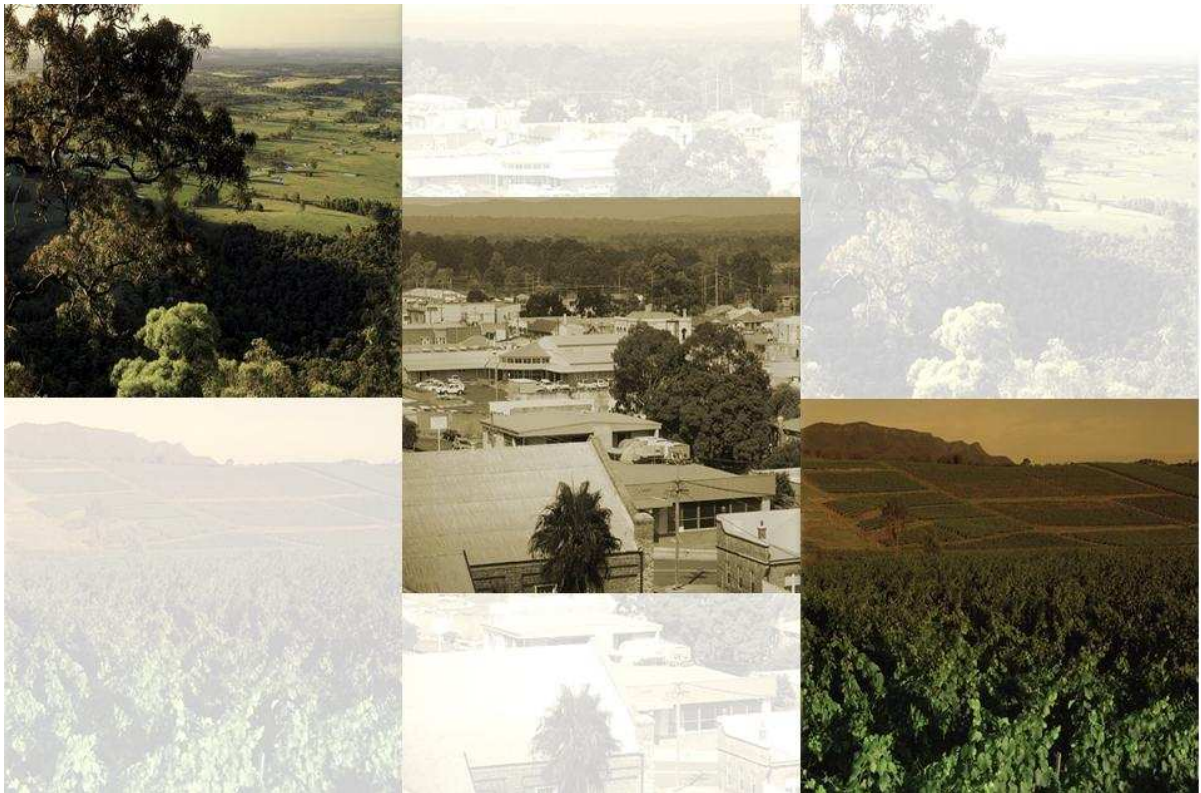




CESSNOCK

DEVELOPMENT CONTROL PLAN 2010

PART E
SPECIFIC AREAS



E.12: GOVERNMENT ROAD PRECINCT

Amendment History

Version No.	Nature of Amendment	Date in Force
1	Adoption by Council on 15 September 2010	23 December 2011

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APPENDIX 2 Flooding and Stormwater Management Assessment (Northrop Engineers, June 2007)

APPENDIX 3 Biodiversity Offset Assessment Report (BOAR) (RPS Harper Somers O’Sullivan, June 2008)

12.1 INTRODUCTION

12.1.1 Introduction

The Government Road Precinct is one of eleven (11) site specific rezonings considered as part of Council’s Draft Comprehensive Local Environmental Plan. At the time of rezoning, the Precinct comprised nine (9) allotments, held in multiple ownerships.

To ensure appropriate consideration is given to issues identified through the rezoning process, and to ensure the Precinct is developed in a coordinated manner, a new Chapter, known as the Government Road Precinct, has been inserted into Cessnock Development Control Plan 2010.

12.1.2 Application

This Chapter applies to all lands within the Government Road Precinct at North Cessnock (currently known as Lots 33 & 34 DP 1004648, Lots 1 & 2 DP 1067096, Lot 1 DP 392537, Lot 1 DP 403312, Lot 1 DP 403335 and Lots A & B DP 421061), (see Figure 1: Locality Plan).

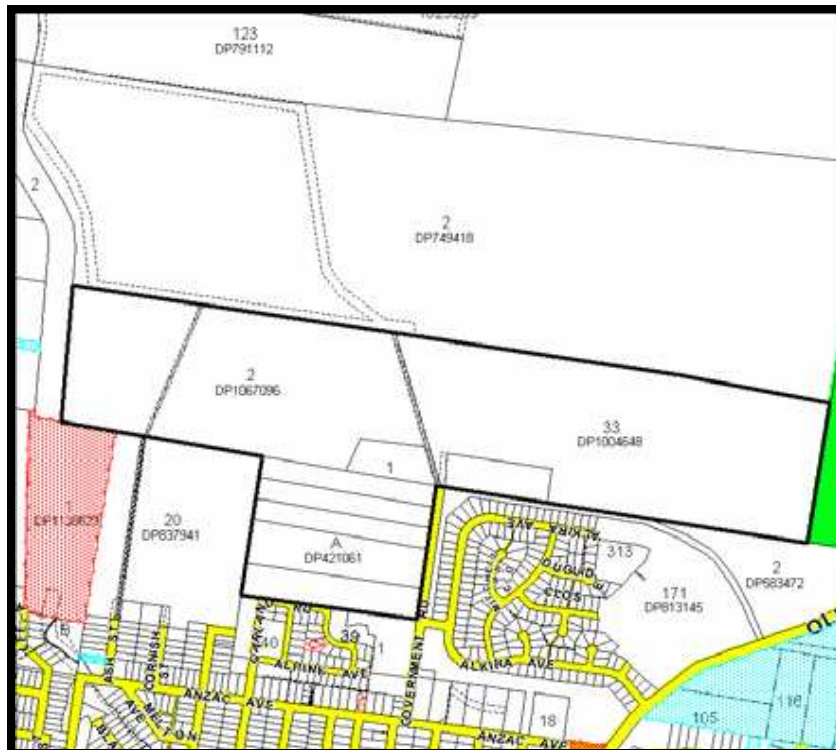


FIGURE 1: LOCALITY PLAN

12.1.3 Purpose

This Chapter adds detail to those planning provisions of the Cessnock Comprehensive Local Environmental Plan, and general provisions of Development Control Plan 2010.

Specifically, this Chapter seeks to highlight matters identified during the rezoning stage that require further investigations prior to further development of land within the Precinct. These matters include;

- Soil Management, Geotechnical and Contamination Issues
- Stormwater and Flood Management
- Flora and Fauna Management
- Bushfire Management
- Current land use constraints

12.1.4 How to use this Chapter

Section 2.0 of this plan provides details of the statutory and land use context for Government Road Precinct. Performance criteria and prescriptive measures are provided in Section 3.0 addressing site contamination and other geotechnical constraints, stormwater and flood management, flora and fauna, bushfire, landscaping, subdivision of land dwellings and ancillary structures.

12.1.5 Relationship with other Plans, Policies and Chapters

Where there is an inconsistency between this Chapter and any environmental planning instrument (EPI), the provisions of the EPI shall prevail. An EPI includes a State Environmental Planning Policy (SEPP) and a Local Environmental Plan (LEP).

This Chapter should be read in conjunction with all Chapters of the Cessnock Development Control Plan 2010, in particular the 'Subdivision Guidelines' and the 'Urban Housing' chapters. Where there is any inconsistency between this Chapter and any future amendments to the City Wide Development Control Plan (DCP), the provisions of this Chapter shall prevail.

All development must also be consistent with Council's Engineering Standards and Policies.

12.2 CONTEXT OF DEVELOPMENT

12.2.1 Statutory Context

This Plan has been prepared in accordance with the requirements of the *Environmental Planning and Assessment Act 1979*, and the Environmental Planning and Assessment Regulations.

This Plan is concerned with the effective implementation of the objectives, principles and provisions of the *Cessnock Local Environmental Plan 1989* (LEP), adding detail to the planning provisions contained in the LEP.

Areas of the site suitable for urban development are zoned R2 Low Density Residential under the LEP. A generous odour buffer is provided to the Waste Water Treatment Plant north-west of the site. A tributary of Black Creek that traverses the south-west corner of the site poses a constraint to residential development due to flooding. The odour buffer and flood prone land is zoned RU2 Rural Landscape. A pocket of land just over 1 hectare in size and zoned RU2 Rural Landscape will contain public recreation facilities to service the Government Road Precinct.

12.2.2 Land Use Context

Government Road Precinct is adjacent to existing residential development in north Cessnock, just 2 kilometres from the Central Business District on Vincent Street. The total site area is approximately 87 hectares, although only 34.91 hectares is zoned R2 Residential and suitable for residential development.

The subject site is located immediately east of Black Creek and a tributary of Black Creek passes diagonally through the south-western corner of the Precinct. The residential land in the south-west of the site drains toward this tributary, with slopes generally orientated to the south-west. There is some flooding associated with Black Creek, the extent of which is shown in Figure 2 –Constraints Plan.

The residential land in the east of the site is gently undulating, with a slight ridge through the centre of the site running a north-south orientation. The land generally slopes to the east and west of the ridge. Development of the site is not constrained by steep slopes.

At the time of rezoning, there were a number of land uses within and adjacent to the Precinct which may impact on future residential development. These include;

Land use	Property Address
Hunter Water Corporation Wastewater Treatment Plant	Located adjacent to north of Precinct upon Lot 2 DP749418
Council Works Depot	Located adjacent to south east of Precinct upon Lot 2 DP583472
Animal boarding establishment	Located within Precinct upon Lot 1 DP403335
Fuel depot	Located within Precinct upon Lot A DP421061

Proponents should refer to Cessnock Development Control Plan 2010 Part C, Chapter 4 Land Use Conflict and Buffer Zones for specific requirements.

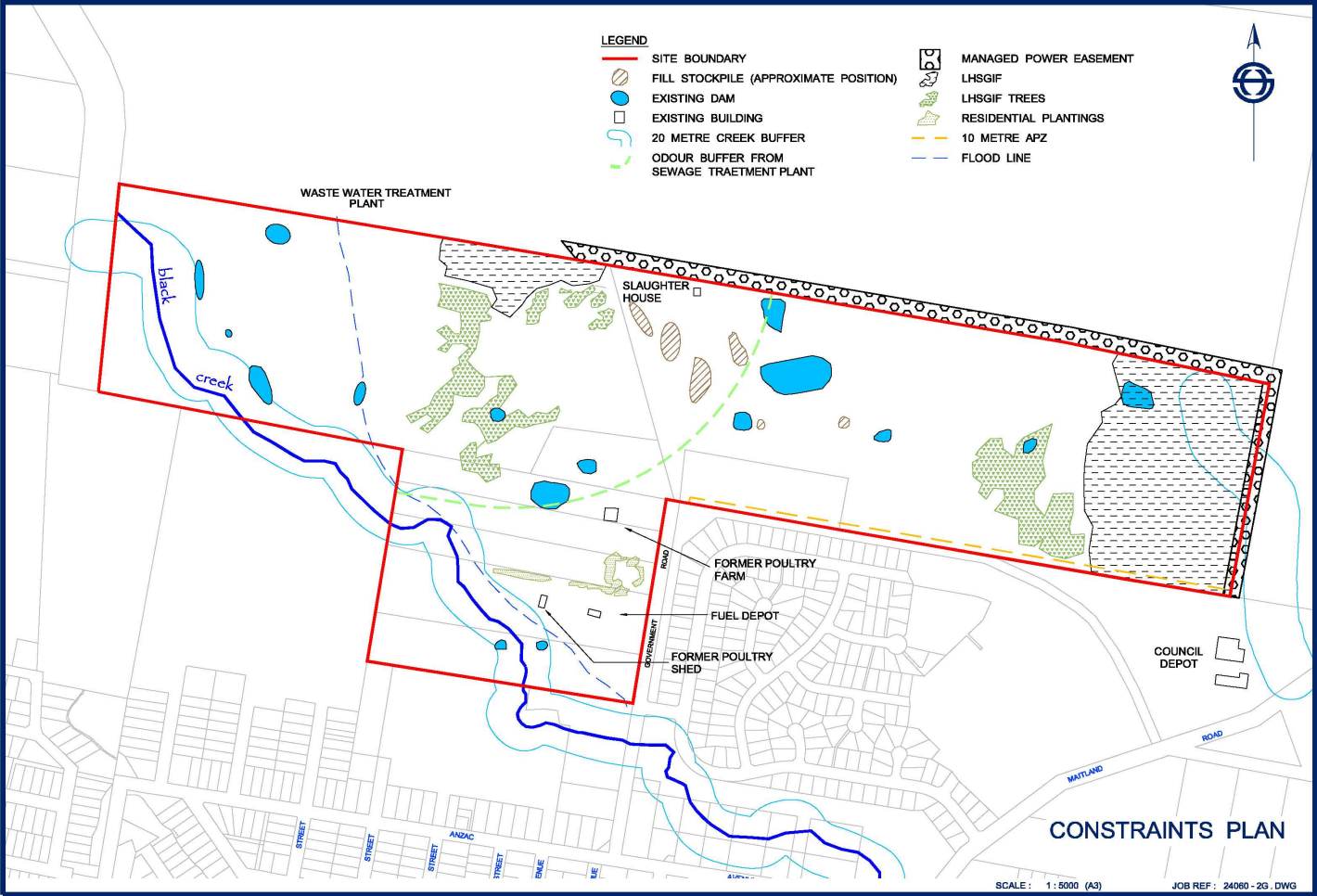


FIGURE 2: CONSTRAINTS PLAN

12.3 DEVELOPMENT GUIDELINES

The following development considerations apply to development within the Government Road Precinct.

12.3.1 Site Contamination and other geotechnical constraints

Geotechnical assessment undertaken as part of the rezoning process revealed that a number of existing lots within this Precinct have the potential to be contaminated from past land uses. A summary of potentially contaminated sites, together with comment on remediation options is provided as Appendix 1.

Any principal development application proposing a more intense land use will be required, as a minimum, to carry out further geotechnical investigation in accordance with the recommendations and comments provided at Appendix 1 and Cessnock Development Control Plan 2010 Part Council Chapter 3: Contaminated Lands of this DCP.

Performance Criteria

- To remove any potential sources of contamination from the site for the safety of future residents and the environment.

Prescriptive Measures

- Carry out any additional testing recommended in the *Remediation Options for Potential Contamination* prepared by Douglas Partners prior to residential subdivision of the Government Road Precinct. The following investigations may be required during the preparation of development applications to address the geotechnical and contamination issues and enable detailed design.

Details of other geotechnical investigations to be provided with any principal development application shall include;

- o Additional assessment of the salinity potential across the site to assess the extent of salinity and implications to the proposed development.
- o Further geotechnical investigation for footing design parameters (classification to AS 2870).
- o Assessment of the depth and the extent of potential soft/wet areas within the lower portions of the site and beneath the on-site dams.
- o Slope stability assessment of on-site dams, if they are to remain on-site.

12.3.2 Stormwater and Flood Management

A *Flooding and Stormwater Management Assessment* (Northrop Engineers, June 2007), prepared in support of the rezoning application, found that there are three distinct catchments within the Precinct, but only one watercourse with evidence of a defined flow path, being the tributary of Black Creek.

The tributary will experience minor flooding during the 1% AEP flood event. Indicative flood levels are shown on the Constraints Plan in Figure 2, with a copy of the Flooding Assessment reproduced at Appendix 2.

Performance Criteria

- To ensure residential development is located above localised flood waters.
- To control the quality and quantity of water entering receiving waterways.

Prescriptive Measures

- Residential development should not occur below the 1% AEP flood line.
- Habitable floor levels should be designed a minimum of 500mm above peak 1% AEP flood levels on site.
- Stormwater management for the development will comply with the requirements of Cessnock Development Control Plan 2010, Part D Chapter 1 – Subdivision Guidelines, Council's Engineering Requirements for Development and industry best practice.

12.3.3 Flora and Fauna Management

A *Flora and Fauna Assessment* (RPS Harper Somers O'Sullivan, June 2007), submitted in support of the rezoning application identified the nature of existing vegetation within the Precinct and potential impacts which may result from future urban development. Potential impacts include the removal of approximately 8 hectares of Lower Hunter Spotted Gum Ironbark Forest, a listed *Endangered Ecological Community* under the Threatened Species Conservation Act, 1995.

In order to maximise the urban potential of this Precinct, Council and the Department of Environment and Climate Change (DECC) have endorsed a proposal for an "off-site offset" to compensate for the removal of the 8 hectares of Lower Hunter Spotted Gum Ironbark Forest. Full details of this arrangement are provided in the Biodiversity Offset Assessment Report (BOAR) (RPS Harper Somers O'Sullivan, June 2008) which is reproduced as Appendix 3.

Performance Criteria

- Ensure that development is carried out in a manner that minimises any adverse impact on threatened species, populations or ecological communities.

Prescriptive Measures

- Development consent for a principal development application which proposes the removal of native vegetation from within the Precinct shall not be granted until transfer of the proposed offset site and other associated actions, as detailed in the Biodiversity Offset Assessment Report (BOAR) (RPS Harper Somers O'Sullivan, June 2008), has been effected.
- *Pomatostomus temporalis temporalis* (Grey-crowned Babblers) occur within the site. To ensure that this species is able to persist within the site following development it is recommended that shrubby tree species, such as *Casuarina spp.* or small-leaved *Melaleuca spp.* be incorporated into street planting and landscaping plant lists.
- One *E. parramattensis subsp. decadens* individual was found to occur in the south of the site. To ensure that this species continues to occur within the site it should be added to street planting and landscaping plant lists, where feasible.
- The planting of locally occurring native plant species should be encouraged in residential plantings to provide foraging opportunities for locally occurring native fauna species.
- Responsible pet ownership should be encouraged to counter potential impacts upon native fauna.

12.3.4 Bushfire Management

Performance Criteria

- Identify potential bushfire threats to individual sites.
- Ensure all new dwellings have measures sufficient to minimise impacts of bushfires.
- Minimise the impact of fire protection measures on vegetation, fauna, views, watercourses, soil erosion and access.

Prescriptive Measures

- Specific assessment shall be undertaken at appropriate times throughout the development process as development of the site progresses in accordance with the current standards of the Rural Fire Service (RFS).
- A Bushfire Threat Assessment must form part of all development applications for new dwellings, residential subdivisions, or modifications of existing dwellings in bushfire prone areas.
- Assessment of threat from bushfire must examine impacts of the proposal within and external to the site, including dwelling construction materials and road networks for emergency traffic.
- Fire protection measures must be capable of being maintained by owners and users.
- Asset protection zones may incorporate fire trails, cleared road verges and fixed building lines.

12.3.5 Landscaping and Visual Amenity

Performance Criteria

- Enhance the amenity of Government Road Precinct through the implementation of an appropriate landscape strategy that consistently addresses public spaces and streets.
- Encourage the planting of locally occurring native plant species in residential plantings to provide foraging opportunities for locally occurring native fauna species.

Prescriptive Measures

- Explore the potential for linkages between existing development and Government Road Precinct, particularly along the Black Creek Tributary with the provision of open, landscaped space.
- *Pomatostomus temporalis temporalis* (Grey-crowned Babblers) occur within the site. To ensure that this species is able to persist within the site through subsequent development it is recommended that shrubby tree species, such as *Casuarina spp.* or small-leaved *Melaleuca spp.* be incorporated into street planting and landscaping plant lists.
- One *E. parramattensis subsp. decadens* individual was found to occur in the south of the site. To ensure that this species continues to occur within the

site in the future it should be added to street planting and landscaping plant lists.

- Consider the use of street plantings to reinforce the internal road hierarchy.

12.3.6 Subdivision of Land

All development applications for land subdivision are to satisfy the provisions of Cessnock Development Control Plan 2010, Part D – Chapter 1 Subdivision Guidelines, whilst also having regard to the following specific requirements:

Performance Criteria

- To provide a legible, fully serviced residential subdivision with adequate access to each residential allotment created.
- To have regard to the principles of good urban design with the aim of creating a functional and high amenity residential subdivision.

Prescriptive Measures

The extent of the buffer zone determines the building line of any new dwellings. It is permissible for a residential allotment to be contained within land zoned RU2 Rural Landscape and affected by the Hunter Water Corporation Sewer Buffer. However, the dwelling in that allotment must be located outside of the sewer buffer zone.

12.3.7 Dwellings and ancillary structures

Performance Criteria

- Maximise the privacy and outlook enjoyed by adjoining and adjacent residents.
- Create a visually attractive streetscape.

Prescriptive Measures

- Residential development should not occur below the 1% AEP flood line.
- Habitable floor levels should be designed a minimum of 500mm above peak 1% AEP flood levels on site.
- Residential development shall be in accordance with the provisions of Cessnock Development Control Plan 2010.

APPENDIX 1

Remediation Options for Potential Contamination (Douglas Partners, March 2009)

APPENDIX 2

Flooding and Stormwater Management Assessment (Northrop Engineers, June 2007)

APPENDIX 3

Biodiversity Offset Assessment Report (BOAR)

(RPS Harper Somers O’Sullivan, June 2008)



MJB:kmj
Project No: 39755.01
Doc Ref: P:\39755.01\Docs\39755.01-01L.doc
9 March 2009

Roger Davies
C/- RPS Harper Somers O'Sullivan
PO Box 428
HAMILTON NSW 2303

Attention: Hannah Benson

Email: hannah@rpshso.com.au

Dear Madam

**REMEDIAL OPTIONS FOR POTENTIAL CONTAMINATION
PROPOSED REZONING
LOTS 1 AND 2 DP 1067096, LOTS 33 AND 34 DP 1004648, LOT 1 DP 392537, LOT 1
DP403312, LOT 1 DP 403335 AND LOTS A AND B DP 421061
GOVERNMENT ROAD, NORTH CESSNOCK**

1. INTRODUCTION

This letter presents a summary of remediation options for potential contaminants identified by Douglas Partners Pty Ltd (DP) for Lots 1 & 2 DP 1067096, Lots 33 & 34 DP 1004648, Lot 1 DP 392537, Lot 1 DP 403312, Lot 1 DP 403335 and Lots A & B DP 421061, Government Road, North Cessnock, New South Wales. The work was carried out at the request of Ms Hannah Benson of RPS Harper Somers O'Sullivan Pty Ltd (RPSHSO) on behalf of Mr Roger Davies.

We understand that Council requires further information to determine whether the site can be made suitable for residential use.

The following scope of work was conducted:

- Brief review of DP preliminary contamination assessment (PCA) of June 2007 and letter dated 8 January 2008 (Ref 1);
- Preparation of this letter report outlining typical remedial options for the identified sources of potential contamination.

2. BACKGROUND REVIEW

DP previously conducted a preliminary contamination and urban capability assessment for the site in June 2007 (Ref 1). The preliminary assessment comprised a desktop study, site inspection and preliminary subsurface investigation. Laboratory testing was not conducted for the preliminary assessment.

The preliminary assessment identified a number of potential contamination issues, which will need to be further assessed and remediated (if required) prior to development, including potential contaminants associated with the following sources:

- Fuel Depot;
- Effluent disposal systems;
- Imported fill stockpiles and general surface fill;
- Former chicken sheds;
- Unsealed farm sheds and stockpiled farm equipment and rubbish;
- Former Piggery and slaughter house;
- Former Cropping;
- Adjacent Wastewater Treatment Plant;
- Adjacent Council Depot.

Site observations made during the preliminary assessment generally suggested that impacts associated with the above potential contaminant sources are likely to be localised.

The preliminary assessment concluded that the site was considered to be suitable for future urban development, subject to the identified issues (including potential contamination issues discussed above) being addressed, and appropriate engineering design. The report also recommended further investigation including detailed sampling and analysis of soils and/or groundwater (as required) to assess the above potential contamination sources.

Further to DP preparing the preliminary assessment, DP prepared a letter, at the client's request, to respond to Council's concerns regarding the suitability of the site for urban development from a contamination perspective.

The letter, dated 8 January 2008 outlined the potential contaminants identified in the preliminary assessment (Ref 1), and stated that the site could be made suitable for residential development from a contamination perspective following further assessment and remediation (as required). It was also suggested that further assessment and remedial works could be undertaken as part of the development application stage (i.e. prior to subdivision of the site for residential development purposes).

3. REMEDIATION OPTIONS

It should be noted that although a detailed investigation has not been undertaken to assess the presence or extent of potential site contamination, conventional remediation techniques could be conducted to address the sources of contamination identified in Ref 1.

A summary of typical remedial options is presented in Table 1 below for each potential contaminant source identified in Reference 1.

Table 1 – Potential Contamination and Typical Remediation Options

Area / Source	General Potential Contaminants	Typical Remediation Options
Effluent Disposal Systems associated with residences on-site	Nutrients, hydrocarbon, heavy metal and microbiological contaminants	Effluent treatment systems to be appropriately decommissioned and soils treated with lime (as required) by a qualified contractor. Impacted soils within effluent disposal system should be stripped, classified and disposed to an appropriate licensed landfill or treated with lime (microbiological contaminants) and subsequently validated.
Imported fill stockpiles and general surface filling (typically beneath buildings and sheds). Predominantly within Lot 33 including stockpiles and nearby surface soils observed to contain fibro sheeting materials	Hydrocarbons, heavy metals, pesticides, PCBs, asbestos	Contaminated soils not suitable for re-use on-site should be stripped, classified and disposed to an appropriate licensed landfill. Validation of impacted area to be conducted following remediation.
Former Chicken Sheds, former/current stockpiles of manure, ash (Lot 1, DP 392537, Lot 1, DP 403312 and Lot A, DP 421061	Hydrocarbons, heavy metals, microbiological contaminants and nutrients	Contaminated soils not suitable for re-use on-site should be stripped, classified and disposed to an appropriate licensed landfill. Microbiological impact could be limed and re-use on-site subject to appropriate validation. Surface microbiological impact may be suitable for spelling (remediation via natural UV radiation). If burial pits are identified, it is likely that excavation and appropriate treatment/disposal will be required for aesthetic, geotechnical and contamination reasons. Validation of impacted areas to be conducted following remediation.
Unsealed farm sheds and stockpiled farm equipment, and rubbish	Hydrocarbons, heavy metals, pesticides, PCB's and asbestos	Contaminated soils not suitable for re-use on-site should be stripped, classified and disposed to an appropriate licensed landfill. Validation of impacted area to be conducted following remediation.
Fuel Depot – UST's, AST's and associated storage shed and equipment storage (Lot 1, DP 421061) and disused AST's (Lot 33, DP 1004648)	Hydrocarbons, heavy metals, phenols	Hydrocarbon impacted soils can be stripped/excavated and treated on site by landfarming or bioremediation until suitable for re-use on-site. Contaminated soils not suitable for landfarming could be excavated/striped, classified and disposed to an appropriate licensed landfill. Validation of impacted area to be conducted following remediation. Groundwater contamination (if present) could be remediated using various techniques including natural attenuation, pump and treat, air sparging etc. The removal of the contaminant source (i.e. soil impact/leaking fuel tanks) would be required to prevent further groundwater impact.

Table 1 – Potential Contamination and Typical Remediation Options (continued)

Former Piggery and slaughter house	Nutrients, microbiological contaminants, hydrocarbons and heavy metals	Contaminated soils not suitable for re-use on-site should be stripped, classified and disposed to an appropriate licensed landfill. Microbiological impact could be treated with lime and re-use on-site subject to appropriate validation. Surface microbiological impact may be suitable for spelling (ie remediation through natural UV radiation). If burial pits are identified, it is likely that excavation and appropriate treatment/disposal will be required for aesthetic, geotechnical and contamination reasons. Validation of impacted areas to be conducted following remediation.
Former Cropping	Heavy metals and pesticides (although site history indicates pesticides were not used on-site)	Contaminated soils not suitable for re-use on-site should be stripped, classified and disposed to an appropriate licensed landfill. Vertical mixing could be considered as a remediation option, following removal of hot spots and subject to meeting NSW DECC guidelines (Ref 6). Validation of impacted area to be conducted following remediation.
Wastewater treatment plant	Nutrients, hydrocarbons, microbiological and heavy metals (groundwater/surfacewater impact).	Remediation of groundwater through pump and treat, natural attenuation or barrier wall, remediation of impacted soils via stripping and appropriate off-site disposal (surface soils).
Council Depot	Hydrocarbons, heavy metals, pesticides, PCBs	Contaminated soils not suitable for re-use on-site should be stripped, classified and disposed to an appropriate licensed landfill. Source of contamination (ie off-site source) should be removed or a permanent barrier installed to prevent future migration and contamination of site. Validation of impacted area to be conducted following remediation.

Notes to Table 1:

Waste Classification of soils to be conducted with reference to NSW DECC Waste Classification Guidelines (Ref 4);

Investigation and remediation of fuel depot and hydrocarbon impacted soils to be undertaken with reference to NSW EPA service station guidelines (Ref 5).

4. COMMENTS

As shown in Table 1 above, typical remediation options are available to address the potential sourced of contamination identified within the site. It is therefore considered that the site could be made suitable for residential development, subject to further investigation and site remediation in accordance with the relevant regulatory and statutory requirements.

It is noted that a detailed Contamination Assessment will be required to assess the presence and extent of contamination within the site, and to confirm remediation requirements.

5. LIMITATIONS

DP have performed investigation and consulting services for this project in general accordance with current professional and industry standards for land contamination investigation.

DP cannot provide unqualified warranties nor does DP assume any liability for site conditions not observed or accessible during the time of the investigations.

No site investigations can be thorough enough to provide absolute confirmation of the presence or absence of substances, which may be considered contaminating, hazardous or polluting.

The typical remedial options provided are based on limited site information and DP experience with similar sites and contaminants. The remedial options should be confirmed following the detailed contamination assessment.

This report and associated documentation and the information herein have been prepared solely for the use of RPSHSO and Mr Roger Davies and any reliance assumed by other parties on this report shall be at such parties own risk. Any ensuing liability resulting from use of the report by other parties cannot be transferred to DP.

Please contact the undersigned if you have any questions regarding the above matter.

Yours faithfully
DOUGLAS PARTNERS PTY LTD

Reviewed by:

Matthew Blackert
Associate

Chris Bozinovski
Principal

References

1. Douglas Partners Pty Ltd, "Preliminary Contamination and Urban Capability Assessment, Lots 1 & 2, DP 1067 06, Lots 33 & 34 DP 1004648, Lot1 DP 392537, Lot 1 DP 403312, Lot 1 DP 403335 and Lots A & B DP 421061, Government Road, North Cessnock", Project 39755, June 2007.
2. Douglas Partners Pty Ltd, "Preliminary Contamination and Urban Capability Assessment, Lots 1 & 2, DP 1067 06, Lots 33 & 34 DP 1004648, Lot1 DP 392537, Lot 1 DP 403312, Lot 1 DP 403335 and Lots A & B DP 421061, Government Road, North Cessnock", Letter 39755-01L, 8 January 2008.
3. NSW EPA Contaminated Sites. "Guidelines for Consultants Reporting on Contaminated Sites", November 1997.
4. NSW DECC, "Waste Classification Guidelines, Part 1: Classifying Waste", April 2008.
5. NSW EPA Contaminated Sites, "Guidelines for Assessing Service Station Sites", December 1994.
6. NSW EPA Contaminated Sites, "Guidelines for Vertical Mixing of Soil on Former Broad-Acre Agricultural Land", January 1995.

**FLOODING AND STORMWATER
MANAGEMENT ASSESSMENT,
GOVERNMENT ROAD PRECINCT,
CESSNOCK**



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Checked	BC	29.06.07

EXECUTIVE SUMMARY

The following report details a Flooding and Stormwater Management Assessment for the proposed rezoning of 80 ha of land within the Government Road Precinct, in Cessnock, NSW.

The subject site is located immediately to the east of Black Creek, and a tributary of Black Creek passes diagonally through the site. Previous flood studies (Hunter Water Australia, October 2005, and Bewsher Consulting, January 1993) indicate the 1% Annual Exceedance Probability (AEP) flood event in Black Creek will impact upon the subject site. Minor flooding will also occur on site during the 1% AEP flood event of a Black Creek tributary which crosses the south western corner of the site.

Runoff from proposed development on the site may have a negative impact upon downstream watercourses, if left untreated. These watercourses include the Black Creek tributary, Black Creek itself, and ultimately the Hunter River. To minimise environmental impact on downstream watercourses and fulfil the requirements of Cessnock City Council's development control guidelines, water quality treatment devices including First flush devices; Rainwater tanks; Grassed swales; Retention trenches; Vegetated buffer strips; Bio-retention swales; Mini wetlands; and Mini wet/dry basins have been identified as possible ways to manage runoff quality and meet Council's requirements.

To limit peak flows from the developed site to those of the predeveloped site; a number of devices have been identified for inclusion at an individual allotment or ultimate development scale, or in combination. These devices include Rainwater tanks with reuse facilities; Small gravel trenches on individual lots (to store and infiltrate runoff into the ground); Pervious paving (to reduce impervious areas on lots); Grassed swales with riffle zones; Bio-retention swales; Detention/retention trenches; and Mini wet/dry basins.

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1. Introduction

1.1 Investigation Objectives

Northrop Engineers have been engaged by Harper Somers O'Sullivan (HSO) to prepare a Flooding and Stormwater Management Assessment for the proposed rezoning of land within the Government Road Precinct, Cessnock, NSW. The land comprises Lots 1 & 2 DP 1067096, Lots 33 & 34 in DP1004648, Lots A & B in DP421061, Lot 1 DP392537, Lot 1 DP403312, and Lot 1 DP 403335, and will be referred to in this report as the 'subject site'.

This report investigates the potential for flooding within the subject site and the potential impact of future development on water quantity and quality within and downstream of the site. The report intends to discuss these issues at a level appropriate for a rezoning application, and does not attempt to provide detailed design solutions to all issues. Information used has been gathered from a number of sources, and provides an overview of site issues and of possible outcomes for future development of the site.

The recommendations of this report have been determined in accordance Cessnock City Council's (Council's) Development Control Plan (DCP) 2006, and after discussions with Council's Flooding Engineer.

1.2 Site Description

Located on the eastern edge of Black Creek, the subject site is bordered by State forest to the east, existing and proposed development to the south, Black Creek to the west, and rural property and Cessnock Waste Water Treatment Works to the north. Covering 72.5 ha, the south western corners of the subject site is traversed by a natural drainage line which is a tributary of Black Creek (refer Figure 1).

The subject site is currently zoned rural residential and a number of large sheds, stock dams and residences exist across the site. From observation, the majority of the natural vegetation has been cleared from site, with some areas having been regraded to locate flat pads for buildings or to create stock dams. The cleared areas of the site are generally being used as grazing land for cattle. Small pockets of vegetation are evident within the east and west corners of the site, and sparse vegetation exists along some parts of the creek line.

A ridge line extending from Government Rd separates the site into two portions. The western portion of the site slopes generally to the west with grades ranging from 3% to 8%, and drains towards the creek lines. Grades within the eastern portion of the site range from 3% to 8%, and generally drain toward the north.

1.3 Odour Buffer Zone

An odour buffer zone has been designated around the existing Cessnock Waste Water Treatment Works, and extends across the western portion of the subject site. It is understood that residential development will not occur within this zone; however, passive open space or recreational sporting facilities have the potential to be located here. The odour buffer zone and potential residentially developable area of the subject site are identified on Figure 2.

1.4 Available Data

The following information was used to prepare this report:

- 1:25,000 Topographical map (with 10m contour intervals) – regional scale;
- Digital Terrain Map (DTM with 1.0m contour intervals, supplied by HSO);
- Site Analysis Maps compiled by HSO;
- The Cessnock City Council 'East Cessnock Flood Study' prepared by Bewsher Consulting Pty Ltd in January 1993 held by Council; and
- The 'Flood Study of Urban Area of Cessnock' prepared by Hunter Water Australia in October 2005 held by Council.



FIGURE 1 - LOCALITY PLAN

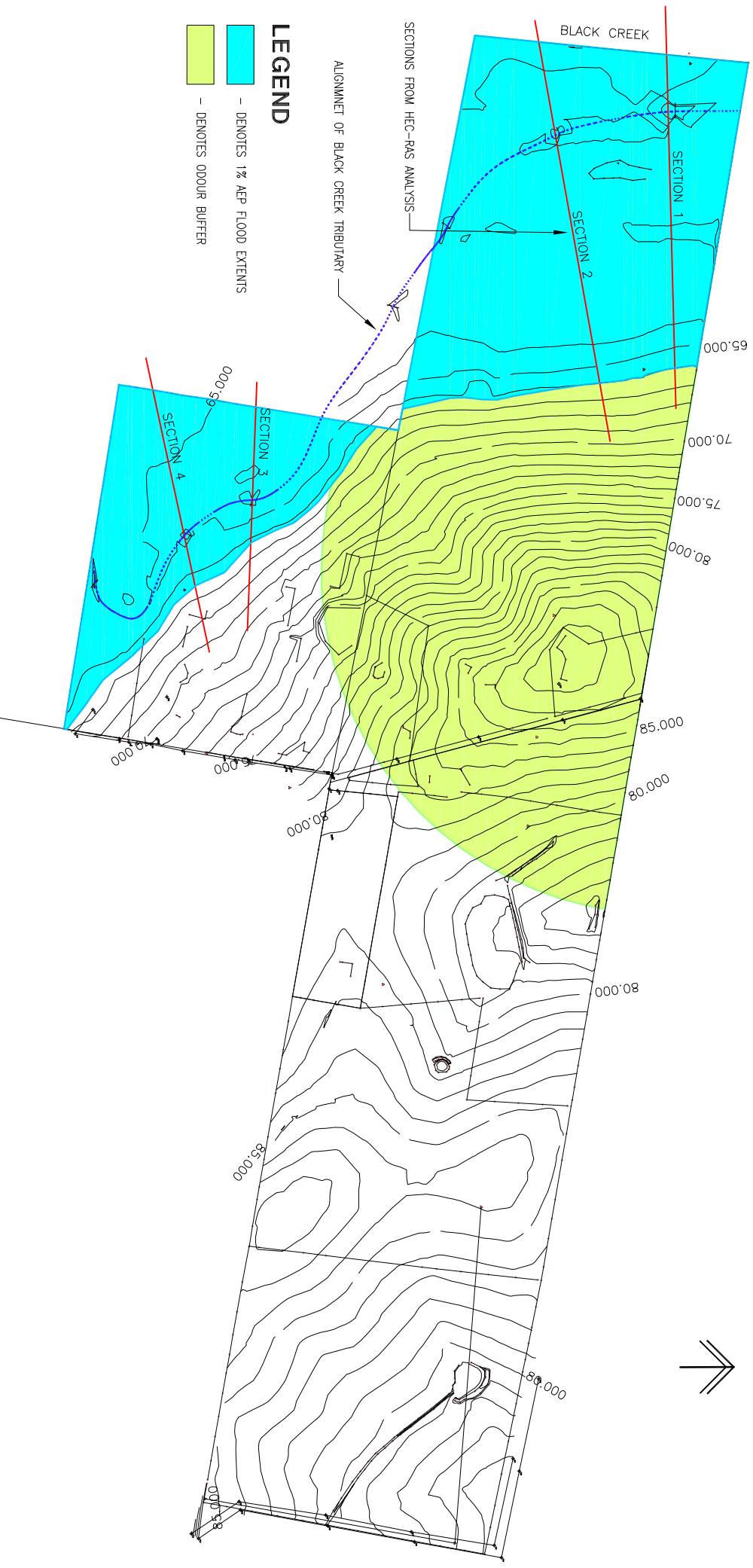


FIGURE 2 - FLOOD EXTENTS

2. Flooding Impacts

Two potential sources of flooding for the subject site have been identified, Black Creek located to the west, and the tributary of Black Creek which traverses the site (refer Figure 2).

The 1% Annual Exceedance Probability (AEP) flood level is considered as being significant for future development of the subject site. Council requires habitable floor levels in all new developments to be set at least 0.5m above the predicted local 1% AEP flood level.

We note that it is a requirement of the Floodplain Development Manual (NSW Government, 2005) that access and egress from developed lands known to be affected by extreme flooding be sufficient to enable timely evacuation if required. Hunter Water Australia's 2005 study investigated the 0.2% AEP flood event for Black Creek, as a potential representation of an extreme flooding event. The 0.2% AEP flood level was estimated by Hunter Water Australia to be in the order of 370mm higher than Hunter Water Australia's estimation of the 1% AEP levels at the closest point of Black Creek to the subject site. Should this event occur then the subject site as illustrated by survey levels has large areas above this level as well as egress routes away from flood affected areas. As such timely evacuation from flood affected lands can be achieved within the site.

2.1 Flooding from Black Creek

Discussions with Council and review of available flooding reports for the area indicate flooding within Black Creek has the potential to impact upon the site.

Council's Flooding Engineer has advised that for the purpose of assessing 1% AEP flood levels for the region containing the site the Bewsher Consulting Ptd Ltd (1993) flood study is regularly considered by Council. Review of this study

indicates the estimated 1% AEP level in Black Creek at its closet point to the site to be 65.0m Australian Height Datum (AHD). We note that the Hunter Water Australia (2005) report supplied by Council estimates the 1% AEP level at this point to be 63.64m AHD.

