Moxham Quarry, Northmead
Flora and Fauna Assessment

Prepared for
LHJ Pty Ltd

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Abbreviations

ABBREVIATION	DESCRIPTION
CA	Controlled Action (under the EPBC Act)
CAMBA	China-Australia Migratory Bird Agreement
CEEC	Critically Endangered Ecological Community
DECCW	Department of Environment, Climate Change and Water (now OEH)
DSEWPC	Department of Sustainability, Environment, Water, Population and Communities
EEC	Endangered Ecological Community
ELA	Eco Logical Australia Pty. Ltd.
EP&A Act	NSW *Environmental Planning and Assessment Act 1979*
EPBC Act	Commonwealth *Environment Protection & Biodiversity Conservation Act 1999*
JAMBA	Japan- Australia Migratory Bird Agreement
JRPP	Sydney West Joint Regional Planning Panel
LGA	Local Government Area
NCA	Non-controlled action (under the EPBC Act)
NCA-SM	Non-controlled action – specified manner (under the EPBC Act)
NES	National Environmental Significance
OEH	NSW Office of Environment and Heritage
REF	Review of Environmental Factors
ROKAMBA	Republic of Korea Australia Migratory Bird Agreement
SEE	Statement of Environmental Effects
SIS	Species Impact Statement
SMCMA	Sydney Metropolitan Catchment Management Authority
STIF	Sydney Turpentine-Ironbark Forest
TEC	Threatened Ecological Community
TSC Act	NSW *Threatened Species Conservation Act 1995*
VMP	Vegetation Management Plan
WM Act	Water Management Act 2000
WoNS	Weeds of National Significance

Key terms include:

- **Subject Site:** the area directly affected by the proposed works, which includes the disused quarry and adjacent bush and access.
- **Study Area:** the subject site and any additional areas which are likely to be impacted upon by the proposal, either directly or indirectly.
- **Locality:** 10 km radius of the site.

Executive Summary

Eco Logical Australia was engaged by LHJ Pty Ltd to prepare a Flora and Fauna assessment in support of an application to allow rezoning of part of the subject site to allow R4 high residential under the Parramatta Local Environmental Plan 2011.

The proposed works will involve draining and partially filling the base of the former Moxham Quarry and the removal of approximately 0.5 ha of aquatic vegetation and the selective removal of 0.3 ha of terrestrial vegetation. Approximately 0.6 ha of native vegetation, and 0.1 ha of standing water will be retained on-site. Commonwealth and State legislation and policies, including the Commonwealth *Environment Protection & Biodiversity Conservation Act 1999* (EPBC Act), NSW *Environmental Planning and Assessment Act 1979*, NSW *Threatened Species Conservation Act 1995* (TSC Act) and the *NSW Water Management Act 2000* apply to the assessment.

Database searches and literature reviews of the local area around site (approximately 10 km radius) revealed 19 threatened flora species, 29 threatened fauna species (two fish, seven frogs, one reptile, 12 birds, five terrestrial mammals and seven bats species) and 28 migratory fauna species that have either been previously recorded or have the potential to occur in the region. Surveys of the adjacent Quarry Branch Creek found 156 flora species (including two threatened species) and 73 fauna species (including four threatened species).

The aquatic, flora and fauna surveys undertaken within the site revealed the presence of 64 flora species and 43 fauna species. Although targeted fish surveys were undertaken, none were recorded. One threatened ecological community (TEC), the Endangered and Critically Endangered Ecological Community (EEC/CEEC) Sydney Turpentine-Ironbark Forest (STIF) was identified, with an extent of approximately 0.6 ha. Additionally, six threatened fauna species, including *Miniopterus schreibersii oceanensis* (Eastern Bent-wing Bat), *Falsistrellus tasmaniensis* (Eastern False Pipistrelle), *Scoteanax rueppellii* (Greater Broad-nosed Bat), *Pteropus poliocephalus* (Grey-headed Flying-fox) and *Ninox strenua* (Powerful Owl) have been identified on or adjacent to the site in surveys. One EPBC Act migratory species, *Rhipidura rufifrons* (Rufous Fantail) was identified adjacent to the Moxham Quarry site (Applied Ecology 2011).

An independent review of ELA's report was undertaken by ACS Environmental in January 2013. This review was broadly supportive of the findings of ELA's report, including the significance of the STIF vegetation on-site and the low habitat value of the standing water in the former quarry for threatened species, though it did not support the proposed development outright. ACS Environmental's main concerns were:

- The impact that any disruption in water flow, including underground water, or increased nutrient loading would have on the STIF and downhill vegetation, including threatened species.
- The impact that bushfire mitigation measures may have on the STIF vegetation
- The impact of the proposed development on the Powerful Owl

In addition, the Sydney West Joint Regional Planning Panel (JRPP) has recently been asked to consider whether this proposal should be submitted for a Gateway determination. The JRPP found that further information on some matters was required prior to a Gateway decision. Specifically, the JRPP required more detail on the significance of riparian areas on-site and the potential impact of the proposed works.

As such, this FFA has been updated to address these and other concerns raised by ACS Environmental, the JRPP and Parramatta City Council.

Assessments of Significance were conducted for one TEC and nine fauna species listed under the TSC Act to determine if these species would be significantly impacted by the proposal. These assessments determined that impacts to the endangered ecological community and threatened species from the rezoning and removal of 0.5 ha of aquatic vegetation and 0.3 ha of terrestrial vegetation from the proposed development are **unlikely** to be significant.

Significance Assessments were undertaken on two vulnerable and one migratory species and one TEC listed under the EPBC Act to determine if these species or communities would be impacted by the proposed works. It was assessed that the proposed works were **unlikely** to have an impact on these species.

Due to the small impacts of the proposed works it is not considered to be a significant impact under the TSC Act and does not require the preparation of a Referral under the EPBC Act.

The assessment of **no significant impact** concluded by this report is reliant on the implementation of the recommendations provided in this report, including the development of a Vegetation Management Plan (VMP) to protect the STIF vegetation community to the west of the development. Further recommendations are detailed in **Section 6**.

1 Introduction

1.1 DESCRIPTION OF PROJECT

Eco Logical Australia was engaged by LHJ Pty Ltd to prepare a flora and fauna assessment to support an application to develop the former Moxham Quarry site for residential dwellings. It is proposed to amend Schedule 1 of the Parramatta Local Environment Plan (LEP) 2011 to allow multi-dwelling housing and residential flat buildings up to a maximum of five stories at 166A Windsor Rd, Northmead. To develop the site approximately 0.5 ha of aquatic habitat and 0.3 ha of terrestrial habitat must be cleared.

1.2 STUDY SITE

The ***subject site*** is located within a disused quarry located directly behind the Northmead Bowling Club, located at 166 Windsor Road, Northmead. The subject site parcels include Lot 7053 (DP 1028240) and the laneway Special Lease No. 93.9 (which is currently owned by the State of NSW). The site is surrounded by Moxham Park, residential housing along Whitehaven Road and the Northmead Scout Hall to the south. John Curtin Reserve is located to the north-west of the study site. The study site lies within the Parramatta City Local Government Area (LGA) and is presently zoned as *E3 Environmental Management*, which permits applications to be made for the development and construction of dwelling houses and roads that do not have an adverse impact on the environmental values of the site (Parramatta LEP 2011).

The wider ***study area*** contains native bushland that is contiguous with a large tract of remnant vegetation that adjoins Quarry Branch Creek. Much of this remnant vegetation is protected within regional parks, including Model Farm Reserve to the north, John Curtin to the west and Moxham Park to the south (**Figure 1**).

The climate is typical of the Sydney region, which can generally be described as warm temperate.

1.3 REPORT OBJECTIVES

This report includes the findings of a comprehensive database search, literature review of the relevant statutory considerations associated with the environmental constraints present at the site, a field survey and an assessment of how the proposal may impact upon the site's values.

The objectives of the report were:

- To identify and describe the flora species and vegetation communities present in the study area, and describe their conservation significance.
- To conduct opportunistic and targeted surveys to identify the threatened and non-threatened terrestrial and aquatic fauna species present or likely to occur within the study site, and assess the likelihood of threatened and migratory species occurring within the study area, and their conservation significance.
- To assess the impacts of the proposal on threatened ecological communities, populations, and species, and other environmental features pursuant to relevant statutory requirements.
- To make recommendations regarding any environmental management, impact mitigation/amelioration measures and rehabilitation actions, which can be implemented to limit the effects of the proposal on vegetation, fauna, habitats and other environmental features as necessary.

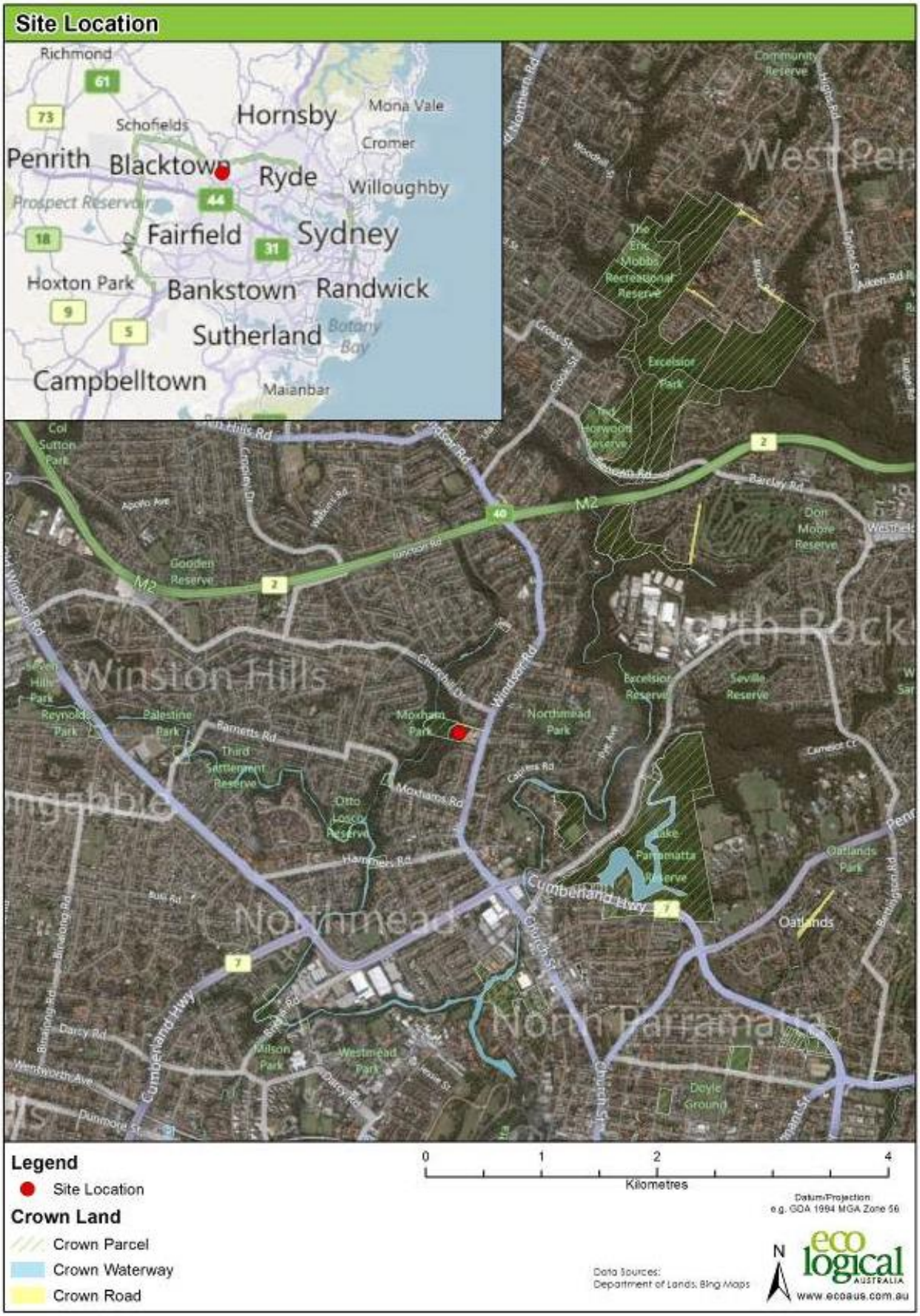

Figure 1: Moxham Quarry subject site within Northmead.

Figure 2: Proposed works

2 Legislative requirements

Commonwealth and State legislation and policies, as well as local policies apply to the assessment, planning and management of ecological issues within the study area at Moxham Quarry, Northmead. A brief outline of the relevant Commonwealth and State Acts and Policies, and local policies, are provided below. The follow are relevant to the proposed works:

- Commonwealth *Environment Protection & Biodiversity Conservation Act 1999* (EPBC Act)
- NSW *Environmental Planning and Assessment Act 1979* (EP&A Act)
- NSW *Threatened Species Conservation Act 1995* (TSC Act)
- NSW *Water Management Act 2000* (WM Act)

2.1 COMMONWEALTH LEGISLATION

2.1.1 Environment Protection and Biodiversity Conservation Act 1999

The EPBC Act establishes a process for assessing the environmental impact of activities and developments where matters of 'national environmental significance' (NES) may be affected. NES matters relevant to this study include threatened species, ecological communities and migratory species (JAMBA/CAMBA/ ROKAMBA) that are listed under the Act.

Under the Act, any action which "has, will have, or is likely to have a significant impact on a matter of national environmental significance" is defined as a "controlled action", and requires approval from the Commonwealth Department of Sustainability, Environment, Water, Population and Communities (SEWPAC) which is responsible for administering the EPBC Act.

Actions that may have a significant impact on one or more matters of NES need to be referred to the Department under the EPBC Act. The EPBC Act referrals process can produce one of three outcomes:

Non-controlled action (NCA): Assessment and approval under the EPBC Act is **not required**. The project may proceed without further approval under the EPBC Act.

Non-controlled action – particular manner (NCA-PM): Assessment and approval under the EPBC Act is **not required** provided the action is undertaken in a specific way (similar to conditions).

Controlled Action (CA): The project will, or is likely, to have a significant impact on one or more matters of national environmental significance. The project **will require** full assessment and approval before it can proceed.

This report highlights any EPBC Act matters of NES and advises if a referral to the Department of Sustainability, Environment, Water, Population and Communities (DSEWPAC) is required. The nationally threatened ecological communities and threatened and migratory species occurring or having the potential to occur in the assessment area are outlined in **Section 4**.

2.2 STATE LEGISLATION AND POLICIES

2.2.1 Environmental Planning and Assessment Act 1979

The *Environmental Planning and Assessment Act 1979* (EP&A Act) is the principal planning legislation for NSW, providing a framework for the overall environmental planning and assessment of development proposals. It provides a framework for the overall environmental planning and assessment of proposals. Various pieces of environmental legislation, including the TSC Act, are linked to the EP&A Act for environmental assessment. The EP&A Act also provides for the making and implementation of environmental planning instruments i.e. State Environmental Planning Policies, Regional Environmental Plans and Local Environmental Plans.

The EP&A Act places a duty on the determining authority to adequately address a range of environmental matters including maintenance of biodiversity and the likely impact to threatened species, populations or ecological communities (under the TSC Act – refer below).

Part 4 of the Act deals with development that requires consent. Applications for development must be made to the relevant consent authority (in this instance Parramatta City Council). The EP&A Regulations specify that the development application must be accompanied by a Statement of Environmental Effects (SEE).

Under Part 5 of the Act, the Minister or public authority which is responsible for deciding whether to approve or proceed with an activity (called a "determining authority") must examine and take into account to the fullest extent possible all matters which are likely to affect the environment if the activity goes ahead. Assessment of activities under Part 5 is undertaken through the preparation of a Review of Environmental Factors (REF).

2.2.2 Threatened Species Conservation Act 1995

The NSW *Threatened Species Conservation Act* (TSC Act), as amended, aims to protect and encourage the recovery of threatened species, populations and communities listed under the Act. The Act also aims to protect critical habitat, and eliminate or manage certain processes that threaten the survival or evolutionary development of threatened species, populations and ecological communities. Further, the Act encourages the conservation of threatened species, populations and ecological communities by the adoption of measures involving co-operative management. The interactions between the TSC Act and the EP&A Act requires consideration of whether a development (Part 4 of the EP&A Act), or an activity (Part 5 of the EP&A Act), is likely to significantly affect threatened species, populations, ecological communities or their habitats.

The TSC Act establishes that it is an offence to cause damage to the habitat of a threatened species, endangered population or endangered ecological community, and that a person must not, by an act or an omission, do anything that causes damage to any habitat (other than a critical habitat) of a threatened species, an endangered population or an endangered ecological community if the person knows that the land concerned is habitat of that kind.

Under the TSC Act, a licence may be required under section 91 if an action is likely to result in: harm to, or picking of, a threatened species, population or ecological community; damage to critical habitat; or damage to a habitat of a threatened species, population or ecological community.

This report assesses potential impact on threatened species, communities and populations and their habitats (**Section 3.4**). The NSW-threatened ecological communities and threatened species occurring or having the potential to occur in the assessment area are outlined in **Section 4.**

2.2.3 Water Management Act 2000

A controlled activity approval under the *Water Management Act 2000* (WM Act) is required for certain types of developments and activities that are carried out in or within 40m of a river, lake or estuary.

The WM Act provides a number of mechanisms for protection of water sources via the water management planning process. If a 'controlled activity' is proposed on 'waterfront land', an approval is required under Section 91 (2) of the WM Act. 'Controlled activities' include; the construction of buildings or carrying out of works; the removal of material or vegetation from land by excavation or any other means; the deposition of material on land by landfill or otherwise. 'Waterfront land' is defined as 'the bed of any river or lake, and any land lying between the river or lake and a line drawn parallel to and 40 metres inland from either the highest bank or shore'.

Approvals for controlled activities are administered by the NSW Office of Environment and Heritage (OEH) and a set of guidelines have been developed to assist applicants who are considering carrying out a controlled activity on waterfront land. The guidelines provide information on the design and construction of a controlled activity, and other mechanisms for the protection of waterfront land and include:

- In-stream works
- Laying pipes & cables in watercourses
- Outlet structures
- Riparian corridors
- Vegetation Management Plans
- Watercourse crossings

These guidelines are available from: http://www.dnr.nsw.gov.au/water/controlled_activity.shtml

The permit typically requires the preparation of a Vegetation Management Plan. The proponents' responsibility under the WM Act is to assess impact and adjacency to 'waterfront land' i.e. within 40 m and to apply guidelines for permits required under s91 of the WM Act. As the proposed works are within 40 m of 'waterfront land', these controls are requirements apply.

3 Methods

3.1 DATABASE SEARCHES AND LITERATURE REVIEW

The following information and databases were reviewed prior to site surveys:

- Atlas of NSW Wildlife;
- EPBC Protected Matters Search Tool;
- Protected Species Records Viewer (DII 2011);
- The Native Vegetation of the Sydney Metropolitan Catchment Management Authority Area (SMCMA) (DECCW 2009); and
- Native vegetation of Southeast NSW (Tozer *et al.* 2006)

Vegetation communities present within the site were reviewed according to Tozer *et al.* (2006) along with aerial imagery of the sites (Microsoft Virtual Earth, 2011) prior to field survey. These indicated that the TEC STIF was present on the site, though the boundaries varied (**Figure 3**)

A search of the Atlas of NSW Wildlife and the EPBC Protected Matters Search Tool for threatened flora and fauna that have either been previously recorded within the region or are likely to occur due to the presence of the required habitat was performed on 8th November 2011. A search of a 10 km radius around the study site using the coordinates -33^0 55' 33"; 150^0 37' 47" was undertaken (Datum GDA94). Species from these searches were combined to produce a list of threatened fauna and flora species that may occur within the study area.

Appendix A of this report lists the threatened ecological communities, flora and fauna species identified by the database searches as potentially occurring within a 10 km radius of the study site. **Appendix A** also contains an assessment of likely occurrence on-site of each threatened ecological community (TEC), flora and fauna species. The likelihood of occurrence was determined by reviewing the recent species records from the region, amount of available habitat present at the study site and surrounding region as well as applying expert knowledge of each species' ecology and biology.

Five terms for the likelihood of occurrence of species are used in this report, as defined below:

- "known" = the species was or has been observed on the site.
- "likely" = a medium to high probability that a species uses the site.
- "potential" = suitable habitat for a species occurs on the site, but there is insufficient information to categorise the species as likely, or unlikely to occur.
- "unlikely" = a very low to low probability that a species uses the site.
- "no" = habitat on site and in the vicinity is unsuitable for the species.

3.2 FIELD SURVEY

Field surveys were designed to target flora and fauna that have either been recorded or were regarded as having the potential to occur in the study area. All attempts were made to conduct the surveys in accordance with the NSW Department of Environment and Conservation (now the NSW Office of Environment and Heritage) *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activates. Working draft* (DEC 2004) and *Survey Guidelines for Australia's threatened frogs* (DECC 2009).

Field survey effort focused on the study site (**Figure 4**). However, observations were made of the fauna, fauna habitat and vegetation present in the areas adjacent to the study area. The field survey team included Dr Rodney Armistead, Andrew Whitford, Belinda Failes, Niels Rueegger and Lucas McKinnon. Surveys were undertaken on the 7th, 13th – 17th, 22nd December 2011 and 31st January 2012. Weather conditions experienced during the survey period are presented in **Table 1.**

3.2.1 Flora surveys

Flora surveys were undertaken using the random meander method throughout all accessible regions of the survey site (**Figure 4**). Aquatic plants were surveyed from the edge of the quarry. All flora species encountered during the surveys were recorded, with species identified to the lowest taxonomic level possible. Notes on vegetation structure were also recorded.

3.2.2 Fish surveys

Fish surveys were conducted using ten funnel style nets, baited with peanut butter and bread and set in shallow water for a minimum of one hour. Shallow set traps allow for captured turtles and mammals access to air. Additional sweep net surveys were undertaken at random locations where access to the water was permitted through the dense vegetation. All fish encountered were identified to species level.

3.2.3 Amphibian surveys

Targeted frog surveys included frog chorus censuses, habitat assessments and opportunistic observations (**Figure 4**). Targeted frog call census was conducted by two people on 13th, 15th and 22nd December 2011 and 31st January 2012, after rain was recorded in the previous five days. Frog calls were broadcast to elicit a response (call playback). The call broadcast started at 1930 hrs on each survey night and was conducted for five minutes, followed by ten minutes listening. This method was conducted for each species and repeated several times each night during the hour long survey period. Call recordings used during the survey were taken from Griffith (2006).

Active searches were conducted during the day by turning over logs, sifting through leaf litter and walking along the water's edge. Additional searches, including spotlight surveys, were conducted in conjunction with call playback surveys. All frog species observed or heard calling during the survey were identified to species level using Robinson (2004) and Griffith (2006). Habitat assessments and opportunistic observations were made throughout the survey period.

3.2.4 Reptile surveys

Reptiles were surveyed during day time hours on two occasions (15th and 16th December 2011). The climatic conditions recorded on both days were deemed to be suitable to undertake reptile surveys. Although the temperatures were generally mild, there was sufficient sun light to encourage considerable reptile activity. These surveys included active searches which involved sifting through leaf litter, and searching beneath rocks, logs and assorted debris. Each search was conducted for a minimum of one hour.

All reptiles observed during the survey were identified to species and recorded.

3.2.5 Diurnal birds surveys

Standardised 20 minute early morning (conducted 14th and 15th December 2011) and late afternoon/evening (conducted 7th and 13th December 2011) diurnal bird censes were undertaken. These surveys involved attempting to identify all birds present through visual or call identification. Surveys were conducted from two locations within the study area (**Figure 4**).

All opportunistic bird species observed or heard calling during the survey were recorded and identified.

3.2.6 Nocturnal birds

Nocturnal birds were surveyed using a combination of habitat assessments, call playback of owl calls and spotlighting.

Spotlighting surveys for nocturnal birds were conducted in conjunction with other nocturnal surveys undertaken on the 6th, 13th, 15th and 22nd December 2011 and 31st January by two people.

Daytime habitat assessments included searches for nests and tree hollows suitable in size and structure to support hollow dependant fauna were made throughout the survey period.

3.2.7 Small and medium sized mammals surveys

Small to medium sized mammal surveys were conducted using 30 Elliott Type A (30 x 11 x 8 cm) aluminium traps and four wire cage traps. Traps were located in the terrestrial vegetation to the west of the site. The location of traps is shown in **Figure 4**. Surveys were conducted over four consecutive nights beginning from the 13th and ending on the 17th December. Traps were checked daily, closed during the day and reopened in late afternoon/evening. Each trap was baited with a mixture of rolled oats, peanut butter, honey and vanilla essence. Each trap was covered with hessian cloth and a plastic bag for insulation and protection, and shredded paper was placed inside each trap to provide nesting material to captured animals. Spotlight surveys for mammals were conducted in conjunction with the frog and nocturnal bird surveys.

3.2.8 Microchiropteran bat surveys

Microbats were surveyed using Anabat detectors over 4 consecutive nights (13th to the 16th December) in 2 locations (**Figure 4**). Both sites were located near the edge of the quarry with the microphones pointing towards the centre of the quarry.

