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Hornsby Quarry

Road Construction Spoil Management project

Environmental Impact Statement

Volume 3: Appendices G to N

August 2015



Volume 3 – Appendices G to N

Appendix G	–	Technical Working Paper: Biodiversity
Appendix H	–	Technical Working Paper: Socio-Economic
Appendix I	–	Technical Working paper: Non-Aboriginal Heritage
Appendix J	–	Technical Working Paper: Aboriginal Heritage
Appendix K	–	Technical Working Paper: Greenhouse Gas and Climate Change
Appendix L	–	Draft Community Involvement Plan
Appendix M	–	Technical Working Paper: Groundwater
Appendix N	–	Discharge Water Quality Monitoring Data

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Appendix G

Technical working paper:
Biodiversity



Hornsby Quarry: Road Construction Spoil Management Project

Technical Working Paper: Biodiversity Assessment Report

Prepared for
Roads and Maritime Services of NSW

28 July 2015

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Contents

Executive summary	xi
1 Introduction	1
1.1 Project background	1
1.2 The project	2
1.3 Study area	2
1.4 Context of Biodiversity Assessment Report	3
2 Methodology	7
2.1 Background information	7
2.1.1 Assessment Guidelines	7
2.1.2 Database searches	7
2.1.3 Previous reports	7
2.2 Assessment methodology	9
2.2.1 Field surveys	9
2.2.2 Survey effort	12
2.2.3 Field study personnel	13
2.2.4 Limitations	13
3 Landscape features	17
3.1 IBRA bioregions and subregions	17
3.2 Mitchell Landscapes	17
3.3 Rivers, stream and estuaries	17
3.4 Wetlands	18
3.5 Groundwater dependent ecosystems	18
3.6 Ecological corridors	18
3.7 Landscape value score	19
4 Native vegetation	27
4.1 Plant Community Types (PCTs)	27
4.1.1 Sydney Blue Gum – Blackbutt – Smooth-barked Apple moist shrubby open forest on shale ridges of the Hornsby Plateau, Sydney Basin (PCT 1237)	27
4.1.2 Smooth-barked Apple - Red Bloodwood - Sydney Peppermint heathy open forest in sandstone gullies of western Sydney, Sydney Basin (PCT 1181 or HN586)	28
4.2 Other vegetation	28
4.2.1 Regeneration native	28
4.2.2 Regeneration exotic, weeds and exotics, cleared	29
4.3 Vegetation zone	31

5	Threatened species	33
5.1	Ecosystem credit species	33
5.1.1	Glossy Black-Cockatoo	34
5.1.2	Gang-gang Cockatoo (Endangered Population has a separate species credit listing).....	34
5.1.3	Little Eagle	34
5.1.4	Little Lorikeet	35
5.1.5	Masked Owl	35
5.1.6	New Holland Mouse	35
5.1.7	Powerful Owl.....	35
5.1.8	Barking Owl	36
5.1.9	Scarlet Robin	37
5.1.10	Sooty Owl	37
5.1.11	Square-tailed Kite	37
5.1.12	Swift Parrot	38
5.1.13	Varied Sittella.....	38
5.2	Species credit species	38
5.2.1	<i>Callocephalon fimbriatum</i> population in the Hornsby and Ku-ring-gai Local Government Areas43	
5.2.2	<i>Chalinolobus dwyeri</i> (Large-eared pied Bat)	43
6	Avoidance and mitigation measures	45
6.1	Avoidance of impacts	45
6.1.1	Alternate location	45
6.1.2	Utilising access tracks	45
6.1.3	Stockpiling location	45
6.1.4	Conveyor location	46
6.2	Mitigation measures	46
6.2.1	Standard mitigation measures	46
6.2.2	Project specific measures.....	47
7	Assessment of impacts	51
7.1	Direct impacts	53
7.1.1	Loss of vegetation and/or habitat	53
7.1.2	Weeds.....	53
7.1.3	Changes to hydrology.....	54
7.2	Indirect impacts	54
7.2.1	Pathogens and animal pests	54
7.2.2	Impact on relevant Key Threatening Processes.....	56
7.2.3	Wildlife connectivity and habitat fragmentation	57
7.2.4	Injury and mortality	57
7.3	Negligible impacts	58
7.3.1	Bushfire.....	58

7.3.2	Noise, vibration and light	58
7.3.3	Groundwater dependent ecosystems.....	59
7.3.4	Aquatic impacts	59
8	Impact summary and offsets	61
8.1	Areas not requiring assessment or offsets	61
8.2	Ecosystem and species credits requiring offsets	61
8.3	Impacts requiring further consideration	62
9	Summary and biodiversity credit report	65
	References	69
	Appendix A Likelihood of occurrence	75
	Appendix B Plot and transect field data	93
	Appendix C Plot and transect field data sheets.....	95
	Appendix D Flora species recorded	97
	Appendix E Fauna species recorded	101
	Appendix F Anabat survey results	103
	Appendix G Hollow- bearing tree survey results	109
	Appendix H Study area description	115
	Appendix I EPBC Act Significant Impact Criteria	123
	Appendix J FBA Methodology and where addressed in document.....	135

List of figures

Figure 1: Location map.....	4
Figure 2: Site map	5
Figure 3: Field survey locations.....	15
Figure 4: IBRA regions and subregions and drainage lines.....	22
Figure 5: Mitchell Landscapes.....	23
Figure 6: Assessment circles	24
Figure 7: Connectivity assessment	25
Figure 8: Native vegetation and PCTs within study area	32
Figure 9: Final project footprint.....	52
Figure 10: PCTs and species polygons requiring offsets.....	63
Figure 11: Call profile for <i>Chalinolobus gouldii</i> recorded at site 2, Hornsby Quarry at 04:09 on 16 December 2014.....	105
Figure 12: Call profile for <i>Chalinolobus gouldii</i> / <i>Mormopterus ozimops ridei</i> (species 2) recorded at site 1, Hornsby Quarry at 04:04 on 16 December 2014	106
Figure 13: Possible call profile for <i>Chalinolobus morio</i> recorded at Hornsby Quarry at 22:46 on 17 December 2014.....	106
Figure 14: Call profile for <i>Myotis macropus</i> / <i>Nyctophilus</i> spp. recorded at Hornsby Quarry at 02:01 on 16 December 2014. Also shown is an unknown call at 15kHz	107
Figure 15: Call profile for <i>Falsistrellus tasmaniensis</i> / <i>Scoteanax rueppellii</i> / <i>Scotorepens orion</i> recorded at Hornsby Quarry at 21:56 on 15 December 2014	107
Figure 16: Call profile for <i>Vespadelus vulturnus</i> recorded at Hornsby Quarry at 19:20 on 17 December 2014.....	108
Figure 17: HBT Locations.....	113

List of tables

Table 1: Summary of survey effort	12
Table 2: Personnel and qualifications	13
Table 3: Area of vegetation in each assessment circle	19
Table 4: Linkage width classes before and after development	20
Table 5: Condition of vegetation within the assessment circle before and after development	20
Table 6: Vegetation in the study area	30
Table 7: Vegetation zones and plot requirements.....	31
Table 8: Ecosystem credit species on development site	33
Table 9: Geographic and habitat questions and answers	39
Table 10: List of candidate species credit species and second filtering step	39
Table 11: Avoidance and mitigation measures	48
Table 12: Noxious weed species encountered in study area.....	53
Table 13: Known and potential Key Threatening Processes and impacts on biodiversity.....	56
Table 14: PCTs requiring offset and ecosystem credits	61
Table 15: Species requiring offset and credits required	61
Table 16: Native flora species list recorded during the field survey	97
Table 17: Exotic species list recorded during the field survey	99
Table 18: Fauna species list recorded during the field survey	101
Table 19: AnaBat results from 15 December 2014 at Hornsby Quarry, Site 1	104
Table 20: AnaBat results from 15 December 2014 at Hornsby Quarry, site 2.....	104
Table 21: AnaBat results from 17 December 2014 at Hornsby Quarry, site 3.....	105
Table 22: Location of FBA methodology requirements for a 'Biodiversity Assessment Report' for stages 1 and 2 and where these are addressed in this report.....	135

Abbreviations

Abbreviation	Description
CEEC	Critically Endangered Ecological Community
CMA	Catchment Management Authority
DotE	Commonwealth Department of the Environment (formerly SEWPaC)
DSEWPaC	Commonwealth Department of Sustainability, Environment, Water, Population and Communities (now DotE)
EEC	Endangered Ecological Community
ELA	Eco Logical Australia Pty Ltd
EP&A Act	<i>Environmental Planning and Assessment Act 1979</i>
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i>
FBA	Framework for Biodiversity Assessment
FM Act	<i>Fisheries Management Act 1994</i>
GDE	Groundwater Dependent Ecosystem
I&I NSW	Industry and Investment NSW
IBRA	Interim Biogeographic Regionalisation for Australia
LGA	Local Government Area
MNES	Matters of National Environmental Significance
NPWS	NSW National Parks and Wildlife Service (part of OEH)
NSW Department of Planning and Environment	NSW Department of Planning and Environment, formerly the Department of Planning and Infrastructure
NW Act	<i>Noxious Weeds Act 1993</i>
OEH	NSW Office of Environment and Heritage (formerly Department of Environment Climate Change and Water, DECCW)
SEARs	Secretary's Environmental Assessment Requirements
TEC	Threatened Ecological Community
TSC Act	<i>Threatened Species Conservation Act 1995</i>
VIS	Vegetation Information System

Key terminology

Terminology	Description
BioBanking	A methodology developed by Office of Environment and Heritage (OEH) which provides a transparent, consistent and scientifically-based set of rules to assess biodiversity values. The BioBanking Assessment Methodology provides rules for the number and type of credits that can be created from undertaking conservation management at a biobank site. The methodology also provides rules for the number and type of credits that a development site will require in order to offset its impacts and thus improve or maintain biodiversity values. This project has used the Major Projects Offset Policy and Framework for Biodiversity Assessment (FBA) to assess the number and type of biodiversity credits required (see below).
Clearing	The removal of vegetation or other obstacles at or above ground level.
Project footprint	The area directly impacted upon by the project. 'Project footprint' is used in this technical working paper as an alternative to 'subject site' as defined by DEC (2004). The project footprint includes all components relating to the project including (but not limited to): • All excavations/construction, including ancillary equipment. • All stormwater/sediment control measures. • All access requirements. • All spoil and material storage areas.
Direct impacts	Those that directly affect species, populations or ecological communities and their associated habitats. Direct impacts include, but are not limited to, loss of individuals or ecological communities and removal of suitable habitat.
Earthworks	All works involved in loosening, excavating, placing, shaping and compacting soil or rock.
Framework for Biodiversity Assessment	The Framework for Biodiversity Assessment (FBA) is a tool that is applied by accredited ecological consultants. It provides a step by step method to identify and assess impacts on biodiversity. The FBA provides clear guidance on avoiding and minimising the biodiversity impacts of a project. It also provides an objective and repeatable method for determining offset requirements before a development application is submitted.
Hornsby Quarry	The former Hornsby Quarry at Lot 1 DP 926103 and Lots A, B, C, D and E DP 318676, located around one kilometre north-west of Hornsby central business district. The site that may be used as a site for spoil management for spoil generated from the NorthConnex project. Site infrastructure to support spoil management at the quarry would include a conveyor, truck loading area, spoil disposition mound, access and internal roads.

Terminology	Description
Indirect impacts	Those which occur when project-related activities affect species, populations or ecological communities in a manner other than direct loss. Indirect impacts include loss of individuals through starvation, exposure, predation by domestic and/or feral animals, loss of breeding opportunities, loss of shade/shelter, hydrological changes, increased soil salinity, erosion, weed invasion, increased noise and/or light, or increased human activity within or directly adjacent to sensitive habitat areas which include sites of known threatened species, endangered ecological communities or features that are potential habitat for threatened species e.g. culverts.
Locality	The locality is defined by a 10 kilometre radius around the study area for the purposes of conducting database search.
M1 Pacific Motorway interchange	The current interchange between the Pacific Highway and the M1 Pacific Motorway at Wahroonga.
Primary habitat	For the purposes of this technical working paper primary habitat for threatened species are those areas or resources that may be used or required by threatened species for breeding or roosting purposes.
SEARs	Secretary's Environmental Assessment Requirements. Requirements and specifications for an environmental assessment prepared by the Secretary of the NSW Department of Planning and Environment under the <i>Environmental Planning and Assessment Act 1979</i> .
Secondary habitat	For the purposes of this technical working paper secondary habitat for threatened species are those areas or resources that may be used by threatened species for foraging purposes.
Site establishment works	Preliminary works carried out prior to carrying out of the project, including: • Installation of environmental controls. • Vegetation clearing. • Establishment of construction facilities. • Road works to Bridge Road and internal access tracks. • Initial dewatering of the quarry void. • Construction of the conveyer.
Spoil	Surplus excavated material. which is either Excavated Natural Material (ENM) or Virgin Excavated Natural Material (VENM)
Stockpile	Temporarily stored materials such as soil, sand, gravel and spoil/waste.
Study area	The area of ecological survey investigation for this technical working paper. The study area can be seen in Figure 1 .
The project	The spoil management facility project, as described in Section 1.1 .

Executive summary

Roads and Maritime is seeking approval under Part 5.1 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) for the use of Hornsby Quarry as a site for handling, management and beneficial reuse of spoil generated by road construction (the project), from the NorthConnex motorway linking the M1 Pacific Motorway at Wahroonga to the Hills M2 Motorway at West Pennant Hills in northern Sydney.

The majority of the project takes advantage of previously cleared areas and the Quarry void. Opportunities to further avoid impacts in the design have also been explored, and as a result of investigations for this assessment, the following ecological values have been avoided:

- The majority of Blue Gum High Forest present at the site, which is listed under the NSW *Threatened Species Conservation Act 1995* (TSC Act) as a critically endangered ecological community (CEEC)
- Habitat for Varied Sittella, which is listed as vulnerable under the TSC Act

The assessed project footprint covers all the areas required for the project, including excavation, spoil stockpiling and placement, machinery and access roads (where road works are proposed). The assessment utilised both desktop analysis and field assessment, using the Framework for Biodiversity Assessment methodology to assess habitat and condition of ecological communities. Targeted survey was conducted for one threatened flora species. Potential indirect impacts that have been considered include disruptions to ecological connectivity, injury and mortality to flora and fauna, weeds, pathogens, hydrological changes, noise, vibration and light.

The project design and project footprint of the project, as assessed in this technical working paper, represents the preferred design for the project. Sufficient flexibility has been provided in the design to allow for refinement during detailed design, or to minimise environmental impacts, or in response to submissions received during the exhibition of the environmental impact statement. As such, the ecological impacts assessed as part of this technical working paper represent a worst case scenario.

A total of 1.64 hectares of direct impacts on native vegetation associated with the proposed project footprint have been identified (see **Table 11**) comprising:

- 0.06 hectares of Blue Gum High Forest (CEEC TSC Act).
- 0.84 hectares of Sandstone Blackbutt Woodland.
- 0.74 hectares of native regeneration.

Blue Gum High Forest has been identified in the study area. Although these stands satisfy the definition for the CEEC under the TSC Act, none of the patches that would be impacted by the project met the EPBC Act definition which has a narrower definition for condition. The Blue Gum High Forest impacted was in “poor” condition due to exotic species, such as privet and lantana.

A total of 21 hollow bearing trees were present, supporting a total of 44 hollows. No trees had very large hollows of a sufficient size to support breeding and roosting for large forest owls. Up to eight trees with hollows would be removed or lopped, accounting for 12 hollows of a range of sizes that provide potential habitat for threatened microbats and other hollow dependent fauna.

The project has substantially avoided biodiversity impacts by utilising, as much as possible, already disturbed sites and taking advantage of existing tracks. A number of mitigation measures to minimise ecological impacts would be implemented as part of the project in line with Roads and Maritime Biodiversity Guidelines – *Protecting and managing biodiversity on RTA projects* (Roads and Traffic Authority 2011). These measures would be detailed in the flora and fauna management plan for the project which includes: site-specific environmental induction; identification of clearing limits and protective fencing; vegetation clearance procedure; pre-clearing surveys; reuse of topsoil and habitat elements; erosion and sediment control; weed management; pathogen management and monitoring.

This Biodiversity Assessment Report assessed the type and quantum of credits as a result of the project using the Framework for Biodiversity Assessment (FBA) methodology to quantify the impacts of the proposal. Due to the small area of Blue Gum High Forest to be impacted, there is a requirement to merge the vegetation zone with the other native vegetation impacted by the project. Therefore these calculations identified the following quantum of offsets for the project:

- Total of 30 ecosystem credits consisting of Sandstone Blackbutt Woodland (PCT 1181 or HN586)
- 33 credits for the endangered population of the Gang-gang Cockatoo in the Hornsby and Ku-ring-gai local government areas.

It is anticipated that where possible offsets would be delivered via BioBanking Agreement(s), which provide for 'in perpetuity' ecological management of the offsets. Other options for delivery of some offsets may be pursued where BioBanking credits cannot be obtained or are not practicable to meet project or conservation objectives. There is a clear commitment to undertake an offset strategy consistent with the offset strategy for the NorthConnex project. This would be prepared to compensate for the loss of native vegetation, endangered ecological communities and threatened species habitat which cannot be avoided or mitigated.

An assessment of the potential impacts on groundwater dependent ecosystems and aquatic habitats concluded there would be no significant impact as a result of filling the quarry void and removing some vegetation. This is because the ground water levels in the void are far lower than the root zone of any of the vegetation to be removed. The water in the void has little value as a 'lake' and is largely disconnected from natural watercourses. There is likely to be no significant impact to aquatic fauna listed under the *Fisheries Management Act 1994*.

Native vegetation, in particular Blue Gum High Forest, that would be potentially impacted by the project does not meet EPBC Act condition criteria. Habitat for some threatened flora and fauna species listed under the EPBC Act would be impacted, but these impacts are expected to be minor in nature and not considered likely to be significant and it is therefore considered that a referral to the Commonwealth Department of the Environment (DotE) is not required.

1 Introduction

1.1 Project background

Roads and Maritime Services (RMS) is seeking approval under Part 5.1 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) for the use of Hornsby Quarry as a site for handling, management and beneficial reuse of spoil generated by road construction (the project) from the NorthConnex project.

On 13 January 2015 RMS received approval under Part 5.1 of the EP&A Act to construct and operate the NorthConnex project, a multi-lane tolled motorway linking the M1 Pacific Motorway at Wahroonga to the Hills M2 Motorway at the Pennant Hills Road interchange at Carlingford in northern Sydney. The Environmental Impact Statement (EIS) exhibited for the NorthConnex project identified that approximately 2.6 million cubic metres of spoil would be generated during the construction of the project. The NorthConnex EIS also identified a number of potential spoil management location options, with the final option(s) to be determined at the construction stage. Following design development, the Hornsby Quarry site has now been identified as one of the preferred options for the management of spoil generated during road construction from late 2015.

The Hornsby Quarry site is not currently the subject of a development approval that would permit handling, management and beneficial reuse of spoil at that site. Therefore, assessment and approval is being pursued in accordance with the EP&A Act. The Secretary's Environmental Assessment Requirements (SEARs) for the project were issued on 2 July 2015 and included a requirement to undertake an assessment of potential impacts of the project on biodiversity values. This Biodiversity Assessment Report has been prepared to inform the EIS being prepared for the Hornsby Quarry Road Construction Spoil Management Project.

The SEARS outlined the requirements to assess impacts to biodiversity and specifically stated that:

- an assessment in accordance with the Framework for Biodiversity Assessment, unless otherwise agreed by OEH, by a person accredited in accordance with s142B(1)(c) of the *Threatened Species Conservation Act 1995* (TSC Act)
- This includes a requirement for a Biodiversity Assessment Report and a Biodiversity Offset Strategy.

This report satisfies the requirement to produce a Biodiversity Assessment Report in accordance with the TSC Act. It is noted that Appendix J provides details of how this report meets the layout and requirements of a Biodiversity Assessment Report, as specified in Table 20 (stage 1) and 21 (stage 2) of the Framework for Biodiversity Assessment. The accredited assessor was Dr Steven Ward (accreditation number 0039).

Although not included at this stage, there is a clear commitment from Roads and Maritime to develop an offset strategy consistent with that being implemented for the NorthConnex project.

No additional matters for further consideration were recommended by the NSW Office of Environment and Heritage.

1.2 The project

The Hornsby Quarry site would receive up to 1.5 million cubic metres of excavated natural material (ENM) and/ or virgin excavated natural material (VENM) from tunnelling and excavation activities at the approved NorthConnex construction sites. Only ENM and/ or VENM would be received and reused at the Hornsby Quarry site.

Key features of the project would include:

- Widening and sealing of the quarry access road (Bridge Road and track) to facilitate all weather access.
- Clearing and grubbing, and establishment of erosion and sediment controls.
- Establishment of a compound site, security fencing and signage around the project area.
- Dewatering of the quarry void (to be undertaken by Hornsby Shire Council in accordance with its existing groundwater licence) to a suitable level that allows working within the void.
- Construction of a conveyor from the stockpile site to the rim of the quarry void.
- Spoil haulage by truck from the NorthConnex construction sites to the Hornsby Quarry site over a period of approximately 28 months.
- Stockpiling of spoil within the Hornsby Quarry site using dozers and wheel loaders.
- Transport of the spoil via the conveyor from the stockpiles to the rim of the quarry void, where the spoil would fall directly into the void.
- Spreading and grading of the spoil on the quarry floor.
- Site demobilisation and rehabilitation of the compound site, stockpile areas and the conveyor corridor to a condition resembling pre-commencement condition, as agreed to with Hornsby Shire Council.

The project is anticipated to commence in late 2015 and is expected to take around 33 months to complete.

1.3 Study area

The Hornsby Quarry site is located off Bridge Road on the western side of the Hornsby town centre. The quarry site covers approximately 35 hectares and is owned by Hornsby Shire Council (**Figure 1**). The quarry site comprises a quarry void, internal access roads and a cleared area to the east which is likely to have been used as processing areas when the quarry was operational. Disused facilities associated with the previous quarrying operations remain on the site, including concrete office block buildings, a crushing and screening plant, a pipeline, security fencing and gates.

Whilst the quarry site is zoned for public recreation (RE1) under the Hornsby Local Environmental Plan 2013, the quarry void itself is unsafe for public access given the steep sides and flooded nature of the void. Hornsby Shire Council currently maintains exclusion fencing around the void to prevent public access for public safety reasons. The areas outside of the void exclusion fencing are open to public access including mountain bike trails which have been established across the site by Council. However, until the quarry void is filled, full rehabilitation of the site for recreational purposes is not possible. The quarry site and surrounds are densely vegetated with some cleared areas comprising the void itself, internal access roads and an area to the east which are likely to have been used as processing areas when the quarry was operational. Dense bushland comprising the Berowra Valley National Park occurs directly to the west.

The quarry site is bounded by a Crown Reserve to the south, vegetated area of the Hornsby Rifle Range and the Berowra Valley National Park to the west, residential dwellings to the north and a TAFE campus to the east. The quarry site also includes vegetated areas to the east abutting the urban interface as well as a square pocket which falls inside urban extent. The vegetation surrounding the quarry site would potentially be at the eastern end of a wildlife corridor given its connectedness to the Berowra Valley National Park.

The designated “study area” is a portion or subset of the quarry site (**Figure 1**). It is noted that some ecological investigation works were undertaken within the broader quarry site prior to the study area being nominated. Plot and transect data collected from the broader quarry site which was collected previously has been utilised as it helps to inform the ecological assessment of the works. This data is still relevant to the nominated study area as the vegetation was mapped in a consistent manner.

The project footprint is a portion or subset of the study area (**Figure 2**). The project footprint has the same meaning as ‘development site’ in accordance with the FBA.

1.4 Context of Biodiversity Assessment Report

The NSW Government has developed a NSW Biodiversity Offsets Policy for Major Projects, including State Significant Development (SSD) and SSI. As part of an application for a Major Project under the EP&A Act, a proponent must prepare an EIS that addresses the SEARs provided by the NSW Department of Planning and Environment (DP&E).

Under the NSW Biodiversity Offsets Policy for Major Projects, the SEARs require the Framework for Biodiversity Assessment (FBA) to be applied to assess impacts on biodiversity. The FBA outlines the assessment methodology to quantify and describe the biodiversity values on the development site, and the biodiversity offsets required for any unavoidable impacts.

The FBA negates the need to conduct Assessments of Significance (7-part tests) under the NSW *Threatened Species Conservation Act 1995* (TSC Act). However, the FBA requires proponents to identify and assess the impacts on all *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) listed threatened species and ecological communities that may be on the development site. These have been assessed in **Appendix I** according to EPBC Act impact assessment processes.

The FBA applies only to terrestrial impacts. Section 115ZG of the EP&A Act states that permits under section 201, 205 or 219 of the *Fisheries Management Act 1994* do not apply to State significant infrastructure. These permits relate to dredging work, harm to marine vegetation and blocking of fish passage. However, potential impacts on freshwater aquatic environments and Groundwater Dependent Ecosystems (GDEs) have been considered in this assessment. Hornsby Shire Council also has a licence to extract water from the quarry void, and thus these works would be carried out under that licence.

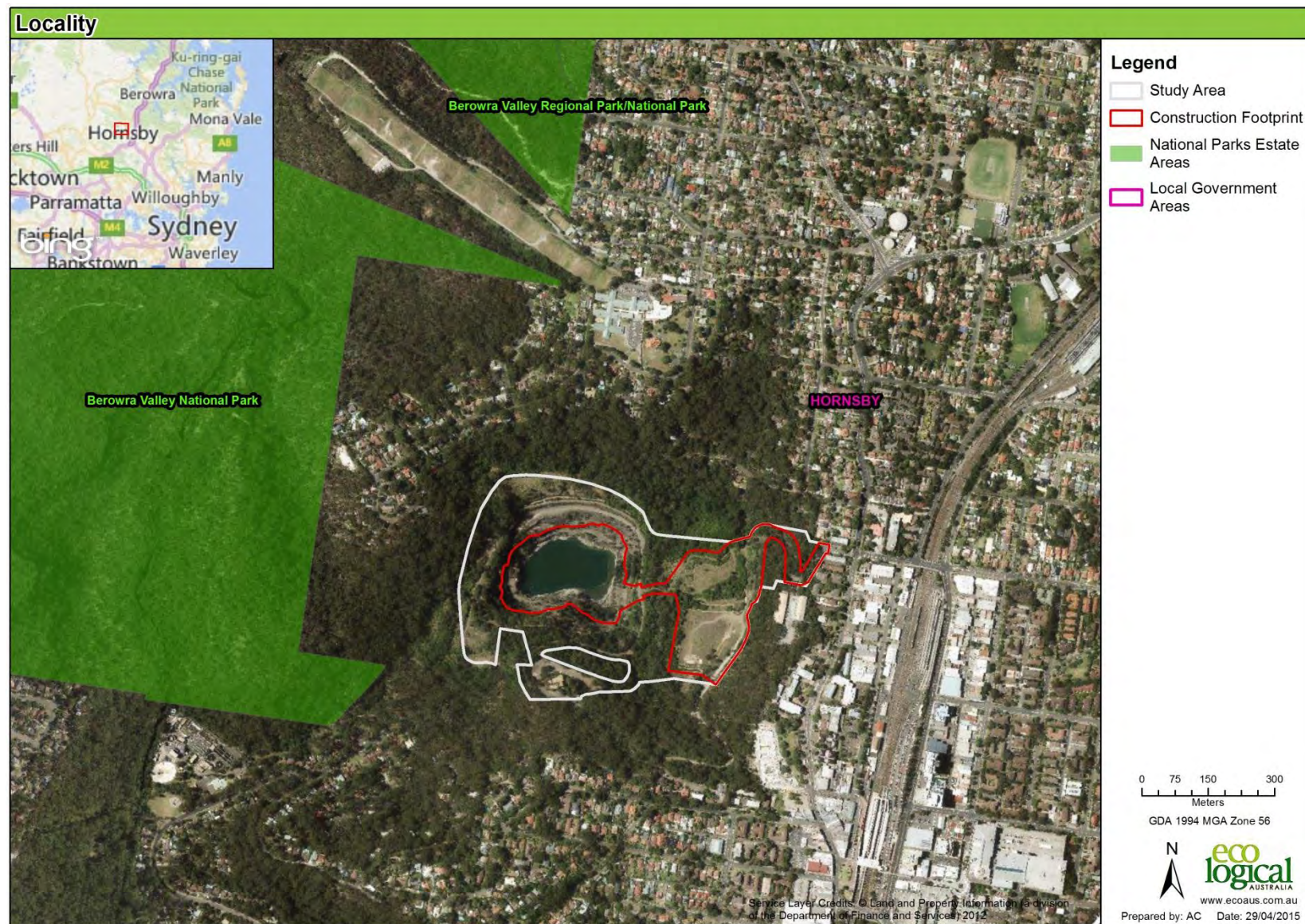


Figure 1: Location map

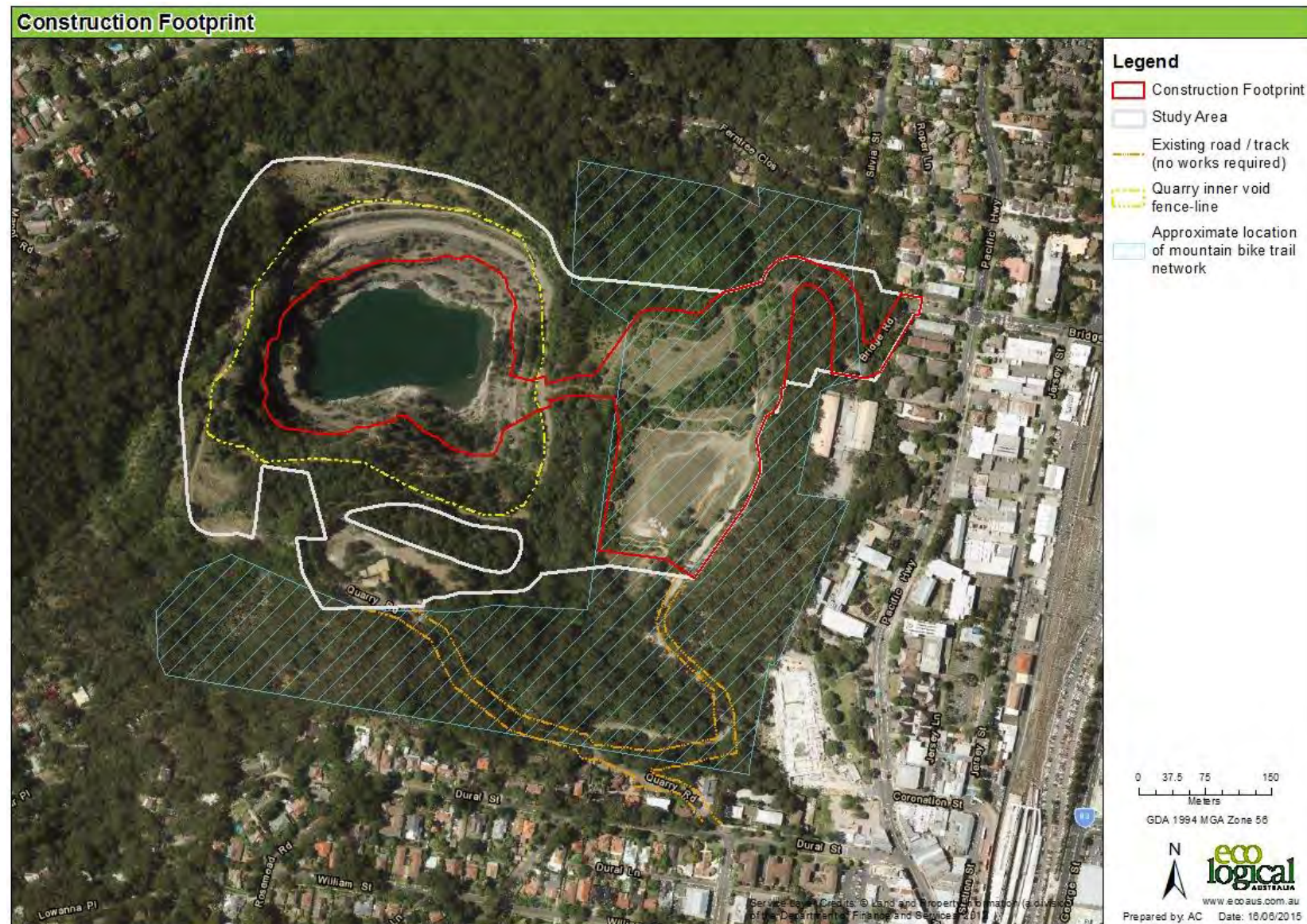


Figure 2: Site map

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2 Methodology

2.1 Background information

A number of database searches, aerial photograph, previous reports and studies were used in this assessment, including:

2.1.1 Assessment Guidelines

The assessment presented in this technical working paper was undertaken in accordance with the survey guidelines specified by the SEARs. Updated versions of the guidelines were used if available and were confirmed with Department of Planning and Environment. These include:

- Policy and guidelines for fish habitat conservation and management (update 2013). This guideline supersedes the Guidelines for Aquatic Habitat Management and Fish Conservation (DPI 2013).
- NSW offset policy for major projects (State significant development and State significant infrastructure) (OEH 2014a).
- NSW Framework for Biodiversity Assessment (OEH 2014b).

2.1.2 Database searches

ELA reviewed aerial photography as well as the following vegetation and soil datasets which overlap within the study area:

- Hornsby Shire Council vegetation mapping (Smith and Smith 2008).
- Western Sydney vegetation mapping (NSW National Parks and Wildlife Service (NPWS 2002).
- Soil Landscapes of the Sydney 1:100,000 Sheet (Chapman and Murphy 1989).

Mapping for Hornsby local government area (Smith and Smith 2008) provides detailed and recently validated vegetation mapping. However this mapping is primarily limited to areas of intact native vegetation and does not attempt to map fragmented vegetation located within urban areas, such as that which occurs within parts of the study area. Smith and Smith (2008) mapping was used as a primary data set, supplemented by NSW NPWS 2002 mapping. Both of these data sets were combined and then validated and refined in the field.

The following threatened species and predicted species databases were reviewed for the locality:

- OEH Atlas of NSW Wildlife (10 kilometre radius search), accessed 19 March 2015.
- EPBC Act Protected Matters Search Tool (10 kilometre radius search) (DotE 19 March 2015).
- NSW DPI Fisheries threatened and protected species records viewer (Hornsby LGA) (FM Act), accessed 19 March 2015
- NSW DPI Fisheries Key Fish Habitat Map (Hornsby LGA), accessed 19 March 2015

2.1.3 Previous reports

- Former CSR Quarry Hornsby & associated lands (PSM 2007).
- Hornsby Quarry and Environs Land Capability Study and Master Plan, Master Plan Report (Parsons Brinckerhoff 2004).
- Review of Options for Filling Hornsby Quarry, Discussion Paper (GHD 2009).
- Hornsby Quarry Land Filling Preliminary Impact Assessment (Cardno 2013)
- Review of Environmental Factors Old Mans Valley and Hornsby Park Proposed Mountain Bike Trail (Dragonfly Environmental 2011)

- Targeted Surveys for the Varied Sittella and Supplementary s5A Assessments, Proposed Mountain Bike Trail Sire, Old Mans Valley, Hornsby (Aquila Ecological Surveys 2011).

Former CSR quarry Hornsby & associated lands (PSM 2007)

Pells Sullivan Meynink Pty Ltd undertook a geotechnical and hydrogeological constraints analysis to inform development of the Hornsby Quarry.

The findings of the study have identified that the quarry sidewalls are susceptible to instability and therefore limit the development potential of the quarry. Remedial options were proposed to remove the risk posed by the quarry walls, namely:

- Backfilling the quarry with natural material.
- A combination of backfilling the quarry and cutting back (flattening) the upper quarry walls.
- Supporting the walls with a combination of drainage holes, rock bolts, shotcrete, mesh and scaling.

Hornsby Quarry and Environs Land Capability Study (Parsons Brinckerhoff 2004)

Council engaged Parsons Brinckerhoff (PB) to undertake a land capability study and master plan to identify the study area's opportunities and constraints and define its future landuse and management needs.

The study concluded that the area has the capacity to accommodate a mix of land uses that relate sensitively to its context in an urban environment within a natural setting. As the study area is visually and physically disconnected from its adjoining urban environment, new land uses must integrate with its context and provide appropriate access to encourage traffic and pedestrian circulation both to and within the study area.

The study noted that there were a range of constraints including ecological constraints which were confined largely to the Blue Gum High Forest (defined as Glen Forest in the PB report). The Parsons Brinckerhoff (2004) report included a map of ecological constraints and did not provide a vegetation map.

Review of Options for Filling Hornsby Quarry, Discussion Paper (GHD 2009)

GHD undertook a review of two options for the rehabilitation and utilisation of Hornsby Quarry:

- Filling the quarry with non-putrescible solid waste.
- Filling the quarry with Virgin Excavated Natural Material (VENM).

The GHD report did not make a recommendation of either options. However they noted the higher cost of approvals, site preparation, site operation, post closure management and carbon pollution for the non-putrescible solid waste option than the VENM option. The report noted a higher royalty to be paid to the Council with the non-putrescible waste than the VENM option. The royalty figures were redacted in the report reviewed.

Hornsby Quarry Land Filling Preliminary Impact Assessment (Cardno 2013)

Cardno was appointed by Hornsby Shire Council to secure approvals for the filling of Hornsby Quarry. Council requested that Cardno provide a preliminary evaluation of the environmental, social and economic impacts that can be expected during quarry filling.

The report determined that the best way to achieve this outcome is for the site to receive VENM spoil and use this spoil to fill the quarry to approximately reduced level (RL) 90metres Australian Height Datum (AHD).

A flora and fauna evaluation was undertaken which identified Blue Gum Diatreme Forest as being present within the study area. Blue Gum Diatreme Forest is a component of Blue Gum High Forest under the TSC Act.

Review of Environmental Factors Old Mans Valley and Hornsby Park Proposed Mountain Bike Trail (Dragonfly Environmental 2011)

Dragonfly Environmental were engaged by Council to determine whether the proposed construction and use of a mountain bike trail network would significantly impact biodiversity values within the quarry site. Dragonfly relied on the previous ecological constraints mapping conducted by Parsons Brinkerhoff (2004) and the mapping for the Hornsby local government area (Smith and Smith 2008). They concluded no significant impact to the Blue Gum High Forest as a result of the trail construction. They concluded no significant impact for five threatened flora, none of which they found at the site.

Dragonfly conducted assessments for nine threatened fauna. They concluded no significant impact for all of these fauna. One species, Varied Sittella was listed as being present in an area between Quarry Road and the void. This conclusion was based on targeted survey and impact assessment for the Varied Sittella by Aquila Ecological Surveys (2011), which is briefly reviewed below.

Targeted Surveys for the Varied Sittella and Supplementary s5A Assessments, Proposed Mountain Bike Trail Sire, Old Mans Valley, Hornsby (Aquila Ecological Surveys 2011)

Aquila Ecological Surveys was engaged by Council to conduct a targeted survey for the Varied Sittella to determine if it was present in the quarry site. The survey and assessment were carried out to determine if there was a significant impact likely due to the mountain bike trail construction.

Aquila detected the Varied Sittella on one occasion. They found that habitat for this species was limited at the quarry due to the presence of the Noisy Miner. The Noisy Miner is an aggressive species that can outcompete other native forest and woodland birds. They concluded no significant impact was likely as a result of the track construction.

The report found that much of site was suitable foraging habitat for a range of large forest owls. They did not detect any threatened owl species during their surveys. They did not carry out targeted surveys for the range of large forest owls potentially occurring in the study area. Rather Aquila assumed presence based on knowledge of habitat requirements. Aquila noted that the large forest owl species were likely to use the site as part of their foraging territories. They assumed the foraging territory was likely to be in the range of 1000 hectares or more.

2.2 Assessment methodology

The assessment presented in this report paper was undertaken in accordance with the survey guidelines specified by the SEARs, which is outlined in **Section 2.1.1**. In addition, the number of vegetation plot/transects utilised in this assessment meets or exceeds the FBA minimum number of plots required (OEH 2014b).

2.2.1 Field surveys

ELA employed a series of field survey methods to undertake the field assessment of the biodiversity values of the study area. The surveys conducted considered the relevant survey guidelines for various threatened species. In a number of instances data from previous surveys was utilised to build on ecological information to inform this assessment. These are identified in **Section 2.1.3**. If information was not available on whether or not threatened species occurred within the study area, then a precautionary approach was adopted, whereby the presence of the species was assumed. This approach is consistent with the SEARs, FBA, and relevant impact assessment guidelines.

The methods used and rationale behind their selection is described below, with field survey locations shown in **Figure 3**. Assessment of vegetation mapping: verification of vegetation communities occurring within the study area to confirm the presence of natural vegetation communities including presence of threatened ecological communities. Where the study site was not covered by the Smith and Smith (2008) vegetation mapping, other mapping sources were used (NPWS 2002). Once vegetation communities were identified from a combination of floristic surveys and transect traverses, plant community types (PCT) were assigned to vegetation mapping units from the published PCTs for the Hawkesbury Nepean Catchment Management Authority (CMA). This was done by comparing the dominant canopy species recorded through the traverses or floristic surveys, the general description of location, soil type and other attributes as described in the profiles (OEH 2015a) and OEH online VIS classification database (OEH 2015b).

- Vegetation polygons assigned to the 'moderate-good' condition category were also assigned to a sub-condition class of poor, moderate or good:
 - Poor condition vegetation had predominantly exotic species in the mid storey and ground cover layers, with very few native species in any stratum.
 - Moderate condition vegetation had predominantly native species in the mid storey and ground cover layers but had some exotic incursions.
 - Good condition vegetation had very few exotic species in any stratum and were predominantly native and species diverse.
- Biometric plots using the methodology described in the FBA. These plots were undertaken in accordance with the FBA. These plot / transect plots include a 20 metre by 20 metre full floristic plot (described below) and a 20 metre by 50 metre plot identifying number of hollow bearing trees and length of fallen wood. They also include 50 metre transect to collect data on canopy cover, midstorey cover, and ground cover for native and exotic species.
- Floristic surveys as part of the plot / transect survey plots (20 metre by 20 metre quadrats) Where a 20 metre by 20 metre quadrat could not fit into a patch of vegetation, e.g. adjacent to a track, 40 metres by 10 metres quadrats were used. Quadrats of these dimensions were required in poor condition vegetation adjacent to Bridge Road.
- Random meander survey technique (Cropper 1993) for threatened flora species: targeted searches for threatened species potentially occurring in the study area. This technique is used in preference to systematic, plot based surveys when attempting to detect threatened plants. Random meander in suitable habitat is more likely to detect threatened species than plot or transect based survey used in floristic surveys. This technique is considered preferable in terms of searching large areas of potential habitat and generally allows for greater area coverage than a plot based survey.
- Targeted threatened flora survey for *Genoplesium baueri*: Prior to the targeted survey in the study area, *G. baueri* was examined at two known reference sites in the northern Sydney region to confirm their flowering status and to also gain further familiarity with their microhabitat. The two reference sites were approximately ten kilometres from the study area. At both reference sites the plants observed consisted of a combination of plants in full flower, plants that had finished flowering but were still clearly visible, as well as numerous plants in early bud that were 1-2 weeks off flowering. The presence of numerous plants at all flowering stages confirmed that it was an ideal time to be targeting the species in northern Sydney. The species requires about six weeks to flower following heavy rainfall. There were several rainfall events in early to mid-December 2014 that provided suitable rainfall. It is thought that this rain triggered the flowering events at the two nearby reference sites.

On Monday 2 February 2015, Dr Lachlan Copeland and Dr Meredith Henderson spent approximately 12 hours targeting *Genoplesium baueri* at the study area. All areas that were considered potential habitat were searched. Areas that were more likely to contain the orchid were noted on a map for later targeted survey. Areas were ruled out on the basis of presence of dense woody weeds, slope, or incorrect soil type. Areas retained for targeted searches were deemed potential habitat. In the area classified as potential habitat, the two botanists walked a series of parallel transects approximately five metres apart carrying a handheld GPS which recorded the approximate location of the tracks walked. Even within the potential habitat there were still considerable areas that were highly unlikely to support the orchid on a fine-scale. These areas of poor habitat were typically areas with a high concentration of weeds or had a dense ground layer of ferns such as *Calochlaena dubia* (Rainbow Fern). These areas were generally searched more quickly so as to allow a more thorough search effort in the more open areas with suitable microhabitat. All areas thought to have any chance at all to support plants of *Genoplesium baueri* were searched thoroughly at a slow pace to as to allow any plants to be detected. The orchid survey was completed in accordance with the EPBC Act *Draft Threatened Orchid Survey Guidelines* (DotE 2013).

- Opportunistic sightings of fauna: identification of faunal species occurring within the study area. The fauna surveys undertaken by ELA consisted of opportunistic sightings whilst conducting other surveys i.e. targeted flora surveys, random meanders and transects. Evidence of fauna usage was noted, for example diggings, chewed plant cones, scats. No targeted fauna surveys were undertaken.
- Fauna habitat assessments identifying potential habitat for threatened fauna species, including marking of habitat features i.e. rock habitats and foraging substrates, presence of termite mounds. Presence of hollow bearing trees and coarse woody debris were recorded as part of the biometric plots. In the absence of fauna surveys, habitat assessments identify important habitat features that may provide potential habitat for threatened fauna. A hollow bearing tree survey was conducted by AECOM (2014) and additional hollow bearing tree survey was undertaken by ELA as part of surveys performed in 2015.
- Microchiropteran bat survey was performed by two ELA ecologists, Dr Meredith Henderson and Danielle Adams-Bennett, on the 15 and 17 December 2014. The survey involved performing a habitat search which involved traversing the site taking notes on vegetation types, presence of flyways, hollow-bearing trees and any other roosting habitats including any man-made structures that represent potential microchiropteran roosting habitat. Following the habitat survey two Anabat detectors were placed in four separate locations (**Figure 3**) over two separate nights on the 15 and 17 December 2014. Each Anabat device was programmed to begin recording prior to dusk at 1800hr and turn off the following morning at 0600hr. Bat calls were analysed by Danielle Adams-Bennett and reviewed by Alicia Scanlon of ELA who has seven years' experience in the identification of ultrasonic echolocation recordings, using the program AnalookW (Version 3.8 25 October 2012, written by Chris Corben, www.hoarybat.com). Call identifications were made using regional based guides to the echolocation calls of microbats in New South Wales (Pennay et al. 2004); and south-east Queensland and north-east New South Wales (Reinhold et al. 2001) and the accompanying reference library of over 200 calls from north-eastern NSW. Available: (<http://www.forest.nsw.gov.au/research/bats/default.asp>).
- Aquatic assessment was limited to freshwater fish (finfish and aquatic invertebrates) as defined in the FM Act. It did not assess the potential impacts to downstream environments due to discharging of water during dewatering (which commenced in 2013), which occurs under Council's existing licence. The databases and published material (**Section 2.1**) were reviewed to identify important habitat and threatened aquatic fauna that may occur in the greater catchment.

2.2.2 Survey effort

The survey effort was focused according to the vegetation communities and potential habitat for threatened flora and fauna species within the study area. A summary of the field survey effort for each survey method is provided in **Table 1**.

