemic native species which are likely generate suitable foraging resources in the future. Additionally, an

informal BioBanking agreement is proposed to offset impacts to vegetation. The measures will assist in addressing the impacts to these species, including addressing the loss of woodland and forest habitat. As a result of these mitigation and offsetting measures, the Future development is not considered likely to significantly impact the species.

b. Yellow-bellied Glider (*Petaurus australis*)

The Yellow-bellied Glider is listed as Vulnerable under the TSC Act. The species has not been detected within the Study area, but has been detected within the locality 29 times. Suitable foraging habitat for the species occurs within the Study area.

The species has a patchy distribution along the east coast and adjacent ranges of Australia from south-eastern South Australia to North Queensland. It is restricted to tall mature eucalypt forests in temperate to subtropical eastern Australia in regions of high rainfall. The species sleeps during the day in leaf-lined nests in hollows of trees. It is a gregarious species and moves about in small groups consisting of a male, up to five females and their young (Strahan 1995).

The Yellow-bellied Glider feeds at night, predominantly on nectar and pollen from eucalypt blossoms and sap. The sap exudes from "V" shaped incisions gnawed on the trunk and main branches of eucalypt trees, and species of Angophora. Tree species incised for sap include Grey Gums (*E. propinqua* and *E. punctata*), Forest Red Gum (*E. tereticornis*), Tallowwood (*E. microcorys*), Red Mahogany (*E. resinifera*) and Messmate (*E. obliqua*) (NPWS, 2002). They are also dietary opportunists and feed on invertebrates, insect exudates and beetle larvae (Russell, 1980). Smooth-barked eucalypts are important to the species because of the diversity of foraging substrates and food resources they provide. The species nests in large tree-hollows in which they build substantial, spherical nests of eucalypt leaves.

Assessment of Significance

(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

No individuals of the Yellow-bellied Glider have been recorded within the Study area. The Yellow-bellied Glider will primarily be impacted by the Future development through direct removal of habitat within the Study area. The habitat to be impacted within the Study area is not considered important for the long-term survival of the species within the locality. Sufficient habitat will be retained within the Study area and an extensive area of habitat is conserved in the locality.

(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

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

The Future development is not considered to significantly increase fragmentation of habitat for this species within the Study area. The majority of the Study area has previously been cleared of treed vegetation through agricultural practices. Although the Future development will increase the amount of overall fragmentation, it will not result in the isolation of important areas of habitat. Habitat connectivity will be maintained within the Study area and with adjacent conservation reserves.

The habitat to be removed or indirectly impacted by the Future development is not considered important for this species as extensive areas of suitable habitat occur within other areas of the Study area and the locality. Extensive areas of suitable habitat will remain and connect to adjacent conserved habitat.

(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 been identified by OEH.

(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 developed for this species, and no threat abatement plans are relevant.

(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 following KTPs are relevant to potential habitat for this species within the Study area:

- 'Clearing of native vegetation' as this reduces the area of forage and nesting habitat available for this species;
- 'Loss of hollow-bearing trees' as this reduces the abundance of nesting habitat; and
- 'Removal of dead wood and dead trees' as this reduces structural complexity and the abundance of important nesting habitat.

Conclusion

The Future development will result in the direct loss of potential habitat for the Yellow-bellied Glider. The habitat to be impacted within the Study area is not considered important for the long-term survival of the species within the locality.

A range of impact avoidance, mitigation and compensation measures have been developed for the Future development, some of which are relevant to these species. Measures include the retention areas of blossoming trees, as well as the planting of locally endemic native species which are likely generate suitable foraging resources in the future. Additionally, an informal BioBanking agreement is proposed to offset impacts to vegetation. The measures will assist in addressing the impacts to these species, including addressing the loss of woodland and forest habitat. As a result of these mitigation and offsetting measures, the Future development is not considered likely to significantly impact the species.

ii. Cave-dependent Bats

The following Assessment of Significance has been prepared as a composite test for a number of cave-roosting microbat species known or considered to have potential to occur within the Study area based on the availability of suitable habitat. These include the following:

- Eastern Bentwing-bat (known to occur)

Eastern Bentwing-bat

The Eastern Bent-wing Bat (Miniopterus schreibersii oceanensis) is listed as Vulnerable under the TSC Act. There are seven records of this species within the locality. This species was recorded within the study area within woodland vegetation communities.

The Eastern Bentwing-bat inhabits a variety of habitats including rainforest, wet and dry sclerophyll forest, monsoon forest, open woodland, melaleuca forests and open grasslands (Churchill 2008). In treed areas, this species forages above the canopy and in more open areas it flies within a few metres of the ground (Churchill 2008). Their diet consists of moths, flies, cockroaches and beetles (Churchill 2008). Foraging can occur long distances from the roost site (Churchill 2008). Caves are the primary roosting habitat, but they also use derelict mines, storm-water tunnels, buildings and other man-made structures (OEH 2012c).