Bat calls were analysed by Peter Knock using the program AnalookW.[1] 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.[2]

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:

1. Recordings containing less than three pulses were not analysed (Law et al. 1999).
2. Only search phase calls were analysed (McKenzie et al. 2002).
3. Four categories of confidence in species identification were used (Mills et al. 1996):
    a. definite – identity not in doubt
    b. probable – low probability of confusion with species of similar calls
    c. possible – medium to high probability of confusion with species with similar calls; and
    d. unidentifiable – calls made by bats which cannot be identified to even a species group.

[1] Version 3.7w 31 December 2009, written by Chris Corben, www.hoarybat.com

[2] http://www.forest.nsw.gov.au/research/bats/default.asp

4. *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).

3.2.9 Vegetation boundary survey

The exact extent of the TEC STIF found on-site was mapped by ELA ecologist Andrew Whitford on 20th January 2012. The extent of the remanent vegetation, including the drip line of all trees, was mapped using a differential GPS (DGPS). The accuracy of a DGPS is sub-metre and can be as high as 10cm. These results are shown in **Figure 4**.

3.2.10 Weather

Temperatures were mild to warm during each survey period. Rain was recorded during the survey period, with several significant rainfall events occurring prior to the beginning of each survey period. The climatic conditions during the night surveys were generally warm and calm. Conditions during surveys are shown in **Table 1**. Data is from the Bureau of Meteorology from the nearest weather station at North Parramatta (Masons Drive, Station 066124).

Table 1: Weather conditions during field work (BOM 2012).

DATE	AMOUNT OF MOON VISIBLE (%)	MINIMUM (°C) TEMPERATURE	MAXIMUM (°C) TEMPERATURE	TEMPERATURE (°C) AT 9AM	TEMPERATURE (°C) AT 3PM	RAINFALL (MM)	CUMULATIVE RAINFALL PREV 5 DAYS (MM)	RELATIVE HUMIDITY (%) AT 9AM	RELATIVE HUMIDITY (%) AT 3PM
05 Dec 2011	50	10.9	18.2	15.0	16.7	4.0	4.0	60	63
06 Dec 2011	50	11.3	18.0	15.0	17.3	2.0.	6.0	79	63
07 Dec 2011	75	9.5	20.9	17.8	20.0	0.2	6.2	61	56
10 Dec 2011	100	14.9	23.4	19.9	21.0	0.2	0.2	82	82
11 Dec 2011	100	15.2	27.2	22.1	19.8	1.2	1.4	73	91
12 Dec 2011	100	16.2	19.0	17.0	18.0	34.8	36.2	95	82
13 Dec 2011	80	16.0	21.7	17.8	21.5	5.4	41.6	65	54
14 Dec 2011	80	13.0	21.3	18.5	19.5	0	41.6	65	57
15 Dec 2011	75	15.2	22.1	19.0	20.7	0	41.6	63	56
16 Dec 2011	75	11.2	20.6	19.2	19.4	0	41.6	66	59
17 Dec 2011	50	13.7	22.5	18.1	21.8	0	41.6	61	53
18 Dec 2011	50	12.7	24.0	17.5	23.5	0	5.4	76	54
31 Jan 2012	25	16.8	20.2	18.0	18.1	9.6	15.6	92	91

Records from Parramatta North (Masons Drive), NSW (BOM 2012)
http://reg.bom.gov.au/climate/dwo/201112/html/IDCJDW2107.201112.shtml and
http://reg.bom.gov.au/climate/dwo/IDCJDW2107.latest.shtml.
Moon data from http://www.sydneyobservatory.com.au/2011/moon-phase-calendar/.

3.3 SURVEY LIMITATIONS

It is likely that some flora and fauna species were missed because of decreased detectability due to life cycle, behavioural attributes and/or environmental factors. In order to determine the diversity of flora and fauna present at the study site, seasonal surveys would be required over a number of seasons. In the absence of these surveys, habitat assessments were undertaken and a precautionary approach applied to any species not recorded that may occur within the site.

3.4 IMPACT ASSESSMENT- TSC ACT LISTED SPECIES

The EP&A Act states that if a species, population or ecological community listed in Schedules 1, 1A and 2 of the TSC Act is identified as occurring or having the potential to occur on the study site, a review of the factors set out to establish if there is likely to be a significant effect on that species, population, ecological community or habitat, must be undertaken. Section 5A of the EP&A Act sets out seven factors that must be addressed as part of an Assessment of Significance (7 Part Test). This enables a decision to be made as to whether there is likely to be a significant effect on the species and, hence, if a Species Impact Statement (SIS) is required.

Species, populations and communities identified during searches of the Atlas of NSW Wildlife and within a 10 km radius of the site (excluding marine species) were subject to the impact assessment and ranked according to their likelihood of occurrence. All species known or assessed as having the potential to occur in the study area were considered during the Assessments of Significance.

3.5 IMPACT ASSESSMENT- EPBC ACT LISTED SPECIES

The EPBC Act Administrative Guidelines on Significance set out 'Significant Impact Criteria' that are to be used to assist in determining whether a proposed action is likely to have a significant impact on matters of national environmental significance (NES). Matters listed under the EPBC Act as being of national environmental significance include:

- Listed threatened species and ecological communities
- Listed migratory species
- Wetlands of International Importance
- The Commonwealth marine environment
- World heritage properties
- National heritage places
- Nuclear actions

Specific 'Significant Impact Criteria' are provided for each matter of national environmental significance except for threatened species and ecological communities in which case separate criteria are provided for species listed as endangered and vulnerable under the EPBC Act.

Species, populations and communities identified during searches of the EPBC Protected Matters Search Tool within a 10 km radius of the site (excluding marine species) were subject to the impact assessment and ranked according to their likelihood of occurrence. All species known or assessed as having the potential to occur in the study area were considered during the Significance Assessment.

Significance Assessments considering the impacts of the development of Moxham Quarry was applied to the following matters of NES.

- Threatened species and ecological communities, including the CEEC STIF
- Migratory species

Figure 3: Original vegetation mapping (DECCW 2009, Tozer *et. al* 2006)

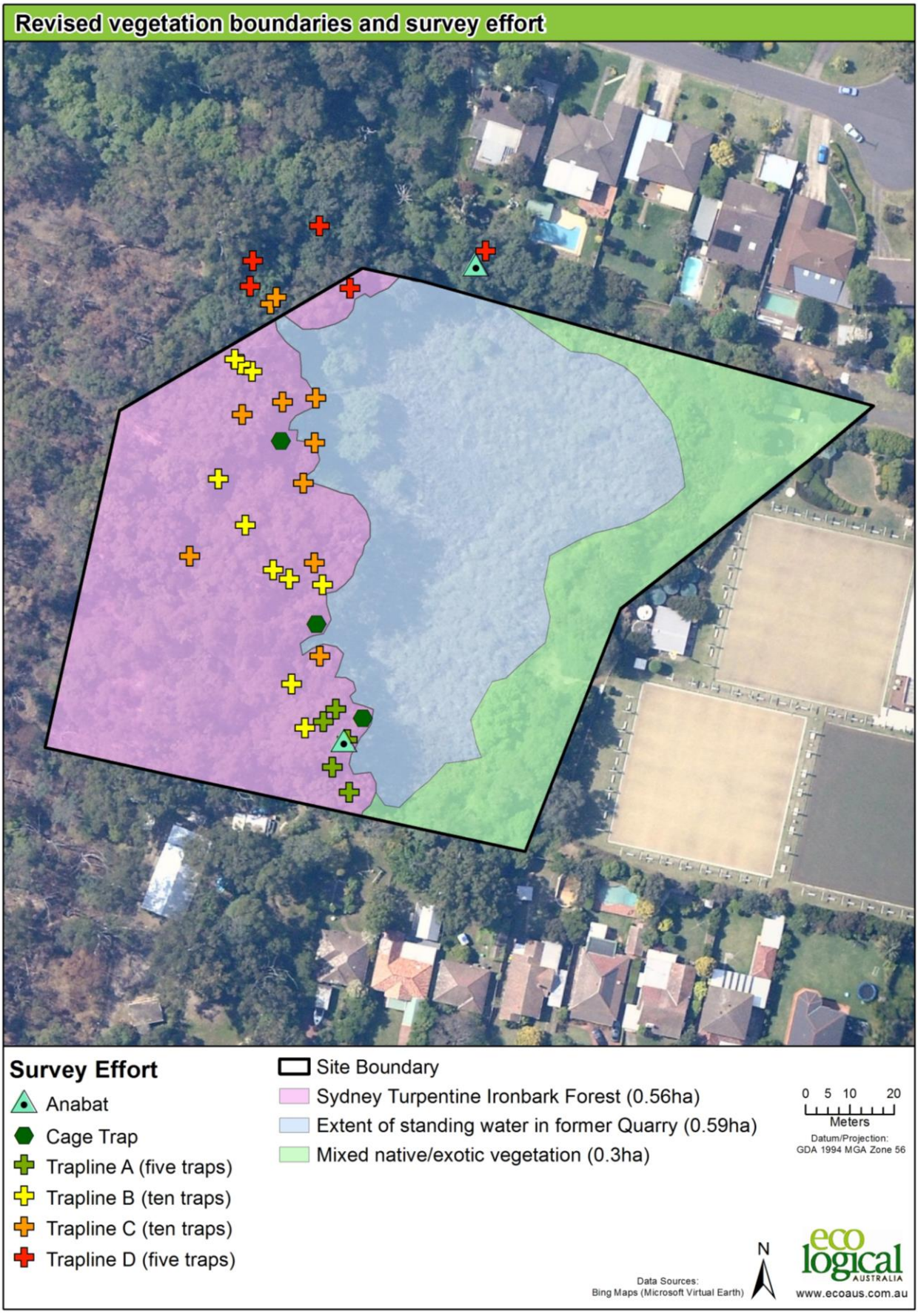

Figure 4: Site survey locations and vegetation mapping

4 Results

4.1 DATABASE AND LITERATURE SEARCH REVIEW (10KM RADIUS)

Database searches and literature review were conducted using 10 km search radius from the Moxham Quarry study site. These database searches revealed the likely occurrence of four endangered ecological communities, 19 threatened flora species, 29 threatened fauna species (two fish, seven frogs, one reptile, 12 birds, five terrestrial mammals and seven bats species) and 28 migratory fauna species that could occur in the locality (**Appendix A**).

Surveys of the adjacent Quarry Branch Creek area (Applied Ecology 2011) found 156 flora species including *Epacris purpurascens*, which is listed as vulnerable under the TSC Act, and *Pimelea curviflora* var. *curviflora*, which is listed as vulnerable under both the TSC and EPBC Act. Applied Ecology (2011) also found 73 fauna species, including three species listed as vulnerable under the TSC Act (*Ninox strenua* (Powerful Owl), *Miniopterus schreibersii oceanensis* (Eastern Bent-wing Bat) and *Myotis macropus* (Southern Myotis) and one listed as vulnerable under both the TSC Act and EPBC Act *Pteropus poliocephalus* (Grey-headed Flying-fox)).

4.2 VEGETATION COMMUNITIES

The subject site supported one TEC (Sydney Turpentine-Ironbark Forest (STIF) as well as other vegetation communities that are not listed as TECs.

4.2.1 Sydney Turpentine Ironbark Forest

STIF is listed as an Endangered Ecological Community (EEC) under the NSW TSC Act and as a Critically Endangered Ecological Community (CEEC) under the commonwealth EPBC Act. STIF is a relatively dense eucalypt forest with tall trees to 20-30 metres tall. The ground cover is generally open comprising shrubs and grasses (DEC 2011). Towards the higher rainfall ridges of this TECs' distribution, STIF often occurs in association with Blue Gum High Forest. The STIF TEC is associated with deep clay soils derived from Wianamatta shale or shale layers with Hawkesbury Sandstone (Tozer *et al.* 2006).

Species associated with STIF include *Syncarpia glomulifera* (Turpentine), *Eucalyptus paniculata* (Grey Ironbark), *E. pilularis* (Blackbutt), *E. crebra* (Narrow-leaved Ironbark), *E. fibrosa* (Broad-leaved Ironbark) and *E. punctata* (Grey Gum). Understorey plants included *Acacia parramattensis* (Parramatta Green Wattle) and *Acacia longifolia* (Sydney Golden Wattle), *Dodonaea triquetra* (Common Hop Bush) and *Themeda australis* (Kangaroo Grass). The STIF species found on site are found in **Table 2**, below. A complete list of flora species found on site is provided in **Appendix B**.

There is approximately 0.6 ha of STIF on site and it represents the majority of the terrestrial vegetation. The STIF on-site is directly connected to extensive areas of native vegetation off-site in the surrounding reserves, including STIF and other communities.

This community was originally widespread on the Wianamatta Shale and Cumberland Plain (ECCW 2011). It presently occurs in Auburn, Bankstown, Baulkham Hills, Blue Mountains, Campbelltown, Canada Bay, Canterbury, Hawkesbury, Hornsby, Kogarah, Ku-ring-gai, Liverpool, Parramatta, Penrith, Ryde, Sutherland, Wingecarribee, Wollongong and Wollondilly. This vegetation community has

undergone a considerable decline and present only an estimated ~4% of pre-European extent remains on the Cumberland Plain (DEWHA 2010).

Table 2: STIF species found within subject site

FAMILY	GENUS	SPECIES	COMMON NAME
Asteraceae	*Ozothamnus*	*diosmifolius*	White Dogwood
Bignoniaceae	*Pandorea*	*pandorana*	Wonga Wonga Vine
Commelinaceae	*Commelina*	*cyanea*	Native Wandering Jew
Convolvulaceae	*Dichondra*	*repens*	Kidney Weed
Fabaceae (Faboideae)	*Glycine*	*clandestina*	
Fabaceae (Faboideae)	*Hardenbergia*	*violacea*	False Sarsaparilla
Fabaceae (Mimosoideae)	*Acacia*	*longifolia*	
Lomandraceae	*Lomandra*	*longifolia*	Spiny-headed Mat-rush
Myrtaceae	*Angophora*	*costata*	Sydney Red/Rusty Gum
Myrtaceae	*Eucalyptus*	*resinifera*	Red Mahogany
Myrtaceae	*Eucalyptus*	*pilularis*	Blackbutt
Myrtaceae	*Kunzea*	*ambigua*	Tick Bush
Myrtaceae	*Syncarpia*	*glomulifera*	Turpentine
Phormiaceae	*Dianella*	*caerulea*	Blue Flax-lily
Pittosporaceae	*Bursaria*	*spinosa*	Native Blackthorn
Poaceae	*Echinopogon*	*caespitosus*	Bushy Hedgehog-grass
Poaceae	*Microlaena*	*stipoides*	
Poaceae	*Themeda*	*australis*	Kangaroo Grass
Ranunculaceae	*Clematis*	*aristata*	Old Man's Beard
Santalaceae	*Exocarpos*	*cupressiformis*	Native Cherry
Sapindaceae	*Dodonaea*	*triquetra*	Large-leaf Hop-bush
Scrophulariaceae	*Veronica*	*plebeia*	

4.3 FLORA

A total of 64 flora species (43 native and 21 exotic) were recorded within the study site (**Appendix B**). This included the overstorey species *Eucalyptus pilularis*, *E. resinifera* and *Angophora costata*. Among the understorey *Kunzea ambigua*, *Pittosporum undulatum* and *D. triquetra* were the dominant species. No threatened flora species were identified within the subject site and no threatened flora species were considered to have potential to occur (**Appendix A**).

Eight aquatic or riparian flora species, primarily exotic, were recorded within sections of the disused quarry where standing water was present. This included the exotic *Arundo donax*, *Cortaderia s*p., *Cyperus papyrus*, *Ludwigia longifolia*, *Salix* sp., *Salvinia molesta*, *Zantedeschia aethiopica* and the native *Typha orientalis.*

Of the exotic species found within the subject site, 14 are listed as noxious in Parramatta LGA under the NSW *Noxious Weeds Act 1993* (NW Act) as shown in **Table 3**. Under the legislation these weeds have certain management responsibilities, specifically:

- **Category 2** noxious weeds must be eradicated from the land and the land must be kept free of the plant.
- **Category 3** noxious weeds must be The plant must be fully and continuously suppressed and destroyed.
- **Category 4** noxious weeds must be managed in a manner that reduces plants numbers, spread and incidence and continuously inhibits reproduction.
- **Category 5** noxious weeds must be managed as per the requirements for a notifiable weed in the NW Act.

These weeds are present predominantly in the impact area, both in the standing water (*Salvinia molesta*) and the surrounding terrestrial vegetation. The STIF vegetation community on the western boundary of the site that will not be directly impacted also contains noxious weeds including *Asparagus aethiopicus* (Asparagus Fern), *Asparagus asparagoides* (Bridal Creeper) and *Lantana camara* (Lantana) which will be managed by a Vegetation Management Plan (VMP) after construction works are completed.

In addition, eight Weeds of National Significance (WoNS) were recorded within the study site. All are invasive, easily spread and can have a significant impact on the areas, especially waterways, that they invade.

Table 3: Noxious weeds and WoNS found within subject site

FAMILY	SCIENTIFIC NAME	COMMON NAME	NOX	WONS
Asparagaceae	*Asparagus plumosus**	Climbing Asparagus	4	Y
Asparagaceae	*Asparagus aethiopicus*	Asparagus Fern	4	
Asparagaceae	*Asparagus asparagoides*	Bridal Creeper	4	Y
Fabaceae	*Genista monspessulana**	Cape Broom	3	Y
Oleaceae	*Ligustrum lucidum**	Large-leaf Privet	4	
Oleaceae	*Ligustrum sinense**	Small-leaf Privet	4	
Onagraceae	*Ludwigia longifolia*	Long-leaf Willow Primrose	3	
Poaceae	*Arundo donax*	Giant Reed	4	
Poaceae	*Cortaderia* sp.	Pampas Grass	3	
Rosaceae	*Rubus fruticosus* agg. spp.*	Blackberry	4	Y
Salicaceae	*Salix alba*	White Willow	5	Y
Salicaceae	*Salix* spp.	Willow	5	Y
Salviniaceae	*Salvinia molesta*	Salvinia	2	Y
Verbenaceae	*Lantana camara*	Lantana	4	Y
*= Identified by ACS Environmental (2013)				

4.4 HABITAT ELEMENTS

A number of habitat elements were present in the study area that may provide habitat to a range of flora and fauna species. These habitat elements included:

- Intact structural vegetation layers (canopy, midstorey and understorey);
- Large trees;
- Thick leaf litter;
- Fine and course woody debris, including fallen logs and branches;
- Large boulders and rocky outcrops; and
- Standing water within the disused quarry with dense fringing and aquatic vegetation.

These habitat elements provide shelter, foraging, roosting habitat and protection from predators for a range of fauna. The thick leaf litter and woody debris throughout the site provides suitable foraging and sheltering habitat for ground dwelling mammals and reptiles. This includes *Acritoscincus platynotum* (Red-throated Skink) and *Saiphos equalis* (Three-toed Skink), which were recorded on site during the survey. Standing water with dense emergent and sub-emergent vegetation provides high quality foraging and breeding habitat for a broad variety of frog species. Standing water encourages a range of invertebrate species to breed, which consequently provides potential foraging habitat for threatened microbat species, including Eastern Freetail Bat and Greater Broad-nosed Bat, both of which were recorded on site.

No hollow bearing trees were recorded within the study site, though some were present adjacent. Therefore, the site may not provide roosting habit for microchiropteran bats species.

Large canopy trees provide foraging, roosting and potential breeding habitat for Powerful Owl and a range of microbat species (see **Appendix A**).

4.5 FAUNA

A total of 43 fauna species were recorded during this survey. This includes four frog, four reptile, 27 bird (21 native and six exotic), eight mammals, including six bat species (**Appendix C**).

The threatened species Powerful Owl, Eastern False Pipistrelle, Greater Broad-nosed Bat and Grey-headed Flying-fox were recorded during these surveys. Powerful Owl were recorded during most nocturnal site visits. Grey-headed Flying-fox were observed flying and undertaking short term roosting activities within the study site. Survey results for threatened species have been highlighted in bold for each category surveyed for.

Table 4: Threatened fauna species with potential to occur in the subject site

SCIENTIFIC NAME	COMMON NAME	TSC ACT	EPBC ACT	LIKELIHOOD OF OCCURRENCE
Ixobrychus flavicollis	Black Bittern	V	-	Potential
Ninox connivens	Barking Owl	V	-	Potential
Ninox strenua	Powerful Owl	V	-	Known
Isoodon obesulus obesulus	Southern Brown Bandicoot	E	-	Potential
Chalinolobus dwyeri	Large-eared Pied Bat	V	V	Potential

SCIENTIFIC NAME	COMMON NAME	TSC ACT	EPBC ACT	LIKELIHOOD OF OCCURRENCE
Falsistrellus tasmaniensis	Eastern False Pipistrelle	V		Known
Miniopterus schreibersii oceanensis	Eastern Bent-wing Bat	V	-	Potential
Mormopterus norfolkensis	Eastern Free-tail Bat	V	-	Potential
Pteropus poliocephalus	Grey-headed Flying-Fox	V	V	Known.
Scoteanax rueppellii	Greater Broad-nosed Bat	V	-	Known
Rhipidura rufifrons	Rufous Fantail	-	M	No

4.5.1 Amphibian surveys

Four species of frog were recorded during surveys. This includes the non-threatened *Litoria fallax* (Dwarf Tree Frog), *L. tyleri* (Tylers Tree Frog), *Crinia signifera* (Common Froglet) and *Limnodynastes peronii* (Spotted Marsh Frog). Previous surveys recorded two additional species; *Uperoleia laevigata* (Smooth Toadlet) and *Litoria dentata* (Bleating Frog) located nearby in the John Curtin Reserve (Applied Ecology 2011). **No** threatened frog species were recorded during surveys.

4.5.2 Reptile surveys

Four species of reptiles were recorded during the surveys including the non-threatened Red-throated Skink), *Eulamprus quoyii* (Eastern Water Skink), *Lampropholis delicata* (Dark-flecked Garden Sun Skink) and Three-toed Skink. **No** threatened reptile species were recorded during surveys.

4.5.3 Diurnal birds

A total of 27 birds, including 21 native and six exotic species were recorded during surveys. No threatened species or species of local significance were recorded at Moxham Quarry. **No** threatened diurnal bird species were recorded during surveys.

4.5.4 Nocturnal birds

Owl call playback surveys were conducted over five nights during December 2011 and January 2012. **Powerful Owl** was the only species recorded during these surveys. This species was recorded on the second night of call playback surveys. No further surveys were undertaken for this species after it had been identified, but it was still heard calling and occasionally observed during each site visit. The subject site provides potential foraging and roosting habitat for this large owl species. Species known to comprise this species' diet include *Trichosurus vulpecula* (Common Brush-tail Possums), *Corvus* sp. (Ravens) and *Gymnorhina tibicen* (Australian Magpies), all of which were recorded within the Moxham Quarry site.

The habitat within and surrounding Moxham Quarry is continuous and forms a large bushland corridor that may be integral to the survival and persistence of the species in the region. Powerful Owl prefer to nest and breed in hollows that have a diameter greater than 45cm, are 100cm deep and are surrounded by canopy and understorey trees (DECC 2006). Due to an absence of large mature hollow-bearing

trees, it is unlikely that the subject site itself has suitable nesting or breeding habitat tree for this species.

Powerful Owl are generally sedentary, occupying large permanent home ranges with a social unit consisting adult pairs and 1-2 dependent young (DEC 2006). Therefore, sighting Powerful Owl suggests that other Powerful Owls may be frequent the site and adjacent areas. The foraging home ranges of Powerful Owl can overlap and, consequently, the local abundance may consist of several individuals. Powerful Owl are large mobile species that have large foraging home ranges that may extend up to 1500 ha.

4.5.5 Small to medium sized mammals

Two species of mammals were recorded during spotlight surveys; the non-threatened Common Brushtail Possum and the exotic *Rattus rattus* (Black Rat) (**Appendix C**).

Diggings observed in and amongst the leaf litter and top soil are similar in size and structure to those produced by the foraging activities of *Isoodon obesulus* (Southern Brown Bandicoot) or *Perameles nasuta* (Long nosed Bandicoot) (**Figure 5**). However, **no** threatened mammal small to medium sized mammal species were recorded during surveys.

Figure 5: Foraging dig located within Moxham Quarry site

4.5.6 Bats

Six bats species were recorded during the survey (**Appendix C**). A total of 1168 call sequences were recorded across the two sites and a total of 7 survey nights (**Appendix D**). Of these, 504 (43%) of the sequences could be identified confidently to species or genus level (see **Appendix D** - **Table 5**). The calls of five microchiropteran bat species, including *Mormopterus* sp. 2, *Chalinolobus gouldii* (Gould's Wattled Bat), *Chalinolobus morio* (Chocolate Wattled Bat), Eastern False Pipistrelle and Greater Broad-nosed Bat, were recorded within the site. Of these the **Eastern False Pipistrelle** and **Greater Broad-nosed Bat** are listed as threatened under the TSC Act.