Survey indicates the lowest point along Black Creek and the subject site to be approximately 64.12m AHD, therefore, adopting a 1% AEP flood level of 65.0m AHD, flooding from Black Creek will impact upon the site.

The 1% AEP flood extents on the subject site, as estimated from the Bewsher Consulting Pty Ltd report, are shown on Figure 2.

2.2 Flooding from other Watercourses

As illustrated in Figure 1, the 1:25000 topographic map of the Cessnock region identifies three distinct catchments, two potential watercourses and stock dams within the subject site. Detailed survey and site observation (following a recent heavy rainfall event) have confirmed that while there are three distinct catchments on site, there is only one watercourse with evidence of a defined flow path (refer Figure 2). It was found that of the three catchments, two catchments drain to localised low points in the site where stock dams have been created. These dams could be maintained or removed and replaced with localised filling during future development of the site, and would not be expected to contribute to flooding on site.

As noted, the topographic map identifies a watercourse traversing the subject site from the south-west, draining towards Black Creek. Site investigation and detail survey indicates this watercourse to be a tributary of Black Creek. The tributary originates some 3.5km to the south-east of the subject site and has a large catchment. This watercourse was the focus of the 1993 Bewsher flood study and is also identified within the Hunter Water Australia study conducted in 2005, and can be considered significant for the subject site.

The Bewsher study estimates the 1% AEP flood levels along the tributary to range from 65.0m AHD at the western boundary of the site (confluence with Black Creek) up to 66.6m AHD at Government Road.

The estimated extent of flooding across the subject site as detailed by the Bewsher study is shown in Figure 2. The majority of land impacted by flooding in the 1% AEP event is situated within the odour buffer zone. Only a portion of the developable land (land outside the odour buffer zone) is therefore likely to be affected by flood water inundation. Egress and access from / to areas affected by flood waters could be readily achieved via evacuation to (or access from) higher ground to the north and east.

2.3 Calculations

Council have adopted the estimated 1% AEP flood levels given within the 1993 Bewsher study as being representative for the site, therefore on Council's advice we have adopted these levels as governing. However, we note that the 1% AEP flood levels given in the more recent (2005) Hunter Water Australia study are generally between 0.9m - 1.4m lower both within Black Creek and along the tributary, than those presented by the Bewsher study.

To improve confidence in the 1% AEP levels adopted for the site, we have undertaken calculations to assess the likely peak 1% AEP flow rate and resultant flood levels within the tributary as it traverses the site.

Runoff routing software 'DRAINS' was used to estimate peak flow for the 1% AEP peak rainfall event within the tributary. DRAINS output and all assumptions used to determine flows are included in Appendix A. Table 1 contains a summary of the results of the calculations and compares results with those of existing reports.

HEC-RAS software was then used to convert the flows from DRAINS into flood levels on site. Sections taken from detailed site survey were used in the HEC-RAS program with Manning’s ‘n’ values estimated from site investigation. Being based on backwater curve equations it was found that the HEC-RAS flood levels were very dependant on the level of flood waters at the junction of Black Creek and the tributary. In accordance with the Bewsher report we adopted a flood level of 65.0 AHD for the purpose of our modelling. It should be noted that the Hunter Water Australia report adopts levels of 63.64 AHD within Black Creek, which explains the difference in flood levels near the junction with Black Creek between the two reports. Table 2 contains a summary of the results from the HEC-RAS modelling and compares results with those of existing reports. The location of modelled cross-sections can be seen in Figure 2.

Table 1: Comparison of Estimated Peak 1% AEP Flows

Source of Data	Peak Estimated 1% AEP Flow from Tributary (m ³ /s)
Hunter Water Australia Report	Not Known
Bewsher Consulting Report	43.5
DRAINS modelling	46.4

Table 2: Comparison of Estimated Peak 1% AEP Flood Levels within the Tributary

Drainage line Location	1% AEP Flood Level by Bewsher (m AHD)	1% AEP Flood Level by Hunter Water Australia (m AHD)	1% AEP Flood Level by Northrop (m AHD)
1	65.0	63.18	65.0
2	65.05	64.1	65.0
3	65.1	64.19	65.16
4	66.5	65.0*	65.29

* interpolated between two cross sections

From the results shown in Table 1 and 2, it can be seen that the flows calculated using DRAINS compare very well (within 7%) with those estimated by the 1993 Bewsher study. Likewise, the HEC-RAS modelling produced levels which validated those predicted by the Bewsher report. It should be reiterated, however, that the HEC-RAS modelling showed levels to be sensitive to the adopted downstream water levels (ie flood levels in Black Creek). For the purposes of this study we believe that our analysis and the estimated flood extent will provide sufficient data to assess the impact of flooding within the subject site and its suitability for rezoning.

3. Buffer Areas to Watercourses

Buffer areas are reserved corridors of land along either side of a watercourse (extending from the top of a watercourse bank), created with the intent of retaining existing vegetation and the environmental integrity of the watercourse, as well as allowing large flows to be safely conveyed.

As a general rule, buildings, roadways and other significant infrastructure are not permitted within buffer areas. However, soft items such as landscaping, seating, educational signs, footpaths and service infrastructure (including stormwater drainage treatments) if they have minimal impact upon the existing vegetation, may be acceptable within the buffer area.

Appropriate buffer widths for significant watercourses are determined by the Department of Water and Energy in accordance with the 'Rivers and Foreshores Improvement Act 1948'.

Prescribed buffer area widths vary, depending on the size or significance of the watercourse, the existing environmental integrity of the watercourse and the potential for either improving or maintaining desirable environmental outcomes. Typical buffer area widths prescribed by the Department of Water and Energy (DWE) range from 10 – 60m.

As noted previously, the 1:25000 topographic map of the Cessnock region shows two potential watercourses within the subject site. Although noted on the 1:25000 map of region, a watercourse within the north-eastern corner of the site was not detected by visual observation or detail survey. Whilst consultation with the DWE is recommended to confirm the absence of a significant watercourse in this area, it is our opinion that this area is simply the top of a watershed catchment and it would be unlikely that a buffer zone would be required. The Black Creek tributary traversing the site, however, has a defined watercourse and consultation with the

DWE will determine if a buffer width is required for this creek. Based on the current state of the bank of this watercourse and past liaison with the DWE regarding buffer widths for similar watercourses within the region, a buffer width of approximately 20m may be anticipated. However, formal consultation and an on site investigation by a DWE representative will be required to confirm the most appropriate width.

4. Stormwater Management on Site

Stormwater management within the rezoning area should, where practical, comply with industry best practise principles for water sensitive urban design (WSUD) and sustainable water use, as well as Council's development guidelines. The design and construction of stormwater infrastructure within the subject site should therefore generally adhere to the following guidelines:

- Holistic management of stormwater generated from the developed site with allotment scale measures integrated into the wider subdivision context. This will involve the use of collection and treatment measures on individual lots, overflowing during larger rainfall events into a street truck drainage system.
- The design of the trunk drainage system being sensitive to maintaining the natural condition of watercourse within the subject site.
- Peak flows from developed areas designed to match predeveloped peak flows, as best as possible, to maintain the existing flow regimes of the system.
- The use of source control devices (grassed swales, infiltration/retention trenches, rainwater tanks, bioretention swales, permeable paving etc) to control water quality, instead of large traditional end of line controls.
- Dispersed release of runoff to drainage lines should be encouraged to reduce scour at outlet points. Discharge of concentrated, high velocity, high erosive potential flow should be avoided.
- The drainage system (both volume and quality devices) should be visually integrated into the subdivision and landscape context, and where possible form part of the open space amenity of the site.
- Watercourse buffer areas should be designed such that they act as an open space corridor (section 3 outlines buffer areas in detail).

4.1 Stormwater Quality

Water quality will play a major part in the planning of any development within the subject site due to the existence of the watercourse on site and the proximity to Black Creek.

It is expected that the existing runoff from agricultural uses on site would contain high amounts of pollutants. As a result, changes to land uses within the site through development (for example the introduction of roads, pavements etc) may not necessarily increase pollutants loads generated from the subject site. It is still, however, expected that runoff from future residential development on the subject site will contain significant amounts of pollutants. As such, stormwater runoff will need to be treated to minimise any adverse impacts upon the ecology of the on site watercourse or Black Creek.

Litter, coarse sediments, fine particles, oils and greases, total phosphorus and total nitrogen are typical pollutants likely to be generated from a residential development. In line with current best practice, the design of future stormwater management systems for the site should set the targets for pollutant removal in keeping with Table 3.

Table 3: Pollutant Removal Targets

Target Pollutant Removal Efficiencies					
Suspended Solids	Total Phosphorus	Total Nitrogen	Litter / Gross Pollutants	Course Sediment	Oil & Greases
80% of annual load	45% of annual load	45% of annual load	100% in the 3 month event	100% in the 3 month event	100% in the 3 month event

* Removal Rates shown are taken from the NSW EPA Managing Urban Stormwater Council Handbook

Stormwater quality devices should be designed within the subject site to act as a treatment train. In a treatment train, individual devices treat stormwater runoff for

different pollutants and to different efficiencies, with the net result being adequate treatment of all pollutants. While the design of these devices will be detailed within the concept and detail design stages of the development, devices should where possible be based on the principle of at source control, and may include:

- First flush devices;
- Rainwater tanks;
- Grassed swales;
- Retention trenches;
- Vegetated buffer strips;
- Bio-retention swales;
- Mini wetlands; and
- Mini wet/dry basins.

Where source control devices do not provide adequate treatment, proprietary treatment devices may be required, but only as a last resort.

It should also be noted that stormwater management principles based on dispersal or infiltration, may be inappropriate in unfavourable soil conditions, or where development may be adversely affected. Conditions will need to be assessed on the subject site during the concept and detail design phases, to determine the appropriateness of these techniques.

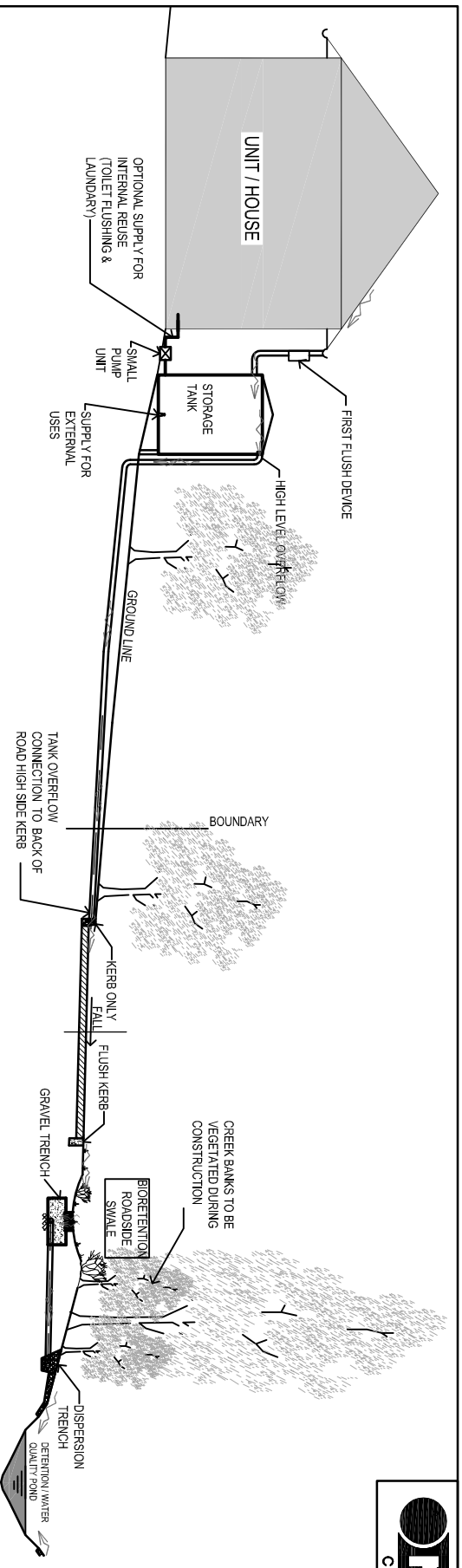
Establishment and on-going maintenance is a key consideration in the selection of treatment devices, as Council does not wish to inherit maintenance liabilities. Appropriate selection of treatment measures should be made, with the nature of the pollutants and the performance measures to be met both forming key inputs into device selection. The selection of appropriate devices within the treatment train will play a large part in the maintenance costs for stormwater quality devices.

Figure 3 illustrates how a treatment train may be incorporated within the development of the site. Indicatively the treatment train may include the following processes:

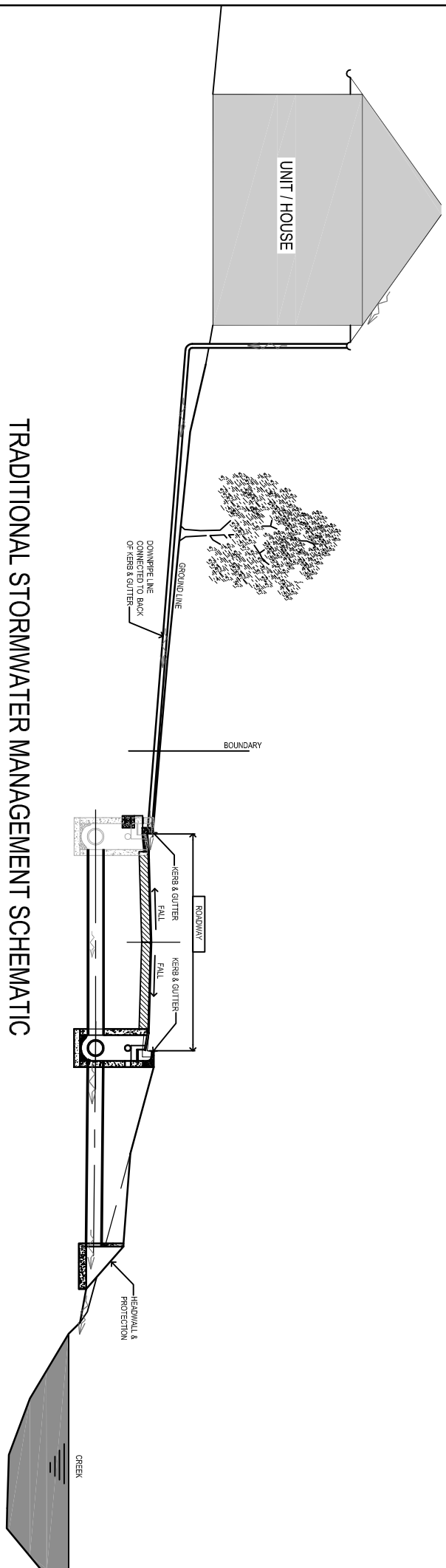
- First flush devices to collect the first portion of runoff from roofs thus removing the vast majority of sediment and nutrients from roof runoff;
- Tanks acting as sediment traps treating the remaining water for sediment and nutrients attached to the sediment;
- Buffer strips located within footpaths treating overland flow from allotments for coarse sediments, nutrients and litter; and
- Biofiltration roadside swales treating runoff for fine sediments, nutrients and litter as well as dispersing flows, thus minimising the potential erosion of the buffer zone and the banks of the watercourse.

Dispersing runoff overland prior to the watercourses will also aid in the polishing of water through the removal of sediments and nutrients attached to sediments. This type of dispersed release will also aid in reducing the erosion potential at the outlet.

It should be noted that the use of these devices and the treatment train itself is only indicative and shall be designed and validated by water quality modelling during the design of the subdivision.



PROPOSED STORMWATER MANAGEMENT SCHEMATIC



TRADITIONAL STORMWATER MANAGEMENT SCHEMATIC

FIGURE 3 - INDICATIVE TREATMENT TRAIN

4.2 Hydrology

The introduction of impervious surfaces within the development of the site will increase peak flows from the site. It is Council's policy that new subdivisions are required to manage stormwater, such that developed peak flows leaving the site are equal to or less than peak pre-developed flows for all storm events and durations up to and including the 1% AEP event.

To reduce peak flows from the site, runoff should be managed as much as possible at the allotment level. Where practical this will be done through actively minimising impervious areas on allotments and through the collection and reuse of roof water. Devices incorporated within individual allotments to perform this function may include:

- Rainwater tanks with reuse facilities;
- Small gravel trenches on individual lots (to storage and infiltrate runoff into the ground); and
- Pervious paving (to reduce impervious areas on lots).

Further to these measures, mitigation of flows from road and footpath surfaces at a subdivision scale will need to be considered. Techniques and devices designed to perform this function will, where possible, be incorporated as part of landscaped or open space areas within the subdivision. Located above the 1% AEP flood level, these devices will also be situated outside buffer zones and watercourses (off-line). Devices used to perform these functions may include:

- Grassed swales with riffle zones;
- Bio-retention swales bordering the buffer zone of watercourses;
- Detention/retention trenches;
- Mini wet/dry basins; or
- A combination of the above devices.

To indicatively determine the detention that may be required during the 1% AEP event due to the development of the subject site, preliminary calculations using the runoff routing software 'DRAINS' were undertaken. Calculations were made to determine peak pre-developed and post-developed flow for each of the site's three catchments. Preliminary modelling of an indicative detention storage volume for each catchment, sufficient to limit peak post developed flows to peak pre-developed flows was then performed.

The detention volumes determined for each catchment should not be assumed to be in anyway a finite requirement for the site, with detailed modelling being required at the concept and detail design stages, to determine exact detention and outlet requirements. Calculations have assumed that allotment scale detention devices will not detain any flows in the 1% AEP event. The use of stormwater devices at the allotment scale could result in a reduction to the detention volume required.

As previously noted, three distinct catchments are evident for the site. As shown on Figure 4, a significant portion of Catchment 1 is considered un-developable area, situated either within the odour buffer zone or located within the 1% AEP flood level. Similarly, a portion of Catchment 2 is situated within the odour buffer zone and un-developable. For the purpose of stormwater detention estimation, Catchment 3 has been conservatively considered to be fully developable.

Pre-developed catchments have been assumed to be 100% pervious while developable areas have been assumed to be 60% impervious. Table 4 summarises the adopted catchment areas including the estimated areas of developable land for each catchment, and the calculated detention requirements.

Table 4: Preliminary detention requirements for the developed site

Catchment	Total Area (ha)	Total Area available for development (ha)	Estimated Pre Developed Peak 1% AEP flow (m ³ /s)	Estimated Post Developed Peak 1% AEP flow (m ³ /s)	Detention required, calculated using DRAINS (m ³)
1	43.5	10.9	1.66	3.46	2560
2	15.2	9.9	1.51	3.15	2340
3	13.8	13.8	2.1	4.38	3140

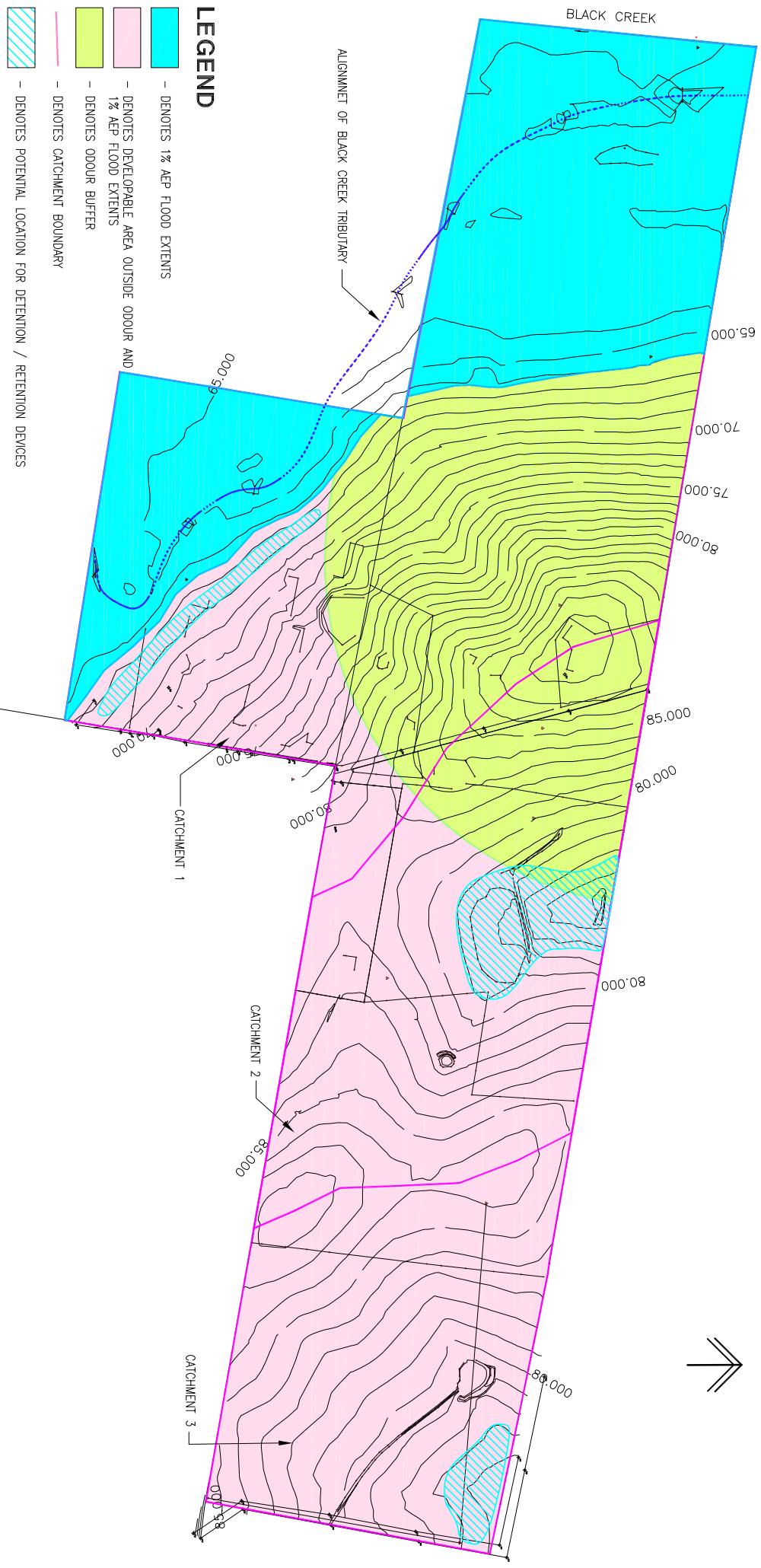


FIGURE 4 - CATCHMENT PLAN

5. Recommendations

Impacts of flooding and stormwater runoff can be mitigated in the development of the subject site by incorporating the following:

- Habitable floor levels designed a minimum of 500mm above peak 1% AEP flood levels on site;
- At source and WSUD stormwater quality and quantity control devices will be incorporated within the development. These devices will include, where practical, grassed swales, bioretention swales, small wet/dry basins, water harvesting tanks, dispersion and retention trenches;
- Generally, residential development should not occur below the 1% AEP flood line. However opportunities for footpaths, cycleways, open space, seating, and sports fields exists within these areas;
- Stormwater management for the development will comply with the requirements of Cessnock City Council's DCP and best practice guidelines.

By rezoning the subject site for residential purposes, a number of stormwater initiatives will be required to be incorporated within the final design to manage stormwater and minimise the impact of the development on existing watercourses. In is our opinion this report demonstrates that appropriate flooding and stormwater measures can be achieved within the site, and future development of the site can be designed in full compliance of Council's Stormwater and Flooding requirements for rezoning.

Appendix A – DRAINS and HEC-RAS Output

DRAINS OUTPUT – 1% AEP FLOW WITHIN THE TRIBUTARY

DRAINS - DATA

Version 9

Size	Ponding Volume (cu.m)	Pressure Change Coeff. Ku	Surface Elev (m)	Max Pond Depth (m)	Base Inflow (cu.m/s)	Blocking Factor	x	y	Bolt-down lid	id	Part Full Shock Loss
				0			328	-176		2	

ILS

Init Vol. (cu.m)	Outlet Type	K	Dia(mm)	Centre RL	Pit Family	Pit Type	x	y	HED	Crest RL	Crest Length(m)	id
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ILS

Paved Area %	Grass Area %	Supp Area %	Paved Time (min)	Grass Time (min)	Supp Time (min)	Paved Length (m)	Grass Length (m)	Supp Length (m)	Paved Slope(%)	Grass Slope %	Supp Slope %	Paved Rough	Grass Rough	Supp Rough	Lag Time or Factor	Gutter Length (m)	Gutter Slope %	Gutter FlowFactor
15	45	40	0	0	0	1500	1200	600	4	6	6	0.013	0.3	0.17	0			

DRAINS - OUTPUT

PIT / NODE DETAILS

Name	Max HGL	Max Pond HGL	Max Surface Flow Arriving (cu.m/s)	Version 8 Max Pond Volume (cu.m)	Min Freeboard (m)	Overflow (cu.m/s)	Constraint
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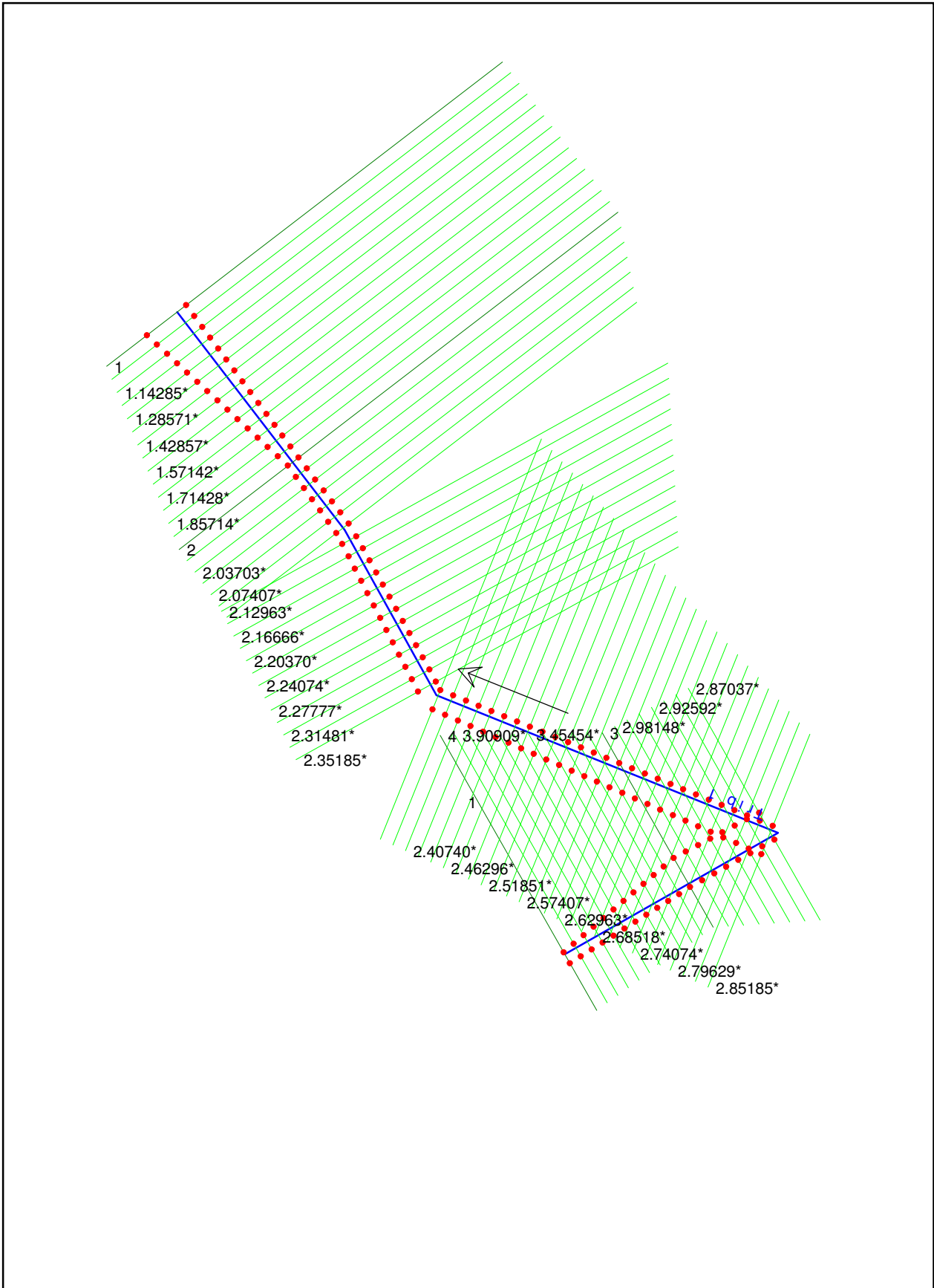
SUB-CATCHMENT DETAILS

Name	Max Flow Q (cu.m/s)	Paved Max Q (cu.m/s)	Grassed Max Q (cu.m/s)	Paved Tc (min)	Grassed Tc (min)	Supp. Tc (min)	Due to Storm
Tributary	46.436	20.347	43.14	27.85	141.83	66.55	AR&R 100 year, 3 hours storm, average 29.84 mm/h, Zone 1

CONTINUITY CHECK for AR&R 100 year, 3 hours storm, average 29.84 mm/h, Zone 1

Node	Inflow (cu.m)	Outflow (cu.m)	Storage Change (cu.m)	Difference %
N1	445876.47	445876.47	0	0

HEC-RAS OUTPUT – 1% AEP FLOOD LEVEL



HEC-RAS Plan: Plan 01 River: Trib 1 Reach: 1 Profile: PF 1

Reach	River Sta	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel Chnl (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl
1	4	46.40	63.35	65.29	64.81	65.31	0.000610	0.96	86.09	152.40	0.24
1	3.90909*	46.40	63.36	65.28		65.31	0.000678	1.00	82.80	154.47	0.25
1	3.81818*	46.40	63.38	65.27		65.30	0.000751	1.04	79.66	156.40	0.27
1	3.72727*	46.40	63.39	65.26		65.29	0.000828	1.07	76.70	158.10	0.28
1	3.63636*	46.40	63.41	65.25		65.28	0.000910	1.10	73.88	159.71	0.29
1	3.54545*	46.40	63.42	65.24		65.28	0.000993	1.12	71.27	161.26	0.30
1	3.45454*	46.40	63.43	65.22		65.27	0.001085	1.14	68.73	162.60	0.31
1	3.36363*	46.40	63.45	65.21		65.26	0.001178	1.16	66.48	164.08	0.33
1	3.27272*	46.40	63.46	65.20		65.24	0.001268	1.17	64.43	163.51	0.34
1	3.18181*	46.40	63.47	65.18		65.23	0.001346	1.17	62.48	157.81	0.34
1	3.09090*	46.40	63.49	65.17		65.22	0.001417	1.17	60.52	149.39	0.35
1	3	46.40	63.50	65.16		65.21	0.001511	1.17	58.68	140.46	0.36
1	2.98148*	46.40	63.47	65.14		65.19	0.001449	1.15	60.15	143.53	0.35
1	2.96296*	46.40	63.45	65.13		65.18	0.001388	1.13	61.72	146.78	0.34
1	2.94444*	46.40	63.43	65.12		65.16	0.001318	1.11	63.55	150.17	0.34
1	2.92592*	46.40	63.40	65.11		65.15	0.001244	1.08	65.55	153.77	0.33
1	2.90740*	46.40	63.38	65.10		65.13	0.001169	1.05	67.75	157.53	0.32
1	2.88888*	46.40	63.35	65.09		65.12	0.001094	1.02	70.18	161.53	0.31
1	2.87037*	46.40	63.33	65.08		65.11	0.001017	0.99	72.83	165.70	0.30
1	2.85185*	46.40	63.30	65.07		65.10	0.000940	0.96	75.75	170.14	0.28
1	2.83333*	46.40	63.28	65.06		65.09	0.000863	0.93	78.91	173.82	0.27
1	2.81481*	46.40	63.25	65.06		65.08	0.000789	0.89	82.28	177.60	0.26
1	2.79629*	46.40	63.23	65.05		65.07	0.000717	0.86	85.94	181.57	0.25
1	2.77777*	46.40	63.20	65.05		65.07	0.000650	0.82	89.85	185.72	0.24
1	2.75925*	46.40	63.18	65.04		65.06	0.000588	0.79	93.98	190.04	0.23
1	2.74074*	46.40	63.15	65.04		65.05	0.000530	0.75	98.40	194.51	0.22
1	2.72222*	46.40	63.13	65.03		65.05	0.000477	0.72	103.07	199.20	0.21
1	2.70370*	46.40	63.10	65.03		65.04	0.000428	0.69	108.01	204.07	0.19
1	2.68518*	46.40	63.08	65.03		65.04	0.000384	0.66	113.23	209.14	0.18
1	2.66666*	46.40	63.05	65.02		65.03	0.000344	0.63	118.71	214.39	0.18
1	2.64814*	46.40	63.03	65.02		65.03	0.000307	0.60	124.48	219.79	0.17
1	2.62963*	46.40	63.00	65.02		65.03	0.000275	0.57	130.54	225.44	0.16
1	2.61111*	46.40	62.98	65.02		65.02	0.000245	0.54	136.93	231.27	0.15
1	2.59259*	46.40	62.95	65.02		65.02	0.000219	0.52	143.55	237.31	0.14
1	2.57407*	46.40	62.93	65.01		65.02	0.000194	0.49	150.49	243.85	0.13
1	2.55555*	46.40	62.90	65.01		65.02	0.000172	0.47	157.65	246.29	0.13
1	2.53703*	46.40	62.88	65.01		65.02	0.000152	0.44	165.10	250.78	0.12
1	2.51851*	46.40	62.85	65.01		65.01	0.000135	0.42	172.80	255.27	0.11
1	2.5*	46.40	62.83	65.01		65.01	0.000120	0.40	180.72	259.77	0.11
1	2.48148*	46.40	62.80	65.01		65.01	0.000107	0.38	188.96	264.28	0.10
1	2.46296*	46.40	62.78	65.01		65.01	0.000095	0.36	197.32	268.77	0.09
1	2.44444*	46.40	62.76	65.01		65.01	0.000084	0.34	206.05	273.30	0.09
1	2.42592*	46.40	62.73	65.01		65.01	0.000075	0.33	214.96	277.82	0.08
1	2.40740*	46.40	62.71	65.01		65.01	0.000067	0.31	224.12	282.36	0.08
1	2.38888*	46.40	62.68	65.01		65.01	0.000060	0.30	233.48	286.87	0.08
1	2.37037*	46.40	62.66	65.00		65.01	0.000054	0.28	243.11	291.42	0.07
1	2.35185*	46.40	62.63	65.00		65.01	0.000048	0.27	253.01	295.96	0.07
1	2.33333*	46.40	62.61	65.00		65.01	0.000044	0.26	263.09	300.51	0.06
1	2.31481*	46.40	62.58	65.00		65.01	0.000039	0.25	273.41	305.06	0.06
1	2.29629*	46.40	62.56	65.00		65.00	0.000035	0.23	284.00	309.61	0.06
1	2.27777*	46.40	62.53	65.00		65.00	0.000032	0.22	294.82	314.16	0.06
1	2.25925*	46.40	62.51	65.00		65.00	0.000029	0.21	305.89	318.71	0.05
1	2.24074*	46.40	62.48	65.00		65.00	0.000026	0.21	317.13	323.28	0.05
1	2.22222*	46.40	62.46	65.00		65.00	0.000024	0.20	328.71	327.83	0.05
1	2.20370*	46.40	62.43	65.00		65.00	0.000021	0.19	340.41	332.41	0.05
1	2.18518*	46.40	62.41	65.00		65.00	0.000020	0.18	352.36	336.96	0.04
1	2.16666*	46.40	62.38	65.00		65.00	0.000018	0.17	364.58	341.55	0.04
1	2.14814*	46.40	62.36	65.00		65.00	0.000016	0.17	377.00	346.11	0.04
1	2.12963*	46.40	62.33	65.00		65.00	0.000015	0.16	389.69	350.69	0.04
1	2.11111*	46.40	62.31	65.00		65.00	0.000013	0.15	402.59	355.26	0.04
1	2.09259*	46.40	62.28	65.00		65.00	0.000012	0.15	415.74	359.84	0.03
1	2.07407*	46.40	62.26	65.00		65.00	0.000011	0.14	429.10	364.41	0.03
1	2.05555*	46.40	62.23	65.00		65.00	0.000010	0.14	442.68	369.01	0.03
1	2.03703*	46.40	62.21	65.00		65.00	0.000010	0.13	456.53	373.57	0.03
1	2.01851*	46.40	62.18	65.00		65.00	0.000009	0.13	470.56	378.17	0.03
1	2	46.40	62.16	65.00		65.00	0.000008	0.12	484.86	382.72	0.03
1	1.92857*	46.40	62.08	65.00		65.00	0.000008	0.13	480.75	379.72	0.03
1	1.85714*	46.40	62.00	65.00		65.00	0.000008	0.13	477.08	376.75	0.03
1	1.78571*	46.40	61.92	65.00		65.00	0.000008	0.13	474.01	373.76	0.03
1	1.71428*	46.40	61.84	65.00		65.00	0.000008	0.14	471.51	370.79	0.03
1	1.64285*	46.40	61.76	65.00		65.00	0.000008	0.14	469.55	367.81	0.03
1	1.57142*	46.40	61.68	65.00		65.00	0.000008	0.14	468.16	364.87	0.03
1	1.5*	46.40	61.60	65.00		65.00	0.000008	0.14	467.31	361.92	0.03
1	1.42857*	46.40	61.53	65.00		65.00	0.000008	0.14	467.08	358.97	0.03
1	1.35714*	46.40	61.45	65.00		65.00	0.000008	0.14	467.34	356.05	0.03
1	1.28571*	46.40	61.37	65.00		65.00	0.000007	0.14	468.19	353.12	0.03
1	1.21428*	46.40	61.29	65.00		65.00	0.000007	0.14	469.60	350.20	0.03
1	1.14285*	46.40	61.21	65.00		65.00	0.000007	0.14	471.56	347.28	0.03

HEC-RAS Plan: Plan 01 River: Trib 1 Reach: 1 Profile: PF 1 (Continued)

Reach	River Sta	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel Chnl (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl
1	1.07142*	46.40	61.13	65.00		65.00	0.000007	0.14	474.08	344.38	0.03
1	1	46.40	61.05	65.00	62.34	65.00	0.000006	0.14	477.14	341.47	0.03

**Appendix B – DRAINS DETENTION CALCUALTIONS FOR
CATCHMENTS OUTPUT**

DRAINS - DATA

PIT / NODE DETAILS

Name	Type	Family	Version 9 Size	Ponding Volume (cu.m)	Pressure Change Coeff. Ku	Surface Elev (m)	Max Pond Depth (m)	Base Inflow (cu.m/s)	Blocking Factor	x	y	Bolt-down lid	id	Part Full Shock Loss
N1	Node							0		328	-176		2	
N2	Node							0		573	-189		36	
N3	Node					1		0		460	-370		43	

DETENTION BASIN DETAILS

Name	Elev	Volume	Init Vol. (cu.m)	Outlet Type	K	Dia(mm)	Centre RL	Pit Family	Pit Type	x	y	HED	Crest RL	Crest Length(m)	id
Basin	0	0	0	Orifice		900	0.45			324	-286	No			49
	0.5	1500													
	1	3000													
	1.5	4500													

SUB-CATCHMENT DETAILS

Name	Pit or Node	Total Area (ha)	Paved Area %	Grass Area %	Supp Area %	Paved Time (min)	Grass Time (min)	Supp Time (min)	Paved Length (m)	Grass Length (m)	Supp Length (m)	Paved Slope(%)	Grass Slope %	Supp Slope %	Paved Rough	Grass Rough	Supp Rough	Lag Time or Factor	Gutter Length (m)	Gutter Slope %	Gutter FlowFactor
Catchment1post	N1	10.875	60	30	10	0	0	0	100	100	20	5	5	5	0.013	0.3	0.17	0			
Catchment1pre	N2	10.875	0	100	0	0	35	0										0			
Catchment1post_basin	Basin	10.875	60	30	10	0	0	0	100	100	20	5	5	5	0.013	0.3	0.17	0			

PIPE DETAILS

Name	From	To	Length (m)	U/S IL (m)	D/S IL (m)	Slope (%)	Type	Dia (mm)	I.D. (mm)	Rough	Pipe Is	No. Pipes	Chg From	At Chg	Chg (m)	RI (m)	Chg (m)	RL (m)	etc (m)
Pipe	Basin	N3	1	0	-0.01	1	Concrete, under roads	1200	1200	0.3	NewFixed	1	Basin	0					

OVERFLOW ROUTE DETAILS

Name	From	To	Travel Time (min)	Spill Level (m)	Crest Length (m)	Weir Coeff. C	Cross Section	Safe Depth Major Storms (m)	SafeDepth Minor Storms (m)	Safe DxV (sq.m/sec)	Bed Slope (%)	D/S Area Contributing %	id
overflow	Basin	N3	5	0.82	50	1.66	Grassed Swale	0.5	0.4	1	1	0	8366

DRAINS - OUTPUT

PIT / NODE DETAILS

Name	Max HGL	Max Pond HGL	Max Surface Flow Arriving (cu.m/s)	Version 8 Max Pond Volume (cu.m)	Min Freeboard (m)	Overflow (cu.m/s)	Constraint
N3	0		0				