Maternity caves have very specific temperature and humidity regimes (OEH 2012c). The Eastern Bentwing-bat occurs along the east and north-west coasts of Australia (OEH 2012c).

Assessment of Significance

(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

The Future development will remove known foraging habitat for the and Eastern Bentwing-bat. The species is highly mobile and are considered likely to utilise habitat resources throughout the locality and within adjacent conservation reserves. The life cycle of the species is not considered likely to be impacted by the future development as the Study area represents foraging habitat only, and will not impact breeding or roosting habitat. Significant areas of suitable foraging habitat exist within the broader locality.

(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

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

The Future development is not considered to significantly increase fragmentation of habitat for the species within the Study area. The majority of the Study area has previously been cleared of treed vegetation through agricultural practices. Although the Future development

will increase the amount of overall fragmentation, it will not result in the isolation of important areas of habitat. Habitat connectivity will be maintained within the Study area and with adjacent conservation reserves.

The habitat to be removed or indirectly impacted by the Future development is not considered important for these species as extensive areas of suitable habitat occur within other areas of the Study area and the locality. Extensive areas of suitable habitat will remain and connect to adjacent conserved habitat.

(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 been identified by OEH.

(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 the Eastern Bentwing-bat. No threat abatement plans are relevant to 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

The following KTPs are relevant to these species within the Study area:

- 'Clearing of native vegetation' as this reduces the area of forage habitat available for the species;

Conclusion

The Future development will result in the direct loss of known forage habitat for the Eastern Bentwing-bat. Given that the species is highly mobile and is likely to utilise numerous habitat resources within the locality, the species is considered to remain viable within the locality and its range.

The long-term viability of the species in the locality is unlikely to be impacted; however as a precautionary measure, and when considered without mitigation, local population of the Eastern Bentwing-bat has potential to be significantly affected by the Future development. A range of impact avoidance, mitigation and compensation measures have been developed for the Future development, some of which are relevant to the species. Measures include the retention areas of forest and woodland vegetation, as well as the planting of locally endemic native species which are likely generate suitable foraging resources in the future. Additionally, an informal BioBanking agreement is proposed to offset impacts to vegetation. The measures will assist in addressing the impacts to these species, including addressing the loss of woodland and forest habitat. As a result of these mitigation and offsetting measures, the Future development is not considered likely to significantly impact the species.

iii. Hollow-dependent Bats

The following Assessment of Significance has been prepared as a composite test for a number of hollow-roosting microbat species that known or considered to have potential to occur within the Study area. These include the following:

- Eastern Freetail-bat (known to occur);
- Yellow-bellied Sheathtail-bat (potential to occur);
- Eastern False Pipistrelle (potential to occur);
- Greater Broad-nosed Bat (potential to occur); and
- Southern Myotis (potential to occur).

Eastern Freetail Bat *Mormopterus norfolkensis*

The Eastern Freetail Bat is listed as Vulnerable under the TSC Act. There are 15 records of this species within the locality. This species was recorded within the Study area within woodland communities.

The Eastern Freetail-bat occurs along the east coast from south Queensland to southern NSW. They roost mainly in tree hollows but will also roost under bark or in man-made structures. The species occurs in dry sclerophyll forest and woodland east of the Great Dividing Range.

Yellow-bellied Sheathtail-bat *Saccolaimus flaviventris*

The Yellow-bellied Sheathtail-bat is listed as Vulnerable under the TSC Act. There is one record of this species within the locality. This species was not recorded during surveys, however there is potential for this species to both forage and breed within the Study area.

The Yellow-bellied Sheathtail-bat inhabits a range of habitats including wet and dry sclerophyll forest, open woodland, *Acacia* shrubland, mallee, grasslands and deserts (Churchill 2008). The species typically forages above the canopy and lower over open species and at the forest edge (Churchill 2008). Their diet predominantly consists of beetles, but grasshoppers, crickets, leafhoppers, shield bugs, wasps and some flying ants are also consumed (Churchill 2008). This species is known to roost in tree hollows and buildings, and in treeless areas they are known to utilise mammal burrows (OEH 2012o). The Yellow-bellied Sheathtail-bat occurs across northern and eastern Australia (OEH 2012o).

Eastern False Pipistrelle *Falsistrellus tasmaniensis*

The Eastern False Pipistrelle is listed as Vulnerable under the TSC Act. There are six records of this species within the locality. This species was not recorded during surveys, however there is potential for this species to both forage and breed within the Study area.