All surveys were diurnal surveys, except for the Anabat survey, and were conducted over five days, two days in December 2013, two days in December 2014 and one day in February 2015. The AECOM HBT survey was conducted in December 2013, over two days. Weather conditions were warm to hot for all survey periods. No significant rainfall was experienced during the survey period but significant rainfall fell prior to the December 2014 and February 2015 surveys.

Table 1: Summary of survey effort

Method	Person hours	Dates	Time of day	Weather
Floristic surveys	16	13 and 20 December 2013 15 and 17 December 2014	Morning and afternoon	Warm to hot and humid Warm to hot and humid
Biometric plots	20	20 December 2013 15 and 17 December 2014	Morning and afternoon	Warm to hot and humid Warm to hot and humid
Fauna habitat assessment	4*	13 and 20 December 2013 15 December 2014	Morning and afternoon	Warm to hot and humid Warm to hot and humid
Targeted flora survey for <i>G. baueri</i>	12	2 February 2015	Morning to early afternoon	Warm and humid
Anabat surveys – detectors set up, left overnight and collected the following morning	N/A	15 and 17 December 2014	Evening	Cool to mild
Hollow bearing tree survey	2 days	AECOM 17 and 20 December 2013	Day	Warm to hot
	20	15 and 17 December 2014	Morning to early afternoon	Warm to hot and humid
Aquatic surveys	16	December 2013 (for Old Mans Valley). Noted that access was not available to water in quarry void	Morning and afternoon	Warm to very hot

*Note: conducted concurrently with Biometric plots

2.2.3 Field study personnel

This assessment was carried out by appropriately qualified and experienced ecologists and environmental professionals as demonstrated in **Table 2**.

Table 2: Personnel and qualifications

Name	Role	Qualifications
Dr Steven Ward	Project Director	Ph.D., University of Western Sydney, 2002 Honours, University of Wollongong, 1999 BSc (Botany / Zoology), University of Western Australia, 1987 Accredited Biobanking and major projects assessor
Dr Meredith Henderson	Ecology assessment	PhD, Victoria University, Melbourne, 2003 BSc (Hons), University of Wollongong, 1991 Accredited Biobanking and major projects assessor
Dr. Lachlan Copeland	Targeted threatened flora survey and advice	PhD in plant systematics, University of New England , 2005 Bachelor of Natural Resources (Hons), University of New England, 1995
Ian Dixon	Aquatic Assessment	AUSRIVAS Accreditation (Australian River Assessment System), 2011 Master of Tropical Environmental Management, Charles Darwin University, 2006 Graduate Diploma of Tropical Environmental Management, Charles Darwin University, 2001 Bachelor of Landscape Architecture, 1999
Danielle Bennett-Adams	Ecology assessment	Bachelor of Animal Science- Major in Wildlife Studies, University Of Western Sydney, 2007
Ashlee Clarke	GIS Analysis and Mapping	Bachelor of Environmental Science, University of Wollongong

2.2.4 Limitations

Following significant rainfall events, access within the inner void fence, which includes both the quarry void and walls, is not permitted due to potentially unstable quarry walls. In December 2014 and February 2015, when the survey was undertaken, there had been significant rainfall events and thus access within the inner void fence was not available. This meant that the void walls could not be surveyed, and survey of the water in the void was not possible. Thus, these areas were subject to visual inspections due to site access restrictions. Species were noted where they could be identified and a qualitative assessment of condition was made by noting disturbance or presence of exotic species.

For flora species, surveys occurred during the time of year in which the potentially occurring threatened flora species are detectable.

A hollow bearing tree survey was conducted for the study area by AECOM (2014) to determine the number and extent of hollow bearing trees that may be important for hollow dependent fauna. Additional survey for hollow bearing trees was conducted by ELA in December 2014 to supplement the AECOM survey. All hollow bearing tree survey data referred to in this report is subject to the limitations stated in both AECOM (2014) and this report.

Locations of hollow bearing trees and plot locations were recorded with hand-held GPS units, which can have errors in the locations of up to 20 metres. Furthermore, traces of paths walked recorded using the handheld GPS units can often be sporadic or have greater errors in accuracy as the units can lose satellite reception due to not being in an optimal position, particularly in areas where foliage cover is high.

Survey effort for most fauna (excluding Anabat survey) consisted of incidental observations and habitat assessment. In the absence of targeted surveys for most threatened fauna species with the potential to occur within the proposed footprint, this technical working paper assumes the presence of the species and potential impacts are addressed in the mitigation section. On the basis that threatened species are present, the assessment and offset calculations adopt a worst case scenario.

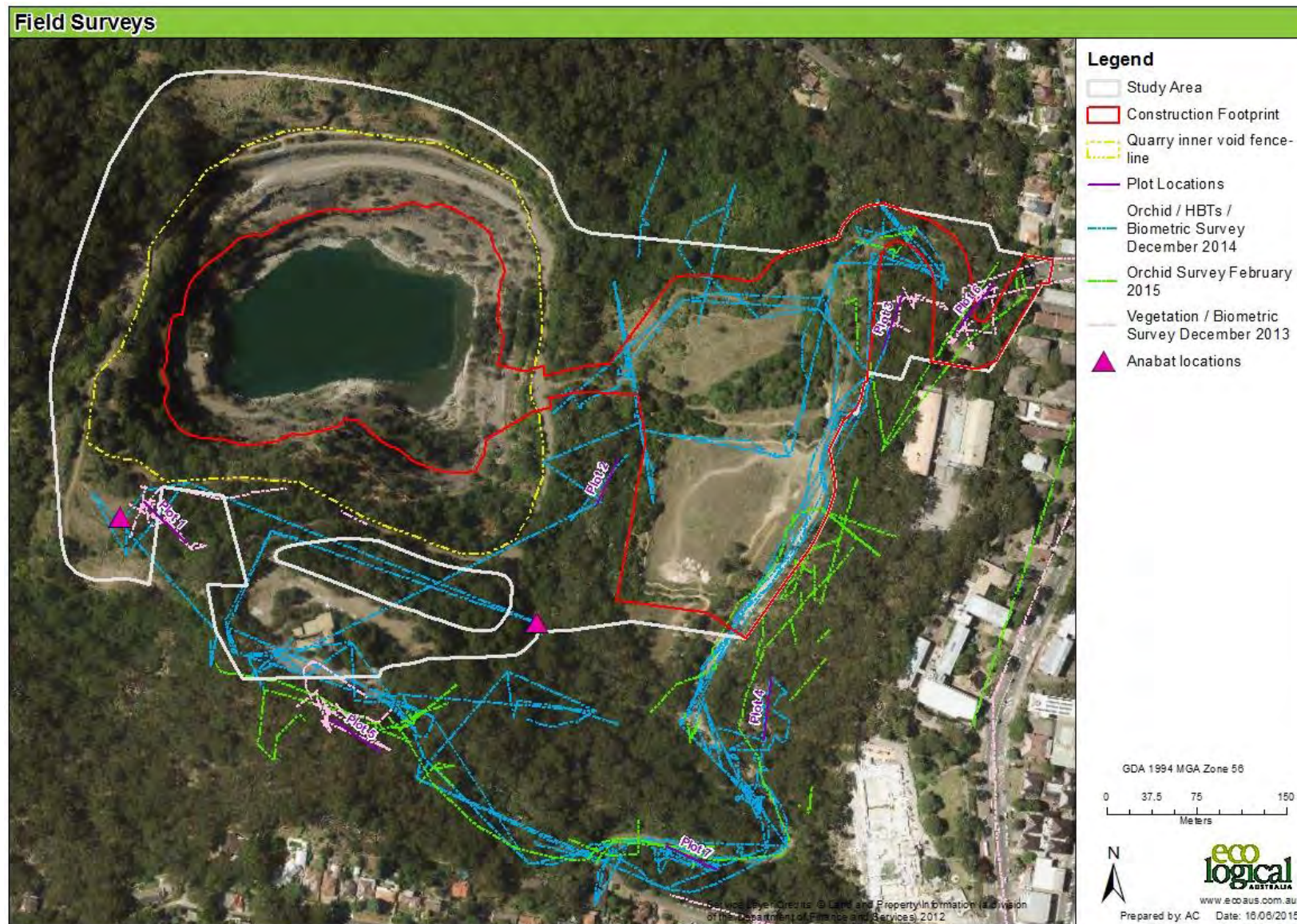


Figure 3: Field survey locations

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3 Landscape features

The study area is located within the Sydney Basin Bioregion which extends north to the Hunter Valley, west to Mudgee and south to Batemans Bay. The study area occurs within a highly urbanised setting surrounded by extensive areas of established urban development to the east, north and south. However, remnant vegetation occurs to the west within Berowra Valley National Park and Regional Park, and in close proximity to the study area itself.

The landscape features of the study area are shown in **Figure 4**.

3.1 IBRA bioregions and subregions

The area for assessment is contained wholly within the Sydney Basin Bioregion. The project footprint crosses two IBRA subregions, Pittwater and Cumberland. According to the FBA, *'the distribution of the species includes the IBRA subregion in which the development site... is, in the opinion of the assessor, mostly located'*. More of the project footprint occurs within the Cumberland IBRA subregion. This subregion was used for the 1000 hectare assessment circle (**Figure 4**).

3.2 Mitchell Landscapes

The project footprint is covered by three separate Mitchell Landscapes. The majority of the site is covered by Pennant Hills Ridges, with the remainder covered by Sydney Basin Hornsby and Sydney Basin Volcanics (Mitchell 2002) (**Figure 5**). The Pennant Hills Ridges Mitchell Landscape was entered into the calculator.

3.3 Rivers, stream and estuaries

The quarry pit is characterised by deep open water, steep walls (banks) and rocky substrate. It lacks natural ecosystem processes that occur in flowing streams, such as nutrient cycling and transport, depositional zones and material exchange with the floodplain. When compared to a natural lake, the quarry pit is devoid of a shallow littoral zone that would accumulate organic matter and provide soft substrate for macrophyte growth. As such, life forms in the pond would be dominated by microorganisms creating a biofilm on hard substrate, and free floating algae (phytoplankton) in open water.

Biofilms are a source of food for larger grazing invertebrates such as aquatic snails and mayfly nymphs; and phytoplankton is the primary food for filter-feeding zooplankton. This primary (plant) and secondary (animal) production forms the lower order of an aquatic food web. But without the habitat structure typical in lakes, wetlands and rivers (e.g. shallow zones for macrophytes, and woody debris for shelter), larger fauna would be limited to hardy, common species.

Presence of larger aquatic species is also restricted by the quarry's disconnection from natural watercourses, although it does not exclude them completely. Certain fish that are known to travel overland or up/around vertical structures (e.g. eels, gudgeons and galaxiids) would find it difficult to access the quarry due to its steep and high perimeter wall. Presence of fish, therefore, is likely limited to human stocking and/or aerial transfer of eggs/newborn via wetland birds (attached to feet/underbelly). This aerial dispersal mechanism is well known for eggs of invasive carp, which often inhabit isolated farm dams. If native fish have managed to colonise the pond, their foraging and shelter habitat is very limited and unlikely to favour a breeding population.

3.4 Wetlands

There were no important or local wetlands relevant to the study area. There were no SEPP 14 wetlands in the study area and no SEPP 14 wetlands are to be impacted.

3.5 Groundwater dependent ecosystems

Groundwater Dependant Ecosystems (GDEs) are defined as ecosystems whose current species composition, structure and function are reliant on a supply of groundwater as opposed to surface water supplies from overland flow paths. The frequency of groundwater influence may range from daily to inter-annually, however it becomes clearly apparent when either the supply of groundwater or its quality (or both) is altered for a sufficient length of time to cause changes in plant function. Groundwater use by an ecological community or individual species does not necessarily imply groundwater dependence.

In Australia, the majority of ecosystems have little to no dependence on groundwater, although the full understanding of the role of groundwater in maintaining ecosystems is generally poor. The exception to this is wetland communities, for which it is thought that most have some level of dependence on groundwater resources.

GDEs are generally classified into six categories:

- Terrestrial vegetation – forests and woodland which develop a permanent or seasonal dependence on groundwater, often by extending roots into the water table.
- Base Flow in streams – aquatic and riparian ecosystems that exist in or adjacent to streams that are fed by groundwater base flow.
- Aquifer and cave systems – aquatic ecosystems that occupy caves or aquifers.
- Wetlands – aquatic communities and fringing vegetation that depend on groundwater fed lakes and wetlands.
- Estuarine and near shore marine ecosystems – various ecosystems including mangroves, salt marsh and seagrass, whose ecological function has some dependence on groundwater discharge.
- Terrestrial fauna – fauna species assemblages reliant on groundwater for drinking water.

A final category is also recognised 'not apparently dependant'. This category acknowledges that some ecosystems, particularly wetland and riparian vegetation, might superficially appear to be groundwater dependent while in fact they are dependent entirely on surface flows and or rainfall.

Groundwater in the Hornsby Quarry study area has a water level of 28.5 metres AHD by PSM 2006 (later quoted in Cardno 2013). A piezometer was drilled by PSM in 2006 (BH HQ1) to the southwest of the quarry void. Analysis of groundwater data from BH HQ1 for the period 20 November 2006 to 2 July 2010 indicated GW levels between 80 metres and just under 120 metres AHD in the area immediately surrounding the quarry void. Current water levels in the void have been estimated by Council to be 19 m AHD (pers. comms. Craig Clendenning, Hornsby Shire Council). Land surrounding the quarry rim is between 60 and 180 metres AHD, making the water table between 41 and 161 metres below ground level. This is likely to be beyond the rooting depth of most plant species in the vegetation types present at the site.

3.6 Ecological corridors

No formal state or regional biodiversity links are present within the study area. Areas of potential impact are also in proximity to existing peri-urban development. For example, roads and residences bound the Quarry site to the north, east and south.

Local wildlife corridors do exist at a smaller scale. At a local scale there are riparian corridors linked to regional parks, namely vegetation adjacent to the Quarry extending to Cowan Reserve. However, these linkages do not meet the definition of state or regional biodiversity links, and therefore linkage impacts were assessed for site based developments as defined under the FBA (OEH 2014b).

The links from within the study area to the adjacent vegetation will not be severed by the proposed works. The proposed works make use of already cleared or degraded areas of vegetation and will not introduce new access points through any local corridor.

3.7 Landscape value score

The assessment method was chosen in accordance with the site based assessment outlined in the FBA.

Assessment circles with a radius of 1,784 metres (1,000 hectares) and 564 metres (100 hectares) are used to assess the impact of proposals on the surrounding vegetation cover at a landscape and local scale (respectively) (**Figure 6**).

The amount of vegetation within the 100 hectare and 1,000 hectare assessment circles before the development was calculated using ArcGIS using the Native Vegetation of the NSW NPWS GIS layer (NPWS 2002) (excluding the non-native categories). Where this layer did not cover the whole circle, the gaps were filled in manually. To determine the native vegetation cover after development in the 1,000 hectare circle, the total amount of clearing was subtracted from the average. The development footprint was then used to calculate the amount of vegetation loss for 100 hectare each circle. **Table 3** outlines the vegetation in each circle, before and after development, and the average and associated Native Vegetation Cover Class (per cent) to be entered into the Credit Calculator.

Table 3: Area of vegetation in each assessment circle

Circle	Native Vegetation Cover (Before Development)	Native Vegetation Cover (After Development)
1 000 ha circle	401 ha (rounded down to 40%) (36-40%)	398.5 ha (36-40%)
100 ha circle	51 ha (51-55%)	49 ha (46-50%)

A connectivity assessment was conducted using the FBA technique for site based developments (OEH 2014b). The site did not contain either state or regionally significant biodiversity links due to not being in biodiversity link plans approved by the Chief Executive of OEH or in a riparian buffer for a 4th or higher order stream. Thus the following aspects were considered:

- The width of the current and future connecting link (**Table 4**)
- The condition of the current and future connecting link (overstorey and mid-storey/ground cover) (**Table 5**).

The project footprint is surrounded by connected vegetation on three sides and does not form a significant linkage between any vegetation zones. As such, the connectivity has not been affected by this development.

Connectivity width assessment

The current most limiting width within the corridor is approximately 30 metres, thus falling into the 30-100 metre linkage width class (**Figure 7**). As the area of minimum width does not occur within the proposed development it does not reduce the minimum width of this link. Professional judgement was used to ascertain that the proposed development will not result in a change in the minimum linkage width class, remaining unchanged at less than 30-100 metres after development, as the study area is connected to both the north and south to vegetation, and these linkages will be retained (**Table 4**).

Table 4: Linkage width classes before and after development

	Linkage Width Class (Before Development)	Linkage Width Class (After Development)
Connectivity Value (Width)	>30-100m	>30-100m

Connectivity condition assessment

The connectivity condition assessment was undertaken on woody vegetation as woody vegetation types dominate the project footprint. Two measures were used to assess the condition of the connection:

- The condition of over-storey vegetation before and after development.
- The condition of ground cover vegetation before and after development.

The vegetation within the link is connected to Ku-ring-gai Chase National Park and so the condition of the overstorey is high. Over-storey vegetation before development has therefore been assessed as Projected Foliage Cover (PFC) at Benchmark. The impact of the proposed development on the average overstorey condition across the entire connection is minimal, as the area within the linkage to be cleared is very small. It is therefore expected that the average overstorey condition after development will remain the same at PFC at Benchmark.

While it is difficult to estimate the condition of the mid-storey and ground cover through the entire connection, from the field visit and analysis of aerial photos, it is likely that some exotic vegetation would be present due observations made on site. However, the average condition of the mid-storey/ground cover vegetation before development has been assessed to also be at benchmark (PFC at Benchmark). As previously described, the impact of the proposed development would be minimal on the condition of the connectivity, and the ground cover after development will remain at PFC at Benchmark (**Table 5**).

Table 5: Condition of vegetation within the assessment circle before and after development

	Width Class (Before Development)	Width Class (After Development)
Connectivity Value (Overstorey Condition)	PFC at Benchmark	PFC at Benchmark
Connectivity Value (Mid-storey/Ground Cover Condition)	PFC at Benchmark	PFC at Benchmark

Patch size

Threatened species sub-zones, which form the base units of vegetation zones, were mapped for the impact area. The threatened species sub-zones allow the entry of data such as adjacent remnant area and patch size for individual vegetation zones.

The majority of the vegetation impacted is adjacent to large patches of vegetation with an area of greater than 501 hectares, and thus the adjacent remnant area and patch size for all threatened species sub-zones was entered as the maximum 501 hectares.

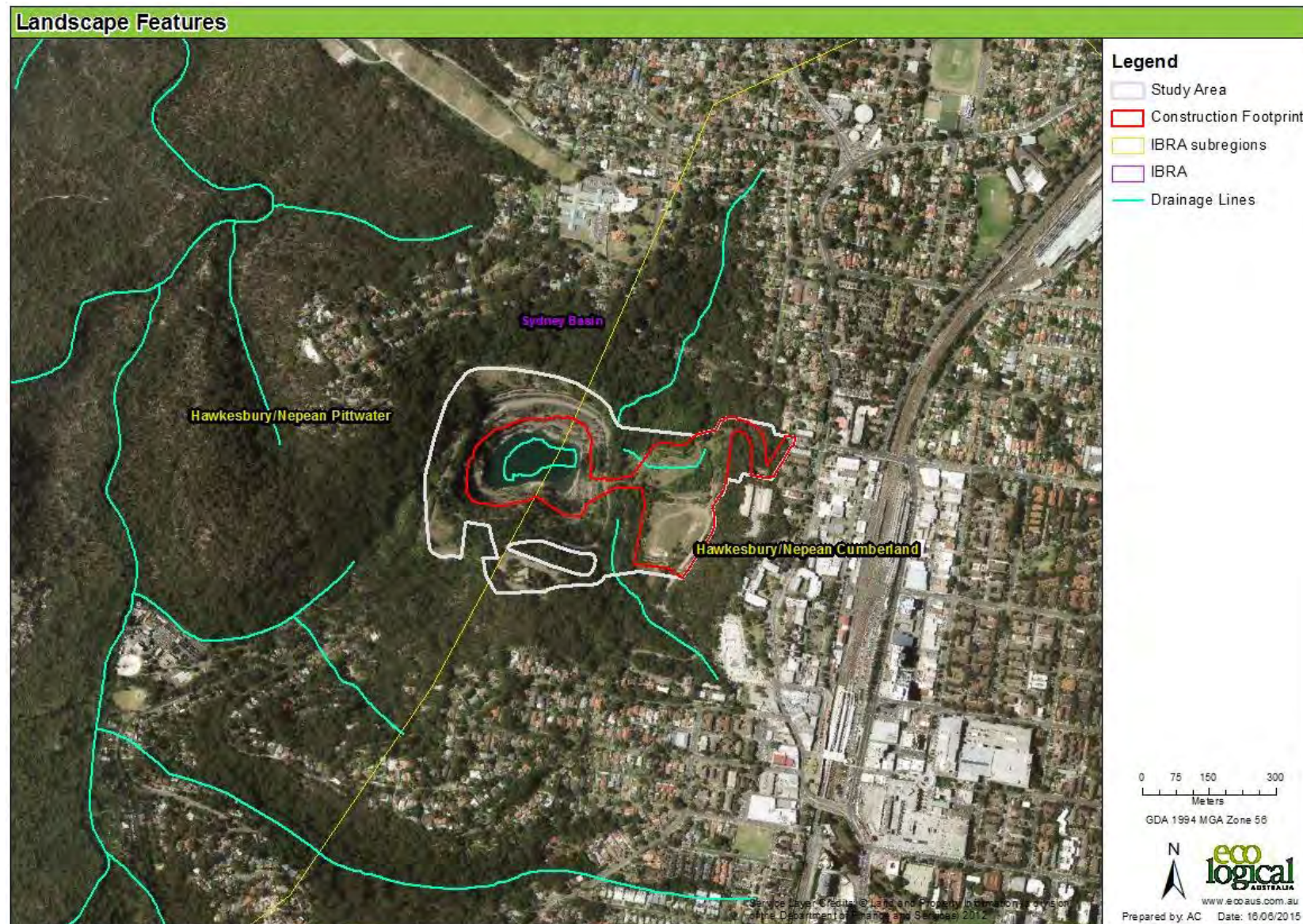


Figure 4: IBRA regions and subregions and drainage lines

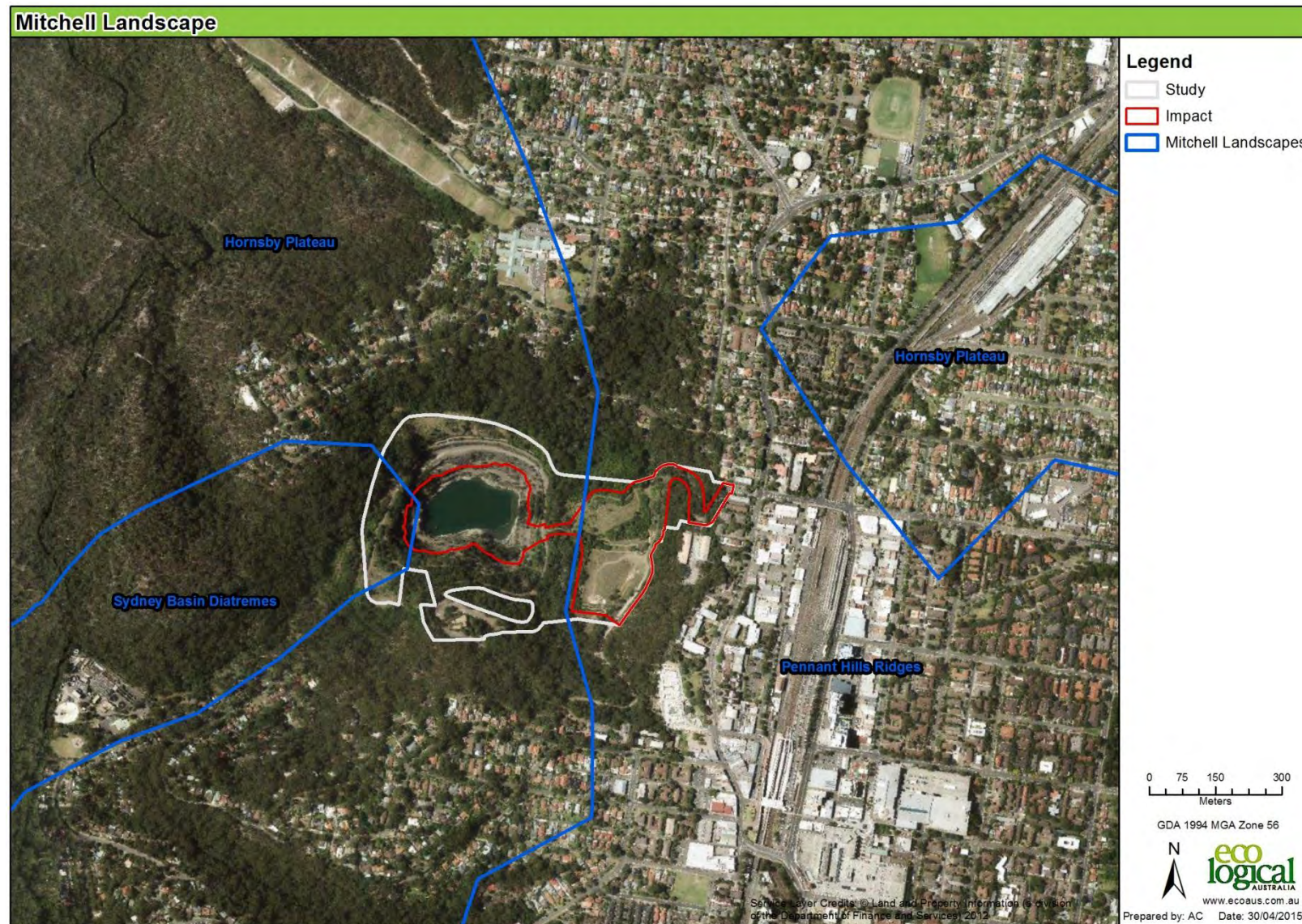


Figure 5: Mitchell Landscapes

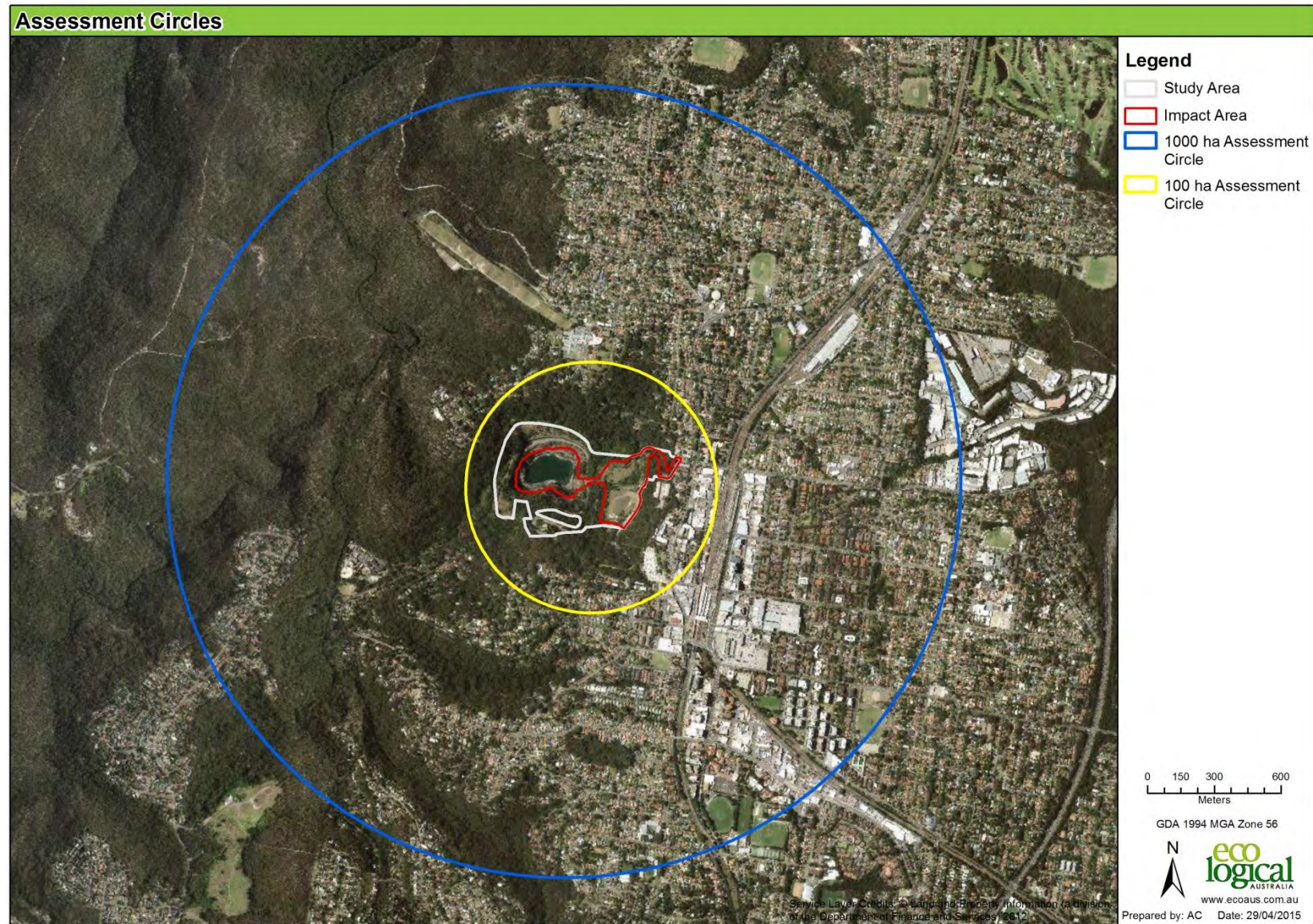


Figure 6: Assessment circles



Figure 7: Connectivity assessment

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4 Native vegetation

4.1 Plant Community Types (PCTs)

There were two PCTs mapped and assessed in the study area. PCTs within the development site are outlined in **Table 6** and shown in **Figure 8**.

4.1.1 Sydney Blue Gum – Blackbutt – Smooth-barked Apple moist shrubby open forest on shale ridges of the Hornsby Plateau, Sydney Basin (PCT 1237)

This PCT is also known as Blue Gum High Forest and is in the North Coast Wet Sclerophyll Forest class. It is a critically endangered ecological community (CEEC). It is 90 percent cleared in the CMA.

The Blue Gum High Forest in the study area did not meet EPBC Act criteria. The EPBC Act Blue Gum High Forest community definition is narrower than the TSC Act definition, in that EPBC Act Blue Gum High Forest:

- Occurs only on sandstone derived soils.
- Requires minimum canopy coverage of 10 per cent.
- Must be part of a patch greater than one hectare.
- Must be dominated by native plants in all structural layers of the community.

Although Blue Gum High Forest was identified in the study area, none of the patches meet the EPBC Act definition. This is because the Blue Gum High Forest occurs on soils not derived from sandstone and often had a canopy cover of less than 10 percent. However the most critical element was that in the main, the areas of Blue Gum High Forest were not dominated by native plants in all structural layers. In general the understorey was typically dominated by woody weeds and the ground cover often dominated by seedlings of these weeds.

The vegetation was identified using previous mapping by Smith and Smith (2008), conducting vegetation validation, comparison of species present with the VIS dataset and the final determination for the CEEC, and conducting a number of floristic and biometric plots in accordance with the FBA method. ELA is cognisant of NSW Land and Environment Court decisions in protecting very small patches of Blue Gum High Forest and individual *Eucalyptus saligna* trees and as such has adopted a precautionary approach to the classification of this community under the TSC Act in including areas dominated by *E. saligna* as part of this CEEC, even when in highly disturbed condition. There were a few small patches that were classified as 'Blue Gum individuals'. These patches were ostensibly a small group of adult *Eucalyptus saligna* in a matrix of woody weeds. Given that individual Blue Gum trees can be considered the CEEC, these patches were included in this PCT.

Canopy species were primarily used to identify this community from the other PCT present. Where the canopy was dominated by *Eucalyptus saligna* and the vegetation was on more fertile loamy rather than sandy soils, the PCT was identified as being present. In most locations where this community was sampled, the vegetation was usually dominated by weeds in the understorey. A precautionary approach was taken when identifying this PCT at the development site. In general, the dominant canopy species were *Eucalyptus saligna* (averaging six trees per 20 metre by 20 metre plot), *Angophora floribunda* (ten per plot) and *Pittosporum undulatum* (12 per plot).

The understorey was typically dominated by woody weeds such as *Ligustrum lucidum* and *L. sinense*. In most areas, the native shrub layer was absent and very few native species were present in the ground layer. Species encountered included *Lomandra longifolia*, *Poa labillardieri*, *Oplismenus aemulus* and *Dichondra repens*.

The project would remove areas of TSC Act listed Blue Gum High Forest located within the eastern portion of the Quarry. Areas to be removed are quantified in **Table 7**.

4.1.2 Smooth-barked Apple - Red Bloodwood - Sydney Peppermint heathy open forest in sandstone gullies of western Sydney, Sydney Basin (PCT 1181 or HN586)

This PCT is also known as Sandstone Blackbutt Woodland (Smith and Smith 2008). It is in the Sydney Coastal Dry Sclerophyll Forest class and is not an EEC or CEEC. However, Sandstone Blackbutt Woodland is a tall open forest recognised as a locally significant community in the Hornsby Shire 2006 Biodiversity Conservation Strategy (Cardno 2013; Smith and Smith 2012). It is 20 percent cleared in the CMA. For clarity, this PCT will be referred to as Sandstone Blackbutt Woodland.

Typical species that occur within the community include *Eucalyptus pilularis* (Blackbutt), *Angophora costata* (Sydney Red Gum) and *Syncarpia glomulifera* (Turpentine).

Mapping from previous studies (e.g. Smith and Smith 2008) was used to identify where this community potentially occurs in the study area. Validation of mapping, comparison of descriptions from the VIS data set with floristic plots was all used to identify and assign this PCT. Canopy species, presence of sandstone outcrops, sandy soil and an absence of more fertile soils were used to help confirm the presence of this PCT within the study area.

The PCT was present in two condition states. Both condition states met the definition of “moderate-good” under the methodology, but these were further separated into ‘moderate’ and ‘poor’ condition. In general the canopy was dominated by the following species: *Eucalyptus pilularis*, *Angophora costata*, *Corymbia gummifera*, *Syncarpia glomulifera*. A smaller tree layer comprised *Allocasuarina littoralis*, *A. torulosa*, *Banksia serrata* and *Elaeocarpus reticulatus*. The understorey was dominated by sclerophyllous shrubs, herbs and grasses including *Imperata cylindrica*, *Breynia oblongifolia*, *Lomandra longifolia*, *Pteridium esculentum*, *Dianella longifolia*, *Xanthorrhoea* sp., *Hibbertia empetrifolia* and *Lomandra obliqua*.

Where the PCT was in poor condition, there were more woody weeds including *Ligustrum lucidum*, *L. sinense*, *Ochna serrulata* and *Lantana camara*. The patches of poor condition forest were adjacent to the road or track edges and appeared to have had a modified soil profile, possibly from earlier road construction.

4.2 Other vegetation

4.2.1 Regeneration native

There were some areas of vegetation that were largely comprised of regenerating native plants, including *Allocasuarina littoralis*. These areas were mostly contained within the quarry void, where access was limited or prohibited due to steepness and unstable walls. No plot/transects were able to be conducted in these areas and it was also difficult to assign the community to a PCT due to not having direct access. It is also noted that this vegetation has regenerated from previous past disturbance and is therefore a highly disturbed community.

For the areas inside the project footprint, this vegetation type was assigned to the closest PCT available. This was deemed to be Smooth-barked Apple - Red Bloodwood - Sydney Peppermint heathy open forest in sandstone gullies of western Sydney, Sydney Basin. This was because it was an open forest with more shrubby sclerophyllous plants than the Blue Gum High Forest PCT. The vegetation condition was considered 'poor'.

4.2.2 Regeneration exotic, weeds and exotics, cleared

Areas that were exclusively or dominated by weeds were assigned to this vegetation type. Large areas within the study area were dominated by weed species such as *Ligustrum lucidum*, *L. sinense*, *Lantana camara* and herbaceous weeds. These areas were usually close to track edges or where the soil profile had been extensively modified. This vegetation type also included two large flat areas east of the void that were dominated by exotic grasses, with no shrubs or trees present. These vegetation types were excluded from the calculations.

Table 6: Vegetation in the study area

Vegetation types			Vegetation Zones for analysis purposes				
Vegetation community	Ancillary	Total in study area (ha)	Veg Zone No.	Plant Community Type (PCT)	Ancillary code	Total impacted (ha)	Justification
Blue Gum High Forest	Poor	3.62	1	Sydney Blue Gum - Blackbutt - Smooth-barked Apple moist shrubby open forest on shale ridges of the Hornsby Plateau, Sydney Basin	Poor	0.06	Merged with Sandstone Blackbutt Woodland in poor condition for calculations because of the small size of the vegetation being impacted. Zones smaller than 0.25 hectares are required to be merged to provide the calculations.
Sandstone Blackbutt Woodland	Moderate	1.40	2	Smooth-barked Apple - Red Bloodwood - Sydney Peppermint heathy open forest in sandstone gullies of western Sydney, Sydney Basin	Moderate	0.58	No change
	Poor	0.44	3		Poor	0.26	No change
Regeneration - Native		3.23				0.74	Merged with Sandstone Blackbutt Woodland in poor condition for calculations This vegetation most closely aligns with the PCT above. Due to access restrictions, no plots/transects were able to be done in this vegetation type because the majority occurred within the inner quarry fence.
Blue Gum Individuals		0.06				0	None of this vegetation is impacted
Regeneration - Exotic		0.46	Excluded from impact assessment as it is not native vegetation			0	Non-native vegetation and other cleared areas do not need to be included in calculations
Weeds and Exotics		10.14				4.02	
Cleared		4.57				3.19	
Water		2.32				2.32	
Total		26.23				11.18	

4.3 Vegetation zone

Vegetation zones and their extent within the project footprint are outlined in **Table 7**.

The vegetation zones outlined in **Table 7** are assessed for impacts in **section 7**.

Table 7: Vegetation zones and plot requirements

Vegetation zone	Vegetation Community	Plant community type	Ancillary Code	Area impacted (ha)	Plots required	Plots collected	Description of plots used
1	Blue Gum High Forest	Sydney Blue Gum - Blackbutt - Smooth-barked Apple moist shrubby open forest on shale ridges of the Hornsby Plateau, Sydney Basin	Poor	0.06	1	2	Plot collected in the Blue Gum High Forest 'poor' zone. Due to the small size of this vegetation was merged with vegetation zone 3.
2	Sandstone Blackbutt Woodland (Moderate)	Smooth-barked Apple - Red Bloodwood - Sydney Peppermint heathy open forest in sandstone gullies of western Sydney, Sydney Basin	Moderate	0.58	1	3	All plots collected in the Smooth-barked Apple Forest 'moderate' zone
3	Sandstone Blackbutt Woodland (Poor) and Regeneration – Native combined	Smooth-barked Apple - Red Bloodwood - Sydney Peppermint heathy open forest in sandstone gullies of western Sydney, Sydney Basin	Poor	1.00	1	2	All plots collected in the Smooth-barked Apple Forest 'poor' zone. This vegetation zone is a combination of Sandstone Blackbutt Woodland Poor and Regeneration – Native.
Total				1.64	3	7	

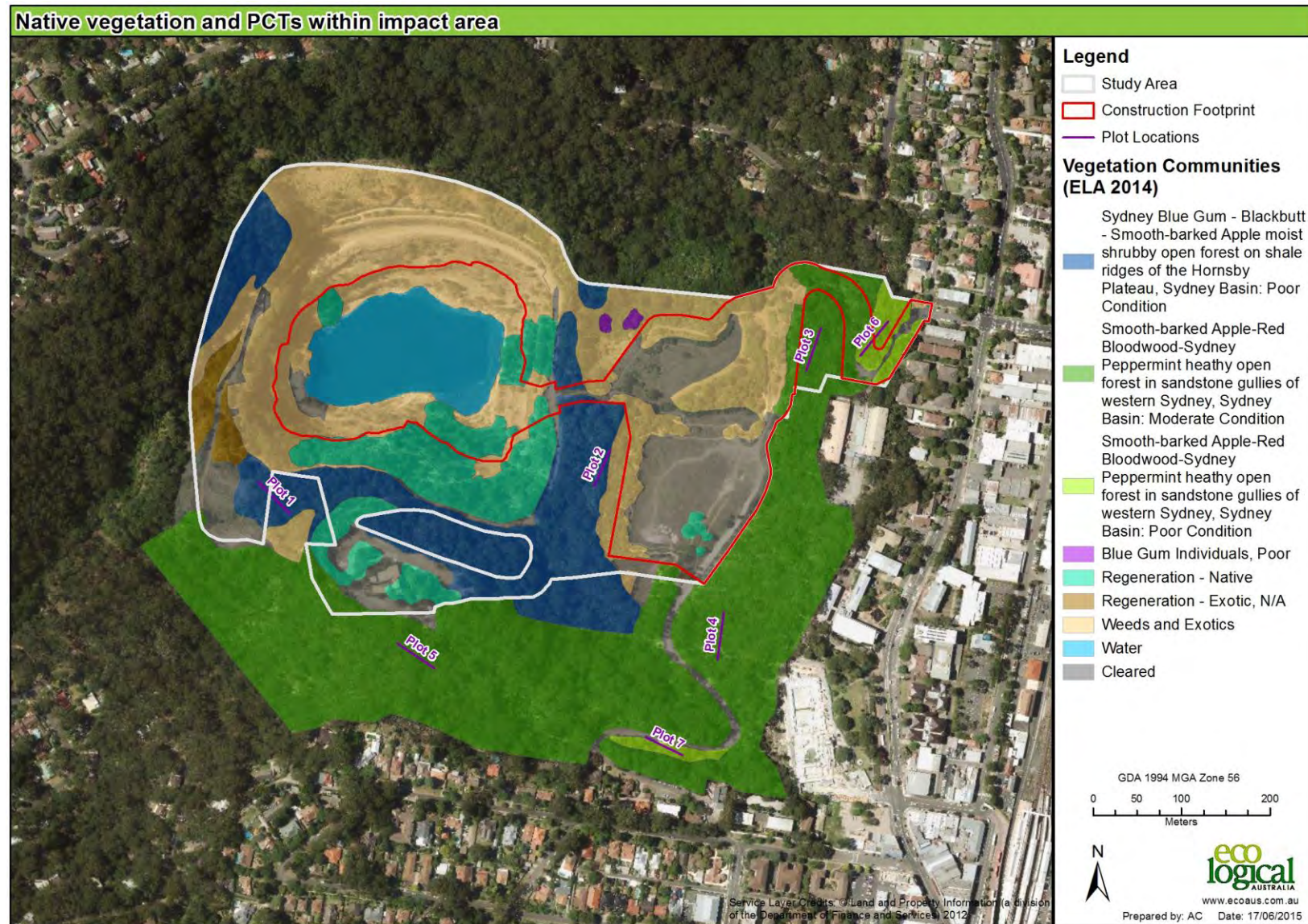


Figure 8: Native vegetation and PCTs within study area

5 Threatened species

5.1 Ecosystem credit species

A number of threatened species have been recorded or may occur within the study area. Ecosystem credit species associated with PCTs in the project footprint are outlined below in **Table 8**.

Table 8: Ecosystem credit species on development site

Species	Inclusion / exclusion	Justification for exclusion
Glossy Black-Cockatoo	Include	N/A
Gang-gang Cockatoo (Endangered Population has a separate species credit listing)	Include	N/A
Little Eagle	Include	N/A
Little Lorikeet	Include	N/A
Masked Owl.	Include	N/A
New Holland Mouse	Include	N/A
Powerful Owl.	Include	N/A
Barking Owl	Include	N/A
Scarlet Robin.	Include	N/A
Sooty Owl	Include	N/A
Square-tailed Kite	Include	N/A
Swift Parrot	Include	N/A
Varied Sittella	Include	N/A
Eastern False Pipistrelle	Exclude	Survey conducted – not present
Eastern Freetail Bat	Exclude	Survey conducted – not present
Golden-tipped Bat	Exclude	Survey conducted – not present
Greater Broad-nosed Bat	Exclude	Survey conducted – not present
Spotted-tail Quoll	Exclude	No suitable habitat in impact area
Superb Fruit Dove	Exclude	No rainforest present and limited most eucalypt forest present in impact area
Yellow Bellied Glider	Exclude	Forest is present but it is not nutrient rich or with abundant hollows in the impact area
Yellow Sheath-tailed Bat	Exclude	Survey conducted – not present

5.1.1 Glossy Black-Cockatoo

The Glossy Black-Cockatoo is listed as vulnerable under the TSC Act. The Glossy Black Cockatoo inhabits open forest and woodlands of the coast and the Great Dividing Range up to 1000 metres in which there are stands of she-oak species providing foraging habitat, particularly where *Allocasuarina littoralis* (Black She-oak) and *A. torulosa* (Forest She-oak) occur (OEH, 2013b).

In the Sydney metropolitan region important breeding habitat has been defined as tree hollows with a minimum diameter greater than 15 centimetres (OEH, 2013b). There are 23 records of the species within the ten kilometre radius Wildlife Atlas search area. There is potential habitat for this species in the project footprint with patches of regenerating *Allocasuarina* species growing on the quarry void walls and benches. There were a small number of hollow bearing trees, which are potential breeding habitat. No Glossy Black Cockatoos were observed during the field survey and no evidence of the species utilising the habitat, such as crushed cones of sheoak, were observed where this tree species was present.

There was some foraging habitat present but there was no evidence of the species utilising this habitat. However it was retained as an ecosystem credit species.

5.1.2 Gang-gang Cockatoo (Endangered Population has a separate species credit listing)

Gang-gang Cockatoo is listed as vulnerable under the TSC Act.

In summer they occur in dense, tall, wet forests of mountains and gullies, as well as alpine woodlands (NSW Scientific Committee, 2008). In winter they occur at lower altitudes in drier more open forests and woodlands, particularly box-ironbark assemblages (Shields & Chrome, 1992). They can often be found in urban areas in autumn/winter (Simpson & Day, 2004). The population size is small and estimated to be between 18 to 40 pairs, yet individuals of this population are likely to move outside the 'defined' population boundary in the general area and should still be considered of this population (OEH, 2013c).

Important breeding habitat in the Sydney metropolitan region has been defined as a tree hollow with a minimum diameter of 10 centimetres (OEH, 2013c) and typically occurs in live trees close to water (NSW Scientific Committee, 2008). There are eight records of the endangered population of Gang-gang and eight of the species within the ten kilometre radius Wildlife Atlas search. No Gang-gang Cockatoos were recorded during the field survey. There is some potential foraging habitat and potential breeding habitat in the study area. There are hollow bearing trees suitable for this species (AECOM, 2014 and ELA 2014).

5.1.3 Little Eagle

Hieraaetus morphnoides (Little Eagle) is a medium-sized bird of prey. It is listed as vulnerable under the TSC Act.

It occupies open eucalypt forest, woodland or open woodland. Sheoak or Acacia woodlands and riparian woodlands of interior NSW are also used. The species nests in tall living trees within a remnant patch, where pairs build a large stick nest in winter. It lays two or three eggs during spring, and young fledge in early summer. It preys on birds, reptiles and mammals, occasionally adding large insects and carrion.

The Little Eagle is found throughout the Australian mainland excepting the most densely forested parts of the Dividing Range escarpment. It occurs as a single population throughout NSW. There was foraging habitat in the project footprint.