The largest numbers of calls were attributed to common species. In particular, *Chalinolobus gouldii* (Gould's Wattled Bat) (297) and *Mormopterus* sp 2 (175) accounted for greater than 93 % of all calls identified. Several of the recorded calls represent feeding buzzes, which indicate that bats were occasionally foraging over the study area. In contrast, only two and three calls of the 1168 calls recorded where from the threatened Eastern False Pipistrelle and Greater Broad-nosed Bat, respectively. Furthermore, each threatened species was only recorded during a single survey night out of the seven that were undertaken. These results suggest that the threatened species identified only utilise the area occasionally.

One megachiropteran species, the TSC and EPBC Act listed **Grey-headed Flying-fox** (GHFF), was recorded flying over and roosting within the survey site. A single individual was recorded roosting during one of the nocturnal spotlighting surveys. The site does not appear to represent preferred roosting habitat and no colonies are present on or adjacent to the site.

5 Impact assessment

5.1 SUMMARY OF IMPACTS

The proposal to develop the former Moxham Quarry into residential allotments will have some impact on the existing environment. The following direct impacts on flora and fauna are anticipated from the proposal:

- Clearing of small amounts of terrestrial native vegetation along the eastern boundary;
- Clearing of small amounts of riparian native and exotic vegetation from the quarry basin;
- The infilling and removal of riparian habitat from within the quarry site;
- Potential loss of foraging habitat for Powerful Owl, microchiropteran bats and frogs;

The areas of vegetation removal are shown in **Figure 6**. There is also potential for indirect impacts as a result of the works. These include include weed invasion into the adjacent bushland and waterways, erosion and sedimentation, pathogens including the invasive Phytophthora Dieback (*Phytophthora cinnamomi*), changes to microclimate and habitat fragmentation related to all of these. While some of these processes are already affecting the site due to existing disturbances, it is possible that they will increase due to the proposed works without adequate management.

5.2 DIRECT IMPACTS

5.2.1 Vegetation removal

The proposal will result in the selective removal of a small amount of terrestrial vegetation (0.3 ha), including trees around the northern, eastern and southern boundaries of the quarry. The exact number of trees to be removed was not assessed given the difficulty of site access, but this vegetation consists mainly of exotic vegetation with some natives interspersed. It should be noted that as much as possible of the native vegetation present in this area will be retained, but for the purposes of this assessment complete removal has been assumed. The proposed works will also remove approximately 0.5 ha of mixed native/exotic aquatic vegetation from the former quarry pit area. These areas are shown in **Figure 6**.

None of the STIF TEC to the west is to be removed, an area of approximately 0.6 ha. In addition, management of the vegetation to the west of the site, including weed control, pest control and revegetation will be undertaken after development. Currently, the area of STIF vegetation is threatened by weed invasion, control of which has never been funded on the site. It is likely that as part of the consent conditions management actions such as weed control, pest control and revegetation will have to be planned, funded and undertaken. This will provide resources for the ongoing management and preservation of this important vegetation community.

It should be noted that no bushfire protection plans have been reviewed as part of this report and this FFA has been prepared on the assumption that **no** removal of native vegetation or any action which may negatively affect the STIF vegetation community will be undertaken as part of bushfire protection works.

5.2.2 Fauna habitat

The proposal will remove potential nesting, roosting and foraging habitat for birds and Grey-headed Flying-fox, and potential roosting and foraging habitat for microchiropteran bats. The proposal will also remove a small amount of potential foraging habitat for Powerful Owl. Although Powerful Owls were observed on-site, the site does not represent significant habitat for this species for the following reasons:

- No hollows of sufficient size to support breeding were located during the survey.
- The home range of the Powerful Owls found on-site already likely incorporate built up areas, especially as the roosting sites identified during site surveys were in adjacent backyards.
- Powerful Owl territories are large, up to 1000ha but more likely about 300-400ha in Sydney.
- The quarry area itself is not potential foraging habitat as no trees are present.
- Powerful Owls are considered generalist predators and will take whatever prey is available.
- The habitat surrounding Moxham Quarry is continuous with a large bushland corridor which may provide important resources for a local population.

Of more potential significance is the removal of approximately 0.5 ha of riparian vegetation that represents breeding and foraging habitat for common species of frogs and foraging habitat for microchiropteran bats, including threatened species.

However, approximately 0.1 ha of the existing standing water will be retained as standing water, maintained primarily for the benefit of the native vegetation to the west and as fauna habitat. This area will be expanded to the extent that is possible without impacting the adjacent STIF vegetation. An indicative location of this water feature is shown in **Figure 6**. The fauna species that have been identified in the riparian area are cosmopolitan species that are likely to find suitable habitat in the retained standing water. The species of birds, bats and terrestrial mammals that most benefited from the current extent of standing water are all cosmopolitan species that are very adaptable to a wide range of conditions. The frogs present in the existing standing water are also all common species which will find suitable habitat in the retained standing water. All fauna species will benefit from the permanent water levels that the stored water will provide to the retained standing water.

The retained standing water will provide a greater diversity of riparian habitat than was present previously with a large proportion of open water area along with the dense vegetation habitat that was present in the former quarry. This will provide more habitat diversity for aquatic and riparian species, including threatened species.

Finally, approximately 0.6 ha of mature native vegetation is to be retained on-site and extensive areas of contiguous fauna habitat exist off-site on adjacent reserves. The bird and bat species identified in the local area forage widely and there is potential habitat in this native vegetation and in the adjacent reserve. No Grey-headed Flying-fox camps or microbat breeding sites are known to occur within the impact area.

The vegetation surrounding the study sites is mature and is likely to maintain many hollow-bearing trees. However, no hollow bearing trees are to be removed.

5.2.3 Flora habitat

Despite an intensive survey and the presence of two threatened flora in the adjacent reserve, no threatened flora species were recorded during survey within the impact area. As the majority of the terrestrial vegetation is to remain on the subject site and the vegetation to be removed comprises largely disturbed mixed native/exotic, it is unlikely that the proposal would impact any threatened flora.

In addition, the proposed works would not significantly reduce the amount of potential habitat for threatened flora within the locality given the amount of similar habitat available nearby. Nevertheless, the proposal may indirectly affect remnant vegetation and, therefore, preparation and implementation of a vegetation management plan is recommended to reduce future impacts, such as weed invasion.

5.2.4 Removal of standing water

Approximately 0.5 ha of standing water will be removed as part of the proposed works, or approximately 80% of the standing water currently present. The significance of this standing water can be assessed in a few ways. Specifically, this can be determined by asking:

- Whether the standing water is listed under any NSW or Commonwealth registers as significant
- Whether the standing water provides habitat to any species listed as threatened under NSW or Commonwealth legislation
- Whether the standing water is recognised, either directly or indirectly under NSW or Commonwealth legislation

In the case of the former Moxham Quarry, the following response can be determined

- The standing water is not listed as a protected wetland under any state or commonwealth registers, including RAMSAR, Wetlands of National Significance or SEPP 14 (NSW).
- The significance of the loss of the riparian aquatic habitat to state and commonwealth listed threatened species, including wetland species, has been assessed in this FFA. The standing water does not represent important habitat for any wetland species and as such, the proposed reduction of riparian area did not represent a significant impact on any wetland species.
- Under the Water Management Act 2000 (WM Act), the standing water is considered a 4th order watercourse and as such, 'waterfront land'.

Under the WM Act, waterfront land includes the bed and bank of any river, lake or estuary and all land within 40 metres of the highest bank of the river, lake or estuary. Any works within a watercourse or on waterfront lands, including modifications or enhancements to the watercourse, must be designed to ensure that no more than minimal harm will be done to waterfront land as a consequence of carrying out the controlled activity. Design of works should protect and enhance water flow, water quality, stream ecology and existing riparian vegetation. Impacts on the hydrologic, hydraulic and geomorphic functions of a watercourse should also be minimised. Further, all waterfront land disturbed by the construction or installation of a controlled activity should be rehabilitated in such a way that the integrity of the watercourse and its riparian corridor is restored or rehabilitated.

5.3 INDIRECT IMPACTS

Potential indirect impacts from the proposal are discussed in the following sections.

5.3.1 Introduction of weeds and soil pathogens

The potential for the introduction and proliferation of weeds is a significant risk associated with the proposed works, given the low occurrence of weeds at present in the terrestrial vegetation to the west of the site. Six noxious weeds, all of which are also weeds of national significance, were recorded within the subject site.

Salvinia molesta is easily spread through small fragments and once established can grow very quickly to form extensive mats across the surface of the water. It is known to block irrigation channels, prevent swimming, fishing and boating while providing an ideal environment for breeding mosquitos (NSW DPI 2006).

Willows are also a major concern for the ecology and biology of waterways. Like Salvinia, willows are invasive, easily spread and can have a significantly impact on the waterways they invade (NSW DPI 2006). Willows spread their roots and drop their leaves into water courses, where they slow water flow, alter aeration and water quality. This can have a significant impact on the local flora and fauna. A single medium sized willow occurs in the western side of the disused quarry. Seed is the main vector of spread and they have been known to be dispersed over 100 km via wind and flowing water (NSW DPI 2006).

There is considerable risk that weed propagules could be transported on vehicles or on the clothing of staff or contractors while the works are being undertaken. Weed invasion is a serious threat to native vegetation with a number of these threats listed as KTP's, including:

- Invasion and establishment of exotic vines and scramblers
- Invasion, establishment and spread of *Lantana camara*.
- Invasion of native plant communities by exotic perennial grasses.
- Spread and dispersal of *Salvinia molesta* and *Salix alba* from the site to other waterways.
- Infection of native plants by Phytophthora Dieback.

If mitigation measures, outlined in Section 6, are undertaken, both during construction and afterwards, then this impact can be minimised.

5.3.2 Runoff and sedimentation

Runoff and sedimentation is a risk during the construction phase and after works are completed. During construction, there is a risk that sediment and nutrients will escape from stockpiles and spillages. After works are completed, the hard surfaces being added to the site will concentrate runoff, increasing its speed and nutrient concentration. The site is also an existing drainage point for surrounding areas, and sediments on site may be mobilised and transported off site via runoff. If the mitigation measures outlined in **Section 6** are implemented, both during all construction phases, then this impact can be minimised and are not considered significant.

5.3.3 Edge effects

This area is currently subject to edge effects from nearby Northmead Bowling Club and Northmead Scout Hall, as evidenced by the tracks, holes cut in the fence, weed invasion, and feral animal invasion (e.g. Black Rats). However, by moving the interface between the bushland and development closer, new edge effects will be created into the current stands of vegetation. However, if mitigation measures, outlined in **Section 6,** are undertaken, both during construction and afterwards, then this impact can be minimised and are not considered significant.

5.3.4 Changed hydrology

Changed hydrology has potential to impact the STIF vegetation community in the subject site and vegetation downslope of the site, including the threatened species *Epacris purpurascens* var. *purpurascen*s and *Pimelea curviflora* var. *curviflora*. This may occur if the groundwater table is lowered or the nutrient loading of the groundwater is increased. However, this is unlikely to occur given the following circumstances:

- The boundary between the STIF vegetation and the standing water will remain unchanged. No impermeable membrane will be installed and flows will not be blocked from reaching the STIF vegetation in any way. Rather, the proposed construction will float above the quarry floor. This means that the roots of any trees that have penetrated into the sandstone to access groundwater will not be affected. As such, the ability of water to permeate the standing water / terrestrial interface and supply the STIF and downstream vegetation will remain unchanged
- Water collected from the catchment will be treated and stored on-site. Stored water will be primarily used to maintain the optimal water level in the retained standing water even during extended dry periods. The optimal water level may vary depending on season or climate conditions, as it does now, but at will be the level that which has the most benefit to and the least impact on the STIF and downhill vegetation at that time. As such, the water in the retained standing water will provide the same water flow through the unchanged permeable interface as exists currently to maintain a healthy environment for the adjacent STIF and the downhill vegetation.
- Overland flows to STIF vegetation currently occur mostly via the standing water. Since the standing water / terrestrial interface is not being changed, and the water will be maintained at current levels, there will be no decrease in water available to the STIF and downhill vegetation via overland flows. Indeed, as the water level in the retained standing water area will be managed, it will also be possible to have periodic higher levels and inundations as occurs currently. The road to the eastt of the retained standing water will be created at a higher level than the STIF vegetation to the west, allowing for inundations that do not risk the proposed development. If anything, there is potential for more frequent inundations of the vegetation to the west given the smaller size of the retained standing water. However, the frequency of these inundation events can be managed and optimized through various mechanisms (e.g. outlets, pumping, etc.) so as to have maximum benefit to the STIF and downhill vegetation and any downstream riparian areas.
- As per Floth (2012), the same amount of water currently entering the site will be present after the proposed works are complete. Given that the proposed construction will float above the quarry floor, any low level water table flow will not be interrupted. Further, surface water will be collected, treated and primarily used to sustain the required water level of the retained standing water, providing the same water flow to the root system of the STIF and the downhill vegetation as currently exists. The remainder of the captured water will be treated and used on-site where it will be recycled and used again.
- As per Floth (2012), water treatment will improve the quality of water entering the retained standing water by removing some sediments and the majority of gross pollutants, hydrocarbons and nutrients. Improving the quality of the water will benefit the STIF vegetation by reducing the conditions that promote weed growth.

As such, there will no increased impact from changed hydrology. In addition, final determination of suitable stormwater management arrangements can be addressed at the DA stage.

5.4 ASSESSMENT OF SIGNIFICANCE (7-PART TEST)

The Assessment of Significance should be applied to selected threatened species, populations and endangered ecological communities and their habitats that occur or may potentially occur within the study area (See **Section 4**).

The Assessment of Significance was applied to nine fauna species and one TEC (refer to **Appendix D**) which concluded that the proposal is **unlikely** to have a significant impact on these species and community. As such a Species Impact Statement is not required for the proposed development.

The proposed works are **not** likely to have a significant impact Sydney Turpentine Ironbark Forest EEC found on site, given that no vegetation characterising this community is to be removed, the disturbed nature of the site and the recommendations proposed in this report. The entirety of the vegetation's approximately 0.6 ha extent on site is to be retained and the indirect and long-term impacts mitigated by the recommendations found in **Section 6**. The extent of clearance is shown in **Figure 7**.

A key threatening process under the NSW TSC Act - Clearing of native vegetation is being undertaken on site, but is not considered to constitute a significant impact.

5.5 EPBC MATTERS

Under the EPBC Act, any action which "has, will have, or is likely to have a significant impact on a Matter of National Environmental Significance" requires approval from the Commonwealth Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) which is responsible for administering the EPBC Act.

Assessment against the significant impact criteria was applied to two threatened species, one migratory species and one CEEC that was known or likely to occur on site. These assessments concluded that the proposal is unlikely to have a significant impact on these matters of NES and a referral to the Minister is not required (**Appendix E**).

The proposed works are **not** likely to have a significant impact on the Turpentine-Ironbark Forest CEEC found on-site is **not** likely to have a significant impact, given that no vegetation characterising this community is to be removed, the disturbed nature of the site and the recommendations proposed in this report. The entirety of the vegetation's approximately 0.6 ha extent on site is to be retained and the indirect and long-term impacts mitigated by the recommendations found in **Section 6**. The extent of clearance is shown in **Figure 7**.

The impact of the proposal on Turpentine-Ironbark Forest in the Sydney Basin Bioregion is **not** likely to have a significant impact, given that no vegetation characterising this community is to be removed, the disturbed nature of the site and the recommendations proposed in this report.

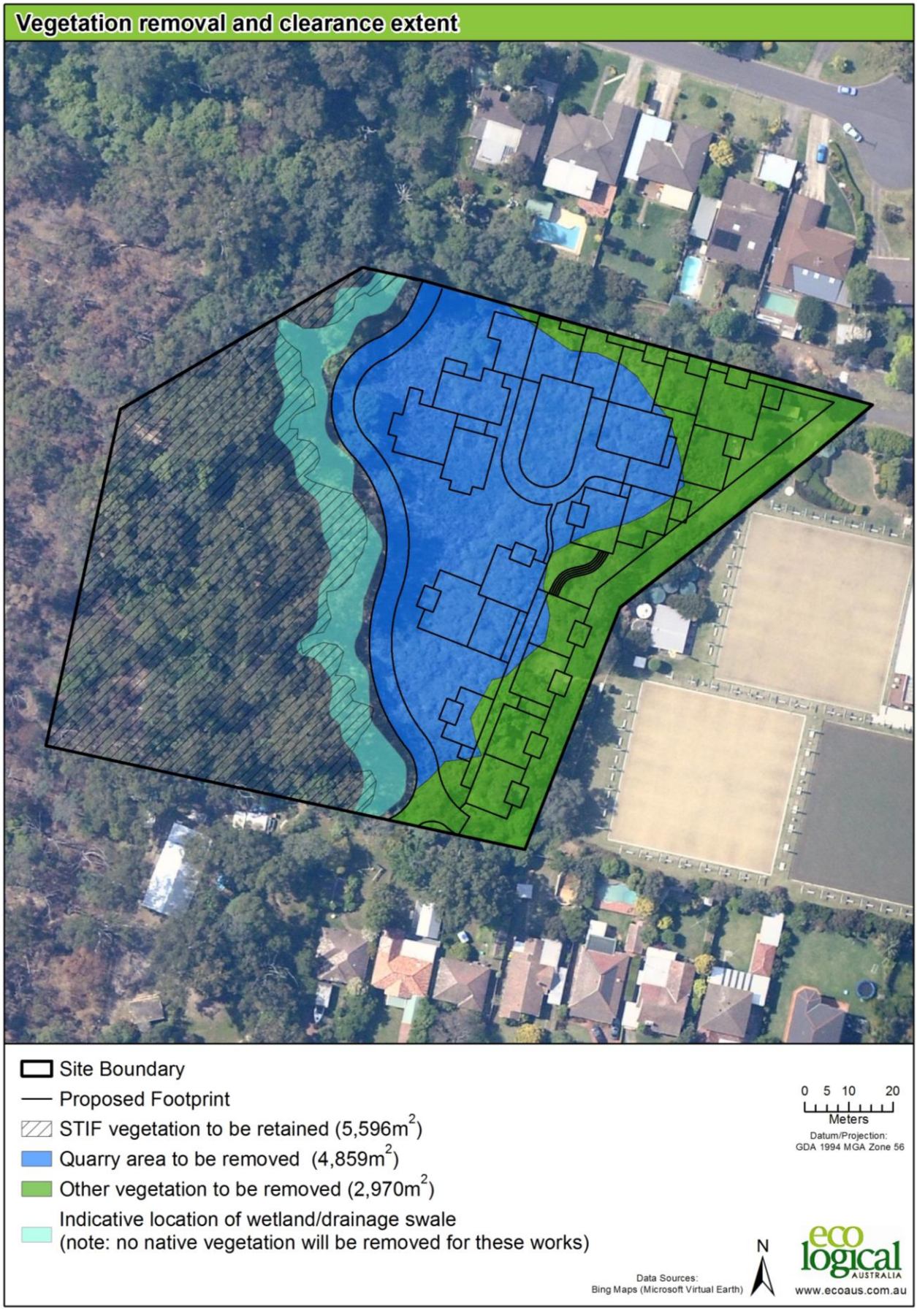

Figure 6: Vegetation removal and clearance extent

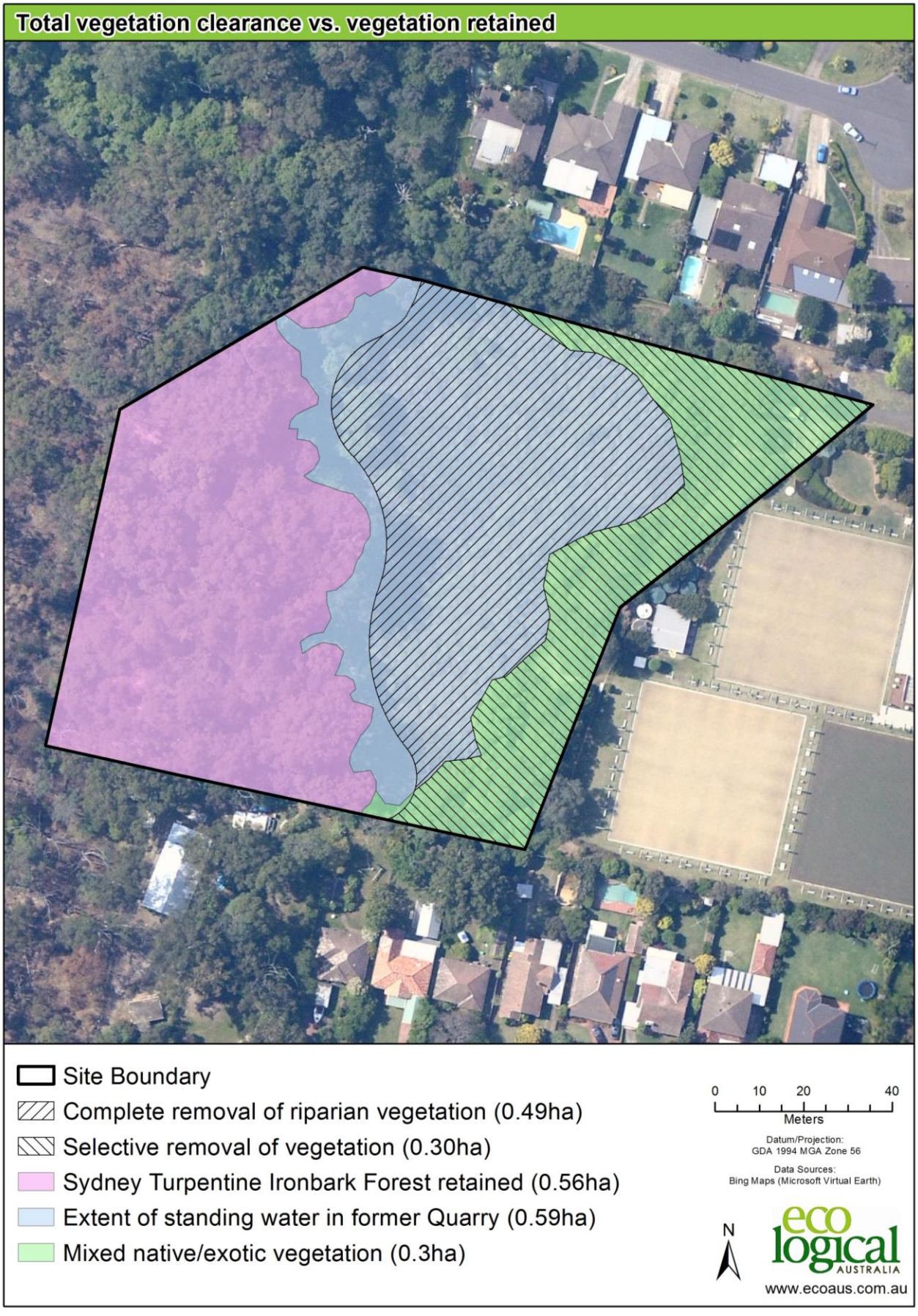

Figure 7: Total vegetation clearance vs. vegetation retained

6 Recommendations

While none of the threatened species were considered to be significantly impacted by the proposal, measures should be taken to further minimise risks associated with the development. The recommendations have been grouped into the various stages of the proposed development.

6.1 PRE-CONSTRUCTION

- Develop a Construction Management Plan (CMP) which includes sediment and erosion control for construction works and post-construction remediation.
- Ensure that the constructed riparian area is designed in such a way as to provide habitat to native species and to mitigate impacts of the development on the STIF to the west.
- Develop a site specific VMP, as per the requirements of the WM Act, including a Weed Control Plan, to protect adjacent vegetation communities and flora and fauna habitat. This VMP should operate for a minimum of five years from the end of construction works and include management of the riparian area and recommendations for construction of the standing water area. This VMP will also include a timetable for revising the VMP to direct management beyond the five years.
- Coarse or large woody debris in the development area should be salvaged and placed in adjacent vegetation where feasible in order to maintain this shelter and food resource for invertebrates, reptiles, mammals and other biota.
- Any hollow-bearing trees or limbs, or seeding native species to be removed should be salvaged and moved to the adjacent bushland.
- Undertake a pre-clearing inspection before any vegetation clearing occurs to ensure no threatened species have migrated to the site.

6.2 DURING CONSTRUCTION

- Clearly mark native vegetation to be retained as no-go areas for construction crews.
- Wash down machinery before clearing entering the site (clean on entry) and when leaving site (clean on exit) to limit / prevent weed spread.
- Limit the risks of Phytophtora Dieback (*Phytophthora cinnamomi*) during construction by following best practice protocols:
    - Ensure construction workers and vehicles do not enter ‘no-go’ areas of native vegetation (e.g. STIF conservation area);
    - All vehicles must be clean of weeds propagules, segments and foreign soil before working entering and leaving the field site;
    - Clean all personal protective equipment, specifically work boots, of foreign soil material that may potentially carry weeds prior to entering the site; and
    - Management of the potential risk of transporting Phytophthora Dieback through appropriate measures outlined in the Phytophthora Statement of Intent (DECC 2008).
- Ensure that all clearing is only conducted in the defined areas.