The Eastern False Pipistrelle inhabits wet sclerophyll and coastal mallee, preferring tall and wet forests where trees are more than 20m in height and the understorey is dense (Churchill 2008). They also occur in open forests and lower altitudes (Churchill 2008). Foraging occurs within gaps and spaces within the forest, avoiding areas with a dense understorey, and along tracks, creeks and rivers (Churchill 2008). Their diet is mainly comprised of beetles and moths, with occasional bugs, ants and flies (Churchill 2008). This species typically roosts in tree hollows, however there are a few records in caves and old buildings (Churchill 2008). The Eastern False Pipistrelle occurs on the south-east coast and ranges of Australia, from southern Queensland to Victoria and Tasmania (OEH 2012d).

Greater Broad-nosed Bat *Scoteanax rueppellii*

The Greater Broad-nosed Bat is listed as Vulnerable under the TSC Act. There are five records of the species within the locality. This species was not positively identified as occurring within the Study area as the calls of this species are difficult to differentiate from those of similar species. However, given the available habitat and the presence of records within the locality, this species is likely to occur within the Study area.

The Greater Broad-nosed Bat inhabits a variety of habitats including moist gullies in mature coastal forest, rainforest, open woodland, Melaleuca swamp woodland, wet and dry sclerophyll forests, cleared paddocks with remnant trees and tree-lines creeks in open areas (Churchill 2008). Foraging occurs at the edge of isolated trees and forest remnants (Churchill 2008). Their diet consists mainly of beetles with moths, ants and large flies consumed occasionally (Churchill 2008). This species roosts in tree hollows, cracks and fissures in trucks and dead branches, under exfoliating bark, as well as the roofs of old buildings (Churchill 2008). The Greater Broad-nosed Bat occurs mainly in the gullies and river systems that drain the Great Dividing Range, from north-eastern Victoria to the Atherton Tableland, extending to the coast over much of its range (OEH 2012f).

Southern Myotis *Myotis macropus*

The Southern Myotis is listed as Vulnerable under the TSC Act. There are 10 records of the species within the locality. This species was not positively identified as occurring within the Study area as the calls of this species are difficult to differentiate from those of similar species. However, given the available habitat and the presence of records within the locality, this species is likely to occur within the Study area.

The species generally roosts in groups of 10 - 15 close to water in caves, mine shafts, hollow-bearing trees, storm water channels, buildings, under bridges and in dense foliage. The species forages over streams and pools catching insects and small fish by raking their feet across the water surface

Assessment of Significance

(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

The Future development will remove known habitat for the Eastern Freetail-bat, and potential habitat for the Yellow-bellied Sheathtail Bat, Eastern False Pipistrelle, Greater Broad-nosed Bat and Southern Myotis. These species are highly mobile and are considered likely to utilise habitat resources throughout the locality and within adjacent conservation reserves. Large hollow-bearing trees will be retained on the site and habitat corridors will be constructed. These areas will continue to provide breeding habitat for these species. Accordingly, the Future development is considered unlikely to result in the extinction of a viable local population of these species.

(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

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

The Future development is not considered to significantly increase fragmentation of habitat for these species within the Study area. The majority of the Study area has previously been cleared of treed vegetation through agricultural practices. Although the Future development will increase the amount of overall fragmentation, it will not result in the isolation of important areas of habitat. Habitat connectivity will be maintained within the Study area and with adjacent conservation reserves. Some dams will be removed, some waterbodies will be retained subject to the landscape plan.

The habitat to be removed or indirectly impacted by the Future development is not considered important for these species as extensive areas of suitable habitat occur within

other areas of the Study area and the locality. Extensive areas of suitable habitat will remain and connect to adjacent conserved habitat.

(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 been identified by OEH.

(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 the hollow-dependent species assessed. 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

The following KTPs are relevant to these species within the Study area:

- 'Clearing of native vegetation' as this reduces the area of forage and roosting habitat available for the species;
- 'Loss of hollow-bearing trees' as this reduces the abundance of roosting habitat for some species;
- 'Removal of dead wood and dead trees' as this reduces the abundance of important roosting habitat; and
- Competition from feral honey bees *Apis mellifera* as they compete with native fauna for tree hollows and floral resources;

Conclusion

The Future development will result in the direct loss of known habitat for the Eastern Freetail-bat, and potential habitat for the Yellow-bellied Sheathtail Bat, Eastern False Pipistrelle, Greater Broad-nosed Bat and Southern Myotis. Given that these species are highly mobile and are likely to utilise numerous habitat resources within the locality, the species are considered to remain viable within the locality and their ranges.