5.1.4 Little Lorikeet

Glossopsitta pusilla (Little Lorikeet) is listed as vulnerable under the TSC Act.

In New South Wales Little Lorikeets are distributed in forests and woodlands from the coast to the western slopes of the Great Dividing Range, extending westwards to the vicinity of Albury, Parkes, Dubbo and Narrabri.

Little Lorikeets mostly occur in dry, open eucalypt forests and woodlands. They have been recorded from both old-growth and logged forests in the eastern part of their range, and in remnant woodland patches and roadside vegetation on the western slopes. They feed primarily on nectar and pollen in the tree canopy, particularly on profusely-flowering eucalypts, but also on a variety of other species including melaleucas and mistletoes. On the western slopes and tablelands White Box *Eucalyptus albens* and Yellow Box *E. melliodora* are particularly important food sources for pollen and nectar respectively.

There was potential foraging habitat in the project footprint.

5.1.5 Masked Owl

Tyto novaehollandiae (Masked Owl) is listed as vulnerable under the TSC Act. It is associated with forest with sparse, open, understorey, typically dry sclerophyll forest and woodland (DECC 2007) and especially the ecotone between wet and dry forest, and non-forest habitat (DotE 2015). The Masked Owl is known to utilise forest margins and isolated stands of trees within agricultural land and heavily disturbed forest where its prey of small and medium sized mammals can be readily obtained. This species is very sparse in the region and there are no known breeding records south of the Hawkesbury River (Kavanagh 2004).

The number of pairs in the locality is unknown. However, there are seven records for Masked Owl on the Wildlife Atlas within ten kilometres of the study area. There is a lack of breeding records of this species south of the Hawkesbury River and there are sparse records of this species in the northern Sydney region in general. This means that this species is unlikely to be breeding in the project footprint. This project may impact on foraging habitat but is unlikely to impact on breeding habitat.

5.1.6 New Holland Mouse

Pseudomys novaehollandiae (New Holland Mouse) is not listed under the TSC Act. It is listed under the EPBC Act. It was not surveyed for, and thus it is not possible to discount the presence of this species. The species utilises open heathlands, woodlands and forests with a heathland understorey and vegetated sand dunes. The number of individuals present at a site can fluctuate widely, and populations will tend to irrupt in the early to mid vegetation succession stage induced by fire. It is considered that habitat for this species in the study area would be limited, particularly given the close proximity to urban interface. However, it is not possible to completely discount its potential presence and thus it has been retained as an ecosystem credit species.

5.1.7 Powerful Owl

Ninox strenua (Powerful Owl) is listed as vulnerable under the TSC Act. They require large tracts of forest or woodland but can also occur in fragmented landscapes. As most prey species require hollows and a shrub layer, these are important habitat components for the owl. Large trees with hollows at least 0.5 metres deep (DotE 2015) and diameter at breast height of 80 to 240 centimetres that are at least 150 years old are required for nesting.

The project could impact on the lifecycle of the Powerful Owl by reducing the amount of potential foraging habitat. Tree hollows with a diameter greater than 300 millimetres constitute potential primary (breeding) habitat for the Powerful Owl. Removal of such habitat may impact the lifecycle of the species by reducing the availability of breeding habitat, which would impact on species fecundity (being the ability to reproduce) in the local area. No hollows of a suitable size were found within the study area.

If Powerful Owl nesting sites occur within the study area, the species may be indirectly impacted through noise and vibration during the project. It is recommended that a buffer of at least 200 metres of native vegetation should be retained around nesting trees of Powerful Owl. The species is known to be extremely sensitive to disturbance around the nest site, particularly during pre-laying, laying and downy chick stages.

During the field survey, there was no evidence of nesting by Powerful Owls but field surveys were primarily conducted in summer when Powerful Owl are not breeding. However, there are 105 records for Powerful Owl on the Wildlife Atlas within ten kilometres of the study area.

Loss of foraging habitat has the potential to reduce the availability of prey species within a mating pair's territory, which may force individuals to travel greater distances during hunting.

A previous study by Aquila Ecological Surveys (2011) suggested that the quarry site would provide for foraging habitat, but that the size of a pair's foraging territory may extend to 1000 hectares. They did not survey for this species, but assumed that foraging habitat would be present (see **section 2.1.3**).

While the project would result in the removal of potential foraging habitat for the Powerful Owl, the project would retain trees containing smaller hollows and areas of high quality foraging habitat. The hollow bearing tree surveys performed (AECOM 2014) did not identify any hollows large enough to provide breeding habitat for Powerful Owl, but there were hollows suitable for prey species of the Powerful Owl.

5.1.8 Barking Owl

Ninox connivens (Barking Owl) is listed as vulnerable under the TSC Act. The Barking Owl inhabits a variety of habitats such as savannah woodland, open eucalypt forests, wetland and riverine forest, including fragmented remnants and partly cleared farmland. This species is flexible in its habitat use and hunting can extend into closed forest and more open areas. The habitat is typically dominated by eucalypts (often Redgum species) (DECC 2007).

The Barking Owl usually roosts in dense foliage in large trees. It usually nests near watercourses or wetlands in large tree hollows with entrances averaging two to 29 metres above ground, depending on the forest or woodland structure and the canopy height (NSW NPWS 2003).

The project could impact on the lifecycle of the Barking Owl by reducing the amount of potential foraging habitat. Loss of foraging habitat has the potential to reduce the availability of prey species within a mating pair's territory, which may force individuals to travel greater distances during hunting. The sizes of home ranges are generally unknown for Barking Owl, but like Powerful Owl are likely to be variable and dependent upon quality of habitat. Tree hollows with a diameter greater than 300 millimetres constitute potential primary (breeding) habitat for the Barking Owl. Removal of such habitat may impact the lifecycle of the species by reducing the availability of breeding habitat, which will impact on species fecundity in the local area. No hollows of suitable size were recorded within the project footprint.

If a Barking Owl nesting site occurs within the study area or 200 metres from the study area, it may be indirectly impacted through noise, vibration and artificial light during the carrying out of the project.

During the field survey there was no evidence of nesting by Barking Owls. It is unlikely that the species would breed within the study area, given the landscape is highly fragmented and disturbed and that the range of the species has contracted considerably in NSW, so that it is rarely found east of the Great Divide. However, there are three records for Barking Owl on the Wildlife Atlas within ten kilometres of the study area. It has been suggested that Barking Owls are itinerant and sporadic inhabitants of the forests east of the Great Dividing Range (David Coombes, Senior Ecologist, pers comm January 2014).

While the project would result in the removal of potential foraging habitat for the Barking Owl, the project will not impact on any hollow bearing trees large enough to provide potential breeding habitat for the Barking Owl. In addition the works have avoided the majority of the existing hollow bearing trees and areas of high quality foraging habitat.

5.1.9 Scarlet Robin

Petroica boodang (Scarlet Robin) is listed as vulnerable under the TSC Act. In NSW, it occurs from the coast to the inland slopes. The Scarlet Robin lives in dry eucalypt forests and woodlands. The understorey is usually open and grassy with few scattered shrubs. This species lives in both mature and regrowth vegetation. It may also occur in mallee or wet forest communities, or in wetlands and tea-tree swamps.

The Scarlet Robin was not recorded within the project area. However there are two records of the species within the ten kilometre Wildlife Atlas search area.

There was some foraging habitat present but there was no evidence of the species utilising this habitat. The area of potential habitat to be cleared was small relative to the potential habitat remaining in vegetation adjacent to the impact areas at the Hornsby Quarry.

5.1.10 Sooty Owl

Tyto tenebricosa (Sooty Owl) is listed as vulnerable under the TSC Act.

Sooty Owls are associated with tall wet old growth forest on fertile soil with a dense understorey and emergent tall *Eucalyptus* species (Environment Australia 2000, Debus and Chafer 1994). Pairs roost in the daytime amongst dense vegetation, in tree hollows and sometimes in caves. The Sooty Owl is typically associated with an abundant and diverse supply of prey items and a selection of large tree hollows (Debus and Chafer 1994, Garnett 1993).

The Sooty Owl was not recorded in the study area and there was no evidence (i.e. whitewash) of it being present. There was only one record of this species occurring in the ten kilometre radius search. It is likely that this species has been filtered in based on the association with the two PCT present on this site. There were no hollows present that were large enough to support a breeding pair.

There is likely to be potential foraging habitat both within the study area and in the area to be impacted by this project.

5.1.11 Square-tailed Kite

Lophoictinia isura (Square-tailed Kite) is listed as Vulnerable under the TSC Act. The Square-tailed Kite is a reddish, medium-sized, long-winged raptor, about the size of a Little Eagle or harrier.

The Square-tailed Kite ranges along coastal and sub-coastal areas from south-western to northern Australia, Queensland, NSW and Victoria. In NSW, scattered records of the species throughout the state indicate that the species is a regular resident in the north, north-east and along the major west-flowing river systems. It is a summer breeding migrant to the south-east, including the NSW south coast, arriving in September and leaving by March.

It hunts for small forest birds and nests in twig and stick nests in the forest canopy. While no nests were observed in the study area or project footprint, the presence of suitable foraging habitat warranted the inclusion of this species.

5.1.12 Swift Parrot

Lathamus discolor (Swift Parrot) is listed as endangered under the TSC Act.

It breeds in Tasmania between September and January. The Swift Parrot feeds mostly on nectar, mainly from eucalypts, but also eats psyllid insects and lerps, seeds and fruit. Migrates to mainland in autumn, where it forages on profuse flowering Eucalypts. Favoured feed trees include winter flowering species such as Swamp Mahogany (*Eucalyptus robusta*), Spotted Gum (*Corymbia maculata*), Red Bloodwood (*C. gummifera*), Mugga Ironbark (*E. sideroxylon*), White Box (*E. albens*) and Forest Red Gum (*E. tereticornis*) (DECC 2007). Box-ironbark habitat in drainage lines and coastal forest in NSW is thought to provide critical food resources during periods of drought or low food abundance elsewhere (Mac Nally et al. 2000).

There were no records of this species from within the ten kilometre radius Atlas search. It may be an occasional visitor to the area utilising the winter flowering eucalypts that are present in the Sandstone Blackbutt Woodland.

5.1.13 Varied Sittella

Daphoenositta chrysoptera (Varied Sittella) is listed as vulnerable under the TSC Act.

The species inhabits eucalypt forests and woodlands, especially with rough-barked species and mature smooth-barked gums with dead branches, mallee and *Acacia* woodland (DECC 2005) and has a widespread range across mainland Australia,

The Varied Sittella was not recorded within the study area. However there is one record of the species within the ten kilometre Wildlife Atlas search area. There was a sighting of this species at the Quarry in 2014 by Dragonfly (2014). This record occurred in an area that will be retained and not impacted directly by the project.

5.2 Species credit species

The following questions were asked in the calculator to determine what species would be filtered into the assessment for consideration (**Table 9**). The answers were obtained from the site visit, and in any cases of ambiguity the default answer of 'Yes' was used, as directed by the methodology. It should be noted that an answer of 'yes' does not mean that the threatened species or its habitat is present, merely that the species is retained in the assessment by the tool (an answer of 'no' results in the threatened species being excluded).

Table 9: Geographic and habitat questions and answers

Question: Does any part of the development impact on	Answer
Heath or eucalypt forest on sandstone with a build-up of litter or other debris and containing, or within 40 metres of, ephemeral or intermittent drainage lines	Yes
Land within 40 metres of heath, woodland or forest	Yes
Land situated in damp, disturbed sites	Yes
Lateritic to shaley ridgetops	Yes
Land within 100 metres of emergent aquatic or riparian vegetation	Yes

Species generated by the tool were used. From review of previous reports, no additional threatened species were added to the list (refer **section 2.1.3**). However, from review of database records (**section 2.1.2**) one additional species, *Genoplesium baueri*, was identified as potentially occurring and targeted survey for this species was conducted. This list was utilised in step 2 (**Table 10**). The list of candidate species was compared against the habitat features at the site following habitat assessment to determine whether the species is considered present. The resulting list of species is compared against the features in the impact area to determine if there is a requirement for survey. A candidate species is not considered present in the development site where:

- the habitat is substantially degraded
- an expert report states that the species is unlikely to be present
- the species is a vagrant and is unlikely to use habitat on the development site
- records of the species are at least 20 years old or have doubtful authenticity.

Table 10: List of candidate species credit species and second filtering step

Species	Inclusion / exclusion	Rationale
<i>Acacia bynoeana</i>	exclude	Areas of dry sclerophyll forest to be impacted, which is the habitat for this species within the study area, are restricted to road edges and tend to be degraded. Furthermore random meander survey did not detect any individuals.
<i>Acacia gordonii</i>	exclude	Areas of dry sclerophyll forest to be impacted, which is the habitat for this species within the study area, are restricted to road edges and tend to be degraded. Furthermore random meander survey did not detect any individuals.
<i>Acacia pubescens</i>	exclude	Areas of dry sclerophyll forest to be impacted, which is the habitat for this species within the study area, are restricted to road edges and tend to be degraded. Furthermore random meander survey did not detect any individuals.
<i>Anthochaera phrygia</i>	exclude	Species is likely to be vagrant and unlikely to use habitat in the project footprint

Species	Inclusion / exclusion	Rationale
<i>Callocephalon fimbriatum</i> population in the Hornsby and Ku-ring-gai Local Government Areas	include	Forest present; areas of <i>Allocasuarina</i> will be removed from within the void
<i>Cercartetus nanus</i>	exclude	Areas of dry sclerophyll forest to be impacted, which is the habitat for this species within the study area, are restricted to road edges and tend to be degraded. Furthermore random meander survey did not detect any individuals.
<i>Chalinolobus dwyeri</i>	include	Forests, potentially crevices in cliff around void – requirement to survey
<i>Darwinia biflora</i>	exclude	Areas of dry sclerophyll forest to be impacted, which is the habitat for this species within the study area, are restricted to road edges and tend to be degraded. Furthermore random meander survey did not detect any individuals
<i>Darwinia peduncularis</i>	exclude	areas of dry sclerophyll forest to be impacted are restricted to road edges and tend to be degraded
<i>Epacris purpurascens</i> subsp. <i>purpurascens</i>	exclude	Areas of dry sclerophyll forest to be impacted, which is the habitat for this species within the study area, are restricted to road edges and tend to be degraded. Furthermore random meander survey did not detect any individuals
<i>Eucalyptus</i> sp. <i>Cattai</i>	exclude	Areas of dry sclerophyll forest to be impacted, which is the habitat for this species within the study area, are restricted to road edges and tend to be degraded. Furthermore random meander survey did not detect any individuals
<i>Genoplesium baueri</i>	This species was not generated by the tool, but was included for consideration from review of Atlas records and because of potential habitat on site	Targeted survey of potential habitat was conducted. Prior to the targeted survey two known reference sites in the northern Sydney region were inspected, and at both sites flowering was in progress (section 2.2.1). The species was not detected during the targeted survey..
<i>Grevillea parviflora</i> subsp. <i>supplicans</i>	exclude	Areas of dry sclerophyll forest to be impacted, which is the habitat for this species within the study area, are restricted to road edges and tend to be degraded. Furthermore random meander survey did not detect any individuals

Species	Inclusion / exclusion	Rationale
<i>Gyrostemon thesioides</i>	exclude	Areas of dry sclerophyll forest to be impacted, which is the habitat for this species within the study area, are restricted to road edges and tend to be degraded. Furthermore random meander survey did not detect any individuals
<i>Haloragodendron lucasii</i>	exclude	Areas of dry sclerophyll forest to be impacted, which is the habitat for this species within the study area, are restricted to road edges and tend to be degraded. Furthermore random meander survey did not detect any individuals
<i>Heleioporus australiacus</i>	exclude	Areas of dry sclerophyll forest to be impacted, which is the habitat for this species within the study area, are restricted to road edges and tend to be degraded. Furthermore random meander survey did not detect any individuals
<i>Leucopogon exolasius</i>	exclude	Areas of dry sclerophyll forest to be impacted, which is the habitat for this species within the study area, are restricted to road edges and tend to be degraded. Furthermore random meander survey did not detect any individuals
<i>Leucopogon fletcheri</i> subsp. <i>fletcheri</i>	exclude	Areas of dry sclerophyll forest to be impacted, which is the habitat for this species within the study area, are restricted to road edges and tend to be degraded. Furthermore random meander survey did not detect any individuals
<i>Melaleuca deanei</i>	exclude	Areas of dry sclerophyll forest to be impacted, which is the habitat for this species within the study area, are restricted to road edges and tend to be degraded. Furthermore random meander survey did not detect any individuals
<i>Persoonia bargoensis</i>	exclude	Areas of dry sclerophyll forest to be impacted, which is the habitat for this species within the study area, are restricted to road edges and tend to be degraded. Furthermore random meander survey did not detect any individuals
<i>Persoonia hirsuta</i>	exclude	Areas of dry sclerophyll forest to be impacted, which is the habitat for this species within the study area, are restricted to road edges and tend to be degraded. Furthermore random meander survey did not detect any individuals

Species	Inclusion / exclusion	Rationale
<i>Persoonia mollis</i> subsp. <i>maxima</i>	exclude	Areas of dry sclerophyll forest to be impacted, which is the habitat for this species within the study area, are restricted to road edges and tend to be degraded. Furthermore random meander survey did not detect any individuals
<i>Petaurus norfolcensis</i>	exclude	Areas of dry sclerophyll forest to be impacted, which is the habitat for this species within the study area, are restricted to road edges and tend to be degraded.
<i>Phascogale cinerea</i>	exclude	Areas of dry sclerophyll forest to be impacted, which is the habitat for this species within the study area, are restricted to road edges and tend to be degraded.
<i>Pomadouris brunnea</i>	exclude	Areas of dry sclerophyll forest to be impacted, which is the habitat for this species within the study area, are restricted to road edges and tend to be degraded. Furthermore random meander survey did not detect any individuals.
<i>Pseudophryne australis</i>	exclude	Areas of dry sclerophyll forest to be impacted, which is the habitat for this species within the study area, are restricted to road edges and tend to be degraded.
<i>Pterostylis saxicola</i>	exclude	Areas of dry sclerophyll forest to be impacted, which is the habitat for this species within the study area, are restricted to road edges and tend to be degraded. Furthermore random meander survey did not detect any individuals.
<i>Tetratheca glandulosa</i>	exclude	Areas of dry sclerophyll forest to be impacted, which is the habitat for this species within the study area, are restricted to road edges and tend to be degraded. Furthermore random meander survey did not detect any individuals.
<i>Zieria involucreta</i>	exclude	Areas of dry sclerophyll forest to be impacted, which is the habitat for this species within the study area, are restricted to road edges and tend to be degraded. Furthermore random meander survey did not detect any individuals.

From this second filtering step (**Table 10**), only two species were considered as potentially occurring on the site. These were the endangered population of *Callocephalon fimbriatum* (Gang-gang Cockatoo) and *Chalinolobus dwyeri* (Large-eared Pied bat). These are discussed in the sections below.

5.2.1 *Callocephalon fimbriatum* population in the Hornsby and Ku-ring-gai Local Government Areas

The endangered population was assumed present within the development site. It is not a species that cannot withstand further loss. The TSPD (OEH 2015c) suggested that loss was limited to up to 5 percent of the foraging habitat only within the CMA. This species is associated with both of the PCT recorded in the development site. It was therefore assumed that both PCT form the species polygon for this species. The total area impacted of suitable habitat for this species is 1.64 hectares (**Table 7**). This is a species for which an offset is to be determined.

5.2.2 *Chalinolobus dwyeri* (Large-eared pied Bat)

Chalinolobus dwyeri (Large-eared Pied Bat) is listed as vulnerable under the TSC Act. The Large-eared Pied Bat is found mainly in areas with extensive cliffs and caves, from Rockhampton in Queensland south to Bungonia in the NSW Southern Highlands. It is generally rare with a very patchy distribution in NSW. There are scattered records from the New England Tablelands and North West Slopes.

Large-eared Pied Bat is found in well-timbered areas containing gullies. It frequents low to mid-elevation dry open forest and woodland close to caves, crevices in cliffs, old mine workings and disused mud nests of *Hirundo ariel* (Fairy Martin). The relatively short, broad wing combined with the low weight per unit area of wing indicates manoeuvrable flight. This species probably forages for small, flying insects below the forest canopy.

Large-eared Pied Bat roosts in caves (near their entrances), crevices in cliffs, old mine workings and in the disused, bottle-shaped mud nests of the Fairy Martin. Females have been recorded raising young in maternity roosts (c. 20-40 females) from November through to January in roof domes in sandstone caves. They remain loyal to the same cave over many years (OEH 2015c).

The Large-eared Pied Bat is found mainly in areas with extensive cliffs and caves, from Rockhampton in Queensland south to Bungonia in the NSW Southern Highlands. It is generally rare with a very patchy distribution in NSW. There are scattered records from the New England Tablelands and North West Slopes.

The Large-eared Pied Bat has been recorded three times within the ten kilometre Wildlife Atlas search, scattered through the study area.

Cave-like crevices could possibly occur in the constriction footprint in the quarry void walls. Their presence cannot be confirmed due to access restriction and lack of detailed inspection of the quarry walls. Areas of potential foraging habitat include both woodlands and forests. Therefore there was a requirement to survey for this species. The survey was conducted in accordance with the draft OEH Threatened Species Survey Guidelines (2004) – see **section 2.2.1. Appendix F** contains details of the survey results.

The survey revealed that there were no Large-eared Pied Bats present. Survey was conducted during the correct season and echolocation units were placed in areas suitable for flyways and as close as possible to the area where potential void wall crevices could potentially occur. No access was able to be gained to the void to place any recording devices within the void.

The species was not detected and there is unlikely to be breeding habitat present. Therefore this species is excluded from further assessment and an offset is not required.

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6 Avoidance and mitigation measures

6.1 Avoidance of impacts

Avoidance measures incorporated into the project are characterised by:

- Examining alternate locations
- Utilising existing access tracks
- Stockpiling location
- Conveyor location.

The proposed design of the project has allowed utilisation of currently disturbed locations within the Quarry site. This therefore reduces the project overall footprint and impacts to biodiversity values of the site by limiting the vegetation clearance.

6.1.1 Alternate location

The Environmental Impact Statement (EIS) exhibited for NorthConnex identified a number of spoil management location options, with the final option(s) to be determined at construction stage.

The options identified in the EIS included the ADI site at St Marys, Gosford Quarry, Hornsby Quarry, the CSR Quarry, the Defence precinct Schofields (HMAS Nirimba) and the Great Southern Rock Quarry Sandy Point.

The management of spoil at Hornsby Quarry represents an opportunity to deposit of a large volume of spoil generated by the NorthConnex project. Additional benefits of the Hornsby Quarry site is that it provides the advantage of a site in relatively close proximity to the NorthConnex works (in comparison to other sites further to the north or west) with easy access via the M1 Pacific Motorway, Pennant Hills Road and the Pacific Highway.

With regards to alternate locations within the study area, the location of the project footprint has predominantly been located to utilise areas that are already cleared. The main area that will be cleared is associated with the access track on the eastern side of the site. This access track requires works to improve the access so that the trucks carrying the spoil will be able to safely enter.

6.1.2 Utilising access tracks

The project would utilise existing access roads and internal access tracks as far as possible to avoid the need to construct new roads and associated vegetation disturbance. However, the widening and sealing of Bridge Road is proposed to allow for safe traffic movements, which would involve some vegetation disturbance and clearing.

6.1.3 Stockpiling location

The location of the proposed stockpile will utilise a currently disturbed / cleared area that is currently utilised as part of the Mountain Bike Trail. No native vegetation has been mapped in this location and is currently dominated by exotic species, including pasture grasses and broadleaf exotic species.

6.1.4 Conveyor location

Alternative locations were proposed for the conveyor which would have required clearing through more intact native vegetation. However, following initial ecological constraints advice, the location of the conveyor has shifted to avoid the greater area of Blue Gum High Forest. The new location takes advantage of an area previously cleared for access to the void. The new location will therefore mostly avoid the CEEC and not result in the need to further fragment the CEEC.

6.2 Mitigation measures

Mitigation measures aim to reduce the ecological impacts of the Major Project to the greatest extent practicable. The relevant ecological impacts and associated mitigation measures and protocols (standard and project specific) are identified in **Table 11** and described in detail below. It is anticipated that the standard control measures (i.e. inductions etc.) would be incorporated in a flora and fauna management plan.

6.2.1 Standard mitigation measures

The mitigation and management measures would be detailed within a flora and fauna management plan, which would be prepared with consideration to the Roads and Maritime Biodiversity Guidelines – Protecting and managing biodiversity on Roads and Maritime projects (the Biodiversity Guidelines) (Roads and Traffic Authority 2011). The measures would include, but are not limited, to the following:

- The disturbance and clearance of established vegetation would be minimised as far as reasonable and feasible.
- Pre-clearing surveys would be undertaken prior to the commencement of site establishment by a suitably qualified ecologist to identify the presence of hollow bearing trees and other habitat features, and threatened flora and fauna. This would be undertaken in accordance with Guide 1 of the Biodiversity Guidelines.
- Exclusion zones would be identified to protect against accidental vegetation damage. This would be undertaken in accordance with Guide 2 of the Biodiversity Guidelines.
- Clearing of vegetation and the removal of bushrock, if required, would be undertaken in accordance with Guide 4 of the Biodiversity Guidelines to manage risks to fauna during vegetation clearing activities.
- Where reasonable and feasible habitat elements (such as woody debris and bushrock) would be stored and reused on site, or in adjacent bushland in accordance with Guide 5 of the Biodiversity Guidelines.
- Rehabilitation efforts will be as per the landowner requirements, with the aim of not precluding future land use (i.e. application of a sterile cover crop to achieve a stabilised groundcover, as per the Blue Book (Landcom 2004)).
- Any handling of fauna would be carried out by appropriately licenced or experienced person and undertaken in accordance with Guide 9 of the Biodiversity Guidelines.
- Works within aquatic habitats or riparian zones would be undertaken to limit impacts on aquatic flora and fauna, and their habitats, and impacts on riparian areas. This would be undertaken in accordance with Guide 10 of the Biodiversity Guidelines.

6.2.2 Project specific measures

Project specific measures are recommended for species where impacts would remain after the implementation of measures detailed in **Section 6.2.1**, or where additional mitigation measures would further reduce the ecological impact. The project specific mitigation measures are controls or protocols which would seek to further reduce impact on threatened species, native vegetation, or riparian and aquatic habitats

Native vegetation management

Rehabilitation efforts will be as per the landowner requirements, with the aim of not precluding future land use (i.e. application of a sterile cover crop to achieve a stabilised groundcover, as per the Blue Book (Landcom 2004)).

Sediment and erosion management

The flora and fauna management plan would include measures to minimise the impacts on all the adjoining vegetation by measures such as:

- Potential chemical pollutants (e.g. fuels, oils, lubricants, paints etc.) would be stored in appropriate containers within bunded areas within construction compounds to minimise the risk of the pollution of aquatic environments.
- Water quality would be protected through the implementation of suitable erosion and sediment control measures in accordance with Managing Urban Stormwater – Soils and Construction, Volume 2D, Main Road Construction (Department of Environment and Climate Change, 2008).

Fauna Protection Measures

A fauna protection protocol should be prepared to mitigate against impacts to aquatic fauna during the void dewatering. This protocol is intended to provide protection for any aquatic fauna that may be stranded as a result of dewatering of the void. No threatened species are expected to be present, however the protocol should also include procedures to manage unexpected finds.

The final project footprint is identified and assessed in the next chapter.

Table 11: Avoidance and mitigation measures

Impact	Flora and fauna management plan / standard mitigation measures	Project Specific	Responsibility	Timing*
Vegetation				
Clearing of native vegetation	• Inductions • Pre-clearing process • Exclusion zones • Clearing of vegetation and removal of bushrock • Re-use of woody debris and bushrock • Weed management • Nest boxes - installation of 12 nest boxes to offset the loss of the hollows that need to be removed • Fauna handling • Pathogen management	• Native vegetation management measures	Environmental representative and project contractor	Pre-commencement, site establishment, Carrying out of the project
Run off	• Erosion and sedimentation controls • Stabilisation of disturbed land in accordance with the requirements of the Blue Book.	• Sediment and erosion management and mitigation measures	Project contractor	Pre-commencement, Site establishment, Carrying out of the project
Spread of weeds	• Weed management • Re-establishment of native vegetation where possible to limit weed spread	• Sediment and erosion management and mitigation measures	Environmental representative and project contractor	Site establishment, Carrying out of the project
Spread of pathogens	• Pathogen management		Project contractor	Site establishment,

Impact	Flora and fauna management plan / standard mitigation measures	Project Specific	Responsibility	Timing*
Threatened fauna				
Loss of native fauna from clearance	- Clearing vegetation and removal of bushrock - Fauna handling	N/A	Environmental representative and fauna handlers	Site establishment,
Loss of habitat for fauna	Re-use of woody debris and bushrock	Native vegetation management measures	Environmental representative, project contractor and nest box installers	Pre-commencement Site establishment, Carrying out of the project
Loss of hollow bearing trees	- Pre-clearing process - Clearing vegetation and removal of bushrock - Re-use of woody debris and bushrock - Installation of 12 nest boxes prior to offset the loss of hollow bearing trees that need to be removed	N/A	Environmental representative, project contractor and nest box installers	Site establishment, Carrying out of the project

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7 Assessment of impacts

The potential impacts on biodiversity are discussed in this chapter. Impacts have been identified as both direct, such as direct clearing of vegetation, and indirect such as increases in noise, lighting and downstream riparian impacts.

The use of existing access tracks along with making the most of the disturbed/cleared area of the mountain bike site east of the void and the proposed conveyor location has avoided many of the potential impacts within the study area (**Table 9**). The project would have both direct and indirect impacts on a range of biodiversity values during the carrying out of the project. Impacts are mainly associated with the project footprint. The level of indirect impacts is considered to be minimal given the mitigation measures to be implemented (**section 6.2**).

The impact assessment has considered impacts during site establishment and the carrying out of the project and includes:

- Access Road construction / widening – site establishment impact
- Storage of spoil – carrying out of project impact
- Construction of conveyor belt – site establishment impact
- Spoil transport to the quarry void via conveyor belt – carrying out of project impact
- Deposition of spoil in quarry void – carrying out of project impact
- Haulage of spoil – carrying out of project impact
- Truck movements – site establishment and carrying out of project impact.

The direct impacts (**Section 7.1**) of the project relate to:

- Loss of vegetation/habitat.
- Weed spread.
- Changed hydrology.

Indirect impacts (**Section 7.2**) of the project relate to:

- Pathogens and animal pests.
- Impact on relevant Key Threatening Processes.
- Wildlife connectivity and habitat fragmentation.
- Injury and mortality.

Negligible impacts (**Section 7.3**) relate to:

- Bushfire
- Noise, vibration and light
- Groundwater dependent ecosystems
- Aquatic impacts.

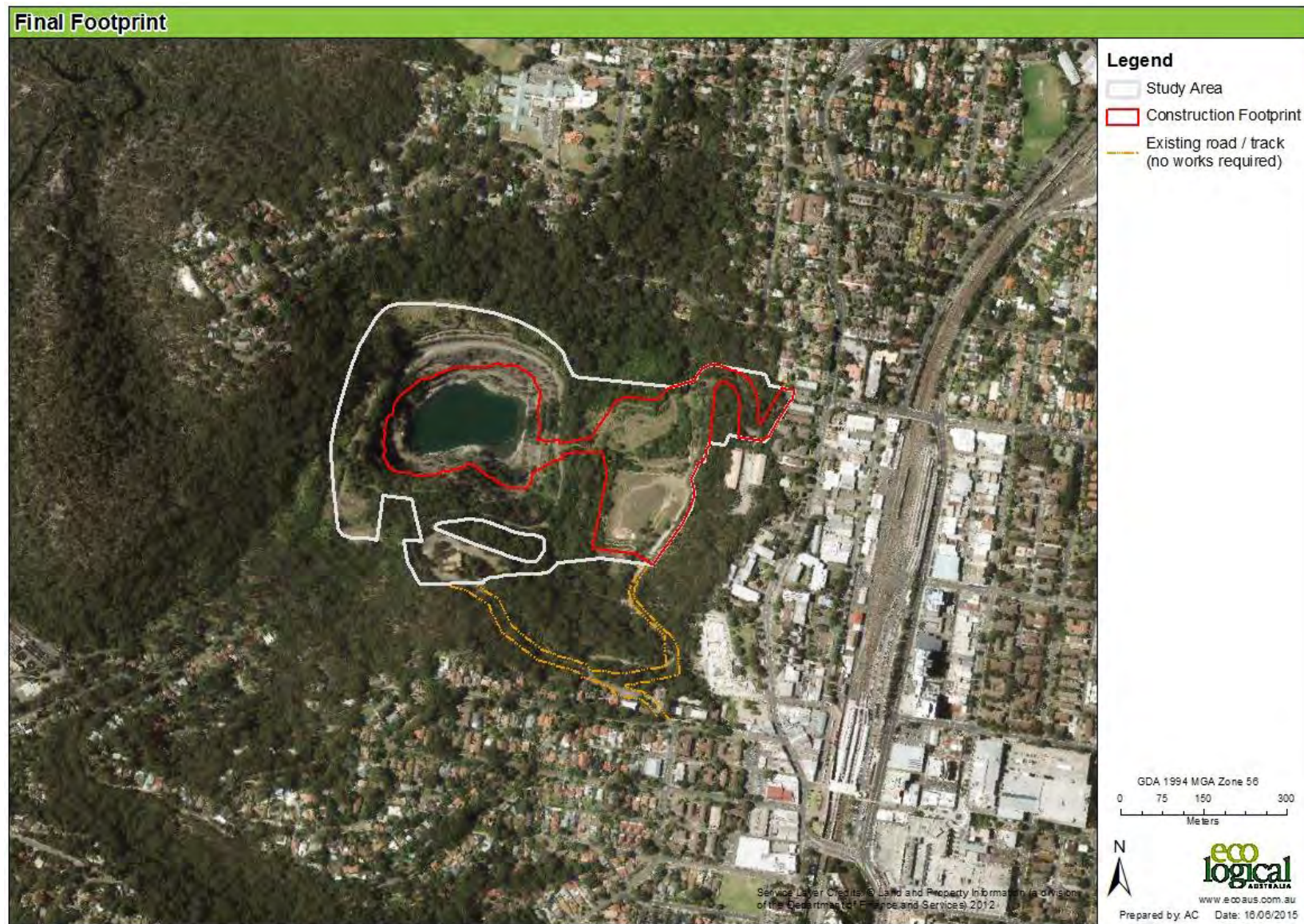


Figure 9: Final project footprint

7.1 Direct impacts

7.1.1 Loss of vegetation and/or habitat

Loss of vegetation and fauna and flora habitat is a necessary consequence of the project. The field survey validated the type and extent of vegetation and various habitats present throughout the study area:

- One critically endangered ecological community (Blue Gum High Forest) has been recorded within the study area.
- One endangered population has potential to occur within the study area, none were recorded within the study area:
 - Gang-gang Cockatoo population in the Hornsby and Ku-ring-gai Local Government Areas
- One PCT associated with threatened species habitat was recorded in the study area. This PCT was Smooth-barked Apple - Red Bloodwood - Sydney Peppermint heathy open forest in sandstone gullies of western Sydney, Sydney Basin.

No critical habitat was identified within the study area for any species, communities or populations.

The amount of project footprint is 11.2 hectares, with a total of 1.64 hectares of native vegetation to be cleared, 4.02 ha of weeds and exotics, and the remainder cleared or water in the quarry void.

There were eight hollow bearing trees likely to be impacted by the project. None of the hollows to be impacted were large enough to be roosting or breeding habitat for large forest owls or large cockatoos. A total of 12 hollows will be impacted by the works. As a result of design alterations, the project would avoid the majority of the large hollow bearing trees present within the Quarry site.

7.1.2 Weeds

Weeds were abundant within the study area with some areas containing prolific weed infestations.

Noxious weeds encountered across the study area are shown in **Table 12**.

Table 12: Noxious weed species encountered in study area

Weed species	Noxious in LGA	Class	Weed of National Significance
<i>Araujia sericifera</i> (Moth vine)	Hornsby	4	✗
<i>Asparagus aethiopicus</i> (Asparagus Fern)	Hornsby	4	✓
<i>Cinnamomum camphora</i> (Camphor Laurel)	Hornsby	4	✗
<i>Ipomoea indica</i> (Morning Glory)	Hornsby	4	✗
<i>Genista monspessulana</i> (Cape Broom)	Hornsby	3	✓
<i>Lantana camara</i> (Lantana)	Hornsby	4	✓
<i>Ligustrum lucidum</i> (Large-leaved Privet).	Hornsby	4	✗
<i>Ligustrum sinense</i> (Small-leaved Privet).	Hornsby	4	✗
<i>Ochna serrulata</i> (Mickey Mouse Plant)	Hornsby	4	✗
<i>Rubus fruticosus</i> aggregate species (Blackberry)	Hornsby	4	✗
<i>Senecio madagascariensis</i> (Fireweed)	Hornsby	4	✓

Class3: The plant must be fully and continuously suppressed and destroyed.

Class 4: The growth of the plant must be managed in a manner that reduces its numbers spread and incidence and continuously inhibits its reproduction.

The comprehensive list of weeds can be found in **Appendix D**. A total of 59 weeds species were recorded across the study area.

Given the high presence of weeds in the study area it is very likely that any vegetation disturbance could potentially create conditions where weeds are likely to invade or intensify. This would have a flow on effect on native flora and fauna by reducing quality of habitat, competition for resources and altering the structure and composition of vegetation communities.

Mitigation measures listed in **Section 6.2** would need to be implemented to contain the spread of weeds during the project.

7.1.3 Changes to hydrology

The development may result in impacts to the hydrology and aquatic ecology of creeks in the project area, via piping of stormwater runoff from newly sealed access roads into waterways east of the Quarry. There are some stormwater outlets that are currently discharging from Bridge Road into the study area. Changes to or upgrades of these outlets may increase surface flow across the Sandstone Blackbutt Woodland community. However it is noted that where the outlets currently discharge, there is already minor erosion and weed plumes. The area of discharge flows into an already diverted creek, which ultimately joins Old Man's Creek to the west of the Quarry.

It is noted that discharge of water from the quarry void is already covered under a current licence held by Hornsby Shire Council, and as such this is not included as part of this development.

7.2 Indirect impacts

7.2.1 Pathogens and animal pests

Pathogens

A number of pathogens are of concern in NSW that have the potential to impact on native flora and fauna. Activities that involve movement of equipment over large areas are of particular concern given the high potential for pathogen spread over large areas.

Although no sign of pathogen infection was identified during the field survey or literature search it is important to assess the potential impacts of these pathogens and mitigate against their spread. The main pathogens of concern are:

- Myrtle Rust (*Uredo rangellii*)
- Chytrid Fungus (*Batrachochytrium dendrobatidis*).

A pathogen of lesser concern is Phytophthora (*Phytophthora cinnamomi*).

Myrtle Rust is an air-borne plant fungus that attacks the young leaves, shoot tips and stems of Myrtaceous plants eventually causing plant death. It is spread by movement of contaminated material such as clothing, infected plants, vehicles and equipment etc. The 'introduction and establishment of Exotic Rust Fungi of the order Pucciniales pathogenic on plants of the family Myrtaceae' is a listed Key Threatening Process under the TSC Act (OEH 2014c).

Chytrid fungus is a water-borne fungus that affects amphibians. It is spread by cross contamination of water bodies and improper handling of frogs. Chytridiomycosis is the infection that causes lethargy, emaciation, skin sloughing and a range of other symptoms that eventually result in death. The infection of frogs by amphibian chytrid fungus causing the disease Chytridiomycosis' is a listed Key Threatening Process under both the EPBC Act and the TSC Act (OEH 2014d).

Chytrid fungus is of particular concern in areas where the threatened Red-crowned Toadlet habitat occurs in the northern extents of the northern interchange study area. There is a potential that the fungus may be introduced into the species' habitat.

Phytophthora is a soil-borne fungus capable of causing tree death (dieback) by attacking the roots of native plants. Spores can be spread over large areas by water, vehicle and machinery movement as well as human and animal movement. 'Dieback caused by Phytophthora' is a listed Key Threatening Process under both the EPBC Act and the TSC Act (OEH 2014e).

Given that no pathogens have been identified or are likely to occur within the study area it is unlikely that pathogens would have a significant impact on flora and fauna as part of this project, provided the mitigation measures listed in **Section 6.2** are adopted to limit the introduction of pathogens.

Animal Pests

Given the study area is disturbed and within a highly urbanised setting it is likely that animal pests would be present within the study area. Most likely pests are:

- European Red Fox (*Vulpes vulpes*)
- European Rabbit (*Oryctolagus cuniculus*)
- Feral Cat (*Felis catus*).

The European Red Fox can be found in a range of habitats. They prey on medium-sized ground-dwelling and semi-arboreal mammals and ground-nesting birds. 'Predation by the European Red Fox *Vulpes vulpes*' is a Key Threatening Process listed under both the EPBC Act and the TSC Act. Animal scats likely to belong to the European Red Fox were noted within the study area. The project is not likely to increase the presence of introduced foxes or increase predation of native fauna because no additional tracks will be created which facilitate movement of predators into otherwise uncleared or undisturbed vegetation.

The European Rabbit causes a number of environmental problems in the Australian landscape. The rabbit can increase the likelihood of soil erosion by creating numerous burrows, threaten the survival of a number of native animal species by altering habitat, reducing native food sources, displacing small animals from burrows and attracting introduced predators such as foxes. 'Competition and grazing by the feral European rabbit (*Oryctolagus cuniculus*)' is a listed Key Threatening Process under both the EPBC Act and the TSC Act. Evidence of Rabbits was identified within the study area particularly in the open/disturbed areas of the mountain bike track. The project is not likely to increase the presence of the European Rabbit within the study area because the project is removing only small areas of native vegetation and will clear some areas that are heavily weed invaded which are utilised by the European Rabbit.

Cats can be found in almost all terrestrial environments in Australia. Predation by feral cats is a particular problem that affects native fauna such as small mammals (such as rodents, dasyurids, and burramyids) and ground-nesting birds. 'Predation by the feral cat (*Felis catus*)' is a listed Key Threatening Process under both the EPBC Act and the TSC Act. No evidence of feral cats was identified during the field survey however feral and domesticated cats are likely to forage throughout the study area given the extensive areas of surrounding urban development. Given the likely abundance of cats in the locality, and the nature of the impacts associated with the project, the project is unlikely to increase the abundance of cats, introduce them into new areas, or increase predation pressure on native fauna.

7.2.2 Impact on relevant Key Threatening Processes

A number of Key Threatening Processes have been identified as being relevant. The activities associated with the project would either contribute to the Key Threatening Processes (known) or may potentially contribute to the Key Threatening Processes (potential). These are listed in **Table 13**.

Table 13: Known and potential Key Threatening Processes and impacts on biodiversity

Key Threatening Process	Relevance to the project	Potential or known
Clearing of native vegetation (TSC Act) Land clearance (EPBC Act)	Clearing of vegetation including native vegetation would be undertaken as part of the project. There would be a need to offset the loss of native vegetation in accordance to the Guideline for Biodiversity Offsets (Roads and Maritime Services 2011). This is discussed in section 8 .	Known
Infection of frogs by amphibian chytrid causing the disease chytridiomycosis (TSC Act) Infection of amphibians with chytrid fungus resulting in chytridiomycosis (EPBC Act)	Potential habitat for frogs within the study area within the ephemeral drainage line located within the mountain bike track. Movement of vehicles, equipment and people during the site establishment phase carries a risk of introduction and spread of the chytrid fungus in these habitats with potential to impact on frog species. With the implementation of appropriate mitigation measures listed in section 6.2 the risk is considered to be low.	Potential
Infection of native plants by <i>Phytophthora cinnamomi</i> (TSC Act)	Movement of vehicles, equipment and people during the site establishment phase carries a risk of introduction and spread of the plant pathogen <i>Phytophthora cinnamomi</i> . Presence of the plant pathogen within the study area is unknown. With the implementation of appropriate mitigation measures listed in section 6.2 the risk is considered to be low.	Potential
Introduction and establishment of Exotic Rust Fungi of the order Pucciniales pathogenic on plants of the family Myrtaceae (TSC Act)	Movement of vehicles, equipment and people during the site establishment phase carries a risk of introduction and spread of 'Myrtle Rust'. Presence of Myrtle Rust within the study area is unknown. With the implementation of appropriate mitigation measures listed in section 6.2 the risk is considered to be low.	Potential
Invasion and establishment of exotic vines and scramblers (TSC Act)	Exotic vines and scramblers are present within the study area including areas along road and track edges within the study area. Movement of vehicles, equipment and people during the site establishment phase carries a risk of introduction and spread of these exotic vines and scramblers and well as disturbing intact vegetation can increase the risk of weed infestations. Appropriate mitigation measures are to be implemented to limit the spread of weeds and reduce the risk of weed infestations of areas.	Potential
Invasion, establishment and spread of <i>Lantana camara</i> (TSC Act)	<i>L. camara</i> is present within the study area including within the disturbed/cleared section of the mountain bike track. Movement of vehicles, equipment and people carries a risk of introduction and spread of <i>L. camara</i> into unaffected areas. Appropriate mitigation measures are to be implemented to limit the spread of weeds and reduce the risk of weed infestations of areas.	Potential

Key Threatening Process	Relevance to the project	Potential or known
Loss of Hollow-bearing Trees (TSC Act)	The project would result in permanent removal or lopping of up to eight hollow bearing trees, containing 12 hollows (AECOM 2014). There would be a need to offset the loss of hollow-bearing trees through the installation of nest boxes in accordance to the Guideline for Biodiversity Offsets (Roads and Maritime, 2011). This is discussed further in section 6.2.2.	Known

7.2.3 Wildlife connectivity and habitat fragmentation

Fragmentation of habitat would be minimal across the study area given that the project footprint is generally following the alignment of the existing track infrastructure. The Hornsby Quarry site abuts and is connected to the vegetation of the Berowra Valley Regional Park to the west. There is likely to be an increase in the gaps between patches of native vegetation resulting from the widening of the access road into the quarry from Bridge Road. The project is not expected to significantly fragment this vegetation given that the project area is already partially cleared and the activities within the Hornsby Quarry study area are temporary.

Wildlife connectivity would not be significantly affected due to the project footprint generally following the existing access track. No new access tracks are proposed and areas where there is existing connectivity will remain.

The edge effect is likely to impact on native vegetation through the increased presence of weeds, particularly around the edges of the project footprint. No threatened species are expected to be affected by increases in weeds. One endangered ecological community may be affected by increases in weeds. However this community, Blue Gum High Forest, is already degraded by the presence of weeds in the study area. Mitigation measures to manage an increase in weed spread are discussed. Such measures include clearance limits, fencing off areas and specific site induction covering sensitive environmental issues.

7.2.4 Injury and mortality

Fauna injury or mortality could occur as a result of both the site establishment and carrying out of the project. The access roads will experience an increase in traffic via truck haulage. However, truck movements will be speed limited and impacts to fauna are likely to be limited.

During the site establishment of the project, injury or mortality may occur as a result of vegetation clearing or direct collision with vehicles and equipment within the project site. Although some mobile species may be able to move away quickly and easily such as some birds, others may be slower to move away or may not relocate at all such as some reptiles and amphibians, potentially resulting in injury or mortality of the individual.