SUB-CATCHMENT DETAILS

Name	Max Flow Q (cu.m/s)	Paved Max Q (cu.m/s)	Grassed Max Q (cu.m/s)	Paved Tc (min)	Grassed Tc (min)	Supp. Tc (min)	Due to Storm
Catchment1post	3.461	2.827	0.819	4.37	28.77	7.79	AR&R 100 year, 1.5 hours storm, average 44.43 mm/h, Zone 1
Catchment1pre	1.659	0	1.659	0	35	0	AR&R 100 year, 2 hours storm, average 37.7 mm/h, Zone 1
Catchment1post_basin	3.461	2.827	0.819	4.37	28.77	7.79	AR&R 100 year, 1.5 hours storm, average 44.43 mm/h, Zone 1

PIPE DETAILS

Name	Max Q (cu.m/s)	Max V (m/s)	Max U/S HGL (m)	Max D/S HGL (m)	Due to Storm
Pipe	1.092	3.3	0.399	0.389	AR&R 100 year, 2 hours storm, average 37.7 mm/h, Zone 1

CHANNEL DETAILS

Name	Max Q (cu.m/s)	Max V (m/s)	Chainage (m)	Max HGL (m)	Due to Storm

OVERFLOW ROUTE DETAILS

Name	Max Q U/S	Max Q D/S	Safe Q	Max D	Max DxV	Max Width	Max V	Due to Storm
overflow	0.486	0.486	1.945	0.297	0.41	2.38	1.38	AR&R 100 year, 2 hours storm, average 37.7 mm/h, Zone 1

DETENTION BASIN DETAILS

Name	Max WL	MaxVol	Max Q Total	Max Q Low Level	Max Q High Level
Basin	-999		0		

CONTINUITY CHECK for AR&R 100 year, 1.5 hours storm, average 44.43 mm/h, Zone 1

Node	Inflow (cu.m)	Outflow (cu.m)	Storage Change (cu.m)	Difference %
N1	6306.53	6306.53	0	0
N2	4207.77	4207.77	0	0
Basin	6306.53	5703.9	794.19	-3
N3	5703.9	5703.9	0	0

DRAINS - DATA

PIT / NODE DETAILS

Name	Type	Family	Version 9 Size	Ponding Volume (cu.m)	Pressure Change Coeff. Ku	Surface Elev (m)	Max Pond Depth (m)	Base Inflow (cu.m/s)	Blocking Factor	x	y	Bolt-down lid	id	Part Full Shock Loss
N1	Node							0		328	-176		2	
N2	Node							0		573	-189		36	
N3	Node					1		0		460	-370		43	

DETENTION BASIN DETAILS

Name	Elev	Volume	Init Vol. (cu.m)	Outlet Type Orifice	K	Dia(mm)	Centre RL	Pit Family	Pit Type	x	y	HED	Crest RL	Crest Length(m)	id
Basin	0	0	0			900	0.45			324	-286	No			49
	0.5	1500													
	1	3000													
	1.5	4500													

SUB-CATCHMENT DETAILS

Name	Pit or Node	Total Area (ha)	Paved Area %	Grass Area %	Supp Area %	Paved Time (min)	Grass Time (min)	Supp Time (min)	Paved Length (m)	Grass Length (m)	Supp Length (m)	Paved Slope(%)	Grass Slope %	Supp Slope %	Paved Rough	Grass Rough	Supp Rough	Lag Time or Factor	Gutter Length (m)	Gutter Slope %	Gutter FlowFactor
Catchment2post	N1	9.896	60	30	10	0	0	0	100	100	20	5	5	5	0.013	0.3	0.17	0			
Catchment2pre	N2	9.896	0	100	0	0	35	0										0			
Catchment2post_basin	Basin	9.896	60	30	10	0	0	0	100	100	20	5	5	5	0.013	0.3	0.17	0			

PIPE DETAILS

Name	From	To	Length (m)	U/S IL (m)	D/S IL (m)	Slope (%)	Type	Dia (mm)	I.D. (mm)	Rough	Pipe Is	No. Pipes	Chg From	At Chg	Chg (m)	RI (m)	Chg (m)	RL (m)	etc (m)
Pipe	Basin	N3	1	0	-0.01	1	Concrete, under	1200	1200	0.3	NewFixed	1	Basin	0					

OVERFLOW ROUTE DETAILS

Name	From	To	Travel Time (min)	Spill Level (m)	Crest Length (m)	Weir Coeff. C	Cross Section	Safe Depth Major Storms (m)	SafeDepth Minor Storms (m)	Safe DxV (sq.m/sec)	Bed Slope (%)	D/S Area Contributing %	id
overflow	Basin	N3	5	0.75	50	1.66	Grassed Swale	0.5	0.4	1	1	0	8366

DRAINS - OUTPUT

PIT / NODE DETAILS

Name	Max HGL	Max Pond HGL	Max Surface Flow Arriving (cu.m/s)	Version 8 Max Pond Volume (cu.m)	Min Freeboard (m)	Overflow (cu.m/s)	Constraint
N3	0		0				

SUB-CATCHMENT DETAILS

Name	Max Flow Q (cu.m/s)	Paved Max Q (cu.m/s)	Grassed Max Q (cu.m/s)	Paved Tc (min)	Grassed Tc (min)	Supp. Tc (min)	Due to Storm
Catchment2post	3.149	2.572	0.745	4.37	28.77	7.79	AR&R 100 year, 1.5 hours storm, average 44.43 mm/h, Zone 1
Catchment2pre	1.509	0	1.509	0	35	0	AR&R 100 year, 2 hours storm, average 37.7 mm/h, Zone 1
Catchment2post_basin	3.149	2.572	0.745	4.37	28.77	7.79	AR&R 100 year, 1.5 hours storm, average 44.43 mm/h, Zone 1

PIPE DETAILS

Name	Max Q (cu.m/s)	Max V (m/s)	Max U/S HGL (m)	Max D/S HGL (m)	Due to Storm
Pipe	0.958	3.2	0.37	0.36	AR&R 100 year, 2 hours storm, average 37.7 mm/h, Zone 1

CHANNEL DETAILS

Name	Max Q (cu.m/s)	Max V (m/s)	Chainage (m)	Max HGL (m)	Due to Storm

OVERFLOW ROUTE DETAILS

Name	Max Q U/S	Max Q D/S	Safe Q	Max D	Max DxV	Max Width	Max V	Due to Storm
overflow	0.473	0.473	1.945	0.294	0.4	2.35	1.37	AR&R 100 year, 2 hours storm, average 37.7 mm/h, Zone 1

DETENTION BASIN DETAILS

Name	Max WL	Max Vol	Max Q Total	Max Q Low Level	Max Q High Level
Basin	0		0		

CONTINUITY CHECK for AR&R 100 year, 1.5 hours storm, average 44.43 mm/h, Zone 1

Node	Inflow (cu.m)	Outflow (cu.m)	Storage Change (cu.m)	Difference %
N1	5738.79	5738.79	0	0
N2	3828.98	3828.98	0	0
Basin	5738.79	5159.93	771.57	-3.4
N3	5159.93	5159.93	0	0

DRAINS - DATA

PIT / NODE DETAILS

Name	Type	Family	Version 9 Size	Ponding Volume (cu.m)	Pressure Change Coeff. Ku	Surface Elev (m)	Max Pond Depth (m)	Base Inflow (cu.m/s)	Blocking Factor	x	y	Bolt-down lid	id	Part Full Shock Loss
N1	Node							0		328	-176		2	
N2	Node							0		573	-189		36	
N3	Node					1		0		460	-370		43	

DETENTION BASIN DETAILS

Name	Elev	Volume	Init Vol. (cu.m)	Outlet Type	K	Dia(mm)	Centre RL	Pit Family	Pit Type	x	y	HED	Crest RL	Crest Length(m)	id
Basin	0	0	0	Orifice		900	0.45			324	-286	No			49
	0.5	1500													
	1	3000													
	1.5	4500													

SUB-CATCHMENT DETAILS

Name	Pit or Node	Total Area (ha)	Paved Area %	Grass Area %	Supp Area %	Paved Time (min)	Grass Time (min)	Supp Time (min)	Paved Length (m)	Grass Length (m)	Supp Length (m)	Paved Slope(%)	Grass Slope %	Supp Slope %	Paved Rough	Grass Rough	Supp Rough	Lag Time or Factor	Gutter Length (m)	Gutter Slope %	Gutter FlowFactor
Catchment3post	N1	13.775	60	30	10	0	0	0	100	100	20	5	5	5	0.013	0.3	0.17	0			
Catchment3pre	N2	13.775	0	100	0	0	35	0										0			
Catchment3post_basin	Basin	13.775	60	30	10	0	0	0	100	100	20	5	5	5	0.013	0.3	0.17	0			

PIPE DETAILS

Name	From	To	Length (m)	U/S IL (m)	D/S IL (m)	Slope (%)	Type	Dia (mm)	I.D. (mm)	Rough	Pipe Is	No. Pipes	Chg From	At Chg	Chg (m)	RI (m)	Chg (m)	RL (m)	etc (m)
Pipe	Basin	N3	1	0	-0.01	1	Concrete, under roads	1200	1200	0.3	NewFixed	1	Basin	0					

OVERFLOW ROUTE DETAILS

Name	From	To	Travel Time (min)	Spill Level (m)	Crest Length (m)	Weir Coeff. C	Cross Section	Safe Depth Major Storms (m)	SafeDepth Minor Storms (m)	Safe DxV (sq.m/sec)	Bed Slope (%)	D/S Area Contributing %	id
overflow	Basin	N3	5	1	50	1.66	Grassed Swale	0.5	0.4	1	1	0	8366

DRAINS - OUTPUT

PIT / NODE DETAILS

Name	Max HGL	Max Pond	Max Surface	Version 8 Max Pond	Min	Overflow	Constraint
------	---------	----------	-------------	--------------------	-----	----------	------------

	HGL	Flow Arriving (cu.m/s)	Volume (cu.m)	Freeboard (m)	(cu.m/s)
N3	0	0			

SUB-CATCHMENT DETAILS

Name	Max Flow Q (cu.m/s)	Paved Max Q (cu.m/s)	Grassed Max Q (cu.m/s)	Paved Tc (min)	Grassed Tc (min)	Supp. Tc (min)	Due to Storm
Catchment3post	4.384	3.58	1.037	4.37	28.77	7.79	AR&R 100 year, 1.5 hours storm, average 44.43 mm/h, Zone 1
Catchment3pre	2.101	0	2.101	0	35	0	AR&R 100 year, 2 hours storm, average 37.7 mm/h, Zone 1
Catchment3post_basin	4.384	3.58	1.037	4.37	28.77	7.79	AR&R 100 year, 1.5 hours storm, average 44.43 mm/h, Zone 1

PIPE DETAILS

Name	Max Q (cu.m/s)	Max V (m/s)	Max U/S HGL (m)	Max D/S HGL (m)	Due to Storm
Pipe	1.327	3.4	0.449	0.439	AR&R 100 year, 2 hours storm, average 37.7 mm/h, Zone 1

CHANNEL DETAILS

Name	Max Q (cu.m/s)	Max V (m/s)	Chainage (m)	Max HGL (m)	Due to Storm

OVERFLOW ROUTE DETAILS

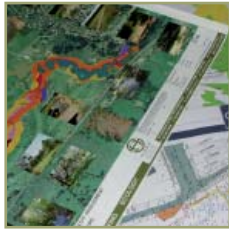
Name	Max Q U/S	Max Q D/S	Safe Q	Max D	Max DxV	Max Width	Max V	Due to Storm
overflow	0.834	0.834	1.945	0.364	0.57	2.91	1.57	AR&R 100 year, 2 hours storm, average 37.7 mm/h, Zone 1

DETENTION BASIN DETAILS

Name	Max WL	MaxVol	Max Q Total	Max Q Low Level	Max Q High Level
Basin	0		0		

CONTINUITY CHECK for AR&R 100 year, 1.5 hours storm, average 44.43 mm/h, Zone 1

Node	Inflow (cu.m)	Outflow (cu.m)	Storage Change (cu.m)	Difference %
N1	7988.25	7988.25	0	0
N2	5329.85	5329.85	0	0
Basin	7988.25	7321.44	854.49	-2.3
N3	7321.44	7321.44	0	0



Biodiversity Offset Assessment Report

For Rezoning and Residential Subdivision
at
Government Road
Cessnock NSW

Prepared for
Roger Davies
PO Box 702
Cessnock NSW 2325

Job Reference 24060 - June 2008



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<i>PROJECT: BIODIVERSITY OFFSET ASSESSMENT REPORT – GOVERNMENT ROAD, CESSNOCK</i>	
<i>CLIENT:</i>	<i>ROGER DAVIES</i>
<i>OUR REF</i>	<i>24060</i>
<i>DATE:</i>	<i>JUNE 2008</i>
<i>APPROVED BY:</i>	<i>ANNA McCONVILLE</i>
<i>SIGNATURE:</i>	
<i>CHECKED BY:</i>	<i>CRAIG ANDERSON</i>
<i>SIGNATURE:</i>	

EXECUTIVE SUMMARY

RPS Harper Somers O'Sullivan (RPS HSO) has been engaged to prepare a Biodiversity Offset Assessment Report (BOAR) for a proposed rezoning and residential development off Government Road, Cessnock (hereafter referred to as the 'development site') and the proposed conservation of a private in-holding property within Yengo National Park (hereafter referred to as the 'offset site'). Development of the site is consistent with the Lower Hunter Regional Strategy and the fundamentally related Draft Lower Hunter Regional Conservation Plan.

Proposed Development Site

The proposed development site was found to contain a number of vegetation communities, however only one community is proposed to be removed and hence requiring offsetting, being Lower Hunter Spotted Gum Ironbark Forest (LHSGIF) Endangered Ecological Community (EEC). The patch in question is approximately 8ha in area.

The patch also contains the threatened flora species *Rutidosis heterogama*, and the ROTAP-listed species *Grevillea montana*. Fauna of note recorded within the proposed development site included a family group of threatened *Pomatostomus temporalis* (Grey-crowned Babbler), which were recorded utilising residential plantings areas, and two threatened microchiropteran bat species, *Miniopterus australis* (Little Bentwing Bat) and *Miniopterus schreibersii* oceanensis (Eastern Bentwing Bat) were recorded utilising the proposed development site.

Proposed Offset Site

The proposed offset site was found to contain three vegetation communities, being Hunter Range Flats Apple-Stringybark-Gum Forest, Hunter Range Ironbark Forest, and Hunter Range Rocky Stringybark-Grey Gum Woodland (DECC, 2007b). The site is approximately 32ha in area. Potential habitat for one threatened flora species and 11 threatened fauna species recorded within 20km of the proposed offset site was found to occur.

It is proposed that the offset lands would be handed over to DECC for amalgamation with Yengo National Park. Gaining control of remaining private in-holdings within National Parks has been identified as a conservation priority by NPWS. The existing crown road reserves running through the property would be closed, thus limiting future public access. Such measures would strengthen the long term conservation value and manageability of this area of Yengo National Park.

In addition, the offset lands contain an existing cleared area that has potential to serve as a suitable helicopter landing site in the middle of an otherwise inaccessible wilderness. This would facilitate several park maintenance and management functions, including emergency fire-fighting operations. Also, it is considered likely that the landforms associated with the offset site, particularly sandstone rock outcrops and overhangs / caves, provide potential for significant aboriginal heritage conservation.

Conclusion

The proposed offset site is sought after by NPWS for addition to the Yengo National Park. It will assist in consolidation, access restriction and ongoing management of

this part of the Park. Whilst the offset does not meet certain criteria set by DECC in regards to Biodiversity Certification (namely “like for like”), it has been identified by both DECC and NPWS that gaining control of lands such as the proposed offset site is a high priority, and a holistic assessment concludes that the proposed offset package is of merit.

It is proposed that upon receiving notice of “in principle support” from DECC for the offsets proposal, the proponent will commence the necessary legal negotiations to enable the transfer of the land at the time of the proposed LEP adoption. The transfer of the lands to the public estate would be made through a Voluntary Planning Agreement under the *Environmental Planning and Assessment Act 1979* prepared in conjunction with the LEP.

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APPENDICES

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APPENDIX B	Personnel Involved in the Project	B-1
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1 INTRODUCTION

RPS Harper Somers O'Sullivan (RPS HSO) has been engaged by Roger Davies to undertake a Biodiversity Offset Assessment Report (BOAR) for the proposed rezoning and development of land off Government Road, Cessnock (hereafter referred to as the 'development site'). Specifically the development site investigation area is comprised of:

- Lots 1 and 2 DP 1067096,
- Lots 33 and 34 DP 1004648,
- Lot 1 DP392537,
- Lot 1 DP403312,
- Lot 1 DP403335; and
- Lots A and B DP 421062.

The vegetated area to be impacted, and hence requiring offsetting, is contained wholly within Lot 33 DP 1004648.

The proposed conservation offset site occurs as private in-holdings within Yengo National Park (hereafter referred to as the 'offset site'). Specifically the conservation offset land is comprised of:

- Lot 5 DP 755268
- Lot 33 DP 755268

1.1 Background

A flora and fauna assessment for the proposed development site was undertaken previously by RPS HSO (2007) and identified two Endangered Ecological Communities (EECs), one threatened flora species and two threatened fauna species listed under the *Threatened Species Conservation Act 1995* (TSC Act 1995).

Whilst ameliorative measures were applied during the concept design and detailed design phase of the project, it became apparent that some loss of biodiversity may occur as a result of the project. In particular, an area of approximately 8ha of Lower Hunter Spotted Gum Ironbark Forest (LHSGIF) is proposed to be removed to accommodate residential development.

As such an offset site has been proposed which contains high quality native bushland that is surrounded by Yengo National Park. This BOAR has been prepared to assess whether the provision of an offset would enhance or maintain biodiversity values within the region. The original flora and fauna assessment report for the proposed development site has been attached as Appendix A.

1.2 Site Particulars

1.2.1 Proposed Development Site

Locality – Government Road, Cessnock North

LGA – Cessnock City Council

Title(s) – Lots 1 & 2 DP 1067096, Lots 33 & 34 DP 1004648, Lot 1 DP392537, Lot 1 DP403312, Lot 1 DP403335 and Lots A & B DP 421062

Area – Total area = 72.5 hectares (ha); development area = 40ha. Area requiring offsetting = 8ha.

Zoning – 1(a) Rural A

Boundaries – The site is bounded on the eastern end of Lot 33 by State Forest (zoned 1(a)); to the north by Hunter Water land (zoned 1(a)); to the west of Lot 2 by Black Creek (zoned 1(a)); to the south of Lot 33 by a Council Depot (zoned 1(a)) and a buffer (zoned 6(a)) separating Lot 33 from land zoned Residential 2(a), to the south of Lot 2 by land zoned 1(a) and to the south of Lot B land zoned 2(a).

Current Land Use – Lot 2, Lot 33 and Lot 34 in the north are used for rural land purposes; predominantly cattle grazing. The remainder of the lots in the south of the site are used for rural purposes including truck parking, cattle grazing, boarding kennels and residential purposes.

Topography – The western end of Lot 33 and the eastern end of Lot 2 are elevated with the land falling away moderately to the west and south to a tributary of Black Creek, which drains east to Cessnock. The tributary traverses low lying land in Lot B and the western portions of Lot A, Lot 1 DP 403335 and Lot 2. In the east, Lot 33 overlays undulating land with two drainage lines traversing from south to north.

Vegetation – Four broad vegetation assemblages have been delineated within the study area, namely Cleared Managed Land, Residential Plantings, remnant ‘Lower Hunter Spotted Gum Ironbark Forest’, which is listed as an Endangered Ecological Community (EEC) under the TSC Act 1995 and remnant elements of ‘Central Hunter Riparian Forest’, which is commensurate with the ‘River-flat eucalypt forest on coastal floodplains’, which is also an EEC listed under TSC Act 1995.

1.2.2 Proposed Offset Site

Locality – Yengo National Park

LGA – Singleton Council

Title(s) – Lots 5 and Lot 33 DP 755268

Area – Approximately 32ha

Zoning – 7 (Environment Protection)

Boundaries – The site is bounded on three sides by Yengo National Park. The northern boundary abuts Lot 34 DP 755268, which is granted as a Perpetual Crown Lease (CL 1928/1 Singleton).

Current Land Use – The proposed offset site is currently vacant bushland. Historically, grazing and logging has occurred within the site with associated land clearing activities, with such activity restricted to flatter terrain surrounding Werong Creek.

Topography – The proposed offset site consists predominantly of the floodplain of Werong Creek which varies from around 70 - 200m wide. Steep slopes rise from the floodplain to high ridge tops outside of the proposed offset site.

Vegetation – Three broad vegetation assemblages have been delineated within the study area by DECC (2007b), namely Hunter Range Flats Apple-Stringybark-Gum Forest, Hunter Range Ironbark Forest and Hunter Range Rocky Stringybark-Grey Gum Woodland.

1.3 Scope of the Study

The scope of this BOAR is to:

- review the existing biodiversity values of the proposed development and the proposed offset sites;
- compare the biodiversity values of the proposed development and the proposed offset sites;
- assess whether the conservation of the proposed offset site will maintain or enhance existing biodiversity values;
- review proposed offset site against the offsetting principles outlined by DECC (2007a); and
- consider any other relevant factors that may influence a holistic assessment of the proposed offset arrangements.

1.4 Qualifications and Licensing

Qualifications

This report was written by Craig Anderson BAppSc, with assistance from Anna McConville BEnvSc and Deborah Landenberger BSc (Hons) of RPS Harper Somers O'Sullivan Pty Ltd. The academic qualifications and professional experience of all RPS HSO consultants involved in the project are documented in Appendix B.

Licensing

Research was conducted under the following licences:

- NSW National Parks and Wildlife Service Scientific Investigation Licence S10300 (Valid 30 November 2008);
- Animal Research Authority (Trim File No: 01/1142) issued by NSW Agriculture (Valid 12 March 2009);

- Animal Care and Ethics Committee Certificate of Approval (Trim File No: 01/1142) issued by NSW Agriculture (Valid 12 March 2010); and
- Certificate of Accreditation of a Corporation as an Animal Research Establishment (Trim File No: 01/1522 & Ref No: AW2001/014) issued by NSW Agriculture (Valid 26 May 2008).

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LEGEND

 Development Site Boundary

 Proposed Development Area (40ha)

TITLE:
Figure 1-1 - Proposed development site location
Government Road
Cessnock

CLIENT:
Roger Davies



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SCALE: 1: 8000 at A4 Size

DRAWN: L.Steel

APPROVED:

DATUM: MGA Zone 56 (GDA 94) **DATE:** 17/06/2008

LAYOUT REF: J:\CBS\24\24060 - Cessnock\Drafting ... fo
Biodiversity Offset Report\Figure 1-1 Site Location B-A4 170608.wor

CONTOUR INTERVAL: N/A

JOB REF: 24060

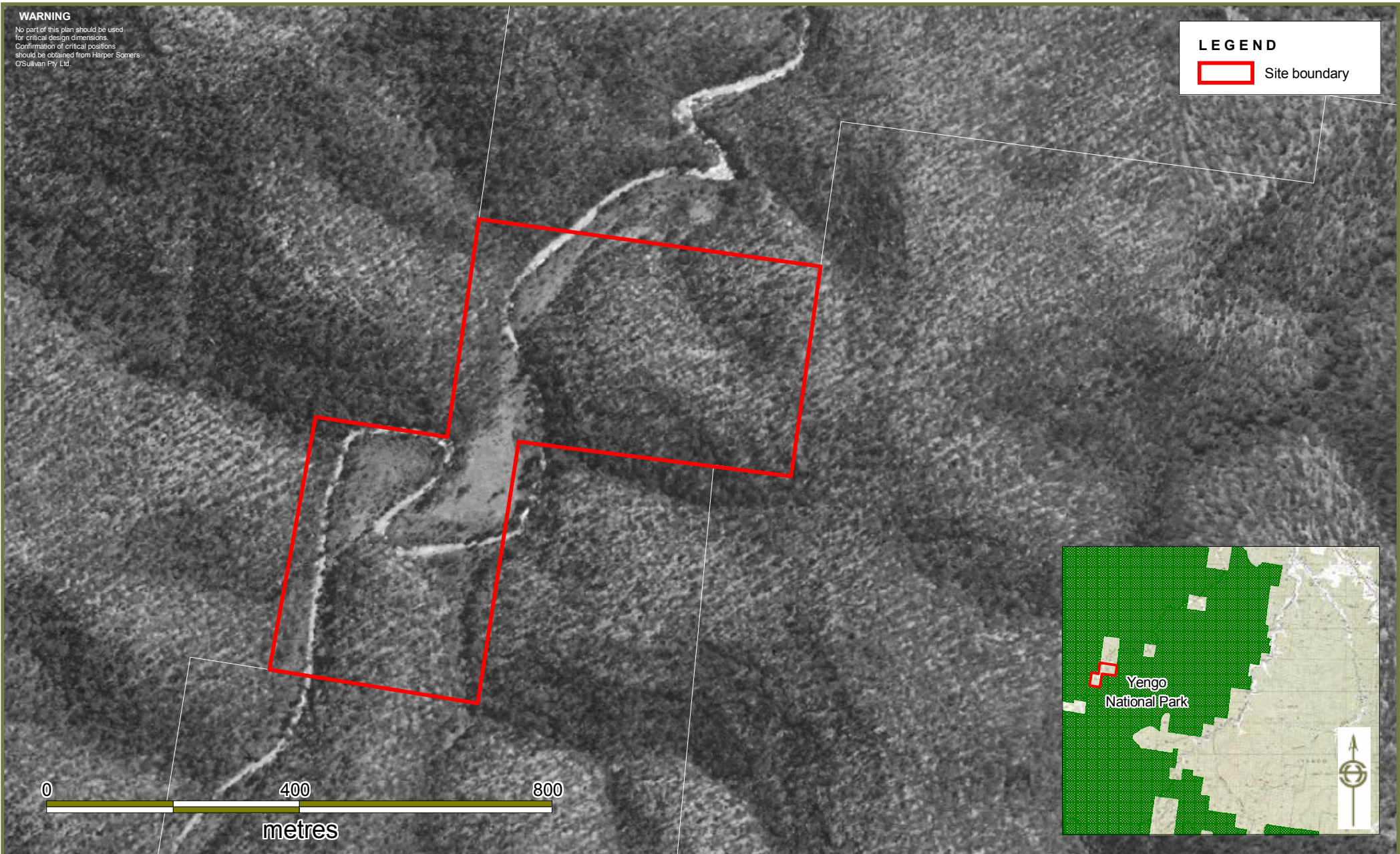
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LEGEND

 Site boundary



TITLE:
Figure 1-2 - Proposed offset site location
Coolawine Site

CLIENT:
Roger Davies



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SCALE: 1: 8000 at A4 Size **DRAWN:** L.Steel **APPROVED:** A.McConville

DATUM: MGA Zone 56 (GDA 94) **DATE:** 16/06/2008

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Biodiversity Offset Report\Figure 1-2 Offset Site Location A-A4 310308.wor

CONTOUR INTERVAL: N/A

JOB REF: 24060

2 BIODIVERSITY VALUES

2.1 Proposed Development Site

2.1.1 Vegetation Communities

The vegetation of the entire development investigation area is presented within the Flora and Fauna Assessment Report contained within Appendix A. Of specific relevance to this BOAR, is the approximately 8ha area of LHS GIF EEC occurring in the eastern end of the site (see Figure 2-1).

LHS GIF is indicated by the presence of *Eucalyptus fibrosa* (Broad-leaved Ironbark), *Corymbia maculata* (Spotted Gum), *E. punctata* (Grey Gum) and *E. moluccana* (Grey Box) as dominant species within the canopy. The LHS GIF corresponds to the Hunter-Macleay Dry Sclerophyll Forest vegetation class mapped by Keith (2004). Most of the LHS GIF stand in the east of Lot 33 has a managed understorey, but there are stands of *M. nodosa* persisting in the southern section of the stand. The LHS GIF is highly fragmented within the proposed development site. Marginal connectivity exists between most of the LHS GIF, except for the eastern portion that has good connectivity to the adjacent Cessnock State Forest aside from a break created by a cleared powerline easement. Despite the management of understorey vegetation for cattle grazing and bushfire risk reduction, the LHS GIF vegetation community, particularly in the east, exhibits a relatively intact assemblage of native plants that are known to occur within the community and a low occurrence of weed species. As such it would have moderate to high regenerating potential if current land-uses were to desist.

2.1.2 Significant Flora

RPS HSO (2007) found the threatened flora species *Rutidosia heterogama* (listed as Vulnerable under both the TSC Act 1995 and the EPBC Act 1999) within the LHS GIF subject to this BOAR. Furthermore, the ROTAP-listed (Briggs & Leigh, 1995) species *Grevillea montana* was noted in low densities within the LHS GIF.

Rutidosia heterogama was found to be widespread and relatively frequent within the LHS GIF stand within the east of Lot 33, except for those areas where *Melaleuca nodosa* exists or was likely to have existed in the past (see Appendix A). Approximately 4.6ha of *Rutidosia heterogama* habitat was mapped within the development site during recent site inspections (**Error! Reference source not found.**). The disturbed nature and managed understorey of this portion of the LHS GIF stand appears to favour *Rutidosia heterogama*.

Reconnaissance surveys were carried out in the forested areas immediately adjacent to the western end of the development site (i.e. Cessnock State Forest) in June 2008. The vegetation in these areas is largely intact with well developed understorey of *Melaleuca nodosa*. As such, *Rutidosia heterogama* is scant to absent in the forest proper. As can be seen in **Error! Reference source not found.**, *Rutidosia heterogama* is abundant in the cleared powerline easement. There is certainly scope for a large component of this population to be conserved and maintained within the Asset Protection Zone (APZ) that is likely to occur in this area in the final development framework. As such, it is considered unlikely that development as envisaged for the site would lead to a local extinction of *Rutidosia heterogama*.

2.1.3 Habitat

The majority of the proposed development investigation area is characterised by Cleared Managed Land, which represents poor potential habitat opportunities for threatened flora and fauna species and is generally suited to common native and introduced open country avian and mammal species. This was confirmed from fauna surveys which were limited to common mammal species such as *Macropus giganteus* (Eastern Grey Kangaroo), *Trichosurus vulpecula* (Common Brush-tail Possum) and *Oryctolagus cuniculus* (Rabbit). Common open country avian species, such as *Platycercus eximius* (Eastern Rosella), *Gymnorhina tibicen* (Australian Magpie), *Manorina melanocephala* (Noisy Miner) and the introduced species *Acridotheres tristis* (Common Myna), were observed during diurnal fauna surveys.

Residential Plantings are not significant for most threatened flora and fauna that occur in the area, but a family group of *Pomatostomus temporalis* (Grey-crowned Babbler) appear to be using planted shrubs and the surrounding lawns of Lot 1 DP 403335 as part of their home range.

The creek lines and flats in the south and west of the site have little opportunity to support locally occurring threatened species, due to their degraded structural condition and the dominance of grassy weeds. There is habitat along the creekline for frog species, but due to the degraded nature of the habitat and its isolation from areas of significant quality habitat this habitat is only likely to support only common frog species.

Persistent stands of LHSGIF have limited potential to permanently support threatened fauna species in their own right, due to their limited extent, lack of hollow-bearing trees (for shelter and breeding habitat) and degraded quality. However, the canopy of LHSGIF would produce blossom on a seasonal basis, which might be accessed intermittently by threatened nectarivorous birds, such as *Melithreptus gularis* (Black-chinned Honeyeater) and *Lathamus discolor* (Swift Parrot) and threatened mobile nectarivorous mammals, such as *Pteropus poliocephalus* (Grey-headed Flying-fox) which was recorded adjacent to the site during nocturnal surveys. Tree canopies within the site represent foraging habitat for threatened insectivorous bats that occur within the locality.

No Regional or Subregional Corridors as defined within NSW National Parks and Wildlife Service (NPWS) Key Habitats and Corridors in North East NSW mapping were found to overlay the site. Furthermore, no land within the site or its vicinity is defined within the NSW NPWS mapping as Key Habitat.

2.1.4 Significant Fauna

A total of 64 fauna species were recorded within the proposed development investigation area during ecological surveys, including 46 bird species, 13 mammal species and two frog species (RPS HSO, 2007).

Three fauna species listed as Vulnerable under the TSC Act 1995 were recorded within the proposed development site:

- *Miniopterus australis* (Little Bentwing-bat);
- *Miniopterus schreibersii oceanensis* (Eastern Bentwing-bat); and
- a family group of *Pomatostomus temporalis* (Grey-crowned Babbler).

Suitable habitat for a further six threatened fauna species was found to occur within the proposed development site despite not being recorded during field surveys:

- *Pteropus poliocephalus* (Grey-headed Flying-Fox);
- *Saccolaimus flaviventris* (Yellow-bellied Sheath-tail-bat);
- *Falsistrellus tasmaniensis* (Eastern False Pipistrelle);
- *Myotis adversus* (Large-footed Myotis);
- *Mormopterus norfolkensis* (East-coast Freetail Bat); and
- *Scoteanax rueppellii* (Greater Broad-nosed Bat).

2 BIODIVERSITY VALUES

2.1 Proposed Development Site

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The vegetation of the entire development investigation area is presented within the Flora and Fauna Assessment Report contained within Appendix A. Of specific relevance to this BOAR, is the approximately 8ha area of LHSGIF EEC occurring in the eastern end of the site (see Figure 2-1).

LHSGIF is indicated by the presence of *Eucalyptus fibrosa* (Broad-leaved Ironbark), *Corymbia maculata* (Spotted Gum), *E. punctata* (Grey Gum) and *E. moluccana* (Grey Box) as dominant species within the canopy. The LHSGIF corresponds to the Hunter-Macleay Dry Sclerophyll Forest vegetation class mapped by Keith (2004). Most of the LHSGIF stand in the east of Lot 33 has a managed understorey, but there are stands of *M. nodosa* persisting in the southern section of the stand. The LHSGIF is highly fragmented within the proposed development site. Marginal connectivity exists between most of the LHSGIF, except for the eastern portion that has good connectivity to the adjacent Cessnock State Forest aside from a break created by a cleared powerline easement. Despite the management of understorey vegetation for cattle grazing and bushfire risk reduction, the LHSGIF vegetation community, particularly in the east, exhibits a relatively intact assemblage of native plants that are known to occur within the community and a low occurrence of weed species. As such it would have moderate to high regenerating potential if current land-uses were to desist.

2.1.2 Significant Flora

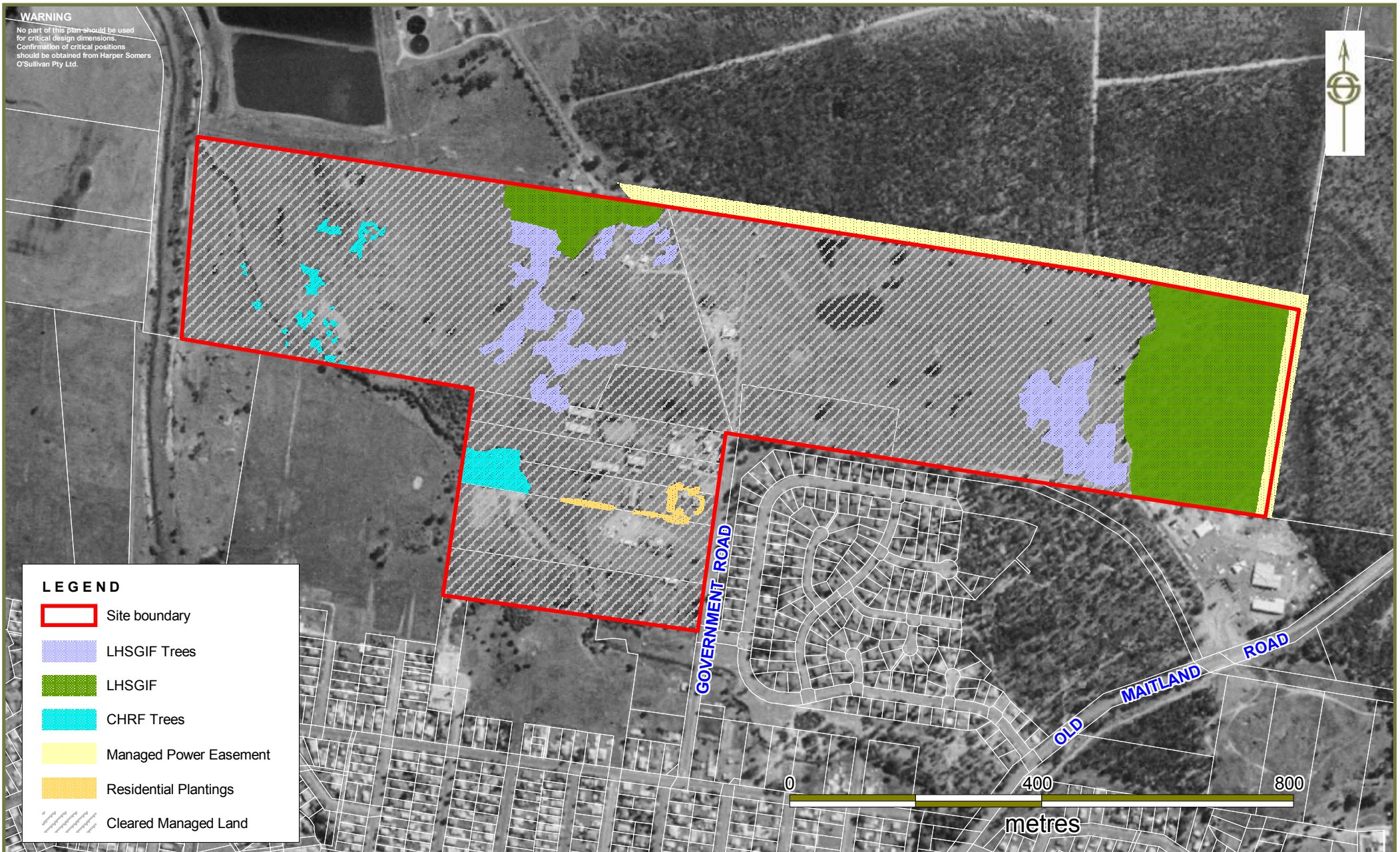
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Reconnaissance surveys were carried out in the forested areas immediately adjacent to the western end of the development site (i.e. Cessnock State Forest) in June 2008. The vegetation in these areas is largely intact with well developed understorey of *Melaleuca nodosa*. As such, *Rutidosia heterogama* is scant to absent in the forest proper. As can be seen in Figure 2-2, *Rutidosia heterogama* is abundant in the cleared powerline easement. There is certainly scope for a large component of this population to be conserved and maintained within the Asset Protection Zone (APZ) that is likely to occur in this area in the final development framework. As such, it is considered unlikely that development as envisaged for the site would lead to a local extinction of *Rutidosia heterogama*.