- Ensure that any excavation will take place outside the drip-line of STIF species. It may be necessary to have an ecologist on site when working near the boundary with STIF vegetation;
- When earthworks are undertaken only use clean fill to reduce the likelihood of introducing weeds.
- Quarry should be drained in such a way as to maintain riparian habitat and reduce the impact on fauna and habitat within the quarry.
- Ensure that drainage from the study site is in line with the *Protection of the Environment Operations Act 1997* requirements so that there is no impact on downstream habitats, and potential threatened species habitat. This includes managing the risks presented by invasive species within the quarry such as *Salvinia molesta* and Plague Minnow.
- Ensure that an ecologist or WIRES member is onsite during the draining of the disused quarry and clearing of vegetation to capture and release fauna found in the construction site. All fauna located within the site will be released into the retained remnant vegetation.

6.3 POST-CONSTRUCTION

- Implement actions outlined in the site specific VMP (e.g. weed control) for a minimum of five years and likely longer.
- Use local provenance native species to revegetate and rehabilitate the subject site and for landscaping within the finished development. This should include the planting of native tree species around the eastern boundary of the site to provide habitat to threatened species identified in the area such as Powerful Owl.

7 Conclusion

The proposed works aim to drain and partially re-fill the former Moxham Quarry which will require the removal of approximately 0.5 ha of aquatic vegetation and 0.3 ha of terrestrial vegetation.

The database search and field assessments conducted for this study demonstrated that the study site contains flora and fauna habitat suitable to support a number of threatened species.

Field surveys identified one TEC, Sydney Turpentine-Ironbark Forest, listed as an EEC under the TSC Act and a CEEC under the EPBC Act. In addition, six threatened or migratory fauna species listed under either the TSC or EPBC Act were identified in or adjacent to the subject site, including Eastern Bent-wing Bat, Grey-headed Flying-fox, Eastern False Pipstrelle, Greater Broad-nosed Bat, Powerful Owl and Rufous Fantail. No threatened flora species were recorded during the survey.

The overall condition of the TEC and surrounding vegetation was high with an intact canopy, shrub and ground layers. Fringing, emergent and sub-emergent vegetation within and along the quarry was dominated by weeds and exotics. This vegetation was extremely dense and may be nourished from nutrient and stormwater runoff from the adjacent Northmead Bowling Club and Windsor Road.

Assessments of Significance were applied to one EEC and nine fauna species to determine if the proposal would result in a significant impact. These assessments determined that cumulative impacts resulting from the proposed works upon the endangered ecological community and threatened species were **unlikely** to be significant, as:

- The proposed habitat removal will not impact on the distribution or local occurrence of any of the threatened species or the ecological community to such a level that it will place it at risk of extinction,
- The development will not isolate any currently interconnecting areas of habitat.
- Extensive areas of suitable habitat exist in the immediate vicinity, including Moxham Park and the vegetation that surrounds Quarry Branch Creek.
- The development will retain and protect an area of vegetation representing an EEC/CEEC, Sydney Turpentine Ironbark Forest.

Therefore, a Species Impact Statement is not required.

Significance Assessments were applied to two vulnerable and one migratory species listed under the EPBC Act to determine if these species would be significantly impacted by the proposed works (**Appendix E**). It was assessed that the proposed works were **unlikely** to have an impact on these species. Areas of suitable habitat are present in the immediate vicinity, including Moxham Park and the vegetation that surrounds Quarry Branch Creek.

Therefore, a referral under the EPBC Act will not be required.

Rehabilitation works to minimise long term and indirect impacts on the remaining vegetation will be undertaken for a minimum of five years as directed by the VMP to be developed as part of the mitigation measures.

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Appendix A:

ENDANGERED ECOLOGICAL COMMUNITIES AND THREATENED SPECIES IN THE REGION

Searches of the Atlas of NSW Wildlife and EPBC Protected Matters search tool were performed for the study area on 12 December 2011. The searches for the study area used latitude -33.78 and longitude 150.99 as their centre with a radius of 10 km.

The results from both searches were compiled into a list of potentially occurring species, populations and communities, with the exception of the listed marine fish, reptile and mammal species and sea bird species from the EPBC Protected Matters and Atlas of NSW Wildlife search, which were considered to not be relevant to the study site.

An assessment of likelihood of occurrence was made for threatened and migratory species identified from the database search. Five terms for the likelihood of occurrence of species are used in this report. This assessment was based on database or other records, presence or absence of suitable habitat, features of the proposal site, results of the field survey and professional judgement. The terms for likelihood of occurrence are defined below:

- "known" = the species was or has been observed on the site
- "likely" = a medium to high probability that a species uses the site
- "potential" = suitable habitat for a species occurs on the site, but there is insufficient information to categorise the species as likely to occur, or unlikely to occur
- "unlikely" = a very low to low probability that a species uses the site
- "no" = habitat on site and in the vicinity is unsuitable for the species

Species, populations and communities considered to have the potential to occur, are likely to occur, or do occur are highlighted. The following abbreviations are uses within the tables:

- TSC Status = Listing under the *Threatened Species Conservation Act 1995*
- EPBC Status = Listing under the *Environment Protection and Biodiversity Conservation Act 1999*
- CE = Critically Endangered
- E = Endangered
- V = Vulnerable
- M = Migratory

SCIENTIFIC NAME	COMMON NAME	TSC ACT	EPBC ACT	HABITAT ASSOCIATIONS	LIKELIHOOD OF OCCURRENCE
PLANTS					
VEGETATION COMMUNITIES					
Blue Gum High Forest of the Sydney Basin Bioregion			CE	This tall forest community typically grows in high rainfall areas with deep soils. Blue Gum High Forest generally occurs within Sydney's northern suburbs. Considerable areas of this vegetation community have been cleared and only 5% of the original forest remains.	No
Cumberland Plain Shale Woodlands and Shale Gravel Transition Forest		E	CE	This vegetation community is restricted to the Sydney Basin Bioregion and is known to occur in the Auburn, Bankstown, Baulkham Hills, Blacktown, Camden, Campbelltown, Fairfield, Hawkesbury, Holroyd, Liverpool, Parramatta, Penrith and Wollondilly LGS's. The dominate species in this community include *E. moluccana* (Grey Box), *E. eugenioides* (Narrow-leaved String-bark), *E. tereticornis* (Forest Red Gum), *Bursaria spinosa* (Blackthorn), *Indigofera australis* (Native Indigo)	No
Shale/Sandstone Transition Forest		E	E	This vegetation community occurs on the edges of the Cumberland Plan where the clay soils from the shale rock intergrade with the soils from the sandstone. The main tree species present include *E. tereticornis* (Forest Red Gum), *E. punctata* (Grey Gum) and several stringy bark species including *E. globoidea* and *E. eugenioides*). Presently, this community occurs in the Hawkesbury, Baulkham Hills, Liverpool, Parramatta, Penrith, Campbelltown and Wollondilly LGA (DEC 2011).	No
Turpentine-Ironbark Forest in the Sydney Basin Bioregion			CE	This vegetation community occurs as an open forest. The dominate species include *Syncarpia glomulifera* (Turpentine), *E. punctata* (Grey Gum), *E. paniculata* (Grey Ironbark) and *E. eugenioides* (Thin-leaved Stringybark).	Known
FLORA					
Acacia bynoeana	Bynoe's Wattle	E	V	The species is found in central eastern NSW, from the Hunter District (Morisset) south to the Southern Highlands and west to the Blue Mountains. It is found in heath and dry sclerophyll forest, typically on a sand or sandy clay substrate, often with ironstone gravels (OEH 2012a). The species seems to prefer open and sometimes slightly disturbed sites (OEH 2012a).	Unlikely
Acacia pubescens	Downy Wattle, Hairy Stemmed Wattle	E	V	Occurs on alluviums, shales and at the intergrade between shales and sandstones. The soils are characteristically gravely soils, often with ironstone. Occurs in open woodland and forest, in a variety of plant communities, including Cooks River/ Castlereagh Ironbark Forest, Shale/ Gravel Transition Forest and Cumberland Plain Woodland.	No

SCIENTIFIC NAME	COMMON NAME	TSC ACT	EPBC ACT	HABITAT ASSOCIATIONS	LIKELIHOOD OF OCCURRENCE
Asterolasia elegans			E	*Asterolasia elegans* is restricted to a few localities on the NSW Central Coast north of Sydney, in the Baulkham Hills, Hawkesbury and Hornsby LGAs. It is found in sheltered forests on mid- to lower slopes and valleys, in or adjacent to gullies (OEH 2012).	No
Caladenia tessellata	Thick-lipped Spider-orchid, Daddy Long-legs	E	V	*Caladenia tessellata* occurs in grassy sclerophyll woodland, often growing in well-structured clay loams or sandy soils south from Swansea, usually in sheltered moist places and in areas of increased sunlight (OEH 2012). It flowers from September to November (OEH 2012).	No
Cryptostylis hunteriana	*Leafless Tongue Orchid*	V	V	*Cryptostylis hunteriana* is known from a range of vegetation communities including swamp-heath and woodland (OEH 2012). The larger populations typically occur in woodland dominated by *Eucalyptus sclerophylla* (Scribbly Gum), *E. sieberi* (Silvertop Ash), *Corymbia gummifera* (Red Bloodwood) and *Allocasuarina littoralis* (Black She oak) where it appears to prefer open areas in the understorey of this community and is often found in association with the *C. subulata* (Large Tongue Orchid) and the *C. erecta* (Tartan Tongue Orchid) (OEH 2012). Bell (2001) has identified Coastal Plains Scribbly Gum Woodland and Coastal Plains Smoothed-barked Apple Woodland as potential habitat on the Central Coast. Flowers between November and February, although may not flower regularly (OEH 2012; Bell 2001).	Unlikely
Darwinia biflora		V	V	*Darwinia biflora* 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 contents.	No
Epacris purpurascens var. *purpurascens*		V	-	Sydney Sandstone Gully Forest and wet heath with strong clay influences (NPWS 1997). Recorded between Gosford in the north to Avon Dam in the south. Found in a range of habitats, but most have a strong shale soil influence. Killed by fire and re-establishes from soil stored seed (OEH 2012b).	Unlikely
Eucalyptus camfieldii	Camfield's Stringybark	V	V	*Eucalyptus camfieldii* 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 (OEH 2012).	No
Genoplesium baueri	Bauer's Midge Orchid	V		*Genoplesium baueri* is 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 (OEH 2012d).	No

SCIENTIFIC NAME	COMMON NAME	TSC ACT	EPBC ACT	HABITAT ASSOCIATIONS	LIKELIHOOD OF OCCURRENCE
Grevillea parviflora subsp. *parviflora*	Small-flower Grevillea		V	*Grevillea parviflora subsp. parviflora* has a sporadically distributed throughout the Sydney Basin mainly around Picton, Appin and Bargo. Separate populations are also known further north from Putty to Wyong and Lake Macquarie and Cessnock and Kurri Kurri. It grows in sandy or light clay soils over thin shales, often with lateritic ironstone gravels. It often occurs in open, slightly disturbed sites such as tracks (OEH 2012).	No
Leptospermum deanei		V	V	*Leptospermum deanei* has been recorded in Hornsby, Warringah, Ku-ring-gai and Ryde LGAs, in woodland on lower hill slopes or near creeks, at sites with sandy alluvial soil or sand over sandstone (OEH 2012). It has also been recorded in riparian scrub dominated by *Tristaniopsis laurina* and *Baeckea myrtifolia*; woodland dominated by *Eucalyptus haemastoma*; and open forest dominated by *Angophora costata*, *Leptospermum trinervium* and *Banksia ericifolia* (OEH 2012).	No
Melaleuca biconvexa	Biconvex Paperbark	V	V	*Melaleuca biconvexa* 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).	No
Melaleuca deanei	Deane's Melaleuca	V	V	*Melaleuca deanei* is generally found in heath on sandstone (OEH 2012), and also associated with woodland on broad ridge tops and slopes on sandy loam and lateritic soils (Benson and McDougall 1998).	No
Persoonia hirsuta	Hairy Geebung	E	E	*Persoonia hirsuta* occurs from Singleton in the north, south to Bargo and the Blue Mountains to the west (OEH 2012). It grows in dry sclerophyll eucalypt woodland and forest on sandstone.	No
Persoonia nutans		E	E	This species is generally 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). This species is endemic to the Western Sydney (Benson and McDougall 2000).	No
Pimelea curviflora var. *curviflora*		V	V	*Pimelea curviflora var. curviflora* 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 (OEH 2012). Associated with the Duffys Forest Community, shale lenses on ridges in Hawkesbury sandstone geology.	No
Pimelea spicata		E	E	In western Sydney, *Pimelea spicata* occurs on an undulating topography of well – structured clay soils, derived from Wianamatta shale (DEC 2004). It is associated with the open woodland and grassland, moist depressions or near creek lines among the Cumberland Plains Woodland (CPW), (Ibid.). Has been located in disturbed areas that would have previously supported CPW (Ibid.).	No

SCIENTIFIC NAME	COMMON NAME	TSC ACT	EPBC ACT	HABITAT ASSOCIATIONS	LIKELIHOOD OF OCCURRENCE
Pterostylis gibbosa		E	E	*Pterostylis gibbosa* is known from a small number of populations in the upper Hunter Valley (Milbrodale), the Illawarra region (Albion Park and Yallah) and near Nowra.Plants of this species grow in woodland and open forest communities with shallow rocky soils.	No
Pterostylis saxicola	Sydney Plains Greenhood		E	*Pterostylis saxicola* is a terrestrial orchid predominantly found in Hawkesbury Sandstone Gully Forest growing in small pockets of soil that have formed in depressions in sandstone rock shelves (NPWS 1997). This species is known from Georges River National Park, Ingleburn, Holsworthy, Peter Meadows Creek, St Marys Tower (NSW Scientific Committee 2011).	No
Tetratheca glandulosa	Glandular Pink-bell	V	V	*Tetratheca glandulosa* is generally associated with ridgetop woodland habits on yellow earths (Travers Morgan 1991) also in sandy or rocky heath and scrub (NPWS 2000). Often associated with sandstone / shale interface where soils have a stronger clay influence (NPWS 2000). Flowers July to November.	No
BONY FISH					
Macquarie australasica	Macquarie Perch	-	E	Macquarie Perch generally occur on the bottom or mid-water in slow-flowing rivers with deep holes, typically in the upper reaches of forested catchments with intact riparian vegetation. In some parts of its range, the species takes refuge in small pools which persist in midland–upland areas during the drier summer periods.	No
Prototroctes maraena	Australian Grayling	-	V	Historically, this species occurs in coastal streams from the Grose River southwards through NSW, VIC and TAS. On mainland Australia this species has been recorded from rivers flowing east and south of the main dividing ranges. This species spends only part of its lifecycle in freshwater, mainly inhabiting clear, gravel-bottomed streams with alternating pools and riffles, and granite outcrops but has also been found in muddy-bottomed, heavily silted habitat. Australian Grayling migrate between freshwater streams and the ocean and as such it is generally accepted to be a diadromous (migratory between fresh and salt waters) species.	No
FROGS					
Heleioporus australiacus	Giant Burrowing Frog	V	V	The Giant Burrowing Frog forages in woodlands, wet heath, dry and wet sclerophyll forest (Ehmann 1997). Associated with semi-permanent to ephemeral sand or rock based streams where the soil is soft and sandy so that burrows can be constructed (Ehmann 1997).	No

SCIENTIFIC NAME	COMMON NAME	TSC ACT	EPBC ACT	HABITAT ASSOCIATIONS	LIKELIHOOD OF OCCURRENCE
Litoria aurea	Green and Golden Bell Frog	E	V	Green and Golden Bell Frog is known to utilise a variety of natural and man-made waterbodies (Pyke & 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 (OEH 2012). Preferred habitat for this species includes shallow, still or slow flowing, permanent and/or widely fluctuating water bodies that are unpolluted and without heavy shading (OEH 2012). Large permanent swamps and ponds exhibiting well-established fringing vegetation (especially bullrushes–Typha sp. and spike rushes–Eleocharis sp.) adjacent to open grassland areas for foraging are preferable (Ehmann 1997; Robinson 1993). Ponds that are typically inhabited tend to be free from predatory fish such as Mosquito Fish (*Gambusia holbrooki*) (OEH 2012).	No
Litoria littlejohni	Little John's Tree Frog		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 (OEH 2012). It occurs along permanent rocky streams with thick fringing vegetation associated with eucalypt woodlands and heaths among sandstone outcrops. It appears to be restricted to sandstone woodland and heath communities at mid to high altitude (NSW Scientific Committee 2000). Males call from low vegetation close to slow flowing pools. Eggs and tadpoles are mostly found in slow flowing pools that receive extended exposure to sunlight, but will also use temporary isolated pools (Robinson 1993).	No
Litoria raniformis	Growling Grass Frog	E	V	Relatively still or slow-flowing sites such as billabongs, ponds, lakes or farm dams, especially where bulrushes (*Typha* sp., *Eleocharis* sp. and *Phragmites* sp.) are present (Ehmann 1997). This species is common in lignum shrublands, black box and River Red Gum woodlands, irrigation channels and at the periphery of rivers in the southern parts of NSW (Ehmann 1997). This species occurs in vegetation types such as open grassland, open forest and ephemeral and permanent non-saline marshes and swamps (OEH 2012). Open grassland and ephemeral permanent non-saline marshes and swamps have also been associated with this species (Ehmann 1997).	No
Mixophyes balbus	Stuttering Frog,	E	V	The Stuttering Frog occupies a variety of forest habitats from rainforest, wet and moist sclerophyll forest and riparian habitat in dry sclerophyll forest that are generally characterised by deep leaf litter or thick cover from understorey vegetation (Ehmann 1997). Breeding habitats are streams and occasionally springs. Not known from streams disturbed by humans or still water environments (Ehmann 1997).	Unlikely

SCIENTIFIC NAME	COMMON NAME	TSC ACT	EPBC ACT	HABITAT ASSOCIATIONS	LIKELIHOOD OF OCCURRENCE
Mixophyes iteratus	Giant Barred Frog, Southern Barred Frog	E	E	Found on forested slopes of the escarpment and adjacent ranges in riparian vegetation, subtropical and dry rainforest, wet sclerophyll forests and swamp sclerophyll forest (OEH 2012; Ehmann 1997). This species is associated with flowing streams with high water quality, though habitats may contain weed species (Ehmann 1997). This species is not known from riparian vegetation disturbed by humans (NSW Scientific Committee 1999).	Unlikely
Pseudophryne australis	Red-crowned Toadlet	V		Red-crowned Toadlets are found in steep escarpment areas and plateaus, as well as low undulating ranges with benched outcroppings on Triassic sandstones of the Sydney Basin (OEH 2012). Within these geological formations, this species mainly occupies the upper parts of ridges, usually being restricted to within about 100 metres of the ridgetop. However they may also occur on plateaus or more level rock platforms along the ridgetop (OEH 2012). They are often associated with open forest to coastal heath and are known to utilise small ephemeral drainage lines which feed water from the top of the ridge to the perennial creeks below for breeding, and are not usually found in the vicinity of permanent water (Ehmann 1997).	Unlikely
REPTILES					
Hoplocephalus bungaroides	Broad-headed Snake	E	V	The Broad-headed Snake typically use exposed sandstone outcrops and benching where the vegetation is predominantly woodland, open woodland and/or heath on Triassic sandstone of the Sydney Basin (OEH 2012). They utilise rock crevices and exfoliating sheets of weathered sandstone during the cooler months and tree hollows during summer (Webb & Shine 1998b).	No
BIRDS					
*Anthochaera phrygia (*syn *Xanthomyza phrygia)*	Regent Honeyeater	E	E, M	Regent Honeyeater are generally associated with temperate eucalypt woodland and open forest including forest edges, wooded farmland and urban areas with mature eucalypts, and riparian forests of *Casuarina cunninghamiana* (River Oak) (Garnett 1993). Areas containing *E. robusta* (Swamp Mahogany) in coastal areas have been observed to be utilised. The Regent Honeyeater primarily feeds on nectar from box and ironbark eucalypts and occasionally from banksias and mistletoes (Garnett 1993).	Unlikely
Botaurus poiciloptilus	Australasian Bittern	V	E	Australasian Bitterns prefer terrestrial wetlands with tall dense vegetation, occasionally estuarine habitats (Marchant & Higgins 1993).	No
Callocephalon fimbriatum	Gang-gang Cockatoo	V		During summer Gang-gang Cockatoos use in dense, tall, wet forests of mountains and gullies, alpine woodlands (Morcombe 2004). In winter they occur at lower altitudes in drier more open forests and woodlands, particularly box-ironbark assemblages (Shields & Chrome 1992). They sometimes inhabit woodland, farms and suburbs in autumn/winter (Simpson & Day 2004).	Unlikely

SCIENTIFIC NAME	COMMON NAME	TSC ACT	EPBC ACT	HABITAT ASSOCIATIONS	LIKELIHOOD OF OCCURRENCE
Dasyornis brachypterus	Eastern Bristlebird	E	E	The Eastern Bristlebird prefers area with dense, low heath or open woodland vegetation. The age of the habitat since fires (fire-age) is of paramount importance to this species; Illawarra and southern populations reach maximum densities in habitat that has not been burnt for at least 15 years; however, in the northern NSW population a lack of fire in grassy forest may be detrimental as grassy tussock nesting habitat becomes unsuitable after long periods without fire; northern NSW birds are usually found in habitats burnt five to 10 years previously.	No
Ixobrychus flavicollis	Black Bittern	V	—	Occurs in both terrestrial and estuarine wetlands generally in areas of permanent water and dense vegetation (Simpson & Day 2004). In areas with permanent water it may occur in flooded grassland, forest, woodland, rainforest and mangroves (Simpson & Day 2004).	Potential
Lathamus discolor	Swift Parrot	E	E, Mar	Swift Parrots breed in Tasmania between September and January. Migrates to mainland in autumn, where it forages on profuse flowering Eucalypts (Blakers *et al.* 1984 ; Schodde and Tidemann 1986). Hence, in this region, autumn and winter flowering eucalypts are important for this species. Favoured feed trees include winter flowering species such as *E. robusta* (Swamp Mahogany), *C. maculata* (Spotted Gum), *C. gummifera* (Red Bloodwood), *E. sideroxylon* (Mugga Ironbark), and *E. albens* (White Box).	Unlikely
Petroica boodang	Scarlet Robin	V		Scarlet Robins occur from the coast to the inland slopes in NSW. After breeding (July - Jan), some disperse to the lower valleys and plains of the tablelands and slopes, and may appear as far west as the eastern edges of the inland plains in autumn and winter. Primarily resides in dry eucalypt forests and woodlands, with usually open and grassy understorey, with scattered shrubs. Abundant logs and fallen timber are important habitat components. In autumn and winter many Scarlet Robins live in open grassy woodlands, and grasslands or grazed paddocks with scattered trees, and may join mixed flocks of other small insectivorous birds.	Unlikely
Petroica phoenicea	Flame Robin	V	—	Flame Robins are found in a broad coastal band around the south-east corner of the Australian mainland, from southern Queensland to just west of the South Australian border. The species is also found in Tasmania. Flame Robins prefer forests and woodlands up to about 1800 m above sea level.	Unlikely
Petroica rodinogaster	Pink Robin	V	—	The Pink Robin is found in Tasmania and the uplands of eastern Victoria and far south-eastern NSW, almost as far north as Bombala. On the mainland, the species disperses north and west and into more open habitats in winter, regularly as far north as the ACT area, and sometimes being found as far north as the central coast of NSW. Inhabits rainforest and tall, open eucalypt forest, particularly in densely vegetated gullies.	Unlikely