Although the project may potentially result in some injury or mortality of fauna species, the project is unlikely to cause a significant increase in fauna injury or mortality incidents. This is because truck movements along the access roads will be speed limited due to the steep and winding nature of the access roads, allowing fauna to move off the road.

7.3 Negligible impacts

7.3.1 Bushfire

It is understood there are no permanent built or inhabited structures within areas surrounded by bush, other than road and drainage infrastructure, therefore no hazard reduction would be required within the study area. The project would not result in impediments to the implementation of bushfire protection measures within the study area. It is possible that activities during site establishment (e.g. welding) or final use of the above ground part of the assets may result in bushfire igniting and spreading from project areas. Under section 63 of the *Rural Fires Act 1997*, the obligation to prevent the occurrence and spread of bushfire needs to be factored in. This can be dealt with by emergency management planning, training and escalation protocols on days of increased bushfire risk.

The project would not result in an increased risk of inappropriate fire regimes which may adversely affect the ecological values of the remnant vegetation and associated habitats within the study area and beyond.

7.3.2 Noise, vibration and light

Indirect impacts on biodiversity caused by noise, vibration and light as part of the site establishment as well as changes in noise or lighting impacts as a result of the carrying out of the project are likely. Certain threatened species are particularly vulnerable to these indirect impacts.

All works associated with spoil management on the Hornsby Quarry site would be confined to standard work hours comprising:

- 7am to 6pm Monday to Friday.
- 8am to 1pm Saturdays.
- No work on Sundays or Public Holidays.

Whilst no works are currently proposed to occur outside of standard work hours there may be circumstances where out-of-hour works are necessary. Works which may be undertaken outside of standard work hours, without further approval, would include any of the following circumstances:

- Works which are determined to comply with the relevant Noise Management Level (NML) at the most affected sensitive receiver.
- The delivery of materials as required by the Police or other authorities for safety reasons.
- Where it is required to avoid the loss of lives, property and / or to prevent environmental harm in an emergency.
- Where agreement is reached with affected receivers.
- Where explicitly approved through an Environment Protection Licence.

Threatened species most at risk from indirect noise and vibration are:

- Nocturnal birds (such as Powerful Owl and Barking Owl) may be impacted by daily noise which could affect their behaviour.
- Bats and nocturnal mammals within the study area could be impacted by increased noise during the site establishment phase of the project and during the carrying out of the project.
- Diurnal birds may be indirectly impacted by noise during the project. Species such as small woodland birds are known to be impacted by noise associated with roads (Reijnen et al, 1995).

Noise and vibration impacts as a result of site establishment and the carrying out of the project are likely to affect fauna species that rely on sound to communicate or are nocturnal and sleep during the day when project activities are at their peak. These may include bats and other nocturnal mammals and diurnal and nocturnal birds.

Changes to the availability of light as a result of vegetation clearance may potentially impact both flora and fauna species. The potential impacts are likely to be a result of:

- Altering light regimes affecting plant growth.
- Changes to micro-climates caused by overshadowing or increased light potentially increasing the likelihood of weed invasion.

In general noise and vibration and light are unlikely to have a significant effect on the diurnal and nocturnal threatened birds and diurnal and nocturnal mammals in the study area, because these areas already receive these types of indirect impacts, and mitigation measures would be enacted by the project. In addition, noise and vibration impacts will be temporary. Works are expected to be conducted over a 33 month period. Haulage of spoil will not be a permanent activity for this site. Similarly these indirect impacts are unlikely to result in significant impacts on the amphibians and reptiles that have the potential to occur in the study area.

7.3.3 Groundwater dependent ecosystems

The main groundwater dependent ecosystems (GDEs) in the study area are Sandstone Blackbutt Woodland. While this vegetation type has a 'moderate' chance of being groundwater dependent, the water levels in the void are likely to be significantly lower than the root zone for the plants in this vegetation type.

Water level adjacent to the quarry is between 49 and 161 metres below ground level, and in-filling of the quarry is not expected to alter this. An impact assessment suggested that groundwater flow in the study area would become closer to the pre-quarry flow rates than they currently are (GHD 2009). Provided the material used to fill the quarry is not contaminated or contain sulphuric ores, soils, or other waste, the groundwater chemistry should not be impacted (GHD 2009). The proposed spoil emplacement and management would comprise of ENM and VENM materials and would not comprise waste materials or materials classified as contaminated. This means that even if vegetation communities do draw on groundwater, filling the quarry with appropriate material will not result in any significant impacts.

Widening of access roads to the quarry will be needed during quarry filling, which may require the clearing of some vegetation with potential groundwater dependence. However the ground water levels are likely to be far lower than the lowest root zone for this vegetation.

7.3.4 Aquatic impacts

A lack of ecosystem processes and aquatic habitat (e.g. soft littoral sediments and macrophyte beds) limits the type of aquatic fauna that could survive in the quarry void pond. Macroinvertebrates present would likely be hardy species suited to disturbed conditions, rather than threatened species that are known to inhabit good quality streams (e.g. Adams Emerald Dragonfly in Berowra Creek). Impacts to threatened fish are unlikely, given none are expected to occur in the quarry pond. Full dewatering or infilling of the quarry pond would extinguish the potential for all aquatic habitat, although it has limited value as a 'lake' (see **section 3.3**).

Loss of this water body would not affect downstream Key Fish Habitat, migration routes, spawning habitat or refuge habitat for any native fish. This is largely due to its isolation and difficulty for overland fish dispersal.

As the water level drops extremely low during the final stages of dewatering, dissolved oxygen may be quickly consumed by bacteria, decomposing algae and aquatic fauna (if any). This could cause impacts on aquatic fauna (e.g. fish) and semi-aquatic fauna (e.g. waterbirds, turtles, frogs and water dragons). Semi-aquatic fauna are capable of relocating themselves, although the surrounding terrain may be difficult to navigate. These impacts are understood to be covered by Hornsby Council's current water licence which allows for dewatering of the void. A faun protection protocol is recommended to provide protection for any aquatic fauna stranded as a result of dewatering.

8 Impact summary and offsets

Although avoidance and mitigation measures have been considered and implemented during the design of the project, impacts on native vegetation (including Endangered Ecological Communities) have been identified that require offsetting. The areas and credits required for offsets are outlined below.

8.1 Areas not requiring assessment or offsets

Areas not requiring assessment or offset, including for PCTs and species are outlined below and shown in **Figure 8**. The areas not requiring assessment were:

- Cleared areas – associated with tracks and roads, and areas dominated by exotics
- Water in the void
- Areas of site value score <17 (none of the vegetation met this criteria).

8.2 Ecosystem and species credits requiring offsets

Ecosystem credits and species credits that measure the impact of the Major Project on biodiversity values in the project footprint are outlined below in **Table 14** and **Table 15** (respectively) and shown in **Figure 10**. Due to the small area of poor condition Sydney Blue Gum Forest being impacted in the assessment (0.06ha), which was less than the minimum size of 0.25ha, this vegetation zone was combined with the poor quality Smooth-barked Apple vegetation zone.

Table 14: PCTs requiring offset and ecosystem credits

PCT requiring offsets	Area (ha)	Vegetation zone	Future site value score	Loss in site value score	Offset multiplier	Ecosystem credits required
HN586 Smooth-barked Apple - Red Bloodwood - Sydney Peppermint heathy open forest in sandstone gullies of western Sydney, Sydney Basin (Moderate condition)	0.58	2	0	49.28	2	16
HN586 Smooth-barked Apple - Red Bloodwood - Sydney Peppermint heathy open forest in sandstone gullies of western Sydney, Sydney Basin (Poor condition)	1.06	Vegetation zones 1 and 3 were merged due to the small size of vegetation zone 1	0	21.01	2	14

Table 15: Species requiring offset and credits required

Species requiring offsets	TS offset multiplier	Required species credits
Gang-gang Cockatoo endangered population in the Hornsby and Ku-ring-gai LGA (1.64ha impacted)	2.0	33

8.3 Impacts requiring further consideration

No matters for further consideration were listed in the SEARS or accompanying agency advice. The project also does not affect:

- A riparian buffer of an important river, stream or estuary
- Important wetland or its buffer
- Impacts on species movements along corridors(state significant biodiversity link)

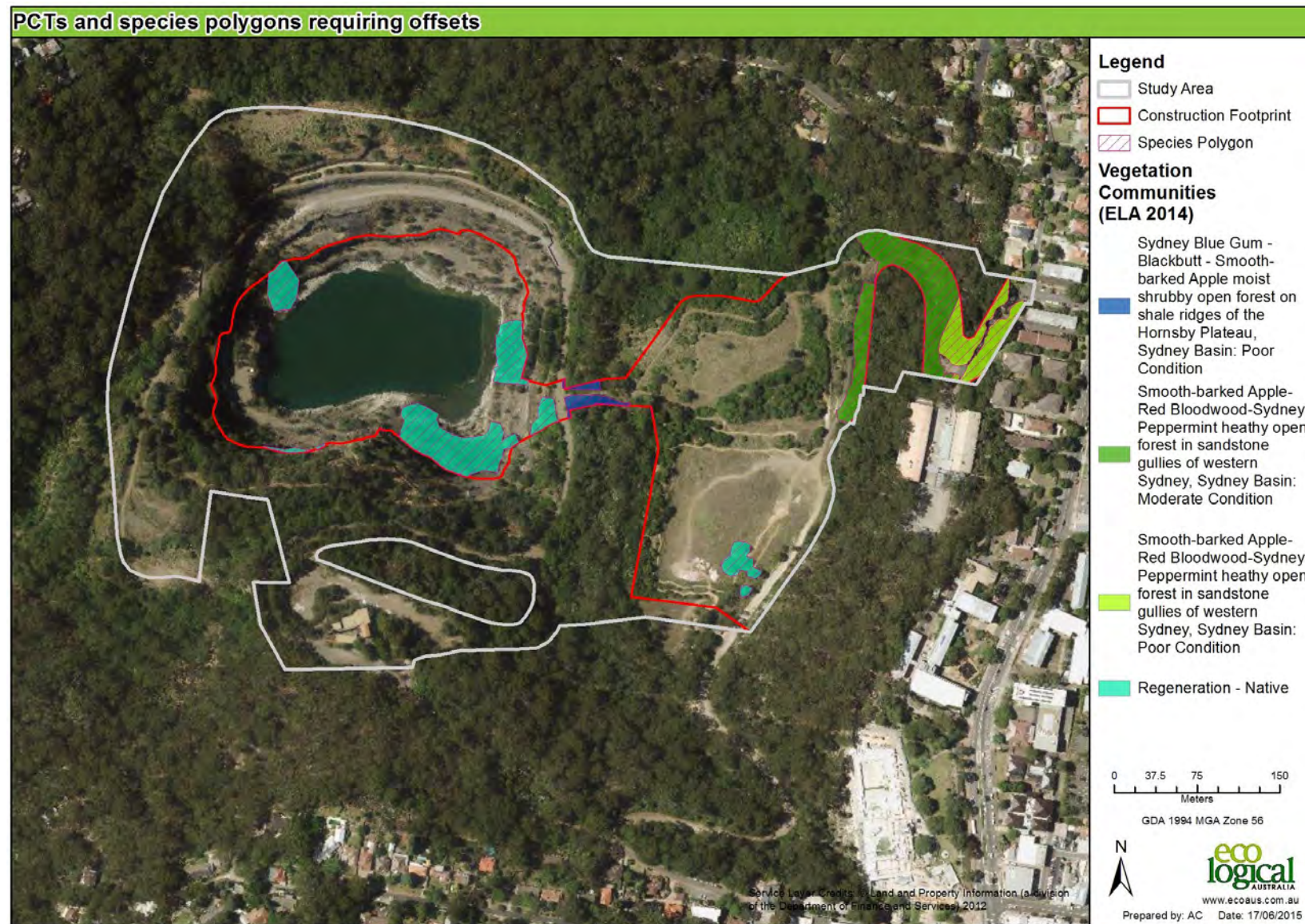


Figure 10: PCTs and species polygons requiring offsets

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9 Summary and biodiversity credit report

This project was assessed as a Major Project in accordance with the Framework for Biodiversity Assessment. The assessed project footprint covers all the areas required for the project, including excavation, spoil placement, machinery and access roads. ELA approached the assessment by conducting both desktop analysis and field assessment, using the FBA methodology to assess habitat and condition of ecological communities.

One plant community type required offsets. This was:

- Smooth-barked Apple - Red Bloodwood - Sydney Peppermint heathy open forest in sandstone gullies of western Sydney, Sydney Basin (Sandstone Blackbutt Woodland) requiring 30 ecosystem credits.

One species credit species required an offset. This was:

- Gang-gang Cockatoo endangered population in the Hornsby and Ku-ring-gai local government areas – requiring 33 credits.

Avoidance of high value ecological matters was achieved through refining the design, especially for the conveyor. The project also avoided native plant communities by taking advantage of previously cleared areas and areas with high dominance of weeds. The spoil stockpiles are to be placed on exotic grasslands, which do not correspond with any PCT.

Mitigation measures have been considered and will be delivered by:

- Delineation of clearance areas
- Management of weed spread
- Conducting the project during standard works hours as described in Section 7.3.2.
- Management of traffic within the site
- Containment of potential pollutants within specific areas to be bunded
- Rehabilitation efforts will be as per landowner requirements, with the aim of not precluding future land use.

An offset strategy consistent with the offset strategy for the NorthConnex project would be prepared to compensate for the loss of native vegetation, endangered ecological communities and threatened species habitat which cannot be avoided or mitigated. A copy of the credit report from the tool is included below.

Biodiversity credit report



This report identifies the number and type of biodiversity credits required for a major project.

Date of report: 17/06/2015

Time: 9:47:28PM

Calculator version: v4.0

Major Project details

Proposal ID: 0039/2015/1830MP

Proposal name: Hornsby Quarry Version 2

Proposal address: Quarry Road NSW

Proponent name: Roads and Maritime

Proponent address:

Proponent phone:

Assessor name: Steven Ward

Assessor address: Level 6, 299 Sussex Street SYDNEY NSW 2000

Assessor phone: 9993 0566

Assessor accreditation: 0039

Summary of ecosystem credits required

Plant Community type	Area (ha)	Credits created
Smooth-barked Apple - Red Bloodwood - Sydney Peppermint heathy open forest on slopes of dry sandstone gullies of western and southern Sydney, Sydney Basin Bioregion	1.64	30.00
Total	1.64	30

Credit profiles

1. Smooth-barked Apple - Red Bloodwood - Sydney Peppermint heathy open forest on slopes of dry sandstone gullies of western and southern Sydney, Sydney Basin Bioregion, (HN586)

Number of ecosystem credits created	30
IBRA sub-region	Cumberland - Hawkesbury/Nepean

Offset options - Plant Community types	Offset options - IBRA sub-regions
Smooth-barked Apple - Red Bloodwood - Sydney Peppermint heathy open forest on slopes of dry sandstone gullies of western and southern Sydney, Sydney Basin Bioregion, (HN586) Red Bloodwood - scribbly gum heathy woodland on sandstone plateaux of the Sydney Basin Bioregion, (HN566) Sydney Peppermint - Smooth-barked Apple - Red Bloodwood shrubby open forest on slopes of moist sandstone gullies, eastern Sydney Basin Bioregion, (ME012) Red Bloodwood - scribbly gum heathy woodland on sandstone plateaux of the Sydney Basin Bioregion, (HU595) Smooth-barked Apple - Sydney Peppermint - Turpentine heathy open forest on plateaux areas of the Sydney Basin Bioregion, (HU622) Spotted Gum - Grey Ironbark open forest in the Pittwater area, Sydney Basin Bioregion, (HN642) Sydney Peppermint - White Stringybark - Smooth-barked Apple forest on shale outcrops, Sydney Basin Bioregion, (HN644) Smooth-barked Apple - Red Bloodwood - Brown Stringybark - Hairpin Banksia heathy open forest of coastal lowlands, (HU833) Scribbly Gum - Red Bloodwood - Angophora inopina heathy woodland on lowlands of the Central Coast, (HU850) Scribbly Gum - Red Bloodwood - Old Man Banksia heathy woodland of southern Central Coast, (HU856) Red Bloodwood - Smooth-barked Apple - Scribbly Gum - Old Man Banksia heathy woodland on sandstone ranges of the Central Coast, (HU857)	Cumberland - Hawkesbury/Nepean and any IBRA subregion that adjoins the IBRA subregion in which the development occurs

Summary of species credits required

Common name	Scientific name	Extent of impact Ha or individuals	Number of species credits created
Gang-gang Cockatoo population, Hornsby and Ku-ring-gai Local Government Areas	Callocephalon fimbriatum population in the Hornsby and Ku-ring-gai Local Government Areas	1.64	33

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Appendix A Likelihood of occurrence

Provided below are the likelihood tables for threatened species listed under the Commonwealth EPBC Act. Species, populations and communities considered to have the potential, are likely or are known to occur are highlighted blue.

The analysis of the likelihood of occurrence table included previous surveys conducted by Eco Logical Australia (ELA).

Key to the table:

- TSC Act = Listing under the NSW *Threatened Species Conservation Act 1995*
- EPBC Act = Listing under the *Environment Protection and Biodiversity Conservation Act 1999*
- CE = Critically Endangered
- E = Endangered (EPBC Act)
- E1 = Endangered (TSC Act)
- E2 = Endangered Population (TSC Act)
- E4 = Extinct (TSC Act)
- V = Vulnerable
- M = Migratory (EPBC Act)
- Mar = Marine (EPBC Act)

Species name	Common name	TSC Act	EPBC Act	Habitat associations	Number of Atlas records	Likelihood of occurrence in the study area
<i>Acacia bynoeana</i>	Bynoe's Wattle	E1	V	<i>Acacia bynoeana</i> is found in central eastern NSW, from the Hunter District (Morisset) south to the Southern Highlands and west to the Blue Mountains, and has recently been found in the Colymea and Parma Creek areas west of Nowra. It is found in heath and dry sclerophyll forest, typically on a sand or sandy clay substrate, often with ironstone gravels (DECC 2007).	6	Unlikely - little ironstone gravels found within the study area
<i>Acacia gordonii</i>	-	E1	E	<i>Acacia gordonii</i> is restricted to the north-west of Sydney, occurring in the lower Blue Mountains in the west, and in the Maroota/Glenorie area in the east, within the Hawkesbury, Blue Mountains and Baulkham Hills local government areas. Grows in dry sclerophyll forest and heathlands amongst or within rock platforms on sandstone outcrops (DECC 2007).	2	Unlikely – verified in field assessment
<i>Acacia pubescens</i>	Downy Wattle	V	V	<i>Acacia pubescens</i> occurs on the NSW Central Coast in Western Sydney, mainly in the Bankstown-Fairfield-Rookwood area and the Pitt Town area, with outliers occurring at Barden Ridge, Oakdale and Mountain Lagoon. It is associated with Cumberland Plains Woodlands, Shale / Gravel Forest and Shale / Sandstone Transition Forest growing on clay soils, often with ironstone gravel (NPWS 1997; Benson and McDougall 1996).	EPBC	Unlikely – verified in field assessment
<i>Allocasuarina glareicola</i>		-	E	<i>Allocasuarina glareicola</i> is primarily restricted to the Richmond district on the north-west Cumberland Plain, with an outlier population found at Voyager Point. It grows in Castlereagh woodland on lateritic soil (DECC 2007).	EPBC	Unlikely – verified in field
<i>Asterolasia elegans</i>	-	E1	E	Occurs north of Sydney, in the Baulkham Hills, Hawkesbury and Hornsby local government areas. Also likely to occur in the western part of Gosford local government area. Known from only seven populations, only one of which is wholly within a conservation reserve. Occurs on Hawkesbury sandstone in sheltered forests on mid- to lower slopes and valleys (OEH 2014).	EPBC	Unlikely – verified in field
<i>Cryptostylis hunteriana</i>	Leafless Tongue Orchid	V	V	<i>Cryptostylis hunteriana</i> is known from a range of vegetation communities including swamp-heath and woodland (DECC 2007). The larger populations typically occur in woodland dominated by <i>Eucalyptus sclerophylla</i> (Scribbly Gum), <i>E. sieberi</i> (Silvertop Ash), <i>Corymbia gummifera</i> (Red Bloodwood) and <i>Allocasuarina littoralis</i> (Black Sheoak); where it appears to prefer open areas in the understorey of this community and is often found in association with the <i>C. subulata</i> (Large Tongue Orchid) and the <i>C. erecta</i> (Tartan Tongue Orchid) (DECC 2007).	EPBC	Unlikely – verified in field assessment

Species name	Common name	TSC Act	EPBC Act	Habitat associations	Number of Atlas records	Likelihood of occurrence in the study area
<i>Darwinia biflora</i>	-	V	V	<i>Darwinia biflora</i> is an erect or spreading shrub to 80cm high associated with habitats where weathered shale capped ridges intergrade with Hawkesbury Sandstone, where soils have high clay content (NPWS 1997).	202	Potential – no individuals recorded during targeted searches however potential habitat is present
<i>Deyeuxia appressa</i>	-	E1	E	A highly restricted NSW endemic known only from two pre-1942 records in the Sydney area. Was first collected in 1930 at Herne Bay, Saltpan Creek, off the Georges River, south of Bankstown. Was then collected in 1941 from Killara, near Hornsby. Has not been collected since and may now be extinct in the wild due to the level of habitat loss and development that has occurred within these areas (OEH 2014).	EPBC	Unlikely – verified in field
<i>Eucalyptus camfieldii</i>	Camfield's Stringybark	V	V	<i>Eucalyptus camfieldii</i> is associated with shallow sandy soils bordering coastal heath with other stunted or mallee eucalypts, often in areas with restricted drainage and in areas with laterite influenced soils, thought to be associated with proximity to shale (DECC 2007).	36	Unlikely - verified in field assessment
<i>Eucalyptus nicholii</i>	Narrow-leaved Black Peppermint	V	V	<i>Eucalyptus nicholii</i> naturally occurs in the New England Tablelands of NSW, where it occurs from Nundle to north of Tenterfield. Grows in dry grassy woodland, on shallow and infertile soils, mainly on granite (DECC 2007). This species is widely planted as an urban street tree and in gardens but is quite rare in the wild (DECC 2007). Plantings undertaken for horticultural and aesthetic purposes are not considered threatened species under the TSC Act.	2	Unlikely – out of natural range
<i>Eucalyptus scoparia</i>	Wallangarra White Gum	E1	V	Known in NSW only from the Tenterfield district where it is very uncommon. Grows on rocky hillsides in shrubby woodland close to granite outcrops.	3	Unlikely – out of natural range
<i>Genoplesium baueri</i>	Bauer's Midge Orchid	E1	E	Known from coastal areas from northern Sydney south to the Nowra district. Previous records from the Hunter Valley and Nelson Bay are now thought to be erroneous. Grows in shrubby woodland in open forest on shallow sandy soils.	17	Potential – no individuals found in the study area following targeted surveys although some habitat present.

Species name	Common name	TSC Act	EPBC Act	Habitat associations	Number of Atlas records	Likelihood of occurrence in the study area
<i>Genoplesium plumosum</i>	Tallong Midge Orchid	E1	E	<i>Genoplesium plumosum</i> occurs on very shallow soils overlying flat to gently sloping sheets of sandstone, with low scrub/heath dominated by Violet Kunzea (<i>Kunzea parvifolia</i>), Common Fringe-myrtle (<i>Calytrix tetragona</i>) and Eggs and Bacon (<i>Dillwynia</i> sp.), with scattered shrubs of Hairpin Banksia (<i>Banksia spinulosa</i>), Black She-oak (<i>Allocasuarina littoralis</i>), Bitter Cryptandra (<i>Cryptandra amara</i>), Slender Wattle (<i>Acacia elongata</i>), Narrow-leaf Geebung (<i>Persoonia linearis</i>), Coral Heath (<i>Epacris microphylla</i>) and a Beard Heath (<i>Leucopogon</i> sp.) (NPWS 2002). The habitat is surrounded by Brittle Gum (<i>Eucalyptus mannifera</i>) and Scribbly Gum (<i>E. rossii</i>) low woodland, with Argyle Apple (<i>E. cinerea</i>) present at some sites (NPWS 2002).	2	Unlikely – verified in field assessment
<i>Grevillea caleyi</i>	Caley's Grevillea	E1	E	<i>Grevillea caleyi</i> is restricted to an eight kilometre square area around Terrey Hills, approximately 20 kilometre north of Sydney. It occurs in three major areas of suitable habitat, namely Belrose, Ingleside and Terrey Hills / Duffys Forest within the Ku-ring-gai, Pittwater and Warringah local government areas. It occurs on ridgetops between elevations of 170 to 240 m asl, on laterite soils in open or low open forests, generally dominated by <i>Eucalyptus sieberi</i> , <i>Corymbia gummifera</i> and <i>E. haemastoma</i> (DECC 2007).	1	Unlikely – verified in field assessment
<i>Grevillea shiressii</i>	-	V	V	<i>Grevillea shiressii</i> occurs along creek banks in wet sclerophyll forest, on sandy soil on Hawkesbury sandstone, restricted to the Gosford area (DECC 2007).	EPBC	Unlikely – verified in field assessment
<i>Haloragis exalata</i> subsp. <i>exalata</i>	Wingless Raspwort	V	V	<i>Haloragis exalata</i> has been recorded in 4 widely scattered localities in eastern NSW; the Central Coast, South Coast and North Western Slopes botanical subdivisions of NSW; where it appears to require protected and shaded damp situations in riparian habitats (DECC 2007).	EPBC	Unlikely – verified in field assessment
<i>Haloragodendron lucasii</i>	-	E1	E	Known locations of this species are confined to a very narrow distribution on the north shore of Sydney. <i>Haloragodendron lucasii</i> is associated with low woodland on sheltered slopes near creeks on moist loamy sand on bench below small sandstone cliff lines, with continuous seepage (Benson and McDougall 1997).	4	Unlikely – verified in field assessment
<i>Kunzea rupestris</i>	-	V	V	Restricted, with most locations in the Maroota - Sackville - Glenorie area and one outlier in Ku-ring-gai Chase National Park, all within the Central Coast botanical subdivision of NSW. Currently known to exist in 20 populations, 6 of which are reserved. Grows in shallow depressions on large flat sandstone rock outcrops. Characteristically found in short to tall shrubland or heathland (OEH 2014).	1	No – verified in field

Species name	Common name	TSC Act	EPBC Act	Habitat associations	Number of Atlas records	Likelihood of occurrence in the study area
<i>Lasiopetalum joyceae</i>	-	V	V	<i>Lasiopetalum joyceae</i> grows in ridgetop woodland, heath, woodland or open scrub, often with a clay influence (NPWS 1997).	25	Unlikely – verified in field assessment
<i>Leptospermum deanei</i>	-	V	V	<i>Leptospermum deanei</i> has been recorded in Hornsby, Warringah, Ku-ring-gai and Ryde local government areas, in woodland on lower hill slopes or near creeks, at sites with sandy alluvial soil or sand over sandstone (DECC 2007). It has also been recorded in riparian scrub dominated by <i>Tristaniopsis laurina</i> and <i>Baeckea myrtifolia</i> ; woodland dominated by <i>Eucalyptus haemastoma</i> ; and open forest dominated by <i>Angophora costata</i> , <i>Leptospermum trinervium</i> and <i>Banksia ericifolia</i> (DECC 2007).	6	Unlikely – verified in field assessment.
<i>Melaleuca biconvexa</i>	Biconvex Paperbark	V	V	<i>Melaleuca biconvexa</i> occurs in coastal districts and adjacent tablelands from Jervis Bay north to the Port Macquarie district. It grows in damp places often near streams (PlantNet 2011).	1	Unlikely – no suitable habitat.
<i>Melaleuca deanei</i>	Deane's Paperbark	V	V	Found in heath on sandstone (DECC 2007), and also associated with woodland on <i>broad</i> ridge tops and slopes on sandy loam and lateritic soils (Benson and McDougall 1998).	66	Unlikely – verified in field assessment
<i>Pelargonium sp. striatellum</i>	Omeo Stork's-bill	E1	E	Known from only 3 locations in NSW, with two on lake-beds on the basalt plains of the Monaro and one at Lake Bathurst. A population at a fourth known site on the Monaro has not been seen in recent years. The only other known population is at Lake Omeo, Victoria. It occurs at altitudes between 680 to 1030 m. It is known to occur in the local government areas of Goulburn-Mulwaree, Cooma-Monaro, and Snowy River, but may occur in other areas with suitable habitat; these may include Bombala, Eurobodalla, Palerang, Tumbarumba, Tumut, Upper Lachlan, and Yass Valley local government areas. It has a narrow habitat that is usually just above the high-water level of irregularly inundated or ephemeral lakes, in the transition zone between surrounding grasslands or pasture and the wetland or aquatic communities (OEH 2014).	EPBC	No – verified in field assessment
<i>Persoonia hirsuta</i>	Hairy Geebung	E1	E	<i>Persoonia hirsuta</i> occurs from Singleton in the north, south to Bargo and the Blue Mountains to the west (DECC 2007). It grows in dry sclerophyll eucalypt woodland and forest on sandstone (PlantNet 2011).	6	Unlikely – verified in field assessment

Species name	Common name	TSC Act	EPBC Act	Habitat associations	Number of Atlas records	Likelihood of occurrence in the study area
<i>Persoonia mollis</i> subsp. <i>maxima</i>	-	E1	E	Deep gullies or on the steep upper hillsides of narrow gullies incised from Hawkesbury Sandstone, characterised by steep sideslopes, rocky benches and broken scarps, with creeks fed by small streams and intermittent drainage depressions. Occurrences of this plant have been recorded on the dry upper-hillsides of gullies and in more exposed aspects <i>E. haemastoma</i> (Scribbly Gum), <i>E. punctata</i> (Grey Gum)) (NPWS 1999).	282	Unlikely – verified in field assessment
<i>Persoonia nutans</i>	Nodding Geebung	E1	E	Associated with dry woodland, Castlereagh Scribbly Gum Woodland, Agnes Banks Woodland and sandy soils associated with tertiary alluvium, occasionally poorly drained (Benson and McDougall 2000). Endemic to the Western Sydney (Benson and McDougall 2000).	1	Unlikely – verified in field assessment
<i>Pimelea curviflora</i> var. <i>curviflora</i>	-	V	V	<i>Pimelea curviflora</i> var. <i>curviflora</i> is confined to the coastal area of Sydney between northern Sydney in the south and Maroota in the north-west. It grows on shaley/lateritic soils over sandstone and shale/sandstone transition soils on ridgetops and upper slopes amongst woodlands (DECC 2007). Associated with the Duffys Forest Community, shale lenses on ridges in Hawkesbury sandstone geology (Pittwater Council 2000).	EPBC	Unlikely – no suitable habitat.
<i>Pimelea spicata</i>	Spiked Rice-flower	E1	E	In western Sydney, <i>Pimelea spicata</i> occurs on an undulating topography of well-structured clay soils, derived from Wianamatta shale (DEC 2004). It is associated with Cumberland Plains Woodland (CPW), in open woodland and grassland often in moist depressions or near creek lines (<i>Ibid.</i>). Has been located in disturbed areas that would have previously supported CPW (<i>Ibid.</i>).	EPBC	Unlikely – verified in field assessment
<i>Prostanthera marifolia</i>	Seaforth Mintbush	CE	CE	<i>Prostanthera marifolia</i> is currently only known from the northern Sydney suburb of Seaforth and has a very highly restricted distribution. It occurs in localised patches in or in close proximity to the Duffys Forest EEC. It grows on deeply weathered clay-loam soils associated with ironstone and scattered shale lenses (DECC 2007).	EPBC	Unlikely – out of range.
<i>Pterostylis saxicola</i>	Sydney Plains Greenhood	E1	E	Most commonly found growing in small pockets of shallow soil in depressions on sandstone rock shelves above cliff lines. The vegetation communities above the shelves where <i>Pterostylis saxicola</i> occurs are sclerophyll forest or woodland on shale/sandstone transition soils or shale soils. Restricted to western Sydney between Freemans Reach in the north and Picton in the south. There are very few known populations and they are all very small and isolated (OEH 2012).	EPBC	Unlikely – verified in field assessment

Species name	Common name	TSC Act	EPBC Act	Habitat associations	Number of Atlas records	Likelihood of occurrence in the study area
<i>Streblus pendulinus</i>	Siah's Backbone	-	E	On the Australian mainland, Siah's Backbone is found in warmer rainforests, chiefly along watercourses. The altitudinal range is from near sea level to 800 m above sea level. The species grows in well-developed rainforest, gallery forest and drier, more seasonal rainforest (SEWPaC 2012).	EPBC	Unlikely – verified in field assessment
<i>Syzygium paniculatum</i>	Magenta Lilly Pilly	V	V	This species occupies a narrow coastal area between Bulahdelah and Conjola State Forests in NSW. On the Central Coast, it occurs on Quaternary gravels, sands, silts and clays, in riparian gallery rainforests and remnant littoral rainforest communities (Payne 1997). In the Ourimbah Creek valley, <i>S. paniculatum</i> occurs within gallery rainforest with <i>Alphitonia excelsa</i> , <i>Acmena smithii</i> , <i>Cryptocarya glaucescens</i> , <i>Toona ciliata</i> , <i>Syzygium oleosum</i> with emergent <i>Eucalyptus saligna</i> . At Wyrabalong NP, <i>S. paniculatum</i> occurs in littoral rainforest as a co-dominant with <i>Ficus fraseri</i> , <i>Syzygium oleosum</i> , <i>Acmena smithii</i> , <i>Cassine australe</i> , and <i>Endiandra sieberi</i> . Payne (1991) reports that the species appears absent from Terrigal formation shales, on which the gully rainforests occur. <i>S. paniculatum</i> is summer flowering (November-February), with the fruits maturing in May (DECC 2007).	4	Unlikely – verified in field assessment
<i>Tetratheca glandulosa</i>	-	V	V	Associated with ridgetop woodland habits on yellow earths (Travers Morgan 1991) also in sandy or rocky heath and scrub (NPWS 1997). Often associated with sandstone / shale interface where soils have a stronger clay influence (NPWS 1997). Flowers July to November.	173	Unlikely – verified in field assessment
<i>Thesium australe</i>	Austral Toadflax	V	V	In eastern NSW it is found in very small populations scattered along the coast, and from the Northern to Southern Tablelands. Grassland on coastal headlands or grassland and grassy woodland away from the coast.	EPBC	Unlikely – no suitable habitat within the study area
Amphibians						
<i>Heleioporus australiacus</i>	Giant Burrowing Frog	V	V	Forages in woodlands, wet heath, dry and wet sclerophyll forest (Ehmann 1997). Associated with semi-permanent to ephemeral sand or rock based streams (Ehmann 1997), where the soil is soft and sandy so that burrows can be constructed (Environment Australia 2000).	18	Unlikely – habitat limited due to heavy modification and quality of watercourses in study area

Species name	Common name	TSC Act	EPBC Act	Habitat associations	Number of Atlas records	Likelihood of occurrence in the study area
<i>Litoria aurea</i>	Green and Golden Bell Frog	E1	V	This species has been observed utilising a variety of natural and man-made waterbodies (Pyke and White 1996) such as coastal swamps, marshes, dune swales, lagoons, lakes, other estuary wetlands, riverine floodplain wetlands and billabongs, stormwater detention basins, farm dams, bunded areas, drains, ditches and any other structure capable of storing water (DECC 2009). Fast flowing streams are not utilised for breeding purposes by this species (Mahony 1999). Preferable habitat for this species includes attributes such as shallow, still or slow flowing, permanent and/or widely fluctuating water bodies that are unpolluted and without heavy shading (DEC 2005). Large permanent swamps and ponds exhibiting well-established fringing vegetation (especially bulrushes— <i>Typha</i> sp. and spikerushes— <i>Eleocharis</i> sp.) adjacent to open grassland areas for foraging are preferable (Ehmann 1997; Robinson 2004). Ponds that are typically inhabited tend to be free from predatory fish such as <i>Gambusia holbrooki</i> (Mosquito Fish) (DEC 2005; NPWS 2003). Formerly distributed from the NSW north coast near Brunswick Heads, southwards along the NSW coast to Victoria where it extends into east Gippsland. Records from west to Bathurst, Tumut and the ACT region. Since 1990 there have been approximately 50 recorded locations in NSW, most of which are small, coastal, or near coastal populations. These locations occur over the species' former range, however they are widely separated and isolated. Large populations in NSW are located around the metropolitan areas of Sydney, Shoalhaven and mid north coast (one an island population). There is only one known population on the NSW Southern Tablelands. Inhabits marshes, dams and stream-sides, particularly those containing <i>Typha</i> spp. (Bulrushes) or <i>Eleocharis</i> spp. (Spikerushes).	1	Unlikely – no suitable habitat
<i>Litoria littlejohni</i>	Littlejohn's Tree Frog	V	V	Littlejohn's Tree Frog has a distribution that includes the plateaus and eastern slopes of the Great Dividing Range from Watagan State Forest (90 km north of Sydney) south to Buchan in Victoria. The majority of records are from within the Sydney Basin Bioregion with only scattered records south to the Victorian border and this species has not been recorded in southern NSW within the last decade. Records are isolated and tend to be at high altitude. This species breeds in the upper reaches of permanent streams and in perched swamps (OEH 2014).	EPBC	Unlikely – verified in field assessment

Species name	Common name	TSC Act	EPBC Act	Habitat associations	Number of Atlas records	Likelihood of occurrence in the study area
<i>Mixophyes balbus</i>	Stuttering Frog	E	V	Stuttering Frogs occur along the east coast of Australia from southern Queensland to north-eastern Victoria. Considered to have disappeared from Victoria and to have undergone considerable range contraction in NSW, particularly in south-east NSW. It is the only Mixophyes species that occurs in south-east NSW and in recent surveys it has only been recorded at three locations south of Sydney. The Dorrigo region, in north-east NSW, appears to be a stronghold for this species. Found in rainforest and wet, tall open forest in the foothills and escarpment on the eastern side of the Great Dividing Range (OEH 2014).	EPBC	Unlikely – verified in field assessment
Fish						
<i>Epinephelus daemeli</i>	Black Rockcod	-	V	Black Rockcod inhabit caves, gutters and beneath bombores on rocky reefs. Larger juveniles use rocky shelves in estuaries. They are opportunistic carnivores, eating mainly other fish and crustaceans. Black Rockcod are apparently slow growing. Smaller fish are mostly females, but they generally change sex to become males at around 100-110 cm in length.	EPBC	No. Marine or estuarine habitat not found on site.
<i>Macquaria australasica</i>	Macquarie Perch	E (under FM Act 1994)	E	Australian Grayling occur in freshwater streams and rivers, especially clear gravelly streams with a moderate flow, as well as estuarine areas. The fish is diadromous, spending part of its lifecycle in freshwater and at least part of the larval and/or juvenile stages in coastal seas. Spawning occurs in freshwater from late summer to winter, with exact timing being dependant on location and annual conditions. Omnivorous, feeding on a variety of small aquatic organisms, including crustaceans, insects and their larvae, and algae.	EPBC	No. The quarry is not a flowing creek and is disconnected from the estuary.
<i>Prototroctes maraena</i>	Australian Grayling	-	V	Macquarie Perch are found in the Murray-Darling Basin (particularly upstream reaches) of the Lachlan, Murrumbidgee and Murray rivers, and parts of south-eastern coastal NSW, including the upper Hawkesbury and Shoalhaven catchments. Macquarie perch are found in both river and lake habitats, especially the upper reaches of rivers and their tributaries. Habitat for this species is bottom or mid-water in slow-flowing rivers with deep holes, typically in the upper reaches of forested catchments with intact riparian vegetation. Macquarie Perch also do well in some upper catchment lakes. In some parts of its range, the species is reduced to taking refuge in small pools which persist in midland–upland areas through the drier summer periods.	EPBC	Unlikely. No records of this species are found in the Hornsby-Berowra region. The quarry does not have good quality habitat found in lakes and pools this species occupies.
Reptiles						

Species name	Common name	TSC Act	EPBC Act	Habitat associations	Number of Atlas records	Likelihood of occurrence in the study area
<i>Hoplocephalus bungaroides</i>	Broad-headed Snake	E	V	The Broad-headed Snake is largely confined to Triassic and Permian sandstones, including the Hawkesbury, Narrabeen and Shoalhaven groups, within the coast and ranges in an area within approximately 250 km of Sydney. It shelters in rock crevices and under flat sandstone rocks on exposed cliff edges during autumn, winter and spring (OEH 2014).	EPBC	Unlikely – verified in field assessment.
AVES (diurnal birds)						
<i>Anthochaera phrygia</i>	Regent Honeyeater	E1	E1, Mi	Regent Honeyeaters mostly occur in dry box-ironbark eucalypt woodland and dry sclerophyll forest associations, wherein they prefer the most fertile sites available, e.g. along creek flats, or in broad river valleys and foothills. In NSW, riparian forests containing <i>Casuarina cunninghamiana</i> (River Oak), and with <i>Amyema cabbagei</i> (Needle-leaf Mistletoe), are also important for feeding and breeding. At times of food shortage (e.g. when flowering fails in preferred habitats), Honeyeaters also use other woodland types and wet lowland coastal forest dominated by <i>Eucalyptus robusta</i> (Swamp Mahogany) or <i>E. maculata</i> (Spotted Gum) (Franklin et al. 1989; Geering & French 1998; Ley & Williams 1992; Oliver et al. 1999; Webster & Menkhorst 1992). Regent Honeyeaters sometimes occur in coastal forest, especially in stands dominated by Swamp Mahogany and Spotted Gum, but also in those with Southern Mahogany <i>E. botryoides</i> , and in those on sandstone ranges with banksias <i>Banksia</i> in the understorey (Franklin et al. 1989; Higgins et al. 2001; Menkhorst 1997c). They have been recorded in open forest including forest edges, wooded farmland and urban areas with mature eucalypts (Garnett 1993). The Regent Honeyeater primarily feeds on nectar from box and ironbark eucalypts and occasionally from banksias and mistletoes (NPWS 1995). As such it is reliant on locally abundant nectar sources with different flowering times to provide reliable supply of nectar (Environment Australia 2000). In NSW, most records are scattered on and around the Great Dividing Range, mainly on the North-West Plains, North-West Slopes and adjacent Northern Tablelands, to west of Armidale; the Central Tablelands and Southern Tablelands regions; and the Central Coast and Hunter Valley regions. The species is concentrated around two main locations, the Capertee Valley and the Bundarra-Barraba area, but Honeyeaters are also recorded along the coast in the Northern Rivers and Mid-North Coast Regions, and in the Illawarra and South Coast Regions, from Nowra south to Moruya, where small numbers are recorded in most years (D. Geering 1997, unpublished data; Higgins et al. 2001; Webster & Menkhorst 1992).	4	Unlikely – limited habitat in the study area; may occasionally fly over area.

Species name	Common name	TSC Act	EPBC Act	Habitat associations	Number of Atlas records	Likelihood of occurrence in the study area
<i>Botaurus poiciloptilus</i>	Australasian Bittern	E	E	Australasian Bitterns are widespread but uncommon over south-eastern Australia. In NSW they may be found over most of the state except for the far north-west. Favours permanent freshwater wetlands with tall, dense vegetation, particularly Typha spp. (Bullrushes) and Eleocharis spp. (Spikerushes) (OEI 2014).	EPBC	No – no suitable habitat in study area
<i>Dasyornis brachypterus</i>	Eastern Bristlebird	E	E	The distribution of the Eastern Bristlebird has contracted to three disjunct areas of south-eastern Australia: southern Queensland/northern NSW, the Illawarra Region and in the vicinity of the NSW/Victorian border. Habitat is characterised by dense, low vegetation including heath and open woodland with a heathy understorey; in northern NSW occurs in open forest with tussocky grass understorey; all of these vegetation types are fire prone (OEI 2014).	EPBC	No – no suitable habitat.
<i>Lathamus discolor</i>	Swift Parrot	E	E1, Ma	Breeds in Tasmania between September and January. Feeds mostly on nectar, mainly from eucalypts, but also eats psyllid insects and lerps, seeds and fruit. Migrates to mainland in autumn, where it forages on profuse flowering Eucalypts. Favoured feed trees include winter flowering species such as Swamp Mahogany (<i>Eucalyptus robusta</i>), Spotted Gum (<i>Corymbia maculata</i>), Red Bloodwood (<i>C. gummifera</i>), Mugga Ironbark (<i>E. sideroxylon</i>), White Box (<i>E. albens</i>) and Forest Red Gum (<i>E. tereticornis</i>) (DECC 2007). Box-ironbark habitat in drainage lines and coastal forest in NSW is thought to provide critical food resources during periods of drought or low food abundance elsewhere (Mac Nally et al. 2000).	EPBC	Unlikely – although suitable habitat within the study area, species is likely to only flyover area rather than utilise resources
MAMMALIA - terrestrial (excluding bats)						
<i>Dasyurus maculatus</i>	Spotted-tailed Quoll Spotted-tailed Quoll (SE mainland population)	V -	- E	The Spotted-tailed Quoll inhabits a range of forest communities including wet and dry sclerophyll forests, coastal heathlands and rainforests (Mansergh 1984; DECC 2007j), more frequently recorded near the ecotones of closed and open forest and in NSW within 200 kilometres of the coast. Preferred habitat is mature wet forest (Belcher 2000b; Green & Scarborough 1990; Watt 1993), especially in areas with rainfall 600 mm/year (Edgar & Belcher 2008; Mansergh 1984). Unlogged forest or forest that has been less disturbed by timber harvesting is also preferable (Catling et al. 1998, 2000). This species requires habitat features such as maternal den sites, an abundance of food (birds and small mammals) and large areas of relatively intact vegetation to forage in (DECC 2007). Maternal den sites are logs with cryptic entrances; rock outcrops; windrows; burrows (Environment Australia 2000).	8	Unlikely – some habitat in area but limited suitable undisturbed forest and close proximity to urban interface across study area.