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LEGEND

-  Site boundary
-  LHSIGF Trees
-  LHSIGF
-  CHRF Trees
-  Managed Power Easement
-  Residential Plantings
-  Cleared Managed Land

TITLE:
Figure 2-1 - Vegetation within the proposed development site
Government Road
Cessnock

CLIENT:
Roger Davies



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SCALE: 1: 8000 at A4 Size **DRAWN:** L.Steel **APPROVED:** A. McConville

DATUM: MGA Zone 56 (GDA 94) **DATE:** 31/3/2008

LAYOUT REF: J:\CBS\24\4\24060 - Cessnock\Drafting ... fo
Biodiversity Offset Report\Figure 2-1 Veg within site A-A4 310308.wor



CONTOUR INTERVAL: N/A

JOB REF: 24060



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LEGEND

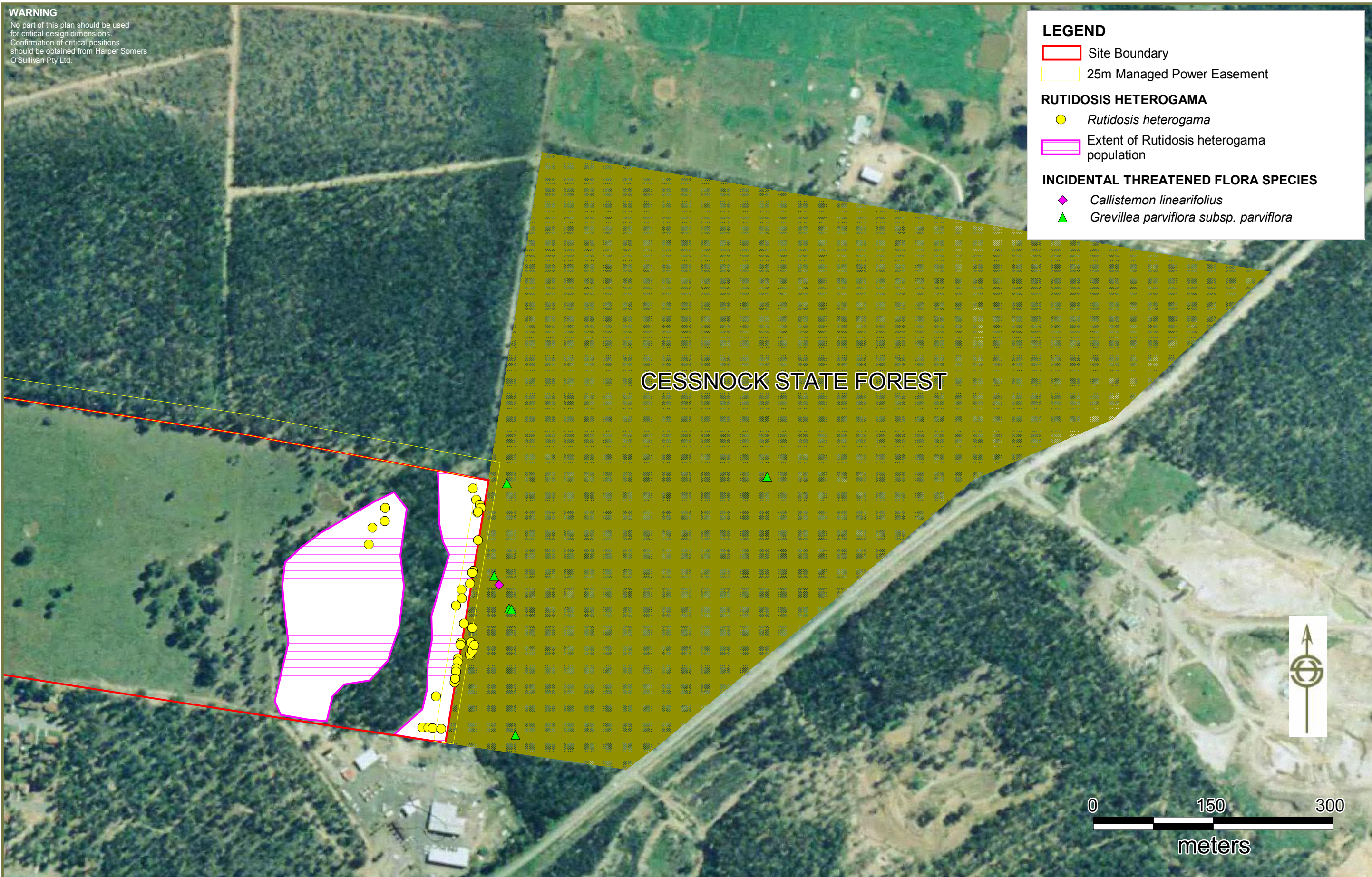
-  Site Boundary
-  25m Managed Power Easement

RUTIDOSIS HETEROGAMA

-  *Rutidosia heterogama*
-  Extent of *Rutidosia heterogama* population

INCIDENTAL THREATENED FLORA SPECIES

-  *Callistemon linearifolius*
-  *Grevillea parviflora* subsp. *parviflora*



TITLE:
 Figure 2-2 -
 Rutidosia heterogama Extent
 Government Road
 Cessnock

CLIENT: Roger Davies

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SCALE: 1: 4500 at A3 Size

DRAWN: D. Landenberger

APPROVED: C. Anderson

DATUM: MGA Zone 56 (GDA 94) **DATE:** 16/6/2008

LAYOUT REF: J:\JOBS\24k\24060 - Cessnock\Drafting\MapInfo\Biodiversity Offset Report\Figure 2-2 Rutidosia extent A-A4 160608.wor

CONTOUR INTERVAL: N/A

JOB REF:
 24060

2.2 Proposed Offset Site

2.2.1 Vegetation Communities

The vegetation communities present onsite were mapped by DECC (2007b) and include the following communities:

- Hunter Range Flats Apple-Stringybark-Gum Forest (corresponds to Coastal Valley Grassy Woodlands mapped by Keith 2004);
- Hunter Range Ironbark Forest (corresponds to Sydney Hinterland Dry Sclerophyll Forest mapped by Keith 2004); and
- Hunter Range Rocky Stringybark-Grey Gum Woodland (corresponds to Sydney Hinterland Dry Sclerophyll Forest mapped by Keith 2004).

Inspection of the site by RPS HSO (Craig Anderson) / DECC (Lucas Grenadier) / NPWS (Robert Harris) did not reveal any significant alterations / additions to the broad-scale vegetation map existing for the area.

A description of the vegetation communities present within the proposed offset site is given below, Figure 2-3 shows the location of vegetation communities and a photographic record of the site is presented in Appendix C.

Hunter Range Flats Apple-Stringybark-Gum Forest

This community occurs as a tall open forest within the creek line and associated alluvial deposits. A significant level of disturbance is evident due to past land practices, which included land clearing for grazing and logging. In select areas, past land use has resulted in a low age cohort of eucalypt species and high dominance of colonising species such as *Acacia* and weed species. Whilst DECC (2007b) found that this community was not representative of the River-flat Eucalypt Forest on Coastal Floodplains EEC due to the lack of diagnostic flora species, it does recognise the conservation value of this community.

Upper Stratum - Approximately 25m height, with a Percent Foliage Cover (PFC) of approximately 32%. The dominant tree species are *Angophora floribunda*, *Eucalyptus eugenioides*, *E. amplifolia* subsp. *amplifolia*, *E. saligna*, *E. punctata*, *E. deanii* and *Melaleuca linariifolia*.

Mid Stratum - Approximately 11m height, with a PFC of approximately 20%. The dominant small tree species are *Acacia parramattensis*, *A. filicifolia*, *Persoonia linearis*, *Cassinia uncata*, *Breynia oblongifolia*, *Allocasuarina torulosa*, *Polyscias sambuccifolia* and *Exocarpus strictus*.

Lower Stratum - Approximately 4m height, with a PFC of approximately 17%. The dominant shrub species are *Acacia parramattensis*, *A. filicifolia*, *Persoonia linearis*, *Cassinia uncata*, *Breynia oblongifolia*, *Polyscias sambuccifolia* and *Exocarpus strictus*.

Ground Cover - up to one metre height, with a PFC of approximately 55%. The dominant groundcover species are *Microlaena stipoides* var. *stipoides*, *Oplismenus imbecillus*, *Cyperus laevigatus*, *Pteridium esculentum*, *Adiantum aethiopicum*, *Imperata cylindrical* var. *major*, *Dichondra repens*, *Pratia purpurescens*, *Cheilianthese sieberi* var. *sieberi*, *Lomandra longifolia*, *Veronica cinerea* and *Rubus parvifolius*.

Hunter Range Ironbark Forest

This community occurs on sandstone with thin layers of shale as a dry open shrub and grassland forest. Past timber harvesting has occurred throughout this community within the Yengo National Park and surrounds. Dedication of the surrounding area as a reserve site has abated these threats and the vegetation is considered to be of high quality. This community is largely intact within the subject site, given its occurrence largely away from the flatter floodplain areas.

Upper Stratum - Approximately 25m height, with a PFC of approximately 36%. The dominant tree species are *Eucalyptus crebra*, *Angophora costata*, *Eucalyptus fibrosa*, *Corymbia eximia*, *E. punctata*, *Syncarpia glomulifera* subsp. *glomulifera* and *E. fergusonii* subsp. *dorsiventralis*.

Mid Stratum - Approximately 5m height, with a PFC of approximately 8%. The dominant small tree species are *Allocasuarina torulosa* and *Angophora floribunda*.

Lower Stratum - Approximately 2m height, with a PFC of approximately 26%. The dominant shrub species are *Podolobium ilicifolium*, *Pultenaea scabra*, *Persoonia linearis*, *Acacia parvipinnula* and *Bursaria spinosa*.

Ground Cover - up to 60cm height, with a PFC of approximately 14%. The dominant groundcover species are *Themeda australis*, *Aristida vagans*, *Pomax umbellata*, *Entolasia stricta*, *Dianella revoluta* var *revoluta*, *D. caerulea*, *Hardenbergia violacea*, *Billardiera scandens*, *Phyllanthus hirtellus*, *Cheilanthes sieberi* var *sieberi*, *Lomandra longifolia* and *L. multiflora* subsp. *multiflora*.

Hunter Range Rocky Stringybark-Grey Gum Woodland

This community exists as low open woodland on exposed sandstone with a variable shrub layer. Shrub and ground cover densities are variable due to exposed rocky and shallow infertile soils. This community is considered to be adequately conserved within the current reserve system (DECC, 2007b). This community is largely to totally intact within the offset site.

Upper Stratum - Approximately 18m height, with a PFC of approximately 15%. The dominant tree species are *Corymbia eximia*, *Eucalyptus sparsifolia*, *E. punctata*, *Angophora costata*, *E. crebra*, *E. fibrosa* and *E. fergusonii* subsp. *dorsiventralis*.

Lower Stratum - Approximately 2m height, with a PFC of approximately 23%. The dominant shrub species are *Persoonia linearis*, *Podolobium ilicifolium*, *Leucopogon muticus*, *Grevillea mucronulata*, *Hibbertia obtusifolia*, *Hovea linearis*, *Acacia linifolia* and *Pultenaea microphylla*.

Ground Cover - up to 30cm height, with a PFC of approximately 18%. The dominant groundcover species are *Entolasia stricta*, *Pomax umbellata*, *Lomandra oblique*, *L. glauca*, *Dianella revoluta* var *revoluta*, *Lomatia confertifolia*, *Cassytha pubescens* and *Cheilanthes sieberi*.

2.2.2 Significant Flora

Whilst targeted threatened flora searches were not undertaken within the proposed offset site during the inspection undertaken with DECC and NPWS, four threatened flora species have been recorded by DECC (2007b) within two of the vegetation assemblages found to occur within the proposed offset site. *Melaleuca groveana* and *Velleia perfoliata*, which are listed as Vulnerable under the TSC Act 1995, have been recorded within the Hunter Range Ironbark Forest (MU20) vegetation community by DECC (2007b). The Hunter Range Rocky Stringybark-Grey Gum Rocky Woodland (MU25) vegetation community has been found to contain *Dillwynia tenuifolia* and *Eucalyptus fracta*, which are also listed as Vulnerable under the TSC Act 1995 (DECC, 2007b).

Only one threatened flora record (*Melaleuca groveana*) exists on the NSW Atlas of Wildlife within a 20km radius of the proposed offset site.

2.2.3 Habitat

The site is part of a large area of intact bushland wilderness. It has contiguous connectivity with Yengo National Park, offering expanses of habitat for a wide variety of native flora and fauna species.

Werong Creek runs through the site, and provides areas of permanent water for native species, both terrestrial and aquatic. Riparian areas, whilst in part regenerating from past disturbance, provide continuous vegetative cover to the creek banks.

Numerous habitat features of note that are critical to fauna species lifecycles were noted during the site inspection, including tree hollows and fallen logs of varying sizes, a variety of fruiting and flowering trees and shrubs, permanent water holes, rock outcrops / overhangs / ledges / caves, dense ground cover etc.

In short, the site occurs as a bushland area in a large expanse of wilderness managed for conservation purposes.

2.2.4 Significant Fauna

A search of the NSW Atlas of Wildlife in a 20km radius of the proposed offset site resulted in the following threatened fauna records:

- *Ixobrychus flavicollis* (Black Bittern) - one record from 1977;
- *Callocephalon fimbriatum* (Gang Gang Cockatoo) - multiple records from 1991 to 2007;
- *Calyptorhynchus lathami* (Glossy Black Cockatoo) - multiple records from 1997 to 2006;
- *Ninox strenua* (Powerful Owl) - one record from 1990;
- *Pyrhrolaemus sagittatus* (Speckled Warbler) - one record from 2002;
- *Pomatostomus temporalis temporalis* (Grey-crowned Babbler) - two records from 2002 and 2004;
- *Dasyurus maculatus* (Spotted-tailed Quoll) - one record from 2005;
- *Phascolarctos cinereus* (Koala) - multiple records from 1984 to 2006;

- *Petaurus australis* (Yellow-bellied Glider) - multiple records from 1997 to 2006;
- *Chalinolobus dwyeri* (Large-eared Pied Bat) - one record from 1997 and four records from 2004; and
- *Vespadelus trougtoni* (Eastern Cave Bat) - two records from 2004.

Whilst no targeted threatened fauna surveys were undertaken, suitable habitat for the majority of these threatened fauna species was found to exist within the proposed offset site.

WARNING


No part of this plan should be used for critical design dimensions. Confirmation of critical positions should be obtained from Harper Somers O'Sullivan Pty Ltd.


LEGEND

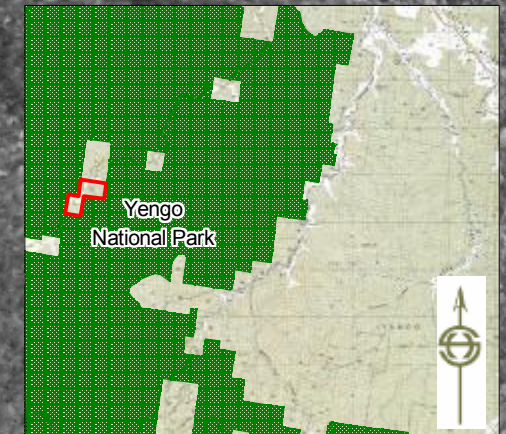
 Site boundary

Vegetation types within offset site

 Hunter Range Flats Apple-Stringybark-Gum Forest

 Hunter Range Ironbark Forest

 Hunter Range Rocky Stringybark-Grey Gum Woodland



TITLE:
Figure 2-3 - Vegetation within the proposed offset site Coolawine Site

CLIENT:
Roger Davies



PLANNING SURVEYING ECOLOGY

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SCALE: 1: 8000 at A4 Size

DRAWN: L.Steel

APPROVED: A.McConville

DATUM: MGA Zone 56 (GDA 94) **DATE:** 31/3/2008

LAYOUT REF: J:\GCS\24K\24060 - Cessnock\Drafting\MapInfo\Biodiversity_Offset_Report_Figure 2-3 Vegetation within proposed offset site B-A4 160608.wor

CONTOUR INTERVAL: N/A

JOB REF: 24060

3 OFFSET PRINCIPLES

This section addresses the proposed biodiversity offset in relation to the 13 offset principles outlined by DECC (2007a).

1. Impacts must be avoided first by using prevention and mitigation measures

Potential impacts on threatened species and EECs have been ameliorated as much as possible during both the concept design phase of the project. The key mitigation measure is that riparian areas (remnant River Flat Eucalypt Forest on Coastal Floodplains EEC) would be conserved within the development footprint and rehabilitation and weed management would be undertaken through the implementation of a Rehabilitation and Weed Management Plan. Landscape plantings would make use of endemic species within the proposed development site, including species aimed at providing foraging resources and habitat for resident avifauna species.

Detailed design of the proposal has not been undertaken to date and there is the potential for key ecological components to be incorporated into the design to prevent or ameliorate potential impacts on threatened species and EECs such as:

- encourage the incorporation of ecologically sensitive landscaping into the detailed design;
- landscape plantings to use species endemic to the area from locally sourced seed material with a focus on LHSGIF EEC species in drier areas and RFEF EEC species in floodplain areas;
- aim to retain threatened species and/or EEC habitat within APZs and similar (ie *Rutidosis heterogama* habitat within the maintained APZ), where possible;
- monitor any threatened species and/or EEC habitat retained within the detailed design for changes over time; and
- staging of development and landscaping to minimise disturbance to *Pomatostomus temporalis* (Grey-crowned Babbler) within the development site.

The development outcome and the proposed offset site are outlined within the Lower Hunter Regional Strategy (LHRS), which is fundamentally linked to the Draft Lower Hunter Regional Conservation Plan (LHRCP).

2. All regulatory requirements must be met

The purpose of the proposed offset site is to maintain or enhance biodiversity values in the region while allowing some development in more disturbed areas. All regulatory requirements will be met as the development process unfolds in accordance with the LHRS. The BOAR herewith provides the fundamental consideration and assessment mechanism for moving forwards in regards to satisfactory biodiversity outcomes.

3. Offsets must never reward ongoing poor performance

The proposed offset site is not utilised at present, and as such no ongoing degrading factors such as grazing are relevant at present. However, in the event that the land is not transferred to the NPWS estate, then it is possible for grazing and other permissible agricultural pursuits to be recommenced on the land.

4. Offsets will complement other government programs

The proposed offset site is an in-holding within Yengo National Park and as such, the addition of this site would compliment and strengthen existing DECC holdings. The acquisition of private in-holdings within existing Park areas has been identified as a conservation priority by DECC / NPWS.

In addition, the proposed offset site has also been identified as a helicopter landing site which could be used by the Rural Fire Service and NPWS for maintenance and fire fighting activities. Fire fighting access is important for both biodiversity protection as well as private and government asset protection, and meeting obligations associated with land management and neighbour protection.

5. Offsets must be underpinned by sound ecological principles

The proposed development site has been subjected to a range of disturbances associated with land clearing for grazing. Biodiversity has been reduced within the proposed development site; however, small areas of intact vegetation do provide habitat for a subset of locally occurring flora and fauna species.

The proposed offset site is located within a large tract of high quality native vegetation within the broader Yengo National Park. Much of the proposed offset site has vegetation that is considered to be high quality. However, the site has been used historically for grazing and other rural activities and as a result some weed invasion has occurred along the creekline and cleared pasture areas. Despite these disturbances the proposed offset site is considered to provide habitat for a variety of flora and fauna species and has a high regeneration potential given the quality of surrounding vegetation and the relative isolation of the site. The dedication of the proposed offset site to conservation is considered likely to result in an increase in biodiversity values within the offset site due to the connectivity to high quality native vegetation and the various best practice management strategies adopted by DECC.

6. Offsets should aim to result in a net improvement in biodiversity over time

The dedication of the proposed offset site to conservation would result in a net improvement of biodiversity over time since a potential source area for weeds and other disturbance would be under conservation management and allowed to regenerate. The proposed offset site would be incorporated into the Yengo National Park Plan of Management and as such best practice management strategies typically implemented by DECC would be undertaken to maintain or enhance biodiversity over time.

Much of the proposed development site is highly degraded, located adjacent to existing development which would provide ongoing disturbances. However, the proposal would result in the loss of 8ha of Lower Hunter Spotted Gum Ironbark Forest.

7. Offsets must be enduring - they must offset the impact of the development for the period that the impact occurs

The proposed offset site would be incorporated into Yengo National Park and as such would be awarded the highest level of protection under DECC stewardship.

8. Offsets should be agreed prior to the impact occurring

Offsets would be approved prior to rezoning of the proposed development site.

9. Offsets must be quantifiable - the impacts and benefits must be reliably estimated

Impacts

The proposed development site was found to contain a number of vegetation communities, however only one community is proposed to be removed and hence requiring offsetting, being LHSIGIF EEC. The patch of LHSIGIF in question is approximately 8ha in area. LHSIGIF within the development site is subject to ongoing grazing and rural maintenance of the understorey and is largely fragmented with low connectivity outside of the site; however, the eastern portion of LHSIGIF does have good connectivity to adjacent areas of Cessnock State Forest. The portion of LHSIGIF within the proposed development site does have some regeneration potential, it is considered to be a small, disturbed portion of the LHSIGIF in the locality.

The patch also contains the threatened flora species *Rutidosia heterogama*, and the ROTAP-listed species *Grevillea montana*. Fauna of note recorded within the proposed development site included a family group of threatened *Pomatostomus temporalis* (Grey-crowned Babbler), which were recorded utilising residential plantings areas, and two threatened microchiropteran bat species, *Miniopterus australis* (Little Bentwing-bat) and *Miniopterus schreibersii oceanensis* (Eastern Bentwing-bat) were recorded utilising the proposed development site.

No cave-roosting habitat occurs within the proposed development site and as such impacts resulting from the proposal on cave-roosting microchiropteran bat species (*Miniopterus australis*, *M. schreibersii oceanensis* and *Myotis adversus*) are likely to be limited to modification of foraging habitat for these species. Hollow-bearing trees within the proposed development site provide potential roosting habitat for hollow-roosting microchiropteran bat species likely to occur within the site (*Mormopterus norfolkensis*, *Scoteanax rueppelli*, *Saccolaimus flaviventris* and *Falsistrellus tasmaniensis*). As such potential impacts arising from the proposal on hollow-roosting microchiropteran bats will be the removal of potential roosting habitat and the modification of foraging habitat.

Potential impacts on *Pomatostomus temporalis* (Grey-crowned Babbler) within the proposed development site will be limited to modification of habitat and it is considered that foraging opportunities will continue to exist within landscape plantings subsequent to development. Careful staging of the project and landscaping will assist in minimising potential impacts on *P. temporalis* (Grey-crowned Babbler) within the development site.

The proposal has the potential to remove 4.6ha of habitat for *Rutidosia heterogama* within the development site. However, it is likely that the APZ in the east of the proposed development site would conserve some of this area of *Rutidosia heterogama* habitat occurring within the development site. This area occurs immediately adjacent to the cleared powerline easement where the species was recorded in abundance outside of the site. The APZ in the east will also conserve some of the LHSIGIF; however, it is likely that understorey maintenance would be required within the APZ and as such the full assemblage of species may not persist within the APZ area.

Benefits

The proposed offset site was found to contain three vegetation communities, being Hunter Range Flats Apple-Stringybark-Gum Forest, Hunter Range Ironbark Forest, and Hunter Range Rocky Stringybark-Grey Gum Woodland (DECC, 2007b). The site is approximately 32ha in area. Potential habitat for one threatened flora species and 11 threatened fauna species recorded within 20km of the proposed offset site was found to occur.

It is proposed that the offset lands would be handed over to DECC for amalgamation with Yengo National Park. Gaining control of remaining private in-holdings within National Parks has been identified as a conservation priority by NPWS. The existing crown road reserves running through the property would be closed, thus limiting future public access. Such measures would strengthen the long term conservation value and manageability of this area of Yengo National Park.

In addition, the offset lands contain an existing cleared area that has potential to serve as a suitable helicopter landing site in the middle of an otherwise inaccessible wilderness. This would facilitate several park maintenance and management functions, including emergency fire-fighting operations. Also, it is considered likely that the landforms associated with the offset site, particularly sandstone rock outcrops and overhangs / caves, provide potential for significant aboriginal heritage conservation.

10. Offsets must be targeted

The proposed development site contains a small area of Hunter-Macleay Dry Sclerophyll Forest (LHSGIF) vegetation class as mapped by Keith (2004). Whilst the proposed offset site contains high quality Coastal Valley Grassy Woodlands (Hunter Range Flats Apple-Stringybark-Gum Forest) and Sydney Hinterland Dry Sclerophyll Forest (Hunter Range Ironbark Forest and Hunter Range Rocky Stringybark-Grey Gum Woodland) mapped by Keith (2004). Therefore, the proposed offset site is not considered to represent 'like for like' biodiversity values compared with the proposed development site.

Searches were undertaken for suitable offset sites in the locality which contained 'like for like' biodiversity values (in particular LHSGIF). Whilst some sites containing LHSGIF were found, they were not considered in a location, configuration or condition that would be suitable for addition to DECC estate. Other potentially suitable sites were not for sale.

Despite the offset site not being 'like for like' with the proposed development site, it does offer good conservation outcomes within the Lower Hunter Region. In-holdings within Yengo National Park have been identified by DECC as priority areas for conservation since they are often a source of weed infestation and disturbance within the boundaries of the National Park. In addition, the Hunter Range Flats Apple-Stringybark-Gum Forest, is considered to be of conservation significance in the local area (DECC, 2007). The dedication of the proposed offset site to Yengo National Park would mean that appropriate management strategies such as weed and pest control to be undertaken to facilitate regeneration of the disturbed floodplain vegetation. The area of key habitat to be removed or modified within the development site is 8ha (LHSGIF), in comparison with 32ha to be conserved within the offset site. This will result in an offsetting ratio of 1:4, which is considered to be adequate to offset the small, disturbed and largely fragmented portion of LHSGIF.

11. Offsets must be located appropriately

The proposed development and offset sites both have floodplain vegetation assemblages; however, the topography of the sites is contrasting. The proposed offset site is located within a high relief area, in comparison with the gently undulating topography of the proposed development site.

It is considered that the proposed offset site is located in an area that will be assured long term conservation status, and will help strengthen, consolidate and expand the reserve system without creating additional undue management burdens from a logistics viewpoint.

12. Offsets must be supplementary

Whilst the proposed offset site is currently zoned for environmental protection under Singleton Council LEP, the proposed incorporation of the site into Yengo National Park would provide enhanced protection and management in perpetuity, and remove potential land uses inconsistent with the objectives of the management of Yengo National Park.

13. Offsets and their actions must be enforceable through development consent conditions, licence conditions, conservation agreements or a contract

The proposed offset site would be dedicated to DECC estate as part of Yengo National Park. The transfer of the offset lands to the public estate would be conducted as part of a Voluntary Planning Agreement at the time of the rezoning gazettal. Once dedicated to DECC estate, no further involvement is expected to be required.

4 CONCLUSION

The proposed development site will require the removal of 8ha of LHSGIF which includes 4.6ha of *Rutidosia heterogama* habitat. The proposed development site also provides habitat for nine threatened fauna species. A range of ameliorative measures have the potential to be implemented during the detailed design and construction phases of the project such as landscaping with endemic plants and the incorporation of *Rutidosia heterogama* habitat into APZ designs. The portion of habitat to be removed as a result of the proposal (8ha of LHSGIF) is considered to be a small, disturbed and fragmented portion of this community within the locality. While the proposed offset site is not considered to represent a 'like for like' offset, the provision of a site which will strengthen the Yengo National Park and minimise the potential for weed and pest proliferation within the park, is considered to have considerable conservation outcomes for the Lower Hunter Region.

5 REFERENCES

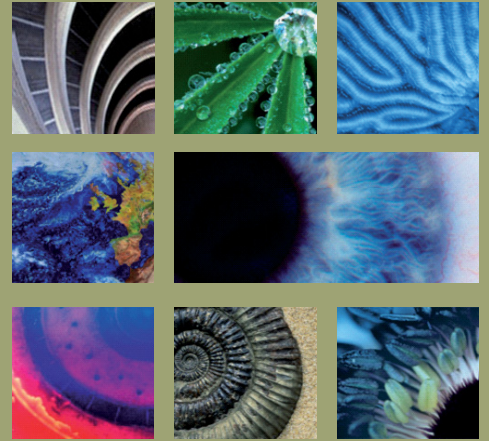
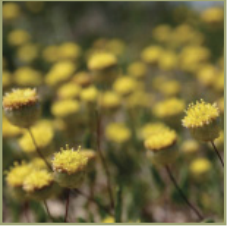
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DECC (2007b) *The Native Vegetation of the Yengo and Parr Reserves and surrounds*, Unpublished Report. Department of Environment and Climate Change, Hurstville.

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RPS Harper Somers O'Sullivan [RPS HSO] (2007) *Flora and Fauna Assessment for Rezoning and Residential Subdivision at Lots 1&2 390 DP1067096, Lots 33&34 DP 1004648, Lot 1 DP 392537, Lot 1 DP 403312, Lot 1 DP 403335 and Lots A & B DP 421061, Government Road, North Cessnock, NSW*, Roger Davies.

APPENDIX A RPS HSO (2007)



Flora and Fauna Assessment

For Rezoning and Residential Subdivision
at

Lot 1&2 390 DPI067096, Lots 33&34
DP 1004648

Lot 1 DP 392537, Lot 1 DP 403312,
Lot 1 DP 403335 and Lots A & B
DP 421061

Government Road
North Cessnock NSW 2325

Prepared for
Roger Davies
PO Box 702
Cessnock NSW 2325

Job Reference 24060 - June 2007



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PROJECT: FLORA & FAUNA ASSESSMENT – GOVERNMENT ROAD, CESSNOCK	
CLIENT:	ROGER DAVIES
OUR REF	24060
DATE:	JUNE 2007
APPROVED BY:	ALLAN RICHARDSON
SIGNATURE:	
CHECKED BY:	CRAIG ANDERSON
SIGNATURE:	

EXECUTIVE SUMMARY

INTRODUCTION

RPS Harper Somers O'Sullivan (RPS HSO) has been engaged by Roger Davies to undertake a Flora and Fauna Assessment for Lots 1 & 2 DP 1067096, Lots 33 & 34 DP 1004648, Lot 1 DP392537, Lot 1 DP403312, Lot 1 DP403335 and Lots A & B DP 421062, Government Road, Cessnock (hereafter referred to as the site). The site is currently zoned 1a (Rural A) and land uses are in keeping with this zoning. The larger northern lots are characterised by cattle grazing, with remnant areas of native forest vegetation in the east of Lot 33 DP 1004648 and in the northeast and west of Lot 2 DP1067096. The smaller southern lots exhibit vegetation characteristics, which suggest that they have been cleared of significant native vegetation and highly managed for a long period of time, although small vestiges of native vegetation communities still persist intermittently within this area. The purpose of this assessment is twofold: firstly to make inventory of current land-uses and ecological attributes to aid strategic development and conceptual land-use planning in support of proposed rezoning of the land; and secondly to provide detailed assessment of ecological attributes for proposed residential subdivision and development within the site.

This report aims to recognise the relevant requirements of the *Environmental Planning and Assessment Act 1979 (EP&A Act 1979)* as amended by the *Environmental Planning and Assessment Amendment Act 1997 (EP&AA Act 1997)* and the *Threatened Species Conservation Act 1995 (TSC Act 1995)*. Assessment of the site under the requirements of State Environmental Planning Policy No. 44 (SEPP 44) – 'Koala Habitat Protection' is also included. Consideration of potential constraints has also been undertaken in relation to the *Native Vegetation Act 2003 (NV Act 2003)* and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999 (EP&BC Act 1999)*.

The results of these investigations are incorporated into this report, which has been structured and conducted to consider survey requirements of Cessnock City Council's Development Control Plan (DCP) No. 56 "Flora and Fauna Survey Guidelines Lower Hunter Central Coast Region 2002". Whilst survey work has been undertaken wholly within the bounds of the site, consideration has been afforded to areas off the site to gain a wider appreciation of the site's context in the local environment.

VEGETATION

Four broad vegetation assemblages have been delineated within the site, namely Cleared Managed Land (CML), Residential Plantings (RP), remnant elements of 'Central Hunter Riparian Forest' (CHRF), which is listed within the *TSC Act 1995* as an Endangered Ecological Community (EEC) within the EEC 'River-flat eucalypt forest on coastal floodplains' (RFEFCF), and remnant 'Lower Hunter Spotted Gum Ironbark Forest (LHSGIF), which is also listed within the *TSC Act 1995* as an EEC.

CML is the dominant vegetation community across the site, due to an apparent long history of anthropogenic land use, particularly cattle grazing within the large northern lots (Lots 2 & 33). The majority of CML is dominated by exotic pasture and grassland species with the introduced *Setaria gracilis* (Slender Pigeon Grass) and *Pennisetum clandestinum* (Kikuyu Grass) prominent and often dominant within this vegetation community. CML in Lot 33 has large areas in the lot's central section that have been planted out with oats for grazing purposes.

RP is largely limited to areas immediately around residential buildings and sheds.

Small numbers of CHRF elements occur along the tributary of Black Creek draining East Cessnock, which traverses the southern four lots and the western portion of Lot 2. Most of the riparian flats area of Lot 2 is covered by CML dominated by *S. gracilis*, but the occurrence of a very small number of *Casuarina glauca* (Swamp Oak), singular *Angophora floribunda* (Rough-barked Apple) and *Eucalyptus tereticornis* (Forest Red Gum) and *Melaleuca stypheloides* and *M. linariifolia* on the flats and associated with the tributary's course indicate that the riparian flats in the south and west were once characterised by CHRF. However, there is not a sufficient presence of CHRF elements to represent this EEC within the site.

Native forest stands occurring in the east of Lot 33 and in the northeast of Lot 2, are remnant stands of LHSGIF, which is indicated by the presence of *Eucalyptus fibrosa* (Broad-leaved Ironbark), *Corymbia maculata* (Spotted Gum), *E. punctata* and *E. moluccana* (Grey Box) as dominant species within the canopy. The stand in Lot 2 has a relatively low diversity of understorey plants due to the dominance of *Melaleuca nodosa*. Most of the LHSGIF stand in the east of Lot 33 has a managed understorey, but there are stands of *M. nodosa* persisting in the southern section of the stand. Despite the managed nature of understorey vegetation for cattle grazing and bushfire risk reduction, the community exhibits a relatively intact assemblage of native plants that are known to occur within LHSGIF and a low occurrence of weed species. As such it would have moderate to high regenerating potential if current land-uses were to desist.

SIGNIFICANT FLORA

In the far southeast of Lot B a single individual of *E. parramattensis* subsp. *decadens* (Drooping Red Gum), which was noted in the Atlas of NSW Wildlife mapping data, was confirmed as occurring in the reported position. *E. parramattensis* subsp. *decadens* is listed as Vulnerable under the *TSC Act 1995*.

The disturbed nature of the managed understorey of LHSGIF in Lot 33's east is suited to a threatened flora species, *Rutidosis heterogama* (Heath Wrinklewort), which is listed as Vulnerable under the *TSC Act 1995*. This species is widespread and relatively frequent across the LHSGIF stand in Lot 33's east, outside of those areas where *M. nodosa* exists or existed in the past.

The ROTAP species *Grevillea montana* was noted in low densities within the LHSGIF stand in the east of Lot 33.

Targeted searches were conducted for other threatened flora species known to occur locally in LHSGIF, particularly for *Callistemon linearifolius*, for which records occur outside the boundary of the site. However, no other threatened flora species were observed and only the common *Callistemon* spp. *C. rigidus* and *C. linearis* were found to occur within the site.

HABITAT

The majority of the site is characterised by CML, which represents poor potential habitat opportunities for threatened flora and fauna species and is only suited to common native open country avian and mammal species and introduced fauna species.

Residential Plantings are not significant for most threatened flora and fauna that occur in the area, but a family group of *Pomatostomus temporalis* (Grey-crowned Babbler) appear to be using planted shrubs and the surrounding lawns of Lot 1 DP 403335 as part of their home range.

The creek lines and flats in the south and west of the site have little opportunity to support locally occurring threatened species, due to their degraded structural condition and the dominance of grassy weeds.

Persistent stands of LHSGIF do not have the potential to permanently support threatened fauna species in their own right, due to their limited extent and degraded quality. There are relatively intact stands of LHSGIF to the north, southwest and east of the site, which might promote good opportunities for locally occurring threatened fauna to use the site, if it were not for power easement buffers, lack of high quality habitat outside the site and the lack of habitat complexity within the site.

In general the areas most likely to contain habitat for threatened species, those being the forested areas, particularly in Lot 33, display a structurally depauperate understorey stratum, unsuited to threatened insectivorous birds and a very low incidence of hollow-bearing trees, which might have otherwise provided nesting or roosting habitat for arboreal mammals, Microchiropteran bats and forest owl species.

No *Allocasuarina* spp. were observed within the site, which might provide foraging opportunities for *Calyptorhynchus lathamii* (Glossy Black-Cockatoo).

KEY HABITATS AND CORRIDORS

No Regional or Subregional Corridors as defined within NSW National Parks and Wildlife Service (NPWS) Key Habitats and Corridors in North East NSW mapping were found to overlay the site. Furthermore, no land to the within the site or its vicinity is defined within the NSW NPWS mapping as Key Habitat. No significant impacts upon Key Habitats occurring to the north are expected if the recommendations provided in Section 7 are adhered to.

FAUNA

A relatively low diversity of common avian species was encountered within the site and this was expected considering the limited extent and degraded condition of native vegetation communities within the site. One common nocturnal bird species, a Tawny Frogmouth, was observed during nocturnal fauna surveys.

One threatened bird species, *Pomatostomus temporalis temporalis* (Grey-crowned Babbler), was observed within residential shrub plantings in the south of the site. *P. t. temporalis* is listed as Vulnerable under the *TSC Act 1995*.

Mammal species observed within the site during diurnal fauna surveys were limited to common and introduced open country species, including Eastern Grey Kangaroos and Rabbits. During nocturnal surveys a single Common Brushtail-Possum and six Microchiropteran bat species were detected. Three threatened Microchiropteran bat species that are listed as Vulnerable under the *TSC Act 1995* were detected during bat surveys, being *Falsistrellus tasmaniensis* (Eastern False Pipistrelle), *Miniopterus australis* (Little Bentwing-bat) and *Miniopterus schreibersii oceanensis* (Eastern Bentwing-bat).

No reptile species and only one common frog species were observed within fauna surveys. The time of year when surveys were conducted is directly attributable to the low incidence of herpetile observations, however very limited habitat exists within the site for herpetile species apart from the most common species.

Targeted surveys, including habitat assessment, were conducted to ascertain the likelihood that the site might provide some significant habitat for threatened fauna species known to occur within the Cessnock LGA. The site was found to represent a small amount of seasonal

foraging habitat (Blossom and Insects) for more mobile threatened species, such as nectivorous birds and bats and insectivorous bats.

ECOLOGICAL PLANNING ISSUES

A number of ecological constraints were identified as occurring within the site and herewith is discussed allowances and offsets that might be made to accommodate those constraints, such that development within the site might maintain or improve ecological value within Strategic and Conceptual Planning for subsequent residential development within the site.

The occurrence of *Pomatostomus temporalis temporalis* (Grey-crowned Babbler) within Residential Plantings vegetation on Lot B is not considered unusual as this species appears to have adapted relatively well, in the Cessnock LGA, to the formation of more open habitat associated with development, provided large shrubby vegetation is retained where the species can shelter and build their bulky nests. This species is unlikely to be disadvantaged by residential development within the site provided suitable shelter plantings are retained or provided within subsequent layout designs and landscaping.

Some 8ha of LHSGIF occurs in the east of Lot 33 and 2ha occurs within Lot 2. LHSGIF within Lot 2 occurs within the odour buffer zone surrounding the Cessnock Sewerage Treatment Works and will remain unchanged through the process of development. LHSGIF in Lot 33 would be removed during subsequent development of the site and would therefore require an offset of similar vegetation or another EEC within the site or through conservation outcomes for vegetation of equal ecological value elsewhere. Some 11.5ha of low-lying land occurring in the west of Lot 2 is highly degraded by weed infestations and the loss of native vegetation, but still contains a small number of remnant elements of CHRF EEC. Within this area there is scope to restore CHRF and such restoration might serve to offset the loss of LHSGIF in Lot 33, particularly since CHRF has been more severely depleted in the Cessnock LGA than LHSGIF. This will ensure that the provisions of "maintain or improve" as contained within the *NV Act 2003* are met.

LHSGIF in Lot 33 also represents foraging habitat for threatened insectivorous bats, and potential seasonal foraging habitat for threatened nectivorous bird and bat species. The suggested restoration of CHRF in the west of Lot 2 would amply offset the loss of foraging habitat for these mobile species within Lot 33, including winter blossom resources represented by *Corymbia maculata* (Spotted Gum), by winter blossom provided by *Eucalyptus tereticornis* (Forest Red Gum), which occurs as a dominant species in the canopy of CHRF.

The loss of *Rutidosis heterogama* in LHSGIF, an asteraceous herb that is relatively widespread within LHSGIF throughout the Cessnock LGA, could be adequately offset by the planting of *Eucalyptus glaucina* in the suggested CHRF offset, due to the relatively low representation of this eucalypt in the Cessnock LGA.

A single *E. parramattensis* subsp. *decadens* occurs in the southeast corner of Lot B. To offset any potential impact upon this species landscape plantings could incorporate this species into street and landscape plantings.

ENVIRONMENTAL LEGISLATION ASSESSMENT

Section 5A of the EP&A Act 1979

Application of Section 5A of the *EP&A Act 1979* (Seven-Part Tests) indicated that impacts of relatively small magnitude may be caused upon LHSGIF and *Rutidosis heterogama* if areas

of vegetation where these threatened entities occur is displaced by subsequent development. However, overall ecological value within the site will be maintained or improved if the recommendations provided herewith (see below) are duly recognised in any potential future land use planning exercise.

Key Threatening Processes

Key Threatening Processes are listed in Schedule 3 of the *TSC Act 1995*. Those potentially applicable to the current rezoning and a future development proposal are “Clearing of Native Vegetation”, “Predation by Feral Cats” and “Human Caused Climate Change”.

Only one of these KTP’s has the potential to be exacerbated by future development, namely “Predation by Feral Cats”, but the encouragement of responsible pet use, as contained in the recommendations within Section 7, will reduce the potential for this KTP to be significantly exacerbated as a consequence of future residential development.

SEPP 44 ‘Koala Habitat Protection’

Two tree species listed in Schedule 2 of SEPP No. 44 – ‘Koala Habitat Protection’ occurs on site, namely *Eucalyptus Punctata* (Grey Gum) and *E. tereticornis* (Forest Red Gum). As such the site represents ‘Potential Koala Habitat’ as defined by the SEPP.

However, no evidence, in the form of direct or secondary indications, suggests that Koalas have used the site or other habitats within the vicinity of the site in the recent past. Therefore, the site is not considered by the definitions of the SEPP to constitute ‘Core Koala Habitat’.

Therefore no further provisions of this policy apply to the site.

EPBC Act 1999

Six nationally listed threatened species under the *EPBC Act 1999* have been recorded within the proximate region of the site as follows:

- | | |
|---|-------------------------|
| • <i>Acacia bynoeana</i> | Bynoe’s Wattle; |
| • <i>Eucalyptus parramattensis</i> subsp. <i>decadens</i> ; | Drooping Red Gum |
| • <i>Grevillea parviflora</i> subsp. <i>parviflora</i> ; | |
| • <i>Pteropus poliocephalus</i> | Grey-headed Flying-fox; |
| • <i>Lathamus discolor</i> | Swift Parrot; and |
| • <i>Xanthomyza phrygia</i> | Regent Honeyeater. |

The potential for the proposal to significantly impact on individuals or local populations for the above species has been assessed under the provisions of the *TSC Act (1995)* in Section 4.1. This assessment concluded that it is considered unlikely the current proposal will have a significant impact upon a local population such that local extinctions would occur. Likewise, it is considered that no significant impacts are likely to occur on a Commonwealth level.