The long-term viability of these species in the locality is unlikely to be impacted; however as a precautionary measure, and when considered without mitigation, local population of the Eastern Freetail-bat has potential to be significantly affected by the Future development. A range of impact avoidance, mitigation and compensation measures have been developed for the Future development, some of which are relevant to these species. Measures include the retention areas of forest and woodland vegetation containing tree hollows, retention of farm dams, and well as the planting of locally endemic native species which are likely generate suitable foraging resources in the future. Additionally, an informal BioBanking agreement is proposed to offset impacts to vegetation. The measures will assist in addressing the impacts to these species, including addressing the loss of woodland and forest habitat. As a result of

these mitigation and offsetting measures, the Future development is not considered likely to significantly impact these species.

Appendix J

Additional Documentation

J.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.

J.1.1 Other Approvals Required for the Development or Activity

The proposal will be assessed under Part 5 of the Environmental Planning and Assessment Act 1979. The development application will be lodged concurrently with this SIS.

J.1.2 Licence Matters

Cumberland Ecology currently holds the following licences:

- Scientific licence (Section 132 C) (National Parks and Wildlife Act 1974)

J.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 of the SIS.

Appendix K

Staff CVs

Dr David Robertson

Director

Dr David Robertson's ecological career has spanned 27 years since completion of his PhD at Melbourne University in 1985. He is a specialist ecologist with expertise in both botany and zoology and has worked as an ecological consultant since 1993.

During part of his career, David has also been a lecturer in plant taxonomy, plant ecology and freshwater ecology at Charles Sturt University and Austalian Catholic University. This has developed his capability to work in both aquatic and terrestrial flora and fauna inventory, management of threatened species, ecological risk assessment, wetland rehabilitation and management, and ecological research for environmental impact assessment.

Throughout his career, David has worked on a wide variety of ecological projects. This includes ecological projects across Australia, including New South Wales, Queensland, ACT, Victoria, Tasmania and Western Australia. He has also gained international experience as the senior ecologist involved with consultancies in Hong Kong, Sri Lanka and the Philippines.

Since the inception of Cumberland Ecology Pty Ltd in 2003, David and his team of ecologists at Cumberland Ecology have worked on ecological investigations throughout NSW, averaging over 80 projects per year. They have worked extensively within the Hunter Valley, Gunnedah Basin, Sydney Region, on coastal projects and in the Western Blue Mountains.

David has had, and continues to have, direct involvement in many large-scale vegetation mapping and flora and fauna impact assessment projects. David has worked on many projects that entail the preparation of ecological offsets and Cumberland Ecology has been engaged to monitor such offsets. Cumberland Ecology has helped to formulate offsets for many mining projects in NSW, and also for mines in north Queensland and in Mindanao (Philippines). Under David's direction, an array of monitoring work has been and is being conducted at sites in the Hunter Valley, Gunnedah, Coffs Harbour and Western Sydney.

Education

Bachelor of Science (Honours), Ecology, University of Melbourne, 1980.

Doctor of Philosophy, Ecology, University of Melbourne, 1986.

David undertook his tertiary education at Melbourne University, completing a Bachelor of Science majoring in botany and zoology. This included a thesis submitted as part of the requirements for the B.Sc. Honours Degree at The University of Melbourne School of Botany:

Aspects of the Ecology of Eucalyptus sideroxylon (A. Cunn, ex W. Wool) at Point Addis, Victoria (November 1980).

He completed his Doctor of Philosophy in 1985 at the School of Botany, which was entitled:

Interrelationships between Kangaroos, Fire and Vegetation Dynamic at Gellibrand Hill Park, Victoria (August 1985).

Professional Memberships and Affiliations

Ecological Society of Australia

Ecological Consultants Association of NSW

He is also an accredited BioBanking Assessor.

Employment History

David has lectured in ecology and aquatic biology at Charles Sturt University. Consultancy employment includes as a senior ecologist with the Australian Museum, senior ecologist in charge of the Ecological Services Practice for ERM Australia, and Director of Cumberland Ecology (current).

2003- 2013 - Cumberland Ecology: Director

1997-2003 - ERM: Senior Ecologist

1998-1999 - Australian Catholic University: Lecturer (part time)

1995-1996 - Australian Museum: Senior Ecological Consultant

1987-1994 - Charles Sturt University: Lecturer

1986-1987 - University of Melbourne: Research Fellow

Experience

David has been involved in the development of biodiversity offset packages for a number of projects, which have included strategic assessments of land as compensatory habitats and involvement in the development of indirect offsets such as threatened species recovery plans. As part of the development of suitable offsets, David is regularly involved in negotiations with clients and regulators about the level of mitigation measures required for flora and fauna impacts.

Recent examples of projects requiring significant offsets work entailing the selection of suitable remnant vegetation for enduring protection and habitat for threatened species listed under the EPBC Act and TSC Act include the:

- Mt Pleasant Project Modification: involved in the selection and subsequent ecological investigations of candidate offset lands, resulting in a substantial offsets package of over 12,000 ha. Further involvement in the development of an Offset Management Plan designed to effectively manage and monitor the offsets for conservation and ecological gains.