Species name	Common name	TSC Act	EPBC Act	Habitat associations	Number of Atlas records	Likelihood of occurrence in the study area
<i>Isodon obesulus</i>	Southern Brown Bandicoot (eastern)	E1	E1	This species is associated with heath, coastal scrub, sedgeland, heathy forests, shrubland and woodland on well drained, infertile soils, within which they are typically found in areas of dense ground cover. Suitable habitat includes patches of native or exotic vegetation which contain understorey vegetation structure with 50–80 per cent average foliage density in the 0.2–1 metres height range. This species is thought to display a preference for newly regenerating heathland and other areas prone to fire, but requires a mosaic of burnt and unburnt areas for survival (Menkhorst & Seebeck 1990).	EPBC	Unlikely – limited heathy forests across the study area
<i>Petrogale penicillata</i>	Brush-tailed Rock-wallaby	E	V	The range of the Brush-tailed Rock-wallaby extends from south-east Queensland to the Grampians in western Victoria, roughly following the line of the Great Dividing Range. However the distribution of the species across its original range has declined significantly in the west and south and has become more fragmented. In NSW they occur from the Queensland border in the north to the Shoalhaven in the south, with the population in the Warrumbungle Ranges being the western limit. Occupy rocky escarpments, outcrops and cliffs with a preference for complex structures with fissures, caves and ledges, often facing north (OEH 2014).	EPBC	No – no suitable habitat
<i>Phascolarctos cinereus</i>	Koala	V	V	Associated with both wet and dry Eucalypt forest and woodland that contains a canopy cover of approximately 10 to 70% (Reed et al. 1990), with acceptable Eucalypt food trees. Some preferred Eucalyptus species are: <i>Eucalyptus tereticornis</i> , <i>E. punctata</i> , <i>E. cypellocarpa</i> , <i>E. viminalis</i>	5	Potential – limited suitable habitat across the study area.
<i>Pseudomys novaehollandiae</i>	New Holland Mouse	-	V	A small burrowing native rodent with a fragmented distribution across Tasmania, Victoria, New South Wales and Queensland. Inhabits open heathlands, open woodlands with a heathland understorey and vegetated sand dunes. A social animal, living predominantly in burrows shared with other individuals. The home range of the New Holland Mouse ranges from 0.44 ha to 1.4 ha and the species peaks in abundance during early to mid stages of vegetation succession typically induced by fire (SEWPaC 2012)	EPBC	No – limited suitable habitat in study area and close proximity to urban interface

MAMMALIA - terrestrial (bats)

Species name	Common name	TSC Act	EPBC Act	Habitat associations	Number of Atlas records	Likelihood of occurrence in the study area
<i>Chalinolobus dwyeri</i>	Large-eared Pied Bat	V	V	The Large-eared Pied Bat has been recorded in a variety of habitats, including dry sclerophyll forests, woodland, sub-alpine woodland, edges of rainforests and wet sclerophyll forests (Churchill 1998; DECC 2007). This species roosts in caves, rock overhangs and disused mine shafts and as such is usually associated with rock outcrops and cliff faces (Churchill 1998; DECC 2007).	EPBC	Potential -, although species not found, based on habitat assessments, suitable habitat is present in study area.
<i>Pteropus poliocephalus</i>	Grey-headed Flying-Fox	V	V	Inhabits a wide range of habitats including rainforest, mangroves, paperbark forests, wet and dry sclerophyll forests and cultivated areas (Churchill 1998, Eby 1998). Camps are often located in gullies, typically close to water, in vegetation with a dense canopy (Churchill 1998).	35	Likely – suitable foraging habitat present in study area. No camps detected during field assessment.

Migratory terrestrial species

<i>Haliaeetus leucogaster</i>	White-bellied Sea-Eagle	-	M	Forages over large open fresh or saline waterbodies, coastal seas and open terrestrial areas (Marchant & Higgins 1993, Simpson & Day 1999). Breeding habitat consists of tall trees, mangroves, cliffs, rocky outcrops, silts, caves and crevices and is located along the coast or major rivers. Breeding habitat is usually in or close to water, but may occur up to a kilometre away (Marchant & Higgins 1993).	EPBC	Unlikely – no suitable habitat
<i>Hirundapus caudacutus</i>	White-throated Needletail	-	M	Forages aerially over a variety of habitats usually over coastal and mountain areas, most likely with a preference for wooded areas (Marchant & Higgins 1993; Simpson & Day 1999). Has been observed roosting in dense foliage of canopy trees, and may seek refuge in tree hollows in inclement weather (Marchant & Higgins 1993).	EPBC	Unlikely
<i>Merops ornatus</i>	Rainbow Bee-eater	-	M	Resident in coastal and subcoastal northern Australia; regular breeding migrant in southern Australia, arriving September to October, departing February to March, some occasionally present April to May. Occurs in open country, chiefly at suitable breeding places in areas of sandy or loamy soil: sand-ridges, riverbanks, road-cuttings, sand-pits, occasionally coastal cliffs.	EPBC	Unlikely – limited suitable habitat.
<i>Monarcha melanopsis</i>	Black-faced Monarch	-	M	Rainforest and eucalypt forests, feeding in tangled understorey (Blakers et al. 1984).	EPBC	Unlikely – limited suitable habitat.

Species name	Common name	TSC Act	EPBC Act	Habitat associations	Number of Atlas records	Likelihood of occurrence in the study area
<i>Monarcha trivirgatus</i>	Spectacled Monarch	-	M	The Spectacled Monarch prefers thick understorey in rainforests, wet gullies and waterside vegetation, as well as mangroves.	EPBC	Unlikely – limited suitable habitat.
<i>Myiagra cyanoleuca</i>	Satin Flycatcher	-	M	Wetter, denser forest, often at high elevations (Simpson & Day 2004).	EPBC	Unlikely – limited suitable habitat.
<i>Rhipidura rufifrons</i>	Rufous Fantail	-	M	The Rufous Fantail is a summer breeding migrant to southeastern Australia (Morcombe, 2004). The Rufous Fantail is found in rainforest, dense wet eucalypt and monsoon forests, paperbark and mangrove swamps and riverside vegetation (Morcombe, 2004). Open country may be used by the Rufous Fantail during migration (Morcombe, 2004).	EPBC	Unlikely – limited suitable habitat.
<i>Anthochaera phrygia</i>	Regent Honeyeater	E1	E1, Mi	SEE DIURNAL BIRDS ABOVE	-	Unlikely – limited habitat in study area
Migratory wetland species						
<i>Ardea alba</i>	Great Egret	-	M	The Great Egret is common and widespread in Australia (McKilligan, 2005). The Eastern Great Egret has been reported in a wide range of wetland. These include swamps and marshes; margins of rivers and lakes; damp or flooded grasslands, pastures or agricultural lands; reservoirs; sewage treatment ponds; drainage channels; salt pans and salt lakes; salt marshes; estuarine mudflats, tidal streams; mangrove swamps; coastal lagoons; and offshore reefs (Kushlan & Hancock 2005; Marchant & Higgins 1993; Martínez-Vilalta & Motis 1992). The species usually frequents shallow waters. It forages in a wide range of wet and dry habitats including permanent and ephemeral freshwaters, wet pasture and estuarine mangroves and mudflats (McKilligan, 2005).	EPBC	No – no habitat in study area
<i>Ardea ibis</i>	Cattle Egret	-	M	Cattle Egrets forage on pasture, marsh, grassy road verges, rain puddles and croplands, but not usually in the open water of streams or lakes and they avoid marine environments (McKilligan, 2005). Some individuals stay close to the natal heronry from one nesting season to the next, but the majority leaves the district in autumn and return the next spring. Cattle Egrets are likely to spend the winter dispersed along the coastal plain and only a small number have been recovered west of the Great Dividing Range (McKilligan, 2005).	EPBC	No – no habitat in study area
<i>Gallinago hardwickii</i>	Latham's Snipe	-	M	A variety of permanent and ephemeral wetlands, preferring open fresh water wetlands with nearby cover (Marchant and Higgins 1993).	EPBC	No – no habitat in study area

Species name	Common name	TSC Act	EPBC Act	Habitat associations	Number of Atlas records	Likelihood of occurrence in the study area
<i>Rostratula australis</i>	Painted Snipe (Australian subspecies)	E	E, M	Prefers fringes of swamps, dams and nearby marshy areas where there is a cover of grasses, lignum, low scrub or open timber (OEH 2012). Nests on the ground amongst tall vegetation, such as grasses, tussocks or reeds (ibid.). Breeding is often in response to local conditions; generally occurs from September to December (OEH 2012). Forages nocturnally on mud-flats and in shallow water (OEH 2012). Feeds on worms, molluscs, insects and some plant-matter (ibid.).	EPBC	No – no habitat in study area
Migratory Marine Species						
<i>Diomedea epomophora epomophora</i>	Southern Royal Albatross	-	V, M	Marine forager	EPBC	No – no habitat in study area
<i>Diomedea epomophora sanfordi</i>	Northern Royal Albatross	-	E, M	Marine forager	EPBC	No – no habitat in study area
<i>Diomedea exulans antipodensis</i>	Antipodean Albatross	V	V, M	Marine forager	EPBC	No – no habitat in study area
<i>Diomedea exulans</i>	Wandering Albatross	E	V, M	Marine forager	1	No – no suitable habitat in study area
<i>Diomedea exulans exulans</i>	Tristan Albatross	-	E, M	Marine forager	EPBC	No – no habitat in study area
<i>Diomedea exulans gibsoni</i>	Gibson's Albatross	V	V, M	Marine forager	EPBC	No – no habitat in study area

Species name	Common name	TSC Act	EPBC Act	Habitat associations	Number of Atlas records	Likelihood of occurrence in the study area
<i>Limicola falcinellus</i>	Broad-billed Sandpiper	V	M	The eastern form of the Broad-billed Sandpiper breeds in northern Siberia before migrating southwards in winter to Australia (DECC 2007). In Australia, Broad-billed Sandpipers over-winter on the northern coast, particularly in the north-west, with birds located occasionally on the southern coast (DECC 2007). In NSW, the main site for the species is the Hunter River estuary, with birds occasionally reaching the Shoalhaven estuary (DECC 2007). There are few records for inland NSW (DECC 2007). Broad-billed Sandpipers favour sheltered parts of the coast such as estuarine sandflats and mudflats, harbours, embayments, lagoons, saltmarshes and reefs as feeding and roosting habitat (DECC 2007). Occasionally, individuals may be recorded in sewage farms or within shallow freshwater lagoons (DECC 2007). Broad-billed Sandpipers roost on banks on sheltered sand, shell or shingle beaches.	1	No. Habitat not suitable.
<i>Macronectes giganteus</i>	Southern Giant-Petrel	E	E, M	Marine Forager	EPBC	No – no habitat in study area
<i>Macronectes halli</i>	Northern Giant-Petrel	V	V, M	Marine Forager	EPBC	No – no habitat in study area
<i>Thalassarche bulleri</i>	Buller's Albatross	-	V, M	Marine Forager	EPBC	No – no habitat in study area
<i>Thalassarche cauta cauta</i>	Shy Albatross, Tasmanian Shy Albatross	V	V, M	Marine Forager	EPBC	No – no habitat in study area
<i>Thalassarche cauta salvini</i>	Salvin's Albatross	-	V, M	Marine Forager	EPBC	No – no habitat in study area
<i>Thalassarche cauta steadi</i>	White-capped Albatross	-	V, M	Marine Forager	EPBC	No – no habitat in study area
<i>Thalassarche eremita</i>	Chatham Albatross	-	E, M	Marine Forager	EPBC	No – no habitat in study area
<i>Thalassarche melanophrys</i>	Black-browed Albatross	V	V, M	Marine Forager	EPBC	No – no habitat in study area

Species name	Common name	TSC Act	EPBC Act	Habitat associations	Number of Atlas records	Likelihood of occurrence in the study area
<i>Thalassarche melanophrys impavida</i>	Campbell Albatross	-	V, M	Marine Forager	EPBC	No – no habitat in study area

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Appendix B Plot and transect field data

Plots labelled from “Plot 1, Plot 4, and Plot 7” were gathered during the December 2014 survey period, “Plot 1, Plot 3 Plot 5 and Plot 6” during the December 2013 survey period.

Vegetation Zone 1

Vegetation Type: Sydney Blue Gum - Blackbutt - Smooth-barked Apple moist shrubby open forest on shale ridges of the Hornsby Plateau, Sydney Basin

Condition: Moderate/Good (Poor)

Plot Name	NPS	NOS	NMS	NGC (G)	NGC (S)	NGC (O)	EPC	NTH	OR	FL	Easting	Northing	Zone
1	16	44	0	0	0	22	35	0*	0%	29	322914	6269614	56
2	8	2	0	0	0	0	38	0*	0%	38	323301	6269610	56

* This zone was merged with zone 3 due to the very small size impacted (0.06ha), which is less than minimum size of 0.25 ha. The higher value of 0.2 was utilised for overstorey regeneration for all plots entered,

Vegetation Zone 2

Vegetation Type: Smooth-barked Apple - Red Bloodwood - Sydney Peppermint heathy open forest in sandstone gullies of western Sydney, Sydney Basin

Condition: Moderate/Good (Moderate)

Plot Name	NPS	NOS	NMS	NGC (G)	NGC (S)	NGC (O)	EPC	NTH	OR	FL	Easting	Northing	Zone
3	18	43.6	0	0	0	46	29.5	1	100%	3	323550	6269789	56
4	32	43	3.5	16	0	24	0	0	100%	61	323933	6269414	56
5	28	56	1.5	56	0	10	0	1	100%	31	323072	6269432	56

Vegetation Zone 3

Vegetation Type: Smooth-barked Apple - Red Bloodwood - Sydney Peppermint heathy open forest in sandstone gullies of western Sydney, Sydney Basin

Condition: Moderate/Good (Poor)

Plot Name*	NPS	NOS	NMS	NGC (G)	NGC (S)	NGC (O)	EPC	NTH	OR	FL	Easting	Northing	Zone
6	6	24	0	0	2	0	88.6	0	20%	0	323578.3	6269783	56
7	8	36.5	1	0	0	2	113	1	20%	2	323502	6269326	56

Appendix C Plot and transect field data sheets

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Appendix D Flora species recorded

The flora lists include species recorded from opportunistic surveys and biometric plots.

Table 16: Native flora species list recorded during the field survey

	Scientific Name	Common Name	Opportunistic	Biometric plots
1	<i>Acacia decurrens</i>	Black Wattle	x	
2	<i>Acacia linifolia</i>		x	
3	<i>Acacia longifolia</i> subsp. <i>longifolia</i>	Sydney Golden Wattle	x	x
4	<i>Acacia myrtifolia</i>	Red-stemmed Wattle	x	
5	<i>Acacia ulicifolia</i>	Prickly Moses		x
6	<i>Adiantum aethiopicum</i>	Common maidenhair	x	
7	<i>Allocasuarina littoralis</i>	Black She-oak		x
8	<i>Allocasuarina</i> sp.		x	
9	<i>Allocasuarina torulosa</i>	Forest Oak		x
10	<i>Angophora costata</i>	Sydney Red Gum	x	x
11	<i>Angophora floribunda</i>	Rough-barked Apple	x	x
12	<i>Austrodanthonia</i> sp.		x	
13	<i>Banksia serrata</i>	Old-man Banksia	x	x
14	<i>Bossiaea heterophylla</i>	Variable Bossiaea		x
15	<i>Bossiaea obcordata</i>	Spiny Bossiaea		x
16	<i>Breynia oblongifolia</i>	Coffee Bush	x	x
17	<i>Carex inversa</i>			x
18	<i>Ceratopetalum gummiiferum</i>	New South Wales Christmas-bush		x
19	<i>Clematis aristata</i>	Old Man's Beard		x
20	<i>Commelina cyanea</i>	Native Wandering Jew		x
21	<i>Corymbia gummifera</i>			x
22	<i>Corymbia maculata</i>	Spotted Gum	x	
23	<i>Cryptostylis</i> sp.			x
24	<i>Cyathochaeta diandra</i>			x
25	<i>Cynodon dactylon</i>	Couch	x	x
26	<i>Dianella caerulea</i> var. <i>caerulea</i>	Blue Flax Lily	x	
27	<i>Dianella longifolia</i> var. <i>longifolia</i>			x
28	<i>Dichondra repens</i>	Kidney Weed	x	x
29	<i>Elaeocarpus reticulatus</i>	Blueberry Ash		x
30	<i>Entolasia marginata</i>	Bordered Panic		x
31	<i>Entolasia stricta</i>		x	x
32	<i>Epacris pulchella</i>	Wallum Heath	x	x
33	<i>Eucalyptus pilularis</i>	Blackbutt	x	x
34	<i>Eucalyptus resinifera</i>	Red Mahogany		x
35	<i>Eucalyptus saligna</i>	Sydney Blue Gum	x	x
36	<i>Eustrephus latifolius</i>	Wombat Berry	x	x
37	<i>Exocarpos cupressiformis</i>	Cherry Ballart	x	
38	<i>Glycine tabacina</i>		x	

	Scientific Name	Common Name	Opportunistic	Biometric plots
39	<i>Goodenia hederacea</i>	Forest Goodenia	x	
40	<i>Grevillea robusta</i> #	Silky Oak	x	
41	<i>Guioa semiglauca</i>	Guioa		x
42	<i>Hibbertia aspera</i>	Rough Guinea Flower	x	
43	<i>Hibbertia empetrifolia</i>			x
44	<i>Hovea linearis</i>			x
45	<i>Imperata cylindrica</i>	Blady Grass	x	x
46	<i>Indigofera australis</i>	Australian Indigo	x	
47	<i>Kennedia rubicunda</i>	Dusky Coral Pea		x
48	<i>Lepidosperma laterale</i>		x	
49	<i>Leptospermum trinervium</i>		x	x
50	<i>Leucopogon parviflorus</i>	Coastal Beard-heath		x
51	<i>Lomandra filiformis</i> subsp. <i>filiformis</i>	Wattle Mat-rush	x	x
52	<i>Lomandra longifolia</i>	Spiny-headed Mat-rush	x	x
53	<i>Lomandra obliqua</i>		x	
54	<i>Lomatia silaifolia</i>	Crinkle Bush		x
55	<i>Melaleuca styphelioides</i>	Prickly-leaved Tea-tree	x	
56	<i>Oplismenus aemulus</i>	Australian Basket Grass		x
57	<i>Oplismenus imbecillis</i>	Creeping Beard Grass		x
58	<i>Oxalis perennans</i>		x	
59	<i>Ozothamnus diosmifolius</i>	Rice Flower	x	x
60	<i>Pandorea pandorana</i>	Wonga Wonga Vine		x
61	<i>Persoonia linearis</i>	Narrow-leaved Geebung	x	
62	<i>Persoonia pinifolia</i>	Pine-leaved Geebung		x
63	<i>Phyllanthus hirtellus</i>	Thyme Spurge		x
64	<i>Pittosporum revolutum</i>	Wild Yellow Jasmine		x
65	<i>Pittosporum undulatum</i>	Native Daphne	x	x
66	<i>Platysace lanceolata</i>	Shrubby Platyscae	x	
67	<i>Poa labillardierei</i>	Tussock		x
68	<i>Polyscias sambucifolia</i>	Elderberry Panax	x	
69	<i>Pomax umbellata</i>		x	
70	<i>Poranthera microphylla</i>			x
71	<i>Pteridium esculentum</i>	Common Bracken	x	x
72	<i>Pterostylis</i> sp.			x
73	<i>Schizaea bifida</i>	Forked Comb Fern		x
74	<i>Smilax glycyphylla</i>	Sweet Sarsaparilla	x	x
75	<i>Syncarpia glomulifera</i>	Turpentine	x	x
76	<i>Themeda australis</i>	Kangaroo Grass	x	
77	<i>Xanthorrhoea</i> sp.		x	x

Denotes native planted or non-indigenous to the area

Table 17: Exotic species list recorded during the field survey

	Scientific Name	Common Name	Opportunistic	Biometric plots
1	<i>Ageratina adenophora</i>	Crofton Weed	x	x
2	<i>Ageratina riparia</i>	Creeping Crofton Weed	x	
3	<i>Anagallis arvensis</i>	Scarlet Pimpernel	x	
4	<i>Andropogon virginicus</i>	Whisky Grass	x	
5	<i>Araujia sericifera</i>	Moth Vine	x	
6	<i>Asparagus aethiopicus</i>	Aparagus Fern	x	x
7	<i>Asparagus asparagoides</i>	Bridal Creeper		x
8	<i>Asphodelus</i> sp.			x
9	<i>Bidens pilosa</i>	Cobblers Pegs	x	x
10	<i>Bromus catharticus</i>	Prairie Grass		x
11	<i>Centaureum</i> sp.		x	
12	<i>Chloris gayana</i>			x
13	<i>Chloris</i> sp.		x	
14	<i>Chrysanthemoides</i> sp.			x
15	<i>Cinnamomum camphora</i>	Camphor Laurel	x	x
16	<i>Cirsium vulgare</i>	Spear Thistle	x	
17	<i>Conyza</i> sp.			x
18	<i>Cortaderia selloana</i>	Pampas Grass	x	
19	<i>Cosmos bipinnatus</i>		x	x
20	<i>Cotoneaster glaucophyllus</i>	Cotoneaster	x	
21	<i>Crataegus monogyna</i>	Hawthorn		x
22	<i>Cytisus scoparius</i>	Scotch Broom	x	
23	<i>Ehrharta erecta</i>	Panic Veldtgrass	x	x
24	<i>Eragrostis curvula</i>	African Lovegrass	x	
25	<i>Erodium</i> sp.			x
26	<i>Erythrina x sykesii</i>	Coral Tree	x	
27	<i>Genista monspessulana</i>	Montpellier Broom	x	x
28	<i>Hedera helix</i>	English Ivy	x	x
29	<i>Hypochaeris radicata</i>	Catsear	x	
30	<i>Ipomoea indica</i>	Morning Glory	x	x
31	<i>Jacaranda mimosifolia</i>	Jacaranda	x	x
32	<i>Lantana camara</i>	Lantana	x	x
33	<i>Ligustrum lucidum</i>	Large Leaved Privet	x	x
34	<i>Ligustrum sinense</i>	Small Leaved Privet	x	x
35	<i>Lonicera japonica</i>	Japanese Honeysuckle		x
36	<i>Modiola caroliniana</i>	Red-flowered Mallow		x
37	<i>Monstera deliciosa</i>	Fruit Salad Plant	x	
38	<i>Nephrolepis cordifolia</i>	Fishbone Fern	x	x
39	<i>Nerium oleander</i>	Oleander	x	
40	<i>Ochna serrulata</i>	Mickey Mouse Plant	x	x
41	<i>Oxalis</i> sp.			x
42	<i>Paspalum dilatatum</i>	Paspalum	x	x

	Scientific Name	Common Name	Opportunistic	Biometric plots
43	<i>Pennisetum clandestinum</i>	Kikuyu	x	x
44	<i>Plantago lanceolata</i>	Lamb's Tongues	x	
45	<i>Rosa</i> sp.			x
46	<i>Rubus</i> sp.	Blackberry		x
47	<i>Rumex</i> sp.			x
48	<i>Senecio madagascariensis</i>	Fireweed	x	
49	<i>Senna pendula</i>	Bird-of-Paradise Shrub	x	x
50	<i>Sida rhombifolia</i>	Paddy's Lucerne	x	x
51	<i>Solanum jasminoides</i>	Potato Vine		x
52	<i>Solanum mauritianum</i>	Wild Tobacco Bush	x	
53	<i>Solanum</i> sp.		x	
54	<i>Sporobolus</i> sp.		x	
55	<i>Tradescantia fluminensis</i>	Wandering Jew		x
56	<i>Trifolium repens</i>	White Clover	x	x
57	<i>Verbena bonariensis</i>	Purpletop	x	
58	<i>Vicia</i> sp.			x
59	<i>Watsonia</i> sp.			x

Appendix E Fauna species recorded

The fauna list includes species recorded from opportunistic surveys and Anabat survey.

Table 18: Fauna species list recorded during the field survey

	Common Name	Scientific Name	Observation Type
1	Australian Brush-turkey	<i>Alectura lathamii</i>	O
2	Australian Magpie	<i>Cracticus tibicen</i>	O
3	Australian Raven	<i>Corvus coronoides</i>	O
4	Bell Miner	<i>Manorina melanophrys</i>	W
5	Black-faced Cuckoo-shrike	<i>Coracina novaehollandiae</i>	O
6	Brush Turkey	<i>Alectura lathamii</i>	O
7	Channel-Billed Cuckoo	<i>Scythrops novaehollandiae</i>	W
8	Eastern Water Dragon	<i>Physignathus lesueurii</i>	O
9	Grey Butcherbird	<i>Cracticus torquatus</i>	W
10	Laughing Kookaburra	<i>Dacelo novaeguineae</i>	W
11	Pacific Black Duck	<i>Anas superciliosa</i>	O
12	Pied Currawong	<i>Strepera graculina</i>	W
13	Red-bellied Black snake	<i>Pseudechis porphyriacus</i>	O
14	Superb Fairy-wren	<i>Malurus cyaneus</i>	O
15	Swamp Wallaby	<i>Wallabia bicolor</i>	O
16	Water Dragon	<i>Physignathus lesueurii</i>	O
17	Gould's Wattled Bat	<i>Chalinolobus gouldii</i>	A
18	White-striped Freetail Bat	<i>Tadarida australis</i>	A
19	Little Forest Bat	<i>Vespadelus vulturnus</i>	A

O denotes observed, W denotes heard, A denotes Anabat.

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Appendix F Anabat survey results

Bat calls were analysed by Danielle Adams – Bennett and reviewed by Alicia Scanlon of ELA who has seven years' experience in the identification of ultrasonic echolocation recordings, using the program AnalookW (Version 3.8 25 October 2012, written by Chris Corben, www.hoarybat.com, Corben and O'Farrell 2002). Call identifications were made using regional based guides to the echolocation calls of microbats in New South Wales (Pennay et al. 2004); and south-east Queensland and north-east New South Wales (Reinhold et al. 2001) and the accompanying reference library of over 200 calls from north-eastern NSW. Available: (<http://www.forest.nsw.gov.au/research/bats/default.asp>).

Bat calls are analysed using species-specific parameters of the call profile such as call shape, characteristic frequency, initial slope and time between calls (Reinhold et al. 2001). To ensure reliable and accurate results the following protocols (adapted from Lloyd et. al. 2006) were followed:

- Search phase calls were used in the analysis, rather than cruise phase calls or feeding buzzes (McKenzie et al. 2002)
- Recordings containing less than three pulses were not analysed and these sequences were labeled as short (Law et al. 1999)
- Four categories of confidence in species identification were used (Mills et al. 1996):
 - o definite – identity not in doubt
 - o probable – low probability of confusion with species of similar calls
 - o possible – medium to high probability of confusion with species with similar calls
 - o low/short – calls made by bats which cannot be identified to even a species group.
- *Nyctophilus* spp. are difficult to identify confidently from their calls and no attempt was made to identify this genus to species level (Pennay et al. 2004)
- Sequences not attributed to microbat echolocation calls were labeled as junk or non-bat calls and don't represent microbat activity at the site
- Sequences labelled as low/short were of poor quality and therefore not able to be identified to any microbat species, they can however be used as an indicator of microbat activity at the site

Echolocation calls were recorded over three nights between 15 and 17 December 2014 at Hornsby Quarry, NSW. Of the 149 sequences recorded, 125 (83%) could be identified to species level (**Table 19** to **Table 21**) with the remainder being too short or of low quality preventing positive identification.

There were up to seven species identified, including potentially one species listed as vulnerable under the NSW TSC Act (Table 19 to **Table 21**, **Figure 11** to **Figure 16**).

General microbat activity was moderate at site 1 with calls recorded on average less often than every two minutes but more often than every ten minutes throughout the survey period. Microbat activity was low at sites 2 and 3 with calls recorded on average less often than every ten minutes throughout the survey period. There were few long sequences or feeding buzzes recorded in the data set, indicating that the area was not an important foraging resource for microbats at the time of the survey.

Chalinolobus gouldii (Gould's Wattled Bat) was the most commonly recorded species, followed by *Tadarida australis* (White-striped Freetail Bat) and *Vespadelus vulturnus* (Little Forest Bat). The remaining species identified were represented by fewer than 20 calls in total.

The calls of the **Eastern False Pipistrelle**, ***Scoteanax rueppellii* (Greater Broad-nosed Bat)** and ***Scotorepens orion* (Eastern Broad-nosed Bat)** are very difficult to separate because many elements of their calls overlap in the range 32 – 39 kHz. The single call recorded was at a frequency of 35.27 kHz placing it within the range of all three species and as no other defining characteristics were observed the call was assigned a mixed species label of **Eastern False Pipistrelle / Greater Broad-nosed Bat / Eastern Broad-nosed Bat**.

The calls of ***Myotis macropus* (Large-footed Myotis)** are very similar to all *Nyctophilus* species and it is often difficult to separate these species. Calls can only be identified as *Nyctophilus* spp. when the time between calls (TBC) is higher than 95ms and the initial slope (OPS) is lower than 300. Calls can only be identified as **Large-footed Myotis** when the time between calls (TBC) is lower than 75ms and the initial slope (OPS) is greater than 400. Where the TBC is between 75 and 95ms and the OPS is between 300 and 400 calls are assigned mixed label of **Large-footed Myotis / Long-eared Bats**.

The calls of Gould's Wattled Bat and the Mormopterus group of species can be difficult to separate. Calls of *Mormopterus ozimops ridei* (species 2) (Eastern Freetail Bat) have a flat shape (slope of less than 100 OPS) and frequency between 28.5 – 31 kHz. Gould's Wattled Bat is distinguished by a frequency of 27.5 – 32.5 kHz and alternation in call frequency between pulses. When no distinguishing characteristics were present calls were assigned a mixed labels of Gould's Wattled Bat / Eastern Freetail Bat.

Table 19: AnaBat results from 15 December 2014 at Hornsby Quarry, Site 1

Scientific name	Common name	Definite	Probable	Possible	Total
<i>Chalinolobus gouldii</i>	Gould's Wattled Bat	41	4	1	46
<i>Chalinolobus gouldii</i> / <i>Mormopterus ozimops ridei</i> (species 2)	Gould's Wattled Bat / Eastern Freetail Bat			16	16
<i>Tadarida australis</i>	White-striped Freetail Bat	18			18
Low					3
Short					8
Total					91

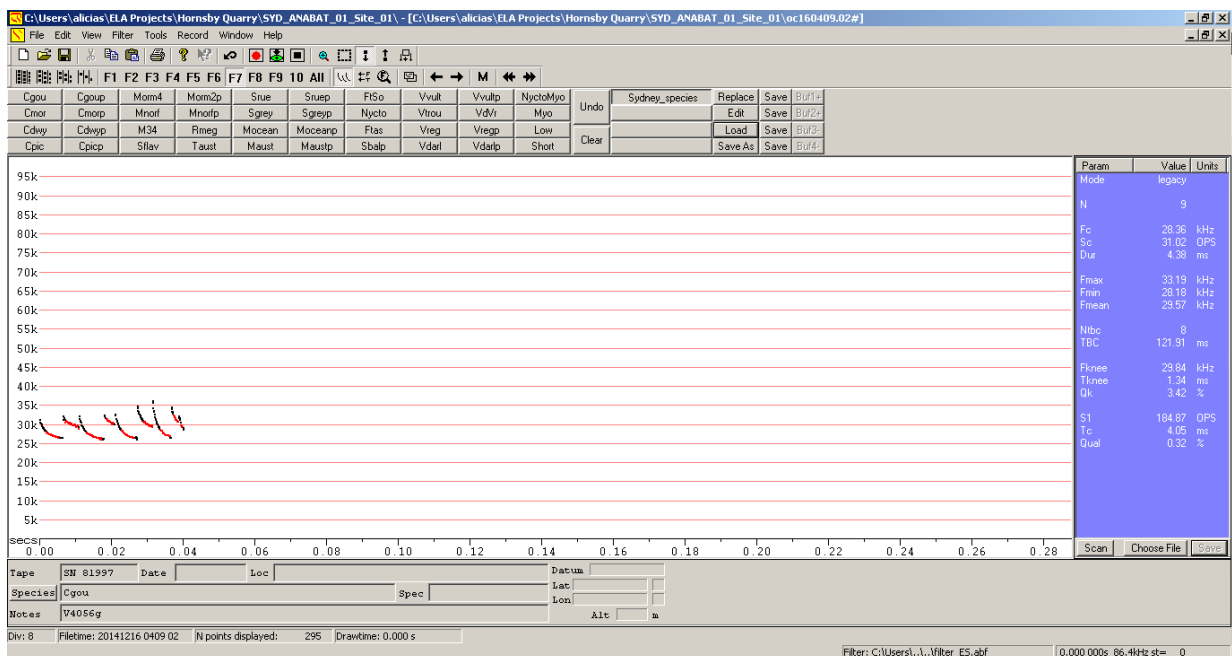
Table 20: AnaBat results from 15 December 2014 at Hornsby Quarry, site 2

Scientific name	Common name	Definite	Probable	Possible	Total
<i>Chalinolobus gouldii</i>	Gould's Wattled Bat	18		1	19
<i>Falsistrellus tasmaniensis</i> * / <i>Scoteanax rueppellii</i> * / <i>Scotorepens orion</i>	Eastern False Pipistrelle / Greater Broad-nosed Bat / Eastern Broad-nosed Bat			1	1
<i>Myotis macropus</i> * / <i>Nyctophilus</i> sp.	Large-footed Myotis / Long-eared Bat			1	1

Short					4
Total					25

Threatened species*Table 21: AnaBat results from 17 December 2014 at Hornsby Quarry, site 3**

Scientific name	Common name	Definite	Probable	Possible	Total
<i>Chalinolobus gouldii</i>	Gould's Wattled Bat	7	2		9
<i>Chalinolobus morio</i>	Chocolate Wattled Bat			2	2
<i>Vespadelus vulturnus</i>	Little Forest Bat	13			13
Low					2
Short					7
Total					33

**Figure 11: Call profile for *Chalinolobus gouldii* recorded at site 2, Hornsby Quarry at 04:09 on 16 December 2014**

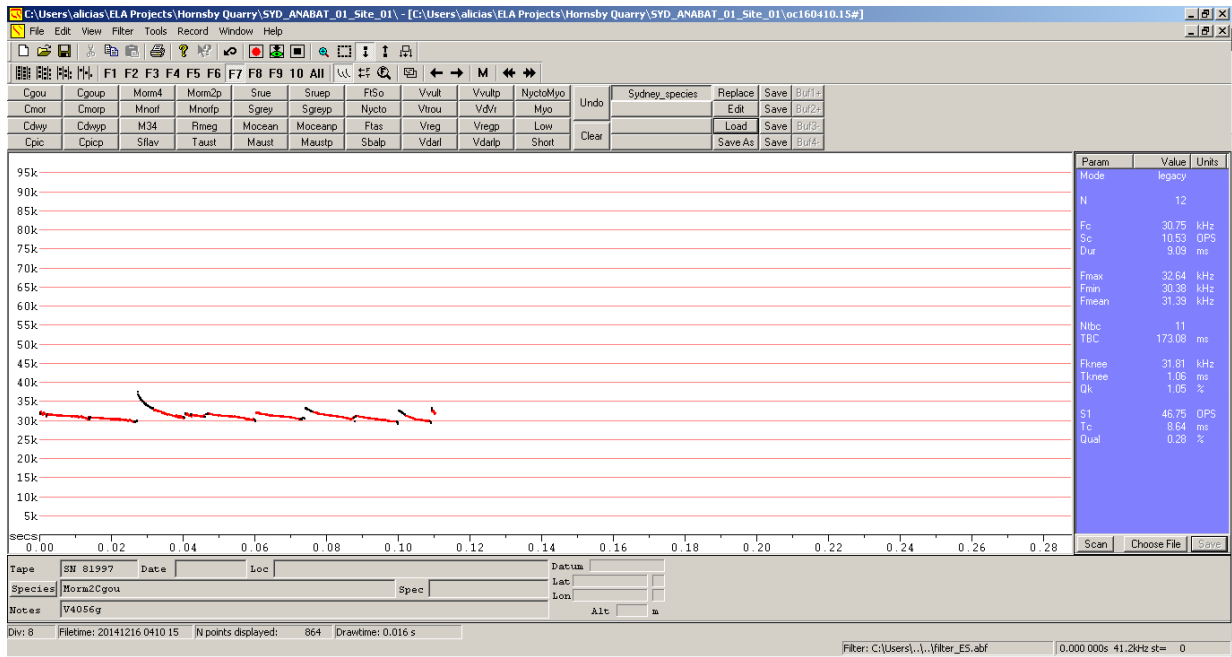


Figure 12: Call profile for *Chalinolobus gouldii* / *Mormopterus ozimops ridei* (species 2) recorded at site 1, Hornsby Quarry at 04:04 on 16 December 2014

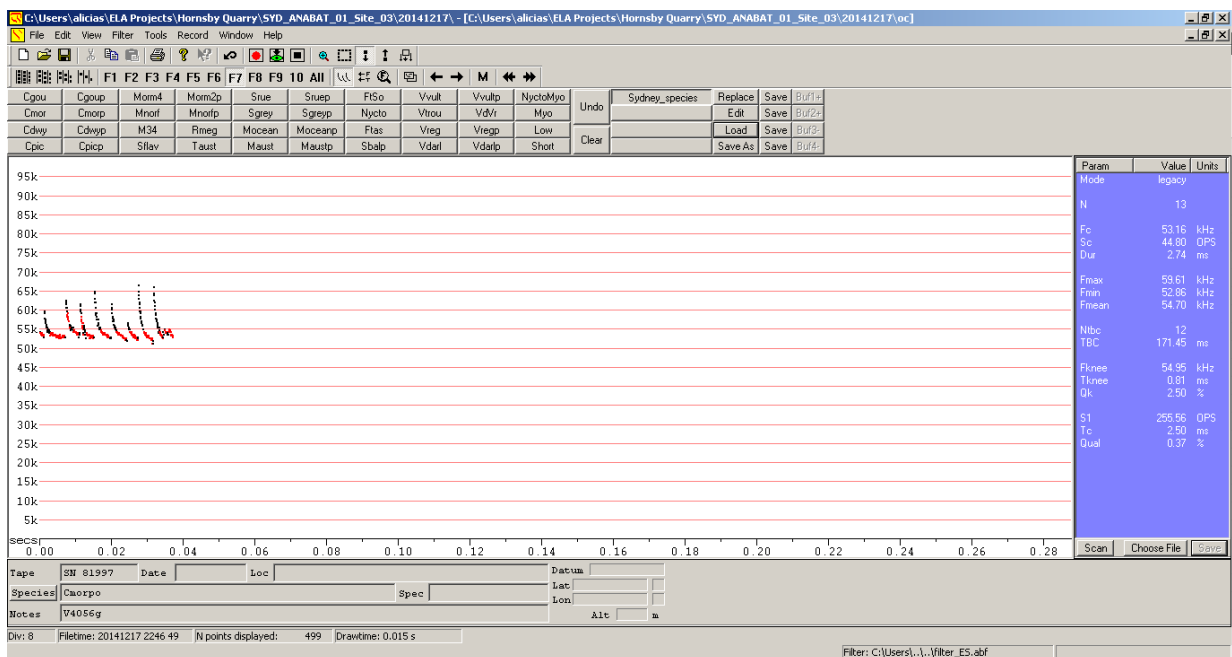


Figure 13: Possible call profile for *Chalinolobus morio* recorded at Hornsby Quarry at 22:46 on 17 December 2014

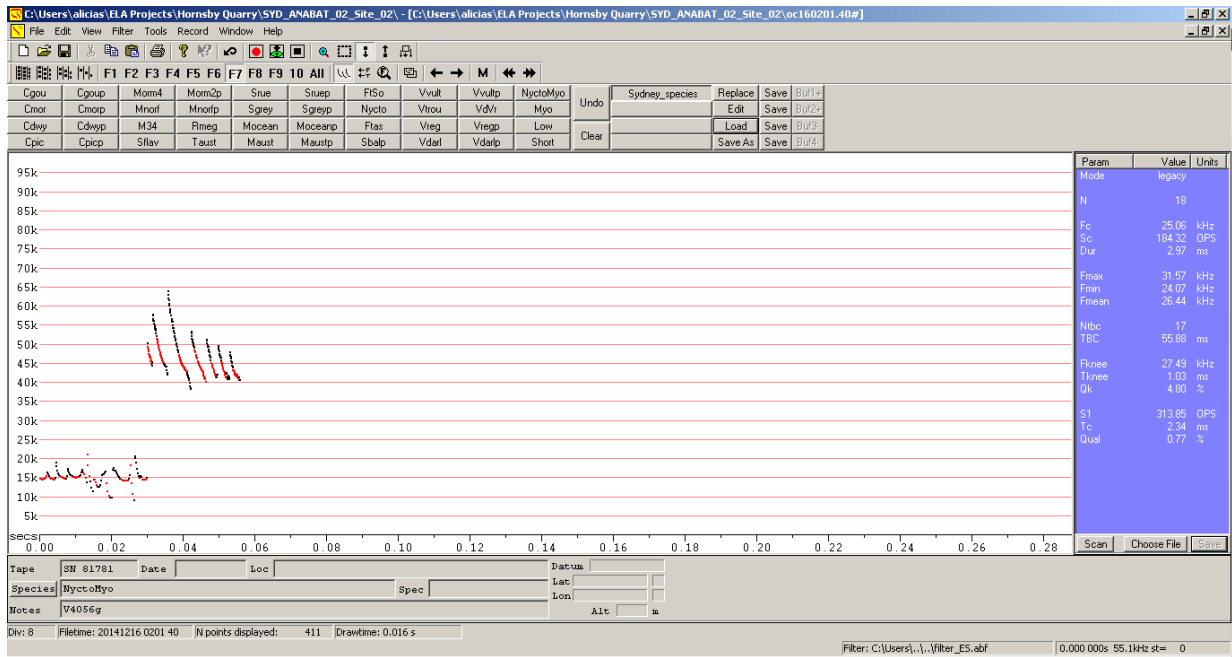


Figure 14: Call profile for *Myotis macropus* / *Nyctophilus* spp. recorded at Hornsby Quarry at 02:01 on 16 December 2014. Also shown is an unknown call at 15kHz

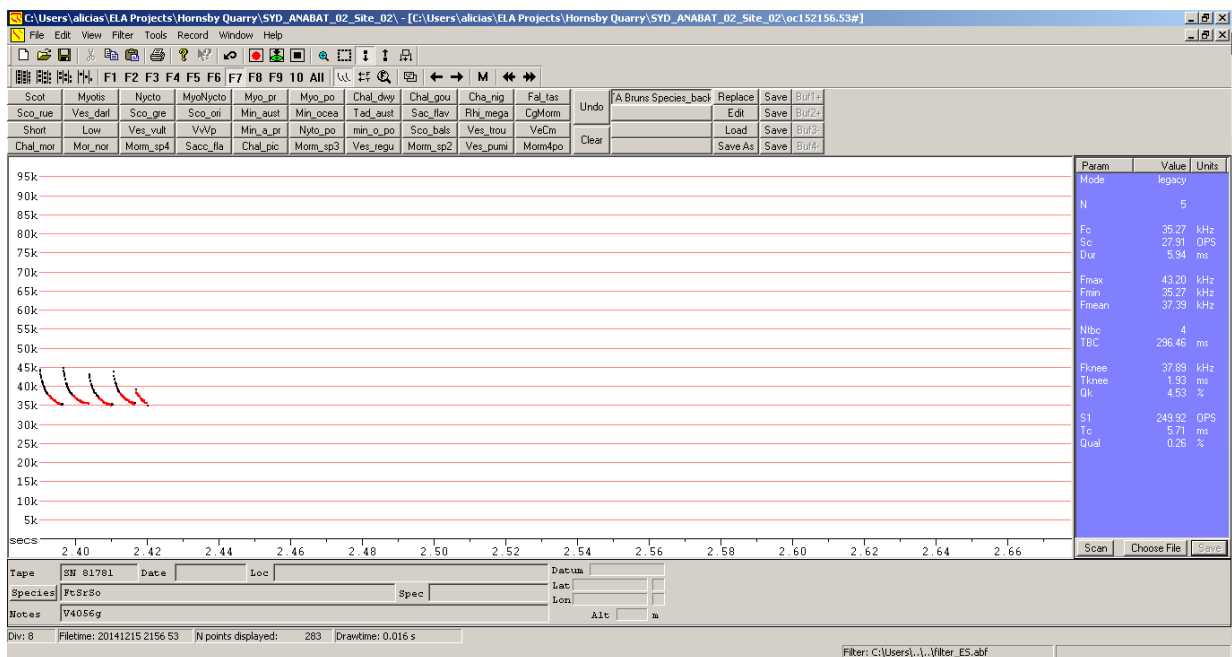


Figure 15: Call profile for *Falsistrellus tasmaniensis* / *Scoteanax rueppellii* / *Scotorepens orion* recorded at Hornsby Quarry at 21:56 on 15 December 2014

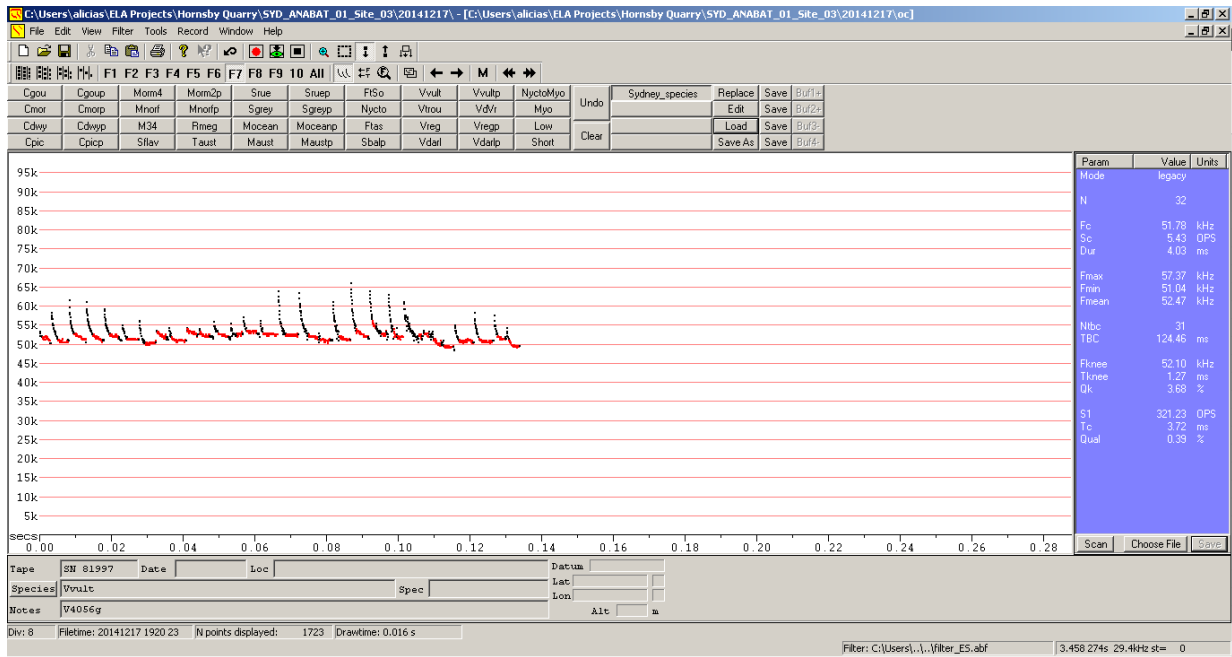


Figure 16: Call profile for *Vespadelus vulturnus* recorded at Hornsby Quarry at 19:20 on 17 December 2014

Appendix G Hollow- bearing tree survey results

Hollow size	Hollow type	Tree sp.	DBH	Crown cover	Evidence of use	Notes	Tree Number	Fauna Group	Hollow No	Source
Large	Trunk	Eucalyptus pilularis	110	0	No	Stag	1	Diurnal Mammals (ex. birds, Bats) and bats	1	ELA 2014
Medium	Trunk	Eucalyptus pilularis	100	0	No	Stag	2	Bats	2	ELA 2014
Medium	Trunk	Eucalyptus pilularis	50	0	No	Stag	3	Bats	3	ELA 2014
Small	Branch	Eucalyptus pilularis	100	50	No		4	Diurnal Mammals (ex. birds, Bats) and bats	4	ELA 2014
Large	Trunk	Eucalyptus pilularis	200	40	No	Open Trunk Hollow	5	Diurnal Mammals (ex. birds, Bats) and bats	5	ELA 2014
Large	Trunk	Stag	85	0	Yes	Nesting material in hollow	Tree 54	Diurnal Mammals (ex. Birds, Bats), Bats	76	AECOM 2014
Medium	Branch	Stag	75	0	N/A		Tree 55	Diurnal Mammals (ex. Birds, Bats), Bats	77	AECOM 2014
Medium	Branch	Stag	75	0	N/A		Tree 55	Diurnal Mammals (ex. Birds, Bats), Bats	78	AECOM 2014
Medium	Branch	Stag	75	0	N/A		Tree 55	Diurnal Mammals (ex. Birds, Bats), Bats	79	AECOM 2014
Medium	Spout	Angophora	50	20	N/A	One leader dead and rotting	Tree 56	Diurnal Mammals (ex. Birds, Bats), Bats	80	AECOM 2014
Medium	Fissure	Eucalyptus	115	40	N/A	Base burnt out, numerous bark	Tree 57	Diurnal Mammals (ex. Birds, Bats), Bats	81	AECOM 2014

