# Macarthur Gardens North Residential Development

## EPBC Assessment Report (EPBC Ref: 2017/8029)

Prepared for
**Landcom**

August 2019


## DOCUMENT TRACKING

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# Abbreviations

| Abbreviation | Description |
|---|---|
| APZ | Asset Protection Zone |
| BBAM | BioBanking Assessment Methodology |
| CEEC | Critically Endangered Ecological Community |
| CEMP | Construction Environmental Management Plan |
| CPW | Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest |
| DNG | Derived Native Grassland |
| DECCW | Department of Climate Change and Water |
| DEWHA | Department of Water, Heritage and the Arts |
| DotEE | Department of the Environment and Energy |
| EP&A Act | *Environmental Planning and Assessment Act 1979* |
| EPBC Act | *Environment Protection and Biodiversity Conservation Act 1999* |
| EMP | Environment Management Plan |
| LEP | Local Environment Plan |
| Matter of NES | Matters of National Environmental Significance |
| OEH | Office of Environment and Heritage |
| PCT | Plant Community Type |
| POM | Plan of Management |
| SEPP | State Environmental Protection Policy |
| TSC Act | *Threatened Species Conservation Act 1995* |
| TEC | Threatened Ecological Community |
| VMP | Vegetation Management Plan |

# Executive summary

**Purpose and Scope of this Report**

On 25 September 2017, Macarthur Gardens North (the site) was referred to the Commonwealth Department of the Environment and Energy (DotEE) for consideration under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) for impacts to Matters of National Environmental Significance (Matter of NES). On 2 November 2017, DotEE determined that the proposed action would be a controlled action requiring further assessment and approval under the EPBC Act (EPBC 2017/8029). This document is the EPBC Act Assessment Report for the proposed development.

**Project Proponent**

The designated proponent for Macarthur Gardens North is Landcom.

**Site Context**

Macarthur Gardens North (the site) is located within the Campbelltown Council Local Government Area (LGA), in the southwest of the Greater Sydney region (**Figure 1**). The land is in Macarthur, west of the Macarthur Station. The site is centrally located, nearby Macarthur Railway Station, Macarthur Shopping Centre, Western Sydney University, Campbelltown TAFE and numerous retail and ancillary services in the area.

**Description of the Proposed Action**

The proposed development is the last stage of the Macarthur Regional Centre Masterplan approved by Campbelltown Council in 2003. The entire development footprint contained in the Masterplan is known as Macarthur Gardens. Macarthur Gardens South on the southern side of the rail corridor is complete. This development provided medium density housing, retirement living and open recreation space. This report is for Macarthur Gardens North, the final stage of the Masterplan.

Landcom propose to develop 9.80 ha of 18.50 ha for residential purposes. The remaining 8.70 ha will be embellished open recreation space (Bow Bowing Creek corridor) to be dedicated to Council.

The site will provide strategically located housing to meet the housing demand within the South West Sydney region. The proposed development will contribute towards the Macarthur Precinct Plan and Campbelltown-Macarthur Regional City Centre vision as defined by NSW Department of Planningand Environment (DP&E):

- Macarthur Precinct Plan: the plan allows for a medium density super-lot containing a minimum of 411 dwellings with 241 of these to be residential and the remaining yield to be medium density, a ground level commercial premises and underground parking. Landcom is reviewing the Macarthur Precinct Plan since this plan allows a higher density compared to the current Masterplan lodged with Council for approval.
- realignment of Bow Bowing creek and re-establishment of an 80m wide vegetated riparian corridor which will include bushland management and revegetation, construction of cycle ways, pedestrian bridges, seats, signage and rain gardens. Works will also include creek line stabilisation and construction of weirs, pools and riffles as required. The creek realignment is considered necessary to manage stormwater flows and mitigate flooding for upstream and adjacent urban development that drains through the Bow Bowing Creek corridor.

- the western boundary of the site will contain a stormwater basin. This basin is one of three basins and is part of the adjacent Macarthur Heights development. The structure will control flood events along the Bow Bowing Creek corridor by detaining stormwater flows. The structure will hold flood waters then release the stormwater in a controlled manner to prevent downstream flooding. The basin on the western boundary is a circular depression that holds stormwater, with concrete stormwater structures that control the flows and will be landscaped with native vegetation once constructed.
- retained vegetation area between the realigned Bow Bowing Creek and the rail line which runs along the southern boundary of the site
- 8.72 ha of open space along Bow-bowing Creek to be revegetated and dedicated to Council which would encourage active living and transport through walking and cycling
- landscaped boulevards with tree lines footpath areas
- on-road cycle-ways.