- Maules Creek Coal Project is a large-scale flora and fauna baseline study of 2,700 hectares of forest and woodland in the locality of Narrabri, New South Wales. The purpose of the study, which has been ongoing since 2008, was to assess the potential impacts of proposed open cut mining on biodiversity. Key biodiversity values of the Project Area include a number of threatened bird and bat species as well as threatened ecological communities such as the critically endangered Box Gum Woodland.

- Warkworth Mine Extension Project: assistance in the development of an approved offset package. Involved in fauna surveys of the offsets to provide baseline data on their ecological value, particularly for threatened species, and which fulfil a component of the Project's conditions of consent.

- Drayton South Coal Project: involved in the strategic selection and survey, including vegetation mapping, flora and fauna investigations, of suitable offsets.

- Shenhua Watermark Coal Project; presents a complex suite of ecological issues including Critically Endangered and Endangered Ecological Communities (including areas of Box Gum Grassy Woodland), threatened flora and fauna. In particular Koalas, an iconic species for which the area is well known, are present within the proposed Watermark Project Boundary. This has resulted in extensive surveying and mapping of suitable offsets.

- Bengalla Mine Project involves the preparation of an EIA to support a State Significant Development application. The Project impacts include clearing of Box Gum Woodland and Derived Native Grassland, as well the removal of habitat for a range of threatened species and an endangered population. This has involved negotiations with State and Federal Government Authorities to develop appropriate offsets for the Project impacts. This includes participation in the Upper Hunter Strategic Assessment. Cumberland Ecology is currently preparing an Assessment Report for submission as part of the UHSA, including summary of the results of extensive flora and fauna survey and calculations using the Biodiversity Certification Assessment Methodology (BCAM).

Dr Alexander Pursche

Project Manager / Ecologist

Alex Pursche is a Project Manager and Ecologist at Cumberland Ecology, based in Sydney. He has a PhD in Ecology, and a Bachelor of Science (Hons) in Ecology.

Alex has eight years experience in fauna monitoring, four of which have been gained working as an environmental contractor for mining and infrastructure clients in New South Wales, Queensland, and the Northern Territory. This included assessment of offset properties, subsidence monitoring, and environmental impact assessment studies for powerlines, pipelines, roadways, urban developments, and mines.

He has extensive experience in identifying terrestrial and marine vertebrate fauna including birds, mammals, reptiles, amphibians, and fish. Alex has experience operating in remote conditions and consistently delivers large scale surveys to clients in a timely manner.

Alex has experience in Geographic Information Systems (GIS - ArcMap) and uni-/multi-variate statistical analysis relevant for testing hypotheses for complex ecological interactions. Alex also has the capacity to produce reports to a high standard suitable for publication in peer reviewed scientific journals.

Recent consultancy work has included:

- Biodiversity Management Plans;
- Fauna monitoring studies;
- Species Impact Statements;
- Production of digitised maps; and
- Ecological impact assessment.

Key Industry Sectors

- Mining;
- Linear Infrastructure;
- Residential development; and
- Conservation.

Education

Doctor of Philosophy, University of NSW 2013

Bachelor of Science (1st Class Honors) 2006

Fields of Competence

- Fauna Surveys;
- Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*;
- NSW *Threatened Species Conservation Act 1995*;
- NSW *Fisheries Management Act 1994;*
- NT *Territory Parks and Wildlife Conservation Act 2000*; and
- QLD *Nature Conservation Act 1992*.

Key Projects

Mount Pleasant Offset Management Plan

Alex is managing the assessment of offset properties for the Mount Pleasant Project (Rio Tinto Coal Australia). This project will see baseline data collected to determine any effects of biodiversity management between 2013 and 2020.

Ecological Impact Assessments

Alex has written fauna and flora impact assessments for residential developments for Great Lakes, Bankstown, Warringah, and Pittwater LGAs.

Fauna Monitoring

Since 2010, Alex has worked monitoring vertebrate fauna for large scale mining and infrastructure projects. Tasks included general fauna assessment as well as targeted searches for *EPBC Act* and *TSC Act* listed threatened species. Recent clients include Rio Tinto, Centennial Coal, Glencore (Xstrata), BHP, LendLease, and Leighton.

Aleksei Atkin

Project Manager / Ecologist

Aleksei Atkin is a Project Manager/Ecologist at Cumberland Ecology, based in Sydney. Aleksei has worked in New South Wales, Queensland and the Northern Territory on numerous projects with threatened species and/or endangered ecological community issues and is experienced in assessing projects in response to threatened species legislation.

Specifically, Aleksei has expertise in targeted fauna survey including:

- Microchiropteran bat trapping and call analysis;
- Ornithological surveys and mist netting;
- Arboreal and terrestrial mammal trapping; and
- Reptile and amphibian surveys.