Hollow size	Hollow type	Tree sp.	DBH	Crown cover	Evidence of use	Notes	Tree Number	Fauna Group	Hollow No	Source
						fissures on trunk		Bats		
Small	Fissure	Stag	35	0	N/A		Tree 58	Bats	82	AECOM 2014
Medium	Fissure	Unknown	40	90	N/A	Longitudinal rot along trunk and 1 limb,	Tree 59	Diurnal Mammals (ex. Bats), Birds, Bats)	83	AECOM 2014
Medium	Spout	Angophora	70	75	N/A	Multi-stemmed. Two leaders appear senescent	Tree 60	Diurnal Mammals (ex. Bats), Birds, Bats)	84	AECOM 2014
Small	Spout	Angophora	70	75	N/A	Multi-stemmed	Tree 60	Mammals (ex. Bats), Bats	85	AECOM 2014
Large	Spout	Eucalyptus	105	90	Yes	Upper limbs appear senescent. Wear around hollow	Tree 61	Diurnal Mammals (ex. Bats), Birds, Bats)	86	AECOM 2014
Medium	Fissure	Eucalyptus	105	90	N/A		Tree 61	Diurnal Mammals (ex. Bats), Birds, Bats)	87	AECOM 2014
Medium	Trunk	Stag	60	0	Yes	Wear and scratching around hollow	Tree 62	Diurnal Mammals (ex. Bats), Birds, Bats)	88	AECOM 2014
Small	Fissure	Stag	45	0	N/A		Tree 63	Bats	89	AECOM 2014
Large	Spout	Stag	90	0	N/A		Tree 64	Diurnal Mammals (ex. Bats), Birds, Bats)	90	AECOM 2014
Large	Trunk	Stag	90	0	N/A		Tree 64	Diurnal Mammals (ex. Bats), Birds, Bats)	91	AECOM 2014
Large	Spout	Stag	90	0	N/A		Tree 64	Diurnal Mammals (ex. Bats), Birds, Bats)	92	AECOM 2014
Small	Fissure	Stag	90	0	N/A		Tree 64	Bats	93	AECOM 2014
Small	Spout	Eucalyptus	90	80	N/A		Tree 65	Mammals (ex. Bats), Bats	94	AECOM 2014

Hollow size	Hollow type	Tree sp.	DBH	Crown cover	Evidence of use	Notes	Tree Number	Fauna Group	Hollow No	Source
Medium	Spout	Eucalyptus	90	80	N/A		Tree 65	Diurnal Mammals (ex. Bats), Birds, Bats,	95	AECOM 2014
Medium	Spout	Eucalyptus	90	80	N/A		Tree 65	Diurnal Mammals (ex. Bats), Birds, Bats,	96	AECOM 2014
Medium	Branch	Eucalyptus	90	80	Yes	Wear and scratching around hollow	Tree 65	Diurnal Mammals (ex. Bats), Birds, Bats,	97	AECOM 2014
Large	Branch	Eucalyptus	90	80	N/A		Tree 65	Diurnal Mammals (ex. Bats), Birds, Bats,	98	AECOM 2014
Medium	Spout	Eucalyptus	60	85	Yes	Wear around hollow entrance	Tree 66	Diurnal Mammals (ex. Bats), Birds, Bats,	99	AECOM 2014
Medium	Spout	Eucalyptus	100	85	N/A		Tree 67	Diurnal Mammals (ex. Bats), Birds, Bats,	100	AECOM 2014
Medium	Spout	Eucalyptus	100	85	N/A		Tree 67	Diurnal Mammals (ex. Bats), Birds, Bats,	101	AECOM 2014
Small	Spout	Eucalyptus	100	85	Yes	Wear around hollow entrance	Tree 67	Mammals (ex. Bats), Birds, Bats,	102	AECOM 2014
Medium	Branch	Eucalyptus	100	85	N/A		Tree 67	Diurnal Mammals (ex. Bats), Birds, Bats,	103	AECOM 2014
Small	Fissure	Unknown	30	5	N/A	Tree with failed and lopped branches. Potential microbat habitat	Tree 68	Bats	104	AECOM 2014
Medium	Trunk	Stag	50	0	N/A		Tree 69	Diurnal Mammals (ex. Bats), Birds, Bats,	105	AECOM 2014
Small	Branch	Stag	50	0	N/A		Tree 69	Mammals (ex. Bats), Birds, Bats,	106	AECOM 2014
Medium	Branch	Stag	50	0	N/A		Tree 69	Diurnal Mammals (ex. Bats), Birds, Bats,	107	AECOM 2014

Hollow size	Hollow type	Tree sp.	DBH	Crown cover	Evidence of use	Notes	Tree Number	Fauna Group	Hollow No	Source
								Mammals (ex. Bats), Bats		2014
Small	Fissure	Stag	50	0	N/A		Tree 69	Bats	108	AECOM 2014
Large	Trunk	Angophora	110	90	N/A	Large hollow in base of tree	Tree 70	Diurnal Birds, Mammals (ex. Bats), Bats	109	AECOM 2014
Small	Spout	Eucalyptus	35	70	N/A	Co-dominant	Tree 71	Mammals (ex. Bats), Bats	110	AECOM 2014
Small	Spout	Eucalyptus	35	70	N/A	Co-dominant	Tree 71	Mammals (ex. Bats), Bats	111	AECOM 2014
Large	Spout	Eucalyptus	50	40	N/A	Vertically opening spout possibly hollow	Tree 72	Diurnal Birds, Mammals (ex. Bats), Bats	112	AECOM 2014
Medium	Branch	Eucalyptus	25	10	N/A	Co-dominant- one leader rotted with possible hollows	Tree 73	Diurnal Birds, Mammals (ex. Bats), Bats	113	AECOM 2014
Small	Branch	Unknown	65	65	N/A	Trunk base burnt and hollowed out.	Tree 74	Mammals (ex. Bats), Bats	114	AECOM 2014

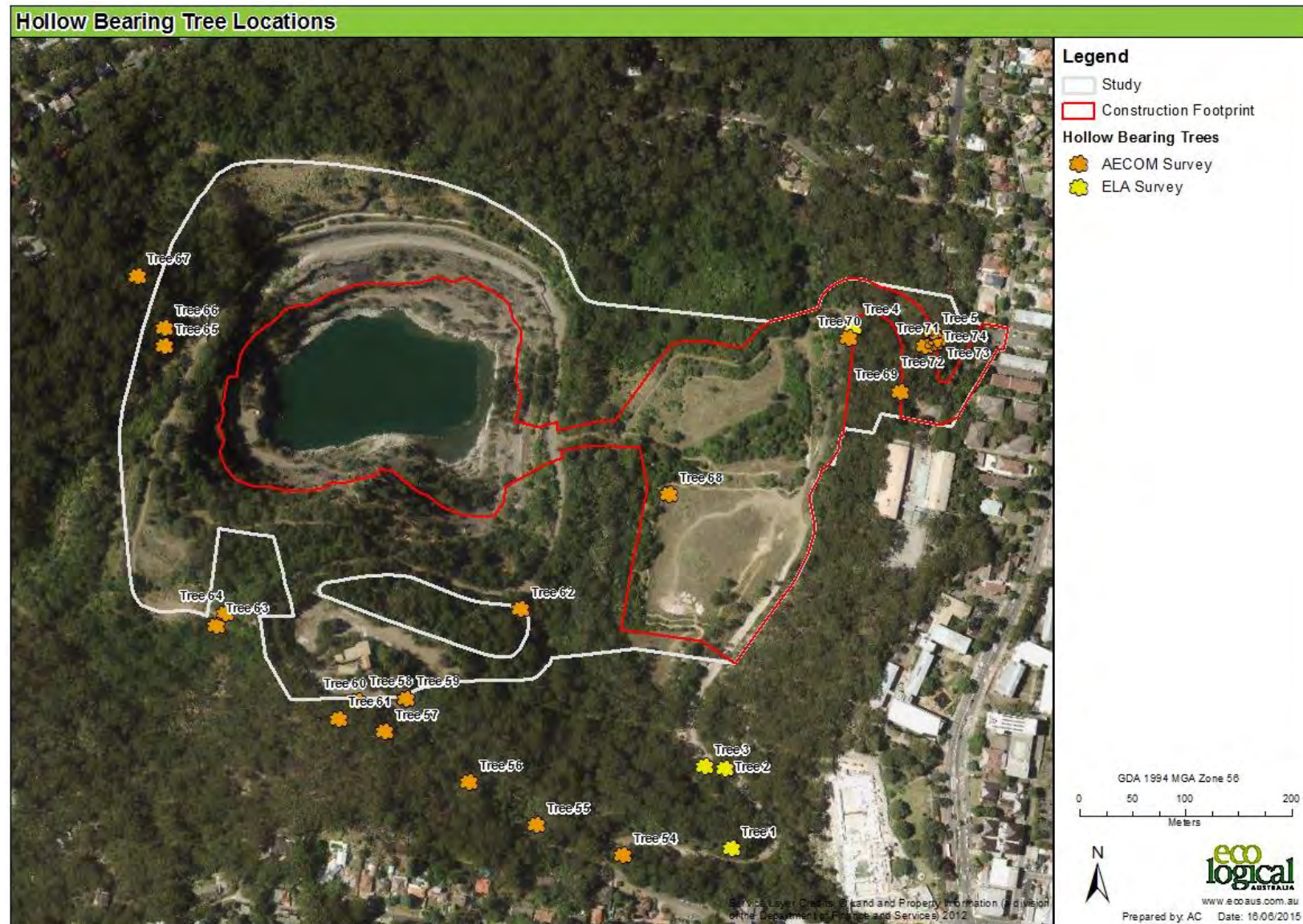


Figure 17: HBT Locations

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Appendix H Study area description

Description	This site consists of the disused Hornsby Quarry and contains a large inner void from which material was mined. The site contains areas of forest, areas that have been cleared and spoil piles. Parts of the site are used for recreational purposes including mountain bike riding. An historical site, including a cemetery, is part of the quarry grounds but is excluded from the project footprint. The following vegetation communities were identified occurring in the site: 1. Blue Gum High Forest 2. Sandstone Blackbutt Woodland 3. Weeds and exotics. In addition to these vegetation communities, there were areas within the void that contain natives that had established on the quarry walls and benches. This vegetation was not considered for a plant community type because the natural soil profile no longer existed. Similarly, areas of spoil pile or overburden were not allocated to a plant community type for the same reason. The site is dominated by the quarry void which is deep, with inaccessible walls and steep sides which were unable to be surveyed.
Condition	Poor to Good. The communities in this site ranged in condition. Where the canopy and understorey component was intact, condition was good. This was largely in the drier sclerophyll forests in the north-east of the site near Bridge Road and along parts of Quarry Road. By contrast areas in poor condition were generally found where the vegetation types were wetter, including areas of Blue Gum High Forest. The Blue Gum High Forest was modified with some native understorey components, but large areas of <i>Ligustrum</i> spp. and some <i>Lantana camara</i>. Some vegetated areas within the site were artificial in that they were exotics existing on spoil piles or overburden. The Quarry site was highly modified and in poor condition.
Threatened species of plant?	No threatened plant species were found at this site.
Threatened community?	This site contains one threatened community: Blue Gum High Forest. This community exists in a highly altered state with very little native understorey and a large component of woody weeds. The community meets the definition under the TSC Act but not the EPBC Act. This is because this vegetation is highly modified with significant weed invasion in the understorey and limited native species in the groundcover.

Photos



Quarry void with water (December 2013). Note regenerating *Allocasuarina* on the walls.



View from inner void fence showing recruiting native vegetation, water in void and benches / walls with no vegetation.



Sandstone Blackbutt Woodland in moderate-good condition.



Part of search area for *Genoplesium baueri*. Note the exposed rock and deep leaf litter.



Typical micro-habitat for *Genoplesium baueri* (at one of the reference sites). Note gaps between plants and minimal leaf litter cover.



Track edge at *Genoplesium baueri* reference site. Note absence of canopy at track edge. This site was approximately 10 kilometres to the north-north-east of the Quarry.



Typical Blue Gum High Forest in poor condition. Note the density of exotics in the understorey.



Sandstone Blackbutt Woodland in moderate-good condition.



Sandstone Blackbutt Woodland in moderate-good condition.



Sandstone Blackbutt Woodland in poor condition. Note the density of exotic grasses in the ground layer and lack of native shrub species in the understorey.



AnaBat echolocation recording device location, potential flyway adjacent to the heritage cemetery.

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Appendix I EPBC Act Significant Impact Criteria

The proposed project footprint of the project supports areas of native vegetation and potential and known habitat for two threatened fauna species. A full list of species recorded within a ten kilometre radius of the project footprint is found in **Appendix A**, however not all of these species or their habitats are likely to be impacted by the project. Potentially impacted species are listed below. Each species has been assessed for potential impacts that may result from the project.

Threatened Flora

- *Darwinia biflora*
- *Genoplesium baueri*

Threatened Fauna

- Large-eared Pied Bat (*Chalinolobus dwyeri*)
- Grey-headed Flying-Fox (*Pteropus poliocephalus*)
- Koala (*Phascolarctos cinereus*)

THREATENED FLORA

Darwinia biflora

Darwinia biflora is a threatened species listed as vulnerable under the EPBC Act. *D. biflora* occurs on the edges of weathered shale-capped ridges, where they intergrade with Hawkesbury Sandstone. The vegetation structure is usually woodland, open forest or scrub-heath. There were some areas of marginal potential habitat for this species in the impact area.

D. biflora was not recorded during the targeted field survey; however this species has been recorded 202 times within ten kilometres from the Wildlife Atlas search of the study area.

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that the project would:

1: Lead to a long-term decrease in the size of an important population of a species

An 'important population' is a population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in recovery plans, key source populations either for breeding or dispersal populations that are necessary for maintaining genetic diversity, and/or populations that are near the limit of the species range.

Darwinia biflora was not recorded during the field survey as such it is unlikely that this constitutes an important population.

2: Reduce the area of occupancy of an important population

D. biflora was not recorded during the field survey and therefore the proposed works are unlikely to reduce any known population.

3: Fragment an existing important population into two or more populations

The project footprint is contained within the known distribution of this species, which is between Maroota, Cowan, North Ryde and Kellyville. The project would not result in the fragmentation of known populations and would not significantly affect habitat connectivity for this species. This is because this species has a relatively large distribution and exists in a fragmented matrix.

4: Adversely affect habitat critical to the survival of a species

D. biflora was not recorded during the field survey and therefore the habitat is not considered to be habitat critical to the survival of this species.

5: Disrupt the breeding cycle of an important population

D. biflora was not recorded during the field survey and as the proposed works will be localised, it is not likely that the breeding cycle of an important population of this species will be disrupted.

6: Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline

In areas within the Hornsby Quarry containing potential habitat in the project footprint, disturbance regimes consist of fire suppression, increased runoff due to roads or stormwater outlets and increases in weed incursions. The project would not significantly alter these current disturbance regimes, but may

push out these regimes to adjoining potential habitat. However it is unlikely that this would significantly impact this species which has not been detected within the project footprint.

7: Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat

The proposed project will not result in invasive species that are harmful to *D. biflora* becoming established in their habitat.

8: Introduce disease that may cause the species to decline,

The proposed project is unlikely to result in introducing diseases that may cause *D. biflora* to decline.

9: Interfere substantially with the recovery of the species.

As the project does not involve the removal of individuals of this species and the project would result in the removal of a small area of potential habitat for *D. biflora* and is not limited to the range of this species known habitat the project are unlikely to interfere with the recovery of this species.

Is a significant impact likely to result?

No, based on the above assessment it is concluded that the project is unlikely to have a significant impact on *D. biflora*. No referral to the DotE for assessment and approval by the Environment Minister for the species is recommended.

Genoplesium baueri

G. baueri is listed as endangered under the EPBC Act. It is associated with sparse sclerophyll forest and moss gardens in sands and sandy loams over sandstone (OEH 2015).

G. baueri has been recorded within 30 metres adjacent to the study area with a specimen recorded immediately south and downslope of the Hornsby Quarry in 2009. The species can be affected by increases in runoff, sedimentation and weed invasion. No specimens were observed during the targeted search of the Hornsby Quarry. The proposed widening of the access roads would impact on a small amount of very low potential habitat. All areas that were likely to contain this species were subject to a targeted survey during optimal flowering conditions and season. Despite a lengthy and targeted survey, completed when two reference sites were in flower, no individuals of this species were found.

A targeted survey during the correct season, during favourable conditions by experienced ecologists did not detect this species at the Quarry. It was concluded that this species is not present within the study area, despite the presence of marginal habitat.

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that the project would:

1: Lead to a long-term decrease in the size of an important population of a species

An 'important population' is a population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in recovery plans, key source populations either for breeding or dispersal populations that are necessary for maintaining genetic diversity, and/or populations that are near the limit of the species range.

Genoplesium baueri was not recorded during the field survey as such it is unlikely that this constitutes an important population.

2: Reduce the area of occupancy of an important population

Genoplesium baueri was not recorded during the field survey and therefore the proposed works are unlikely to reduce any known population.

3: Fragment an existing important population into two or more populations

The brittle midge orchid is endemic to New South Wales. The species generally occurs within coastal areas from Ulladulla on the south coast to Port Stephens on the mid-north coast, although it has been recorded from as far west as Woodford in the Blue Mountains and Penrose State Forest in the southern highlands (DotE 2015). The project footprint is contained within the known distribution of this species. The project would not result in the fragmentation of known populations and would not significantly affect habitat connectivity for this species. This is because this species has a relatively large distribution and exists in a fragmented matrix.

4: Adversely affect habitat critical to the survival of a species

Genoplesium baueri was not recorded during the field survey and therefore the habitat is not considered to be habitat critical to the survival of this species.

5: Disrupt the breeding cycle of an important population

Genoplesium baueri was not recorded during the field survey. The breeding cycle of this species is cued to significant rainfall in summer. No breeding habitat or known populations of this species will be impacted by the proposed works.

6: Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline

In areas within the Hornsby Quarry containing potential habitat in the project footprint, disturbance regimes consist of fire suppression, increased runoff due to roads or stormwater outlets and increases in weed incursions. The project would not significantly alter these current disturbance regimes, but may push out these regimes to adjoining potential habitat. However it is unlikely that this would significantly impact this species which has not been detected within the project footprint.

7: Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat

The proposed project will not result in invasive species that are harmful to *Genoplesium baueri* becoming established in its habitat. A targeted survey of this species showed that the species is not present within the project footprint.

8: Introduce disease that may cause the species to decline,

The proposed project is unlikely to result in introducing diseases that may cause *Genoplesium baueri* to decline.

9: Interfere substantially with the recovery of the species.

As the project does not involve the removal of individuals of this species and the project would result in the removal of a small area of marginal habitat for *Genoplesium baueri* and is not limited to the range of this species' known habitat, the project are unlikely to interfere with the recovery of this species.

Is a significant impact likely to result?

No, based on the above assessment it is concluded that the project is unlikely to have a significant impact on *Genoplesium baueri*. No referral to the DotE for assessment and approval by the Environment Minister for the species is recommended.

THREATENED FAUNA

Large-eared Pied Bat

Chalinolobus dwyeri (Large-eared Pied Bat) is listed as vulnerable under the EPBC Act. The Large-eared Pied Bat is found mainly in areas with extensive cliffs and caves, from Rockhampton in Queensland south to Bungonia in the NSW Southern Highlands. It is generally rare with a very patchy distribution in NSW. There are scattered records from the New England Tablelands and North West Slopes.

Large-eared Pied Bat is found in well-timbered areas containing gullies. It frequents low to mid-elevation dry open forest and woodland close to caves, crevices in cliffs, old mine workings and disused mud nests of *Hirundo ariel* (Fairy Martin). The relatively short, broad wing combined with the low weight per unit area of wing indicates manoeuvrable flight. This species probably forages for small, flying insects below the forest canopy.

Large-eared Pied Bat roosts in caves (near their entrances), crevices in cliffs, old mine workings and in the disused, bottle-shaped mud nests of the Fairy Martin. Females have been recorded raising young in maternity roosts (c. 20-40 females) from November through to January in roof domes in sandstone caves. They remain loyal to the same cave over many years (DECC 2005).

The Large-eared Pied Bat is found mainly in areas with extensive cliffs and caves, from Rockhampton in Queensland south to Bungonia in the NSW Southern Highlands. It is generally rare with a very patchy distribution in NSW. There are scattered records from the New England Tablelands and North West Slopes.

The Large-eared Pied Bat was not recorded during a targeted survey within the study area, but has been recorded three times within the ten kilometre Wildlife Atlas search.

The walls of the Quarry void may contain cave-like crevices with moisture required for roost sites for this species. The site contains areas of potential foraging habitat include both woodlands and forests, thus impacts to potential secondary habitat is all native vegetation within the project footprint. There may also be some indirect impacts, primarily from noise and light. It is proposed to mitigate these potential indirect impacts by conducting the works within daylight hours (during standard work hours) and not during the night, and fitting noise producing equipment with attenuation devices (mufflers).

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that the project would:

1. Lead to a long-term decrease in the size of an important population of the species

No. The study area does not contain any known breeding areas and the paucity of records suggests that the species would rarely pass through the area while foraging/migrating. Therefore, an important population of this species is unlikely to occur. Further a targeted survey for microbats in the study area showed that this species was not present.

2. Reduce the area of occupancy of an important population

No. An important population of Large-eared Pied Bat does not occur within the study area.

3. Fragment an existing important population into two or more populations

No. An important population of Large-eared Pied Bat does not occur within the study area.

4. Adversely affect habitat critical to the survival of a species

No. The potential foraging habitat for the species within the study area is not considered to be critical to the species survival.

5. Disrupt the breeding cycle of an important population

No. No breeding habitat will be impacted by the project.

6. Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline

No. The loss of potential foraging habitat from the site is unlikely to cause a decline in the species.

7. Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat

No.

8. Introduce disease that may cause the species to decline, or

No.

9. Interfere substantially with the recovery of the species.

No.

Is a significant impact on the species likely to result?

No.

Grey-headed Flying Fox

Pteropus poliocephalus (Grey-headed Flying-fox) are listed as vulnerable under the EPBC Act. Grey-headed Flying-foxes are found within 200 kilometres of the eastern coast of Australia, from Bundaberg in Queensland to Melbourne in Victoria. They occur in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops. Roosting camps are generally located within 20 kilometres of a regular food source and are commonly found in gullies, close to water, in vegetation with a dense canopy (DECC 2005).

Individual camps may have tens of thousands of animals and are used for mating, birth and the rearing of young. Annual mating commences in January and a single young is born each October or November. Site fidelity to camps is high with some camps being used for over a century. They travel up to 50 kilometres to forage (DECC 2005).

This species feeds on the nectar and pollen of native trees, in particular *Eucalyptus*, *Melaleuca* and *Banksia*, and fruits of rainforest trees and vines. They also forage in cultivated gardens and fruit crops and can inflict severe crop damage (DECC 2005).

The project footprint for the project would not disturb any known flying fox roosting camps. The nearest Grey-headed Flying-fox roost or "camp" is located to the south-east at Gordon, around eight kilometres and at the Parramatta Park bat camp is located south. There are several other camps located throughout the Sydney metropolitan area that are located further from the project. The project includes surface infrastructure along large sections of tunnel.

Foraging habitat would be lost through the clearing of potential marginal foraging habitat across the project footprint. Areas of potential foraging habitat to be cleared have been calculated based on the clearing of native vegetation within the project footprint. While the species would also forage on cultivated gardens and fruit crops, this has not been included in the analysis; as such foraging habitat is widespread within the Sydney urban area and including such data within the calculation of available regional Grey-headed Flying-fox habitat extent would be problematic. It is anticipated that direct impacts to Grey-headed Flying-foxes would be the loss of up to 0.9 hectares of potential secondary habitat within the project footprint (note that this figure excludes urban / native and exotics).

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that the project would:

1. Lead to a long-term decrease in the size of an important population of the species

No. The project study area does not support a breeding population (camp) of Grey-headed Flying-fox. While there would be some loss of foraging habitat, the species forages widely on a variety of vegetation. Therefore, the study area is unlikely to support an important population of this species and no decline is expected to result in foraging Grey-headed Flying-fox populations.

2. Reduce the area of occupancy of an important population

No. An important population of Grey-headed Flying-fox does not occur within the study area.

3. Fragment an existing important population into two or more populations

No. The species is highly mobile and an important population of Grey-headed Flying-fox does not occur within the study area.

4. Adversely affect habitat critical to the survival of a species

No breeding habitat (camps) would be impacted by the project. There will be some loss of foraging habitat (0.9 hectares) with the camp in closest proximity to the study area located to the south at Gordon, around 8.5 kilometres away. Under the DECC (2009c) Draft National Recovery Plan foraging habitat within a 50 kilometre radius of a roost site with greater than 30,000 individuals is foraging habitat critical to survival. The Gordon camp site can vary in the number of individuals present from zero to 80,000 (Ku-ring-gai Council 2013) and the data for this camp suggests that the camp will vary during the breeding season (summer) between 20,000 and 40,000. Therefore there is foraging habitat present which meets the definition of habitat critical to the survival of the species. However, the amount of loss of habitat is not considered to be significant in terms of the regional context, as from analysis of the Native Vegetation mapping GIS dataset for the Sydney Metropolitan Area (Office of Environment and Heritage 2013d), more than 77,000 hectares of native vegetation were identified as occurring within 50 kilometres of the Gordon camp site, noting that this dataset is limited in its extent to the Sydney metropolitan Catchment management Authority area, and thus includes approximately 50% of the native vegetation within 50 kilometres of the camp site.

5. Disrupt the breeding cycle of an important population

No. No breeding habitat (camps) would be impacted by the project.

6. Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline

No. The species forages widely across the landscape on a variety of vegetation. The loss of 0.9 hectares of foraging habitat within the project study area is unlikely to cause a decline in the species.

7. Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat

No.

8. Introduce disease that may cause the species to decline, or

No.

9. Interfere substantially with the recovery of the species.

No.

Is a significant impact on the species likely to result?

No.

Koala

Phascolarctos cinereus (Koala) is listed as vulnerable under the EPBC Act and has a fragmented distribution throughout eastern Australia, ranging from north-east Queensland to the Eyre Peninsula in South Australia (DotE 2013 sprat). In NSW, this species mainly occurs on the central and north coasts. There are also some populations west of the Great Dividing Range.

The Koala is associated with both wet and dry eucalypt forest and woodland that contains a canopy cover of approximately 10 to 70 per cent (Reed et al. 1990) with acceptable eucalypt food trees. This species feeds on more than 70 eucalypt species and 30 non-eucalypt species, but in any one area will select preferred browse species (DECC rec plan). Primary and secondary food trees have been identified for each Koala management area in NSW but some primary food species of the Sydney metropolitan area are: *Eucalyptus amplifolia*, *E. tereticornis*, and *E. microcorys* (DECC 2008d).

The Koala was not recorded within the study area. One secondary feed tree species, *E. resinifera*, was found in the study area. Koalas have only been recorded five times within the database search area with the most recent record being from 2000. No Koalas have been recorded from the Quarry site. An old (1968) record exists for this species in Berowra Valley Regional Park. The most recent record from 2000 is from Crosslands Road, Galston approximately six kilometres to the north of the Quarry.

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that the project would:

1. Lead to a long-term decrease in the size of an important population of the species

No. An important population does not occur as the region is not identified in recovery plans, is not a key source population, and is not near the limit of the species' range.

The Koala is also not expected to occur within the study area as the majority of potential habitat is fragmented and isolated. Whilst Hornsby Quarry site is connected to other potential habitat, if Koalas are present, they would likely be migrating males.

There are no important populations of Koala within the project footprint. Important Koala populations in the Sydney Basin Bioregion are south-west at Campbelltown and in the Central Coast. The population at Pittwater is thought to be extinct (DotE 2015 SPRAT page).

2. Reduce the area of occupancy of an important population

No (see above). No important population is present. A small area of potential habitat at Hornsby Quarry will be reduced in extent.

3. Fragment an existing important population into two or more populations

No. An existing important population within the study area is not present. Impacts on potential habitat at Hornsby Quarry would be at the edge of the vegetation extent, and other vegetation within the study area is already fragmented and isolated, and therefore no fragmentation of habitat is expected.

4. Adversely affect habitat critical to the survival of a species

No. Koala habitat is only present at the site as marginal. This habitat is unlikely to be critical to the survival of the species, given there was no population detected on site and that no primary feed trees exist within the impact area and secondary feed trees did not cover 50 per cent of the potential habitat.

5. Disrupt the breeding cycle of an important population

No. An important population was not detected on the site and the proposed works will not impact on breeding at any known population.

6. Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline

No. The loss of habitat from the study area is considered to be marginal and unlikely to lead to the decline of the species.

7. Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat

No. The decline in Koala has been attributed to habitat loss and degradation, mortality through road kill and predation by domestic animals, disease and climate change. The project will not introduce any invasive species that is known to be harmful to Koala.

8. Introduce disease that may cause the species to decline, or

No. The decline of the Koala has been attributed to the chlamydia and more recently to the Koala retrovirus. It is believed that these diseases are present in the NSW populations, although not always expressed symptomatically. Given the presence of these diseases in the populations in NSW, the project will not be introducing a disease that may cause decline in Koala populations.

9. Interfere substantially with the recovery of the species.

No given the marginal potential habitat present and the absence of a population at the site.

Is a significant impact on the species likely to result?

No.

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Appendix J FBA Methodology and where addressed in document

Table 22: Location of FBA methodology requirements for a 'Biodiversity Assessment Report' for stages 1 and 2 and where these are addressed in this report

Report section	Information	Maps & data	FBA reference	Section in this Report
Introduction	Introduction to the biodiversity assessment including: • identification of development site footprint, including: ○ operational footprint ○ construction footprint indicating clearing associated with temporary construction facilities and infrastructure • general description of development site • sources of information used in the assessment, including reports and spatial data.	• Site Map (as described in Section 3.2) • Location Map (as described in Section 3.2) • Digital shape files for all maps and spatial data	Chapter 3 and Section 3.2	Chapter 1 – Introduction and Chapter 2 Methodology Appendix H -study area description with photographs.

Report section	Information	Maps & data	FBA reference	Section in this Report
Landscape features	Identification of landscape features at the development site, including: • IBRA bioregions and subregions, NSW landscape region and area (ha) • native vegetation extent in the outer assessment circle or buffer area • cleared areas • evidence to support differences between mapped vegetation extent and aerial imagery • rivers and streams classified according to stream order • wetlands within, adjacent to and downstream of development site • landscape value score components, including: ○ identification of method applied (i.e. linear or site-based) ○ percent native vegetation cover in the landscape ○ connectivity value ○ patch size ○ area to perimeter ration • landscape value score.	• IBRA bioregions and subregions (as described in Paragraphs 4.1.1.3–4) • NSW landscape regions (as described in Paragraphs 4.1.1.5–6) • Rivers and streams (as described in Paragraphs 4.1.1.8–10) • Wetlands (as described in Paragraphs 4.1.1.11–13) • Other landscape features (as required by SEARs) • Native vegetation extent (as described in Paragraphs 4.1.1.12–15) • State, regional and local biodiversity links (as described in Paragraphs 4.1.1.16–17) • Regional vegetation used to calculate patch size	Section 4.1, Appendix 4 and Appendix 5	Chapter 3 – Landscape features

Report section	Information	Maps & data	FBA reference	Section in this Report
Native vegetation	Identify native vegetation extent within the development site, including cleared areas and evidence to support differences between mapped vegetation extent and aerial imagery. Describe PCTs within the development site, including: • vegetation class • vegetation type • area (ha) for each vegetation type • species relied upon for identification of vegetation type and relative abundance • justification of evidence used to identify a PCT (as outlined in Paragraph 5.2.1.8) • EEC status (as outlined in Subsection 5.2.1) • estimate of percent cleared value of PCT. Describe vegetation zones within the development site, including: • condition class and subcategory (where relevant) • area (ha) for each vegetation zone • survey effort as described in Paragraphs 5.2.1.5–7 (number of plots/transects). Where use of local data is proposed: • identify relevant vegetation type • identify source of information for local benchmark data • justify use of local data in preference to database values.	• Map of native vegetation extent within the development site (as described in Section 5.1) • Map of PCTs within the development site • Map of condition class and subcategory (where relevant) • Map of plot and transect locations relative to PCTs and condition class • Map of EECs • Plot and transect field data (MS Excel format) • Plot and transect field data sheets • Table of current site value scores for each vegetation zone within the development site • Map of vegetation zones with a current site value score of <17.	Chapter 5	Chapter 2 – Methodology for details on methods, Appendix B, C and D for details on species data and plot sheets. Chapter 4 – Native vegetation

Report section	Information	Maps & data	FBA reference	Section in this Report
Threatened species	Identify ecosystem credit species associated with PCTs on the development site as outlined in Section 6.3, including: • list of species derived • justification for exclusion of any ecosystem credit species predicted above. Identify species credit species on the development site as outlined in Sections 6.5 and 6.6, including: • list of candidate species • justification for inclusions and exclusions based on habitat features • indication of presence based on targeted survey or expert report • details of targeted survey technique, effort, timing and weather • species polygons • species that cannot withstand a further loss. Where use of local data is proposed: • identify relevant species or population • identify aspect of species/population data • identify source of information for local data • justify use of local data in preference to database values. Where expert reports are used in place of targeted survey: • identify the relevant species or population • justify the use of an expert report • indicate and justify the likelihood of presence of the species or population and information considered in making this assessment • estimate the number of individuals or area of habitat (whichever unit of measurement applies to the species/individual) for the development site, including a description of how the estimate was made • identify the expert and provide evidence of their expert credentials.	• Table of vegetation zones and landscape Tg values, particularly indicating where these have changed due to species exclusion • Targeted survey locations • Table detailing the list of species credit species and presence status on site as determined by targeted survey, indicating also where presence was assumed and/or where presence was determined by expert report • Species credit species polygons (as described in Paragraph 6.5.1.19) • Table detailing species and habitat feature/component associated with species and its abundance on site (as described in Paragraph 6.5.1.19) • Species polygons for species that cannot withstand a loss	Chapter 6	Chapter 2 – methodology for survey details and Appendix F and G for anabat results and HBT survey results; Chapter 5 – Threatened Species Appendix A likelihood of occurrence for EPBC Act species.

Report section	Information	Maps & data	FBA reference	Section in this Report
Avoid and minimise impacts	Demonstration of efforts to avoid and minimise impact on biodiversity values in accordance with Section 8.3. Identification of final project footprint during construction and operation in accordance with Subsection 8.3.3. Assessment of direct and indirect impacts unable to be avoided at the development site in accordance with Sections 8.3 and 8.4. The assessment would include but not be limited to: type, frequency, intensity, duration and consequence of impact. Statement of onsite measures proposed to avoid and minimise direct and indirect impacts of the Major Project.	• Table of measures to be implemented before, during and after construction to avoid and minimise the impacts of the project, including action, outcome, timing and responsibility • Map of final project footprint, including construction and operation • Maps demonstrating indirect impact zones where applicable	Chapter 8	Chapter 6 – Avoidance and mitigation measures Chapter 7 – Assessment of impacts

Report section	Information	Maps & data	FBA reference	Section in this Report
Impact summary	Identification of areas not requiring assessment in accordance with Section 9.5. Identification of areas not requiring offset in accordance with Section 9.4. Identification of PCTs and species polygons requiring offset in accordance with Section 9.3. Identification of impacts that require further consideration in accordance with Section 9.2, including: • the entity and/or impact for which further consideration is necessary • supporting information relevant to the impact, as outlined in Subsection 9.2.2. Ecosystem credits and species credits that measure the impact of the Major Project on biodiversity values at the development site, including: • future site value score for each vegetation zone at the development site • change in landscape value score • number of required ecosystem credits for the impact of development on each vegetation zone at the development site • number of required species credits for the impact of development on each threatened species that occurs on the development site.	• Map of areas not requiring assessment • Map of PCTs and species polygons not requiring offset • Map of PCTs and species polygons requiring offset • Map of the occurrence of the entity or impact that requires further consideration • Table of PCTs requiring offset and the number of ecosystem credits required • Table of species and populations requiring offset and the number of species credits required • Full biodiversity Credit Calculator output • Submitted proposal in the Credit Calculator	Chapter 9 Subsections 10.4.3 and 10.4.4	Chapter 8 – Impact summary and offsets
Biodiversity credit report	Credit profiles for ecosystem credits and species credits at the development site.	• Table of credit type and matching credit profile • Biodiversity credit report from the Credit Calculator	Subsection 10.4.5	Chapter 9 – Summary and biodiversity credit report

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Appendix H

Technical working paper:
Socio-Economic

Roads and Maritime Services

Hornsby Quarry: Road Construction Spoil Management Project

Socio-economic impact assessment

July 2015

Prepared for

Roads and Maritime Services

Prepared by

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Contents

Glossary of terms and abbreviations	ii
Executive summary	iv
1 Introduction	1
1.1 Project background	1
1.2 The project	1
1.3 Project location.....	4
1.4 Purpose of this report.....	4
1.5 Methodology.....	4
1.6 Definition of the study area	6
1.7 Structure of this report	6
2 Consultation and key stakeholder issues	11
3 Existing context	13
3.1 Overview of existing environment.....	13
3.2 Socio-demographic profile of local residents	13
3.3 Community facilities	15
3.4 Economic / business environment	19
3.5 Travel patterns	23
3.6 Summary	23
4 Impact assessment	25
4.1 Economic and business impacts.....	25
4.2 Property impacts	27
4.3 Amenity impacts.....	28
4.4 Community cohesion and severance.....	30
4.5 Traffic and access arrangements.....	35
5 Mitigation and management strategies	37
6 Conclusion	39
7 References.....	41
Appendix A – Study area	45
Appendix B – Socio-economic profile	49
Appendix C – Community facility inventory.....	55

Glossary of terms and abbreviations

Term	Definition
ABS	Australian Bureau of Statistics
AWDT	Average Weekday Daily Traffic
EIS	Environmental Impact Statement
ENM	Excavated Natural Material
EP&A	Environmental Planning and Assessment
FTE	Full-Time Equivalent
GRP	Gross Regional Product
GSP	Gross State Product
LGA	Local Government Area
NSW	New South Wales
RE1	Public Recreation Zoned Land
SA1	Statistical Area 1
SEARs	Secretary's Environmental Assessment Requirements
TAFE	Technical and Further Education
VENM	Virgin Excavated Natural Material

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Executive summary

Roads and Maritime Services (Roads and Maritime) is seeking approval under Part 5.1 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) for the use of Hornsby Quarry as a site for handling, management and beneficial reuse of spoil generated by road construction ('the project').

This technical working paper presents an assessment of the potential social and economic impacts as a result of the project. This assessment has been undertaken in accordance with the Secretary's Environmental Assessment Requirements (SEARs) and the *Roads and Maritime Services Socio-economic Assessment Practice Note* (Roads and Maritime, 2013) and includes socio-economic profiling of the study area, an assessment of potential positive and negative impacts of the project and an assessment of management and mitigation measures.

During the duration of the project, there is the potential for a boost in the local and regional economies due to project expenditure. Local and regional businesses would principally benefit from this expenditure through purchases made by businesses and workers associated with the project, to build and support the development of the project.

It was determined through economic multipliers that project expenditure would contribute a total (direct and indirect) of \$120 million of output, \$23 million of household income, around 235 full-time equivalent jobs and \$40 million of value added to the New South Wales economy over the total project duration.

The project facilitates the infilling and rehabilitation of the site upon completion of the project to provide recreational facilities for the community such as additional walking and mountain bike trails. The project removes the ongoing safety risk to the community by stabilising the quarry site so it can be opened to the public. The project is a safe and sustainable solution to addressing community concerns regarding the safety of the quarry site. The project has the potential to positively impact the local and regional economies by removing the ongoing costs for the maintenance of the Hornsby Quarry site currently incurred by the Hornsby Shire Council and the community.

There are potential long term benefits for local businesses from increased recreational tourism at the redeveloped quarry site. Businesses that may directly benefit from increased tourism include food and beverage retailers, accommodation providers, and other retail outlets catering to the needs of those using the rehabilitated quarry site for recreational purposes.

The project will require the temporary closure and/or changes to walking paths and mountain bike trails in the bushland surrounding the Hornsby Quarry site. The closure and/or changes to these paths are necessary to ensure public safety.

There is the potential for residents, users of community infrastructure and local businesses to experience impacts to amenity due to the project in the form of increases in noise and vibration, potential increases in dust and changes in visual amenity.

An increase in heavy vehicles on the existing road network during the project would potentially result in congestion due to increased delays at intersections along the project corridor and in surrounding areas. The increase in truck volumes, as a proportion of overall traffic, is anticipated to be minor as the Pacific Highway and local road network is already currently considered congested.

Access to the TAFE NSW – Northern Sydney Institute Hornsby Campus ('Hornsby TAFE') via Bridge Road will be temporarily reduced from two-lanes for bi-directional traffic to one lane that would need to be shared for entry and exit from the Hornsby TAFE. Consultation with Hornsby TAFE is ongoing and appropriate mitigation measures will be developed to ensure access to the site would be maintained. This would include the preparation of a Traffic Management Plan identifying traffic protocols for the shared access road.

Cumulative impacts to local residents, community facilities and businesses are most likely to result from the concurrent construction of the NorthConnex project and Hornsby West Side Development. Cumulative impacts will arise from the additional workforce vehicles on the local road network, additional project expenditure and additional employment opportunities in the area.

The study recommends a number of mitigation measures that are intended to minimise any impacts that would be associated with the project. These are detailed in **Section 6.0** of this report.

On balance, it is considered that the overall social and economic impacts of the project would be positive for the region.

1 Introduction

1.1 Project background

Roads and Maritime Services (Roads and Maritime) is seeking approval under Part 5.1 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) for the use of Hornsby Quarry as a site for handling, management and beneficial reuse of spoil generated by road construction (the project).

On 13 January 2015, Roads and Maritime received approval under Part 5.1 of the EP&A Act to construct and operate the NorthConnex project, a multi-lane tolled motorway linking the M1 Pacific Motorway at Wahroonga to the Hills M2 Motorway at the Pennant Hills Road interchange at Carlingford in northern Sydney. The Environmental Impact Statement (EIS) exhibited for NorthConnex identified that approximately 2.6 million cubic metres of spoil would be generated during the construction of the project. The NorthConnex EIS also identified a number of potential spoil management location options, with the final option(s) to be determined at the construction stage.

The Hornsby Quarry site has now been identified as one of the preferred options for the management of spoil generated during tunnel excavation activities from late 2015, noting that it is not a standalone solution. The Hornsby Quarry site is located close to NorthConnex and would minimise the distance required for haulage. In particular, spoil from the northern interchange compound and northern portals could be solely handled and reused at the Hornsby Quarry site. The handling, management and reuse of up to 1.5 million cubic metres of spoil at the Hornsby Quarry site would also alleviate the need for an increased number of other sites accepting small spoil volumes, thus reducing overall potential impacts within the wider community and the environment.

Hornsby Shire Council has also been actively seeking opportunities for material to fill the quarry void, with the aim of future rehabilitation of the Hornsby Quarry site and return to use for public recreation. Beneficially reusing spoil from NorthConnex would be an important first step towards preparing the Hornsby Quarry site in anticipation of Hornsby Shire Council separately rehabilitating and developing the site for public recreation in the future.

The Hornsby Quarry site is not currently the subject of a development approval that would permit handling, management and beneficial reuse of spoil at that site. Therefore, assessment and approval is being pursued in accordance with the EP&A Act. The Secretary's environmental assessment requirements (SEARs) for the project were issued on 2 July 2015 and included a requirement to undertake an assessment of potential impacts of noise and vibration from the project. This social and economic assessment has been prepared to inform the EIS being prepared for the Hornsby Quarry Road Construction Spoil Management Project.

1.2 The project

The Hornsby Quarry site would receive a minimum of one million cubic metres of excavated natural material (ENM) and/ or virgin excavated natural material (VENM) from the approved NorthConnex construction sites. Only ENM and/ or VENM would be received and reused at the Hornsby Quarry site.

Key features of the project would include:

- Widening and sealing of the quarry access road (Bridge Road) to facilitate all weather access.
- Clearing and grubbing, and establishment of erosion and sediment controls.
- Establishment of a compound site, security fencing and signage around the project area.
- Dewatering of the void (to be undertaken by Hornsby Shire Council in accordance with its existing groundwater licence) to a suitable level that allows working within the void.
- Construction of a conveyor from the stockpile site to the rim of the quarry void.

- Spoil haulage by truck from the NorthConnex construction sites to the Hornsby Quarry site over a period of approximately 28 months.
- Stockpiling of spoil at three stockpile sites within the Hornsby Quarry site using dozers and wheel loaders.
- Transport of the spoil via the conveyor from the stockpiles to the rim of the quarry void, where the spoil would fall directly into the void.
- Spreading and grading of the spoil on the quarry floor.
- Site demobilisation and rehabilitation of the compound site, stockpile areas and the conveyer corridor.

The project is anticipated to commence in late 2015 and is expected to take around 33 months to complete.

Detailed descriptions of each project activity can be found in **Section 4.1** of the EIS for the project.

An indicative project program is provided in **Table 1-1**.

Table 1-1 **Indicative program**

Phase	Indicative project timeframe															
	2015				2016				2017				2018			
Site establishment (including preparatory works)																
Establishment of conveyor																
Spoil haulage and stockpiling																
Spoil emplacement (operation of conveyor)																
Site clean-up and demobilisation																

An overview of project activities is included in **Table 1-2**. Detailed descriptions of each activity can be found in **Section 4.1** of the EIS for the project.

Table 1-2 Overview of works

Phase	Typical activities
Site establishment	The following works would be completed: • Dewatering of the void to a suitable working level. • Clearing and grubbing, and establishment of erosion and sediment controls. • Establishment of a compound site. • Establishment of security fencing and signage around the project site. • Widening and sealing of the currently unsealed quarry access road (Bridge Road) to facilitate all weather access.
Conveyor construction works	The construction of the conveyor works would include establishment of footings and the conveyor.
Spoil haulage and stockpile maintenance	Trucks would enter and leave via Bridge Road during standard work hours over a maximum period of 28 months. Spoil would be unloaded from the haulage trucks and stockpiled using dozers. It is expected that this activity would commence whilst the conveyor is still being constructed.
Spoil emplacement	Once the conveyor is constructed, these works would occur concurrently with spoil haulage and stockpiling activities, but would also continue for a period after the completion of spoil haulage onto the site. The activities include: • Placement of spoil from the stockpiles into the conveyor by front end loader. • Transport of the spoil via conveyor to the quarry void rim where the spoil would fall directly into the void. • Front-end loaders and articulated trucks would move the spoil along the quarry floor with dozers and rollers spreading the material. Periodic maintenance pumping would be undertaken during all phases in accordance with Council's existing groundwater licence.
Site demobilisation and rehabilitation	The construction compound and conveyor would be dismantled and removed from the site. Disturbed areas would be rehabilitated to a standard agreed with the Council. Security fencing would be removed, however would be retained around the quarry void if the void is deemed to remain an ongoing risk to public safety. Public access would then be reinstated to the areas outside the void exclusion zone.