**Matters of National Environmental Significance**

There are six Matters of NES protected under the EPBC Act that require further assessment in relation to potential impacts from the propose action:

- Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest (CPW) – critically endangered
- *Anthochaera phrygia* (Regent Honeyeater) – critically endangered
- *Lathamus discolor* (Swift Parrot) – critically endangered
- *Pteropus poliocephalus* (Grey-headed Flying-fox) – vulnerable
- *Litoria aurea* (Green and Golden Bell Frog) – vulnerable
- *Pimelea spicata* (Spiked Rice Flower) – endangered.

**Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest (CPW)**

CPW is an ecological community that occurs predominantly on the shale soils throughout the Cumberland Plain of Western Sydney, in the drier parts of the Sydney Basin Bioregion, NSW. There is currently 3.1 ha of CPW on the site, which occurs as several small patches that border areas of River-flat Eucalypt Forest and cleared land. The patches varied in condition and extent including areas of Derived Native Grassland, moderate condition and regeneration. The patches of remnant native vegetation were bordered by cleared land or transport infrastructure.

**Impacts to CPW**

The proposed development would result in direct impacts to 2.23 ha of CPW and indirect impacts to 0.87 ha of CPW (**Figure 2** and **Figure 3**). On a regional scale this loss represents < 0.02% of the total remaining CPW, based on extant vegetation areas calculated in Tozer, 2003.

Approximately 0.87 ha of remnant CPW within the site would be retained and managed as conservation lands. Temporary, indirect impacts during the realignment of Bow Bowing Creek are likely to occur to this vegetation. The indirect impacts would be limited to temporary sedimentation and changes to water flows and local hydrology. The remnant patches of CPW would be managed through the implementation of a Vegetation Management Plan consistent with the DotEE Management Plan guidelines (DotEE 2014). This would prevent any lasting indirect impacts to the retained CPW on site.

The areas that have been designated as development lands have been chosen to avoid and minimise impacts to CPW where possible. Following preliminary field investigations by Travers Bushfire and Ecology (2016) and subsequent re-iterations of the development layout, Landcom have been able to

achieve a reduction in the CPW clearance. The following principles were followed in selecting development land:

- avoid CPW by maximising use of degraded areas characterised by grazed exotic pasture.
- consideration of recovery potential
- where possible avoid loss of good quality CPW
- maintain existing connectivity.

**Conservation, Enhancement, and Offsetting of Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest**

Of the CPW at Macarthur Gardens North, 0.87 ha or 34 % would be retained and managed as conservation lands under a Vegetation Management Plan (VMP). This 0.87 ha will still be offset to compensate for potential indirect impacts to the community. Campbelltown City Council endorsed a three year VMP (Travers Bushfire and Ecology 2019) in the assessment and determination of DA1571/2015. DPI Water (now the NSW Natural Resource Access Regulator) endorsed this VMP in its assessment and issue of the General Term of Approval for this consent. Travers Bushfire and Ecology (2019) have updated the existing VMP to include a five year implementation period for the Bow Bowing Creek corridor in consideration of the BioBanking Statement requirements and vegetation mapped within the creek corridor. The proposed development has gone through several design iterations and has considered the critical nature of realigning Bow Bowing Creek to manage increased stormwater flows through the corridor resulting from the neighbouring urban development. The design has specifically chosen to retain patches of CPW that would form part of the future Bow Bowing Creek realignment corridor. The realignment of the corridor would include the revegetation of 1.03 ha of CPW that would also be guided under the VMP.

The proposed action would directly impact 2.23 ha of CPW and indirectly impact 0.87 ha of CPW within the site. The Office of Environment and Heritage issued a BioBanking Statement (BS45) in February 2018 for direct impacts to CPW as part of the proposed action. The statement followed the preparation of a Biodiversity Assessment Report (BAR) (Travers Bushfire and Ecology 2017). The BAR determined the amount of ecosystem credits required to offset this impact. The BAR determined that 74 ecosystem credits would be required to offset the impact to CPW. The BioBanking Statement does not account for credits for the indirect impacts to 0.87 ha of CPW. The intention is to offset the remaining 0.87 ha using the BioBanking Scheme. It is expected that an additional 33 credits would be required to offset the indirect impacts.