SCIENTIFIC NAME	COMMON NAME	TSC ACT	EPBC ACT	HABITAT ASSOCIATIONS	LIKELIHOOD OF OCCURRENCE
Polytelis swainsonii	Superb Parrot	V	V	The Superb Parrot is found throughout eastern inland NSW. On the South-western Slopes their core breeding area is roughly bounded by Cowra and Yass in the east, and Grenfell, Cootamundra and Coolac in the west. Birds breeding in this region are mainly absent during winter, when they migrate north to the region of the upper Namoi and Gwydir Rivers. The other main breeding sites are in the Riverina along the corridors of the Murray, Edward and Murrumbidgee Rivers where birds are present all year round. Mainly inhabits forests and woodlands dominated by eucalypts, especially *Eucalyptus camaldulensis* (River Red Gums) and box eucalypts such as *Eucalyptus melliodora* (Yellow Box) or *E. microcarpa* (Grey Box). Nest in hollows.	Unlikely
NOCTURNAL BIRDS					
Ninox connivens	Barking Owl	V	—	Associated with a variety of habitats such as savanna woodland, open eucalypt forests, wetland and riverine forest. The habitat is typically dominated by Eucalypts (often Redgum species), however often dominated by Melaleuca species in the tropics (Simpson & Day 2004). It usually roosts in dense foliage in large trees such as *Allocasuarina cunninghamiana* (River She-oak), other *Casuarina* and *Allocasuarina, Eucalypts*, *Angophora, Acacia* and rainforest species from streamside gallery forests (NPWS 2003). It usually nests near watercourses or wetlands (NPWS 2003) in large tree hollows with entrances averaging 2-29 metres above ground, depending on the forest or woodland structure and the canopy height (Debus 1997).	Potential
Ninox strenua	Powerful Owl	V		Powerful Owls are associated with a wide range of wet and dry forest types with a high density of prey, such as arboreal mammals, large birds and flying foxes (Environment Australia 2000, Debus & Chafer 1994). Large trees with hollows at least 0.5m deep are required for shelter and breeding (Environment Australia 2000).	Known
MAMMALS					
Dasyurus maculatus *(Dasyurus maculatus* subsp. *Maculatus)*	Spotted-tailed Quoll	V	E	The Spotted-tailed Quoll inhabits a range of forest communities including wet and dry sclerophyll forests, coastal heathlands and rainforests (Mansergh 1984; Belcher *et al.* 2008), more frequently recorded near the ecotones of closed and open forest. 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.. Maternal den sites are logs with cryptic entrances; rock outcrops; windrows; burrows (Belcher *et al.* 2008).	No
Isoodon obesulus obesulus	Southern Brown Bandicoot	E		The Southern Brown Bandicoot is associated with heath, coastal scrub, heathy forests (Menkhorst & Knight 2004), shrubland and woodland on well drained soils. This species is thought to display a preference for newly regenerating heathland and other areas prone to fire .	Potential

SCIENTIFIC NAME	COMMON NAME	TSC ACT	EPBC ACT	HABITAT ASSOCIATIONS	LIKELIHOOD OF OCCURRENCE
Petrogale penicillata	Brush-tailed Rock-wallaby	E	V	Brush-tailed Rock-wallabies occur in rocky areas in a variety of habitats, typically north facing sites with numerous ledges, caves and crevices (Eldridge and Close 2008).	No
Potorous tridactylus *Potorous tridactylus tridactylus*	Long-nosed Potoroo Long-nosed Potoroo (SE Mainland Population)	V	V	Long-nosed Potoroo are associated with dry coastal heath and dry and wet sclerophyll forests (Johnston 2008) with dense cover for shelter and adjacent more open areas for foraging (Menkhorst & Knight 2010).	Unlikely
Pseudomys novaehollandiae	New Holland Mouse		V	The New Holland Mouse is a small burrowing native rodent with a fragmented distribution across Tasmania, Victoria, New South Wales and Queensland (Kemper and Wilson 2008). Inhabits open heathlands, open woodlands with a heathland understorey and vegetated sand dunes. .	No
MICROBATS					
Chalinolobus dwyeri	Large-eared Pied Bat	V	V	The Large-eared Pied Bat occurs in a variety of habitats, including dry sclerophyll forests, woodland, sub-alpine woodland, edges of rainforests and wet sclerophyll forests (Churchill 2008; Hoye and Schulz 2008). This species roosts in caves, rock overhangs and disused mine shafts and as such is usually associated with rock outcrops and cliff faces (Churchill 2008).	Potential
Falsistrellus tasmaniensis	Eastern False Pipistrelle	V		Prefers moist habitats with trees taller than 20m (Churchill 2008; Law *et al.* 2008). Roosts in tree hollows but has also been found roosting in buildings or under loose bark (Law *et al.* 2008).	Known
Miniopterus schreibersii oceanensis	Eastern Bent-wing Bat	V	-	The Eastern Bent-wing Bat is generally associated with a range of habitats such as rainforest, wet and dry sclerophyll forest, monsoon forest, open woodland, paperbark forests and open grassland (Churchill 2008). It forages above and below the tree canopy on small insects (Hoye and Hall 2008). This species will utilise caves, old mines, and stormwater channels, under bridges and occasionally buildings for shelter (Dwyer 1995).	Potential

SCIENTIFIC NAME	COMMON NAME	TSC ACT	EPBC ACT	HABITAT ASSOCIATIONS	LIKELIHOOD OF OCCURRENCE
Mormopterus norfolkensis	Eastern Free-tail Bat	V	-	Most records of this species are from dry eucalypt forest and woodland east of the Great Dividing Range (Churchill 2008). Individuals have, however, been recorded flying low over a rocky river in rainforest and wet sclerophyll forest and foraging in clearings at forest edges (Environment Australia 2000; Hoye *et al.* 2008). Primarily roosts in hollows or behind loose bark in mature eucalypts, but have been observed roosting in the roof of a hut (Hoye *et al.* 2008).	Potential
Myotis macropus	Large-footed Myotis	V	-	Large-footed Myotis occurs among most habitat types such as mangroves, paperbark swamps, riverine monsoon forest, rainforest, wet and dry sclerophyll forest, open woodland and River Red Gum woodland, as long as they are close to water (Churchill 2008). While roosting is most commonly associated with caves, this species has been observed to roost in tree hollows, amongst vegetation, in clumps of Pandanus, under bridges, in mines, tunnels and stormwater drains (Churchill 2008). However the species apparently has specific roost requirements, and only a small percentage of available caves, mines, tunnels and culverts are used (Richards *et al.* 2008).	Unlikely
Pteropus poliocephalus	Grey-headed Flying-Fox	V	V	Grey-headed Flying-Fox inhabit a wide range of habitats including rainforest, mangroves, paperbark forests, wet and dry sclerophyll forests and cultivated areas (Churchill 2008). Camps are often located in gullies, typically close to water, in vegetation with a dense canopy (Churchill 2008; Tidemann *et al.* 2008).	Known.
Scoteanax rueppellii	Greater Broad-nosed Bat	V	-	Greater Broad-nosed Bat are generally associated with moist gullies in mature coastal forest, or rainforest, east of the Great Dividing Range (Churchill 2008), tending to be more frequently located in more productive forests (Churchill 2008; Hoye & Richards 2008). They prefer denser vegetation types and are known to natural and man-made structures including roads, creeks and small rivers, where it hawks backwards and forwards for prey (Hoye & Richards 2008).	Known
MIGRATORY SPECIES					
Apus pacificus	Fork-tailed Swift	-	M	Fork-tailed Swift occur among a variety of habitats but with a tendency for more arid areas, but also over coasts and urban areas (Simpson & Day 2004).	No
Ardea alba	Great Egret	-	M	Great Egrets are common and widespread in Australia (McKilligan, 2005). They forage in a wide range of wet and dry habitats including permanent and ephemeral freshwaters, wet pasture and estuarine mangroves and mudflats (McKilligan, 2005).	Unlikely

SCIENTIFIC NAME	COMMON NAME	TSC ACT	EPBC ACT	HABITAT ASSOCIATIONS	LIKELIHOOD OF OCCURRENCE
Ardea ibis	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 leave 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).	Unlikely
Arenaria interpres	Ruddy Turnstone	-	M	Frequents beaches along the coast of NSW. Flies from Siberia or Alaska to Australia in August - September each year (Geering *et al.* 2008).	No
Calidris acuminata	Sharp-tailed Sandpiper	-	M	It prefers the grassy edges of shallow inland freshwater wetlands. It is also found around sewerage treatment ponds, flooded grasslands, mudflats, mangroves, rocky shores and beaches (Morcombe 2004; Geering *et al.* 2008).	No
Calidris canutus	Red Knot, Knot	-	M	Red Knots are widespread around the Australian coast, less in the south and with few inland records. Small numbers visit Tasmania and off-shore islands. It is widespread but scattered in New Zealand. They breed in North America, Russia, Greenland and Spitsbergen. Red Knots are a non-breeding visitor to most continents (Morcombe 2004; Geering *et al.* 2008).	No
Calidris ferruginea	Curlew Sandpiper	-	M	Intertidal mudflats of estuaries, lagoons, mangrove channels; around lakes,, dams, floodwaters, flooded saltbush surrounds of inland lakes (Geering *et al.* 2008	No
Calidris ruficollis	Red-necked Stint	-	M	The Red-necked Stint breeds in north-eastern Siberia and northern and western Alaska. It follows the East Asian-Australasian Flyway to spend the southern summer months in Australia. It is found widely in Australia, except in the arid inland. In Australia, Red-necked Stints are found on the coast, in sheltered inlets, bays, lagoons, estuaries, intertidal mudflats and protected sandy or coralline shores. They may also be seen in saltworks, sewage farms, saltmarsh, shallow wetlands including lakes, swamps, riverbanks, waterholes, bore drains, dams, soaks and pools in saltflats, flooded paddocks or damp grasslands. They are often in dense flocks, feeding or roosting. (Geering *et al.* 2008)	No
Calidris melanotos	Pectoral Sandpiper	-	M	This species inhabitas coastal habitats with large intertidal mudflats or sandflats, including inlets, bays, harbours, estuaries and lagoons (Geering *et al.* 2008).. Often recorded on sandy beaches with mudflats nearby, sandy spits and inlets, or exposed reefs or rock platforms (Marchant and Higgins 1999).	No

SCIENTIFIC NAME	COMMON NAME	TSC ACT	EPBC ACT	HABITAT ASSOCIATIONS	LIKELIHOOD OF OCCURRENCE
Calidris tenuirostris	Great Knot	-	M	Sheltered coastal habitats containing large intertidal mudflats or sandflats, including inlets, bays, harbours, estuaries and lagoons (Geering *et al.* 2008).. Often recorded on sandy beaches with mudflats nearby, sandy spits and inlets, or exposed reefs or rock platforms (Marchant and Higgins 1999).	No
Charadrius bicinctus	Double-banded Plover	-	M	In Australia, the Double-banded Plover is found mainly on the east coast and Tasmania and is a regular visitor to Norfolk and Lord Howe Islands. It has been recorded occasionaly in Western Australia. It is widespread throughout New Zealand. The Double-banded Plover is found on coastal beaches, mudflats, sewage farms, river banks, fields, dunes, upland tussock grasses and shingle (Geering *et al.* 2008).	No
Charadrius leschenaultii	Greater Sand Plover	-	M	Entirely coastal in NSW, foraging on intertidal sand and mudflats in estuaries, roosting during high tide on sandy beaches or rocky shores (Geering *et al.* 2008)	No
Charadrius mongolus	Lesser Sand Plover	-	M	Favours coastal areas including beaches, mudflats and mangroves where they forage . They may be seen roosting during high tide on sandy beaches or rocky shores (Geering *et al.* 2008).	No
Gallinago hardwickii	Latham's Snipe	-	M, Mar	Latham's Snipe occur in a variety of permanent and ephemeral wetlands, preferring open fresh water wetlands with nearby cover (Marchant and Higgins 1999). They occur in a variety of vegetation around wetlands (Marchant and Higgins 1999) including wetland grasses and open wooded swamps (Simpson & Day 2004).	Unlikely
Haliaeetus leucogaster	White-bellied Sea-Eagle	-	M, Mar	Forages over large open fresh or saline waterbodies, coastal seas and open terrestrial areas (Marchant & Higgins 1993, Simpson & Day 2004). 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).	Unlikely

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Heteroscelus brevipes	Grey-tailed Tattler		M, Mar	Grey-tailed Tattlers breed in Siberia and on passage are seen along the East Asian-Australasian Flyway (the migration route to Australia). When non-breeding they are found in China, Philipines, Taiwan, Vietnam, Malay Peninsula, Indonesia, New Guinea, Micronesia, Fiji, New Zealand and Australia. They are more commonly seen in the north of Australia. Grey-tailed Tattlers are usually seen in small flocks on sheltered coasts with reefs and rock platforms or with intertidal mudflats. They are also found in intertidal rocky, coral or stony reefs, platforms and islets that are exposed at high tide, also shores of rock, shingle, gravel and shells and on intertidal mudflats in embayments, estuaries and coastal lagoons, especially those fringed with mangroves (Morcombe 2004).	No
Hirundapus caudacutus	White-throated Needletail	-	M, Mar	White-throated Needletail forage 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 2004). Has been observed roosting in dense foliage of canopy trees, and may seek refuge in tree hollows in inclement weather (Marchant & Higgins 1993).	No
Limosa lapponica	Bar-tailed Godwit	-	M, Mar	Mainly coastal, usually sheltered bays, estuaries and lagoons with large intertidal mudflats or sandflats. Breeds in Northern Russia, Scandinavia, NW Alaska (Geering *et al.* 2008).	No
Limosa limosa	Black-tailed Godwit	-	M	Mainly coastal, usually sheltered bays, estuaries and lagoons with large intertidal mudflats or sandflats (Geering *et al.* 2008). Often found inland in small numbers (i*bid*). Breeds in Iceland, Nth Atlantic, Europe, Russian and China (*ibid*).	No
Merops ornatus	Rainbow Bee-eater	-	M, Mar	Rainbow Bee-eater are 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 (Simpson & Day 2004). They occur 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 (ibid).	Unlikely
Monarcha melanopsis	Black-faced Monarch	-	M, Mar	Black-faced Monarch prefers wetter, denser forest, often at high elevations (Simpson & Day 2004).	No
Myiagra cyanoleuca	Satin Flycatcher	-	M, Mar	Satin Flycatchers occur in wetter, denser forest, often at high elevations (Simpson & Day 2004).	No
Numenius madagascariensis	Eastern Curlew	-	M, Mar	Intertidal coastal mudflats, coastal lagoons, sandy spits (Simpson & Day 2004; Geering *et al.* 2008). Breeds in Russia, NE China (*ibid*).	No
Numenius phaeopus	Whimbrel		M, Mar	Intertidal coastal mudflats, river deltas and mangroves, occasionally sandy beaches (Simpson & Day 2004; Geering *et al.* 2008). Breeds Siberia and Alaska (*ibid.*).	No

SCIENTIFIC NAME	COMMON NAME	TSC ACT	EPBC ACT	HABITAT ASSOCIATIONS	LIKELIHOOD OF OCCURRENCE
Pluvialis fulva	Pacific Golden Plover		M, Mar	Breeds North Siberia, Alaska (Simpson & Day 2004; Geering *et al.* 2008). Mainly coastal, beaches, mudflats and sandflats and other open areas such as recreational playing fields in Australia (*ibid.*).	No
Rhipidura rufifrons	Rufous Fantail	-	M, Mar	The Rufous Fantail is a summer breeding migrant to south-eastern Australia (Morcombe, 2004). Rufous Fantails are 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).	Potential
*Rostratula australis (*syn *R. benghalensis)*	Painted Snipe (Australian subspecies)	E	E, M, Mar	This species 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). Roosts during the day in dense vegetation (NSW Scientific Committee 2004). Forages nocturnally on mud-flats and in shallow water (OEH 2012). Feeds on worms, molluscs, insects and some plant-matter (ibid.).	Unlikely
Tringa stagnatilis	Marsh Sandpiper		M, Mar	Coastal - Permanent or ephemeral wetlands of varying degrees of salinity, commonly inland (Simpson & Day 2004). Breeds Eastern Europe to Eastern Siberia (*ibid*).	No

Disclaimer: Data extracted from the Atlas of NSW Wildlife and DSEWPC Protected Matters Report is only indicative and cannot be considered a comprehensive inventory. 'Migratory marine species' and 'listed marine species' listed on the EPBC Act (and listed on the DSEWPC protected matters report) have not been included in this table, since they are considered unlikely to occur within the study area due to the absence of marine habitat.

CE = Critically Endangered; E = Endangered; E2 = Endangered Population; V = Vulnerable; M = Migratory.

Appendix B

FLORA RECORDED DURING FIELD SURVEY

FAMILY	GENUS	SPECIES	COMMON NAME	NATIVE/EXOTIC	STIF	NOX	WONS
Araceae	*Zantedeschia*	*aethiopica*	Arum Lily	Exotic	No		
Asclepiadaceae	*Marsdenia*	*rostrata*	Common Milk Vine	Native	No		
Asparagaceae	*Asparagus*	*officinalis*	Asparagus	Exotic	No		
Aspleniaceae	*Asplenium*	spp.		Native	No		
Asteraceae	*Ageratina*	*adenophora*	Crofton Weed	Exotic	No		
Asteraceae	*Bidens*	*pilosa*	Cobbler's Pegs	Exotic	No		
Asteraceae	*Ozothamnus*	*diosmifolius*	White Dogwood	Native	Yes		
Bignoniaceae	*Pandorea*	*pandorana*	Wonga Wonga Vine	Native	Yes		
Casuarinaceae	*Allocasuarina*	*distyla*		Native	No		
Casuarinaceae	*Allocasuarina*	*littoralis*	Black Sheoak	Native	No		
Commelinaceae	*Commelina*	*cyanea*	Creeping Christian	Native	Yes		
Convolvulaceae	*Dichondra*	*repens*	Kidney Weed	Native	Yes		
Crassulaceae	*Bryophyllum*	sp.	Mother-of-Millions	Exotic	No		
Cyperaceae	*Cyperus*	*papyrus*	Papyrus	Exotic	No		
Cyperaceae	*Typha*	*orientalis*		Native	No		
Dilleniaceae	*Hibbertia*	*scandens*	Climbing Guinea Flower	Native	No		
Euphorbiaceae	*Glochidion*	*ferdinandi*	Cheese Tree	Native	No		
Euphorbiaceae	*Omalanthus*	*populifolius*	Bleeding Heart, Native Poplar	Native	No		
Fabaceae (Caesalpinioideae)	*Senna*	*pendula* var. *glabra*	Cassia	Exotic	No		
Fabaceae (Faboideae)	*Daviesia*	*ulicifolia*	Gorse Bitter Pea	Native	No		

FAMILY	GENUS	SPECIES	COMMON NAME	NATIVE/EXOTIC	STIF	NOX	WONS
Fabaceae (Faboideae)	*Desmodium*	spp.		Native	No		
Fabaceae (Faboideae)	*Glycine*	*clandestina*		Native	Yes		
Fabaceae (Faboideae)	*Glycine*	*tabacina*	Glycine	Native	No		
Fabaceae (Faboideae)	*Hardenbergia*	*violacea*	False Sarsaparilla	Native	Yes		
Fabaceae (Mimosoideae)	*Acacia*	*longifolia*		Native	Yes		
Lauraceae	*Cinnamomum*	*camphora*	Camphor Laurel	Exotic	No		
Lomandraceae	*Lomandra*	*longifolia*	Spiny-headed Mat-rush	Native	Yes		
Luzuriagaceae	*Eustrephus*	*latifolius*	Wombat Berry	Native	No		
Malaceae	*Cotoneaster*	sp.	Cotoneaster	Exotic	No		
Malvaceae	*Sida*	spp.	Sida	Exotic	No		
Myrtaceae	*Angophora*	*costata*	Sydney Red/Rusty Gum	Native	Yes		
Myrtaceae	*Eucalyptus*	*pilularis*	Blackbutt	Native	Yes		
Myrtaceae	*Eucalyptus*	*resinifera*	Red Mahogany	Native	Yes		
Myrtaceae	*Kunzea*	*ambigua*	Tick Bush	Native	Yes		
Myrtaceae	*Leptospermum*	*polyanthum*		Native	No		
Myrtaceae	*Syncarpia*	*glomulifera*	Turpentine	Native	Yes		
Oleaceae	*Olea*	*europaea*	Common Olive	Exotic	No		
Oxalidaceae	*Oxalis*	*perennans*		Native	No		
Phormiaceae	*Dianella*	*caerulea*	Blue Flax-lily	Native	Yes		
Phormiaceae	*Dianella*	*longifolia*		Native	No		
Pittosporaceae	*Bursaria*	*spinosa*	Native Blackthorn	Native	Yes		
Pittosporaceae	*Pittosporum*	*undulatum*	Sweet Pittosporum	Native	No		
Plantaginaceae	*Plantago*	spp.	Plantain	Exotic	No		
Poaceae	*Austrodanthonia*	spp.	Wallaby Grass	Native	No		
Poaceae	*Echinopogon*	*caespitosus*	Bushy Hedgehog-grass	Native	Yes		
Poaceae	*Ehrharta*	*erecta*	Panic Veldtgrass*	Exotic	No		

FAMILY	GENUS	SPECIES	COMMON NAME	NATIVE/EXOTIC	STIF	NOX	WONS
Poaceae	*Lachnagrostis*	*aemula*	Blowngrass	Native	No		
Poaceae	*Microlaena*	*stipoides*		Native	Yes		
Poaceae	*Themeda*	*australis*	Kangaroo Grass	Native	Yes		
Proteaceae	*Hakea*	*sericea*	Needlebush	Native	No		
Proteaceae	*Persoonia*	*linearis*	Narrow-leaved Geebung	Native	No		
Ranunculaceae	*Clematis*	*aristata*	Old Man's Beard	Native	Yes		
Santalaceae	*Exocarpos*	*cupressiformis*	Native Cherry	Native	Yes		
Sapindaceae	*Dodonaea*	*triquetra*	Large-leaf Hop-bush	Native	Yes		
Scrophulariaceae	*Veronica*	*plebeia*		Native	Yes		
Smilacaceae	*Smilax*	*australis*	Lawyer Vine	Native	No		
Solanaceae	*Solanum*	*pseudocapsicum*	Madeira Winter Cherry	Exotic	No		
Salviniaceae	*Salvinia*	*molesta*	Salvinia	Exotic	No	2	Y
Onagraceae	*Ludwigia*	*longifolia*	Long-leaf Willow Primrose	Exotic	No	3	
Poaceae	*Cortaderia*	sp.	Pampas Grass	Exotic	No	3	
Asparagaceae	*Asparagus*	*aethiopicus*	Asparagus Fern	Exotic	No	4	
Poaceae	*Arundo*	*donax*	Giant Reed	Exotic	No	4	
Asparagaceae	*Asparagus*	*asparagoides*	Bridal Creeper	Exotic	No	4	Y
Verbenaceae	*Lantana*	*camara*	Lantana	Exotic	No	4	Y
Salicaceae	*Salix*	*alba*	White Willow	Exotic	No	5	Y
Salicaceae	*Salix*	spp.	Willow	Exotic	No	5	Y
Fabaceae	*Genista*	*monspessulana**	Cape Broom	Exotic	No	3	Y
Asparagaceae	*Asparagus*	*plumosus**	Climbing Asparagus	Exotic	No	4	Y
Oleaceae	*Ligustrum*	*sinense**	Small-leaf Privet	Exotic	No	4	
Oleaceae	*Ligustrum*	*lucidum**	Large-leaf Privet	Exotic	No	4	
Rosaceae	*Rubus*	*fruticosus* agg. spp.*	Blackberry	Exotic	No	4	Y

*= recorded by ACS Environmental (2013)

FAMILY	GENUS	SPECIES	COMMON NAME	NATIVE/EXOTIC	STIF	NOX	WONS

Appendix C

FAUNA RECORDED DURING FIELD SURVEY

CLASS	FAMILY	GENUS	SPECIES	COMMON NAME	ORIGIN	ELA 2012	ACS 2013	PREVIOUS SURVEYS	TSC ACT	EPBC ACT
Amphibian	Hylidae	*Litoria*	*fallax*	Dwarf Green Tree Frog	Native	X	X	X		
		Litoria	*dentata*	Bleating Tree Frog	Native			X		
		Litoria	*peronii*	Spotted Emerald Tree Frog	Native			X		
		Litoria	*tyleri*	Tyler's Tree Frog	Native	X				
	Myobatrachidae	*Crinia*	*signifera*	Common Eastern Froglet	Native	X		X		
		Limnodynastes	*peroni*	Striped Marsh Frog	Native					
		Limnodynastes	*tasmaniensis*	Spotted Marsh Frog	Native		X			
		Pseudophryne	*bibroni*	Bibrons Toadlet	Native			X		
		Uperoleia	*laevigata*	Smooth Toadlet	Native			X		
Aves	Acanthizidae	*Acanthiza*	*nana*	Yellow Thornbill	Native			X		
		Acanthiza	*pusilla*	Brown Thornbill	Native	X		X		
		Gerygone	*mouki*	Brown Gerygone	Native			X		
		Sericornis	*frontalis*	White-browed Scrubwren	Native		X			
		Smicrornis	*brevirostris*	Weebill	Native					
	Accipitridae	*Accipiter*	*fasciatus*	Brown Goshawk	Native			X		
	Ardeidae	*Egretta*	*novaehollandiae*	White-faced Heron	Native			X		
	Artamidae	*Gymnorhina*	*tibicen*	Australian Magpie	Native	X		X		
		Strepera	*graculina*	Pied Currawong	Native	X		X		
	Cacatuidae	*Cacatua*	*galerita*	Sulphur-crested Cockatoo	Native	X		X		
		Eolophus	*roseicapillus*	Galah	Native			X		