Additionaly, Aleksei has experience in terrestrial restoration ecology, bush regeneration, flora surveys and mapping vegetation communities for a variety of projects, including residential subdivisions, linear infrastructure and mining.

Recent consultancy work has included:

- Flora and fauna impact assessments for Major Projects;
- Preparation of Vegetation and Bushland Management Plans;
- Pre-clearing surveys, clearing supervision and nest box monitoring;
- Targeted threatened fauna habitat assessment and survey;
- Vegetation community mapping; and
- Monitoring of impacts from approved activities on ecological issues.

Fields of Competence

- Ecological field surveys and biological monitoring
- Environmental impact assessment;
- Preparation of ecological management plans;
- Monitoring environmental restoration performance criteria; and
- Bushland Regeneration.

Key Industry Sectors

- Urban development;
- Mining and Extraction industries; and
- Government utilities.

Education

Bachelor of Natural Science majoring in Nature Conservation, University of Western Sydney

Currently completing Masters of Wildlife Management, Macquarie University

Key Projects

Targeted Fauna Surveys

Aleksei has conducted targeted surveys for numerous threatened fauna species on large scale infrastructure and mining projects. These surveys include habitat assessments, survey design, trapping and identification.

Flora and Fauna Impact Assessment within the Sydney region

Aleksei has been involved in numerous ecological assessments including Species Impact Statements and Flora and Fauna Assessments as part of development applications for a variety of projects.

Nest Box Monitoring and Pre-clearing surveying

Aleksei has conducted and implemented nest box management plans, pre-clearing surveys and clearing supervision on high profile infrastructure and mining projects.

Macropod Management Plans

Aleksei is experienced in the preparation and implementation of macropod management plans for the Dept. of Defence.

Bo Davidson

Project Manager / Ecologist

Bo Davidson is a Project Manager and Ecologist at Cumberland Ecology. He has a Bachelor of Environmental Science, a Postgraduate Diploma of Environmental Studies and a Master of Environment (Environmental Studies).

Bo has experience in fauna surveys and environmental impact assessment. He has worked on development applications for residential rezoning as well as conducting fauna field surveys for public infrastructure and major mining operations.

Fields of Competence

- Fauna field surveys;
- Environmental impact assessment;
- Data analysis; and
- Pre clearance and clearance supervision.

Key Industry Sectors

- Urban development; and
- Major mining operations.

Education

Master of Environment (Environmental Studies) (Macquarie University).

Postgraduate Diploma of Environmental Studies (Macquarie University).

Bachelor of Environmental Science (Macquarie University).

Key Projects

Maules Creek Whitehaven Coal Mine

Bo has been involved in flora and fauna management for the Maules Creek coal mine. Work to date has consisted of pre-clearing surveys and clearance supervision for preliminary infrastructure, as well as project management and client liaison.

During the operational clearance phase, Bo was responsible for coordinating a large field team, as well as managing logistics, resources and data collection. In addition, he was the primary adviser to staff and contractors for all ecological matters during this phase of the project.

Muswellbrook Sewerage Treatment Plant

Bo was responsible for coordinating preliminary planning for a Flora and Fauna Assessment for a proposed sewerage treatment plant and associated infrastructure. This project involved regular client liaison, assisting with the organisation of meetings with the Muswellbrook Shire Council and conducting desktop research.

North-West Growth Centre (NWGC)

Bo has been involved with pre-clearing surveys and tree-felling observation at a range of sites within the NWGC. These works involved surveys for threatened fauna and/or their habitats as well as for Threatened Ecological Communities. This work also involved liaison with felling crews, site engineers and site managers.

Box Hill North rezoning proposal

Bo assisted with a range of works concerning the proposed re-zoning of a 380ha parcel of land at Box Hill North, NSW. This work included the preparation of a Flora and Fauna Assessment, a Referral to the Commonwealth, and a Biobanking Offsets report. This project also involved the organisation of several fieldwork sessions and regular liaison with clients.

Cecilia Phu

Senior Project Manager / Botanist

Cecilia Phu is a senior project manager and botanist at Cumberland Ecology based in Sydney. She has a Bachelor of Science (Honours) with a major in Biology.

Cecilia has been involved in numerous ecological impact assessment projects with threatened species and endangered ecological community issues, and routinely assesses projects in response to State and Commonwealth threatened species legislation. Her work entails vegetation mapping, targeted survey for threatened species, impact assessment and report preparation. Cecilia manages major ecological impact assessments, biodiversity offsetting and management projects.