This reporting enabled an assessment of the quantum of biodiversity offsets required to meet the 'improve or maintain' outcome for biodiversity. Credits are currently being sourced. Landcom is committed to finding credits from a reputable supplier.

**Management of CPW**

The overarching approach to the management of the CPW is 'assisted regeneration' where the natural processes that lead to the re-establishment of native plant species are 'triggered' by management, with the long-term goal being self-perpetuation of the CPW.

Landcom will undertake management actions, relevant ecological monitoring programs and provisions for adaptive management at the site. This would include the revegetation of Bow Bowing Creek to CPW along with the conservation of some patches of CPW on site. The CPW to be retained on site and the revegetation of Bow Bowing Creek would assist with:

- the interface between CPW and development,

- weed control,
- native species revegetation,
- management of lighting,
- human disturbance,
- retention of dead timber,
- erosion control.

The sites will receive management that is monitored and reviewed accordingly as per the requirements of the VMP (Travers Bushfire and Ecology 2019). This will ensure that management for conservation is maintained for a long enough period of time that is suited to revegetation of the creekline and will allow for adaptive management. The condition of CPW remnants would increase over time, with native plant species diversity and richness expected to increase. Following the completion of the VMP, the land will be dedicated to Council.

**Conservation Outcomes**

The BS45, approvals under the EPBC Act and the retirement of BioBanking credits will achieve the following CPW outcomes:

- purchasing of 74 ecosystem credits for CPW (ME020/HN528/PCT 849) for direct impacts to 2.23 ha of CPW. The amount of credits has been calculated using the BBAM. The credits that would be sourced and retired for CPW would allow perpetual protection and on-going management.
- purchase of additional 33 credits to offset indirect impacts to 0.87 ha of CPW (ME020/HN528/PCT 849) using the BBAM
- the protection, management and assisted regeneration of approximately 0.87 ha of woodland within the Macarthur Gardens North retention areas
- regeneration of 1.03 ha of CPW along Bow Bowing Creek with proposed management under a Vegetation Management Plan.

**Social and economic factors**

The development of the land is important to meet the social and economic needs for Sydney's continued growth. Macarthur Gardens North is strategically important considering its proximity to the University, TAFE, Campbelltown CBD and commercial centres, and Sydney's train network.

A Metropolis of Three Cities (GSC 2017) provides a guide for growth and change for the Sydney metropolitan area up to the year 2036. The population within Sydney and its suburbs is expected to increase exponentially. The Metropolis of Three Cities plan aims to provide housing for the growing population and also increase liveability. This will occur over the next 40 years (up to 2056) and will inform district and local plans within the growth regions. The site falls within the Greater Macarthur 2040 (DP&E 2018) interim plan.

**Conclusion**

This assessment report presents an analysis of the potential impacts to the CPW critically endangered ecological community, including measures for avoidance and mitigation. It also outlines the proposed offset methodology of the purchasing and retiring of credits through the endorsed NSW BioBanking Scheme. This report outlines the management works, and ecological monitoring programs that are proposed for the retention areas and revegetation and realignment of Bow Bowing Creek within the Macarthur Gardens North site.

The planning and design objectives for the proposed development aims for a positive conservation outcome for CPW. Despite the removal of some CPW to create a residential community, the development allows for the restoration of some existing and regeneration of new CPW within the development footprint. The development objectives considered:

- first, avoid losses and protect biodiversity in situ
- second, mitigate impacts to the greatest reasonable extent
- third, offset remaining impacts as a last resort.

The assessment provided in this report concludes that the proponent has suitably avoided and mitigated impacts and has proposed an offset package underpinned by sound ecological principles, which will be enduring and enforceable.