CLASS	FAMILY	GENUS	SPECIES	COMMON NAME	ORIGIN	ELA 2012	ACS 2013	PREVIOUS SURVEYS	TSC ACT	EPBC ACT
	Campephagidae	*Coracina*	*novaehollandiae*	Black-faced Cuckoo-shrike	Native			X		
	Charadriidae	*Vanellus*	*miles*	Masked Lapwing	Native			X		
	Climacteridae	*Cormobates*	*leucophaeus*	White-throated Tree-creeper	Native		X	X		
	Columbidae	*Columba*	*leucomela*	White-headed Pigeon	Native			X		
		Columba	*livia*	Feral Pigeon	Exotic	X				
		Streptopelia	*chinensis*	Spotted Turtledove	Exotic	X				
	Corvidae	*Corvus*	*mellori*	Little Raven	Native	X				
		Corvus	*coronoides*	Australian Raven	Native	X		X		
	Cuculidae	*Cacomantis*	*flabelliformis*	Fan-tailed Cuckoo	Native			X		
		Eudynamys	*scolopacea*	Common Koel	Native	X				
		Scythrops novaehollandiae	*novaehollandiae*	Channel-billed Cuckoo	Native	X				
	Dicruridae	*Rhipidura*	*fuliginosa*	Grey Fantail	Native			X		
		Rhipidura	*leucophrys*	Willie Wagtail	Native	X		X		
		Rhipidura	*rufifrons*	Rufous Fantail	Native			X		M
	Estrildidae	*Neochmia*	*temporalis*	Red-browed Finch	Native		X	X		
	Eupetidae	*Psophodes*	*olivaceus*	Eastern Whipbird	Native			X		
	Halcyonidae	*Dacelo*	*novaeguineae*	Laughing Kookaburra	Native	X		X		
	Hirundinidae	*Hirundo*	*neoxena*	Welcome Swallow	Native	X				
	Maluridae	*Malurus*	*cyaneus*	Superb Fairy-wren	Native	X		X		
		Malurus	*lamberti*	Variegated Fairy-wren	Native		X			
	Meliphagidae	*Acanthorhynchus*	*tenuirostris*	Eastern Spinebill	Native			X		
		Anthochaera	*carunculata*	Red Wattlebird	Native			X		
		Anthochaera	*chrysoptera*	Little Wattlebird	Native			X		
		Lichenostomus	*chrysops*	Yellow-faced Honeyeater	Native			X		
		Manorina	*melanocephala*	Noisy Miner	Native	X		X		

CLASS	FAMILY	GENUS	SPECIES	COMMON NAME	ORIGIN	ELA 2012	ACS 2013	PREVIOUS SURVEYS	TSC ACT	EPBC ACT
		Manorina	*melanophrys*	Bell Miner	Native			X		
		Meliphaga	*lewinii*	Lewins honeyeater	Native	X		X		
		Phylidonyris	*nigra*	White-cheeked Honeyeater	Native		X	X		
		Phylidonyris	*novaehollandiae*	New Holland Honeyeater	Native			X		
	Monarchidae	*Myiagra*	*inquieta*	Restless Flycatcher	Native			X		
	Nestoridae	*Calyptorhynchus*	*funereus*	Yellow-tailed Black Cockatoo	Native			X		
	Oriolidae	*Oriolus*	*sagittatus*	Olive-backed Oriole	Native			X		
	Pachycephalidae	*Colluricincla*	*harmonica*	Grey Shrike-thrush	Native			X		
		Pachycephala	*pectoralis*	Golden Whistler	Native			X		
	Pardalotidae	*Pardalotus*	*punctatus*	Spotted Pardalote	Native		X	X		
	Petroicidae	*Eopsaltria*	*australis*	Yellow Robin	Native			X		
		Microeca fascinans	*fascinans*	Jack Winter	Native	X				
	Phalacrocoracidae	*Microcarbo*	*melanoleucos*	Little Pied Cormorant	Native	X				
	Podargidae	*Podargus*	*strigoides*	Tawny Frogmouth	Native			X		
	Psittacidae	*Aprosmictus*	*erythropterus*	King Parrot	Native			X		
		Platycercus	*elegans*	Crimson Rosella	Native	X				
		Trichoglossus	*chlorolepidotus*	Scaly-breasted Lorikeet	Native			X		
		Trichoglossus	*haematodus*	Rainbow Lorikeet	Native	X		X		
	Ptilonorhynchidae	*Ptilonorhynchus*	*violaceus*	Satin Bowerbird	Native			X		
	Pycnonotidae	*Pycnonotus*	*jocosus*	Red-whiskered Bulbul	Exotic	X		X		
	Rhipiduridae	*Rhipidura*	*albiscapa*	Grey Fantail	Native		X			
	Strigidae	*Ninox*	*novaeseelandiae*	Southern Boobook	Native			X		
		Ninox	*strenua*	Powerful Owl	Native	X		X	V	
	Sturnidae	*Acridotheres*	*tristis*	Common Myna	Exotic	X		X		
		Sturnus	*vulgaris**	European Starling	Exotic	X				

CLASS	FAMILY	GENUS	SPECIES	COMMON NAME	ORIGIN	ELA 2012	ACS 2013	PREVIOUS SURVEYS	TSC ACT	EPBC ACT
		Turdus	*merula* *	Common Blackbird	Exotic					
	Threskiornithidae	*Threskiomis*	*molucca*	Australian White Ibis	Native	X				
	Timaliidae	*Zosterops*	*lateralis*	Silvereye	Native			X		
		Sericornis	*frontalis*	White-browed Scrubwren	Native			X		
Fish	Anguillidae	*Anguilla*	*australis*	Short finned eel	Native			X		
	Eleotridae	*Gobiomorphus*	*coxii*	Coxs Gudgeon	Native			X		
	Poeciliidae	*Gambusia*	*holbrookii*	Plague Minnow	Exotic	X		X		
Mammalia	Canidae	*Canis*	*lupus*	Domestic Dog	Exotic			X		
		Vulpus	*vulpus*	Red Fox	Exotic		X			
	Felidae	*Felis*	*catus*	Domestic Cat	Exotic			X		
	Muridae	*Rattus*	*rattus*	Black Rat	Exotic	X		X		
	Phalangeridae	*Trichosurus*	*vulpecula*	Common Brushtail Possum	Native	X		X		
	Pseudocheiridae	*Pseudocheirus*	*peregrinus*	Ringtail Possum	Native		X	X		
Mammalia (Chiroptera)	Miniopteridae	*Miniopterus*	*schreibersii oceanensis*	Eastern Bent-wing Bat	Native			X	V	
	Molossidae	*Mormopterus*	*species 2*	Mormopterus species 2	Native	X				
	Pteropodidae	*Pteropus*	*poliocephalus*	Grey-headed Flying-fox	Native	X		X	V	V
	Vespertilionidae	*Chalinolobus*	*gouldii*	Gould's Wattled Bat	Native	X		X		
		Chalinolobus	*morio*	Chocolate Wattled Bat	Native	X				
		Falsistrellus	*tasmaniensis*	Eastern False Pipstrelle	Native	X			V	
		Myotis	*macropus*	Southern Myotis	Native			X		
		Nyctophilus	*sp*	Long-eared Bat	Native					
		Scoteanax	*rueppellii*	Greater Broad-nosed Bat	Native	X			V	
Reptilia	Elapidae	*Pseudechis*	*porphyriacus*	Red-bellied Black Snake	Native			X		
	Gekkonidae	*Phyllurus*	*platurus*	Broad-tailed Gecko	Native		X	X		
	Scincidae	*Acritocscincus*	*platynotum*	Red-throated Skink	Native	X				

CLASS	FAMILY	GENUS	SPECIES	COMMON NAME	ORIGIN	ELA 2012	ACS 2013	PREVIOUS SURVEYS	TSC ACT	EPBC ACT
		Eulamprus	*quoyii*	Eastern Water Skink	Native	X		X		
		Lampropholis	*delicata*	Dark-flecked Garden Sun Skink	Native	X		X		
		Saiphos	*equalis*	Three-toed Skink	Native	X		X		
		Tiliqua	*scincoides*	Eastern Blue-tongue Lizard	Native			X		

Appendix D

ANABAT RESULTS – MOXHAM QUARRY, 7 ANABAT NIGHTS.

Bat calls were analysed using the program AnalookW (Version 3.7w 31 December 2009, 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 (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:

- Recordings containing less than three pulses were not analysed (Law *et al.* 1999).
- Only search phase calls were analysed (McKenzie *et al.* 2002).
- Four categories of confidence in species identification were used (Mills *et al.* 1996):
    - a. definite – identity not in doubt
    - b. probable – low probability of confusion with species of similar calls
    - c. possible – medium to high probability of confusion with species with similar calls; and
    - d. unidentifiable – 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).

A total of **1168** call sequences were recorded within the study area; Moxham Quarry at two (2) sites for a total of 7 Anabat nights. Of these, **504 (43%)** of the sequences could be identified confidently to species or genus level (see Table 1). The calls of **5 species** were recorded with only **1 possible** call profile attributed to the TSC vulnerable species *Falsistrellus tasmaniensis* at any site over all nights.

Bat activity within the study area varied between nights and the sites. The Anno3 site recording a range of calls from 320 calls on the first night to a low of 58 on the last and the Anno4 site a range from 355 to 0. The last night at the Anno4 site failed to record after 19:47 and, therefore, no identifiable calls were attributed for that night.

The Anno3 site, particularly on the second night, contained a lot of fragmented and low quality calls interspersed with a high number of 'junk' calls. This could be attributed to poor weather possible rain or a windy night.

Some feeding buzzes were recorded; indicating bats were foraging over the study area but at a generally low level.

By far the largest recorded number of calls were attributed to common species in particular Gould's wattled Bat (297) and *Mormopterus* sp2 (175) or greater than 93 % of all calls identified.

The calls of East-coast Freetail Bat and *Mormopterus* sp2 can be difficult to separate when the characteristic frequency is 31kHz and when the sequence does not show any alternation between pulses.

Table 5. Anabat data analysis

Anno3					
Night	**Label**	**Number**	**Definite**	**Probable**	**Possible**
14-Dec-11	*Chalinolobus gouldii*	168	139	18	11
14-Dec-11	*Chalinolobus morio*	2	0	2	0
14-Dec-11	*Mormopterus* sp2	64	61	0	3
14-Dec-11	Short	43			
14-Dec-11	Junk	26			
14-Dec-11	Low	17			

Total calls Identified	234
Total sequences	320
% Identified	73.125

Night	**Label**	**Number**	**Definite**	**Probable**	**Possible**
16-Dec-11	*Chalinolobus gouldii*	6	1	4	1
16-Dec-11	*Chalinolobus morio*	1	0	1	0
16-Dec-11	*Falsistrellus tasmaniensis*	2	0	2	0
16-Dec-11	*Mormopterus* sp2	12	10	1	1
16-Dec-11	Short	4			
16-Dec-11	Junk	66			
16-Dec-11	Low	31			

Total calls Identified	21
Total sequences	122
% Identified	17.21311

Night	**Label**	**Number**	**Definite**	**Probable**	**Possible**
17-Dec-11	*Chalinolobus gouldii*	18	14	0	4
17-Dec-11	*Chalinolobus morio*	1	1	0	0
17-Dec-11	*Mormopterus* sp2	23	20	1	2
17-Dec-11	Short	5			
17-Dec-11	Junk	2			
17-Dec-11	Low	9			

Total Calls Identified	42
Total sequences	58
% Identified	72.41379

Anno4					
Night	**Label**	**Number**	**Definite**	**Probable**	**Possible**
14-Dec-11	*Mormopterus* sp2	2	2	0	1
14-Dec-11	Short	6			
14-Dec-11	Junk	20			
14-Dec-11	Low	3			

Total Calls Identified	2
Total sequences	31
% Identified	6.451613

Night	**Label**	**Number**	**Definite**	**Probable**	**Possible**
15-Dec-11	*Chalinolobus gouldii*	50	31	7	12
15-Dec-11	*Mormopterus* sp2	1	1	0	0
15-Dec-11	Short	4			
15-Dec-11	Junk	15			
15-Dec-11	Low	12			

Total Calls Identified	51
Total sequences	82
% Identified	62.19512

Night	**Label**	**Number**	**Definite**	**Probable**	**Possible**
16-Dec-11	*Chalinolobus gouldii*	18	14	1	3
16-Dec-11	*Chalinolobus morio*	18	5	2	11
16-Dec-11	*Scoteanax rueppellii*	3	2	1	0
16-Dec-11	*Mormopterus* sp2	35	32	1	2
16-Dec-11	Short	43			
16-Dec-11	Junk	195			
16-Dec-11	Low	43			

Total Calls Identified	74
Total sequences	355
% Identified	20.84507

Night	**Label**	**Number**	**Definite**	**Probable**	**Possible**
17-Dec-11	*Chalinolobus gouldii*	37	22	4	11
17-Dec-11	*Chalinolobus morio*	5	1	1	3
17-Dec-11	*Mormopterus* sp2	38	37	0	1
17-Dec-11	Short	29			
17-Dec-11	Junk	32			
17-Dec-11	Low	46			

Total Calls Identified	80
Total sequences	187
% Identified	42.78075

Night	Label	Number	Definite	Probable	Possible
18-Dec-11	Junk	13			

Total Calls Identified	0
Total sequences	13
% Identified	0

Full total Id	**504**
Full total sequences	**1168**
Full % Identified	**43.15068**

Appendix D

EP&A ACT ASSESSMENT OF SIGNIFICANCE (7-PART TEST)

The Assessment of Significance (7-part test) is applied to species, populations and ecological communities listed on Schedules 1, 1A and 2 of the TSC Act and Schedules 4, 4A and 5 of the Fisheries Management Act. The assessment sets out 7 factors, which when considered, allow proponents to undertake a qualitative analysis of the likely impacts of an action and to determine whether further assessment is required via a Species Impact Statement (SIS). All factors must be considered and an overall conclusion made based on all factors in combination. An SIS is required if, through application of the 7-part test, an action is considered likely to have a significant impact on a threatened species, population or ecological community.

All species known or assessed as having the potential to occur in the study area were considered during the Assessments of Significance.

The Assessments of Significance was not applied to species that were either:

- Not found and habitat present on site was deemed unsuitable;
- The habitat present on site or within the adjacent area was found to be extremely small in size in contrast to the habitat available elsewhere in the locality;
- The subject site is outside a recognised known range; or
- Likelihood of occurrence was considered “unlikely”.

The threatened ecological communities and species that are the subject of 7-part tests for this proposal include:

Endangered Ecological Communities

- Sydney Turpentine-Ironbark Forest

Fauna

Aves

- Black Bittern
- Barking Owl
- Powerful Owl

Mammals

- Southern Brown Bandicoot
- Large-eared Pied Bat
- Eastern False Pipistrelle
- Eastern Bentwing Bat
- East Coast Freetail Bat
- Grey-headed Flying-fox

Sydney Turpentine Ironbark Forest Endangered Ecological Community (STIF)

Sydney Turpentine Ironbark Forest (STIF) is characterised with a canopy containing some or all of the following species: *Syncarpia glomulifera* (Turpentine), *Eucalyptus paniculata* (Grey Ironbark), *Angophora costata* (Smooth-barked Apple) and *Eucalyptus globoidea* (White Stringybark), and a grassy, herbaceous or shrubby understorey. The community originally existed as a forest but disturbance and clearing means that the community now predominantly exists as woodland or remnant trees.

a. in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at the risk of extinction.

This is not a threatened species.

b. in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction

This is not an endangered population.

c. in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

i. is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

STIF has been previously been mapped within and surrounding the study site (Tozer *et al.* 2006). This mapping was confirmed during the current field assessments. The vegetation in the study area was found to generally be in good condition, although a few weeds were present. The weeds were generally confined to area adjacent to the study site.

DECC estimates that 0.5% of the original extent of STIF community now remains (NSW Scientific Committee – updated 2011). No STIF vegetation will be removed as part of development works. The proposed vegetation removal will be limited to aquatic vegetation. Indirect effects may occur from the proposed works, including weed invasion, disease, water run-off and soil sedimentation. However, if the recommendations made within the report are adhered to then these impacts should be avoided.

ii. is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.

The proposal does not aim to remove vegetation characteristic of STIF. Given this, it is unlikely that the proposal will substantially and adversely impact upon the ecological community such that its local occurrence is likely to be placed at risk of extinction.

d. in relation to the habitat of a threatened species, population or ecological community:

i. the extent to which habitat is likely to be removed or modified as a result of the action proposed, and

The proposed works will not remove vegetation characteristic of STIF. However, the condition of some of the community may deteriorate if recommendations in this report are not adhered to.

ii. whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and

The proposed works will not remove vegetation characteristic of STIF STIF habitat surrounding the site forms a large continuous patch that is associated with Quarry Branch Creek. There are some isolated patches of remnant trees within the urban residential development. The proposal will not exacerbate the existing levels of fragmentation or isolation habitat that exist for STIF EEC.

iii. the importance of the habitat to be removed, modified, fragmented or isolated to the long term survival of the species, population or ecological community in the locality,

The proposed works will not remove vegetation characteristic of STIF. As such, the long-term survival of the EEC in the locality will be unaffected.

e. whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly),

There is no critical habitat for this EEC.

f. whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan,

There is currently no Recovery Plan or Threat Abatement Plan for the STIF EEC.

g. whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

A number of key threatening processes are relevant to this proposal with respect to STIF. These include:

- Clearing of native vegetation (TSC Act) / Land clearance (EPBC Act)
- Invasion and establishment of exotic vines and scramblers (TSC Act)
- Invasion, establishment and spread of *Lantana camara* (TSC Act)
- Invasion of native plant communities by exotic perennial grasses (TSC Act)

The proposed works involve the removal mixed native/exotic aquatic vegetation within the subject site, but will not remove vegetation characteristic of STIF. A VMP will be prepared to mitigate any long-term or indirect impact that the proposed works may have on the STIF. As such, the proposed works are not likely to increase the impact of any KTPs.

Conclusion of the 7 Part Test for Sydney Turpentine Ironbark Forest Endangered Ecological Community

The proposed works will not remove vegetation characteristic of STIF. Impacts associated with the current proposal are considered unlikely to have a significant impact on this community if recommendations in this report are followed.

Black Bittern (*Ixobrychus flavicollis*)

The Black Bittern is listed as vulnerable under the TSC Act. They have a wide distribution, from southern NSW north to Cape York and along the north coast to the Kimberley region. In NSW, records of the species are scattered along the east coast, with individuals rarely being recorded south of Sydney or inland.

Black Bitterns are cryptic species inhabiting both terrestrial and estuarine wetlands generally with permanent water and dense vegetation and littoral habitats. The species may occur in flooded grassland, forest, woodland, rainforest and mangroves (DECCW 2010a). This species forages along the edges of still or running water of permanent wetlands that are fringed by dense vegetation (Simpson and Day 2004).

Black Bitterns are generally solitary but will occur in pairs during the breeding season, from December to March. Nests are built in spring on branches that overhang the water and consist of a bed of sticks and reeds on a base of larger sticks. During the day, Black Bitterns roost in trees or on the ground amongst dense reeds. When disturbed they freeze or will fly up to a branch or flush for cover where it will freeze again (DECCW 2010a).

Key threats identified for the Black Bittern include (DECCW 2010a):

- Clearing of riparian vegetation.
- Predation by foxes and feral cats on eggs and juveniles.
- Grazing and trampling of riparian vegetation by stock.
- Drainage, salinisation, siltation and pollution of wetlands and water-bodies.
- Poor representation of preferred habitats in conservation reserves.

Suitable habitat for the Black Bittern is present within the study area in the form freshwater wetland with tall and dense vegetation. This species has the potential to forage and nest among dense vegetation present within the study area. Although, this species was not recorded within the study area during the surveys, the species was recorded in parts of western Sydney last spring, and we therefore, encourage a precautionary approach to the clearing aquatic vegetation on the site.

Black Bitterns are large mobile species and, if necessary, will move beyond the study area if disturbed. The works should be conducted outside the spring and summer breeding and nesting period, so not to disturb the maternal behaviour of the species or any dependant fledglings.

a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

The the aquatic habitat, that constitutes potential BIack Bittern habitat, will be removed as part of the works. The removal of this habitat may impact upon the potential foraging and nesting behaviour of the species. However, no Black Bittern were recorded in the area and considerable areas of potential habitat will remain within the locality, in the form of the riparian zone along Quarry Branch Creek.

Therefore, it is unlikely that the works will adversely impact on the lifecycle of this species to such a level that a viable population of this species would be placed at risk of extinction.

b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction

This is not an endangered population

c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

i. Is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

ii. Is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction

This is not an endangered ecological community.

d) in relation to the habitat of a threatened species, population or ecological community:

i. The extent to which habitat is likely to be remove or modified as a result of the action proposed, and

Potential BIack Bittern habitat in the study area will be removed and/or modified as part of the works. That is 0.5 ha aquatic habitat and 0.3ha terrestrial habitat.

ii. Whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and

Black Bitterns are a mobile species and, if necessary, will move throughout and beyond the study area. There are other waterways within the region that offer suitable habitat to the species. It is unlikely that the works will result in the fragmentation or isolation of habitats of this species.

iii. The importance of the habitat to be removed, modified, fragmented or isolated to the long term survival of the species, population or ecological community in the locality,

The proposal will result in the removal of the entire potential Black Bittern habitat from the site. The site is relatively small and, at best, would only support a nesting pair or a small population of the species. There are other areas of potential roosting and breeding habitat outside the study area along Quarry Branch Creek. Given the mobile nature of the species, the extent of clearing and presence of suitable habitat elsewhere in the region, it is unlikely that the species will be become isolated or fragmented.

e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly),

No critical habitat has been declared for this species.

f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan,

Currently no recovery plan or threat abatement plan for Black Bittern although there are two priority actions. The proposal does not conflict with any of these priority actions.

g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

A number of key threatening processes are relevant to this proposal with respect to the Black Bittern. These include:

- Clearing of native vegetation (TSC Act) / Land clearance (EPBC Act)
- Predation by the European Red Fox (*Vulpes vulpes*) (TSC Act and EPBC Act)
- Predation by the feral cat (*Felis catus*) (TSC Act and EPBC Act)
- Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands (TSC Act)
- Invasion and establishment of exotic vines and scramblers (TSC Act)
- Invasion, establishment and spread of *Lantana camara* (TSC Act)
- Invasion of native plant communities by exotic perennial grasses (TSC Act)
- Predation and hybridisation of feral dogs (*Canis lupus familiaris*) (TSC Act)

The proposal involves the removal aquatic vegetation within the study area.

Conclusion of the 7 Part Test for Black Bittern

The proposal is unlikely to have a significant impact on the Black Bittern for the following reasons:

- Areas of known and potential habitat present elsewhere within and extending beyond the boundary of the study area, and
- The proposal would not isolate or fragment any currently connecting areas of habitat particularly given this species is highly mobile.

Barking Owl (*Ninox connivens*)

Barking Owls are found throughout Australia except for the central arid regions and Tasmania. The species is quite common in parts of northern Australia, but is generally considered uncommon in southern Australia. It has declined across much of its distribution across NSW and now occurs only sparsely. It is most frequently recorded on the western slopes and plains. It is rarely recorded in the far west or in coastal and escarpment forests. This species inhabits eucalypt woodland, open forest, swamp woodlands and, especially in inland areas, timber along watercourses. Dense vegetation is used occasionally for roosting. During the day they roost along creek lines, usually in tall understorey trees with dense foliage such as *Acacia* and *Casuarina* species, or the dense clumps of canopy leaves in large Eucalypts. Territories range from 30 to 200 hectares and birds are present all year. Three eggs are laid in nests in hollows of large, old eucalypts including *Eucalyptus camaldulensis* (River Red Gum), *Eucalyptus albens* (White Box), *Eucalyptus polyanthemos* (Red Box) and *Eucalyptus blakelyi* (Blakely's Red Gum) (NPWS 2003).

a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

The Barking Owl has the potential to forage across the survey site, but is unlikely to nest or breed within the site due to a generally absence of suitable large tree hollows. The proposed development will result in the removal of aquatic vegetation from the disused quarry on the site. No trees that have been identified as important roosting, foraging or nesting activities are to be removed or impacted upon by the proposed works.

Given that this species is highly mobile, the type of habitat proposed for removal and lack of suitable nesting habitat within the study site, it is unlikely that the proposal would impact on this species such that it would place a local population at risk of extinction.

b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction

This is not an endangered population.

c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

- **i. is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or**
- **ii. is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.**

This is not an endangered ecological community.

d) in relation to the habitat of a threatened species, population or ecological community:

i. the extent to which habitat is likely to be removed or modified as a result of the action proposed, and

As previously stated, the proposed development will result in the removal of aquatic vegetation from the disused quarry. No trees identified as important roosting, foraging or nesting activities are to be removed or impacted upon by the proposed works. This species is highly mobile and it is unlikely that the proposed habitat removal would impact upon this species.

ii. whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and

The removal of the aquatic habitat is unlikely to lead to the fragmentation or isolation of habitat for this species.

the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality,

The removal of the aquatic habitat is unlikely to affect the long-term survival of the highly mobile Barking Owl.

e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly),

No critical habitat of this species has been identified by the Director-General of the National Parks & Wildlife Service on the Register of Critical Habitat for Barking Owl.

f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan,

A recovery plan for Barking Owl has been prepared. The overall objective of the plan is to recover the species to a position of viability in nature in NSW. It is thought that this will be achieved by implementing actions under five specific objectives which increase understanding and awareness of the species, undertake threat abatement and mitigation and which allow for efficiencies and coordination of the plan (NPWS 2003).