1.3 Project location

The Hornsby Quarry site is located off Bridge Road on the western side of the Hornsby town centre. The site covers about 35 hectares and is owned by Hornsby Shire Council.

The Hornsby Quarry site comprises the quarry void, internal access roads and a cleared area to the east which were used as processing areas when the quarry was operational. Disused facilities associated with the previous quarrying operations remain on the site, including concrete office block buildings, a crushing and screening plant, a pipeline, security fencing and gates.

Whilst the site is zoned for public recreation (RE1) under the *Hornsby Local Environmental Plan 2013*, the quarry void itself is unsafe for public access given the steep sides and flooded nature of the void. Hornsby Shire Council currently maintains exclusion fencing around the void to prevent public access for public safety reasons. The areas outside of the void exclusion fencing are open to public access including mountain bike trails which have been established across the site by Council. However, until the quarry void is filled, full rehabilitation of the site for recreational purposes is not possible.

The Hornsby Quarry site and surrounds are densely vegetated with some cleared areas comprising the void itself, internal access roads and the cleared former processing areas. Dense bushland comprising the Berowra Valley National Park occurs directly to the west.

1.4 Purpose of this report

The SEARs for the project were issued on 2 July 2015 and have informed the preparation of the EIS for the project. The SEARs provide combined land use, property and socio-economic requirements and include:

- *An assessment of potential impacts on directly affected properties and land uses, including impacts related to access, land use and amenity related changes;*
- *An assessment of the effects on existing mountain bike trails and recreation areas within Old Man's Valley, including, where applicable, details of rerouted trails and access paths; and*
- *An assessment of social and economic impacts to businesses along Pennant Hills Road and the Pacific Highway, and the community associated with traffic, access, property, public domain and amenity related changes.*

This technical working paper presents the assessment of the potential social and economic impacts as a result of the project. The SEARs that relate to land use and property impacts are addressed in the land use and property assessment (**Section 7.1** of the EIS). This assessment has been undertaken in accordance with the SEARs and the *Roads and Maritime Services Socio economic Assessment Practice Note* (Roads and Maritime, 2013).

1.5 Methodology

This study has been conducted in accordance with the guidance presented in the *Roads and Maritime Services Socio-economic Assessment Practice Note* (Roads and Maritime, 2013). A moderate to comprehensive level of assessment has been adopted in accordance with Roads and Maritimes guidance.

The methodology for this study covers the existing socio-economic context, an assessment of impacts and mitigation measures as follows:

- Define the relevant study area for the project, taking into account the extent or scale of the potential impacts of the project, including both direct and indirect impacts, and the context of the area surrounding the project.
- A profile of the project area and surrounds, including any relevant statistics to provide a better understanding of the social and economic circumstances of the project area that will be potentially affected by the project.

- A description of any groups or particular communities that may be affected by the project, including directly impacted property owners, the general community, local businesses and recreational users, as well as those indirectly affected through traffic impacts, including public transport routes and cycling restrictions. Any economic impacts will be considered at a local and regional level, where appropriate.
- An assessment of the impacts of the project on individual businesses on a property-by-property basis, where appropriate.
- An assessment of the impacts of the project with regard to property impacts, business impacts, community values, as well as access and connectivity. The focus will be largely on directly affected properties but will also consider those in the vicinity of the project, as well as impacts on through traffic and transport movements in the project area.
- A cumulative assessment of the socio-economic impacts of all phases of the project, combined with the impacts of other planned and anticipated projects.
- Identification of measures to mitigate or manage the socio-economic impacts as a result of the project.

1.5.1 Economic multipliers

Economic multipliers are used to quantify economic impacts or changes in economic activity resulting from a stimulus such as the carrying out of the project. These multipliers can be calculated from input-output tables. The Australian Bureau of Statistics (ABS) prepares a national input-output table, the most recent being for 2009/10 (ABS, *Australian National Accounts: Input-Output Tables 2009/10*, 5209.0.55.001, 20 September 2013). The table describes inter-industry transactions among 114 industries, showing the fixed amounts of inputs that are required to produce a given output at the national level. The table is compiled in accordance with the Australian national accounting system, and international Government accounting standards.

State-level input-output tables can be derived by adjusting the national table to reflect each state's inter-industry transactions and final demand flows, based on information and data at the state level within the Australian national accounting system and on the latest Census data.

Four multipliers are usually used to measure economic impact: output (value of production or turnover), value added (which can be directly compared to gross domestic product and gross state product), household income and employment. Two types of multipliers can be calculated:

- Type 1 multipliers, which measure the direct and production-induced impacts of a stimulus or activity – the latter impacts refer to the subsequent rounds of purchases of inputs by businesses supplying the direct suppliers of the stimulus or activity (industrial flow-on effects).
- Type 2 multipliers, which capture the Type 1 effects and also measure the consumption-induced effects that flow from the expenditure of income that is earned from the production of additional output.

Input-output multipliers are based on a number of assumptions that provide a relative measure (to be compared with other industries) of the interdependence between one industry and the rest of the economy. This interdependence arises solely from the sales and purchase links between industries and is based on estimates of transactions occurring over a recent historical period. The limitations of input-output analysis therefore include:

- *Lack of supply-side constraints* – it is assumed that extra output can be produced in one area without taking resources away from other activities, thus potentially overstating economic impacts. The actual impact is likely to be dependent on the extent to which the economy is operating at or near capacity.

- *Fixed prices* – it is assumed that any change in the demand for productive factors would not induce any change in their cost.
- *Fixed ratios for intermediate inputs and production* – it is assumed that there is a fixed input structure in each industry and fixed ratios for production (as described by fixed technological coefficients).
- *No allowance for purchasers' marginal responses to change* – it is assumed that households consume goods and services in exact proportion to their initial budget shares and that this applies equally to industrial consumption of intermediate inputs and factors of production.
- *Absence of budget constraints* – it is assumed for consumption-induced effects (Type 2 multipliers) that household and government consumption is not subject to budget constraints.

It is preferable to apply Type 1 multipliers, because an input-output model is based on the above simplifying assumptions which have the effect of imposing few constraints to economic expansion. As a result, Type 2 multipliers could overstate potential impacts, particularly where assessing the expansion of an existing activity rather than the contribution of an existing activity.

1.6 Definition of the study area

The study area for the socio-economic assessment has been identified as the geographical statistical areas (as defined by the ABS) that encompass the project, as well as the wider catchment as it relates to the proposed haulage routes and the Hornsby Quarry site.

The study area comprises the areas that are most likely to experience social or economic impacts, as the spoil from the construction of NorthConnex is transported to the Hornsby Quarry site. The area comprises the areas immediately surrounding the quarry as well as the areas along the following haulage routes:

- Into Hornsby Quarry - Pacific Highway from the intersection with Pennant Hills Road, along George Street and onto Bridge Road.
- Out of Hornsby Quarry:
 - Non-peak hours - Bridge Road and south along George Street and the Pacific Highway onto Pennant Hills Road.
 - Peak hours - Bridge Road and north along Jersey Street North, the Pacific Highway, Yirra Road, Belmont Parade and Ku-ring-gai Chase Road to connect with the M1 Pacific Motorway.

Appendix A provides the ABS Statistical Area 1 reference codes that have been used to define the study area and **Figure 1-1** presents a map of the study area for the socio-economic assessment.

1.7 Structure of this report

The report has the following structure:

- **Section 1** introduces the project;
- **Section 2** presents an overview of community consultation and the key social and economic issues;
- **Section 3** provides a summary and analysis of the existing social and economic environment;
- **Section 4** details the potential social and economic impacts of the project;

- **Section 5** details the mitigation and management strategies recommended to address the potential social and economic impacts of the project;
- **Section 6** provides the references used to assist in the preparation of this report;
- **Appendix A** presents the statistical areas used to define the study area for the socio-economic assessment;
- **Appendix B** provides a detailed set of data tables for the socio-economic characteristics of the study area; and
- **Appendix C** presents the community infrastructure identified in the study area.

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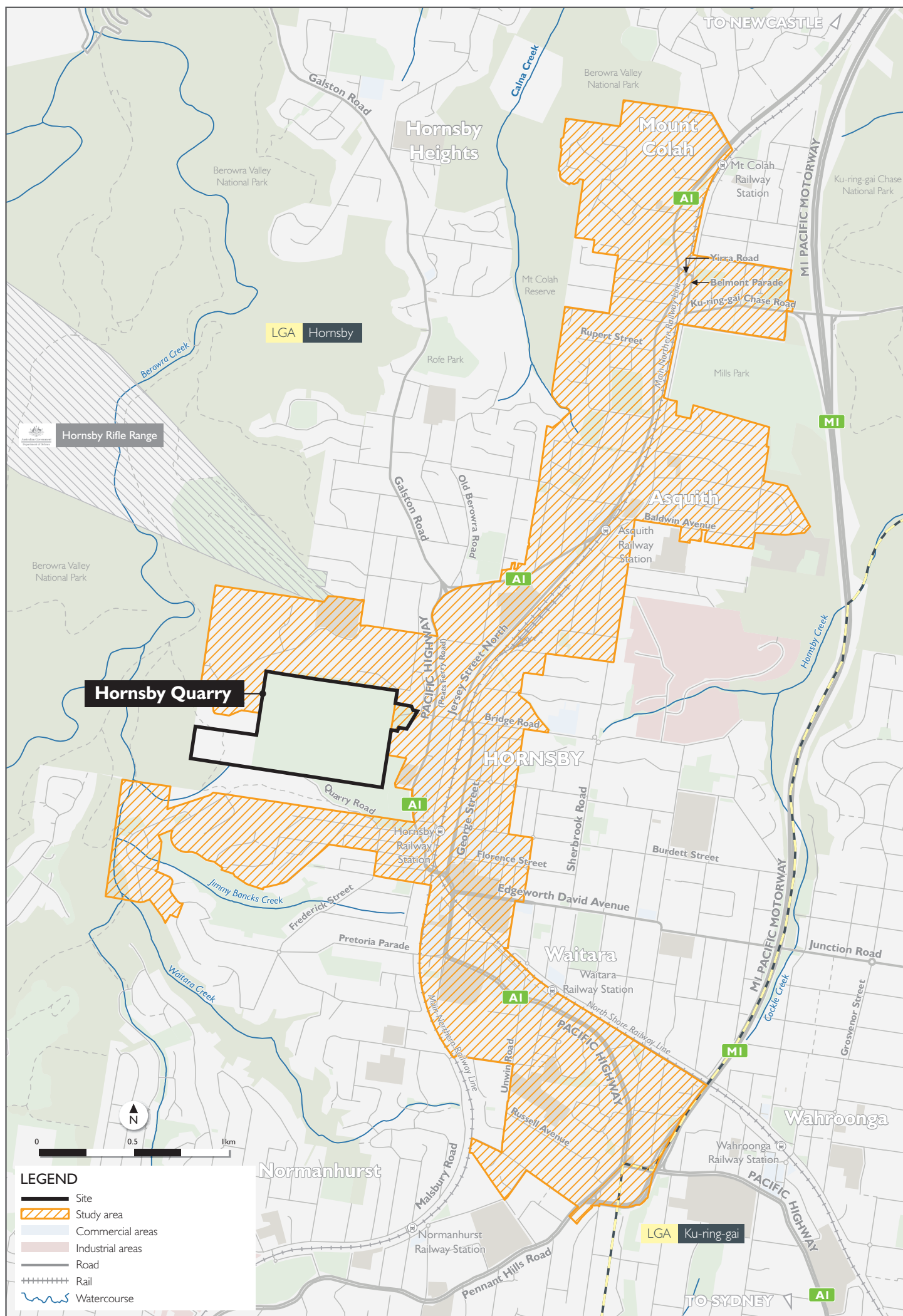


Figure 1-1 Study area for the socio-economic assessment

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2 Consultation and key stakeholder issues

Consultation with key stakeholders, including local communities, community groups and local businesses will occur throughout the EIS process. Community consultation being conducted as part of the project is discussed in detail in **Chapter 5** (Consultation) of the Hornsby Quarry EIS.

Table 2-1 identifies potential community and key stakeholder issues identified through stakeholder mapping.

Table 2-1 Potential community and stakeholder issues

Issue	Detail	Report section
Businesses and the economy	The haulage route should minimise impacts to businesses and the local economy.	Section 4.1
Properties	There is a concern that property damage could occur as a result of vibration from haulage.	Section 4.2
Amenity	- The project needs to take into account the air quality, noise and emission impacts from trucks hauling the spoil. - The project needs to consider the impacts on visual amenity at the Hornsby Quarry site.	Section 4.3
Community and recreational facilities	- Impacts on local schools, childcare facilities and health facilities. - The peak out-route passes several schools during school drop off times. - The project results in the temporary loss of public space and access. - Impacts to recreational opportunities (including mountain bike facilities) at the Hornsby Quarry.	Section 4.4 and Section 4.5
Traffic and transport (including access arrangements)	- The haulage route passes through residential and commercial areas. - Safety concerns from the increase in the amount of traffic around schools and child care facilities. - The proposed route has the potential to impact freight and commuter traffic. - The spoil haulage route should minimise impacts on access to the staff and student carpark for the Hornsby TAFE.	Section 4.5
Uncertainty	Uncertainty around project scale and design.	Section 4.4

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3 Existing context

3.1 Overview of existing environment

3.2 Socio-demographic profile of local residents

Data for the socio-demographic profile of the local resident population has been collated from the 2011 Census of Housing and Population (ABS, 2012) Basic Community Profiles, unless otherwise stated. A detailed set of data tables are provided at **Appendix B**.

The study area has been profiled by examining the data for statistical areas defined as Statistical Area 1 (SA1) by the Australian Bureau of Statistics (ABS). The study area adopted for this assessment is presented in **Section 1.6** and **Appendix A** of this report.

The geographical area of comparison is Hornsby Local Government Area (LGA).

The following indicators provide the key characteristics of people that reside in the study area and how they compare with Hornsby LGA and New South Wales:

- **Population:** In 2011, the population of the study area was 15,292 residents and the population of Hornsby LGA was 156,847 residents. The population of Hornsby LGA increased by 3.6 per cent between 2006 and 2011. This was slower than the average population growth across New South Wales (NSW) of 5.6 per cent over the same period.
- **Population Projections:** The population of Hornsby LGA is projected to increase 23 per cent between 2011 and 2031 resulting in 201,750 residents by 2031. This growth is predicted to be slower than New South Wales growth of 27 per cent over the same period.
- **Median Age:** In 2011, the average median age in the study area was 39 years. This is in line with the median age of Hornsby LGA and NSW of 39 and 38 years, respectively.
- **Population Age:** In 2011, 14.5 per cent of residents in the study area were aged 65 years and over. Residents in Hornsby LGA aged 65 years and over accounted for 14.4 per cent of the total population. Between 2006 and 2011, the proportion of residents in Hornsby LGA aged 65 years and older, has increased by 1 percentage point.
- **Indigenous Population:** The indigenous population of the study area and Hornsby LGA accounted for 0.5 per cent and 0.4 per cent of the total population, respectively. These were lower than the NSW average of 2.5 per cent of the population identifying as indigenous.
- **Language spoken at home:** In 2011, 34.7 per cent of residents in the study area and 28.4 per cent of the residents in Hornsby LGA spoke a language other than English at home. Both the study area and Hornsby LGA had a higher proportion of residents speaking a language other than English at home than the NSW average of 22.0 per cent.
- **Population mobility:** The study area has a higher level of internal migration than both Hornsby LGA and NSW averages. In the study area, 16.0 per cent of residents lived at a different address one year ago and 45.0 per cent lived at a different address five years ago. This is significantly higher than the Hornsby LGA and NSW averages of 11.6 per cent and 13.9 per cent, respectively, for one year migration and 34.1 per cent and 36.9 per cent respectively for five year migration.
- **Dwellings:** In 2011, the majority of dwellings in the study area were apartments/units (45.9 per cent), followed by separate houses (42.2 per cent) and semi-detached dwellings (11.4 per cent). The study area has less separate houses and more apartment/unit dwellings than Hornsby LGA or NSW averages.
- **Household size and composition:** The average household size in the study area was 2.6 people per household. The majority of these households were family households (70.3 per cent).

The average house sizes in Hornsby LGA and NSW were 2.9 and 2.6 people per household, respectively. Hornsby LGA and NSW had higher proportions of family households than the study area at 80.1 per cent and 71.9 per cent family households, respectively.

- **Housing tenure:** The majority of housing in the study area was rented in 2011 (34.6 per cent), followed by housing owned with a mortgage (33.9 per cent) and then housing owned outright (28.1 per cent). The study area had a greater proportion of renting than Hornsby LGA or NSW averages (20.3 per cent and 30.1 per cent respectively).
- **Median incomes:** The median household income in the study area in 2011 ranged between \$818 and \$2,700 per week. The Hornsby LGA median household income was \$1,824 per week and the NSW median was \$1,237. The median household income in some areas within the study area is significantly higher than the Hornsby LGA and NSW median household incomes, while the median household income in some areas within the study area is significantly lower than the Hornsby LGA and NSW medians.
- **Socio-economic advantage/disadvantage indexes:** The Index of Relative Economic Advantage/Disadvantage is a continuum of advantage to disadvantage. A higher score on the Index indicates an area has attributes of “higher advantage” such as a relatively high proportion of people with high incomes or a skilled labour force. It also means an area has a low proportion of people with low incomes and relatively few unskilled people in the labour force. In 2011, Hornsby LGA recorded an Index of Relative Economic Advantage/Disadvantage of a score of 1106 and decile of 10. This is a relatively high score, highlighting that the area is relatively advantaged when compared to other regions across Australia.
- **Need for assistance:** In 2011, 4.7 per cent of the population of the study area was identified as requiring assistance with core activities. This was higher than the Hornsby LGA average of 3.7 per cent requiring assistance with core activities, but lower than the NSW average of 4.9 per cent requiring assistance with core activities.
- **Labour force status:** In 2011, the unemployment rate for the study area was 5.6 per cent. This was higher than the Hornsby LGA unemployment rate (4.8 per cent), but lower than the NSW average unemployment rate (5.9 per cent).
- **Industry of employment:** In 2011, 14.4 per cent of residents of the study area were employed in the health care and social assistance industry. The second most common industry of employment was professional, scientific and technical services (12.8 per cent) and retail trade (9.9 per cent). Hornsby LGA had a similar distribution of industries of employment with 12.9 per cent of residents employed in the health care and social assistance industry and 12.8 per cent of residents employed in the professional, scientific and technical services industry.

In summary, the study area is generally homogenous with the wider Hornsby LGA socio-economic characteristics. Residents are more likely to live in non-family households, in rental apartments or flats, and have been living at their current address for less than 5 years than the remainder of Hornsby LGA and NSW. Residents generally have high socio-economic indexes and are more likely to speak a language other than English at home than the NSW average.

3.3 Community facilities

The immediate area surrounding the Hornsby Quarry is predominately bushland, with residential properties located to the north and south of the Hornsby Quarry. Community facilities adjacent to the Hornsby Quarry site are located to the east, along the Pacific Highway, and to the south of the site, on Dural Street.

The facilities within closest proximity to the Hornsby Quarry site include:

- TAFE NSW – Northern Sydney Institute Hornsby Campus ('Hornsby TAFE');
- Multiple child care centres;
- Mt Wilga Hospital;
- Hornsby Uniting Church;
- Hornsby Shire Council Chambers;
- Hornsby Court House;
- Hornsby Police Station;
- Hornsby Mall;
- Hornsby Transport Interchange;
- Hornsby Park and playground; and
- Hornsby Aquatic and Leisure Centre.

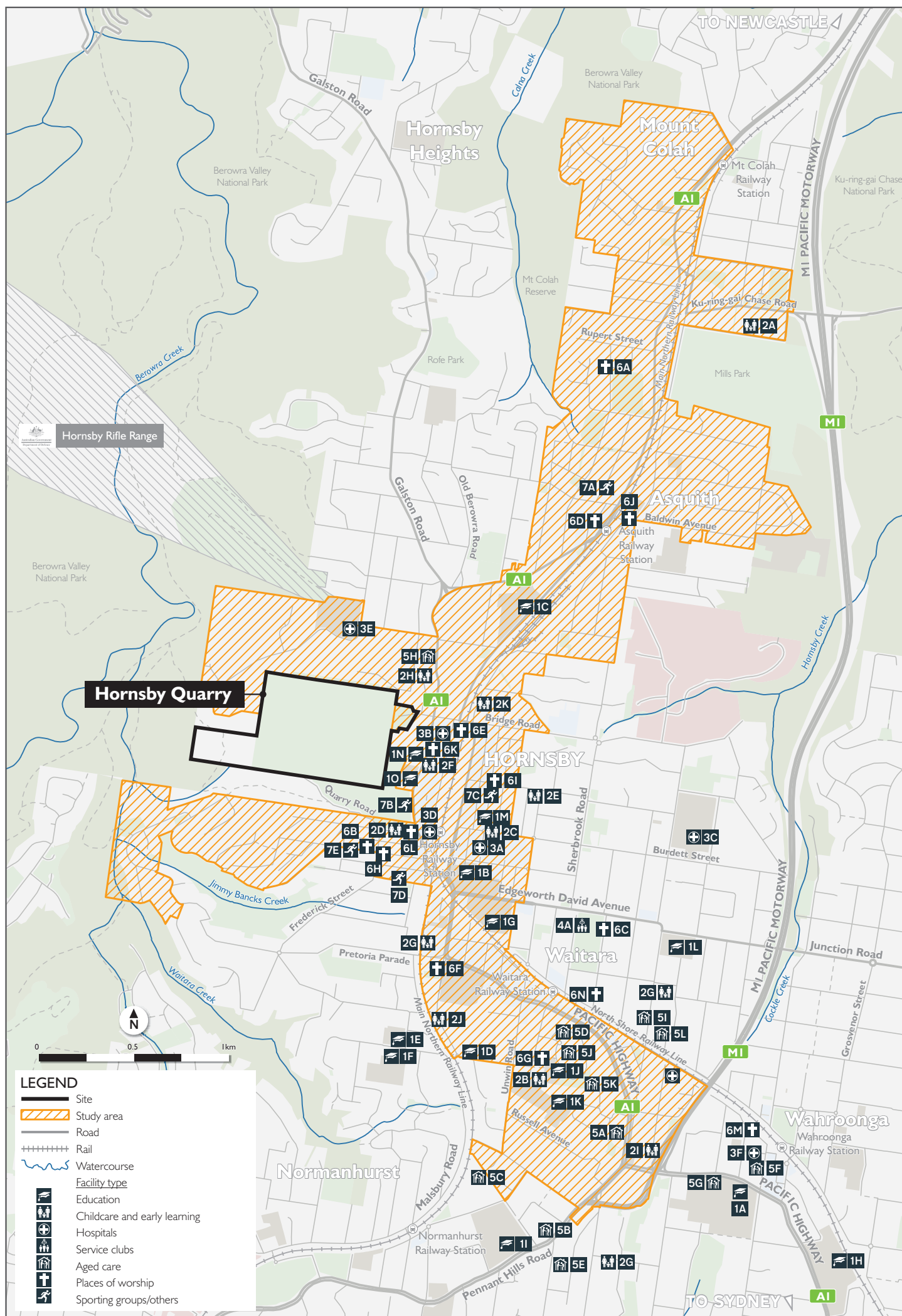
The broader study area is home to a significant amount of community infrastructure, particularly along the proposed haulage route. The broad study area incorporates the suburbs of Hornsby, Waitara, North Wahroonga and Asquith, all containing facilities that are essential to meeting the local needs of the people within these communities. Of particular note, the broader study area contains a large concentration of education facilities, ranging from early childhood through to tertiary, and aged care facilities.

Figure 3-1 indicates the proximity of community infrastructure to the project and **Appendix C** provides a list of community infrastructure presented in **Figure 3-1**.

The bushland immediately surrounding the Hornsby Quarry, including Old Mans Valley and Berowra Valley National Park, is used for recreational purposes and contains mountain bike trails and a number of walking trails, including Benowie walking track, which leads to the Blue Gum Walk and Hornsby Shire mountain bike trail. The Hornsby Quarry site is currently used by a number of mountain bike riding and walking clubs for social and recreational uses, including day use and overnight camping. Hornsby Shire Council recorded an estimated 300 visitors undertaking approximately 900 laps each week in 2013/14.

The Hornsby Quarry site is recognised as currently unstable and, as such, the bushland around the site must be used with caution, limiting the recreational activity that can take place. The site does not provide infrastructure such as toilet or drinking water facilities for recreational users. Access roads through the site are provided and used in emergencies such as bushfires.

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3.4 Economic / business environment

The Hornsby LGA has a relatively diversified economy and is not heavily reliant on one industry. In 2011-12, the Hornsby LGA had an estimated \$6 billion gross regional product (AECOM GRP Model, 2014). The largest contributing industries to the economy were manufacturing, health care/social assistance, professional/scientific/ technical services and education/training all contributing around eight to nine per cent of total industry contribution to the economy (gross sector value added) (AECOM GRP Model, 2014)

There were 4,318 businesses in the Hornsby, Waitara, Asquith and Mount Colah areas in 2013 (ABS, 2014a). The largest numbers of businesses were in the industries of professional/scientific/technical services, construction and rental/hiring/real estate services. Most of the businesses in the study area were small businesses with 64 per cent of businesses having turnover of less than \$200,000 and 98 per cent of businesses employing less than 20 employees¹ (ABS, 2014a).

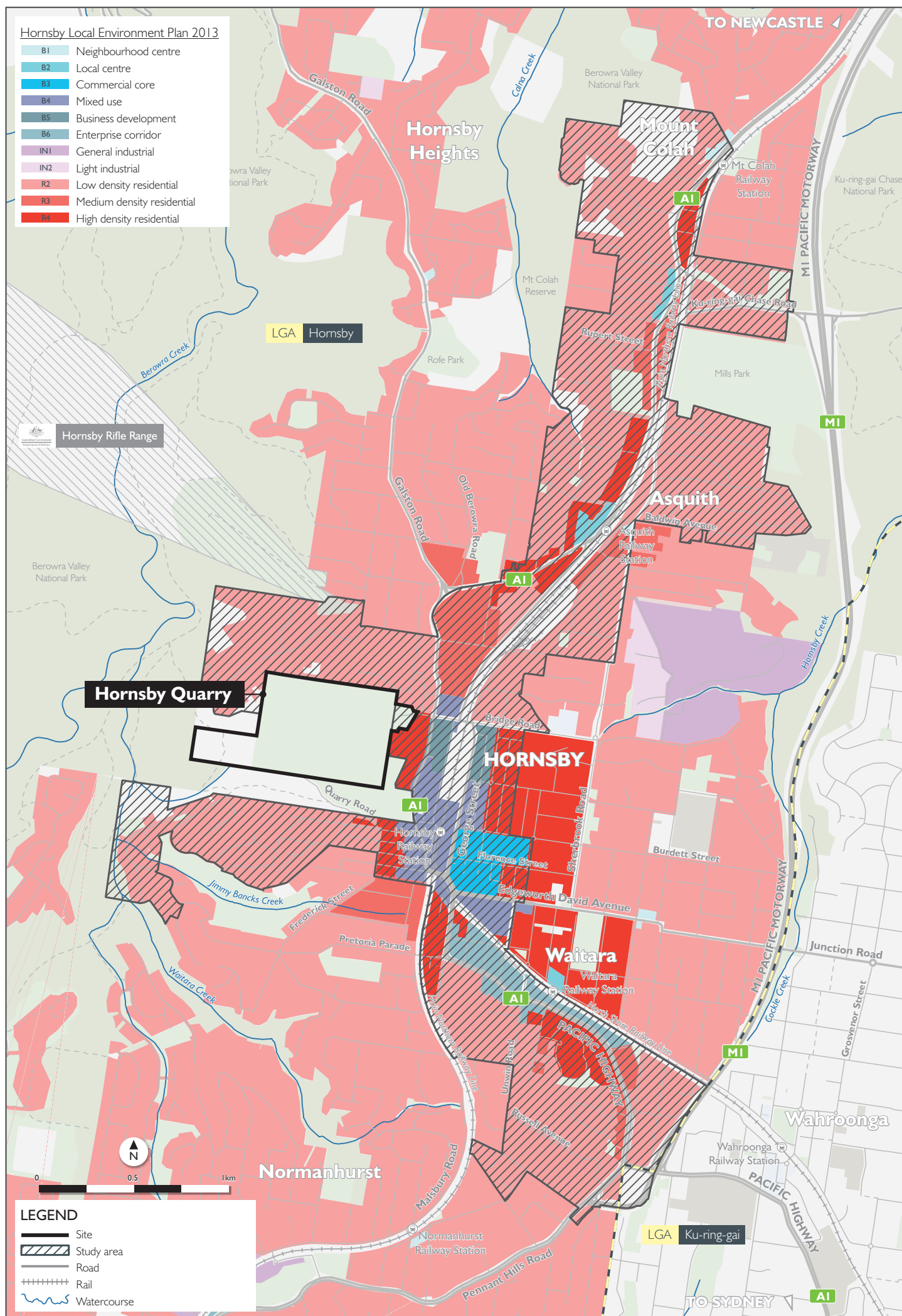
A number of businesses were identified as being located on the haulage routes along the Pacific Highway (between Pennant Hills Road and George Street, Hornsby), George Street, Bridge Road (west of George Street), Jersey Street North and the Pacific Highway (between Wattle Street and Yirra Road). These businesses fall within the following industries:

- Retailers, including supermarkets and pharmacies.
- Cafés, restaurants, pubs and bars.
- Accommodation services.
- Service stations and mechanics.
- Car dealerships.
- Other service providers such as funeral homes, travel agents, real estate agents, physiotherapists, dry cleaners, dentists, beauty and hair salons.

Figure 3-2 shows the current land use in the vicinity of the project.

¹ The ABS defines a small business as having less than 20 employees.

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3.5 Travel patterns

3.5.1 Passenger vehicles and public transport

Private vehicles are the predominant mode of transport in the study area with 47 per cent of residents travelling to work by car (as a driver or passenger). This is consistent with the higher than average vehicle ownership in the Hornsby LGA of 1.7 cars per household (the Sydney Metropolitan average is 1.6 cars per household).

The study area also has a high proportion of residents travelling by train to work compared with the Hornsby LGA average. In the study area, 26 per cent of residents travelled by train to work, while in Hornsby LGA, 21 per cent travelled by train to work. Train travel is a key method of transport for journeys to work in the area, particularly to the Sydney central business district.

Hornsby Station is located to the east of the Pacific Highway opposite Dural Lane. The North Shore, Northern and Central Coast & Newcastle Lines stop at Hornsby Train Station. Trains run every four mins during the morning peak and every four and a half minutes during the evening peak.

Hornsby has a number of bus services operating in the project area. Hornsby station has a major bus interchange and both HillsBus and Transdev operate buses that stop at this station. The frequency of bus services operating at this interchange ranges from every 10 minutes to once an hour.

Walk-only trips in the area represent 14 per cent of the average weekday travel mode share in Hornsby. Pedestrian footpaths are provided along the sides of the roads, with regular crossings via signalised intersections as well as two pedestrian overpasses at Hornsby train station. There are no separated cyclist facilities within the Hornsby area.

3.5.2 Freight and commercial travel patterns

Traffic surveys, completed for the NorthConnex project in December 2013, found that heavy vehicles represented around three to six per cent of total traffic across the weekday (referred to as average weekday daily traffic (AWDT)) on the Pacific Highway. This is mainly due to the nature of the Pacific Highway, whereby it passes through urban areas, characterised by highly signalled traffic flows. It is generally considered an unfavourable environment for long distance freight travelling between Pennant Hills Road and the M1 Pacific Motorway and as such the majority of freight and commercial vehicles travelling on this road are local freight movements for delivery to and from local businesses (refer to Technical working paper: Traffic and transport for the NorthConnex EIS) (AECOM, 2014).

3.6 Summary

The study area is home to a significant amount of community infrastructure essential to meeting the needs of the local communities. Of significant importance is the bushland immediately surrounding the Hornsby Quarry which is currently used for recreational purposes and contains a 6km mountain bike trail and a number of walking trails. The bushland is currently used by a number of mountain bike riding and walking clubs for social and recreational uses, including day use and overnight camping.

The proposed haulage route is generally considered congested due to the high dependency of local residents on transportation by car and the movements associated with local freight and commercial vehicles (refer to **Section 4.5**).

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4 Impact assessment

During the project there is the potential for positive and negative impacts on local residents, businesses and the regional economy. An assessment of the potential impacts has been undertaken to determine the type, direction and magnitude of the potential impacts.

The following potential impacts during the project have been identified:

- Increase in output, industry value added, household income and employment from direct and indirect impacts due to project expenditure and employment;
- Amenity impacts, resulting in decreased air quality, increased noise and vibration and decreased visual amenity for community facilities, residential properties and businesses in close proximity to the haulage route, and residential properties and Hornsby TAFE adjacent to the Hornsby Quarry site;
- Changes in accessibility to residential properties, community facilities and businesses due to traffic congestion from project traffic along haulage routes;
- Community cohesion impacts from the potential closure and/or changes to the mountain bike trails and some walking trails in bushland adjacent to the Hornsby Quarry site; and
- Cumulative impacts due to concurrent construction activities associated with NorthConnex, Hornsby West Side Development and other construction projects in the region.

The following potential benefits following completion of the project have been identified:

- Reduction in ongoing costs for the maintenance of the Hornsby Quarry site currently incurred by the Hornsby Shire Council and the community;
- Facilitating the rehabilitation of the Hornsby Quarry site, resulting in potential improvements in landscape character and visual amenity;
- Facilitating the rehabilitation of the Hornsby Quarry site and the expected subsequent provision by Hornsby Shire Council of additional walking and bike paths for public use, potentially resulting in increased community cohesion; and
- Removal of the ongoing safety risk to the community by stabilising the quarry site so it can be opened to the public.

4.1 Economic and business impacts

The expenditure of the project would be of significant benefit to the economy. This expenditure would inject economic stimulus benefits into the local, regional and state economies. Local and regional businesses would principally benefit from this expenditure through purchases made by businesses and workers associated with the project, to build and support the development of the project. The analysis assumes that ten per cent of labour, plant and equipment, materials or other inputs would be sourced from interstate or overseas.

The workforce expected to be created during the project (classified as 'initial' employment in this assessment) includes:

- Up to 80 employees for early works (site preparation, site establishment and establishment of conveyor);
- 15 employees for spoil management; and
- 20 employees for site demobilisation.

These employees will be required for varying durations over the approximate 33 month project lifetime.

The workforce presented above does not include those employed in the haulage of spoil from the NorthConnex construction sites to the Hornsby Quarry site. These workers have been included as part of the NorthConnex workforce. The impact of this workforce has been assessed in the Business Impacts Technical Assessment of the NorthConnex EIS.

The full-time equivalent (FTE) Hornsby Quarry Spoil Management workforce is presented in **Table 4-1**. The employment presented in the table below differs from the employment presented above as it represents the FTE positions required per year for the project and takes into account the duration of employment and the number of individuals employed.

Table 4-1 Hornsby Quarry Spoil Management Workforce, FTE positions per year

Workforce (FTE/year)	2015	2016	2017	2018	Total
Early works (site preparation, site establishment and establishment of the conveyor)	20	20			40
Spoil management		11	15	11	37
Site demobilisation				15	15
Total positions (FTE)	20	31	15	26	92

Table 4-2 presents the direct, indirect and total impacts of project expenditure on the New South Wales economy over the 33 month project duration.

Direct impacts (including employment) are the initial and 'first-round' effects of project expenditure where 'first round' effects refer to the impacts on businesses supplying directly to the project. Businesses that may directly benefit from the project may include local construction contractors and those businesses who service or supply goods to the construction industry such as food and beverage retailers, accommodation providers, and other retail outlets that would cater to the day-to-day needs of the project workforce. The increase in turnover may subsequently lead to increased employment opportunities and incomes for those businesses (and employees) providing goods and services.

The project expenditure would also have flow-on effects to other businesses in the area and to the wider state economy. These flow-on effects are also referred to as indirect effects.

The assessment of direct, indirect and total impacts of project expenditure has been conducted using the economic multiplier methodology presented in **Section 1.5.1**. As project expenditure was not available for the assessment, the 'initial' employment coefficient from the state-level input-output table was used to estimate project expenditure based on FTE employment provided.

Table 4-2 shows that for New South Wales²:

- Project expenditure, in terms of output, contributes an estimated \$88 million directly, with flow-on (indirect) effects of \$33 million, giving an estimated total impact of \$120 million (rounded).
- Household income generated by carrying out the project is estimated to be \$16 million with flow-on effects of \$7 million, giving an estimated total household income contribution of \$23 million.

² The analysis assumes that four per cent of labour, plant and equipment, materials or other inputs would be sourced from interstate and six per cent of equipment, materials and other inputs would be sourced from overseas.

- Direct employment (initial and 'first round') supported by the project is estimated to average 138 FTE positions during the 33 month project (including 92 FTE jobs presented in **Table 4-1** – classified as 'initial' employment). Flow-on employment is estimated to average 96 FTE positions over the 33 months, giving a total of 235 FTE positions (rounded) over the project duration, or on average 59 FTE positions per year.
- Value added attributable to the project is estimated to be around \$27 million directly, with flow-on effects of around \$13 million, giving an estimated total value added contribution of \$40 million. This is the estimated contribution to Gross State Product (GSP).

Table 4-2 Direct, indirect and total impacts of expenditure on the New South Wales economy

Area	Increase in industry output	Increase in household income	Increase in employment	Increase in value added
	\$ million	\$ million	FTE positions ^(a)	\$ million
Direct	88	16	138	27
Indirect	33	7	96	13
Total ^(b)	120	23	235	40

Source: AECOM (2014)

Notes:

- (a) Total FTE positions supported over the project duration (2015-2018). The average number of FTE positions supported per year is 59 FTE positions.
- (b) Totals may not sum due to rounding.

4.1.2 Economic and business benefits arising from the completion of the project

In its current state, Hornsby Quarry presents an ongoing safety risk and requires ongoing maintenance costs to ensure wall stability. The project has the potential to positively impact the local and regional economy by removing the ongoing costs for the maintenance of the Hornsby Quarry site currently incurred by the Hornsby Shire Council and the community.

The Hornsby Shire Council has been actively exploring options for infilling the quarry void to rehabilitate the site for public use. The project facilitates the infilling and rehabilitation of the Hornsby Quarry site to provide recreational facilities for the community without significant capital outlay required by the Hornsby Shire Council and the community, thus enabling community funds to be utilised elsewhere.

There are potential long term benefits for local businesses from increased recreational tourism at the redeveloped quarry site. Businesses that may directly benefit from increased tourism include food and beverage retailers, accommodation providers, and other retail outlets catering to the needs of those using the rehabilitated quarry site for recreational purposes.

4.2 Property impacts

No residential properties or businesses would be acquired (partially or fully) for the project. The project would be confined to land owned by Hornsby Shire Council. Hornsby Shire Council has been consulted during the design development for the project and is supportive of works to fill and stabilise the Hornsby Quarry void, as a necessary first step towards potential rehabilitation and development of the Hornsby Quarry site for recreational purposes in the future.

4.3 Amenity impacts

Amenity impacts include any factors that affect the ability of a resident, visitor or business owner to enjoy their home and daily activities, for example, noise, vibration, detrimental changes to views or changes to air quality. Amenity impacts may also affect passive or active users of the open space and recreational facilities surrounding the Hornsby Quarry site such as the walking and mountain bike tracks and Hornsby Park.

Amenity impacts during the project have been discussed in detail in **Section 6.2** (Noise and vibration), **Section 6.3** (Air quality) and **Section 7.2** (Visual and urban design) of the EIS for the project.

With reference to those assessments, the potential impacts to residents and businesses during the project within the study area as a result of changes in amenity would occur as a result of:

- Changes in visual amenity due to activities at the Hornsby Quarry site and the increase in vehicles on the road network;
- Increases in noise and vibration, including increases in road traffic noise; and
- Potential changes in local air quality due to increased dust emissions associated with surface disturbance and/or the handling, transport and management of spoil.

4.3.1 Visual Amenity

It is anticipated that visual amenity would not be impacted for residences along Fern Tree Close and Manor Road due to the project. These residents are currently screened by existing vegetation, which would be maintained throughout the life of the project.

It is anticipated that visual impacts during the project would be primarily limited to the increase in vehicles on the local road network for the transport of materials and spoil.

Residents and community facilities located on Bridge Road may be visually impacted through the clearance of some vegetation adjacent to Bridge Road. Visual amenity for the Hornsby TAFE may be impacted as buildings adjacent to the Hornsby Quarry site would have clear views to the future stockpile area where the conveyor infrastructure is to be established. This receiver location is expected to experience the greatest visual change of all receivers external to the Hornsby Quarry site. However, the intermittent nature of users of the Hornsby TAFE site would act to mitigate the extent and duration of potential visual impacts.

Visitors to Hornsby Mountain Bike Trail and Benowie Walking Track would have partial views of the site establishment activities, depending on the timing and nature of rerouting proposed by Hornsby Shire Council. It is anticipated that some trails would be rerouted to ensure the safety of the public and would maintain adequate distance from the project. Some temporary closures of the trails may occur, during which no site activities would be visible. Nonetheless, given the intermittent nature of visitors to these trails, the visual impacts are not considered to be significant.

Works for the project would be limited to standard work hours only. Therefore, there will be no visual impacts during night time hours as a result of lighting or other activities.

4.3.2 Noise and Vibration

Noise mitigation surrounding stationary plant and equipment (such as mulchers) and noise mounds about 5 metres high surrounding the stock piling area have been included in the design of the project to mitigate noise from works at the Hornsby Quarry site. The noise assessment conducted for this project determined that no sensitive receivers would be highly noise affected (noise levels greater than 75 dB(A)) due to works on the Hornsby Quarry site. However, some receivers will experience moderate effects, including:

- Residential receivers overlooking the site could experience moderate exceedances of up to 23 dB(A) during times of noise intensive works associated with the site establishment phase. Noise

would reduce with distance, and receivers in the second or third rows back from the site could experience maximum exceedances of up to 14 dB(A) during site establishment.

- During the spoil haulage and emplacement phase, residential receivers overlooking the site could experience exceedances of the noise management levels of up to 19 dB(A) and receivers in the second or third rows back from the site could experience maximum exceedances of up to 5 dB(A) during spoil haulage and emplacement.
- Classrooms at the Hornsby TAFE that look directly over the project site could experience exceedances of the internal noise criterion of up to 9 dB(A) during the site establishment phase and up to 2 dB(A) exceedances during the 'conveyor construction and haulage' and 'spoil haulage and emplacement' phases.

The noise assessment indicates that noise levels at commercial and industrial receivers and community facilities, including childcare centres and places of worship, adjacent to the site would generally remain compliant with the applicable noise management levels.

Visitors to Hornsby Shire Mountain Bike Trail and Benowie Walking Track during work hours are expected to be affected by noise during works, depending on the timing and nature of rerouting proposed by Hornsby Shire Council. It is anticipated that some trails would be rerouted to ensure the safety of the public and would maintain adequate distance from the project, limiting the noise impact on recreational users of the site.

The noise assessment determined that any increase in noise from haulage of spoil along the Pacific Highway would remain compliant with the applicable noise criteria, except on Bridge Road to the west of the Pacific Highway. The noise assessment predicted that noise levels on Bridge Road to the west of the Pacific Highway would increase by about 7-10 dB(A) dependent on the time of day, exceeding the noise criteria for these sensitive receivers and resulting in a number of residences at this location being impacted by noise during work hours. Noise levels on Bridge Road to the east of the Pacific Highway are expected to remain below noise management levels.

The site establishment and project works, as well as all haulage vehicles and workforce vehicles would be limited to standard work hours only. Therefore, there will be no noise impacts during night time hours as a result of project spoil haulage and handling activities.

Due to the relatively large offset distances between the site and sensitive receivers and the nature of the work, the project is not predicted to result in exceedances of the applicable structural damage and human comfort vibration criteria.

4.3.3 Air Quality

The air quality assessment determined that the project dust deposition rates and cumulative concentrations of total suspended particulates, carbon monoxide, volatile organic compounds and polycyclic concentrations of total aromatic hydrocarbons would all be well below the applicable assessment criteria.

For particulate matter concentrations, the project contributions to the airshed are generally below applicable criteria however the air quality assessment noted some exceedances of the cumulative criteria at sensitive receptors located adjacent to the site. These exceedances are attributable to high existing background concentrations. These exceedances could be minimised through the implementation of management and monitoring measures, to be documented in a dust management plan for the project.

Sensitive receivers that may be impacted by reduced air quality would include recreational users of the walking and mountain bike tracks and Hornsby Park, residential properties overlooking the site and students and teachers at the Hornsby TAFE campus.

The visual, noise and vibration and air quality impact assessments determined that there would be no amenity impacts on retirement villages, place of worship, schools (other than Hornsby TAFE), hospitals and childcare centres due to carrying out of the project.

For businesses, residences and community facilities, including aged care facilities, places of worship, educational facilities, hospitals and recreational facilities along the haulage routes, the increase in noise from haulage vehicles is not expected to exceed acceptable noise levels and air quality impacts are expected to be negligible. Businesses and community facilities with outdoor areas such as outdoor seating or play areas are not expected to be significantly impacted by changes in amenity due to the project.

4.3.4 Amenity benefits arising from the completion of the project

The project will facilitate Hornsby Shire Council's rehabilitation of the quarry void to provide a space for community use and recreation. There is potential for the future character of the Hornsby Quarry site to change dramatically due to Hornsby Shire Council's rehabilitation of the site, whereby landscape character and visual amenity will be positively impacted. Visual amenity would improve for residents and businesses adjacent to the Hornsby Quarry site from the redevelopment and rehabilitation of the site for use as recreational land.

4.4 Community cohesion and severance

Community severance occurs when people are separated from the facilities, services and social networks they wish to use within their community. This can be due to modified travel patterns or psychological barriers created by transport infrastructure such as highways or bridges, and can manifest in outcomes such as trip delays, diversions and traffic noise. Severance also arises where there are changes in the comfort and attractiveness of areas.

Existing physical connections and linkages in the study area are instrumental in shaping current community cohesion. Existing paths of travel by vehicle, bicycle and foot are critical to maintaining community cohesion and also contribute to the community character of the area. Access to existing community infrastructure such as educational facilities, health services and places of worship is also seen as fundamental to creating and maintaining a sense of community cohesion and wellbeing.

Access to community infrastructure will be maintained throughout the project to maintain links to the community for residents. Access to community facilities in the immediate vicinity of the project such as Hornsby College, Hornsby Uniting Church, Hornsby Shire Council Chambers, Hornsby Court House and Hornsby Police Station will remain throughout the project. Residents may experience some congestion and resulting delays around these facilities during peak times as a result of haulage vehicles using the local road network.

There is no formal footpath on either side of Bridge Road (from where it turns south towards the Hornsby TAFE), however pedestrians currently use the roadside verge or Bridge Road itself to access the TAFE. Pedestrian access to the TAFE via Bridge Road would be restricted during the project, for safety reasons.

Signage would be provided to redirect pedestrians along an alternate route to Hornsby TAFE entrances on Pacific Highway / Peats Ferry Road. **Figure 4-1** shows the indicative alternative access route for pedestrians. This is not a highly utilised access point for the Hornsby TAFE and all other access points to the Hornsby TAFE would be maintained throughout the project.