Cecilia also has experience in survey design, community and population data analysis (SPSS and ePRIMER), as well as collection, storage and analysis of geospatial data in order to provide key strategic advice to clients and department agencies (CivilCad, MapInfo). Recent consultancy work has included:

- Vegetation mapping;
- Flora and fauna impact assessment;
- BioBanking assessments;
- Offset assessments via EPBC offsetting policy;
- Development of bushland management plans with focuses on threatened species habitat management, weed control and bush regeneration;
- Monitoring studies for approved activities.

Fields of Competence

- Commonwealth *Environment Protection and Biodiversity Conservation Act 1999;*
- NSW *Environmental Planning and Assessment Act 1979;*
- *NSW Threatened Species Conservation Act 1995;*
- BioBanking Assessors Training Course at TAFE Ryde;
- Botanical survey, biological monitoring, pre-clearing and clearing surveys and environmental impact assessment; and
- Geospatial Information Systems (GIS).

Key Industry Sectors

Urban, industrial and logistics, infrastructure, extraction.

Education

Bachelor of Science, University of Sydney, 2006.

Bachelor of Science (Honours) in Biology, University of Sydney, 2008

Key Projects

Flora and Fauna Impact Assessments

Cecilia has over six years experience in conducting and managing ecological assessments in the Hunter region and the Gunnedah Basin for major mining projects. Additionally she has worked within the Galilee and Bowen Basins in north Queensland. Cecilia has also worked extensively in the Sydney Metropolitan area and has particular experience within the Sydney Growth Centres and the Western Sydney Employment Area.

BioBanking Assessments

Cecilia has assessed a number of impacts and offsets for projects using the BioBanking assessment methodology in the Sydney Basin and Hunter Valley regions. Work has included vegetation mapping, flora and fauna surveys and habitat assessments. Data collected during fieldwork was utilised within the BioBanking Credit Calculator.

Management Plans and Monitoring

Cecilia has prepared management plans for development and offsetting projects in the Sydney, north east NSW and western NSW areas. Such projects have involved monitoring of grazing, vegetation restoration and animal population census.

Other Projects

Cecilia has been involved in terrestrial and aquatic ecology studies for a gold mining project in the Philippines. She has worked closely with local botanists and zoologists in the Philippines and was involved in the preparation of the terrestrial ecology and aquatic reports for the Project's international Environmental Impact Statement.

Dr Gitanjali Katrak

Senior Project Manager / Ecologist

Gitanjali Katrak is a Project Manager/Ecologist at Cumberland Ecology, based in Sydney. She has a Bachelor of Sciences (Biological Sciences) with Honours and a PhD in intertidal wetland ecology.

Gitanjali has has been involved in terrestrial and aquatic surveys, impact assessments, ecological monitoring and statistical analyses. She has also managed State Significant Developments and Section 5A assessments with endangered ecological community and threatened species issues. Gitanjali has also been involved in the preparaton of Statements of Evidence for the NSW Land and Environment Court.

Recent consultancy work has included:

- Flora and fauna impact assessments for State Significant Developments, Part 3A projects and Part 5 projects;
- Vegetation mapping, aquatic surveys and targeted threatened species habitat assessment and surveys;
- Impact assessment and offsetting for mining projects; and
- Statisical analyses for ongoing monitoring programmes.

Fields of Competence

- *Commonwealth Environment Protection and Biodiversity Conservation Act 1999;*
- NSW *Threatened Species Conservation Act 1995*;
- Terrestrial and aquatic ecological surveys, particularly aquatic invertebrate identification and assessment of threatened species and ecological communities; and
- Statistical analyses.

Key Sectors

- Urban development; and
- Mining and Extraction industries.

Education

- Bachelor of Science (Honours) in Biological Sciences, La Trobe University, VIC. 2002
- Doctor of Philosophy, Intertidal Wetland Ecology. Flinders University, SA. 2011

Key Projects

Wallarah 2 Coal Project

Gitanjali is currently managing the Ecological Impact Assessments and Offset Strategy for the Development Application of the State Significant Wallarah 2 Coal Project.

St. Mary's Development – Lend Lease

Gitanjali is involved with the progressive development of the former ADI site at St Marys, Western Sydney. Assessments have included the preparation of large scale Species Impact Statements for the Development Precinct DA's and ongoing monitoring within the Regional Park.

Land and Envrionment Court cases

Gitanjali has been involved in court proceedings for several Land and Environment court cases dealing with a variety of issues, including aquatic pollution, groundwater dependent ecosystems, threatened species issues and offset strategies.

Flora and fauna surveys

Gitanjali has been involved in ecological assessments including Species Impact Statements and Flora and Fauna Assessments as part of development applications for a variety of projects in the greater Sydney Metropolitan area.

Statistical analysis

Gitanjali has experience conducting statistical analyses, using programmes such as SPSS and PRIMER, to determine biological patterns and community structure.

Alexander Graham

Research and Field Assistant

Alex Graham is a Research and Field Assistant at Cumberland Ecology, based in Sydney. He is soon to complete a Bachelor of Science majoring in Biology.