The five objectives are:

- Increase understanding of the biology, ecology and management of Barking Owl;
- Increase education and awareness of and involvement in the conservation of Barking Owl and its habitat in NSW;
- Undertake threat abatement and mitigation;
- Gain efficiencies through links with other conservation plans and conservation groups; and
- Provide organisational support.

Nine strategies made up of 17 priority actions have also been identified for this species (NPWS 2003).

The proposal does not conflict with any of the objectives outlined in the recovery plan or the priority actions.

g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

Key threatening processes of relevance to Barking Owl include the clearing of native vegetation and loss of hollow bearing trees.

The proposed development will not result in the clearing of native vegetation that constitutes suitable habitat for the species. Therefore, it is unlikely that the proposal would exacerbate any key threatening processes to such an extent that they would place any local populations of this species at risk of extinction.

Conclusion of the 7 Part Test for Barking Owl

The proposed development is unlikely to significantly impact Barking Owl given that the proposed works:

- The proposed works will result in the removal of aquatic vegetation from the study area.
- No potential nesting habitat would be impacted.
- This species is highly mobile and forages widely.
- The proposal would not isolate habitat for this species.
- Potential habitat for this species would remain within the study area, directly adjacent to the site and is present throughout the locality.

On the basis of the above considerations, it is unlikely that the proposed development will result in a significant effect on Barking Owl. Consequently, a Species Impact Statement is not required.

Powerful Owl (*Ninox strenua*)

Powerful Owl was recorded within the survey site on multiple occasions. They were observed roosting among the larger trees present within and surrounding the survey site.

Powerful Owl (*Ninox strenua*) is listed as a vulnerable species under Schedule 2 of the TSC Act. It is endemic to eastern and south-eastern Australia, mainly on the coastal side of the Great Dividing Range from Mackay to south-western Victoria and occurs at low densities. In NSW it is widely distributed throughout the eastern forests from the coast inland to tablelands, with scattered, mostly historical records on the western slopes and plains (DECC 2006).

Powerful Owl occurs primarily in densely vegetated gullies of open and tall open forest, but they are also found in a wider range of habitats, including forests and woodlands within the metropolitan regions of cities. However, optimal habitat requires large tracts of forest or woodland habitat, including a tall shrub layer and abundant hollows supporting high densities of arboreal marsupial prey species.

This species roosts in dense mid-canopy trees (such as Turpentine, She-oaks and rainforest trees), or tall shrubs in sheltered gullies, typically on wide creek flats and at the heads of minor drainage lines. Nesting occurs in large hollows (greater than 45 cm wide and greater than 100 cm deep) in eucalypts in unlogged, unburnt gullies and lower slopes within 100 m of streams or minor drainage lines. Nest trees are typically emergent, and are often the largest and oldest in a stand. Powerful Owl are faithful to traditional nesting hollows but can also use other hollows within the nesting gully (DECC 2006).

Pairs of birds occupy large home ranges (300-1500 ha), utilising various portions of this area at different times, depending on the local abundance of arboreal mammals as a food source. Powerful Owl prey particularly on the Greater Glider and Ringtail Possum although the relative importance of prey items appears to vary regionally, with other prey such as Sugar Gliders, Brushtail Possums, Grey-headed Flying-foxes, insects and birds also used (Cooke *et al.* 2005).

This species is threatened by a number of processes including loss and fragmentation of suitable forest and woodland habitat from land clearing for residential and agricultural development, which also affects the populations of arboreal prey species. Other threats include loss of hollow-bearing trees suitable for nesting, disturbance around nest sites (particularly during pre-laying, laying and downy chick stages), high frequency hazard reduction burning (affecting prey availability), secondary poisoning, road kills, and predation of fledglings by foxes, dogs and cats.

Eco Logical Australia (ELA) Senior Ecologist, Dr. David Bain has assisted in considering the considered the impact of the proposed works on the Powerful Owl. Dr. Bain has worked extensively with the Powerful Owl including as BirdLife Australia's Powerful Owl Project Officer.

(a) In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Factors likely to have an adverse effect on the life cycle of the Powerful Owl include a substantial loss and/or fragmentation of foraging habitat, loss of suitable nesting and roosting habitat, disturbance around nest sites (particularly during pre-laying, laying and downy chick

stages), high frequency hazard reduction burning (affecting prey availability), secondary poisoning, road kills, and predation of fledglings by foxes, dogs and cats (McNabb 1996; DEC 2006)

The proposed development will result in the removal of aquatic vegetation from the disused quarry. No trees identified as important roosting, foraging or nesting habitat will be removed or impacted upon by the proposed works.

No hollows of sufficient size to support breeding were located during the survey. Powerful Owl use large hollows (greater than 45 cm wide and greater than 100 cm deep) in eucalypts in unlogged, un-burnt gullies and lower slopes within 100 m of streams or minor drainage lines.

The home range of the Powerful Owls found on-site already likely incorporate built up areas, especially as the roosting sites identified during site surveys were in adjacent backyards. As such, it is unlikely increased light will have an impact. In addition, Powerful Owl territories are large, up to 1000ha but more likely about 300-400ha in Sydney. The loss of up 0.3ha of potential foraging habitat for one pair is not considered a significant impact on the species.

Increases in fox/cat numbers (which may occur under the proposed development) may potentially impact on Powerful Owls. However, this is mainly a concern near the breeding hollows when juveniles are learning to fly. Once they can fly and move away from the nest hollow then this is not a significant issue. As no breeding areas found nearby, this unlikely to have a significant impact

Powerful Owls will only take prey from within a tree – not off the ground. If no trees are present then foraging habitat is not present. This means the quarry area itself is not potential foraging habitat. The majority of the existing foraging habitat, the bushland to the west of the proposed development, is not being impacted. In addition, the urban dwelling Powerful Owls are quite used to and adept at foraging in proximity to urban development (e.g. taking prey from house roofs, etc.) Therefore it is unlikely that the proposed development would make the area less attractive for foraging.

Ringtail Possums (*Pseudocheirus peregrinus*) are the favoured prey for the species. However, Powerful Owls are considered generalist predators and will take what is available. This means if habitat for Ringtail Possums is impacted the resident owls are likely to forage for something else. Incidentally, Black Rat (Rattus rattus) not considered a significant prey species as the largest proportion in any dietary analysis is about 0.2%.

The habitat surrounding Moxham Quarry is continuous with a large bushland corridor which may provide important resources for a local population. Thus, it is unlikely that the loss of aquatic vegetation from Moxham Quarry will significantly disrupt the life cycle of the species such that a viable local population is placed at risk of extinction.

(b) In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.

Not applicable.

(c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,

Not applicable.

(d) in relation to the habitat of a threatened species, population or ecological community:

(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and

The proposed development will result in the removal of aquatic vegetation and small amount of terrestrial vegetation, which does not represent habitat for the species. Therefore, the proposed will not result in the removal habitat for this species.

(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and

The proposed development will result in the removal of aquatic vegetation and small amount of terrestrial vegetation, which is unlikely to lead to the fragmentation or isolation of habitat for this species.

(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality,

The proposed development will result in the removal of aquatic vegetation and small amount of terrestrial vegetation is unlikely to affect the long-term survival of the highly mobile Powerful Owl.

(e) Whether the action proposed is likely to have an adverse effect on critical habitat.

No critical habitat for this species has been identified.

(f) Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

A recovery plan for the Large Forest Owls, including the Powerful Owl, was produced by the former Department of Environment and Conservation with the following objectives or actions:

1. Model and map owl habitat and validate with surveys;
2. Monitor owl population parameters;
3. Audit forestry prescriptions;
4. Manage and protect habitat off reserves and state forests;
5. Undertake research;
6. Increase community awareness and involvement in owl conservation; and
7. Provide organisational support and integration.

The proposal is unlikely to impact on the objectives of the recovery plan for this species.

(g) The action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

Key threatening processes for Powerful Owl include the clearing of native vegetation and loss of hollow bearing trees.

The proposal will not result in the clearing of native vegetation that constitutes suitable habitat for the species. Clearing is limited to the aquatic vegetation in the disused quarry.

Conclusion of the 7 Part Test for Powerful Owl

The proposed development is unlikely to significantly impact Powerful Owl given that:

- The proposed works will only result in the removal of aquatic vegetation from the study area.
- No potential nesting habitat would be impacted.
- This species is highly mobile and forages widely.
- The proposal would not isolate habitat for this species.
- Potential habitat for this species would remain within the study area, directly adjacent to the site and is present throughout the locality.

On the basis of the above considerations, it is unlikely that the proposal will result in a significant effect on Powerful Owl. Consequently, a Species Impact Statement is not required.

Southern Brown Bandicoot (*Isoodon obesulus obesulus*)

The Southern Brown Bandicoot is listed as an endangered species under the TSC Act and the EPBC Act. It has a patchy distribution, being found in south-eastern NSW, east of the Great Dividing Range south from the Hawkesbury River, southern coastal Victoria and the Grampian Ranges, south-eastern South Australia, south-west Western Australia and the northern tip of Queensland.

The species is generally found in heath or open forest with a heathy understorey on sandy or friable soils. Males have a home range of approximately 5-20 ha whilst females forage over smaller areas of about 2-3 ha. The species nest during the day in a shallow depression in the ground covered by leaf litter, grass or other plant material. Nests may be located under Grass trees *Xanthorrhoea* sp., blackberry bushes and other shrubs, or in rabbit burrows.

Southern Brown Bandicoot feed on a variety of ground-dwelling invertebrates and the fruit-bodies of hypogeous (underground-fruiting) fungi. Their searches for food often create distinctive conical holes in the soil (Paull 2008: DECC 2010).

Threats to the species include loss and fragmentation of habitat, burning regimes that impact on understorey species and floristic structure, and predation by cats, dogs and foxes.

Southern Brown Bandicoot has not been detected during extensive targeted field surveys across the local area, although there are records of the species within 10 km of the subject site. There are significant areas of apparently suitable habitat for the species in the local area.

a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at the risk of extinction.

The species was not recorded during the survey. However, foraging digs typical of foraging bandicoots were located within the study site. The proposed development will result in the removal and modification of approximately 0.5 ha of aquatic vegetation and 0.3 ha of associated terrestrial vegetation that is unlikely to provide critical foraging and breeding habitat for the species. The species may use the wooded areas that constitute the STIF EEC, within and surrounding the study site. As a consequence, they are unlikely to be impacted by the proposed works. Furthermore, considerable areas of potential habitat surrounding the site, including the vegetation that is associated with Quarry Branch Creek has the potential to provide habitat for the species.

Consequently, it is concluded that the proposal would not place a viable local population at risk of extinction.

b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction

Not applicable.

c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

i. is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

ii. is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.

Not applicable.

d) in relation to the habitat of a threatened species, population or ecological community:

i. the extent to which habitat is likely to be removed or modified as a result of the action proposed, and

The proposal will remove approximately 0.5 ha of aquatic vegetation and 0.3 ha of terrestrial vegetation that is unlikely to be critical foraging and breeding habitat for the species. Based on previous assessments undertaken in the area, there is potential habitat for the Southern Brown Bandicoot along Quarry Branch Creek and associated parks and reserves.

ii. whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and

The area of potential habitat is unlikely to fragment or isolate any areas of potential habitat or affect any presently connected patches of potential habitat. As such, the loss of habitat will not result in the fragmentation or isolation of foraging habitat for Southern Brown Bandicoot.

iii. the importance of the habitat to be removed, modified, fragmented or isolated to the long term survival of the species, population or ecological community in the locality,

The habitat to be removed is not of particular or unique value for Southern Brown Bandicoot (i.e. restricted breeding habitat or an essential movement corridor). The removal of a small area of potential habitat is not likely to affect the long-term survival of the species in the locality, if it is present.

e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly),

Critical habitat has not been declared for the Southern Brown Bandicoot.

f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan,

A Recovery Plan has been prepared for the Southern Brown Bandicoot (DEC 2010a) and includes the following objectives and actions:

1. To continue a statewide recovery team and regional groups to enable efficient implementation of the recovery program;
2. To identify and implement land management practices that assist in the recovery of the species (actions include intensive predator control, establish mortality registers, ensure informed environmental assessment and planning decisions are made);

3. Clarify the status of the species by better defining its distribution and relative abundance;
4. Undertake research to broaden the knowledge base; and
5. Improve community awareness of the conservation significance of the species.

g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

The removal of potential habitat constitutes a threatening process as per the Recovery Plan for the species. However, the proposal is unlikely to impact on core habitat for the species such that it will place the species at risk of local extinction. A large continuous patch of potential habitat for the species exists in the surrounding area.

Conclusion of the 7 Part Test for Southern Brown Bandicoot

Whilst some potential habitat for Southern Brown Bandicoot will be impacted by the proposal, a significant area of similar, contiguous potential habitat remains available for the species in the locality. The extent of habitat in the local area should enable a local population to carry out normal life cycle processes and thus a local population would not be placed at risk of extinction. Furthermore, the proposed development will not isolate or fragment an area of known habitat from currently interconnecting areas of potential habitat for this species.

Therefore, it is unlikely that the proposed development will significantly effect Southern Brown Bandicoot. Consequently, the proposed development will not significantly impact Southern Brown Bandicoot.

Microchiropteran bats

The four microchiropteran bat species have been grouped together for the Assessment of Significance as the predicted impacts are similar. Where considerable differences occur, each species is discussed separately.

Large-eared Pied-bat (*Chalinolobus dwyeri*)

The Large-eared Pied Bat is listed as vulnerable under Schedule 2 of the TSC Act. It is a small to medium-sized bat with long, prominent ears and glossy black fur. The lower body has broad white fringes running under the wings and tail-membrane, meeting in a V-shape in the pubic area. The species 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 (Hoye and Shultz 2008).

Large-eared Pied Bat roosts in caves (near their entrances), crevices in cliffs, old mine shafts and in the disused, bottle-shaped mud nests of the *Hirundo ariel* (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.

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 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 (Hoye and Shultz 2008).

The threats to this species include clearing and isolation of forest and woodland habitats near cliffs, caves and old mine workings for agriculture or development; loss of foraging habitat close to cliffs, caves and old mine workings from forestry activities; too-frequent burning, usually associated with grazing; damage to roosting and maternity sites from mining operations, and recreational caving activities; and use of pesticides

Large-eared Pied Bat was recorded during the field survey. Impacts are possible due to the clearing of potential foraging habitat on site.

Eastern False Pipistrelle (*Falsistrellus tasmaniensis*)

The Eastern False Pipistrelle was recorded within the study site. This species is a highly mobile species preferring to forage in wet sclerophyll forest to open forest, where trees are greater than 20 m in height (Hoye *et al*., 2008; Churchill 2008). The species has been found to roost in tree hollows and hollow trunks of eucalypt trees, though observations of roosts in caves and buildings have also been observed. Most roosts comprise colonies of three to 80 individuals, with research indicating that roost swapping is frequent (Hoye *et al*., 2008; Churchill 2008).

Eastern Bentwing Bat (*Miniopterus schreibersii oceanensis*)

Eastern Bentwing Bat are generally associated with a range of habitats such as rainforest, wet and dry sclerophyll forest, monsoon forest, open woodland, paperbark forests and open grassland (Churchill 2008). It forages above and below the tree canopy on small insects (Hall

and Hall 2008). This species is known to utilise caves, old mines, and stormwater channels, under bridges and occasionally buildings for shelter (Hall and Hall 2008).

East Coast Freetail Bat (*Mormopterus norfolkensis*)

The East coast Freetail Bat was recorded within the study site. Most records of this species are from dry eucalypt forest and woodland east of the Great Dividing Range (Churchill 2008). Individuals have, however, been recorded flying low over a rocky river in rainforest and wet sclerophyll forest and foraging in clearings at forest edges (Hoye *et al.* 2008)). Primarily roosts in hollows or behind loose bark in mature eucalypts, but have been observed roosting in the roof of a hut (Hoye *et al.* 2008).

The East Coast Freetail Bat is a mobile species preferring to forage in forest openings and gaps usually within 3-6km of a roost (Hoye *et al*., 2008; Churchill 2008). The species has been found to roost in tree hollows, usually in spouts of large mature trees, however, individuals have been recorded roosting in buildings, under metal caps of power poles and have been successfully recorded using bat boxes (a colony in NSW has been monitored in the same boxes for over 5 years) (Hoye *et al*., 2008; Churchill 2008).

a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at the risk of extinction.

Large-eared Pied Bat, Eastern False Pipistrelle and East Coast Freetail Bat were recorded during the survey.

Factors likely to have an adverse effect on the life cycle of these four bat species would include a substantial loss and/or fragmentation of foraging habitat near cliffs, damage of suitable roosting or breeding habitat, too frequent fire, and recreational caving activities. It is unlikely that the site provides roosting, shelter or breeding habitat in the form of caves, hollow bearing trees or rock crevices. Therefore, the breeding potential of these species is unlikely to be affected.

The proposal will result in the removal and modification aquatic and terrestrial vegetation that may constitute potential foraging habitat for these species. The aquatic environmental potentially supports a variety of invertebrate prey species for these micro-bat species. The loss of potential foraging habitat is expected to be minimal when considering the large undisturbed areas of potential habitat available in the surrounding landscapes. Thus, it is unlikely that the loss of vegetation will significantly disrupt the life cycle of the species such that a viable local population is placed at risk of extinction.

b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction

None of these bats species constitute an endangered population and, therefore, this question does not apply.

c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

i. **is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or**

ii. **is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.**

Not applicable.

d) in relation to the habitat of a threatened species, population or ecological community:

i. **the extent to which habitat is likely to be removed or modified as a result of the action proposed, and**

The proposal will result in the removal of 0.5 ha of aquatic vegetation. A small part of the quarry consists of open water, which represents a potential drinking resource for this speices. The rest of the quarry site (including the 0.3ha of terrestrial vegetation) represents foraging habitat that supports a variety of insect prey species. The loss of potential foraging habitat is expected to be minimal when considering the large undisturbed areas of potential habitat available in the surrounding landscape, including vegetation along Quarry Branch Creek. These areas would be expected to contain a higher density of resources for these species.

ii. **whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and**

Habitat to be removed is unlikely to isolate any currently interconnected areas of potential habitat for these highly mobile species. As such, the removal of habitat will not result in the fragmentation or isolation of foraging habitat for any of these species.

iii. **the importance of the habitat to be removed, modified, fragmented or isolated to the long term survival of the species, population or ecological community in the locality,**

The vegetation to be removed is unlikely to isolate any currently interconnected areas of potential habitat for these highly mobile species. Better quality, interconnected habitat for these four species remains in adjacent areas. The primary roosting habitat in the form of caves, hollow bearing trees, culverts or bridges are not present on site. Therefore the modification of the small amount of habitat is not likely to affect the long-term survival of microbats in the locality.

e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly),

No critical habitat for microbats has been identified on the Register of Critical Habitat.

f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan,

No recovery plan or threat abatement plan has been prepared for Large-eared Pied Bat, Eastern False Pipistrelle, Eastern Bent-winged Bat or East Coast Freetial Bat. However, there are a number of strategies and subsequent Priority Actions have been identified to help manage and recover each species. One of the priority actions common across these species is the retention of hollow-bearing trees, maintaining diversity of age groups, species diversity and structural diversity. The current development is not in conflict with this priority action, however, the development does involve the removal of hollow-bearing trees.

g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

Several key threatening processes are relevant to the microbats on site, as follows:

1. The proposal will result in the modification of the subject site and the removal of some exotic vegetation, which is considered to represent a marginal cumulative contribution to the Key Threatening Process: 'clearing of native vegetation'.
2. The proposal involves the removal of no hollow-bearing trees.
3. 'Removal of dead wood and dead trees' is a KTP that the proposal will cumulatively contribute to through the removal of dead stags within the proposed subdivision.

Conclusions

The proposal is unlikely to significantly affect the four microbat species given that:

- The proposed works would only remove a small area of foraging habitat within the study area;
- Pre-clearing surveys and the presence of an ecologist during clearing should minimise direct mortality during construction;
- Would not isolate an area of known habitat from currently interconnecting areas of potential habitat for this species; and
- Larger areas of more suitable foraging habitat are present within surrounding land.

On the basis of the above considerations, it is not likely that the proposed development will significantly affect the survival of these four species. Consequently, a Species Impact Statement is not required.

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

Grey-headed flying-fox was recorded during the survey. Several individuals were recorded flying over the site. One individual was recorded roosting within the study area. Grey-headed flying-fox are highly mobile and it is likely that this individual using the site to undertake a short term rest.

This species inhabits a wide range of habitats including rainforest, mangroves, paperbark forests, wet and dry sclerophyll forests and cultivated areas (Churchill 2008). Camps are often located in gullies, typically close to water, in vegetation with a dense canopy (Churchill 2008).

a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction,

The impact area provides potential short term foraging and refuge but not roosting habitat for the species. There is no evidence that the site supports a camp and there are no known camps close by (Roberts 2006). The vegetation to be removed or modified during the proposed works represents a small amount of foraging habitat and no roosting habitat. Therefore, it is unlikely that the proposed works will have an adverse effect on the life cycle of the Grey-headed Flying-fox such that a viable local population would be placed at the risk of extinction.

b) ***in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.***

No endangered populations occur in the study area.

c) ***In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:***

i) Is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction; or

ii) Is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.

This is not an EEC.

d) ***In relation to the habitat of a threatened species, population or ecological community.***

i) The extent to which habitat is likely to be removed or modified as a result of the action proposed;

The proposal will result in the removal of 0.5 ha of aquatic vegetation and 0.3ha of terrestrial vegetation that constitutes potential foraging but not roosting habitat for Grey-headed Flying-fox.

ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and

Grey-headed Flying-fox is a highly mobile species capable of traversing large distances (up to 50 km) including over cleared land. The parcel of vegetation proposed for removal is located on the edge of a large tract of remnant vegetation. The loss of habitat from this site will not lead to the creation of additional fragmented parcels of habitat.

iii) The importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.

The impact area is considered potential foraging but not roosting habitat for the Grey-headed Flying-fox. However, the impact area is not considered important foraging habitat as it contains low vegetation that is less that 2-3m in height, while GHFF generally only roost among trees that are 8-10m in height (DEC 2007)

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

No areas identified under the TSC Act as 'critical habitat' will be affected by the proposed activity.

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

A draft national recovery plan has been prepared for the Grey-headed Flying–fox. No NSW recovery plan or threat abatement plans have been prepared for this species although a number of guidelines specific to the habitat requirements of the grey-headed flying-fox have been prepared. Ten strategies comprising of 31 priority actions have been identified to help recover this species (DECC 2008).

The proposal does not conflict with any of the priority actions identified and is not contrary to the objectives and actions of the national *Grey-Headed Flying-Fox Recovery Plan*.

g) Whether the action proposed constitutes or is part of a Key Threatening Process (KTP)

There are several KTP's are relevant to this species on the site, as follows:

1. The proposal will result in the modification of the subject site and the removal of some trees, which is considered to represent a marginal cumulative contribution to the Key Threatening Process: 'clearing of native vegetation'.
2. The proposal involves the removal of no hollow-bearing trees.

Conclusions

The proposed development is unlikely to impose a significant effect on Grey-headed Flying-fox given that:

- The proposed works will not remove any roosting and only a small amount of foraging habitat.
- The proposed works will not result in the isolation of known habitat from currently interconnecting areas of potential habitat for this species.
- No camps exist in the region that will be impacted upon by the propose works.
- Larger areas of suitable foraging habitat are present within surrounding region.

On the basis of the above considerations, it is unlikely that the proposal will result in a significant effect on Grey-headed Flying-fox. Consequently, a Species Impact Statement is not required.

Appendix E

EPBC ACT SIGNIFICANCE ASSESSMENTS

The EPBC Act Administrative Guidelines on Significance set out **'Significant Impact Criteria'** that are to be used to assist in determining whether a proposed action is likely to have a significant impact on matters of national environmental significance. Matters listed under the EPBC Act as being of national environmental significance include:

- Listed threatened species and ecological communities
- Listed migratory species
- Wetlands of International Importance
- The Commonwealth marine environment
- World Heritage properties
- National Heritage places
- Nuclear actions

Specific **'Significant Impact Criteria'** are provided for each matter of national environmental significance except for threatened species and ecological communities in which case separate criteria are provided for species listed as endangered and vulnerable under the EPBC Act. All species known or assessed as having the potential to occur in the study area were considered during the Significance Assessmemnts.

The Significance Assessments was not applied to species that were either:

- Not found and habitat present on site was deemed unsuitable;
- The habitat present on site or within the adjacent area was found to be extremely small in size in contrast to the habitat available elsewhere in the locality;
- The subject site is outside a recognised known range; or
- Likelihood of occurrence was considered "unlikely".