Recommendations

The following recommendations have been generated to provide ecological guidelines for rezoning and development of the site to offset potential impacts as a result of the proposal.

- Currently *Pomatostomus temporalis temporalis* (Grey-crowned Babblers) occur within the site. To ensure that this species is able to persist within the site through subsequent development it is recommended that shrubby tree species, such as *Casuarina* spp. or

small-leaved *Melaleuca* spp. be incorporated into street planting and landscaping plant lists.

- One *E. parramattensis* subsp. *decadens* individual was found to occur within the site. To ensure that this species continues to occur within the site in the future it should be added to street planting and landscaping plant lists.
- Approximately 8ha of LHSGIF currently occurs at the eastern end of Lot 33. It is likely that this vegetation will be removed during subsequent development of the site. To offset the loss of this EEC it is suggested that 8ha of the low-lying areas occurring in the west of Lot 2 be restored to previously occurring CHRFF.
- The likely removal of LHSGIF from Lot 33 during subsequent development of the site, would remove habitat currently containing *Rutidosia heterogama*. To offset the loss of *R. heterogama* from Lot 33, it is recommended that *Eucalyptus glaucina* be planted within CHRFF offset vegetation in the west of Lot 2.
- Currently within the areas that occur outside the odour buffer zone (potential development areas) there are three definable drainage lines. Each of these drainage lines run into natural watercourses beyond the site and have potential to impact upon downstream habitats. It is recommended that a water management strategy be incorporated into strategic planning of the site to ensure impacts to offsite watercourses are prevented.
- The planting of locally occurring native plant species should be encouraged in residential plantings to provide foraging opportunities for locally occurring native fauna species.
- Responsible pet ownership should be encouraged to counter potential impacts upon native fauna.

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1 INTRODUCTION

RPS Harper Somers O'Sullivan (RPS HSO) has been engaged by Roger Davies to undertake a Flora and Fauna Assessment for Lots 1 & 2 DP 1067096, Lots 33 & 34 DP 1004648, Lot 1 DP392537, Lot 1 DP403312, Lot 1 DP403335 and Lots A & B DP 421062, Government Road, Cessnock (hereafter referred to as the site). The site is currently zoned 1a (Rural A) and land uses are in keeping with this zoning. The larger northern lots are characterised by cattle grazing, with remnant areas of native forest vegetation in the east of Lot 33 DP 1004648 and in the northeast and west of Lot 2 DP1067096. The smaller southern lots exhibit vegetation characteristics, which suggest that they have been cleared of significant native vegetation and highly managed for a long period of time, although small vestiges of native vegetation communities still persist intermittently within this area. The purpose of this assessment is twofold: firstly to make inventory of current land-uses and ecological attributes to aid strategic development and conceptual land-use planning in support of proposed rezoning of the land; and secondly to provide detailed assessment of ecological attributes for proposed residential subdivision and development within the site.

This report aims to recognise the relevant requirements of the *Environmental Planning and Assessment Act 1979 (EP&A Act 1979)* as amended by the *Environmental Planning and Assessment Amendment Act 1997 (EP&AA Act 1997)* and the *Threatened Species Conservation Act 1995 (TSC Act 1995)*. Assessment of the site under the requirements of State Environmental Planning Policy No. 44 (SEPP 44) – 'Koala Habitat Protection' is also included. Consideration of potential constraints has also been undertaken in relation to the *Native Vegetation Act 2003 (NV Act 2003)* and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999 (EP&BC Act 1999)*.

The results of these investigations are incorporated into this report, which has been structured and conducted to consider survey requirements of Cessnock City Council's Development Control Plan (DCP) No. 56 "Flora and Fauna Survey Guidelines Lower Hunter Central Coast Region 2002". Whilst survey work has been undertaken wholly within the bounds of the site, consideration has been afforded to areas off the site to gain a wider appreciation of the site's context in the local environment.

1.1 Site Particulars

Locality – Government Road, Cessnock North

LGA – Cessnock City Council

Title(s) – Lots 1 & 2 DP 1067096, Lots 33 & 34 DP 1004648, Lot 1 DP392537, Lot 1 DP403312, Lot 1 DP403335 and Lots A & B DP 421062

Area – Total 72.5ha

Zoning – Rural A 1(a)

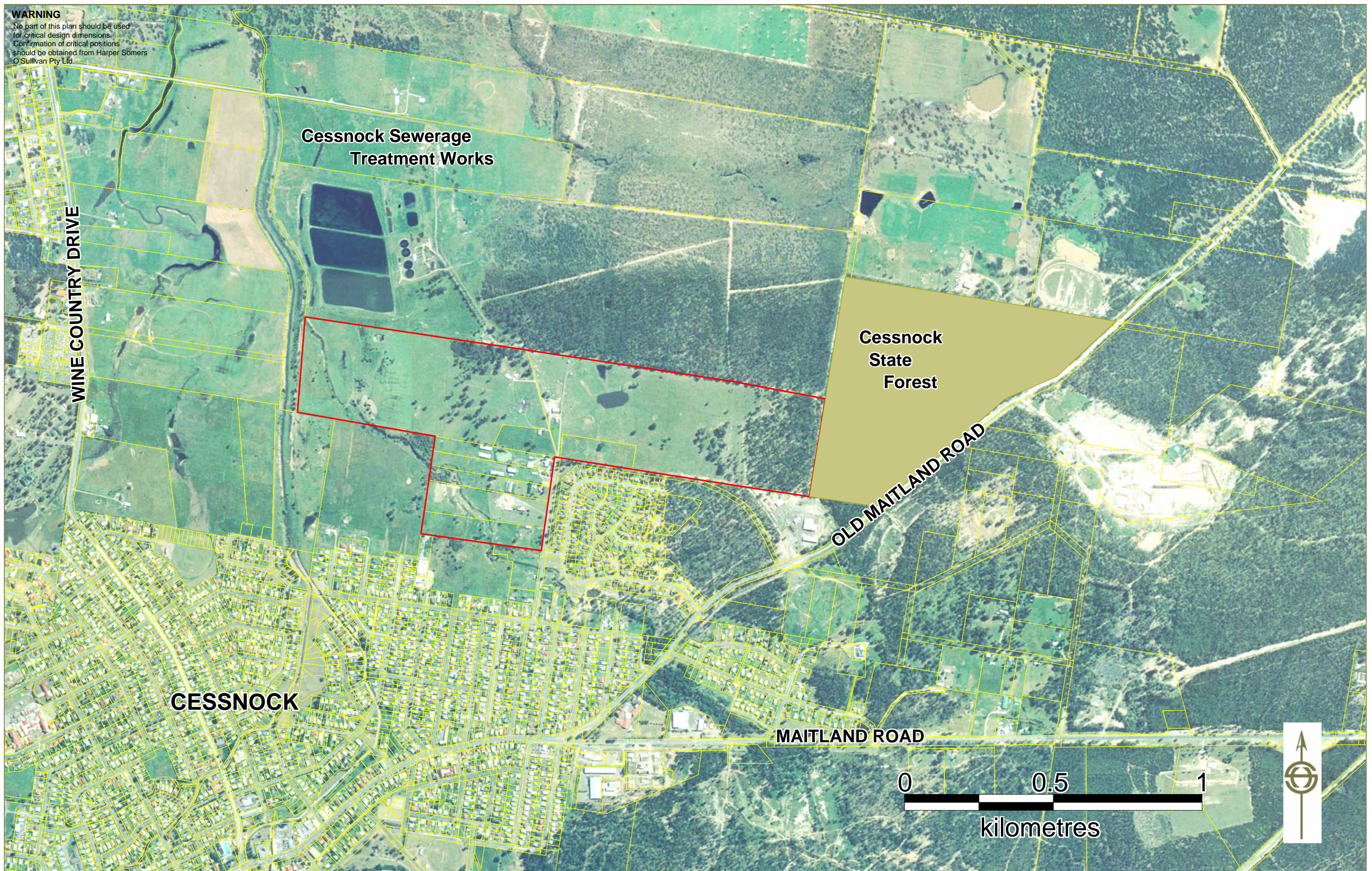
Boundaries – The site is bounded on the eastern end of Lot 33 by State Forest (zoned 1(a)); to the north by Hunter Water land (zoned 1(a)); to the west of Lot 2 by Black Creek (zoned 1(a)); to the south of Lot 33 by a Council Depot (zoned 1(a)) and a buffer (zoned 6(a)) separating Lot 33 from land zoned Residential 2(a), to the south of Lot 2 by land zoned 1(a) and to the south of Lot B land zoned 2(a).

Current Land Use – Lot 2, Lot 33 and Lot 34 in the north are used for rural land purposes; predominantly cattle grazing. The remainder of the lots in the south of the site are used for rural purposes including truck parking, cattle grazing, boarding kennels and residential purposes.

Topography – The western end of Lot 33 and the eastern end of Lot 2 are elevated with the land falling away moderately to the west and south to a tributary of Black Creek draining east Cessnock. The tributary traverses low lying land in Lot B and the western portions of Lot A, Lot 1 DP 403335 and Lot 2. In the east Lot 33 overlays undulating land with two drainage lines traversing from south to north.

Vegetation – Four broad vegetation assemblages have been delineated within the study area, namely Cleared Managed Land (CML), Residential Plantings (RP), remnant elements of 'Central Hunter Riparian Forest' (CHRF), which is listed within the *TSC Act 1995* as an Endangered Ecological Community (EEC) within the EEC 'River-flat eucalypt forest on coastal floodplains' (RFEFCF) and remnant 'Lower Hunter Spotted Gum Ironbark Forest (LHSGIF), which is also listed within the *TSC Act 1995* as an EEC.

WARNING
No part of this plan should be used for critical design dimensions. Confirmation of critical positions should be obtained from Harper Somers O'Sullivan Pty Ltd.



TITLE: FLORA & FAUNA ASSESSMENT
SITE LOCATION MAP

FIGURE: 1-1
PAGE: 3

CLIENT: ROGER DAVIES
GOVERNMENT ROAD, CESSNOCK

PLANNING SURVEYING ECOLOGY



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SCALE: 1: 12000 at A3 Size DRAWN: A. Richardson APPROVED: M. Doherty

DATUM: MGA Zone 56 (GDA 94) DATE: 28/5/2007

LAYOUT REF: J:\JOBS\24K\24060 - Cessnock\Drafting\MapInfo
24060.FIGURE 1-1 SITE LOCATION MAP-A-A3

CONTOUR INTERVAL: N/A

JOB REF: 24060

1.2 Description of the Proposal

This assessment has been undertaken to make inventory of those ecological elements occurring within the site to assist Strategic and Conceptual Planning for the rezoning of the site and to provide assessment of those ecological elements in regard to the site's use for residential subdivision land-uses.

1.3 Scope of the Study

The scope of this flora, fauna and ecological constraints assessment report is to:

- identify vascular plant species found on the site;
- identify and map existing vegetation communities;
- assess the status of identified plant species and vegetation communities under relevant legislation;
- identify existing habitat types on the site and assess the habitat potential for threatened species, populations, or ecological communities known from the proximate area;
- through preliminary research identify threatened fauna potentially using the site;
- employ targeted survey techniques to identify fauna, in particular threatened species using the site; and
- assess the potential of the proposed development to have a significant impact on any threatened species, populations or ecological communities identified during field surveys or as having potential habitat on the site.

Whilst survey work has been undertaken wholly within the bounds of the site, consideration has been afforded to areas off the site in order to appreciate the environmental context of the site.

The purpose of this report is to:

- ensure planning, management and development decisions are based on sound scientific information and advice by documenting the presence of any biodiversity components or potential significant impacts that may exist on the site;
- provide information to enable compliance with applicable assessment requirements contained within the *TSC Act (1995)*, *EP&A Act (1979)*, the *NV Act 2003*, the Commonwealth *EPBC Act (1999)*, and any other relevant state, regional and local environmental planning instruments; and
- enable the provision and analysis of ecological data that is comparable with data for other sites within the region to ensure continuity and consistency for survey and results.

1.4 Qualifications and Licensing

Qualifications

This report was written by Allan Richardson BEnvSc (Hons), Sam Bishop BEnvSc, Matt Doherty BLMC, and Craig Anderson BAppSc of RPS Harper Somers O'Sullivan Pty Ltd. The academic qualifications and professional experience of all HSO consultants involved in the project are documented in Appendix D.

Licensing

Research was conducted under the following licences:

- NSW National Parks and Wildlife Service Scientific Investigation Licence S10300 (Valid 30 October 2007);
- Animal Research Authority (Trim File No: 01/1142) issued by NSW Agriculture (Valid 12 March 2008);
- Animal Care and Ethics Committee Certificate of Approval (Trim File No: 01/1142) issued by NSW Agriculture (Valid 12 March 2010); and
- Certificate of Accreditation of a Corporation as an Animal Research Establishment (Trim File No: 01/1522 & Ref No: AW2001/014) issued by NSW Agriculture (Valid 26 May 2008).

1.5 Certification

As the principal author, I, Allan Richardson make the following certification:

- The results presented in the report are, in the opinion of the principal author and certifier, a true and accurate account of the species recorded, or considered likely to occur within the site;
- Commonwealth, state and local government policies and guidelines formed the basis of project surveying methodology, or where the survey work has been undertaken with specified departures from industry standard guidelines, details of which are discussed and justified in Section 2;
- All research workers have complied with relevant laws and codes relating to the conduct of flora and fauna research, including the *Animal Research Act 1995*, *National Parks and Wildlife Act 1974* and the *Australian Code of Practice for the Care and Use of Animals for Scientific Purposes*.

Signature of Principal Author and Certifier:



Allan Richardson
Ecologist
RPS Harper Somers O'Sullivan Pty Ltd

2 METHODOLOGY

A variety of field survey techniques were employed over the course of fieldwork for this assessment to record the full suite of flora species and fauna guilds across the site.

RPS HSO have undertaken numerous assessments of this nature within the region and wider NSW. Considerable local knowledge and experience supports an excellent understanding of the key ecological issues for this locality, and in particular the management strategies required to appropriately address and accommodate these issues in accordance with the requirements of determining authorities. Our extensive portfolio coupled with commonwealth, state and local government policies and guidelines form the basis for our adopted project methodology.

Furthermore, the results of these investigations are incorporated into this report, which has been structured and conducted with consideration of survey requirements of Cessnock City Council's Development Control Plan (DCP) No. 56 "Flora and Fauna Survey Guidelines Lower Hunter Central Coast Region 2002".

Targeted and general spotlighting surveys and targeted habitat searches were undertaken across the site in place of trapping surveys, given the paucity of suitable habitat.

2.1 Flora Survey

2.1.1 Vegetation Mapping

Flora surveys and vegetation mapping carried out on the site has been undertaken as follows.

- Aerial Photograph Interpretation (API) to map the community(s) extent into definable map units.
- Confirmation of the community type(s) present (dominant species) via undertaking flora surveys and identification.
- Review of The Lower Hunter and Central Coast Regional Environment Management Strategy (LHCCREMS) Vegetation Survey, Classification and Mapping, 2002.
- Consideration was given to the potential for the derived vegetation communities to constitute 'Endangered Ecological Communities' (EEC) as listed within the *TSC Act (1995)*.
- Flora surveys were carried out across the site, with an emphasis on potentially significant species, as outlined below. The general flora survey included consideration of the site in line with methodology such as the "Random Meander Technique" described by Cropper (1993).
- Map the type and general extent of the community(s) present into definable map units where appropriate.

2.1.2 Significant Flora Survey

A list of potentially occurring significant flora species from the locality (10km radius) was compiled, which included threatened species (Endangered or Vulnerable) and Endangered Ecological Communities (EEC) listed under the *TSC Act (1995)*, those species listed on the *EPBC Act (1999)*, Rare or Threatened Australian Plants (ROTAP) listed flora species (Briggs and Leigh 1996), as well as any other species deemed to be of local importance.

Consideration was given to those species identified as occurring within the region (10km) radius given past records. Targeted searches were undertaken throughout the site for these species during the survey period

Assessment of the potential for the derived vegetation communities to constitute EEC's as listed within the *TSC Act (1995)* was also undertaken.

2.2 Habitat Survey

An assessment of the relative value of the habitat present on site was carried out. This assessment focused primarily on the identification of specific habitat types and resources on the site favoured by known threatened species from the region. The assessment also considered the potential value of the site (and surrounds) for all major guilds of native flora and fauna.

The assessment was based on the specific habitat requirements of each threatened fauna species in regards to home range, feeding, roosting, breeding, movement patterns and corridor requirements. Consideration was given to contributing factors including topography, soil, light and hydrology for threatened flora and assemblages.

2.3 Fauna Survey

The fauna survey methodology initially consisted of the production of an Expected Fauna Species List for the area (Appendix C) and an assessment of the potential use of the site by threatened fauna species (as listed under the *TSC Act 1995*) identified from the vicinity of the site. This was achieved by undertaking literature and database reviews followed by confirmation through field surveys where additional species observed were noted on the list.

2.3.1 Avifauna Survey

The presence of avifauna on the site was carried out via targeted diurnal surveys as well as opportunistic observations during all other phases of fieldwork

Diurnal surveys were carried out during the early morning hours when bird species are most active and throughout the day to maximise chances of species encountered. Birds were identified by direct observation or by recognition of calls or distinctive features such as nests, feathers, and owl regurgitation pellets etc.

The potential for significant nocturnal bird species such as the forest owls, namely *Ninox strenua* (Powerful Owl), *N. connivens* (Barking Owl) and *Tyto novaehollandiae* (Masked Owl), to occur on the site was assessed by evaluating the suitability of habitat within the site to support such species

2.3.2 Herpetofauna Survey

Searches for reptiles and amphibians were conducted during ecological investigations, but were largely based upon known habitat requirements of threatened herpetofauna species due to coolness of conditions and unlikely activity of this faunal group during the time when fauna surveys were conducted.

2.3.3 Secondary Indications and Incidental Observations

Opportunistic sightings of secondary indications (scratches, scats, diggings, tracks etc.) of resident fauna were noted. Such indicators included:

- Distinctive scats left by mammals. Any scats unable to be positively identified in the field were collected for further analysis, and scats of predator species containing fur / bones were sent for analysis if appropriate;
- Scratch marks made by various types of arboreal animals;
- Nests made by various guilds of birds;
- Scats consistent with Koalas;
- Feeding scars on *Eucalyptus* trees made by Gliders;
- Chewed Casuarinaceae cones indicative of past feeding by Glossy Black-Cockatoos.
- Chewed fruit remains indicative of past feeding by frugivorous birds such as Fruit-Doves; and
- Whitewash, regurgitation pellets and prey remains from Owls.

Any other incidental observations of fauna were recorded during all phases of fieldwork.

3 RESULTS

The prevailing weather conditions during the survey period are presented in Table 1 below.

Table 1 Prevailing Weather Conditions

		June 2007
		17
<i>Temperature</i>		12-24°C
<i>Wind</i>		Low
<i>Cloud</i>		0%
<i>Rain</i> (24 hrs to 9:00am)		0mm
<i>Sun</i>	<i>Rise</i>	06:39
	<i>Set</i>	17:03
<i>Moon</i>	<i>Rise</i>	6:57
	<i>Set</i>	17:02

3.1 Flora Survey

3.1.1 Vegetation Community Mapping

Four broad vegetation assemblages have been delineated within the study area, namely Cleared Managed Land (CML), Residential Plantings (RP), remnant elements of 'Central Hunter Riparian Forest' (CHRF), which is listed within the *TSC Act 1995* as an Endangered Ecological Community (EEC) within the EEC 'River-flat eucalypt forest on coastal floodplains' (RFEFCF), and remnant 'Lower Hunter Spotted Gum Ironbark Forest (LHSGIF), which is also listed within the *TSC Act 1995* as an EEC (Figure 3-1).

CML is the dominant vegetation community across the site, due to an apparent long history of anthropogenic land use, particularly cattle grazing within the large northern lots (Lots 2 & 33). The majority of CML is dominated by exotic pasture and grassland species with the introduced *Setaria gracilis* (Slender Pigeon Grass) and *Pennisetum clandestinum* (Kikuyu Grass) prominent and often dominant within this vegetation community. *S. gracilis* is more dominant in the west and *P. clandestinum* is dominant around residences and across much of the smaller lots in the south. CML in Lot 33 has large areas in the lot's central section that have been planted out with oats for grazing purposes.

RP is largely limited to areas immediately around residential buildings and sheds. No significant vegetation was found to occur in these areas.

Small numbers of CHRF elements occur along the tributary of Black Creek draining East Cessnock, which traverses the southern four lots and the western portion of Lot 2. Most of the riparian flats area in the west of Lot 2 is covered by CML dominated by *S. gracilis*, but the occurrence of *Cynodon dactylon* (Couch), *Microlaena stipoides*

(Weeping Grass) in the ground layer and a very small number of *Casuarina glauca* (Swamp Oak), singular *Angophora floribunda* (Rough-barked Apple) and *Eucalyptus tereticornis* (Forest Red Gum) and *Melaleuca stypheloides* and *M. linariifolia* on the flats and associated with the tributary's course indicate that the riparian flats in the south and west were once characterised by CHRF. CHRF is noted within the scientific committee's final determination as being commensurate with the EEC 'River-flat eucalypt forest on coastal floodplains'. The vegetation is patchy and not extensive, which severely limits its significance both in terms of its value for supporting threatened fauna and flora species and its likelihood of constituting EEC. The area where this vegetation occurs in Lot 2 lies within the odour buffer, which makes allowance for the Cessnock Sewerage Treatment Works to the north of Lot 2. This vegetation community occurs within riparian areas that are flood prone and are therefore unsuitable for development purposes.

Native forest stands occurring in the east of Lot 33 and in the northeast of Lot 2, are remnant stands of LHSGIF, which is indicated by the presence of *Eucalyptus fibrosa* (Broad-leaved Ironbark), *Corymbia maculata* (Spotted Gum), *E. punctata* and *E. moluccana* (Grey Box) as dominant species within the canopy. The stand in Lot 2 has a relatively low diversity of understorey plants due to the dominance of *Melaleuca nodosa*. Most of the LHSGIF stand in the east of Lot 33 has a managed understorey, but there are stands of *M. nodosa* persisting in the southern section of the stand. Despite the management of understorey vegetation for cattle grazing and bushfire risk reduction, the community exhibits a relatively intact assemblage of native plants that are known to occur within LHSGIF and a low occurrence of weed species. As such it would have moderate to high regenerating potential if current land-uses were to desist. The ROTAP species *Grevillea montana* was noted within the Lot 33 stand and *Rutidosia heterogama*, which is listed as Vulnerable under the *TSC Act 1995* was found to be quite common outside of those areas where *M. nodosa* occurs or previously occurred within the stand. Within the CML, in Lot 33 and Lot 2, there are areas containing remnant trees from LHSGIF, but the lack of significant understorey elements prevents these areas as being identifiable as LHSGIF.

3.1.2 Significant Flora

In the far southeast of Lot B a single individual of *E. parramattensis* subsp. *decadens* (Drooping Red Gum), which was noted in the Atlas of NSW Wildlife mapping data, was confirmed as occurring in the reported position. *E. parramattensis* subsp. *decadens* is listed as Vulnerable under the *TSC Act 1995*.

The disturbed nature of the managed understorey of LHSGIF in Lot 33's east is suited to a threatened flora species, *Rutidosia heterogama* (Heath Wrinklewort), which is listed as Vulnerable under the *TSC Act 1995*. This species is widespread and relatively frequent across this LHSGIF stand, apart from those areas where *M. nodosa* exists or existed in the past (Figure 3-2).














The ROTAP species *Grevillea montana* was noted in low densities within the LHSGIF stand in the east of Lot 33.

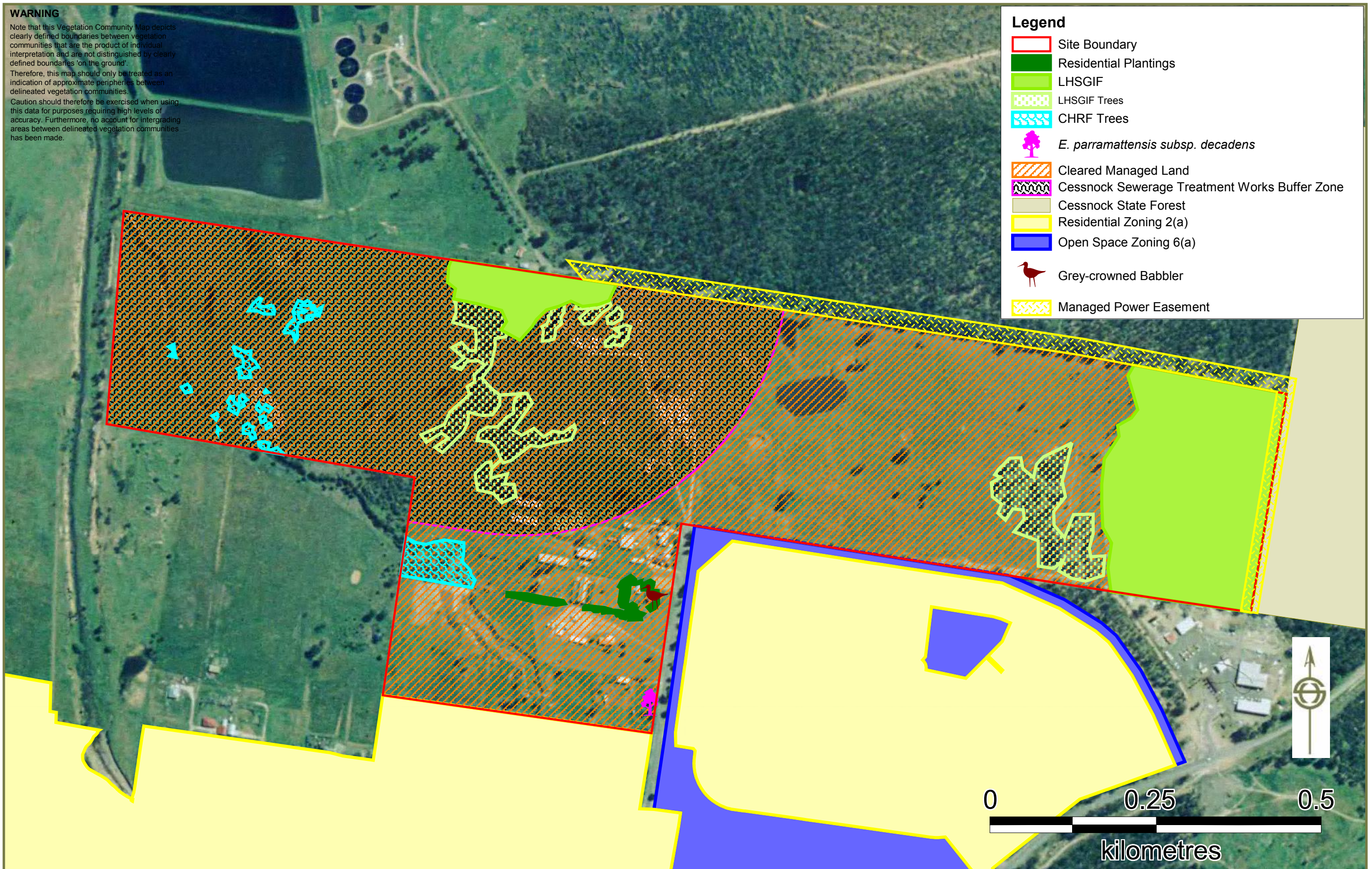
Targeted searches were conducted for other threatened flora species known to occur locally in LHSGIF, particularly for *Callistemon linearifolius*, for which records occur outside the boundary of the site. However, no other threatened flora species were observed and only the common *Callistemon* spp. *C. rigidus* and *C. linearis* were found to occur within the site.

WARNING

Note that this Vegetation Community Map depicts clearly defined boundaries between vegetation communities that are the product of individual interpretation and are not distinguished by clearly defined boundaries 'on the ground'. Therefore, this map should only be treated as an indication of approximate peripheries between delineated vegetation communities. Caution should therefore be exercised when using this data for purposes requiring high levels of accuracy. Furthermore, no account for intergrading areas between delineated vegetation communities has been made.

Legend

-  Site Boundary
-  Residential Plantings
-  LHSGIF
-  LHSGIF Trees
-  CHRF Trees
-  *E. parramattensis subsp. decadens*
-  Cleared Managed Land
-  Cessnock Sewerage Treatment Works Buffer Zone
-  Cessnock State Forest
-  Residential Zoning 2(a)
-  Open Space Zoning 6(a)
-  Grey-crowned Babbler
-  Managed Power Easement



TITLE: FLORA & FAUNA ASSESSMENT
VEGETATION COMMUNITY MAP

FIGURE: 3-1
PAGE: 11

CLIENT: ROGER DAVIES
GOVERNMENT ROAD, CESSNOCK



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DATUM: MGA Zone 56 (GDA 94) DATE: 28/5/2007









LAYOUT REF: J:\JOBS\24K\24060 - Cessnock\Drafting\MapInfo
24060.FIGURE 3-1 VEGETATION COMMUNITY MAP.A-A3

CONTOUR INTERVAL: N/A

JOB REF: 24060

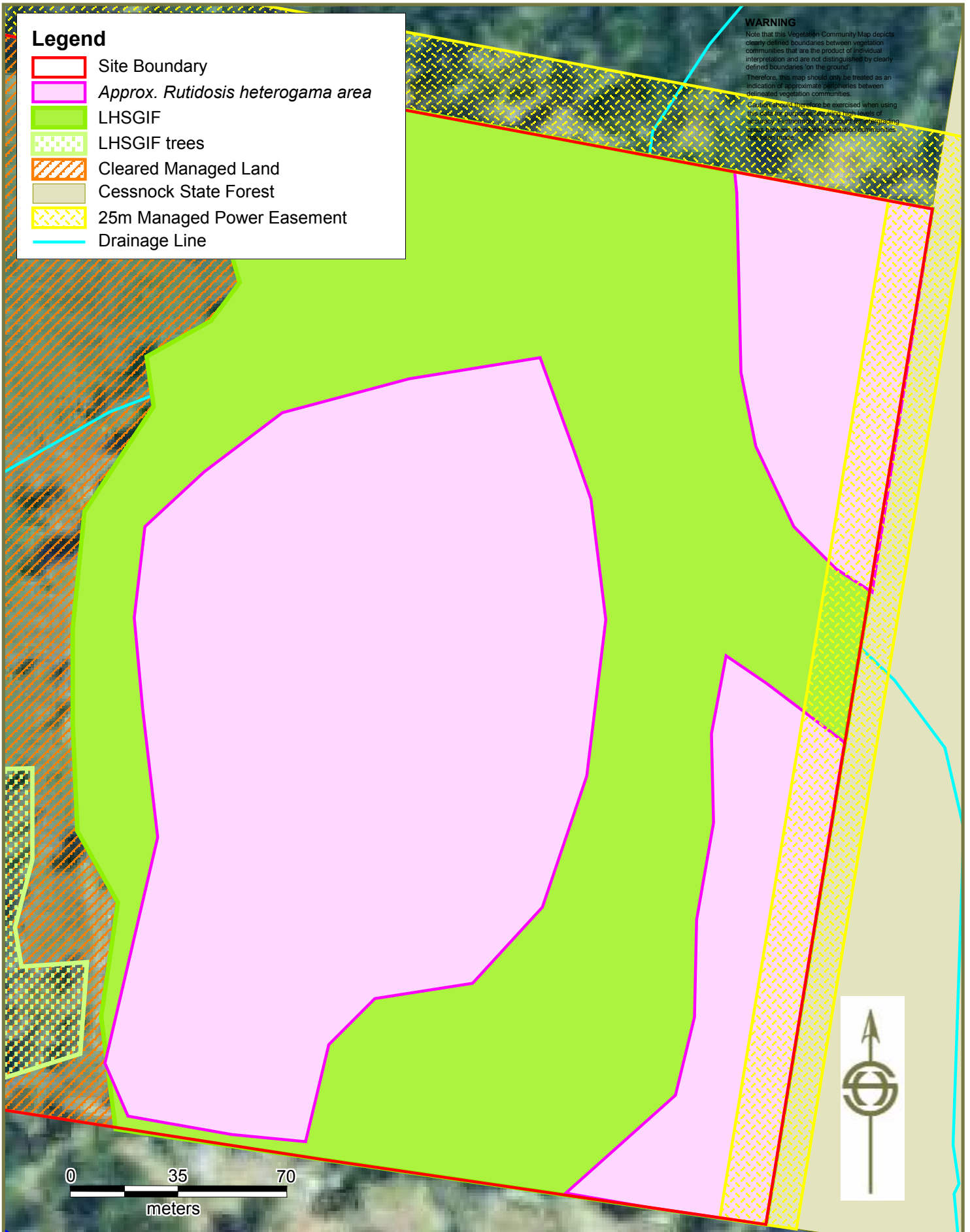
PLANNING SURVEYING ECOLOGY

Legend

-  Site Boundary
-  *Approx. Rutidosis heterogama area*
-  LHSGIF
-  LHSGIF trees
-  Cleared Managed Land
-  Cessnock State Forest
-  25m Managed Power Easement
-  Drainage Line

WARNING

Note that this Vegetation Community Map depicts clearly defined boundaries between vegetation communities that are the product of individual interpretation and are not distinguished by clearly defined boundaries 'on the ground'. Therefore, this map should only be treated as an indication of approximate boundaries between delineated vegetation communities. Caution should therefore be exercised when using this data for purposes requiring high levels of accuracy. Furthermore, no account is being taken of areas between delineated vegetation communities that are not mapped.



TITLE: FLORA & FAUNA ASSESSMENT
POTENTIAL RUTIDOSIS MAP

FIGURE: 3.2
PAGE: 12

CLIENT: ROGER DAVIES
GOVERNMENT ROAD, CESSNOCK



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DATUM: MGA Zone 58 (GDA 94) DATE: 28/5/2007

LAYOUT REF: 24060-24060 - Cessnock/Drafting/MapInfo

24060 FIGURE 3.2 RUTIDOSIS HETEROGAMA MAP A-A4

CONTOUR INTERVAL: N/A

JOB REF: 24060

PLANNING SURVEYING ECOLOGY

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3.2 Habitat Description and Distribution in the Vicinity

The majority of the site is characterised by CML, which represents poor potential habitat opportunities for threatened flora and fauna species and is only suited to common native open country avian and mammal species and introduced fauna species.

Residential Plantings are not significant for most threatened flora and fauna that occur in the area, but a family group of *Pomatostomus temporalis* (Grey-crowned Babbler) appear to be using planted shrubs and the surrounding lawns of Lot 1 DP 403335 as part of their home range.

The creek lines and flats in the south and west of the site have little opportunity to support locally occurring threatened species, due to their degraded structural condition and the dominance of grassy weeds. There is habitat along the creekline for frog species, but due to the degraded nature of the habitat and its isolation from areas of significant quality habitat this habitat is only likely to support common frog species.

Persistent stands of LHSGIF do not have the potential to permanently support threatened fauna species in their own right, due to their limited extent and degraded quality. There are relatively intact stands of LHSGIF to the north, southwest and east of the site, which might promote good opportunities for locally occurring threatened fauna to use the site, if it were not for power easement buffers, lack of high quality habitat outside the site and the lack of habitat complexity within the site.

In general the areas most likely to contain habitat for threatened species, those being the forested areas, particularly in Lot 33, display a structurally depauperate understorey stratum, unsuited to threatened insectivorous birds and a very low incidence of hollow-bearing trees, which might have otherwise provided nesting or roosting habitat for arboreal mammals, Microchiropteran bats and forest owl species. However, the canopy of this stand would produce blossom on a seasonal basis, which might be accessed intermittently by threatened nectarivorous birds, such as *Melithreptus gularis* (Black-chinned Honeyeater) and *Lathamus discolor* (Swift Parrot) and threatened nectarivorous mammals, such as *Pteropus poliocephalus* (Grey-headed Flying-fox) and *Petaurus norfolcensis* (Squirrel Glider), although the considerable distances between on site trees and adjacent forests, as occasioned by managed power easement buffer zones, and the lack of significant shelter within the site are likely to reduce the site's accessibility to Squirrel Gliders.

Tree canopies within the site represent foraging habitat for threatened insectivorous bats that occur within the locality.

No *Allocasuarina* spp. were observed within the site, which might provide foraging opportunities for *Calyptorhynchus lathami* (Glossy Black-Cockatoo).

KEY HABITATS AND CORRIDORS

No Regional or Subregional Corridors as defined within NSW National Parks and Wildlife Service (NPWS) Key Habitats and Corridors in North East NSW mapping were found to overlay the site. Furthermore, no land to the within the site or its vicinity is defined within the NSW NPWS mapping as Key Habitat. No significant impacts upon Key Habitats occurring to the north are expected if the recommendations provided in Section 7 are adhered to.

3.3 Fauna Survey

The very degraded and cleared nature of the site severely reduces its value to native fauna species, particularly those threatened species, which require extensive stands of quality habitat.

One common native mammal species, being *Macropus giganteus* (Eastern Grey Kangaroo), was observed in the east of the site during diurnal fauna surveys and arboreal and terrestrial mammal species observed during nocturnal surveys were limited to *Trichosurus vulpecula* (Common Brush-tail Possum) and *Oryctolagus cuniculus* (Rabbit). *Pteropus poliocephalus* (Grey-headed Flying-fox) was heard in forest adjacent to the site during nocturnal surveys and it is therefore likely that this species would use the site intermittently when seasonal blossom is available within the site.

This relatively low incidence of mammal observations was consistent with habitat assessment of the site and little other opportunities for mammal species are present within the site other than the likelihood that introduced rodents might occur around residential areas and bats as noted below.

3.3.1 Bat Call Detection

Six Microchiropteran bat species were detected within the site during nocturnal hours. *Chalinolobus gouldii* (Gould's Wattled Bat), *Falsistrellus tasmaniensis* (Eastern False Pipistrelle), *Miniopterus australis* (Little Bentwing-bat) were identified confidently and calls not inconsistent with a *Vespadelus* sp., *Mormopterus* sp2 and *Miniopterus schreibersii oceanensis* (Eastern Bentwing-bat) were also detected. *F. tasmaniensis*, *M. australis* and *M. schreibersii oceanensis* are listed as Vulnerable under the *TSC Act 1995*.

3.3.2 Avifauna Survey

Common open country avian species, such as *Platycercus eximius* (Eastern Rosella), *Gymnorhina tibicen* (Australian Magpie), *Manorina melanocephala* (Noisy Miner) and the introduced species *Acridotheres tristis* (Common Myna), were observed during diurnal fauna surveys.

Large numbers of *Glossopsitta concinna* (Musk Lorikeet) were observed in the vicinity of the site and in the LHSGIF stand in Lot 2. Usually a more western species, large numbers have been seen closer to the coast than normal over the last several months, but this occurrence is not considered to be of significance to concept planning within the site.

A family group of *Pomatostomus temporalis* (Grey-crowned Babbler) were observed in Lot 1 DP 403335. *P. temporalis* is listed as Vulnerable under the *TSC Act 1995*. Although this species is listed as Vulnerable it is known to adapt well with managed areas in the Cessnock LGA provided suitable nesting trees are present.

The site's potential to represent habitat for forest owl species was evaluated by habitat attributes and was found to be highly unsuitable for these species due to the limited size of the site, lack of significant hollows, its isolation and its inability to support their prey species.

Only one nocturnal bird species, being *Podargus strigoides* (Tawny Frogmouth), was seen within the site during nocturnal fauna surveys.

3.3.3 Herpetofauna Survey

No reptile species were encountered within the site, but assessment of on site habitat concluded that the site is only likely to support common species.

One frog species, *Crinia signifera* (Common Eastern Froglet), was heard calling within the site and although surveys were conducted at a time when most frog species are silent, there is limited habitat suitable within the site for any frog species, other than common varieties.

3.3.4 Secondary Indications and Incidental Observations

Opportunistic sightings of secondary indications (scratches, scats, diggings, tracks etc.) did not reveal any evidence that threatened fauna species might currently use the site or have used the site in the past.

4 THREATENED SPECIES AND COMMUNITIES ASSESSMENT

4.1 Identification of Subject Species and Communities

Threatened flora and fauna species (listed under the *TSC Act 1995* and/or the *EPBC Act 1999*) that have been gazetted / recorded from within the vicinity of the site have been considered within this assessment. EEC's known from the broader area have also been addressed. Each species / community is considered for its potential to occur on the site and the likely level of impact as a result of the proposal. This assessment deals with each species / community separately and identifies the ecological parameters of significance associated with the proposal.

Those species / communities that have been identified as having a moderate chance of occurrence (or greater) on site have been subject to Seven-part tests of significance in Appendix A.

This assessment deals with the following heads of consideration in tabulated form (refer to Table 2 overleaf):

'Species / Community' – Lists each threatened species / EEC's known from the vicinity. The status of each threatened species under the *TSC Act (1995)* and the Commonwealth *EPBC Act (1999)* are also provided. Note that no Endangered Populations occur in the vicinity of the site.

'Habitat Description' – Provides a brief account of the species / community and the preferred habitat attributes required for the existence / survival of each species / community.

'Chance of Occurrence on Site' – Assesses the likelihood of each species / community to occur along or within the immediate vicinity of the site in terms of the aforementioned habitat description and taking into account local habitat preferences, results of current field investigations, data gained from various sources (such as Atlas of NSW Wildlife, Hunter Bird Observer Club records etc) and previously gained knowledge via fieldwork undertaken within other ecological assessments in the locality.