Access to public transport, including Hornsby Train Station and the station bus interchange, will be maintained throughout the project. Residents and workers accessing the station by bus or car may experience some congestion and resulting delays during peak times as a result of haulage vehicles using the local road network.

The project has been designed to avoid direct impacts to community facilities, with the exception of unavoidable restrictions to existing mountain bike and pedestrian trails. The project will require the closure and/or changes to some walking paths and mountain bike trails in the bushland surrounding the Hornsby Quarry during the project. The paths are used by a variety of walking and mountain bike riding groups for both day and overnight recreational activities. They are also popular with the general public for recreational purposes. The closure and/or changes to these paths is necessary during the project to ensure public safety. A map showing the trails that would be closed and those that would remain open during the project is provided in **Section 4.1** (Project description) of the EIS for the project.

Appropriate signage would be erected prior to and during works to advise the public of the alterations to mountain bike and pedestrian trails, including information regarding alternative cycling and walking routes.

Exclusion fencing is currently maintained around the quarry void by Hornsby Shire Council to prevent public access for safety reasons. The project would result in public exclusion zones being expanded to include the site area for the duration of the project. Exclusion zones would be required to ensure the safety of the public and personnel undertaking the works. The expanded exclusion zone would include areas which are currently publicly accessible, including part of the mountain bike trail and walking tracks.

Residents, particularly elderly residents, and business owners are likely to experience uncertainty about the project prior to and during the project but it is expected that this can be managed through continuing consultation.

4.4.1 Community cohesion benefits arising from the project

The project has the potential to improve community cohesion of the study area and bring the community together through enabling the provision of additional public recreational space. Recreational walking and bike paths for public use provide open and recreational space for the community to meet and share.

The project also reduces the ongoing safety risk to the community by stabilising the quarry site, providing Council with the option to open the site to the public. The project is a safe and sustainable solution to addressing community concerns regarding the safety of the quarry site.

As there is no acquisition of residential properties, the project is not expected to impact the sense of belonging in the surrounding communities.

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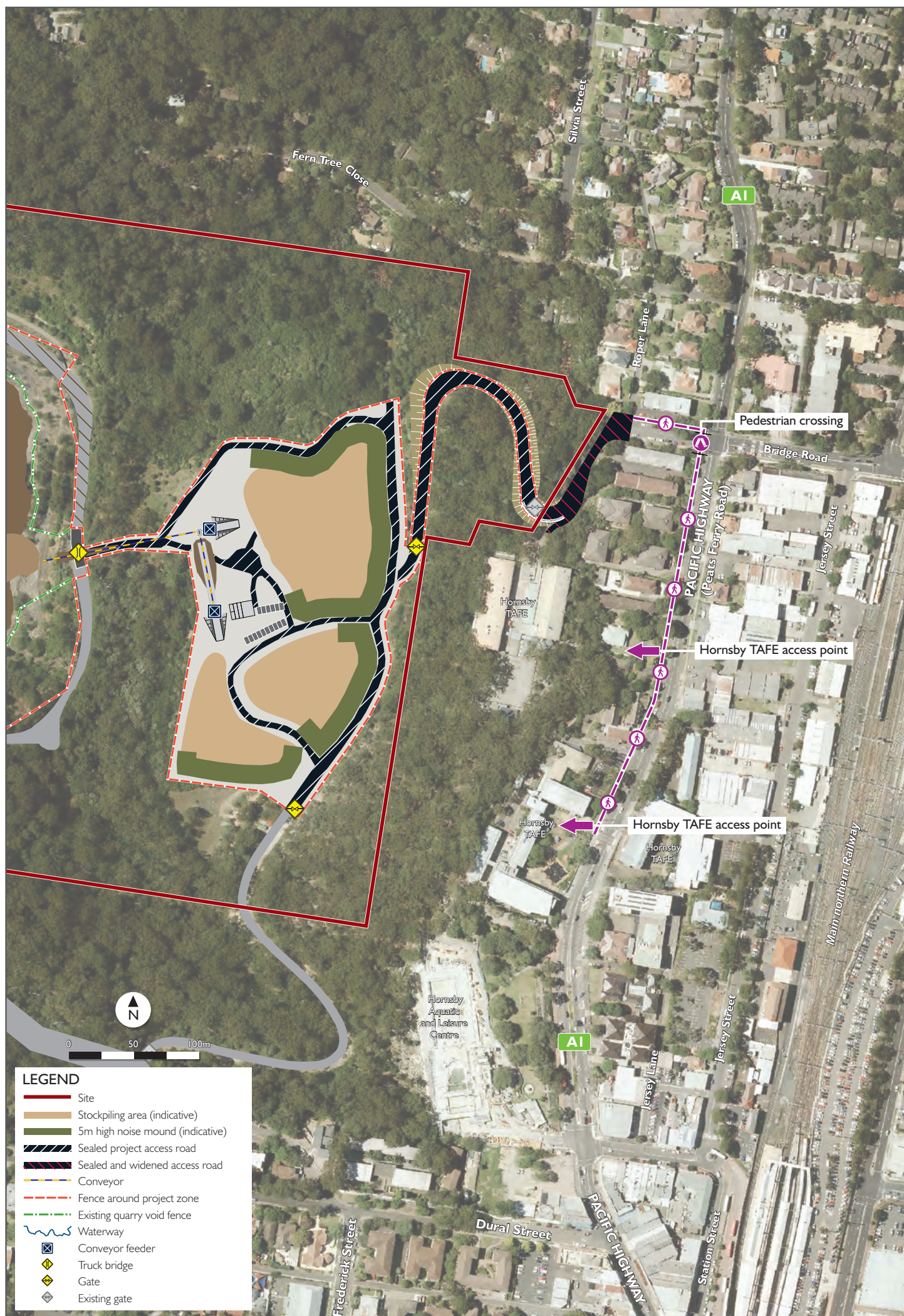


Figure 4-1 Indicative alternative pedestrian access

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4.5 Traffic and access arrangements

The traffic and transport impact assessment prepared for the project describes in detail potential changes to conditions for road users as a result of the project, including:

- Increased congestion on the Pacific Highway, Pennant Hills Road and the local road network;
- Changes in accessibility to the Hornsby TAFE; and
- An increase in bus service travel times due to slower travel speeds and increased intersection delays.

Traffic attributable to the project will arise from the haulage of spoil and project workforce movements. The maximum number of trucks accessing the Hornsby Quarry site per hour at the peak of project works would be 35 vehicles per hour. The total maximum number of trucks is estimated to be 385 vehicles per weekday during the peak of spoil generation at NorthConnex tunnelling sites. All works and haulage associated with spoil management on the Hornsby Quarry site would be confined to standard work hours, being:

- 7:00 am to 6:00 pm from Monday to Friday;
- 8:00 am to 1:00 pm on Saturdays; and
- No work to be conducted on Sundays or public holidays.

Traffic attributable to the project workforce is not expected to impact on peak period traffic. The project workforce is expected to begin their shifts at 6:00am, avoiding peak traffic periods. Traffic generated by the project workforce is estimated to be approximately 20 light vehicles per day.

An increase in heavy vehicles on the existing road network during the project would potentially result in congestion due to increased delays at intersections along the project corridor and in surrounding areas. Businesses that rely on deliveries from and to their premises may experience some increases in transit times due to increased traffic on the road network from project heavy vehicles. Residents trying to access community facilities, such as schools, child care centres, community centres, health care and places of worship may experience some delays due to increased congestion on the local road network. Heavy vehicles will be required to comply with school zone travel speeds to maintain road safety around schools.

It is not anticipated that this increase in congestion will impact freight movements, as the Pacific Highway and local road networks are not major freight thoroughfares and are mainly used for freight and deliveries for local businesses. The increase in truck volumes, as a proportion of overall traffic, is anticipated to be minor as the Pacific Highway and local road network is already currently considered congested.

Users of public transport services could potentially be impacted by:

- An increase in bus service travel times due to slower travel speeds and increased intersection delays;
- Longer travel times to and from bus stops by supplementary travel modes (eg car passenger, walking to/from bus stop, etc) due to an increase in traffic volumes, slower travel speeds and increased intersection delays; and
- Increased delays at intersections for on-road cyclists due to an increase in traffic volumes travelling along the corridor.

It is anticipated that vehicle and pedestrian access to individual properties or businesses in the vicinity of the project, including those located on Bridge Road, will not be impacted during the project. Therefore, it is expected that local residents will not be deterred from shopping at local businesses or visiting community facilities during the project. Parking along Bridge Road will be maintained throughout the project.

Vehicular access to the Hornsby TAFE via Bridge Road will be maintained throughout the project. However, access will be temporarily reduced from two-lanes for bi-directional traffic to one lane that would need to be shared for entry and exit from the Hornsby TAFE. Access from Bridge Road to the Hornsby TAFE is mainly used to access workshop buildings and for deliveries. All other access points to the Hornsby TAFE site will be maintained throughout the project.

Consultation with Hornsby TAFE is ongoing and appropriate mitigation measures will be developed as part of ongoing consultation activities to ensure access to the site would be maintained. This would include the preparation of a Traffic Management Plan identifying traffic protocols for the shared access road (including right of way and appropriate safety protocols to ensure the safety of Hornsby TAFE visitors, students and staff). Consultation with the Hornsby TAFE has also explored opportunities for the temporary relocation of Hornsby TAFE deliveries to the main entrance of the Hornsby TAFE (via the Pacific Highway) to avoid conflicts with haulage traffic, where possible.

Traffic and transport impacts during the project are discussed in detail in **Section 6.1** (Traffic and Transport) of the EIS for the project.

4.5.1 Traffic and access benefits arising upon completion of the project

Upon completion of the project, it is anticipated that traffic on the Pacific Highway and local roads in study area will return to levels experienced before the project's commencement. Access to residential properties, businesses, community facilities and public transport is not expected to be negatively impacted.

4.5.2 Cumulative impacts

Cumulative impacts to local residents, community facilities and businesses are most likely to result from the concurrent construction of the NorthConnex project and Hornsby West Side Development. Cumulative impacts will arise from the additional construction workforce vehicles on the local road network, additional expenditure and additional employment opportunities in the area.

Cumulative impacts are likely to intensify the impacts identified as a result of the Hornsby Quarry project, particularly with regard to employment and economic stimulus. The demand for labour for major projects such as NorthConnex, Hornsby West Side Development and other projects in the area would increase employment opportunities for local residents. There is potential for wages to increase due to higher demand for construction workers.

The opportunity for local businesses to supply goods or services to the construction of these projects and their construction workforces has the potential to increase business turnover due to higher demand from the multiple projects.

There is the potential for construction workforce vehicles for NorthConnex to contribute further to congestion on the road network as additional vehicles use the local road network when staff drive to, and from, their shifts. This is not expected to impact peak period traffic as these workforces are expected to begin their shifts outside of peak hours. The development proposed at Hornsby West Side may increase construction vehicles, including heavy vehicles used in the construction of the development, if it were to be constructed concurrent to the project.

The NorthConnex project construction site is located some distance away from the Hornsby Quarry site and, as such, local residents, community facilities and local businesses are not expected to be affected by cumulative amenity impacts.

5 Mitigation and management strategies

The recommended measures to mitigate or manage impacts generated during the project are summarised in **Table 5-1**.

Table 5-1 Mitigation measures

Impact	Detail
Amenity	
Noise and Vibration	Mitigation measures specific to noise and vibration can be found in Section 6.2 of the EIS for this project.
Air quality	Mitigation measures specific to air quality can be found in Section 6.3 of the EIS for this project.
Visual Amenity	Mitigation measures specific to landscape character and visual amenity can be found in Section 7.2 of the EIS for this project.
Traffic and access arrangements	
Accessibility	Mitigation measures specific to traffic and access arrangements can be found in Section 6.1 of the EIS for this project.
Community cohesion	
Community cohesion	A community involvement plan would be developed and implemented to provide timely, regular and transparent information about changes to access and traffic conditions, details of future work programs and general works progress throughout the project. Information would be provided in a variety of ways including letter box drops, media releases, internet sites, signage and a hotline.
Cumulative impacts	
Cumulative impacts	Monitor the development of significant projects with significant proximity to the project and amend the Construction Environment Management Plan for the project if, or when, required.

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6 Conclusion

This report has identified and assessed the potential impacts to local residents, users of community facilities and local businesses associated with spoil management at Hornsby Quarry site.

This assessment has been conducted with regard to the existing social and economic environment, an assessment of potential positive and negative impacts and an assessment of management and mitigation measures.

During the project, there is the potential for a boost in the local and regional economies due to project expenditure. Local and regional businesses would principally benefit from this expenditure through purchases made by businesses and workers associated with the project, to build and support the development of the project.

A total of 235 FTE jobs (including direct and indirect employment) are expected to be created during the 33 month duration of the project. Employment opportunities would grow in the region through the potential increase in business patronage and through the increase in demand for project workers.

In its current state, Hornsby Quarry presents an ongoing safety risk and requires ongoing maintenance costs to ensure wall stability. The project has the potential to positively impact the local and regional economy by removing the ongoing costs for the maintenance of the Hornsby Quarry site currently incurred by the Hornsby Shire Council and the community. The project removes the ongoing safety risk to the community by stabilising the quarry site so it can be opened to the public.

While the project will require the closure and/or changes to walking paths and mountain bike trails in the bushland surrounding the Hornsby Quarry, the project will facilitate the infilling and rehabilitation of the site by Council to provide additional recreational facilities for the community in future.

There are potential long term benefits for local businesses from increased recreational tourism at the redeveloped quarry site. Businesses that may directly benefit from increased tourism include food and beverage retailers, accommodation providers, and other retail outlets catering to the needs of those using the rehabilitated quarry site for recreational purposes.

Visual impacts are not anticipated during night time hours as works would be limited to standard work hours only. Residents of Fern Tree Close and Manor Road will not experience visual amenity impacts due to the project. Temporary visual amenity impacts are likely to occur for residences and community facilities located on Bridge Road, Hornsby TAFE and visitors to Hornsby Mountain Bike Trail and Benowie Walking Track, with direct and indirect views of the quarry site.

Noise mitigation surrounding plant and equipment and noise mounds about 5 metres high surrounding the stockpile area have been included in the design of the project to mitigate noise from works at the site. The noise assessment conducted for this project determined that no sensitive receivers would be highly affected by noise due to works on the site. However, some receivers such as residents overlooking the site and students and teachers at Hornsby TAFE, will experience minor effects due to their proximity to the site. Noise impacts will be limited to standard work hours as no night time work is expected over the project duration.

The noise assessment determined that any increase in noise from haulage of spoil along the Pacific Highway would remain compliant with the applicable noise criteria, except on Bridge Road to the west of the Pacific Highway, where noise levels would increase by approximately 6 dB(A), exceeding the noise criteria for these sensitive receivers.

Due to the relatively large offset distances between the site and sensitive receivers and the nature of the work, the project is not predicted to result in exceedances of the applicable structural damage and human comfort vibration criteria.

The air quality assessment noted some exceedances in the Office of Environment and Heritage (OEH) air quality criteria at sensitive receptors located adjacent to the site, due to high background concentrations. These exceedances could be minimised through the implementation of monitoring and measures to be outlined in a dust management plan. Sensitive receivers that may be impacted by reduced air quality would include recreational users of the walking and mountain bike tracks, residential properties overlooking the site and students and teachers at Hornsby TAFE.

The visual, noise and vibration and air quality impact assessments determined that there would be no amenity impacts on retirement villages, place of worship, schools (other than Hornsby TAFE), hospitals or childcare centres due to the project.

An increase in heavy vehicles on the existing road network during the project would potentially result in congestion due to increased delays at intersections along the project corridor and in surrounding areas. The increase in truck volumes, as a proportion of overall traffic, is anticipated to be minor as the Pacific Highway and local road network is already currently considered congested.

Residents trying to access community facilities, such as schools, child care centres, community centres, health care and places of worship may experience some delays due to increased congestion on the local road network. Project vehicles will be required to comply with school zone travel speeds to maintain road safety around schools.

Access to the Hornsby TAFE via Bridge Road will be temporarily reduced from two-lanes for bi-directional traffic to one lane that would need to be shared for entry and exit from the Hornsby TAFE. Hornsby TAFE has been consulted and appropriate mitigation measures will be developed to ensure access to the site would be maintained. This would include the preparation of a Traffic Management Plan identifying traffic protocols for the shared access road.

Cumulative impacts to local residents, community facilities and businesses are most likely to result from the concurrent construction of the NorthConnex project and Hornsby West Side Development. Cumulative impacts will arise from the additional construction workforce vehicles on the local road network, additional expenditure and additional employment opportunities in the area.

Where necessary, a number of mitigation measures have been proposed to minimise any impacts that would be associated with undertaking the project.

Overall the positive impacts on businesses and the economic benefit of the project are expected to outweigh any negative impacts that cannot be satisfactorily mitigated.

7 References

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Appendix A

Study area

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Appendix A – Study area

Table 7-1 ABS reference codes

Statistical Area Level 1, ABS reference codes			
1140306	1140324	1140518	1140530
1140311	1140325	1140519	1140532
1140312	1140501	1140520	1140540
1140313	1140502	1140521	1140548
1140314	1140507	1140522	1140567
1140315	1140508	1140523	1140570
1140316	1140510	1140524	1140571
1140317	1140511	1140527	
1140318	1140513	1140528	

Source: ABS (2011), Australian Statistical Geography Standard

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Appendix B

Socio-economic profile

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Appendix B – Socio-economic profile

Table 7-2 Key demographic characteristics of the study area, 2011

Key demographic characteristic	Study Area	Hornsby LGA	NSW
Total population	15,292	156,847	6,917,658
Median age	39*	39	38
Population 15+	12,570	126,419	5,585,148
% aged 15+	82.2%	80.6%	80.7%
Population aged 65+	2,223	22,586	1,018,179
% aged 65+	14.5%	14.4%	14.7%
Indigenous population	75	562	172,620
% Indigenous	0.5%	0.4%	2.5%
Speaks language other than English at home	5,302	44,582	544,106
% ESL	34.7%	28.4%	22.0%
Has need for assistance with core activities	723	5,838	338,362
% Need for assistance	4.7%	3.7%	4.9%
Median total household income (\$/weekly)	\$818-\$2,700	\$1,824	\$1,237

Source: Australian Bureau of Statistics (2012), 2011 Census of Housing and Population, TableBuilder 2011

* Average median age of all SA1s in the study area.

Table 7-3 Population projections

Year	Hornsby LGA	NSW
2011	163,800	7,218,550
2016	171,400	7,708,850
2021	181,100	8,230,400
2026	191,300	8,739,950
2031	201,750	9,228,350

Source: New South Wales state and regional population projections, 2011 – 2031, NSW Department of Planning and Infrastructure, 2014 release

Table 7-4 Household characteristics, 2011

Households	Study Area	Hornsby LGA	NSW
Average household size	2.6	2.9	2.6
Family households	70.3%	80.1%	71.9%
Non-family households	29.7%	19.9%	28.1%
Total households	5,763	52,671	2,471,295

Source: Australian Bureau of Statistics (2012), 2011 Census of Housing and Population, Community Profiles.

Table 7-5 Dwellings, 2011

Dwellings	Study Area	Hornsby LGA	NSW
Separate house	42.2%	75.5%	69.5%
Semi-detached, row or terrace house, townhouse	11.4%	7.6%	10.7%
Flat, unit or apartment	45.9%	16.5%	18.8%
Other dwelling	0.4%	0.3%	0.9%
Dwelling structure not stated	0.2%	0.1%	0.1%
Total occupied private dwellings	5,770	52,672	2,471,299

Source: Australian Bureau of Statistics (2012), 2011 Census of Housing and Population, Community Profiles.

Table 7-6 Housing tenure, 2011

Housing tenure	Study Area	Hornsby LGA	NSW
Owned outright	28.1%	36.8%	33.2%
Owned with a mortgage	33.9%	39.9%	33.4%
Renting	34.6%	20.3%	30.1%
Other tenure type	1.2%	1.5%	0.8%
Tenure type not stated	2.2%	1.5%	2.6%
Total Households	5,765	52,673	2,471,296

Source: Australian Bureau of Statistics (2012), 2011 Census of Housing and Population, Community Profiles.

Table 7-7 Socio-economic Indexes for Areas (SEIFA), 2011

SEIFA index	Disadvantage	Social-economic advantage/disadvantage	Economic resources	Education and occupation
Hornsby LGA	1085	1106	1083	1122

Source: Australian Bureau of Statistics (2012), 2011 Census of Housing and Population, Socio-Economic Indexes for Areas (SEIFA).

Table 7-8 Method of Travel to work, 2011

Mode	Study Area	Hornsby LGA	NSW
Car (driver or passenger)	55.6%	71.1%	78.1%
Train	33.8%	18.6%	7.7%
Bus	0.9%	3.9%	4.6%
Truck	0.9%	0.9%	1.5%
Walked only	7.0%	3.6%	5.1%
Other	1.8%	1.8%	3.0%
Total One Method	6,087	60,699	2,516,427

Source: Australian Bureau of Statistics (2012), 2011 Census of Housing and Population, Community Profiles.

Table 7-9 Labour force characteristics, 2011

Labour force statistics	Study Area	Hornsby LGA	NSW
Total labour force	8,058	82,482	3,334,857
Employed full-time	4,983	49,753	2,007,925
% Full-time	61.8%	60.3%	60.2%
Employed part-time	2,231	24,883	939,464
% Part-time	27.7%	30.2%	28.2%
Employed away from work	271	2,679	120,121
% Away from work	3.4%	3.2%	3.6%
Employed hours not stated	124	1,238	70,821
% Hours not stated	1.5%	1.5%	2.1%
Unemployed	449	3,929	196,526
Unemployment rate	5.6%	4.8%	5.9%

Source: Australian Bureau of Statistics (2012), 2011 Census of Housing and Population, Community Profiles.

Table 7-10 Internal Migration, 2011

Internal Migration	Study Area	Hornsby LGA	NSW
Persons who lived at a different address 1 year ago	2,414	14,435	946,005
% of total population	16.0%	11.6%	13.9%
People who lived at a different address 5 years ago	6,390	37,119	2,380,678
% of total population	45.0%	34.1%	36.9%

Source: Australian Bureau of Statistics (2012), 2011 Census of Housing and Population, Community Profiles.

Table 7-11 Industry of employment, 2011

Industry	Study Area	Hornsby LGA	NSW
Agriculture, forestry and fishing	0.1%	0.5%	2.2%
Mining	0.2%	0.2%	1.0%
Manufacturing	5.9%	6.4%	8.4%
Electricity, gas, water and waste services	0.7%	0.9%	1.1%
Construction	5.2%	6.1%	7.3%
Wholesale trade	5.4%	5.9%	4.4%
Retail trade	9.9%	9.2%	10.3%
Accommodation and food services	5.1%	4.7%	6.7%
Transport, postal and warehousing	3.2%	3.0%	4.9%
Information media and telecommunications	3.7%	3.6%	2.3%
Financial and insurance services	7.8%	7.2%	5.0%
Rental, hiring and real estate services	1.5%	1.6%	1.6%
Professional, scientific and technical services	12.8%	12.8%	7.9%
Administrative and support services	3.9%	3.2%	3.3%
Public administration and safety	4.9%	4.8%	6.1%
Education and training	8.0%	10.3%	7.9%
Health care and social assistance	14.4%	12.9%	11.6%
Arts and recreation services	1.3%	1.4%	1.5%
Other services	3.6%	3.4%	3.7%
Inadequately described/Not stated	2.3%	2.0%	2.5%
Total	7,598	78,553	3,138,330

Source: Australian Bureau of Statistics (2012), 2011 Census of Housing and Population, Community Profiles.

Appendix C

Community facility inventory

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Appendix C – Community facility inventory

Inventory of community and recreational facilities within the study area and surrounds

Group	Description
Education Facilities	
1A	Abbotsleigh School for Girls
1B	AU Academy
1C	Asquith Boys' High school
1D	Barker College
1E	Clarke Road School
1F	Hornsby South Public School
1G	Hornsby Girls' High School
1H	Knox Grammar School
1I	Normanhurst Boys' High School
1J	Our Lady of the Rosary Catholic School
1K	St Leo's Catholic College
1L	Waitara Public School
1M	Hornsby Ku-ring-Gai Community College
1N	TAFE NSW - Northern Sydney Institute
1O	Hornsby College
Childcare and early learning facilities	
2A	Alphabet Academy
2B	Catholic Care Family and Early Learning Centre
2C	Hornsby Central Preschool Kindergarten
2D	Hornsby Ku-ring-gai Montessori Preschool
2E	Hornsby Shire Council Nursery and Preschool Centre
2F	Hornsby TAFE Children's Centre
2G	Mountbatten Institute
2H	Mt Errington Early Learning Centre
2I	Peter Rabbit Preschool
2J	The Jack and Jill Kindergarten
2K	The Three Bears Kindergarten
2L	Wahroonga Long Day Care Centre
2M	Wahroonga Next Generation Child Care Centre
Hospitals and emergency services	
3A	Hornsby Cardiac Diagnostic Unit
3B	Hornsby Fire Station
3C	Hornsby Ku-ring-gai Hospital
3D	Hornsby Police Station
3E	Mt Wilga Private Hospital
3F	Neringah Hospital Wahroonga
3G	Northern Sydney Ambulance Station (Wahroonga)
Service clubs	
4A	Rotary Club of Waitara
Aged Care facilities	
5A	Belvedere Aged Care Facility
5B	Bowden Brae Retirement Village
5C	Bramblewood Retirement Village
5D	Catholic Community Services- Chantal Cottage Respite
5E	Greenwood Aged Care
5F	Hammond Care Neringah Hospital
5G	Netherby Aged Care Facility

Group	Description
5H	Regis Ku-ring-gai Gardens
5I	Tallwood's Corner Aged Care Service
5J	The Grange Village
5K	Wahroonga Nursing Home
5L	Wynwood House
Places of Worship	
6A	Australia Ling Liang Church
6B	Baha'i Community of Hornsby
6C	Breakthrough Church
6D	Church of Christ, Asquith
6E	Community Church, Hornsby
6F	Hornsby Baptist Church
6G	Hornsby Catholic Parish
6H	Hornsby Uniting Church
6I	Potters House Fellowship Hornsby
6J	St Patrick's Catholic Church
6K	St Peter's Anglican Church
6L	Sydney Manna Church
6M	The Hive Church
6N	Waitara Seventh-day Adventist Church
Sporting groups/Others	
7A	Asquith Scout Hall
7B	Hornsby Aquatic and Leisure Centre
7C	Hornsby Ku-ring-gai Police Community Youth Club
7D	Hornsby RSL Gymnastics Club
7E	Hornsby Wing Chun Academy

Appendix I

Technical working paper:
Non-Aboriginal Heritage

Roads and Maritime Services

Hornsby Quarry Road Construction Spoil Management Project
Technical working paper: non-Aboriginal heritage assessment
July 2015

Prepared for
Roads and Maritime Services

Prepared by
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Contents

Glossary of terms and abbreviations	iv
Executive summary	i
2 Introduction	5
2.1 Project background	5
2.2 The project	5
2.3 Project location.....	7
2.4 Purpose of this report.....	7
2.5 Structure of this report	9
3 Statutory Controls	13
3.1 Environment Protection and Biodiversity Conservation Act 1999	13
3.2 Environmental Planning and Assessment Act 1979	13
3.3 The Heritage Act 1977	13
3.4 Hornsby Local Environmental Plan 2013.....	14
4 Methodology.....	15
4.1 Desktop review.....	15
4.2 Field inspection	16
5 Historical context.....	17
5.1 Aboriginal land use.....	17
5.2 Early settlement	17
5.3 Early 20th Century to present day	18
6 Results	19
6.1 Heritage inventory search results	19
6.2 Field inspection	20
7 Significance assessments.....	25
7.1 Significance assessment criteria.....	25
7.2 Historical Themes	31
7.3 Significance grading.....	32
8 Impact Assessment.....	35
8.1 Direct Impacts	35
8.2 Indirect Impacts.....	35
9 Statement of Heritage Impact	37
9.1 Key findings.....	39
10 Mitigation and Management Measures.....	41
11 References.....	43

List of tables

Table 1	Indicative program.....	6
Table 2	Overview of project works.....	6
Table 3	SEARs Requirements	7
Table 4	Heritage items identified on heritage registers	19
Table 5	Coordinates of heritage items identified within the project site.....	20
Table 6	Diatreme Hornsby Quarry and surrounding vegetation (NSW Office of Environment & Heritage, 2015) 26	
Table 7	Old Man's Valley Cemetery/Higgins' Family Cemetery (NSW Office of Environment & Heritage, 2015) 27	
Table 8	Complex of Higgins Family heritage items (including heritage walk depression era sandstone steps, sandstone receptacle, cool room and Higgins Homestead/Memorial) (Parsons Brinckerhoff Australia Pty Ltd, 2004)	29
Table 9	Hornsby Quarry Industrial Machinery and Buildings (Parsons Brinckerhoff Australia Pty Ltd, 2004) 30	
Table 10	Diatreme Hornsby Quarry and surrounding vegetation Historical Themes (NSW Office of Environment & Heritage, 2015).....	31
Table 11	Old Man's Valley Cemetery/Higgins' Family Cemetery, sandstone receptacle, cool room, site of Higgins homestead/memorial and sandstone stairs Historical Themes (NSW Office of Environment & Heritage, 2015).....	31
Table 12	Hornsby Quarry Industrial Machinery and Buildings Historical Themes.....	32
Table 13	Grading of significance criteria (from NSW Heritage Office, 2001:11)	32
Table 14	Diatreme Hornsby Quarry and surrounding vegetation grading of fabric	33
Table 15	Complex of Higgins Family heritage items (including heritage walk depression era sandstone steps, sandstone receptacle, cool room and Higgins Homestead/Memorial) grading of fabric 33	
Table 16	Hornsby Quarry Industrial Machinery and Buildings grading of fabric.....	33
Table 17	Impact types and assessment	39

List of figures

Figure 1	Regional context of the project	10
Figure 2	Historic heritage constraints within and near the project site	11

List of plates

Plate 1	Diatreme Hornsby Quarry	21
Plate 2	Heritage Walk Depression era stairs circa August 1994 (Hornsby Shire Council, 1994) 23	
Plate 3	Heritage Walk Depression era stairs circa December 2013.....	23
Plate 4	Cool room.....	23
Plate 5	Cool room location	23
Plate 6	Old Man's Valley Cemetery	23
Plate 7	Higgins Homestead/Memorial.....	23
Plate 8	Sandstone receptacle (Parsons Brinckerhoff Australia Pty Ltd, 2004:173).....	24

Plate 9	Sandstone receptacle (Parsons Brinckerhoff Australia Pty Ltd, 2004:173).....	24
Plate 10	Hornsby Quarry Machinery	24
Plate 11	Hornsby Quarry structure with graffiti	24

Glossary of terms and abbreviations

Term	Meaning
OEH	NSW Office of Environment and Heritage.
Roads and Maritime	Roads and Maritime Services.
SEPP	State Environmental Planning Policy.
LEP	Local Environmental Plan
SHR	State Heritage Register
S170	Section 170

Executive summary

Roads and Maritime has identified the former Hornsby Quarry site as one of the preferred locations for receipt and management of spoil from the NorthConnex project, a tolled motorway linking the M1 Pacific Motorway at Wahroonga to the Hills M2 Motorway at Carlingford. Roads and Maritime is proposing that spoil generated during the construction of the roads and road infrastructure facilities associated with the NorthConnex project be received at the Hornsby Quarry site for handling, management and beneficial reuse to stabilise the current quarry void on the site. The proposal would contribute to the potential future rehabilitation and redevelopment of the quarry by Hornsby Council for recreational purposes and public benefit.

The proposal is declared to be State significant infrastructure under Part 5.1 of the *Environmental Planning and Assessment Act 1979* by virtue of clause 14, and clause 1, Schedule 3 of *State Environmental Planning Policy (State and Regional Development) 2011*. The Secretary's environmental assessment requirements (SEARs) for the project were issued on 2 July 2015 and included a requirement to undertake an assessment of potential impacts of the project on non-Aboriginal heritage.

The proposal would allow the Hornsby Quarry site to receive up to 1.5 million cubic metres of excavated natural material (ENM) and virgin excavated natural material (VENM) from the construction of roads and road infrastructure facilities forming part of the NorthConnex project. Spoil handling, management and beneficial reuse at the Hornsby Quarry site would include site establishment and conveyer construction, dewatering of the quarry void, spoil haulage onto site, spoil stockpiling, spoil emplacement into the void via conveyer.

This report has been prepared for the purpose of identifying and assessing the potential environmental impacts of the construction and operation of the project on non-Aboriginal heritage.

An inspection of Hornsby Quarry site was undertaken by heritage specialists Dr Darran Jordan and Ms Rochelle Coxon on 13 December 2013. This inspection was undertaken as part of early investigations into spoil management locations for the NorthConnex project.

A further inspection was undertaken by Dr Darran Jordan on 15 December 2014. This inspection was aimed at informing the preparation of a non-Aboriginal heritage impact assessment for the project, and guiding the development of the project design to avoid impacts on non-Aboriginal heritage where reasonable and feasible.

During the field inspections, the area was surveyed for previously unrecorded items as well as previously identified items of historic heritage. Non-Aboriginal heritage items in proximity to the Hornsby Quarry site were also inspected to confirm the assessed historic heritage significance of those items. This inspection was undertaken to inform an assessment of potential impacts to non-Aboriginal heritage values within the project area. The identified items were mapped and photographed. Items of historic heritage value identified in proximity to the Hornsby Quarry area are summarised in the following table.

Table 1-1 Items of historic heritage value in proximity to the Hornsby Quarry

Item Name	Listing	Significance
Diatreme Hornsby Quarry and surrounding vegetation	Australian Heritage Places Inventory Identifier 2613 Register of the National Estate Place ID 2613 NSW State Heritage Inventory Item A54/538	Local
Old Man's Valley Cemetery/Higgins Family Cemetery	Register of the National Estate Place ID 2614 NSW State Heritage Register Listing No. 01764 NSW State Heritage Inventory Item A55 National Trust of Australia Listing No. 9167	State
Heritage walk depression era sandstone steps	Hornsby LEP 2013 Items 513 and 537	Local
Sandstone receptacle	Hornsby LEP 2013 Item A55	Local
Cool room	Hornsby LEP 2013 Item A55	Local
Higgins Homestead/Memorial	Hornsby LEP 2013 Item A55	Local
Hornsby Quarry Industrial Machinery and Buildings	Unlisted	Local

Of these heritage items, the project will unavoidably impact on the 'Diatreme Hornsby Quarry and surrounding vegetation'. There will be direct impacts to this heritage item due to the erection and use of the conveyor and the placement of spoil into the quarry void. There will be no direct impacts to other non-Aboriginal heritage items, including no direct impacts within the State Heritage Register curtilage of the 'Old Man's Valley Cemetery/Higgins Family Cemetery'.

The project may have minor indirect impacts on non-Aboriginal heritage items during works on the site, through introduction of new visual elements within view-lines to and from heritage items. Access to heritage items may also be blocked or restricted for the duration of the works.

The following management and mitigation measures have been identified and are recommended for application to the project to ensure minimal impacts on non-Aboriginal heritage:

- Archival recording of the extent of the diatreme will be undertaken following initial dewatering of the quarry void to show the full extent of the geological feature. This will occur prior to any works commencing within the void. The archival recordings would be made available to Hornsby Shire Council for its records and future use.
- The identified heritage items 'Old Man's Valley Cemetery/Higgins' Family Cemetery', 'sandstone receptacle', 'cool room', 'site of Higgins homestead/memorial and sandstone stairs' and 'Hornsby Quarry Industrial Machinery and Buildings' should be avoided during the proposed works.
- All Roads and Maritime staff and contractors working at the Hornsby Quarry site should be made aware of the location of heritage items and informed of their responsibility regarding the protection of those items.
- A dilapidation survey should be conducted immediately prior to the commencement of work. This dilapidation survey would enable the condition of the items located within 100 metres of vibration intensive works to be assessed and to produce a baseline recording to be used as comparison to ensure the project does not impact on the condition of the heritage items.
- Appropriate dust management measures should be considered and developed in consultation with a suitably qualified heritage specialist in relation to the listed heritage item 'Old Man's Valley Cemetery/Higgins' Family Cemetery'.

- The location of the item Diatreme Hornsby Quarry and surrounding vegetation should be considered during the conveyor construction/use and stabilisation works so that the diatreme itself is not damaged during this phase of works.
- A Heritage Management Plan would be developed to protect known heritage values during the proposed works. The Plan should include procedures for an appropriately qualified heritage consultant to conduct periodic inspections of heritage sites for which baseline dilapidation surveys are undertaken, to monitor their condition during construction. The Plan should also outline stop work procedures for use in the event of unexpected finds and should contain measures to protect surrounding heritage items.

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2 Introduction

2.1 Project background

Roads and Maritime Services (Roads and Maritime) is seeking approval under Part 5.1 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) for the use of Hornsby Quarry site for handling, management and beneficial reuse of spoil generated by road construction (the project).

On 13 January 2015 Roads and Maritime received approval under Part 5.1 of the EP&A Act to construct and operate the NorthConnex project, a multi-lane tolled motorway linking the M1 Pacific Motorway at Wahroonga to the Hills M2 Motorway at the Pennant Hills Road interchange at Carlingford in northern Sydney. The Environmental Impact Statement (EIS) exhibited for the NorthConnex project identified that approximately 2.6 million cubic metres of spoil would be generated during the construction of the project. The NorthConnex EIS also identified a number of potential spoil management location options, with the final option(s) to be determined at the construction stage. Following design development, the Hornsby Quarry site has now been identified as one of the preferred options for the management of spoil generated during road construction from late 2015.

The Hornsby Quarry site is not currently the subject of a development approval that would permit handling, management and beneficial reuse of spoil at that site. Therefore, assessment and approval is being pursued in accordance with the EP&A Act.

Roads and Maritime has formed the opinion that the proposal is likely to significantly affect the environment, such that an EIS is required to be prepared. Therefore, the proposal is declared to be State significant infrastructure under Part 5.1 of the EP&A Act by virtue of clause 14, and clause 1, Schedule 3 of *State Environmental Planning Policy (State and Regional Development) 2011*. The Secretary's environmental assessment requirements (SEARs) for the project were issued on 2 July 2015 and included a requirement to undertake an assessment of potential impacts of the project on non-Aboriginal heritage.

This technical working paper: non-Aboriginal heritage assessment has been prepared to inform the EIS for the project.

2.2 The project

The Hornsby Quarry site would receive up to 1.5 million cubic metres of excavated natural material (ENM) and/or VENM from the approved NorthConnex construction sites. Only ENM and/or VENM would be received and reused at the Hornsby Quarry site.

Key features of the project would include:

- Widening and sealing of the quarry access road (Bridge Road and track) to facilitate all weather access.
- Clearing and grubbing, and establishment of erosion and sediment controls.
- Establishment of a compound site, security fencing and signage around the construction area.
- Dewatering of the void (to be undertaken by Hornsby Council in accordance with its existing groundwater licence) to a suitable level that allows working within the void.
- Construction of a conveyor from the stockpile site to the rim of the quarry void.
- Spoil haulage by truck from the NorthConnex construction sites to the Hornsby Quarry site over a period of approximately 28 months.
- Stockpiling of spoil at stockpile sites within the Hornsby Quarry site using dozers.
- Transport of the spoil via the conveyor from the stockpiles to the rim of the quarry void, where the spoil would fall directly into the void.
- Spreading and grading of the spoil on the quarry floor.

- Site demobilisation and rehabilitation of the compound site, stockpile areas and the conveyer corridor.

The project is anticipated to commence in late 2015 and is expected to take around 33 months to complete. An indicative program is provided below in Table 1.

Table 1 Indicative program

Construction activity	Indicative construction timeframe													
	2015				2016				2017				2018	
Site establishment works (including preparatory works)														
Establishment of conveyer														
Spoil haulage and stockpiling														
Spoil emplacement (operation of conveyor)														
Site clean-up and demobilisation														

An overview of the works is included in Table 2. Detailed descriptions of each activity can be found in Section 4.1 of the EIS for the project.

Table 2 Overview of project works

Phase	Proposed activities
Site establishment (including preparatory works)	The following works would be completed: - Dewatering of the void to a suitable working level. - Clearing and grubbing, and establishment of erosion and sediment controls. - Establishment of a compound site. - Establishment of security fencing and signage around the construction site. - Widening and sealing of the currently unsealed quarry access road (Bridge Road) to facilitate all weather access.
Establishment of conveyor	The construction of the conveyor would include establishment of footings and the conveyor.
Spoil haulage and stockpiling	Trucks would enter and leave via Bridge Road during standard work hours over a maximum period of 28 months. Spoil would be unloaded from the dump trucks and stockpiled using dozers. It is expected that haulage and stockpiling would commence whilst the conveyor is still being constructed.
Spoil emplacement	Once the conveyor is constructed, these works would occur concurrently with spoil haulage and stockpiling activities, but would also continue for a period after the completion of spoil haulage onto the site. The activities include: - Placement of spoil from the stockpiles into the conveyor by front end loader. - Transport of the spoil via conveyor to the quarry void rim where the spoil would fall directly into the void. - Front-end loaders and articulated trucks would move the spoil along the quarry floor and dozers and rollers will spread the material. Periodic maintenance pumping of water from the void would be conducted during spoil haulage and emplacement activities.
Site demobilisation and rehabilitation	The compound and conveyor would be dismantled and removed from the site. Disturbed areas would be rehabilitated to a standard agreed with the Council. Security fencing would be removed, however would be retained around the quarry void if the void is deemed to remain an ongoing risk to public safety. Public access would then be reinstated to the areas outside the void exclusion zone.

2.3 Project location

The Hornsby Quarry site is located off Bridge Road on the western side of the Hornsby town centre. The site covers about 35 hectares and is owned by Hornsby Shire Council (refer to Figure 1).

The site comprises a quarry void, internal access roads and a cleared area to the east which was used as a processing area when the quarry was operational. Disused facilities associated with the previous quarrying operations remain on the site, including concrete office block buildings, a crushing and screening plant, a pipeline, security fencing and gates.

Whilst the site is zoned for public recreation (RE1) under the *Hornsby Local Environmental Plan 2013*, the quarry void itself is unsafe for public access given the steep sides and flooded nature of the void. Hornsby Shire Council currently maintains exclusion fencing around the void to prevent public access for safety reasons. The areas outside of the void exclusion fencing are open to public access including mountain bike trails which have been established across the site by Council. However, until the quarry void is filled, full rehabilitation of the site for recreational purposes is not possible.

The site and surrounds are densely vegetated with some cleared areas comprising the void itself, internal access roads and the past processing area. Dense bushland comprising the Berowra Valley National Park occurs directly to the west. Any noise management and mitigation measures (such as acoustic treatment) along Bridge Road are to be determined at the detailed design stage.

2.4 Purpose of this report

The SEARs for the project were issued on 2 July 2015. The SEARs have informed the preparation of the EIS for the project. The SEARs requirements specific to potential impacts on non-Aboriginal heritage along with the action taken to address them in this assessment, are summarised in the following table.

Table 3 SEARs Requirements

SEARs requirement	Assessment action
Impacts to State and local historic heritage (including conservation areas, built heritage, landscapes and archaeology) should be assessed, including—in particular—the Hornsby Diatrema and surrounding vegetation, Hornsby Heritage steps, the Old Man's Valley Cemetery, street trees on Dural Street, and the TAFE college. Where impacts to State or locally significant historic heritage are identified, the assessment shall:	Impacts to State and local historic heritage were assessed. Section 6 of this report contains details of the heritage items identified in proximity to the project area.
outline the proposed mitigation and management measures (including measures to avoid significant impacts and an evaluation of the effectiveness of the mitigation measures) generally consistent with the guidelines in the NSW Heritage Manual (Heritage Office and DUAP 1996),	Mitigation and management measures consistent with the guidelines in the NSW Heritage Manual (Heritage Office and DUAP 1996) are included in Section 10.
be undertaken by a suitably qualified heritage consultant(s) with relevant heritage expertise (note: where archaeological excavations are proposed the relevant consultant must meet the NSW Heritage Council's Excavation Director criteria),	This assessment was undertaken by Dr Darran Jordan, a suitably qualified archaeologist and heritage specialist at AECOM. No archaeological excavations were required for this assessment.
include a statement of heritage impact for all heritage items/conservation areas to be impacted (including significance assessment). This should include detailed mapping of all heritage items and how they are affected by the proposal,	Statements of heritage impact, impact assessments and statements of significance are included in Sections 7 and 8 of this report. Heritage curtilages are mapped in Figure 2.

SEARs requirement	Assessment action
include details of any proposed mitigation measures (architectural and landscape),	Mitigation and management measures consistent with the guidelines in the NSW Heritage Manual (Heritage Office and DUAP 1996) are included in Section 10.
consider impacts from, including but not limited to, vibration, demolition, archaeological disturbance, altered historical arrangements and access, landscape and vistas, and architectural noise treatment (as relevant),	Impacts to heritage are considered in Sections 7 and 8 of this report.
where physical archaeological test excavations are proposed, develop an appropriate archaeological assessment methodology, including research design, in consultation with the Heritage Council of New South Wales (for items of State significance) and the Department, to guide the test excavations, and include the results of these excavations, and	No archaeological excavations were required for this assessment.
provision of future mitigation strategies for all identified archaeological impacts that would arise from the proposal.	Mitigation and management measures consistent with the guidelines in the NSW Heritage Manual (Heritage Office and DUAP 1996) are included in Section 10.

Initial investigations and assessments were completed in November 2013 (AECOM, 2013) as part of the investigation of spoil management locations for the NorthConnex project. The past report identified the potential environmental constraints related to non-Aboriginal heritage within areas of the Hornsby Quarry site. A further inspection was undertaken by Dr Darran Jordan on 15 December 2014. This inspection was aimed at informing the preparation of a non-Aboriginal heritage impact assessment for the project, and guiding the development of the project design to avoid impacts on non-Aboriginal heritage where reasonable and feasible. This non-Aboriginal heritage report supplements past assessments, and identifies potential non-Aboriginal heritage constraints within the footprint of the project. The study area for this assessment is shown in Figure 2.

This assessment has been undertaken in accordance with the SEARs and the following guidelines:

- *NSW Heritage Manual* (NSW Heritage Office & NSW Department of Urban Affairs and Planning, 1996b);
- *The Burra Charter* (the Australia ICOMOS charter for places of Cultural Significance) (ICOMOS (Australia), 2013);
- *Assessing Heritage Significance* (NSW Heritage Office, 2001a);
- *Assessing Significance for Historical Archaeological Sites and 'Relics'* (NSW Heritage Branch, 2009);
- *Heritage Curtilages* (NSW Heritage Office & NSW Department of Urban Affairs and Planning, 1996a); and
- *Levels of Heritage Significance* (NSW Heritage Office, 2008).

2.5 Structure of this report

The report has the following structure:

- Chapter 1 introduces the project.
- Chapter 2 details the legislation and statutory controls relevant to the project.
- Chapter 3 details the methodology for the non-Aboriginal heritage assessment.
- Chapter 4 provides a summary of background information and inventory search results.
- Chapter 5 outlines the findings of the field inspection.
- Chapter 6 details the significance assessments.
- Chapter 7 details the impact assessment results.
- Chapter 8 provides a statement of heritage impact.
- Chapter 9 details the mitigation and management recommendations.
- Chapter 10 provides the references used to assist in the preparation of this report.



Figure 1 Regional context of the project