Alex has nearly 3 years of experience in flora and fauna surveys and impact assessments as part of development applications for a variety of projects, particularly residential subdivisions and mining projects in NSW. This includes environmental impact assessments and assessments of offset properties.

Recently, Alex has managed Section 5A assessments involving endangered ecological community and threatened species issues. He has extensive experience in identifying terrestrial vertebrate fauna, including mammals, birds, reptiles, and amphibians.

Recent consultancy work has included:

- Species Impact Statements for proposed residential developments;
- Monitoring studies;
- Habitat assessments and surveys targeting threatened species;
- Fauna impact assessments (7-part tests); and
- Fauna surveys in regional NSW.

Fields of Competence

- *Commonwealth Environment Protection and Biodiversity Conservation Act 1999;*
- NSW *Threatened Species Conservation Act 1995*;
- Ecological surveys, particularly assessment of threatened species and ecological communities; and
- Report writing.

Key Industry Sectors

- Urban development;
- Linear Infrastructure;
- Mining and Extraction industries; and
- Residential development

Education

Undertaking Bachelor of Science in Biological Sciences, Macquarie University, NSW 2014.

Key Projects

Greystones Development – Lend Lease

Alex is involved with the progressive development of the former pine plantation site in Pemulwuy, western Sydney. Assessments have included the preparation of large scale Species Impact Statements for the Nelsons Ridge DA.

Flora and fauna surveys

Alex has been involved in flora and fauna surveys as part of development applications for a variety of projects in the greater Sydney Metropolitan area.

Mining Surveys and Monitoring

Alex has conducted surveys for large-scale mining projects, involving general and targeted surveys for mammals, reptiles, amphibians and birds. He has worked on various mining sites including Shenhua Watermark, Rio Tinto, and most recently was involved in surveys conducted for the Whitehaven Maules Creek site.

Fauna Monitoring

Alex has worked as pasrt of a team monitoring fauna for large scale infrastructure projects, including targeted searches for *EPBC Act* and *TSC Act* listed threatened species. Recent clients include Lend Lease, Leighton, Burton and AbiGroup.

Bryan Furchert

Project Manager / Botanist

Bryan Furchert is a Project Manager and Botanist at Cumberland Ecology, based in Sydney. He has a Bachelor of Biodiversity and Conservation.

Bryan has six years experience in bushland regeneration as a Team Leader. He has experience in assessment of degradation of native vegetation communities and identification of factors contributing to exotic weed invasion of communities on a site by site basis.

Bryan has extensive experience in vegetation management and community restoration within Hawkesbury Sandstone soil communities. This includes undertaking botanical surveys of vegetation communities throughout the Sydney Basin Bioregion, within the Brigalow Belt South Bioregion in New South Wales and within the Northern Brigalow Belt Bioregion in Queensland.

Bryan also has experience in Geospatial Information Systems (MapInfo), statistical analysis of biodiversity values with biodiversity indices, and population census of fauna species.

Recent consultancy work has included:

- Vegetation Management Plans;
- Flora and fauna impact assessment;
- Species Impact Statements; and
- Monitoring studies.

Fields of Competence

- NSW *Noxious Weeds Act 1993*
- Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*;
- NSW *Threatened Species Conservation Act 1995*;
- Weeds of National Significance (WoNS) – identification and control; and
- Botanical surveys.

Key Industry Sectors

- Urban development;
- Industiral and logistics;
- Infrastructure; and
- Extraction.

Education

Bachelor of Biodiversity and Conservation, Macquarie University, 2012.

Diploma of Conservation and Land Management, Belmont TAFE, 2009.

Completed professional development courses have included:

- Recognising Water Weeds (DPI), and
- Aboriginal Site Awareness (The Aboriginal Heritage Office).

Key Projects

Bushland Restoration

Bryan worked on the restoration of natural bushland areas in a number of Hawkesbury Sandstone soil derived coastal vegetation communities (including endangered ecological communities) between 2006 and 2012. Tasks included weed management, including noxious weeds and WoNS, revegetation, preparation for ecological and fuel reduction burns, and erosion control.

Botanical Surveys

Bryan has undertaken botanical surveying for site and BioBanking assessments, targeted threatened species searches, and identification and mapping of Critically Endangered and Endangered Ecological Communities.

State Significant Projects and Development Applications

Bryan has undertaken vegetation mapping for large extraction projects and prepared Vegetation Management Plans, Ecological Constraints Analyses, Ecological Impact Assessments, Flora and Fauna Assessments and Species Impact Statements for Development Applications.

Long-term Monitoring

Bryan has also undertaken flora monitoring and reporting for long term restoration projects for urban bushland remnants, and large biodiversity offset areas.