'Likely Level of Impacts from Proposal' – Assesses the likely level / significance of impacts to each species / community that would result from the proposed rezoning and subsequent development, taking into account both short and long term impacts. This assessment is largely based on the chance of occurrence of each species / community on site with due recognition to other parameters such as home range, habitat utilisation, connectivity etc. It also considers the scope of the proposal, including the likely extent of disturbance, duration of construction works etc. The 'subject species / communities' are identified within this part of the assessment process and have been recommended where necessary for the application of the Seven-part test of significance in Appendix A.

Table 2 Threatened Species and Communities Considered and Assessment of Potential Impacts

Species / Community	Habitat Description	Chance of Occurrence On Site	Likely Level of Impact
Plants			
<i>Acacia bynoeana</i> Bynoe's Wattle (E, V*)	Small, prostrate shrub found in low heath and open woodland, generally on loamy clays and sand. Occurs from the Lower Hunter south to Southern Highlands. Recently found in several locations within the HEZ and other parts of the Cessnock LGA where it has been found growing in Kurri Sand Swamp Woodland (KSSW). Has also been recently recorded as isolated populations within Yellow Bloodwood Woodland and Blue-leaved Stringybark Woodland.	Low – Moderate - Such habitat may exist within the site however highly degraded due to past land practices over the majority of the site. However despite targeted searches this species was not located within the site.	Low – Despite the existence of this species elsewhere in the Cessnock LGA targeted searches did not locate individuals during flora surveys. Due to the absence of individuals in the study area there is unlikely to be any significant impact upon this species.
<i>Callistemon linearifolius</i> (V)	Shrub that grows in dry sclerophyll forest on the coast and adjacent ranges. Re-sprouting / juvenile specimens difficult to distinguish from other <i>Callistemon</i> species such as <i>C. rigidus</i> or <i>C. linearis</i> without the aid of flowering parts. Significant populations recently found within the HEZ and Werakata National Park.	Low – Moderate - Such habitat may exist within the site however highly degraded due to past land practices over the majority of the site. However despite targeted searches this species was not located within the site.	Low – Despite the existence of this species elsewhere in the Cessnock LGA targeted searches did not locate individuals during flora surveys. Due to the absence of individuals in the study area there is unlikely to be any significant impact upon this species.
<i>Eucalyptus glaucina</i> Slaty Red Gum (V, V*)	Red Gum species that grows in grassy woodland on deep, fertile and moist soils. Recorded within Hunter Lowland Redgum Forest and Central Hunter Ironbark Spotted Gum Grey Box Forest communities in the lower Central Hunter. Interbreeding known to occur between this species and <i>E. tereticornis</i> .	Low – Moderate - Such habitat may exist within the site however highly degraded due to past land practices over the majority of the site. However despite targeted searches this species was not located within the site.	Low – Despite the existence of this species elsewhere in the Cessnock LGA targeted searches did not locate individuals during flora surveys. Due to the absence of individuals in the study area there is unlikely to be any significant impact upon this species.
<i>Eucalyptus camfieldii</i> Camfield's Stringybark (V, V*)	Tree or mallee to 10m high, but often less. Rare and localised, in coastal shrub heath on sandy soils on sandstone, often restricted drainage. Records from the Hunter Region largely in near coastal areas from the Port Stephens LGA to the Central Coast (Atlas of NSW Wildlife data). An apparently isolated population occurs in KSSW to the east of the HEZ.	Low – Moderate - Such habitat may exist within the site however highly degraded due to past land practices over the majority of the site. However despite targeted searches this species was not located within the site.	Low – Despite the existence of this species elsewhere in the Cessnock LGA targeted searches did not locate individuals during flora surveys. Due to the absence of individuals in the study area there is unlikely to be any significant impact upon this species.
<i>Eucalyptus parramattensis</i> ssp. <i>decadens</i> Drooping Red Gum (V, V*)	Red Gum species that grows in dry sclerophyll woodland on sandy soils, often in low damp sites. Locally, this species occurs almost exclusively in association with Kurri Sand Swamp Woodland (KSSW) and ecotonal areas, but a small disjunct stand of stunted individuals have been recently recorded within coastal heath in the Lake Macquarie LGA (HSO pers. obs.).	High – This species was found to occur, as one individual, within the southern corner of the site adjacent to Government Road. Habitat exists within the site however highly degraded due to past land practices over the majority of the site.	High – Removal of habitat and specimen identified within the site is likely to have an impact on this species within the locality. Considering the species occurs within the site it has been assessed by Seven-part test within Appendix A.
<i>Grevillea parviflora</i> ssp. <i>parviflora</i> (V, V*)	Occurs in light, clayey soils in woodlands. Most plants appear capable of suckering from a rootstock. Relatively widespread within the Cessnock LGA. Occurs within Werakata National Park. Much confusion surrounds the taxonomy of this species and other similar <i>Grevillea</i> taxa (S. Bell pers. comm.), and a NPWS-funded study of the species is currently in progress.	Low – Moderate - Such habitat may exist within the site however highly degraded due to past land practices over the majority of the site. However despite targeted searches this species was not located within the site.	Low – Despite the existence of this species elsewhere in the Cessnock LGA targeted searches did not locate individuals during flora surveys. Due to the absence of individuals in the study area there is unlikely to be any significant impact upon this species.

Species / Community	Habitat Description	Chance of Occurrence On Site	Likely Level of Impact
<i>Rutidosia heterogama</i> (V, V*) Heath Wrinklewort	Small asteraceous herb recently rediscovered in the Hunter Region growing in disturbed areas and adjacent parcels of bushland within the Cessnock LGA.	High – This species was found to occur within the Woodland, occurring in the eastern portion of the site.	High – Removal of habitat and specimens identified within the site is likely to have an impact on this species within the locality. Further targeted survey work would be needed to gauge the significance of the population on site and the surrounding area in the event that direct habitat impact is proposed. Considering the species occurs within the site it has been assessed by Seven-part test within Appendix A.
Herpetofauna			
<i>Litoria aurea</i> Green and Golden Bell Frog (E, V*)	Inhabits swamps, lagoons, streams and ponds as well as dams, drains and storm water basins. Thought to be displaced from more established sites by other frog species, thus explaining its existence on disturbed sites. Previously widespread within the region, but now sparsely distributed within the Lower Hunter and Central Coast areas. A relatively stable population occurs on Kooragang Island.	Low – This species was not recorded within the site during fieldwork. Potential habitat for this species occurs within the dams, though perceived as marginal due to the low to absent occurrence of surrounding vegetation.	Low – Whilst some potentially suitable habitat may be present, the habitat is considered marginal and this species was not recorded within the site.
<i>Litoria brevipalmata</i> Green-thighed Frog (V)	Occurs in a range of habitats in areas where surface water gathers after rains. Males congregate around temporary pools that form after very heavy rains. Only record within catchment of Hunter River from two separate locations within the HEZ, otherwise found in Olney State Forest (Atlas of NSW Wildlife data).	Low – This species was not recorded within the site during fieldwork. This species is unlikely to occur within the site due to the lack of appropriate habitat.	Low – Due to the distinct lack of preferred habitat within the site it is considered unlikely this species will be affected by the proposal.
Avifauna			
<i>Stictonetta naevosa</i> Freckled Duck (V)	Inhabits both open lakes and wetlands surrounded by thick vegetation, especially swamps in which lignum, Cumbungi or Paperbarks grow. Permanent or temporary wetlands of varying salinity are known to be used. It is thought to be a frequent visitor to inland districts and rare in coastal areas. Records in the Hunter Region exist from Ellalong Lagoon, Pambalong Nature Reserve, Hunter Wetland Centre, Grahamstown Reservoir (Atlas of NSW Wildlife data), Deep Pond and Walka Water Works (HSO ecologist pers. obs.).	Low – This species was not recorded within the site during fieldwork. This species is unlikely to occur within the site due to the lack of appropriate habitat.	Low – Due to the distinct lack of preferred habitat within the site it is considered unlikely this species will be affected by the proposal.
<i>Oxyura australis</i> Blue-billed Duck (V)	A frequenter of deep freshwater swamps with thick vegetation. In NSW mostly occurring within 300km of the Murray-Darling basin, but may occur in more coastal areas during dry inland conditions. This species has been observed in the Hunter Region on Ash Island and Walka Water Works (HSO ecologist pers. obs.).	Low – This species was not recorded within the site during fieldwork. This species is unlikely to occur within the site due to the lack of appropriate habitat.	Low – Due to the distinct lack of preferred habitat within the site it is considered unlikely this species will be affected by the proposal.
<i>Ixobrychus flavicollis</i> Black Bittern (V)	Solitary species, living near water (estuarine to brackish) in mangroves and other trees which need to form only a narrow fringe of cover. A riparian species that occasionally ventures into the open within estuarine habitats. Sedentary resident along Dora and Stockton Creeks in western Lake Macquarie, but is likely to occur in any brackish to estuarine forested coastal creeks in the lower NSW coast.	Low – A minimal amount of poorly vegetated creekline habitat occurs within the western flood prone area of Lot 2 and due to its degraded state and isolation from more suitable habitat it is unlikely to represent significant habitat for this species	Low – Due to the distinct lack of preferred habitat within the site it is considered unlikely this species will be affected by the proposal.

Species / Community	Habitat Description	Chance of Occurrence On Site	Likely Level of Impact
<i>Botaurus poiciloptilus</i> Australasian Bittern (V)	A secretive species inhabiting permanent freshwater swamps possessing stands of tall rush species such as Bull Rushes (<i>Typha</i> sp.) and Spike Rushes (<i>Eleocharis</i> sp.). Records exist for this species within wetlands of the Hunter Floodplain (Atlas of NSW Wildlife data).	Low – The dense and extensive reed bed habitat that this species requires as core habitat does not occur within the vicinity of the site, therefore this species is unlikely to occur within the site.	Low – Due to the distinct lack of preferred habitat within the site it is considered unlikely this species will be affected by the proposal.
<i>Ephippiorhynchus asiaticus</i> Black-necked Stork (E)	Inhabits swamps associated with river systems and large permanent pools but sometimes appears on the coast or in estuaries. It has also been recorded on farm dams and sewage treatment ponds. Within the Hunter Region it occurs spasmodically on freshwater or estuarine wetlands.	Low – Moderate – This species is known to range widely and intermittently use small isolated dams as part of foraging routines. Although a very small amount of this habitat type occurs within the western portion of site it is unlikely that it would represent a significant resource to this species, due to the occurrence of more suitable habitat within the locality.	Low – Unlikely to occur within the site and potential habitat will remain unchanged through the process of rezoning and subsequent residential development.
<i>Hamirostra melanosternon</i> Black-breasted Buzzard (V)	Raptor that occurs in woodlands, scrubs and grasslands, mainly west of the divide. Records in the Hunter are likely to be accidental or erroneous, but may move toward more coastal localities during extended periods of drought.	Low – This species was not recorded within the site during fieldwork. This species is unlikely to occur within the site due to the lack of significant appropriate habitat and the site being outside of its preferred range.	Low – Due to the distinct lack of preferred habitat within the site it is considered unlikely this species will be affected by the proposal.
<i>Lophoictinia isura</i> Square-tailed Kite (V)	Inhabits open forests and woodlands, particularly those on fertile soils with abundant passerines. They may also range in nearby open habitats but not into extensive treeless regions. This species is notably absent from alpine regions and small isolated remnant woodlands in large open areas. Records exist from the Cessnock and Maitland LGA's and north of Port Stephens (Atlas of NSW Wildlife data).	Low – Moderate - This species was not recorded within the site during fieldwork. Limited foraging habitat exists on site, but the site may lie within the foraging range of locally occurring individuals.	Low – Whilst some potentially suitable habitat may be present, the habitat is considered marginal and this species was not recorded within the site.
<i>Calyptorhynchus lathamii</i> Glossy Black-Cockatoo (V)	Occurs in forests and woodlands where it forages predominantly on <i>Allocasuarina</i> cones. Requires large Eucalypt tree hollows for nesting.	Low – This species was not recorded within the site during fieldwork. This species is unlikely to occur within the site due to the lack of appropriate habitat.	Low – Due to the distinct lack of preferred habitat within the site it is considered unlikely this species will be affected by the proposal.
<i>Lathamus discolor</i> Swift Parrot (E, E*)	On the mainland this species frequents Eucalypt forests and woodlands with large trees having high nectar production during winter. Mainland winter foraging sites often vary from year to year. Nests only in Tasmania, but regularly visits the Hunter Region in winter.	Low – Moderate (on a seasonal basis) – This species was not recorded within the site during fieldwork. Limited amount of seasonal foraging habitat occurs on site in the form of winter flowering eucalypt species <i>Corymbia maculata</i> (Spotted Gum).	Low – Very limited foraging habitat occurs within the site and this species is unlikely to be recorded in small isolated pockets of vegetation as occurs within the site. Therefore the potential removal of habitat within the site is unlikely to significantly impact upon this species
<i>Neophema pulchella</i> Turquoise Parrot (V)	Inhabits forests and woodlands with suitable nest hollows and grassy foraging areas. Generally found in more western locations within the Hunter Region (found coastally north of Port Stephens), although some isolated records from the forested areas within the Cessnock LGA do exist.	Low – This species was not recorded within the study area during fieldwork. Potential habitat is available for this species within the eastern portion of the site, though unlikely due to the degraded nature of the site.	Low – Whilst some potentially suitable habitat may be present, the habitat is considered marginal and this species was not recorded within the site.
<i>Ninox strenua</i> Powerful Owl (V)	Occurs in sclerophyll forests and woodlands where suitable prey species occur (being predominantly arboreal mammals). Requires large hollows, usually in Eucalypt trees, for nesting. Roosts in dense vegetation within such areas.	Low – Moderate – This species was not detected during targeted field surveys and evidence of Powerful Owl activity was not observed within the site at the time of survey. Potential foraging habitat exists as part of a larger home range. Tree hollows of size were not observed within the site.	Low – Whilst some potentially suitable habitat may be present, the habitat is considered marginal and this species was not recorded within the site.
<i>Tyto novaehollandiae</i> Masked Owl (V)	Found in a range of habitats, locally within sclerophyll forests and woodlands where appropriate / preferred prey species occur (being predominantly terrestrial mammals). Requires large Eucalypt hollows for nesting and prefers to roost in these hollows as well.	Low – Moderate – This species was not detected during targeted field surveys and evidence of Powerful Owl activity was not observed within the site at the time of survey. Potential foraging habitat exists as part of a larger home range. Tree hollows of size were not observed within the site.	Low – Whilst some potentially suitable habitat may be present, the habitat is considered marginal and this species was not recorded within the site.

Species / Community	Habitat Description	Chance of Occurrence On Site	Likely Level of Impact
<i>Ninox connivens</i> Barking Owl (V)	Occurs mainly in dry sclerophyll woodland. Nests in large Eucalypt hollows, and roosts in hollows or thick vegetation. Hunts a range of prey species including birds and both terrestrial and arboreal mammals. Spasmodic Hunter Region records are largely limited to the south-western ranges and adjacent forests on the valley floor.	Low – Moderate – This species was not detected during targeted field surveys and evidence of Powerful Owl activity was not observed within the site at the time of survey. Potential foraging habitat exists as part of a larger home range. Tree hollows of size were not observed within the site.	Low – Whilst some potentially suitable habitat may be present, the habitat is considered marginal and this species was not recorded within the site.
<i>Pomatostomus temporalis</i> Grey-crowned Babbler (V)	Occupies open forests and woodlands, <i>Acacia</i> shrubland and adjoining farmland. They feed on terrestrial invertebrates and insects on lower trunks and branches. They prefer wooded areas with an intact ground cover. Appears unable to persist in cleared and highly fragmented habitats.	High – This species was observed on the site within highly managed areas with residential plantings. Though, foraging and roosting habitat for this species is present within the woodland occurring within the site and associated melaleuca stands, this species was not observed within these areas during fieldwork.	Low – Impacts unlikely due to this species' ability to persist in disturbed areas and if recommendations to include shelter trees in landscape plantings is observed. Considering the species occurs within the site it has been assessed by Seven-part test within Appendix A.
<i>Chthonicola sagittata</i> Speckled Warbler (V)	Occupies Eucalypt and Cypress woodlands in drier coastal areas and on the western slopes of the Great Dividing Range. Appears unable to persist in districts where no forested fragments larger than 100ha remain. Occurs in the central and southern Hunter Region where suitable habitat exists. Associated with extensive stands of <i>Bursaria spinosa</i> in some areas (HSO pers. obs.).	Low – This species was not recorded within the study area during fieldwork. Potential habitat is available for this species within the eastern portion of the site, though unlikely due to the degraded nature of the site.	Low – Whilst some potentially suitable habitat may be present, the habitat is considered marginal and this species was not recorded within the site.
<i>Climacteris picumnus</i> Brown Treecreeper (V)	Frequents drier forests and woodlands, particularly open woodland lacking a dense understorey. Also found in grasslands in proximity to wooded areas where there are sufficient logs, stumps and dead trees nearby. Feeds on invertebrate larvae and small insects, particularly ants. Utilises hollows for roosting/nesting. Appears not to persist in remnants less than 200ha. A number of records exist in the Cessnock LGA including breeding records south east of Kurri Kurri (HSO pers. obs.).	Low – Moderate – This species was not recorded within the site during fieldwork. Habitat for this species is marginal due to the lack of preferred habitat.	Low – Whilst some potentially suitable habitat may be present, the habitat is considered marginal and this species was not recorded within the site.
<i>Meliphaga gularis</i> Black-chinned Honeyeater (V)	Occurs within dry Eucalypt woodland within an annual rainfall range of 400-700 mm, particularly within vegetation associations containing Ironbark and Box species. Feeds on insects, nectar and lerp. Appears not to occur in forested remnants less than 200ha. Regular winter records occur in the Cessnock LGA (HSO pers. obs.)	Low – This species was not recorded within the study area during fieldwork. Potential habitat is available for this species within the eastern portion of the site, though unlikely due to the degraded nature of the site.	Low – Whilst some potentially suitable habitat may be present, the habitat is considered marginal and this species was not recorded within the site.
<i>Xanthomyza phrygia</i> Regent Honeyeater (E, E*)	Nomadic honeyeater that disperses to non-breeding areas, including the coast, in winter, where flowering trees are sought. Within the region, mostly recorded in Box-Ironbark Eucalypt associations along creek flats, river valleys and foothills. Nests mainly west of the divide, although more easterly breeding attempts have occurred at Quorrobolong in the lower Hunter Valley.	Low – Moderate (on a seasonal basis) – This species was not recorded within the site during fieldwork. This species utilises the region only during the winter periods outside of which it is absent. Potential habitat exists in parts of the site, predominantly in the form of scattered winter-flowering Eucalypts (<i>C. maculata</i>).	Low - Very limited foraging habitat occurs within the site and this species is unlikely to be recorded in small isolated pockets of vegetation as occurs within the site. Therefore the potential removal of habitat within the site is unlikely to significantly impact upon this species
Mammals			
<i>Petaurus norfolcensis</i> Squirrel Glider (V)	Occurs in Eucalypt forests and woodlands where it feeds on sap exudates and blossoms. In these areas tree hollows are utilised for nesting sites. Also requires winter foraging resources when the availability of normal food resources may be limited, such as winter-flowering shrub and small tree species.	Low – This species was not recorded within the study area during fieldwork. Potential habitat is available for this species within the eastern portion of the site, though unlikely due to the degraded nature and size of the habitat within the site.	Low – Whilst some potentially suitable habitat may be present, the habitat is considered marginal and this species was not recorded within the site.

Species / Community	Habitat Description	Chance of Occurrence On Site	Likely Level of Impact
<i>Petaurus australis</i> Yellow-bellied Glider (V)	Usually associated with tall, mature wet Eucalypt forest. Also known from tall dry open forest and mature woodland. The diverse diet of this species is primarily made up of Eucalypt nectar, sap, honey dew, manna and invertebrates found under decorticating bark and pollen. Tree hollows for nest sites are essential, as are suitable food trees in close proximity. Most records in the Lower Hunter Region occur in the Watagan Mountains and other areas exhibiting significant stands of forest (DEC 2005).	Low – This species was not recorded within the study area during fieldwork. Potential habitat is available for this species within the eastern portion of the site, though unlikely due to the degraded nature and size of the habitat within the site.	Low – Whilst some potentially suitable habitat may be present, the habitat is considered marginal and this species was not recorded within the site.
<i>Phascolarctos cinereus</i> Koala (V)	Occurs in forests and woodlands where it requires suitable feed trees (particular <i>Eucalyptus</i> spp.) and habitat linkages. Will occasionally cross open areas, although it becomes more vulnerable to predator attack and road mortality during these excursions. Records from the Lower Hunter Region are largely confined to the greater Port Stephens area, the Lake Macquarie hinterland and the Watagan Mountains, with a small number of records from Cessnock LGA (DEC 2005).	Low – This species was not recorded within the study area during fieldwork. Potential habitat is available for this species within the eastern portion of the site, though unlikely due to the degraded nature and size of the habitat within the site.	Low – Whilst some potentially suitable habitat may be present, the habitat is considered marginal and this species was not recorded within the site.
<i>Pteropus poliocephalus</i> Grey-headed Flying-fox (V, V*)	Forages over a large area for nectar / fruits etc. Roosts in communal base camps situated within wet sclerophyll forests or rainforest. Likely to forage in Eucalypts when flowering.	High – This species was recorded within close proximity to the site during fieldwork, and has potential to utilise the woodland areas within the site for foraging. Potential habitat is available for this species within the woodland areas of the site.	Low – Whilst some potentially suitable habitat may be present, the habitat is considered marginal and this species was not recorded within the site. Considering the species has at least a moderate chance of occurring within the site it has been assessed by Seven-part test within Appendix A.
<i>Saccolaimus flaviventris</i> Yellow-bellied Sheath-tail-bat (V)	This species habits encompasses a range of habitats from rainforest to arid shrubland. It is known to roost in tree-hollows, but is often not detected due to its sparse distribution and high-flying hunting habits.	Moderate – This species were not detected during targeted field surveys. Habitat is available for this species within woodland areas and associated ecotones with cleared/ managed areas. Preferred roosting habitat is available within observed tree hollows occurring within the site.	Low – Moderate – Given the generalist habitat requirements for these species, any removal or modification of potential habitat on site is likely to be offset by the abundance of habitat existing within the region. Notwithstanding, any proposed removal of woodland and adjacent areas has some potential to impact upon this species. Considering the species occurs within the site it has been assessed by Seven-part test within Appendix A.
<i>Falsistrellus tasmaniensis</i> Eastern False Pipistrelle (V)	This species is found in a variety of forest types such as open forests, woodlands and wetter sclerophyll forests (usually with trees >20m). This species roosts in tree hollows. Appears to locally favour upland habitats. A limited number of records occur on the central coast and the Lower Hunter Region (DEC 2005).	High – This species was detected within woodland occurring in the eastern portion of the site during targeted field surveys. Habitat is available for this species within woodland areas and associated ecotones with cleared/ managed areas.	Low – Moderate – Given the generalist habitat requirements for these species, any removal or modification of potential habitat on site is likely to be offset by the abundance of habitat existing within the region. Notwithstanding, any proposed removal of woodland and adjacent areas has some potential to impact upon this species. Considering the species occurs within the site it has been assessed by Seven-part test within Appendix A.
<i>Miniopterus australis</i> Little Bentwing-bat (V) <i>Miniopterus schreibersii</i> Eastern Bentwing-Bat (V)	Prefers to forage in well-vegetated areas, such as within wet and dry sclerophyll forests and rainforests. Requires caves or similar structures for roosting habitat. This species utilises a range of habitats for foraging, including rainforest, wet and dry sclerophyll forests, woodlands and open grasslands. Requires caves or similar structures for roosting habitat.	High – These species were detected during targeted field surveys. Habitat is available for these species within woodland areas and associated ecotones with cleared/ managed areas. Preferred roosting habitat is not available within the site.	Low – Moderate – Given the generalist habitat requirements for these species, any removal or modification of potential habitat on site is likely to be offset by the abundance of habitat existing within the region. Notwithstanding, any proposed removal of woodland and adjacent areas has some potential to impact upon this species. Considering these species have a high chance of occurring within the site they have been assessed by Seven-part test within Appendix A.

Species / Community	Habitat Description	Chance of Occurrence On Site	Likely Level of Impact
<i>Myotis adversus</i> Large-footed Myotis (V)	Usually found near bodies of water, including estuaries, lakes, reservoirs, rivers and large streams, often in close proximity to their roost site. Although usually recorded foraging over wet areas, it also utilises a variety of wooded habitats adjacent to such areas including rainforest, wet and dry sclerophyll forest, woodland, and swamp forest. Roosts in small colonies of between 15 and several hundred individuals in caves, mines and disused railway tunnels. A number of records from the Central Coast, with fewer numbers in the Lower Hunter Region (DEC 2005) and Central Hunter Region (HSO pers. obs.).	Moderate – This species was not detected during targeted field surveys. Habitat is available for this species within woodland areas and associated ecotones with cleared / managed areas. Preferred roosting habitat is not available within the site.	Low – Moderate – Given the generalist habitat requirements for this species, any removal or modification of potential habitat on site is likely to be offset by the abundance of habitat existing within the region. Notwithstanding, any proposed removal of woodland and adjacent areas has some potential to impact upon this species. Considering the species has a high chance of occurring within the site it has been assessed by Seven-part test within Appendix A.
<i>Mormopterus norfolkensis</i> East-coast Freetail-bat (V) <i>Scoteanax rueppellii</i> Greater Broad-nosed Bat (V)	This species forages predominantly in dry forests and woodlands east of the divide. It roosts in tree hollows, under bark and within man-made structures. Forages in moister gullies and wet sclerophyll forests as well as in lightly wooded areas and open spaces / ecotones. This species roosts in tree hollows.	Moderate – These species were not detected during targeted field surveys. Habitat is available for this species within woodland areas and associated ecotones with cleared/ managed areas. Preferred roosting habitat is available within observed tree hollows occurring within the site.	Low – Moderate – Given the generalist habitat requirements for these species, any removal or modification of potential habitat on site is likely to be offset by the abundance of habitat existing within the region. Notwithstanding, any proposed removal of woodland and adjacent areas has some potential to impact upon these species. Considering these species have a at least a moderate chance of occurring within the site they have been assessed by Seven-part test within Appendix A.
Endangered Ecological Communities			
Hunter Lowland Redgum Forest (HLRF)	Found on gentle slopes arising from depressions and drainage flats on permian sediments of the Hunter Valley floor in the Sydney Basin and NSW North Coast Bioregions. Dominant canopy species include <i>Eucalyptus tereticornis</i> , <i>E. amplifolia</i> and <i>E. moluccana</i> with scattered other Eucalypt species also present. Classified by the Lower Hunter Central Coast Regional Biodiversity Conservation Strategy (LHCCREMS) as Map Unit (MU) 19.	Low – This community was not found to occur within the site.	Low - Due to the absence of suitable habitat and a lack of characteristic species in the study area there is unlikely to be any significant impact upon this EEC.
Kurri Sand Swamp Woodland (KSSW)	Occurs on soils developed over poorly drained Tertiary sand deposits that blanket Permian sediments around Kurri Kurri. Dominant canopy species include <i>Eucalyptus parramattensis</i> ssp. <i>decadens</i> , <i>E. capitellata</i> , <i>E. agglomerata</i> , <i>E. fibrosa</i> and <i>Angophora bakeri</i> . It is also typified by a diverse understorey / shrub layer comprised of mainly Proteaceous and Fabaceous species. Classified by the Lower Hunter Central Coast Regional Biodiversity Conservation Strategy (LHCCREMS) as Map Unit (MU) 35.	Low – This community was not found to occur within the site.	Low - Due to the absence of suitable habitat and a lack characteristic species in the study area there is unlikely to be any significant impact upon this EEC.
Lower Hunter Spotted Gum Ironbark Forest (LHSGIF)	This community is widespread throughout the central to lower Hunter Valley, with forests between Cessnock and Beresfield forming the core of its distribution. This community is dominated by <i>Corymbia maculata</i> (Spotted Gum) and <i>Eucalyptus fibrosa</i> (Broad-leaved Ironbark) with occasional occurrences of <i>E. punctata</i> (Grey Gum) and <i>E. crebra</i> (Grey Ironbark). Classified by the Lower Hunter Central Coast Regional Biodiversity Conservation Strategy (LHCCREMS) as Map Unit (MU) 17.	High – Approximately 8 of LHSGIF occurs within the eastern portion of the site.	Moderate – High - The loss of LHSGIF within the site is unlikely to be significant to the maintenance of this EEC in the wider locality, but its loss contributes to the incremental decline of this community in the local area. Considering the community occurs within the site it has been assessed by Seven-part test within Appendix A.

Species / Community	Habitat Description	Chance of Occurrence On Site	Likely Level of Impact
River-flat Eucalypt forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bio-regions	Associated with silts, clay-loams and sandy loams, on periodically inundated alluvial flats, drainage lines and river terraces associated with coastal floodplains. Composition of the tree stratum varies considerably, the most widespread and abundant dominant trees include <i>Eucalyptus tereticornis</i> (Forest Red Gum), <i>E. amplifolia</i> (Cabbage Gum), <i>Angophora floribunda</i> (Rough-barked Apple) and <i>A. subvelutina</i> (Broad-leaved Apple). Correlates with LHCCREMS communities - 'Central Hunter Riparian Forest' Map Unit (MU) 13, 'Wollombi Redgum-River Oak Woodland' MU14 and 'Redgum Roughbarked Apple Swamp Forest' MU38.	Low – Moderate – Remnant elements of this community occur as the LHCCREMS delineated community Central Hunter Riparian Forest (MU 13), though highly degraded and discontinuous with larger areas of this community within the local area. Habitat occurs along the creekline within the southwestern portion of the creek and associated floodplain.	Low – The majority of this community occurs within the area identified as an odour buffer zone due to the proximity of the neighbouring sewerage works. Furthermore, habitat for this community is highly degraded and occurs within flood-prone land so future development is not likely to constitute any significant impact upon this community.

Key: (V) = Vulnerable Species listed under Threatened Species Conservation Act 1995 (TSC Act 1995).
 (E) = Endangered Species listed under TSC Act 1995.
 (V*) = Vulnerable Species listed under Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act 1999).
 (E*) = Endangered Species listed under EPBC Act 1999.
 (CE*) = Critically Endangered Species listed under EPBC Act 1999
 (M*) = Listed as a Migratory species under the EPBC Act 1999

4.2 Key Threatening Processes

A Key Threatening Process (KTP) is defined in the *TSC Act (1995)* as a process that threatens, or could threaten, the survival or evolutionary development of species, populations or ecological communities. Something can be a threat if it:

- adversely affects two or more threatened species, populations or ecological communities; or
- could cause species, populations or ecological communities that are not currently threatened to become threatened.

KTP's are listed in Schedule 3 of the *TSC Act (1995)*. Those potentially applicable to the current rezoning and a future development proposal (both directly and indirectly) are summarised below and detailed in Appendix A (Section g).

- Potential development may require the removal of native vegetation and as such could contribute to the Key Threatening Process "Clearing of Native Vegetation". Clearing of vegetation at this scale represents a small cumulative impact and as such it is unlikely to significantly contribute to this process on a regional scale. Recommended offset planting would further nullify this if carried out.
- The proposal is likely to contribute to the Key Threatening Process "Predation by the Feral Cat" as a result of residential development. The extent to which the proposal could contribute to this process is considered unlikely to be significant if responsible pet ownership is encouraged.
- Any further development with the site may contribute to the Key Threatening Process "Human Caused Climate Change" as a result of clearing vegetation. It is considered that clearing and modification of the landscape would constitute a minor incremental change. Thus the extent to which the proposal could contribute to this process is considered unlikely to be significant.

No other KTP's are believed to be relevant to the current proposal.

5 CONSIDERATIONS UNDER SEPP 44 – ‘KOALA HABITAT PROTECTION’

5.1.1 First Consideration – Is the Land ‘Potential Koala Habitat’?

Schedule 2 of State Environmental Planning Policy (SEPP) No. 44 – ‘Koala Habitat Protection’ lists 10 tree species that are considered indicators of ‘Potential Koala Habitat’. The presence of any of the species listed on a site proposed for development triggers the requirement for an assessment for ‘Potential Koala Habitat’. SEPP 44 defines potential Koala Habitat as:

“areas of native vegetation where the trees of the types listed in Schedule 2 constitute at least 15% of the total number of trees in the upper or lower strata of the tree component“.

Two tree species listed in Schedule 2 of SEPP No. 44 – ‘Koala Habitat Protection’ occurs on site, namely *Eucalyptus punctata* (Grey Gum) and *E. tereticornis*. As such the site represents ‘Potential Koala Habitat’ as defined by the SEPP.

5.1.2 Second Consideration – Is the Land ‘Core Koala Habitat’

No evidence, in the form of direct or secondary indications, suggests that Koalas have used the site or other habitats within the vicinity of the site in the past. Therefore, the site is not considered by the definitions of the SEPP to constitute ‘Core Koala Habitat’.

Therefore no further provisions of this policy apply to the site.

6 CONSIDERATIONS UNDER THE EPBC ACT 1999

Considerations have been made under the Commonwealth *EPBC Act (1999)*. Searches of the Department of Environment and Heritage On-line Database were undertaken to gather baseline data on the site and general locality. This data, combined with other local knowledge and records, was utilised to assess whether the type of activity proposed on the site will have, or is likely to have a significant impact upon a matter of National Environmental Significance (NES), or on the environment of Commonwealth land*.

* The site is not land owned by the Commonwealth, and hence this portion of the Act is not applicable. The matters of NES and site-specific responses are listed below.

- *World Heritage areas:*

The site is not a World Heritage area, and is not in close proximity to any such area.

- *Wetlands protected by international treaty (the RAMSAR convention):*

The site is not part of any RAMSAR Wetland area, and is not in proximity to any such area.

- *Nationally listed threatened species and ecological communities:*

Six nationally listed threatened species under the *EPBC Act 1999* that have been recorded within the region and might have opportunity to occur within the site are as follows:

- | | |
|---|-------------------------------|
| • <i>Acacia bynoeana</i> | Bynoe's Wattle; |
| • <i>Eucalyptus parramattensis</i> subsp. <i>decadens</i> ; | Earp's Gum (Drooping Red Gum) |
| • <i>Grevillea parviflora</i> subsp. <i>parviflora</i> ; | |
| • <i>Pteropus poliocephalus</i> | Grey-headed Flying-fox; |
| • <i>Lathamus discolor</i> | Swift Parrot; and |
| • <i>Xanthomyza phrygia</i> | Regent Honeyeater. |

The potential for the proposal to significantly impact on individuals or local populations for the above species has been assessed under the provisions of the *TSC Act 1995*. This assessment concluded that it is considered unlikely the current proposal will have a significant impact upon a local population such that local extinctions would occur. Likewise, it is considered that no significant impacts are likely to occur on a Commonwealth level. The removal of one individual of *E. parramattensis* subsp. *decadens*, might be expected to have an incremental impact upon this species occurring in the locality, but its inclusion into street tree planting lists as recommended below would offset this loss such that a referral to the Department of Environment and Water Resources will not be necessary.

- *Nationally listed migratory species:*

Seven nationally listed migratory species have been recorded within the wider locality of the site,

- | | |
|---------------------------------|---------------------------|
| • <i>Haliaeetus leucogaster</i> | White-bellied Sea-Eagle |
| • <i>Hirundapus caudacutus</i> | White-throated Needletail |
| • <i>Merops ornatus</i> | Rainbow Bee-eater |

- *Monarcha melanopsis* Black-faced Monarch
- *Myiagra cyanoleuca* Satin Flycatcher
- *Rhipidura rufifrons* Rufous Fantail, and
- *Xanthomyza phrygia* Regent Honeyeater.

Although these nationally listed migratory species are known to occur within the wider locality of the site, the proposed re-zoning and subsequent residential subdivision is not likely to cause any significant impact to these species due to the lack of suitable habitat within the site. Therefore it is considered that a referral to the Department of Environment and Water Resources will not be necessary.

- *All nuclear actions:*

No type of nuclear activity is proposed for the site.

- *The environment of commonwealth marine areas:*

The proposed activity on the site will not have a significantly adverse effect on any Commonwealth marine area.

Summary Statement:

Based on the above, it is considered the current proposal may have an impact on *Eucalyptus parramattensis* subsp. *decadens* if offset provisions are not incorporated into strategic planning for the site. Otherwise there are no matters of NES that would require referral to the Commonwealth Department of Environment and Water Resources.

7 CONCLUSION AND RECOMMENDATIONS

Conclusion

Flora, fauna and habitat studies undertaken over land at Lots 1 & 2 DP 1067096, Lots 33 & 34 DP 1004648, Lot 1 DP392537, Lot 1 DP403312, Lot 1 DP403335 and Lots A & B DP 421062, Government Road, Cessnock, have led to the production of this Flora and Fauna Assessment. Four broad vegetation assemblages have been delineated within the site, namely Cleared Managed Land (CML), Residential Plantings (RP), remnant elements of 'Central Hunter Riparian Forest' (CHRF), which is listed within the *TSC Act 1995* as an Endangered Ecological Community (EEC) within the EEC 'River-flat eucalypt forest on coastal floodplains' (RFEFCF) and remnant 'Lower Hunter Spotted Gum Ironbark Forest' (LHSGIF), which is also listed within the *TSC Act 1995* as an EEC. The condition of CHRF in the west of Lot 2 is reduced to a very small number of trees with the understorey dominated by *Setaria gracilis* (Slender Pigeon Grass). The condition of this community is less than skeletal, such that it can no longer be considered as constituting EEC.

LHSGIF EEC is largely reduced within the site to two stands, a 2ha stand in the northeast of Lot 2 and an 8ha stand in the east of Lot 33. Both stands exhibit depauperate structural diversity, with the understorey in Lot 2 dominated by *Melaleuca nodosa* to the exclusion of most other species and the understorey of the Lot 33 stand managed for cattle grazing and to reduce bushfire threats. Although managed, the LHSGIF stand in Lot 33 exhibits a relatively diverse compliment of native flora species that are known to occur in LHSGIF and a low incidence of weeds. If current land-use was suspended it is likely that this stand of LHSGIF would have moderate to high regenerative potential. The managed nature of this stand has provided disturbed habitat suited to the threatened Asteraceous herb *Rutidosia heterogama*, and it is relatively frequent within the stand where *M. nodosa* does not occur. One other threatened flora species was observed in the south-eastern corner of Lot B, being *E. parramattensis* subsp. *decadens* (Drooping Red Gum).

Fauna within the site was largely limited to common and introduced bird and mammal species and this was consistent with what might be expected with the site, considering initial habitat assessment. The canopy trees provide the most suitable habitat for threatened fauna species, due to the potential occurrence of seasonal blossom, accessible to nectivorous birds and bats, and their attractiveness to insects, which are the favoured prey of Microchiropteran bat species. Three threatened species of Microchiropteran bat species were recorded within the site, namely, *Falsistrellus tasmaniensis* (Eastern False Pipistrelle), *Miniopterus australis* (Little Bentwing-bat) and *Miniopterus schreibersii oceanensis* (Eastern Bentwing-bat). The State listed Vulnerable species *Pomatostomus temporalis temporalis* was observed in Lot 1 DP 403335 within Residential Plantings vegetation. Habitat within the site was only found as suitable to common herpetile species.

An assessment was undertaken of the potential effects of the proposal under the guidelines of Section 5A of the *EP&A Act 1979* (Seven-part Test) for the threatened species/ecological communities recorded on site and known from the region. This assessment determined that impacts caused by the removal of LHSGIF EEC from within the site as a consequence of subsequent residential subdivision development must be considered as an incremental loss of this EEC in the locality although it is not likely to be significant at a regional scale or considered likely to threaten the existence of this EEC in the local area. Assessment determined that the loss of habitat and individuals of *Rutidosia heterogama* during subsequent development might constitute a significant impact upon the species within the locality of the site, but not on a regional scale. The removal of *E. parramattensis* subsp. *decadens* and residential plants used by *P. t. temporalis* are unlikely to be considered as

significant at a regional level nor be likely to place either species at a greater risk of extinction, but would constitute an impact at the local level.

In order that overall ecological values within the site may be maintained or improved despite impacts that may occur throughout the process of development, a number of provisions and offsets are incorporated into the following recommendations.

Recommendations

The following recommendations have been generated to provide ecological guidelines for rezoning and development of the site to offset potential impacts as a result of the proposal.

- Currently *Pomatostomus temporalis temporalis* (Grey-crowned Babbler) occurs within the site. To ensure that this species is able to persist within the site through subsequent development it is recommended that shrubby tree species, such as *Casuarina* spp. or small-leaved *Melaleuca* spp. be incorporated into street planting and landscaping plant lists.
- One *E. parramattensis* subsp. *decadens* individual was found to occur within the site. To ensure that this species continues to occur within the site in the future it is recommended that this species be added to street planting and landscaping plant lists.
- Approximately 8ha of LHSGIF EEC currently occurs at the eastern end of Lot 33. It is likely that this vegetation will be removed during subsequent development of the site. To offset the loss of this EEC it is suggested that 8ha of the low-lying areas occurring in the west of Lot 2 be restored to previously occurring CHRF EEC.
- The likely removal of LHSGIF from Lot 33 during subsequent development of the site, would remove habitat currently containing *Rutidosia heterogama*. To offset the loss of *R. heterogama* from Lot 33, it is recommended that *Eucalyptus glaucina* be planted within CHRF offset vegetation in the west of Lot 2.
- Currently within the areas that occur outside the odour buffer zone (potential development areas) there are three definable drainage lines. Each of these drainage lines run into natural watercourses beyond the site and have potential to impact upon downstream habitats. It is recommended that a water management strategy be incorporated into strategic planning of the site to ensure that deleterious impacts to offsite watercourses are averted.
- The planting of locally occurring native plant species should be encouraged in residential plantings to provide foraging opportunities for locally occurring native fauna species.
- Responsible pet ownership should be encouraged to counter potential impacts upon native fauna.