Threatened and migratory species and communities listed under the EPBC Act that are considered likely or potentially to occur within the study area are:

- Turpentine-Ironbark Forest in the Sydney Basin Bioregion;
- *Pteropus poliocephalus* (Grey-headed Flying-fox);
- *Chalinolobus dwyeri* (Large-eared Pied Bat); and
- *Rhipdura rufifrons* (Rufous Fantail).

The relevant Significant Impact Criteria have been applied to these threatened and migratory species to determine the significance of impact of the project.

MATTERS TO BE ADDRESSED	IMPACT (COMMONWEALTH LEGISLATION)
a. any environmental impact on a World Heritage Property;	No
b. any environmental impact on Wetlands of International Importance;	The proposal will not affect any part of RAMSAR wetland.
c. any impact on Commonwealth Listed Critically Endangered or Endangered Species;	No
d. any impact on Commonwealth Listed threatened Species;	Yes. Two Commonwealth listed vulnerable species are considered potential or likely to occur in the study area: • Grey-headed Flying-fox (*Pteropus poliocephalus*) • Large-eared Pied Bat (*Chalinolobus dwyeri*) The significant impact criteria in terms of the vulnerable species are discussed below: Grey-headed Flying-fox (*Pteropus poliocephalus*) *a. lead to a long-term decrease in the size of an important population of a species,* The habitat on the site does not represent an area critical for the long-term survival of these species. The loss of approximately 0.3 ha of potential foraging habitat for this species is not considered to lead to a long-term decrease in any population size in the area due the small extent of the removed habitat and the proximity of a large amount of remnant bushland. *b. reduce the area of occupancy of an important population* Only a small area of habitat will be removed and no hollows removed. The proposal will not reduce the area of occupancy for an important population of this species. The species have not been recorded on the site and significant areas of habitat exist in the adjacent land. *c. fragment an existing important population into two or more populations* The proposed clearing will not further increase the fragmentation of any populations. *d. adversely affect habitat critical to the survival of a species*

MATTERS TO BE ADDRESSED	IMPACT (COMMONWEALTH LEGISLATION)
	No habitat on site is considered to be critical to the survival of either species. *e. disrupt the breeding cycle of an important population* The site does not contain breeding habitat for the Grey-headed Flying-fox. As the site is not considered to contain any important populations, this proposal will not cause any disruption to the breeding cycle of an important population. *f. modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline* The proposal requires the removal of approximately the loss of approximately 0.3ha of potential Grey-headed Flying-fox habitat and it is not expected to cause a decline in the species in this area. *g. result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat* The proposal will not increase the risk from invasive species. *h. introduce disease that may cause the species to decline* The proposal will not lead to the introduction of a disease that may cause these species to decline at the site. *i. interferes substantially with the recovery of the species.* As the proposal is not considered to decrease or fragment existing populations, the recovery of the species will not be substantially impacted Large-eared Pied Bat (*Chalinolobus dwyeri*) *a. lead to a long-term decrease in the size of an important population of a species,* The habitat on the site does not represent an area critical for the long-term survival of these species. The loss of approximately 1.3 ha of potential foraging habitat for this species is not considered to lead to a long-term decrease in any population size in the area due the small extent of the removed habitat and the proximity of a large amount of remnant bushland. *b. reduce the area of occupancy of an important population* Only a small area of habitat will be removed and no hollows removed. The proposal will not reduce the area of occupancy for an important population of this species. The species have not been recorded on the site and significant areas of habitat exist in the adjacent land.

MATTERS TO BE ADDRESSED	IMPACT (COMMONWEALTH LEGISLATION)
	c. fragment an existing important population into two or more populations The proposed clearing will not further increase the fragmentation of any populations. *d. adversely affect habitat critical to the survival of a species* No habitat on site is considered to be critical to the survival of either species. *e. disrupt the breeding cycle of an important population* The site does not contain breeding habitat for the Large-eared Pied Bat, As the site is not considered to contain any important populations, this proposal will not cause any disruption to the breeding cycle of an important population. *f. modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline* The proposal requires the removal of approximately the loss of approximately 1.3ha of Large-eared Pied Bat habitat and it is not expected to cause a decline in the species in this area. *g. result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat* The proposal will not increase the risk from invasive species. *h. introduce disease that may cause the species to decline* The proposal will not lead to the introduction of a disease that may cause these species to decline at the site. *i. interferes substantially with the recovery of the species.* As the proposal is not considered to decrease or fragment existing populations, the recovery of the species will not be substantially impacted
e. Any impact on a Commonwealth Listed Critically Endangered or Endangered Ecological Community;	Yes, one Commonwealth listed Critically Endangered Ecological Community is considered likely to occur in the study area: • Turpentine-Ironbark Forest in the Sydney Basin Bioregion *An action is likely to have a significant impact on a critically endangered or endangered ecological community if there is a real chance or possibility that it will:* *a. reduce the extent of an ecological community* None of the CEEC will be removed as part of works. The edge of the community has been precisely mapped and the works will not encroach on this edge. *b. fragment or increase fragmentation of an ecological community, for example*

MATTERS TO BE ADDRESSED	IMPACT (COMMONWEALTH LEGISLATION)
	by clearing vegetation for roads or transmission lines The proposed works will be on the edge of the community and will not fragment it. *c. adversely affect habitat critical to the survival of an ecological community* As none of the CEEC is being removed, no habitat critical to its survival is being removed. *d. modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns* The quarry adjacent to the CEEC is being removed, but permanent water will remain in the form of a small channel separating the development from the CEEC. *e. cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting* The CEEC on site already exists on the fringe of urban development, however the proposed development will bring this closer. However, if management actions recommended in this report are followed, the indirect impacts from this proximity will be mitigated. *f. cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to:* • *assisting invasive species, that are harmful to the listed ecological community, to become established, or* • *causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community, or* The proposed development will not cause a substantial reduction in the quality or integrity of this CEEC, provided the indirect effects are mitigated as recommended in this report. g. *interfere with the recovery of an ecological community.* The proposed works will not remove any vegetation characteristic of STIF. As such, the proposed development will not interfere with the recovery of this CEEC
h. any environmental impact on Commonwealth Listed Migratory	Yes. one Commonwealth listed migratory species are considered likely to occur in the study area: • Rufous Fantail *(Rhipdura rufifrons)*

MATTERS TO BE ADDRESSED	IMPACT (COMMONWEALTH LEGISLATION)
Species;	The guidelines in terms of the migratory species are discussed below: *a. substantially modify (including fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat of the migratory species* The proposal will not substantially modify, destroy or isolate an area of important habitat for the Rufous Fantail as: • The proposal involves only a minimal removal of habitat or potential habitat on the periphery of large remnants. • This species is capable of flying large distances and thus the proposed fragmentation will not isolate habitat for these species. *b. result in invasive species that is harmful to the migratory species becoming established in an area of important habitat of the migratory species* The proposal will not introduce or facilitate an invasive species that is harmful to this species in an area of important habitat or otherwise. *c. seriously disrupt the lifecycle (breeding, feeding, migration or nesting behaviour) of an ecologically significant proportion of the population of the species.* The proposal is unlikely to disrupt the lifecycle of an ecologically significant proportion of the population of a migratory species for the following reasons: • The proposal involves minor impacts to a small area of habitat or potential habitat for the Rufous Fantail. The vegetation to be removed is considered to provide only a portion of foraging habitat for the Rufous Fantail, not considered an ecologically significant portion of the species • The proposal involves minor impacts to a small area of habitat or potential habitat for the Rufous Fantail. The vegetation to be removed is considered to provide only a portion of foraging habitat for the Rufous Fantail, not considered an ecologically significant portion of the species
i. does any part of the Proposal involve a Nuclear Action;	No. The project does not include a Nuclear Action.
j. any environmental impact on a Commonwealth	No. There are no Commonwealth Marine Areas within the study area.

MATTERS TO BE ADDRESSED	IMPACT (COMMONWEALTH LEGISLATION)
Marine Area;	
k. In addition, any direct or indirect impact on Commonwealth lands	No. The project does not directly or indirectly affect Commonwealth land.

CONCLUSION OF EPBC ACT ASSESSMENT

It is unlikely that the development will significantly impact on these threatened or migratory species. None of the listed CEEC will be removed as part of the proposed works and the site provides only marginal foraging or roosting habitat for the assessed fauna species. In addition, the level of habitat removal will be negligible in the context of the available habitat in the locality. Referral to the Commonwealth under the EPBC Act would not be recommended.

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11SUTECO-0089

26 September 2013

Dear Len,

Impact of hydrology changes on environmental values at the former Moxham Quarry, Northmead

The Sydney West Joint Regional Planning Panel (JRPP) has recently been asked to consider whether a proposal to amend Schedule 1 of the Parramatta Local Environment Plan (LEP) 2011 to allow multi-dwelling housing and residential flat buildings up to a maximum of five stories at 166A Windsor Rd, Northmead should be submitted for a Gateway determination. The JRPP found that further information on some matters was required prior to a Gateway decision. Specifically, the JRPP required more detail on the significance of riparian areas on-site and the impact of the proposed works. As such, Eco Logical Australia (ELA), who previously prepared the Flora and Fauna Assessment (FFA) for the proposed works (2012), has been asked to summarise the impact of works on the riparian environmental values of the site.

One issue raised during the JRPP was whether the quarry area represented an 'ecologically valued wetland'. This can be answered in a few ways:

- The former Moxham Quarry is **not** listed as a protected wetland under any state or commonwealth registers, including RAMSAR, Wetlands of National Significance or SEPP 14 (NSW).
- As part of the FFA (ELA 2012), the significance of the loss of the riparian aquatic habitat to state and commonwealth listed threatened species, including wetland species, was assessed. It was determined that the former Moxham Quarry did **not** represent important habitat for any wetland species and as such, the proposed reduction of riparian area did not represent a significant impact on any wetland species.
- However, under the *Water Management Act 2000* (WM Act), the former Moxham Quarry **is** considered a 4th order watercourse and as such, 'waterfront land'.

Under the WM Act, waterfront land includes the bed and bank of any river, lake or estuary and all land within 40 metres of the highest bank of the river, lake or estuary. Any works within a watercourse or on waterfront lands, including modifications or enhancements to the watercourse, must be designed to ensure that no more than minimal harm will be done to waterfront land as a consequence of carrying out the controlled activity. Design of works should protect and enhance water flow, water quality, stream ecology and existing riparian vegetation. Impacts on the hydrologic, hydraulic and geomorphic functions of a watercourse should also be minimised. Further, all waterfront land disturbed by the construction or installation of a controlled activity should be rehabilitated in such a way that the integrity of the watercourse and its riparian corridor is restored or rehabilitated.

The proposed works would maintain a portion of the existing standing water along the western boundary, between the proposed development and the vegetation to the west. The retained standing water will not be modified except for a retaining wall along the eastern boundary. The western edge and the native vegetation present will remain untouched. This vegetation comprises the community Sydney Turpentine Ironbark Forest (STIF), which is listed as endangered under the NSW *Threatened Species Conservation Act 1995* and a critically endangered under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*. STIF is typically present near the transition between shale and sandstone soils on the more fertile and higher rainfall areas found at higher elevations around the Cumberland Plain (OEH 2012). STIF often forms a transition between vegetation communities such as Cumberland Plain Woodlands on lower elevation, drier areas and Blue Gum High Forest on higher elevation, wetter areas (OEH 2012). It should be noted that while STIF does prefer higher rainfall than other communities, it is not a riparian community and does not require constant access to standing water.

Although the proposed works will reduce the standing water surface area by approximately 80%, the proposed works will **not** significantly impact the STIF vegetation, reduce water quality, affect water flow or stream ecology, and in fact are likely to improve water quality and STIF vegetation, given the following:

The riparian/terrestrial interface will remain undisturbed.

- The boundary between the STIF vegetation and the standing water will remain unchanged. No excavation, contouring or laying of an impermeable membrane will be undertaken. As such, the ability of water to permeate this boundary and supply the STIF and downstream vegetation will remain unchanged. The area of standing water to be removed is shown in **Appendix A**.

The water levels at the riparian/terrestrial interface will remain unchanged.

- Water collected from the catchment will be treated and stored on-site. Stored water will be primarily used to maintain the required water level in the retained standing water even during extended dry periods. As such, the water in the retained standing water will provide the same water flow through the unchanged permeable interface as exists currently to maintain a healthy environment for the adjacent STIF and the downhill vegetation.

There will be no decrease in overland flows to the west of the site.

- Overland flows to STIF vegetation currently occur mostly via the standing water. Since this standing water interface is not being changed, and the water will be maintained at current levels, there will be no decrease in water available to the STIF and downhill vegetation via overland flows. Indeed, as the water level in the retained standing water area will be managed, it will also be possible to have periodic higher levels and inundations as occurs currently. The road to the east of the retained standing water will be created at a higher level than the STIF vegetation to the west, allowing for inundations that do not risk the proposed development. If anything, there is potential for more frequent inundations of the vegetation to the west given the smaller size of the retained standing water. However, the frequency of these inundation events can be managed and optimized through various mechanisms (e.g. outlets, pumping, etc.) so as to have maximum benefit to the STIF and downhill vegetation and any downstream riparian areas.

No excavation is being undertaken.

- No excavation below the current bed of the former quarry is being proposed. Rather, the proposed construction will float above the quarry floor. This means that the roots of any trees that have penetrated into the sandstone to access groundwater will not be affected.

The water movement and hydrology through the site will not be affected.

- As per Floth (2012), the same amount of water currently entering the site will be present after the proposed works are complete. Given that the proposed construction will float above the quarry floor, any low level water table flow will not be interrupted. Further, surface water will be collected, treated and primarily used to sustain the required water level of the retained standing water, providing the same

water flow to the root system of the STIF and the downhill vegetation as currently exists. The remainder of the captured water will be treated and used on-site where it will be recycled and used again.

The quality of the water entering the riparian area will be improved.

- As per Floth (2012), water treatment will improve the quality of water entering the retained standing water by removing some sediments and the majority of gross pollutants, hydrocarbons and nutrients. Improving the quality of the water will benefit the STIF vegetation by reducing the conditions that promote weed growth.

The works will not impact significantly on any fauna species.

- The fauna species that have been identified in the riparian area are cosmopolitan species that are likely to find suitable habitat in the retained standing water. The species of birds, bats and terrestrial mammals that most benefited from the current extent of standing water are all cosmopolitan species that are very adaptable to a wide range of conditions. The frogs present in the existing standing water were also all common species which will find suitable habitat in the retained standing water. All fauna species will benefit from the permanent water levels that the stored water will provide to the retained standing water.

The works will create greater riparian habitat diversity.

- The retained standing water will provide a greater diversity of riparian habitat than was present in the former quarry with a large proportion of open water area along with the dense vegetation habitat that was present in the former quarry. This will provide more habitat diversity for aquatic and riparian species, including threatened species.

The works will improve the condition of the vegetation to be retained.

- Management of the vegetation to the west of the site, including weed control, pest control and revegetation will be undertaken. Currently, the area of STIF vegetation is threatened by weed invasion, control of which has never been funded on the site. It is likely that as part of the consent conditions management actions such as weed control, pest control and revegetation will have to be planned, funded and undertaken. This will provide resources for the ongoing management and preservation of this important vegetation community.

If you have questions about any aspect of this letter, please do not hesitate to call me on **02 8536 8628** or email me at **andreww@ecoaus.com.au**.

Yours sincerely,

Andrew Whitford, Manager, Restoration Ecology & Implementation

References

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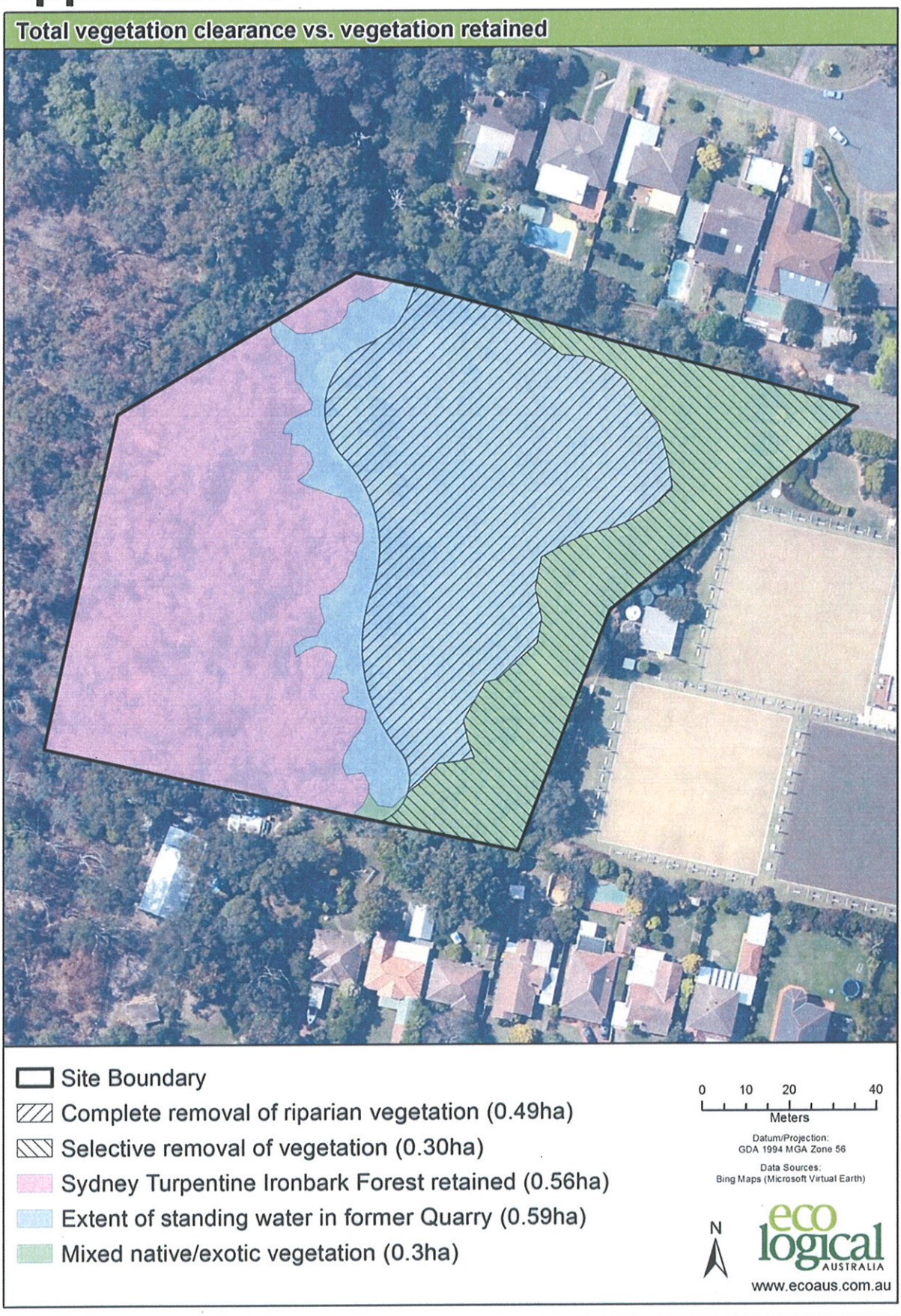
Appendix A: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Sydney Turpentine Ironbark Forest retained (0.56ha)
Extent of standing water in former Quarry (0.59ha)
Mixed native/exotic vegetation (0.3ha)
0 10 20 40
Meters
Datum/Projection:
GDA 1994 MGA Zone 56
Data Sources:
Bing Maps (Microsoft Virtual Earth)
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Delivered via email: len.jones@joneswilliams.com.au

11SUTECO-0089

26 September 2013

Dear Len,

Impact of hydrology changes on environmental values at the former Moxham Quarry, Northmead

The Sydney West Joint Regional Planning Panel (JRPP) has recently been asked to consider whether a proposal to amend Schedule 1 of the Parramatta Local Environment Plan (LEP) 2011 to allow multi-dwelling housing and residential flat buildings up to a maximum of five stories at 166A Windsor Rd, Northmead should be submitted for a Gateway determination. The JRPP found that further information on some matters was required prior to a Gateway decision. Specifically, the JRPP required more detail on the significance of riparian areas on-site and the impact of the proposed works. As such, Eco Logical Australia (ELA), who previously prepared the Flora and Fauna Assessment (FFA) for the proposed works (2012), has been asked to summarise the impact of works on the riparian environmental values of the site.

One issue raised during the JRPP was whether the quarry area represented an 'ecologically valued wetland'. This can be answered in a few ways:

- The former Moxham Quarry is **not** listed as a protected wetland under any state or commonwealth registers, including RAMSAR, Wetlands of National Significance or SEPP 14 (NSW).
- As part of the FFA (ELA 2012), the significance of the loss of the riparian aquatic habitat to state and commonwealth listed threatened species, including wetland species, was assessed. It was determined that the former Moxham Quarry did **not** represent important habitat for any wetland species and as such, the proposed reduction of riparian area did not represent a significant impact on any wetland species.
- However, under the *Water Management Act 2000* (WM Act), the former Moxham Quarry **is** considered a 4th order watercourse and as such, 'waterfront land'.

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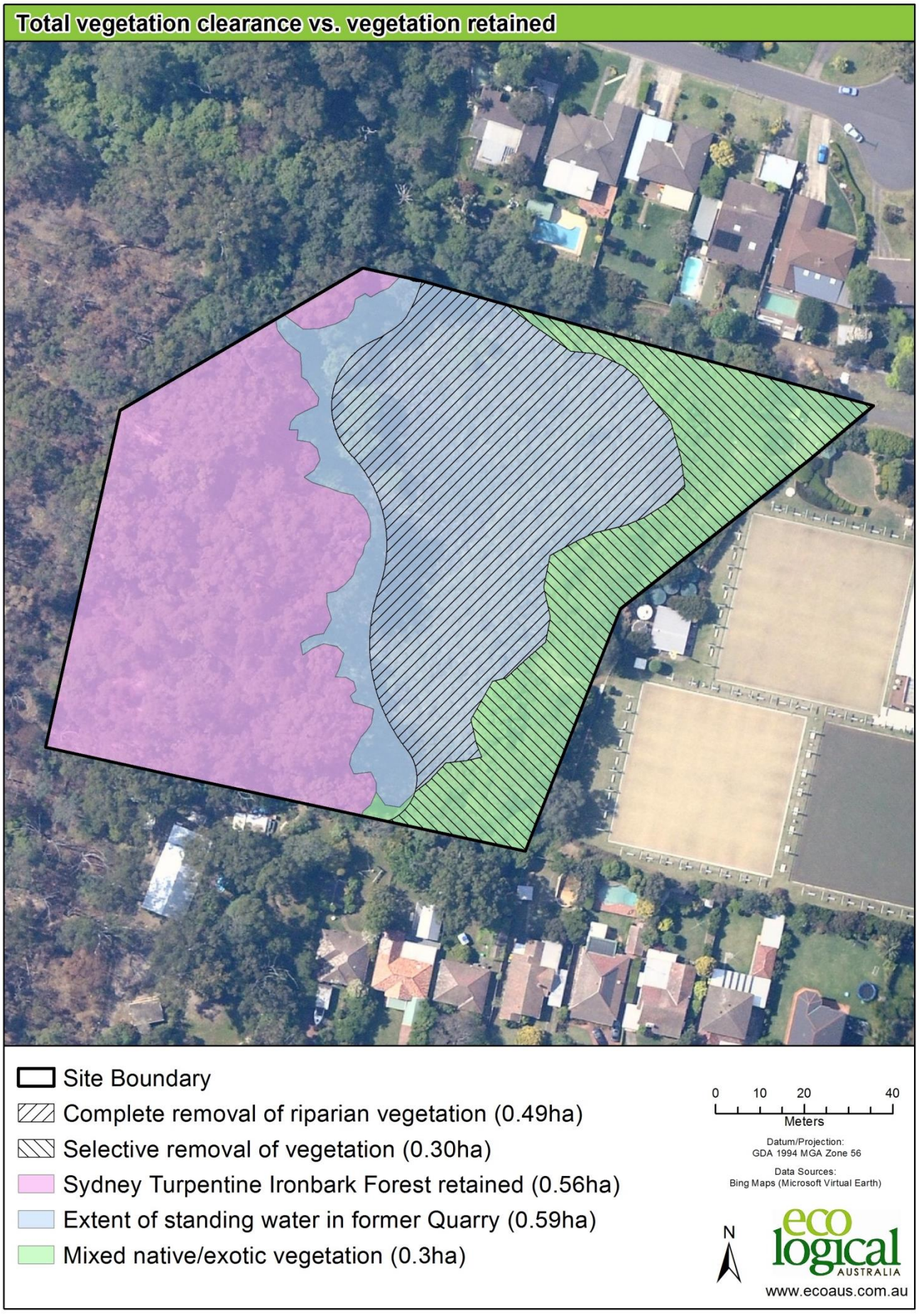
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