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APPENDIX A: SEVEN-PART TESTS

CONSIDERATION UNDER SECTION 5A OF THE EP&A ACT 1979

Considerations of the effects of the proposed development under the guidelines of Section 5A of the *Environmental Planning and Assessment Act 1979 (EP&A Act 1979)* for the concerned threatened species/populations/ecological communities are given below.

The majority of information used for the assessment has been sourced from NSW DEC Threatened Species Information and Environmental Impact Assessment Guidelines, DEC Atlas of NSW Wildlife (DEC, 2005) and other published or widely available literature sources such as scientific journals and reports. For the purposes of the Seven-Part Test, threatened species have been grouped into 'guilds', that is species sharing similar habitat or ecological requirements have been grouped and assessed together.

The following species / communities have been considered:

1. *Eucalyptus parramattensis* ssp. *decadens* Drooping Red Gum
2. *Rutidosia heterogama* Heath Wrinklewort
3. *Pomatostomus temporalis* Grey-crowned Babbler
4. *Pteropus poliocephalus* Grey-headed Flyingfox
5. Hollow Dwelling Microbats

<i>Mormopterus norfolkensis</i>	East-coast Freetail-bat
<i>Scoteanax rueppellii</i>	Greater Broad-nosed Bat
<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheath-tail-bat
<i>Falsistrellus tasmaniensis</i>	Eastern False Pipistrelle
6. Cave Dwelling Microbats

<i>Miniopterus australis</i>	Little Bentwing-bat
<i>Miniopterus schreibersii</i>	Eastern Bentwing-Bat
<i>Myotis adversus</i>	Large-footed Myotis
7. Lower Hunter Spotted Gum - Ironbark Forest in the Sydney Basin Bioregion.

Species Profiles

***Eucalyptus parramattensis* ssp. *decadens* Drooping Red Gum**

Eucalyptus parramattensis ssp. *decadens* has a scattered distributed within the lower Hunter Valley from Tomago to Kurri Kurri. It occurs in woodland on sandy soils in wet sites. Any occurrences are likely to be restricted to areas along riparian vegetation strips or within close proximity to the water table. In the Port Stephens area, it occurs in open wet sclerophyll woodland on heavy, often waterlogged, interbarrier depression soils. It is commonly associated with *Melaleuca quinquinervia* (Broad-leaved Paperbark) and *Eucalyptus robusta* (Swamp Mahogany). Within the Cessnock LGA it occurs almost exclusively within Kurri Sand Swamp Woodland (KSSW) and its ecotones with neighbouring communities. Within this community it occurs as a co-dominant canopy species. An isolated individual has also been recorded within Central Hunter Ironbark / Spotted Gum / Grey Box Forest in the North Rothbury area (HSO Ecologists pers. obs.).

It is distinguished from *E. p. parramattensis* by the larger fruit, which are greater than 7mm in diameter.

According to Briggs and Leigh (1995) criterion, *E. p. decadens* is ROTAP-coded 2V, indicating that it is not known to occur within the reserve system. Within conservation reserves, this species is only known from Werakata National Park. Additional areas are conserved within the conservation zone of the HEZ. In terms of potential habitat, a total of 532.5ha of KSSW exists in Werakata National Park, although detailed surveys have revealed that only a 37ha area of KSSW within this reserve is dominated by *E. p. decadens* (Harper Somers O'Sullivan 2004a). Additional specimens and known habitat areas are reserved within the conservation zones of the HEZ, where 122ha of habitat dominated by this species exists.

Rutidosia heterogama**Heath Wrinklewort**

Rutidosia heterogama is a perennial herb that grows to 30cm in height. It grows in heath, often along disturbed roadsides, mainly in coastal districts from MacLean to the Hunter Valley, and inland to Torrington (Harden 1992). Analysis of the NPWS Atlas of NSW Wildlife indicates that the species has been mainly recorded in the northeast of NSW, with no records south of Armidale. Nonetheless, there are historical records of the species from the 1940's in the Cessnock and Maitland areas (D. Stevenson pers. comm.). This species is currently known from Werakata National Park and in parts of the 7(b) conservation lands within the Hunter Economic Zone. Additional populations have been recorded within Aberdare State Forest (HSO ecologists pers. obs.). This species is ROTAP-coded 2VCa.

Pomatostomus temporalis**Grey-crowned Babbler**

The eastern subspecies of the Grey-crowned Babbler ranges from Mt Lofty Range, SA to Cape York Peninsula, Qld, generally in areas receiving an average annual rainfall between 250 and 1000 mm. The Grey-crowned Babbler inhabits open Eucalypt woodlands with a grassy groundcover and sparse, tall shrub layer. This species may also be observed along streams in cleared areas and grassy road verges (Morcombe, 2000). Grey-crowned Bblers forage mainly on insects and spiders, spending the majority of their time searching through leaf litter and soil for food, but also venturing into vegetation. They live in extended families usually consisting of a breeding pair with offspring. Pairs mate for life and are usually the only breeding birds within the group. The other group members help them build the nest and feed the young.

Breeding occurs between July and February. Their large domed nests (up to 50cm wide) are constructed in trees at a height of about 4-7m. They tend to be built into an upward sloping or horizontal, multiple forked branches in a tree's upper outer foliage and have a side entrance tunnel (Morcombe, 2000). Nest-like structures are also used for overnight roosts. The group as a whole defends a territory (usually about 12 hectares) throughout the year (Frith, 1977).

Although common in the Qld part of its range, *P. temporalis* is one of several woodland birds known to be declining in South-eastern Australia. The key threat is the highly fragmented nature of remnant habitat. The cause of declines due to fragmentation seems to be related to population dynamics such as reduced breeding success, less effective immigration and stochastic effects (Garnett *et al*, 2000). However, within the Lower Hunter Valley this species appears to be coping with habitat fragmentation / modification to a greater extent than populations elsewhere within its range. In this area it has been noted to occur regularly within partially cleared areas and in some situations, where only scattered trees remain in proximity to more suitable habitat. It has also been noted from human-inhabited areas, including areas where domestic pets are present.

Within the Lower Hunter Valley, this species is known from Werakata National Park (University of Newcastle 2001; authors pers. obs.). It has been recorded in Wollemi, Goulburn River and Yengo National Parks (Atlas of NSW Wildlife 2005; authors pers. obs.).

Pteropus poliocephalus**Grey-headed Flying-fox**

The Grey-headed Flying Fox is endemic to Australia and presently occurs along the east coast from Bundaberg in Queensland to Melbourne, Victoria (NSW National Parks and Wildlife Service, 1999). Regular movements have been recorded over the Great Dividing Range to the western slopes of NSW and QLD (NSW National Parks and Wildlife Service, 2001).

Although this species occurs over a large range the total area being utilised at any one time is relatively small. This species utilises subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths swamps and mangroves, as well as urban gardens and fruit crops for foraging (Churchill, 1998; NSW National Parks and Wildlife Service, 1999). The Grey-headed Flying Fox is considered an important pollinator and seed disperser of native trees, as they forage on nectar and pollen of eucalypts, angophoras, melaleucas and banksias, as well as fruit of rainforest trees and vines (NSW National Parks and Wildlife Service, 1999; Strahan, 1995).

The Grey-headed Flying Fox has been recorded to forage on more than 80 plant species of which eucalypt blossom is considered the major food source and figs to be the most common fruit consumed (Churchill, 1998). These bats will disperse and commute up to 50km daily to foraging areas from their day roost (Strahan, 1995).

Grey-headed Flying Fox roost in large colonies of up to tens of thousands and often share camps with Little Red Flying-foxes *Pteropus scapulatus* and Black Flying-foxes *P. alecto* (Churchill, 1998; NSW National Parks and Wildlife Service, 1999). Colonies are usually formed in gullies with a dense vegetation canopy and a water source nearby. Camps have also been formed in modified vegetation in urban areas (NSW National Parks and Wildlife Service, 2001). Site fidelity is high, with some camps in NSW used for over a century (NSW National Parks and Wildlife Service, 1999). These bats usually return annually to particular camps for rearing young (NSW National Parks and Wildlife Service, 2001).

Mating begins in January and females give birth to single young in October/November after a 6 month gestation period. The young are carried continually, flights included, for the first 3 weeks and are then left in the camp for the following 2 months (NSW National Parks and Wildlife Service, 1999). This species migrates (up to hundreds of km) to where a suitable food source is available. The population concentrates in May and June in northern NSW and Queensland where animals exploit winter-flowering trees such as Swamp Mahogany, Forest Red Gum and Paperbark, dispersing south during the summer (NSW National Parks and Wildlife Service, 2001). When migration occurs they do not move as a colony, but as individuals or small groups resulting in the intermixing sub-populations (Churchill, 1998). It is estimated that the population of this species has declined by 30% over the last 10 years. It has been estimated that the population will continue to decrease by at least 20% in the next three generations if the current rate of habitat loss and culling continues (NSW National Parks and Wildlife Service, 2001). Presently less than 15% of suitable habitat and 5% of present roost sites occur in conservation reserves.

Mormopterus norfolkensis**East-coast Freetail-bat**

This species is distributed along the east coast of New South Wales from south of Sydney extending north into south-eastern Queensland, near Brisbane. There are no records west of the Great Dividing Range. Although the habitat preferences are not clear (and critical or specific habitat for this species is not known), most records of this species have been reported from dry Eucalypt forest and woodland. Individuals have, however, been recorded flying low over a rocky watercourse in rainforest and foraging in clearings on the edge of forested land. It is expected that open forested areas and the cleared land adjacent to bushland, constitutes important habitat for this species, and specific foraging activity may be

concentrated over small areas of open water, such as dams and creeks, in and near forests. It is a predominantly tree-dwelling species (roosting in hollows or behind loose bark in mature Eucalypts), but one individual was recorded roosting in the roof of a hut, together with a number of Gould's Wattled Bats and an Eastern Broad-nosed Bat (Allison & Hoyer 1995). The diet is thought to consist of small insects including leafhoppers, chafers, weevils and other beetles. Foraging is apparently undertaken above the tree canopy or in clearings on forest edges (AMBS 1995). Examination of wing morphology indicates that the bat has a direct and fast flight more suited for foraging in open habitats, above the canopy and along watercourses.

Scoteanax rueppellii**Greater Broad-nosed Bat**

The Greater Broad-nosed Bat occurs only along the eastern coastal strip of Queensland and NSW where it is restricted to the coast and adjacent areas of the Great Dividing Range. In NSW it extends as far south as the Bega Plain. They are only found at low altitudes (below 500m).

This species apparently feeds on large moths and beetles, and some small vertebrates, emerging just after sundown, flying slowly and directly at a height of 3-6 metres, deviating only slightly to catch larger insects. It is also predatory on vertebrates including other bats, and is a noted carnivore on other captured bats in bat traps. *S. rueppellii* is known to hunt along tree-lined creeks, the junction of woodland and cleared paddocks, and low along rainforest creeks. It may have a preference for wet gullies in tall timber country.

The species roosts mainly in tree hollows but it has also been found in the roof spaces of old buildings. Little is known of the reproductive cycle, but it is suggested that the species follows the typical vespertilionid pattern. What is known is that females congregate in maternity colonies and single young are born in January, slightly later than the other Vespertilionid bats that share its range. Males appear to be excluded from the colony during the birthing and rearing of the young.

Saccolaimus flaviventris**Yellow-bellied Sheath-tail-bat**

This species is widespread across Australia and its apparent rarity is probably due to its flying so high and fast that it is seldom collected. It has been reported from a wide variety of habitats. Hunting height appears to vary depending upon the height of the dominant vegetation in Eucalypt forests it feeds above the canopy, but in mallee or open country it comes lower to the ground. Prey species include beetles, long-horned grasshoppers, shield bugs and flying ants.

Usually solitary, but occasionally occurring in colonies of less than ten individuals, the Yellow-bellied Sheath-tail-bat roosts in tree hollows, animal burrows, dry clay cracks, under rock slabs, abandoned Sugar Glider nests, and has been found resting on the walls of buildings in broad daylight, and one such individual, caught at Queanbeyan, NSW, appeared to be so exhausted that it made no effort to escape. Similar reports suggest that it is migratory in southern Australia and that individuals found resting in the open are in the course of a winter migration from the cooler to warmer areas. They have been reported from southern Australia only between January and June.

Males have a prominent throat-pouch which is devoid of glandular tissue but a subcutaneous gland lies behind it. The throat-pouch is represented by a rudimentary fold of skin in the female. There is no seasonal difference in testicular size in males and there is no relationship between reproductive condition in males and the size of the throat pouch. Pregnancy is always restricted to the right uterine horn. Single young are born between December and mid-March. Sub-adults have only been collected in January and February.

Falsistrellus tasmaniensis**Eastern Falsistrelle**

The Eastern Falsistrelle occurs along the coastal ranges from southern Queensland to western Victoria, and is endemic to Australia. These bats inhabit sclerophyll forests from the Great Divide to the east coast. In Tasmania they are found in wet sclerophyll and coastal mallee. A preference has been noted for wet habitats where trees are more than 20m high. Based upon the size and shape of its wings the bat is thought to be highly mobile with a relatively large hunting range. A specimen of this species has been radio-tracked and found to move 12km from where it was hunting to where it was roosting in a very large tree.

On the mainland they eat moths, rove beetles, chafers, weevils, plant bugs, flies and ants. Their flight is swift and direct, within or just below the tree canopy. They tend to fly fast in a fixed horizontal plane with sudden darting changes in course. It has been observed roosting in holes and hollow trunks of Eucalypts, with recorded colony sizes ranging from 3 to 36 individuals. Colonies are usually almost entirely male or female groups, although evenly mixed colonies sometimes occur. They have been recorded roosting in a cave at Jenolan, NSW, and they are occasionally found in old wooden buildings.

Males produce sperm in late summer and store it in the epididymis over the winter. Females produce a large 'hibernation follicle' in autumn. Ovulation, fertilisation and pregnancy occur in late spring and early summer. Single young are born in December. Lactation continues through January and February. The Eastern Falsistrelle hibernates generally during winter, particularly in the southern extent of its range.

Miniopterus australis**Little Bentwing-bat**

This species inhabits tropical rainforest to warm-temperate wet and dry sclerophyll forest occurring along the coastal plains and adjacent ranges from Cape York to north-eastern NSW around the Hunter River. Its distribution within Australia becomes increasingly coastal towards the southern limit of its range in NSW.

It is a sub-canopy hunter with a preference for well-timbered areas but it is also known to hunt in clearings adjacent to forests. Prey items include crane flies, ants, moths and wasps. Flight characteristics include rapid movement with considerable manoeuvrability.

The species is a cave dweller that congregates in the summer months in maternity roost colonies and disperses during winter. In the southern part of their range they hibernate during winter but in the north they remain active throughout the year. Recorded roosts include caves, mines, stormwater drains, disused railway tunnels and houses. Mating, fertilisation and implantation occur in July to August, followed by a period of retarded embryonic development until mid-September. Pregnant females congregate in specified large nursery caves to rear their young. Births occur in December, when single young are born. It is often found to roost with the Large Bentwing-bat (*Miniopterus schreibersii*), and benefits from this larger species' ability to increase the roost temperature using metabolic heat. There is a huge nursery colony of 100,000 adult bats at Mt. Etna caves, in central Queensland.

Miniopterus schreibersii**Eastern Bentwing-bat**

The Large (or 'Common') Bentwing-bat may occur throughout the world. However, Parnaby (1992) notes that the Australasian populations are unlikely to be the same species that occurs outside this area. Within Australia, it is found across the coastal and near coastal areas of the north of the NT and WA and also down the east coast from Cape York to Adelaide on the coastal plains and adjacent ranges.

It is a cave (and similar man-made structures) roosting species that generally feeds above the forest canopy in wet and dry tall open forest, catching insects on the wing. However, the species has also been recorded utilising rainforest, monsoon forest, open woodland, paperbark forests and open grasslands. Moths are the main prey item. Flight is very fast and typically relatively level with swift shallow dives; the estimated flight speed is 50km per hour.

The species is known to migrate over large distances, apparently utilising different roosts for different seasonal needs. The pattern of movement varies with local climate and the dispersion of suitable roost sites. It hibernates over winter in the southern parts of its range and development of the embryo may be delayed over winter by lowering body temperature using roosts in the cooler areas of a cave. Pregnant females roost in large colonies in nursery caves. Birth generally occurs around December. Females cluster together in a roost that generally possesses a domed roof, which allows for the retention of warm air, which may also promote faster growth. The young can fly by 7 weeks and reach adult size and are weaned by 10 weeks. The mothers then leave the cave to disperse to their winter roosts and a few weeks later, usually in March, there is a mass exodus of juveniles. The maternity colony is deserted by April.

The longevity record for an Australian bat is from a pregnant female Large Bentwing-bat that was banded and recaptured 18 years later (she was again pregnant).

Myotis adversus

Large-footed Myotis

The Large-footed Myotis has been recorded along much of the coastal strip of Australia occurring from the east of SA, around the Victorian, NSW, Queensland and NT coasts and into WA as far as the Kimberleys.

In NSW, the Large-footed Myotis is found in various habitats of the coast and adjacent ranges. Recently, it has also been found along the Murray River valley well into South Australia. A variety of foraging habitats are used by this species although it is usually found near large bodies of water, including estuaries, lakes, reservoirs, rivers and large streams, often in close proximity to their roost site. Although the Large-footed Myotis is usually recorded foraging over wet areas, it also utilises a variety of wooded habitats adjacent to such areas including rainforest, wet and dry sclerophyll forest and woodland, and swamp forest. The Large-footed Myotis has been reported feeding on flying insects (including beetles, flies, moths and grasshoppers), aquatic insects (such as boatmen) and small fish. Observations of the feeding behaviour found that it foraged predominantly just above the water (average height of 9 cm from the water surface), but also raked the surface of the water with the recurved claws of its large feet and sometimes also used its tail membrane as a scoop. Flying insects are caught as the bat spirals downward through the air. This species feeds alone, in pairs, or infrequently in small groups. The species has a slow and manoeuvrable flight pattern.

It roosts in small colonies of between 15 and several hundred individuals with recorded roosts including caves, mines and disused railway tunnels as well as dense rainforest foliage in the tropical parts of its range. Some occurrences of roosting in tree hollows are also noted. Males establish territories within the colony and monopolise a cluster of females during the breeding season. Outside the breeding season, males roost separately. The number of pregnancies per year varies with latitude. In NSW and Victoria there is one pregnancy per year, the single young being born in November to December. In southern Queensland they produce two litters of single young in October and January. Males show two peaks of testicular development: in April to June and in September to November. Lactation lasts for about eight weeks and young born in late September suckle until late December. The bond between mother and young extends a further 3 to 4 weeks after

weaning; they hunt together and roost together during this period. In northern Queensland they are reported to have three births per year.

Lower Hunter Spotted Gum – Ironbark Forest in the Sydney Basin Bioregion

Lower Hunter Spotted Gum – Ironbark Forest (LHSGIF) is widespread throughout the central to Lower Hunter Valley, with forests between Cessnock and Beresfield forming the core of its distribution. This community is dominated by *Corymbia maculata* (Spotted Gum) and *Eucalyptus fibrosa* (Broad-leaved Ironbark) with occasional occurrences of *E. punctata* (Grey Gum) and *E. crebra* (Grey Ironbark). Several distinctions have been noted within the LHCCREMS community profiles between this community and other Spotted Gum / Ironbark associations, often characterised by the dominant canopy composition, range, soil type and topography (NPWS 2000).

Within the Lower Hunter, the peak of distribution occurs within the forested areas between Beresfield and Cessnock. On the basis of revised vegetation mapping conducted in 2002, a total of 32,366ha of LHSGIF has been mapped within the LHCCREMS study area boundary, representing a significant proportion of forested areas found within the Lower Hunter Valley, and in particular within the bounds of the Cessnock City Council Local Government Area (NPWS 2000a; House 2003).

The relatively small area of reservation of the community in the locality along with ongoing threats from urban and industrial development, logging, inappropriate fire regimes, etc., suggests that this community may be under substantial threat. 2,541ha of this community is currently known to be reserved within Werakata National Park, representing the most widespread community within that reserve. Although not classified as a direct reservation, 2,762ha occurs within State Forests, of which 99% occurs in the Cessnock LGA. Some areas have been mapped within Wallaroo State Forest (NPWS 2000; House 2003), although this could be erroneous (being more likely to be Seaham Spotted Gum Ironbark Forest). Within the HEZ study area, 461.4ha of LHSGIF is proposed to be reserved within the 7(b) conservation zone.

Seven-part Test of Significance of Impacts to Threatened Species and EEC's

For the purposes of the Environmental Planning and Assessment Act 1979 and, in particular, in the administration of Sections 78A, 79B, 79C, 111 and 112, the following factors have been taken into account in deciding whether there is likely to be a significant effect on threatened species, populations or ecological communities, or their habitats:

- 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;

Eucalyptus parramattensis* ssp. *decadens **Drooping Red Gum**

A single individual was observed to occur within the southern portion of the site, with other individuals occurring outside the site within close proximity. This individual is isolated from more significant stands in the region, but the exchange of gametes between this individual and others in the local area would still be possible through pollen vectors such as bees, flying foxes and nectivorous bird species. This species is likely to be sustainable into the future, through either the consideration of its locality within any design scope or its inclusion within landscape plant lists as recommended in Section 7. Although it is not likely to be important to the maintenance of the population in the wider locality, the loss of this individual would contribute to the incremental decline of this species within the local area.

Rutidosia heterogama **Heath Wrinklewort**

This species is widespread and relatively frequent across the LHSGIF, within the eastern portion of the site, apart from those areas where *M. nodosa* exists or existed in the past. The local distribution of this species is relatively unknown, though populations are known for the wider region within the Hunter Economic Zone and Werakata National Park.

Pomatostomus temporalis **Grey-crowned Babbler**

This species was observed within residential shrub plantings in the south of the site. Foraging and roosting habitat for this species is present within the woodland occurring within the site and associated melaleuca stands, though the species was not observed within these areas during fieldwork. This species is unlikely to be impacted on by residential development within the site provided suitable shelter plantings are retained or provided within subsequent layout designs and landscaping. Roosting habitat could be provided for this species within creekline vegetation consisting of melaleuca and casuarina stands.

Pteropus poliocephalus **Grey Headed Flying Fox**

This species was identified to be utilising habitat adjacent to the site and likely to utilise the site for foraging as part of a greater home range. Though potentially adding to the incremental decline of habitat for this species, given that this species has a nightly feeding range of 20-50km and that the site would offer only a very small part of any local population's foraging resources, it is unlikely that rezoning and subsequent development of the site would have an adverse effect on the life cycle of the species such that a viable local population would be placed at risk of extinction.

Hollow Dwelling Bats

Mormopterus norfolkensis
Scoteanax ruepellii

East-coast Freetail-bat
Greater Broad-nosed Bat

Saccolaimus flaviventris
Falsistrellus tasmaniensis

Yellow-bellied Sheathtail-bat
 Eastern False Pipistrelle

Falsistrellus tasmaniensis (Eastern False Pipistrelle) was detected at a 'Confident Level' using the Anabat recording in the eastern section of the site. Potential foraging habitat, for this species and other threatened hollow dwelling bats, occurs throughout the site and in the surrounding forested areas. Any hollow-bearing trees on site also offer potential roosting habitat. Given the high mobility of these species and the existence of large areas of similar habitat throughout the locality, any local populations of these species would be highly unlikely to be solely dependent on the habitat resources on-site and such, it is considered unlikely that the life cycle would be effected such that a viable local population would be placed at risk of extinction as a consequence of the proposal.

Cave Dwelling Bats

Miniopterus australis
Miniopterus schreibersii
Myotis adversus

Little Bentwing-bat
 Eastern Bentwing-Bat
 Large-footed Myotis

Miniopterus australis (Little Bentwing-bat) was detected at a confident level, with a call not inconsistent with *Miniopterus schreibersii* (Eastern Bentwing-Bat) also detected. Potential foraging habitat, for this species and other threatened cave dwelling bats, occurs throughout the site and in the surrounding forested areas. The site does not contain any roosting habitat for these species due to the lack of caves and other similar roosting sites. Given the high mobility of these species and the existence of large areas of similar habitat throughout the locality, any local populations of these species would be highly unlikely to be solely dependent on the habitat resources on-site and such, it is considered unlikely that the life cycle would be effected such that a viable local population would be placed at risk of extinction as a consequence of the proposal.

- 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;*

No populations of any of the species considered for this assessment (that are relevant to this locality) have been identified under Part 2 of Schedule 1 of the *TSC Act 1995*.

- c) *In the case of a critically endangered or 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;*

Lower Hunter Spotted Gum – Ironbark Forest

A 7.8 ha area of LHSIGF within the eastern portion of the site was noted during flora surveys. This community is small and moderately degraded through past farming practices and similar assemblage exists beyond this site as part of Cessnock State Forest and private land. Therefore this community, though contributing to the incremental decline of this community, could not be considered highly significant to the maintenance of this EEC in the wider locality and unlikely place its existence in the local area at risk of extinction.

- d) *In relation to the habitat of a threatened species, population or ecological community:*
- (i) *The extent to which habitat is likely to be removed or modified as a result of the action proposed, and*

The proposal has the potential to remove native vegetation within the eastern portion of the site with the western portion of the site restricted from development. The majority of the site contains no significant habitat for threatened species.

- (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*

No areas of known habitat for the threatened species considered herewith are likely to be isolated as a result of the proposal.

Lower Hunter Spotted Gum Ironbark Forest

No areas of LHSGIF considered herewith are likely to be isolated as a result of the proposal.

- (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;*

Eucalyptus parramattensis ssp. decadens

Drooping Red Gum

The loss of habitat within the site is unlikely to threaten the existence of this species in the wider locality, but potentially likely to threaten its existence in the immediate locality.

Rutidosia heterogama

Heath Wrinklewort

The loss of habitat within the site is unlikely to threaten the existence of this species in the wider locality, with known populations within the wider Cessnock LGA (Hunter Economic Zone conservation lands), but potentially likely to threaten its existence in the immediate locality.

Pomatostomus temporalis

Grey-crowned Babbler

The loss of habitat within the site is unlikely to threaten the existence of this species in the wider locality, and with consideration of landscaping is unlikely to threaten its existence in the immediate locality.

Pteropus poliocephalus

Grey-headed Flying-fox

The loss of habitat within the site is unlikely to threaten the existence of this species in the wider locality.

Microchiropteran Bats

The loss of habitat within the site is unlikely to threaten the existence of these species in the wider locality.

Lower Hunter Spotted Gum Ironbark Forest

The loss of LHSGIF within the site is unlikely to threaten the existence of this community in the wider locality, but is potentially likely to threaten its existence in the immediate locality (i.e. the site).

- e) *Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly);*

None of the site has been designated 'critical habitat' under Part 3 of the *TSC Act 1995*.

- f) *Whether the proposed action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan;*

No Recovery Plan or Threat Abatement Plan exists for these species or EEC.

- 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.*

Any proposed development that requires the removal of native vegetation and as such could contribute to the Key Threatening Process "Clearing of Native Vegetation". Clearing of degraded vegetation at this scale represents a small cumulative impact, given the recommendation to retain the majority of remaining native vegetation within the site. As such it is unlikely to significantly contribute to this process on a regional scale. Offset planting as recommended in Section 7 would nullify the impact.

The proposal is likely to contribute to the Key Threatening Process "Predation by the Feral Cat" as a result of residential development. *F. catus* was not observed within the study site, although it would be considered to be having some impact on native fauna in the local area. Future development is unlikely to increase numbers of this feral species, it is likely that an increased number of domestic animals may result in increased predation of native fauna within the site and adjacent stands of vegetation. To counter such a possibility, cat ownership should not be allowed within any future development, unless such animals are contained at night. Given this is done, the extent to which the proposal could contribute to this process is considered unlikely to be significant.

The proposal is likely to contribute to the Key Threatening Process "Human Caused Climate Change" as a result of clearing vegetation and modification of the environment. Due to the already extensively cleared area of the site further modification of the landscape could only constitute a very minor incremental change. Thus the extent to which the proposal would contribute to this process is considered unlikely to be significant.

No other KTP's are believed to be relevant to the current proposal.

APPENDIX B: FLORA SPECIES LIST

Flora Species List

The following list includes all species of vascular plants observed on site during fieldwork. It should be noted that such a list couldn't be considered comprehensive, but rather indicative of the flora present on the site. It can take many years of flora surveys to record all of the plant species occurring within any area, especially plant species that are only apparent in some seasons such as Orchids.

A number of species cannot always be accurately identified during a brief survey, generally due to a lack of suitable flowering and/or fruiting material. Any such species are identified as accurately as possible, and are indicated in the list as indicated:

- specimens that could only be identified to genus level are indicated by the generic name followed by the abbreviation "sp.", indicating an unidentified species of that genus;
- specimens for which identification of the genus was uncertain are indicated by a question mark ("?") placed in front of the generic, which is followed by the abbreviation "sp." and;
- specimens that could be accurately identified to genus level, but could be identified to species level with only a degree of certainty are indicated by a ("?") placed in front of the epithet.

Authorities for the scientific names are not provided in the list. These follow the references outlined below.

Harden, G. (ed) (2000). *Flora of New South Wales, Volume 1*. Revised edition. UNSW, Kensington, NSW.

Harden, G. (ed) (2002). *Flora of New South Wales, Volume 2*. Revised edition. UNSW, Kensington, NSW.

Harden, G. (ed) (1992). *Flora of New South Wales, Volume 3*. UNSW, Kensington, NSW.

Harden, G. (ed) (1993). *Flora of New South Wales, Volume 4*. UNSW, Kensington, NSW.

Names of families and higher taxa follow a modified Cronquist System (1981).

Introduced species are indicated by an asterisk "**".

Threatened species listed under the Threatened Species Conservation Act 1995 (TSC Act 1995) or the Environmental Protection of Biodiversity and Conservation (EPBC Act 1999) and / or Rare or Threatened Australian Plant (ROTAP) listed species are indicated in **bold font** and marked as:

(V) = Vulnerable Species listed under the TSC Act

(E) = Endangered Species listed under the TSC Act

(EE) = Species listed under the Commonwealth EPBC Act 1999 as Endangered

(EV) = Species listed under the Commonwealth EPBC Act 1999 as Vulnerable

(R) = ROTAP as per Briggs and Leigh (1996)

The following standard abbreviations are used to indicate subspecific taxa:

ssp. - subspecies

var.- variety

agg. aggregate

× - hybrid between the two indicated species

FAMILY	Common Name
<i>Scientific Name</i>	
CLASS FILICOPSIDA (FERNS)	
SINOPTERIDACEAE	
<i>Cheilanthes sieberi</i> ssp. <i>sieberi</i>	Mulga Fern
CLASS CYCADOPSIDA (CYCADS)	
ZAMIACEAE	
<i>Macrozamia flexuosa</i>	
CLASS MAGNOLIOPSIDA (FLOWERING PLANTS)	
SUBCLASS MAGNOLIIDAE (Dicotyledons)	
ASTERACEAE	
* <i>Bidens pilosa</i>	Cobbler's Pegs
<i>Brachycome</i> sp.	
* <i>Cirsium vulgare</i>	Spear Thistle
* <i>Conyza bonariensis</i>	Flaxleaf Fleabane
<i>Helichrysum scorpioides</i>	Button Everlasting
* <i>Hypochoeris radicata</i>	Cat's Ear
<i>Ozothamnus diosmifolium</i>	Everlasting
<i>Rutidosis heterogama</i> (V, EV)	Heath Wrinklewort
* <i>Senecio madagascariensis</i>	Fireweed
* <i>Sonchus oleraceus</i>	Common Sowthistle
<i>Xanthium occidentale</i>	Noogoora Burr
BRASSICACEAE	
<i>Lepidium</i> sp.	Peppergrass
CACTACEAE	
* <i>Opuntia stricta</i>	Prickly Pear
CAMPANULACEAE	
<i>Wahlenbergia gracilis</i>	Native Bluebell
CASUARINACEAE	
<i>Casuarina glauca</i>	Swamp She-oak
CELASTRACEAE	
<i>Maytenus silvestris</i>	
CONVOLVULACEAE	
<i>Dichondra repens</i>	Kidney Weed
CRASSULACEAE	
* <i>Bryophyllum delagoense</i>	Mother of Millions
EPACRIDACEAE	
<i>Styphelia triflora</i>	Five Corners

EUPHORBIACEAE	
<i>Breynia oblongifolia</i>	Breynia
FABOIDEAE	
<i>Daviesia gentstifolia</i>	
<i>Daviesia ulicifolia</i>	Gorse Bitter-pea
<i>Desmodium varians</i>	
<i>Dillwynia retorta</i>	Heathy Parrot Pea
<i>Glycine clandestina</i>	Love Creeper
<i>Hardenbergia violacea</i>	False Sarsaparilla
* <i>Trifolium repens</i>	White Clover
GOODENIACEAE	
<i>Goodenia heterophylla</i>	Variable-leaved Goodenia
LAURACEAE	
<i>Cassytha pubescens</i>	Common Devil's Twine
* <i>Cinnamomum camphora</i>	Camphor Laurel
LOBELIACEAE	
<i>Pratia purpurascens</i>	White Root
MALVACEAE	
* <i>Sida rhombifolia</i>	Paddy's Lucerne
MIMOSOIDEAE	
<i>Acacia elongata</i>	Swamp Wattle
<i>Acacia falcata</i>	Falcate Wattle
<i>Acacia longifolia</i>	Sydney Golden Wattle
MYRTACEAE	
<i>Angophora floribunda</i>	Rough-barked Apple
<i>Callistemon linearis</i>	Narrow-leaved Bottlebrush
<i>Callistemon rigidus</i>	Stiff Bottlebrush
<i>Corymbia maculata</i>	Spotted Gum
<i>Eucalyptus crebra</i>	Narrow-leaved Ironbark
<i>Eucalyptus fibrosa</i> ssp. <i>fibrosa</i>	Broad-leaved Ironbark
<i>Eucalyptus moluccana</i>	Grey Box
<i>Eucalyptus parramattensis</i> ssp. <i>decadens</i> (V, EV)	Drooping Red Gum
<i>Eucalyptus punctata</i>	Grey Gum
<i>Eucalyptus tereticornis</i>	Forest Red Gum
<i>Melaleuca decora</i>	
<i>Melaleuca nodosa</i>	Ball Honey-myrtle
<i>Melaleuca stypheloides</i>	Prickly-leaved Paperbark
<i>Melaleuca thymifolia</i>	Thyme Honey-myrtle
OXALIDACEAE	
<i>Oxalis perennans</i>	
PITTOSPORACEAE	
<i>Bursaria spinosa</i>	Blackthorn

PLANTAGINACEAE	
* <i>Plantago lanceolata</i>	Lamb's Tongues
POLYGONACEAE	
<i>Persicaria strigosa</i>	Knotweed
PROTEACEAE	
<i>Grevillea montana</i> (R)	
<i>Hakea sericea</i>	Bushy Needlebush
<i>Persoonia linearis</i>	Narrow-leaved Geebung
RUBIACEAE	
<i>Pomax umbellata</i>	Pomax
SOLANACEAE	
<i>Solanum cinereum</i>	Narrawea Burr
* <i>Solanum nigrum</i>	Black Nightshade
THYMELAEACEAE	
<i>Pimelea linifolia</i> ssp. <i>linifolia</i>	Slender Rice Flower
VERBENACEAE	
* <i>Verbena bonariensis</i>	Purple-Top
SUBCLASS LILIIDAE (Monocotyledons)	
CYPERACEAE	
<i>Cyperus</i> sp.	
<i>Fimbristylis dichotoma</i>	Old Mate
<i>Lepidosperma laterale</i>	Variable Sword-sedge
JUNCACEAE	
<i>Juncus ettusus</i>	
LOMANDRACEAE	
<i>Lomandra filiformis</i> ssp. <i>filiformis</i>	Wattle Mat Rush
<i>Lomandra glauca</i>	
PHORMIACEAE	
<i>Dianella caerulea</i> var. <i>caerulea</i>	Blue Flax Lily
<i>Dianella longifolia</i> var. <i>longifolia</i>	
POACEAE	
<i>Aristida ramosa</i>	Three-awn Speargrass
<i>Aristida vagans</i>	Three-awn Speargrass
<i>Austrodanthonia tenuior</i>	Wallaby Grass
* <i>Chloris vigata</i>	Feathertop Rhodes Grass
<i>Cynodon dactylon</i>	Common Couch
<i>Cymbopogon refractus</i>	Barbed-wire Grass
<i>Digitaria parviflora</i>	Smallflower Fingergrass
<i>Echinopogon caespitosus</i> var. <i>caespitosus</i>	Tufted Hedgehog Grass
<i>Entolasia stricta</i>	Wiry Panic
<i>Eragrostis brownii</i>	Brown's Love Grass

<i>*Hyparrhenia hirta</i>	Coolatai Grass
<i>Imperata cylindrica</i> var. <i>major</i>	Blady Grass
<i>Microlaena stipoides</i> var. <i>stipoides</i>	Weeping Grass
<i>Paspalum distans</i>	
<i>Paspalum distichum</i>	Water Couch
<i>*Pennisetum clandestinum</i>	Kikuyu
<i>*Setaria gracilis</i>	Slender Pigeon Grass
<i>*Sporobolus elongatus</i>	Slender Rat's-tail Grass
<i>Themeda australis</i>	Kangaroo Grass
TYPHACEAE	
<i>Typhus domingensis</i>	Narrow leaved Cumbungi

APPENDIX C: EXPECTED FAUNA SPECIES LIST

Below is a list of fauna species that could be *reasonably* expected to be found within the region at some occurrence. Such an approach has been taken given the unlikelihood to record *all* potentially occurring species within an area during formal fauna surveys (due to seasonality, climatic limitations, crypticism etc).

Family sequencing and taxonomy follow for each fauna class:

Birds – Christidis and Boles (1994).

Herpetofauna - Cogger (1996).

Mammals - Strahan (ed.) (1995) and Churchill (1998).

✓ - Species observed or indicated by scats, tracks etc. on site during this investigation.

* - Indicates an introduced species

Known and Expected Bird List

- Appendix Key:** ✓ = Species Detected
 * = introduced species
(C) = listed as CAMBA species
(J) = listed as JAMBA species
(E) = listed as Endangered in NSW.
(V) = listed as Vulnerable in NSW.
(EV) = Species listed under the Commonwealth EPBC Act as Vulnerable
(EE) = Species listed under the Commonwealth EPBC Act as Endangered
(EM) = Species listed under the Commonwealth EPBC Act as Migratory
(EMa) = Species listed under the Commonwealth EPBC Act as Marine
 Species indicated in **BOLD** font are those threatened species known from within 10km of site (NPWS, 2003)
- Data Source:** 1 = Species recorded during this survey

Family Name	Scientific Name	Common Name	1
Megapodiidae (Mound Builders)	<i>Alectura lathami</i>	Australian Brush-turkey	
Phasianidae (True Quails, Pheasants and Fowls)	<i>Coturnix pectoralis</i>	Stubble Quail (EMa)	
	<i>Coturnix ypsilophora</i>	Brown Quail	
Anatidae (Swans, Geese and Ducks)	<i>Anas castanea</i>	Chestnut Teal (EM)	
	<i>Anas gracilis</i>	Grey Teal (EM)	
	<i>Anas platyrhynchos</i>	*Mallard	
	<i>Anas superciliosa</i>	Pacific Black Duck (EM)	✓
	<i>Aythya australis</i>	Hardhead (EM)	
	<i>Chenonetta jubata</i>	Australian Wood Duck (EM)	
	<i>Cygnus atratus</i>	Black Swan (EM)	
	<i>Oxyura australis</i>	Blue-billed Duck (V, EM)	
	<i>Stictonetta naevosa</i>	Freckled Duck (V, EM)	
	<i>Biziura lobata</i>	Musk Duck	
Podicipedidae (Grebes)	<i>Tachybaptus novaehollandiae</i>	Australasian Grebe	
	<i>Podiceps cristatus</i>	Great Crested Grebe	
Anhingidae (Darters)	<i>Anhinga melanogaster</i>	Darter	

Phalacrocoracidae (Cormorants)	<i>Phalacrocorax carbo</i>	Great Cormorant	
	<i>Phalacrocorax melanoleucos</i>	Little Pied Cormorant	
	<i>Phalacrocorax sulcirostris</i>	Little Black Cormorant	
	<i>Phalacrocorax varius</i>	Pied Cormorant	
Pelecanide (Pelicans)	<i>Pelecanus conspicillatus</i>	Australian Pelican (EMa)	
Ardeidae (Hérons, Bitterns and Egrets)	<i>Ardea alba</i>	Great Egret (C,J, EM, EMa)	
	<i>Ardea ibis</i>	Cattle Egret (C,J, EM, EMa)	✓
	<i>Ardea intermedia</i>	Intermediate Egret (EMa)	
	<i>Ardea pacifica</i>	White-necked Heron	
	<i>Botaurus poiciloptilus</i>	Australasian Bittern (V)	
	<i>Butorides striatus</i>	Striated Heron	
	<i>Egretta garzetta</i>	Little Egret	
	<i>Egretta novaehollandiae</i>	White-faced Heron	✓
	<i>Ixobrychus flavicollis</i>	Black Bittern (V)	
	<i>Nycticorax caledonicus</i>	Nankeen Night Heron (EMa)	
Threskiornithidae (Ibises and Spoonbills)	<i>Platalea flavipes</i>	Yellow-billed Spoonbill	
	<i>Platalea regia</i>	Royal Spoonbill	
	<i>Threskiornis molucca</i>	Australian White Ibis (EMa)	
	<i>Threskiornis spinicollis</i>	Straw-necked Ibis (EMa)	
Ciconiidae (Storks)	<i>Ephippiorhynchus asiaticus</i>	Black-necked Stork (E)	
Accipitridae (Hawks, Kites and Eagles)	<i>Accipiter fasciatus</i>	Brown Goshawk (EM, EMa)	
	<i>Accipiter cirrhocephalus</i>	Collared Sparrowhawk (EM)	
	<i>Accipiter novaehollandiae</i>	Grey Goshawk (EM)	
	<i>Aquila audax</i>	Wedge-tailed Eagle (EM, EMa)	✓
	<i>Aviceda subcristata</i>	Pacific Baza (EM)	
	<i>Circus approximans</i>	Swamp Harrier (EM, EMa)	
	<i>Circus assimilis</i>	Spotted Harrier (EM)	
	<i>Elanus axillaris</i>	Black-shouldered Kite (EM)	✓
	<i>Haliaeetus leucogaster</i>	White-bellied Sea-Eagle (C, EM, EMa)	✓
	<i>Haliastur sphenurus</i>	Whistling Kite (EM, EMa)	
	<i>Hamirostra melanosternon</i>	Black-breasted Buzzard (V)	
<i>Hieraaetus morphnoides</i>	Little Eagle (EM)		
Falconidae (Falcons)	<i>Falco berigora</i>	Brown Falcon (EM)	
	<i>Falco cenchroides</i>	Nankeen Kestrel (EM, EMa)	✓
	<i>Falco longipennis</i>	Australian Hobby (EM)	
	<i>Falco peregrinus</i>	Peregrine Falcon (EM)	
	<i>Falco subniger</i>	Black Falcon	
Rallidae (Crakes, Rails and Gallinules)	<i>Fulica atra</i>	Eurasian Coot	
	<i>Gallinula philippensis</i>	Buff-banded Rail (EMa)	
	<i>Gallinula tenebrosa</i>	Dusky Moorhen	
	<i>Porphyrio porphyrio</i>	Purple Swamphen (EMa)	
	<i>Porzana fluminea</i>	Australian Spotted Crake	
	<i>Porzana pusilla</i>	Baillon's Crake (EMa)	
	<i>Porzana tabuensis</i>	Spotless Crake (EMa)	

	<i>Rallus pectoralis</i>	Lewin's Rail	
Turnicidae (Button-Quails)	<i>Turnix pyrrhotorax</i>	Red-chested Button-quail	
	<i>Turnix varia</i>	Painted Button-quail	
Rostratulidae (Painted Snipe)	<i>Rostratula benghalensis</i>	Painted Snipe (EM, V, EMa)	
	<i>Vanellus miles</i>	Masked Lapwing (EM)	✓
	<i>Erythrogonys cinctus</i>	Red-kneed Dotterel (EM)	
	<i>Elseyornis melanops</i>	Black-fronted Dotterel (EM)	
Laridae (Gulls and Terns)	<i>Chlidonias hybrida</i>	Whiskered Tern (EMa)	
Columbidae (Pigeons and Doves)	<i>Columba livia</i>	Rock Dove #	
	<i>Columba leucomela</i>	White-headed Pigeon	
	<i>Geopelia humeralis</i>	Bar-shouldered Dove	✓
	<i>Geopelia striata</i>	Peaceful Dove	
	<i>Leucosarcia melanoleuca</i>	Wonga Pigeon	
	<i>Macropygia amboinensis</i>	Brown Cuckoo-Dove	
	<i>Ocyphaps lophotes</i>	Crested Pigeon	✓
	<i>Phaps chalcoptera</i>	Common Bronzewing	
	<i>Phaps elegans</i>	Brush Bronzewing	
	<i>Streptopelia chinensis</i>	Spotted Turtle-Dove #	
	<i>Lopholaimus antarcticus</i>	Topknot Pigeon	
	Cacatuidae (Cockatoos)	<i>Calyptrohynchus funereus</i>	Yellow-tailed Black-Cockatoo
<i>Calyptorhynchus lathami</i>		Glossy Black-Cockatoo (V)	
<i>Cacatua roseicapilla</i>		Galah	✓
<i>Cacatua tenuirostris</i>		Long-billed Corella	
<i>Cacatua sanguinea</i>		Little Corella	
<i>Cacatua galerita</i>		Sulphur-crested Cockatoo	
<i>Callocephalon fimbriatum</i>		Gang-gang Cockatoo	
Psittacidae (Parrots)	<i>Alisterus scapularis</i>	Australian King Parrot	
	<i>Glossopsitta pusilla</i>	Little Lorikeet	
	<i>Lathamus discolor</i>	Swift Parrot (E, EE, EMa)	
	<i>Neophema pulchella</i>	Turquoise Parrot (V)	
	<i>Platycercus elegans</i>	Crimson Rosella	
	<i>Platycercus eximius</i>	Eastern Rosella	✓
	<i>Psephotus haematonotus</i>	Red-rumped Parrot	
	<i>Trichoglossus chlorolepidotus</i>	Scaly-breasted Lorikeet	✓
	<i>Trichoglossus concina</i>	Musk Lorikeet	✓
<i>Trichoglossus haematodus</i>	Rainbow Lorikeet		
Cuculidae (Old World Cuckoos)	<i>Cuculus saturatus</i>	Oriental Cuckoo (C,J, EM)	
	<i>Cacomantis flabelliformis</i>	Fan-tailed Cuckoo (EMa)	
	<i>Cacomantis variolosus</i>	Brush Cuckoo	
	<i>Chrysococcyx basalis</i>	Horsfield's Bronze-Cuckoo (EMa)	
	<i>Chrysococcyx lucidus</i>	Shining Bronze-Cuckoo (EMa)	
	<i>Cuculus pallidus</i>	Pallid Cuckoo (EMa)	
	<i>Eudynamys scolopacea</i>	Common Koel (EMa)	
	<i>Scythrops novaehollandiae</i>	Channel-billed Cuckoo (EMa)	
Centropodidae (Coucals)	<i>Centropus phasianinus</i>	Pheasant Coucal	

Strigidae (Hawk Owls)	<i>Ninox strenua</i>	Powerful Owl (V)	
	<i>Ninox connivens</i>	Barking Owl (V)	
	<i>Ninox boobook</i>	Southern Boobook (EMa)	
Tytonidae (Barn Owls)	<i>Tyto alba</i>	Barn Owl	
	<i>Tyto capensis</i>	Grass Owl (V)	
	<i>Tyto novaehollandiae</i>	Masked Owl (V)	
Podargidae (Frogmouths)	<i>Podargus strigoides</i>	Tawny Frogmouth	✓
Caprimulgidae (Nightjars)	<i>Eurostopodus mystacalis</i>	White-throated Nightjar (EMa)	
Aegothelidae (Owlet-nightjars)	<i>Aegotheles cristatus</i>	Australian Owlet-nightjar	
Apodidae (Typical Swifts)	<i>Hirundapus caudacutus</i>	White-throated Needletail (C,J, EM)	
	<i>Apus pacificus</i>	Fork-tailed Swift (C,J, EM)	
Alcedinidae (True Kingfishers)	<i>Alcedo azurea</i>	Azure Kingfisher	
Halcyonidae (Kingfishers and Kookaburras)	<i>Dacelo novaeguineae</i>	Laughing Kookaburra	✓
	<i>Todiramphus sanctus</i>	Sacred Kingfisher (EMa)	
	<i>Todiramphus macleayii</i>	Forest Kingfisher (EMa)	
Meropidae (Bee-eaters)	<i>Merops ornatus</i>	Rainbow Bee-eater (J, ,EM, EMa)	
Coraciidae (Typical Rollers)	<i>Eurystomus orientalis</i>	Dollarbird (EMa)	
Menuridae (Lyrebirds)	<i>Menura novaehollandiae</i>	Superb Lyrebird	
Climacteridae (Australo-Papuan Trecreepers)	<i>Cormobates leucophaeus</i>	White-throated Trecreeper	✓
	<i>Climacteris picumnus</i>	Brown Trecreeper (V)	
Maluridae (Fairy-Wrens and Emu- Wrens)	<i>Malurus cyaneus</i>	Superb Fairy-wren	✓
	<i>Malurus lamberti</i>	Variiegated Fairy-wren	
	<i>Stipiturus malachurus</i>	Southern Emu-wren	
Pardalotidae (Pardalotes, Scrubwrens, Thornbills)	<i>Pardalotus punctatus</i>	Spotted Pardalote	✓
	<i>Paradalotus striatus</i>	Striated Pardalote	✓
	<i>Sericornis frontalis</i>	White-browed Scrubwren	
	<i>Chthonicola sagittata</i>	Speckled Warbler (V)	
	<i>Smicromnis brevirostris</i>	Weebill	✓
	<i>Gerygone mouki</i>	Brown Gerygone	
	<i>Gerygone fusca</i>	Western Gerygone	
	<i>Gerygone olivacea</i>	White-throated Gerygone	
	<i>Acanthiza pusilla</i>	Brown Thornbill	✓
	<i>Acanthiza reguloides</i>	Buff-rumped Thornbill	✓
	<i>Acanthiza chrysorrhoa</i>	Yellow-rumped Thornbill	✓
	<i>Acanthiza nana</i>	Yellow Thornbill	✓
	<i>Acanthiza lineata</i>	Striated Thornbill	✓
	<i>Hylacola pyrrhopygia</i>	Chestnut-rumped Heathwren	
Meliphagidae (Honeyeaters)	<i>Anthochaera carunculata</i>	Red Wattlebird	✓

	<i>Plectrhynga lanceolata</i>	Striped Honeyeater	
	<i>Anthochaera chrysoptera</i>	Brush Wattlebird	
	<i>Philemon corniculatus</i>	Noisy Friarbird	
	<i>Philemon citreogularis</i>	Little Friarbird	
	<i>Xanthomyza phrygia</i>	Regent Honeyeater (E, EE, EM)	
	<i>Manorina melanophrys</i>	Bell Miner	
	<i>Manorina melanocephala</i>	Noisy Miner	✓
	<i>Meliphaga lewinii</i>	Lewin's Honeyeater	
	<i>Lichenostomus chrysops</i>	Yellow-faced Honeyeater	✓
	<i>Lichenostomus melanops</i>	Yellow-tufted Honeyeater	✓
	<i>Lichenostomus fuscus</i>	Fuscous Honeyeater	
	<i>Lichenostomus penicillatus</i>	White-plumed Honeyeater	
	<i>Lichenostomus leucotis</i>	White-eared Honeyeater	
	<i>Melithreptus brevirostris</i>	Brown-headed Honeyeater	
	<i>Melithreptus lunatus</i>	White-naped Honeyeater	
	<i>Melithreptus gularis</i>	Black-chinned Honeyeater (V)	
	<i>Entomyzon cyanotis</i>	Blue-faced Honeyeater	
	<i>Lichmera indistincta</i>	Brown Honeyeater	
	<i>Phylidonyris novaehollandiae</i>	New Holland Honeyeater	
	<i>Phylidonyris nigra</i>	White-cheeked Honeyeater	✓
	<i>Acanthorhynchus tenuirostris</i>	Eastern Spinebill	
	<i>Myzomela sanguinolenta</i>	Scarlet Honeyeater	
	<i>Epthianura albifrons</i>	White-fronted Chat	
Eopsaltriidae (Robins)	<i>Microeca fascinans</i>	Jacky Winter	
	<i>Petroica multicolor</i>	Scarlet Robin	
	<i>Petroica phoenicea</i>	Flame Robin (EMa)	
	<i>Petroica rosea</i>	Rose Robin	
	<i>Eopsaltria australis</i>	Eastern Yellow Robin	
	<i>Melanodryas cucullata</i>	Hooded Robin (V)	
Pomatostomidae (Australo-Papuan Babblers)	<i>Pomatostomus temporalis</i>	Grey-crowned Babbler (V)	✓
Cinclosomidae (Quail-thrushes and allies)	<i>Psophodes olivaceus</i>	Eastern Whipbird	
	<i>Cinclosoma punctatum</i>	Spotted Quail-thrush	
Neosittidae (Sittellas)	<i>Daphoenositta chrysoptera</i>	Varied Sittella	
Pachycephalidae (Whistlers, Shrike-tit, Shrike-thrushes)	<i>Falcunculus frontatus</i>	Crested Shrike-tit	
	<i>Pachycephala pectoralis</i>	Golden Whistler	
	<i>Pachycephala rufiventris</i>	Rufous Whistler	
	<i>Colluricincla harmonica</i>	Grey Shrike-thrush	✓
Dicruridae (Monarchs, Fantails and Drongo)	<i>Monarcha melanopsis</i>	Black-faced Monarch	
	<i>Myiagra cyanoleuca</i>	Satin Flycatcher	
	<i>Myiagra rubecula</i>	Leaden Flycatcher	
	<i>Myiagra inquieta</i>	Restless Flycatcher	
	<i>Grallina cyanoleuca</i>	Magpie-lark (EMa)	
	<i>Rhipidura rufifrons</i>	Rufous Fantail (EMa)	
	<i>Rhipidura fuliginosa</i>	Grey Fantail	✓
	<i>Rhipidura leucophrys</i>	Willie Wagtail	✓

	<i>Dicrurus bracteatus</i>	Spangled Drongo (EMa)	
Campephagidae (Cuckoo-shrikes and Trillers)	<i>Coracina novaehollandiae</i>	Black-faced Cuckoo-shrike (EMa)	✓
	<i>Coracina papuensis</i>	White-bellied Cuckoo-shrike (EMa)	
	<i>Coracina tenuirostris</i>	Cicadabird (EM, (EMa)	
	<i>Lalage sueurii</i>	White-winged Triller	
Oriolidae (Orioles and Figbird)	<i>Oriolus sagittatus</i>	Olive-backed Oriole	
	<i>Sphecotheres viridis</i>	Figbird	
Artamidae (Woodswallows, Butcherbirds, Currawongs)	<i>Artamus leucorhynchus</i>	White-breasted Woodswallow	
	<i>Artamus cyanopterus</i>	Dusky Woodswallow	
	<i>Artamus personatus</i>	Masked Woodswallow	
	<i>Cracticus torquatus</i>	Grey Butcherbird	
	<i>Cracticus nigrogularis</i>	Pied Butcherbird	✓
	<i>Gymnorhina tibicen</i>	Australian Magpie	✓
	<i>Strepera graculina</i>	Pied Currawong	✓
Corvidae (Crows and allies)	<i>Corvus coronoides</i>	Australian Raven	✓
	<i>Corvus orru</i>	Torresian Crow	
	<i>Corvus tasmanicus</i>	Forest Raven (EMa)	
Cororacidae (Mud-nesters)	<i>Corcorax melanorhamphos</i>	White-winged Chough	
Ptilinorhynchidae (Bowerbirds)	<i>Ptilinorhynchus violaceus</i>	Satin Bowerbird	
Motacillidae (Old World Wagtails, Pipits)	<i>Anthus novaeseelandiae</i>	Richard's Pipit	
Passeridae (Sparrows, Weaverbirds, Waxbills)	<i>Passer domesticus</i>	House Sparrow #	✓
	<i>Taeniopygia guttata</i>	Zebra Finch	
	<i>Taeniopygia bichenovii</i>	Double-barred Finch	
	<i>Neochmia temporalis</i>	Red-browed Finch	
	<i>Lonchura castaneothorax</i>	Chestnut-breasted Mannikin	
Dicaeidae (Flowerpeckers)	<i>Dicaeum hirundinaceum</i>	Mistletoebird	✓
Hirundinidae (Swallows and Martins)	<i>Hirundo neoxena</i>	Welcome Swallow (EMa)	✓
	<i>Hirundo nigricans</i>	Tree Martin (EMa)	
	<i>Hirundo ariel</i>	Fairy Martin	
Sylviidae (Old World Warblers)	<i>Acrocephalus stentoreus</i>	Clamorous Reed Warbler	
	<i>Cincloramphus mathewsi</i>	Rufous Songlark	
	<i>Cisticola exilis</i>	Golden-headed Cisticola	
	<i>Megalurus gramineus</i>	Little Grassbird	
	<i>Megalurus timorensis</i>	Tawny Grassbird	
Zosteropidae (White-eyes)	<i>Zosterops lateralis familiaris</i>	Silvereye (EMa)	✓
Muscicapidae (Thrushes)	<i>Zoothera lunulata</i>	Bassian Thrush	
	<i>Zoothera heinei</i>	Russet-tailed Thrush	
Sturnidae (Starlings and allies)	<i>Sturnus vulgaris</i>	Common Starling #	✓
	<i>Acridotheres tristis</i>	Common Myna #	✓

Known and Expected Mammal List

- Appendix Key:** ✓ = Species Detected
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(EV) = Species listed under the Commonwealth EPBC Act as Vulnerable
(EE) = Species listed under the Commonwealth EPBC Act as Endangered
 Species indicated in **BOLD** font are those threatened species known from within 10km of site (NPWS, 2003)
- Data Source:** 1 = Species recorded during this survey

Family Name	Scientific Name	Common Name	1
Tachyglossidae (Echidnas)	<i>Tachyglossus aculeatus</i>	Short-beaked Echidna	
Dasyuridae (Dasyurids)	<i>Antechinus flavipes</i>	Yellow-footed Antechinus	
	<i>Antechinus stuartii</i>	Brown Antechinus	
	<i>Planigale maculata</i>	Common Planigale (V)	
	<i>Sminthopsis murina</i>	Common Dunnart	
Peramelidae (Bandicoots and Bilbies)	<i>Isoodon macrourus</i>	Northern Brown Bandicoot	
	<i>Peremeles nasuta</i>	Long-nosed Bandicoot	
Phascolarctidae (Koala)	<i>Phascolarctos cinereus</i>	Koala (V)	
Vombatidae (Wombats)	<i>Vombatus ursinus</i>	Common Wombat	
Petauridae (Wrist-winged Gliders)	<i>Petaurus breviceps</i>	Sugar Glider	
	<i>Petaurus norfolcensis</i>	Squirrel Glider (V)	
	<i>Petaurus australis</i>	Yellow-bellied Glider (V)	
Pseudocheiridae (Ringtail Possums, Greater Glider)	<i>Pseudocheirus peregrinus</i>	Common Ringtail Possum	
Acrobatidae (Feathertail Glider)	<i>Acrobates pygmaeus</i>	Feathertail Glider	
Phalangeridae (Brush-tail Possums and Cuscuses)	<i>Trichosurus vulpecula</i>	Common Brushtail Possum	✓
Macropodidae (Wallabies and Kangaroos)	<i>Macropus giganteus</i>	Eastern Grey Kangaroo	✓
	<i>Macropus robustus</i>	Common Wallaroo	
	<i>Macropus rufogriseus</i>	Red-necked Wallaby	
	<i>Wallabia bicolor</i>	Swamp Wallaby	
Pteropodidae (Flying-foxes, Blossom- bats)	<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox (V) (EV)	✓
	<i>Pteropus scapulatus</i>	Little Red Flying-fox	
Rhinolophidae (Horseshoe-bats)	<i>Rhinolophus megaphyllus</i>	Eastern Horseshoe-bat	
Emballonuridae (Sheath-tail-bats)	<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheath-tail-bat (V)	
Molossidae (Freetail-bats)	<i>Mormopterus norfolkensis</i>	East Coast Freetail-bat (V)	
	<i>Mormopterus</i> sp.1	Little Freetail-bat	
	<i>Mormopterus</i> sp.2	Eastern Freetail-bat	✓
	<i>Tadarida australis</i>	White-striped Freetail-bat	

Vespertilionidae (Vespertilionid Bats)	<i>Miniopterus australis</i>	Little Bentwing-bat (V)	✓
	<i>Miniopterus schreibersii</i>	Common Bentwing-bat (V)	✓
	<i>Nyctophilus geoffroyi</i>	Lesser Long-eared Bat	
	<i>Nyctophilus gouldii</i>	Gould's Long-eared Bat	
	<i>Chalinolobus dwyeri</i>	Large-eared Pied Bat (V) (EV)	
	<i>Chalinolobus gouldii</i>	Gould's Wattled Bat	✓
	<i>Chalinolobus morio</i>	Chocolate Wattled Bat	
	<i>Falsistrellus tasmaniensis</i>	Eastern Falsistrelle (V)	✓
	<i>Myotis adversus</i>	Large-footed Myotis (V)	
	<i>Scoteanax rueppellii</i>	Greater Broad-nosed Bat (V)	
	<i>Scotorepens greyii</i>	Little Broad-nosed Bat	
	<i>Scotorepens orion</i>	Eastern Broad-nosed Bat	
	<i>Vespadelus darlingtoni</i>	Large Forest Bat	
	<i>Vespadelus regulus</i>	Southern Forest Bat	
	<i>Vespadelus pumilus</i>	Eastern Forest Bat	
	<i>Vespadelus vulturnus</i>	Little Forest Bat	
	<i>Vespadelus sp.</i>		✓
Muridae (Murids)	<i>Hydromys chrysogaster</i>	Water Rat	
	<i>Melomys burtoni</i>	Grassland Melomys	
	<i>Mus musculus</i>	House Mouse*	
	<i>Pseudomys novaehollandiae</i>	New Holland Mouse	
	<i>Rattus fuscipes</i>	Bush Rat	
	<i>Rattus lutreolus</i>	Swamp Rat	
	<i>Rattus norvegicus</i>	Brown Rat*	
	<i>Rattus rattus</i>	Black Rat*	
Canidae (Dogs)	<i>Canis familiaris</i>	Dog *	✓
	<i>Canis familiaris dingo</i>	Dingo	
	<i>Vulpes vulpes</i>	Red Fox*	✓
Felidae (Cats)	<i>Felis catus</i>	Feral Cat*	
Leporidae (Rabbit and Hare)	<i>Oryctolagus cuniculus</i>	European Rabbit*	✓
	<i>Lepus capensis</i>	Brown Hare*	
Equidae (Horse and Donkey)	<i>Equus caballus</i>	Horse*	
Suidae (Pigs)	<i>Sus scrofa</i>	Pig*	
Bovidae (Horned Ruminants)	<i>Bos taurus</i>	Cow*	✓
	<i>Capra hircus</i>	Goat*	
Cervidae (Deer)	<i>Cervus timorensis</i>	Rusa Deer*	
Camelidae (Alpaca)	<i>Lama sp.</i>	Alpaca*	

Known and Expected Reptile List

- Appendix Key:** ✓ = Species Detected
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(EV) = Species listed under the Commonwealth EPBC Act as Vulnerable
(EE) = Species listed under the Commonwealth EPBC Act as Endangered
(EMa) = Species listed under the Commonwealth EPBC Act as Marine
 Species indicated in **BOLD** font are those threatened species known from within 10km of site (NPWS, 2003)
- Data Source:** 1 = Species recorded during this survey

Family Name	Scientific Name	Common Name	1
Cheloniidae (Turtles)	Chelonia mydas	Green Turtle (V, EMa)	
Chelidae (Tortoises)	<i>Chelodina longicollis</i>	Long-necked Tortoise	
Agamidae (Dragons)	<i>Amphibolurus muricatus</i>	Jacky Lizard	
	<i>Physignathus lesuerii</i>	Eastern Water Dragon	
	<i>Pogona barbata</i>	Eastern Bearded Dragon	
Pygopodidae (Legless Lizards)	<i>Lialis burtonis</i>	Burton's Snake Lizard	
	<i>Pygopus lepidopus</i>	Common Scaly-foot	
	<i>Delma plebeia</i>	Leaden Delma	
Varanidae (Monitors)	<i>Varanus gouldii</i>	Gould's Monitor	
	<i>Varanus rosenbergi</i>	Heath Monitor (V)	
	<i>Varanus varius</i>	Lace Monitor	
Scincidae (Skinks)	<i>Cryptoblepharus virgatus</i>		
	<i>Ctenotus taeniolatus</i>	Copper-tailed Skink	
	<i>Ctenotus robustus</i>	Striped Skink	
	<i>Cyclodomorphus casuarinae</i>	She-oak Skink	
	<i>Egernia cunninghamii</i>	Cunningham's Skink	
	<i>Egernia major</i>	Land Mullet	
	<i>Egernia modesta</i>		
	<i>Egernia striolata</i>	Tree-crevice Skink	
	<i>Egernia saxatilis</i>	Black Rock Skink	
	<i>Egernia whitii</i>	White's Skink	
	<i>Eulamprus quoyii</i>	Eastern Water Skink	
	<i>Eulamprus tenuis</i>		
	<i>Lampropholis delicata</i>	Grass Skink	
	<i>Lampropholis guichenoti</i>	Garden Skink	
	<i>Lygisaurus foliorum</i>	Tree-base Litter-skink	
	<i>Morethia boulengeri</i>	South-eastern Morethia	
	<i>Pseudomoia platynota</i>	Red-throated Skink	
	<i>Saiphos equalis</i>		
	<i>Saproscincus mustelinus</i>	Weasel Skink	
	<i>Tiliqua scincoides</i>	Eastern Blue-tongued Lizard	
Typhlopidae (Blind Snakes)	<i>Ramphotyphlops bituberculatus</i>	Prong-snouted Blind Snake	
	<i>Ramphotyphlops weidii</i>	Brown-snouted Blind Snake	
	<i>Ramphotyphlops nigrescens</i>	Black Blind Snake	
Boidae (Pythons)	<i>Morelia spilota</i>	Diamond Python	
Colubridae (Tree Snakes)	<i>Boiga irregularis</i>	Brown Tree Snake	
	<i>Dendralaphis punctulata</i>	Green Tree Snake	
Elapidae (Venomous Snakes)	<i>Furina diadema</i>	Red-naped Snake	
	<i>Acanthopis antarcticus</i>	Death Adder	
	<i>Cacophis krefftii</i>	Dwarf Crowned Snake	
	<i>Cacophis squamulosus</i>	Golden Crowned Snake	
	<i>Demansia psammophis</i>	Yellow-faced Whip Snake	
	<i>Furina diadema</i>	Red-naped Snake	

Family Name	Scientific Name	Common Name	1
	<i>Hoplocephalus bungaroides</i>	Broad-headed Snake (V, EV)	
	<i>Hoplocephalus bitorquatus</i>	Pale-headed Snake (V)	
	<i>Notechis scutatus</i>	Eastern Tiger Snake	
	<i>Pseudonaja textilis</i>	Eastern Brown Snake	
	<i>Rhinoplocephalus nigrescens</i>	Eastern Small-eyed Snake	
	<i>Vermicella annulata</i>	Bandy Bandy	
	<i>Hemiaspis signata</i>	Black-bellied Swamp Snake	
	<i>Pseudechis porphyriacus</i>	Red-bellied Black Snake	

Known and Expected Frog List

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(EE) = Species listed under the Commonwealth EPBC Act as Endangered
 Species indicated in **BOLD** font are those threatened species known from within 10km of site (NPWS, 2003)
- Data Source:** 1 = Species recorded during this survey

Family Name	Scientific Name	Common Name	1
Hylidae (Tree Frogs)	<i>Litoria aurea</i>	Green and Golden Bell Frog (E, EV)	
	<i>Litoria caerulea</i>	Green Tree Frog	
	<i>Litoria chloris</i>	Red-eyed Green Tree Frog	
	<i>Litoria dentata</i>	Bleating Tree Frog	
	<i>Litoria fallax</i>	Dwarf Green Tree Frog	
	<i>Litoria gracilentia</i>	Graceful Tree Frog	
	<i>Litoria latopalmata</i>	Broad-palmed Frog	
	<i>Litoria lesueuri</i>	Lesueur's Frog	
	<i>Litoris nasuta</i>	Rocket Frog	
	<i>Litoria peronii</i>	Peron's Tree Frog	
	<i>Litoria phyllochroa</i>	Green Leaf Tree Frog	
	<i>Litoria tyleri</i>	Tyler's Tree Frog	
	<i>Litoria verreauxii</i>	Verreaux's Frog	
	Myobatrachidae (Ground Frogs)	<i>Adelotus brevis</i>	Tusked Frog
<i>Crinia signifera</i>		Common Eastern Froglet	✓
<i>Crinia tinnula</i>		Wallum Froglet (V)	
<i>Limnodynastes dumerilli</i>		Eastern Banjo Frog	
<i>Limnodynastes ornatus</i>		Ornate Burrowing Frog	
<i>Limnodynastes peronii</i>		Striped Marsh Frog	
<i>Limnodynastes tasmaniensis</i>		Spotted Grass Frog	
<i>Mixophyes fasciolatus</i>		Great Barred Frog	
<i>Pseudophryne coriacea</i>		Red-backed Toadlet	
<i>Pseudophryne bibronii</i>		Brown Toadlet	
<i>Uperoleia fusca</i>		Dusky Toadlet	
<i>Uperoleia laevigata</i>		Smooth Toadlet	✓

APPENDIX D: PERSONNEL INVOLVED IN THE PROJECT

CRAIG ANDERSON BAPPSc(EAM)**Director****Date of Birth** 5th November 1971**Qualifications** Bachelor Applied Science (Environmental Assessment & Management) University of Newcastle, New South Wales (1994)
Currently undertaking Graduate Diploma in Archaeological Heritage through University of New England**Fields of Special Competence** Production of complex ecological impact assessment documents
Detailed understanding of environmental legislation
Conflict resolution and environmental impact mediation
Land and Environment Court hearings
Flora, habitat, and fauna surveys including threatened species
Bushfire Threat Assessment & Management reporting
Project Management (including areas outside environmental concern)**Professional Affiliations/ Study Groups** Ecological Consultants Association of NSW (ECA)
Planning Institute of Australia (PIA)
Society for Growing Australian Plants (SGAP)
Frog and Tadpole Study Group (FATS)
Society of Frogs & Reptiles (SOFAR)
Hunter Birds Observers Club (HBOC)
Bird Observers Club of Australia (BOCA)
Australasian Bat Society (ABS)
Hunter Heritage Network (HHN)**Credentials** RFS / PIA NSW Consulting Planners Bushfire Training Course
Occupational Health and Safety Induction Training
NSW Driver's Licence: Car (Class "C")
NSW NPWS Scientific Investigation Licence (No. S10300)**EMPLOYMENT HISTORY**

2001 – current Senior Ecologist & Manager HSO Ecology
Harper Somers O'Sullivan, Newcastle.
(Company Director as of July 2003)

2000 – 2001 Senior Ecologist & NSW Projects Manager
Wildthing Environmental Consultants, Salt Ash.

1996 – 1999 Ecologist
Wildthing Environmental Consultants, Salt Ash.

1995 – 1996 Ecologist / Environmental Officer
Pulver Cooper & Blackley, Newcastle.

1995 Environmental Officer / Survey Assistant
Kel Nagle Cooper & Associates, Newcastle.

MATTHEW DOHERTY BLMC**Senior Ecologist**

Date of Birth	28 th September 1978
Qualifications	Bachelor of Landscape Management and Conservation University of Western Sydney, NSW Bush Regeneration Certificate II Western Institute of TAFE, NSW
Fields of Special Competence	Planning and Conducting Field Surveys for Flora, Fauna and Habitat Identification Liaison and Mediation with Clients, Stakeholders and Governing Bodies Geographic Information System Operation for Project Design and Mapping Report Preparation including Threatened Species Assessment, Vegetation Management Plans, Constraints Reports and Species Impact Statements Tree Climbing to Install, Monitor and Maintain Supplementary Habitat (Nestboxes) Project Management
Credentials	Spikeless Tree Climbing Techniques, Total Height Safety Occupational Health and Safety Induction Training (Greencard) NSW Driver's Licence (Class C) NSW NPWS Scientific Investigation Licence (S10300)

EMPLOYMENT HISTORY

April 2005 – Current	Ecologist / Senior Ecologist Harper Somers O'Sullivan, Broadmeadow, NSW
April 2004 – April 2005	Ecologist Andrews.Neil Pty Ltd, Gosford, NSW
June 2003 – April 2004	Project Officer/ Horticultural Services Gosford City Council, NSW
Jan 1997 – June 2003	Bar Tender/ Manager Bars, Pubs, Clubs
Jan 1999 – Dec 1999	Environmental Officer Dept of Land & Water Conservation, Newcastle, NSW

ALLAN RICHARDSON BENVSc(HONS)**Ecologist**

Date of Birth	06 th June 1962
Qualifications	B.Env.Sc. (Environmental Management Major) University of Newcastle, New South Wales (2003) B.Env.Sc. (Hons) (Biology) University of Newcastle, New South Wales (2004)
Fields of Special Competence	Ornithological Surveys and Research Terrestrial flora and fauna surveys Flora & Fauna Assessment and Reporting GPS Survey and GIS Mapping Projects Site and Logistics Management Tertiary Tutoring and Demonstrating
Academic Awards	2002 Hunter Environmental Institute Scholarship
Professional Affiliations	Hunter Bird Observers Club
Credentials	NSW Driver's Licence: Car (Class "C") Boat Licence

EMPLOYMENT HISTORY

Jan 2005 – current	Ecologist Harper Somers O'Sullivan
Jul 2003 – May 2004	Casual Tutor/Demonstrator The University of Newcastle
Jul – Nov 2003	Casual Tutor/Demonstrator The University of Newcastle
Jan 2002	Ornithological Surveyor Wetland Care Australia
Nov 1998 – Sep 2000	Manager, Caretaker, Ecologist Yarrahapinni Youth, School and Ecology Centre
Nov 1997	Ornithological Surveyor State Forests

SAM BISHOP B. ENVSC**ECOLOGIST/BUSHFIRE CONSULTANT**

Over two years experience undertaking a diverse array of, ecological, environmental and bushfire surveys, assessments and management.

Date of Birth: 17/04/78

Qualifications: B. EnvSc
University of Newcastle, New South Wales

Fields of Special Competence

Conducting Field Surveys for Flora, Fauna and Habitat Identification.

Flora identification and targeted threatened flora species searches

Geographical Information Systems project design and mapping

Report Preparation including Threatened Species Assessment, Endangered Ecological Communities assessment, and Vegetation Management Plans

Detailed understanding of environmental legislation and threatened flora species issues

Bushfire Threat Assessment & Management reporting

Bushfire Risk Management Plans

Fuel Management Plans

Tree Clearance Supervision and Fauna Handling

Nestbox Installation & Maintenance

Credentials Occupational Health and Safety Induction Training
NSW Driver's Licence (Class C)
NSW NPWS Scientific Investigation Licence (S10300)

Affiliations Member of the Fire Protection Association Australia (FPA)
Society of Frogs & Reptiles (SOFAR)
Hunter Bird Observers Club (HBOC)

EMPLOYMENT HISTORY

July 2006 – Current Ecologist
HSO Ecology, Broadmeadow, NSW

February 2005 - July 2006 Ecologist
Wildthing Environmental Consultants, Wallsend, NSW

APPENDIX B Personnel Involved in the Project

Curriculum Vitae

Name: Craig Anderson
Office: RPS Harper Somers O'Sullivan
Position in Company: Director - Environment
Qualifications / Memberships: Bachelor Applied Science (Environmental Assessment & Management) University of Newcastle, NSW (1994)
Currently undertaking Graduate Diploma in Archaeological Heritage through UNE
Ecological Consultants Association of NSW (ECA)
Planning Institute of Australia (PIA)
Frog and Tadpole Study Group (FATS)
Hunter Birds Observers Club (HBOC) Committee Member 2008
Bird Observers Club of Australia (BOCA)
Hunter Heritage Network (HHN)
RFS/PIA NSW Consulting Planners Bushfire Training

Areas of Expertise:

- Production of complex ecological impact assessment documents
- Detailed understanding of environmental legislation
- Conflict resolution and environmental impact mediation
- Land and Environment Court hearings
- Flora, habitat, and fauna surveys including threatened species
- Bushfire Threat Assessment & Management reporting
- Project Management (including areas outside environmental concern)

Experience Includes:

Craig is the Director of the Environment Division at RPS HSO, and has over 14 years experience in a wide range of environmental consulting. He has undertaken and managed commissions for a diverse range of projects, including State Significant Developments such as the Hunter Economic Zone (HEZ).

Extensive background in ecological field surveys, encompassing all aspects of flora and fauna identification, targeted surveying and mapping. Involved in the initial formulation of an Association of Consulting Ecologists for NSW in 1998. Elected member on the Inaugural Council (served two terms). Has acted as an expert witness in several Land and Environment Court matters relating to ecology and bushfire assessment. An experienced negotiator of ecological / development outcomes, and has a detailed understanding of legislation related to ecological matters. Craig has been actively involved in representations to the Department of Environment on behalf of the NSW Urban Taskforce in regards to proposed changes to the NSW Threatened Species Conservation Act.

Craig has also been involved in submissions on bushfire legislation and represented industry groups such as the NSW Urban Taskforce and Urban Development Institute of Australia (UDIA) on matters relating to issues such as the proposed listing of the Lower Hunter Spotted Gum – Ironbark Forest (LHSGIF) as an endangered ecological community, and regional environmental biodiversity strategies. Craig has also recently provided advice and submission material to the UDIA in relation to the Native Vegetation Act 2003 and the operations of the Catchment Management Authority (CMA).

Curriculum Vitae

Name: Anna McConville

Office: RPS Harper Somers O'Sullivan

Position in Company: Ecologist

Qualifications / Memberships: B.Env. Sc.
M.Phil. (Env. Sc.) Candidate
"The Ecology of the East Coast Freetail Bat (*Mormopterus norfolkensis*) in the Hunter Region"
Member of the Australasian Bat Society
Member of the Royal Zoological Society of Australia
Member of the Wildlife Preservation Society of Australia

Areas of Expertise:

- Terrestrial Flora and Fauna Surveys
- Targeted threatened flora and fauna surveys
- Ecological impact assessment and reporting
- Ecological condition and threatened species monitoring
- Geographic Information Systems mapping and analyses
- Detailed understanding of legislation and threatened species issues

Experience Includes:

Anna has over 3 years experience as an ecological consultant in NSW after completing university. Anna is experienced in designing and conducting flora and fauna surveys for environmental impact assessment and ecological monitoring. Key experience includes flora and fauna surveys for two major highway upgrades on the north coast of NSW and other infrastructure projects, ecological constraints and opportunities investigations for local environmental studies both in the Hunter and on the north coast; implementation of ecological monitoring programs in the Lake Macquarie and Hunter Valley regions. Anna has also undertaken Biodiversity Certification and BioBanking feasibility investigations.

Anna is also currently completing a research degree investigating the habitat preferences of the East Coast Freetail Bat (*Mormopterus norfolkensis*), a threatened species, in the Hunter Region. The project investigates landscape-scale habitat use, roost selection and diet and aims to provide essential information to develop management strategies for the species.

Curriculum Vitae

Name:	Deborah Landenberger
Office:	RPS Harper Somers O'Sullivan
Position in Company:	Ecologist/ Botanist
Qualifications / Awards	B. Sc (Hons – First Class) NSW Driver's Licence (Class C) OH&S Induction Training (Green Card) NPWS Scientific Investigation Licence NSW Animal Ethics Research Authority
Memberships:	Australian Plant Society Australian Network for Plant Conservation Australasian Native Orchid Society

Areas of Expertise:

- Flora identification and habitat assessment
- Targeted threatened flora surveys
- Delineation and mapping of vegetation communities
- Endangered Ecological Community (EEC) assessment
- Threatened Flora Management Plans
- Experience in PATN Statistical package
- Ecological Monitoring and Reporting
- Vegetation and Bushland Management Plans
- Project Management and quote preparation
- Experience with GPS/GIS for project design and mapping
- Detailed understanding of environmental legislation

Project Experience Includes:

Deborah Landenberger has broad range of Ecological Assessment reporting experience underpinned by over 10 years of ecological field experience. Experience within the consulting industry has primarily included a wide range of flora assessment disciplines as required by a wide range of public and private clients. Debbie has a strong grounding in threatened flora species ecology and vegetation mapping ranging from the South Coast of NSW to Guyra in the north west and Port Macquarie on the north coast of NSW.

Debbie's strong botanical interests have been central in a number of important projects, these include major vegetation mapping projects in the south of Lake Macquarie, Minmi to the west of Newcastle, Ben Lomond (near Guyra), Oberon, North Arm Cove, Singleton and Bulahdelah. Her knowledge of non-parametric statistics, such as PATN statistical program has enabled RPS HSO to undertake large mapping projects using sound scientific methodology. Her knowledge of threatened flora species includes 2 years research on the threatened flora species *Tetratheca juncea*. Debbie's wide ranging knowledge and experience of Australian flora is a vital part of RPS HSO's ability to meet the consultation and regulatory needs of the development community.

APPENDIX C Offset Site Photographs