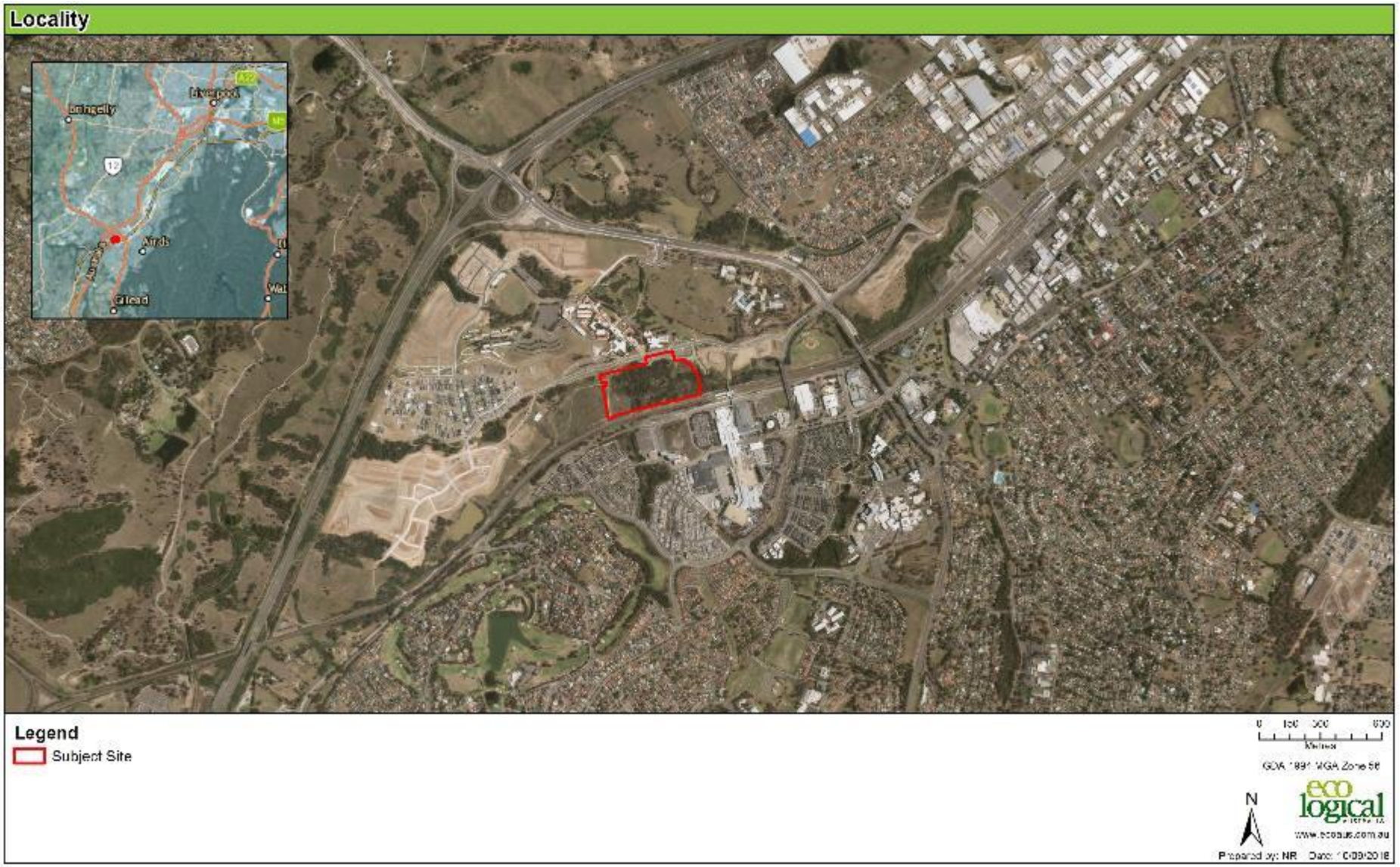


**Figure 1: Location of the site**

# 1 Scope of this report

On 25 September 2017, the Macarthur Gardens North site was referred to the Commonwealth Department of the Environment and Energy (DotEE) for consideration under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). On 2 November 2017, DotEE decided that the proposed action would be a controlled action requiring further assessment and approval under the EPBC Act (EPBC 2017/8029). This document is the EPBC Act Assessment Report for the proposed development. The level of assessment under the EPBC Act for the project was set at 'Preliminary Documentation'

The purpose of this Assessment Report is to address the information requirements requested by DotEE and to (**Table 1**):

- provide sufficient information on the proposed action to allow DotEE, interested parties and the community to understand the action and its potential and likely environmental impacts;
- identify the relevant matters of national environmental significance (MNES) and place them within the context of the local and regional environments;
- outline how potential impacts on matters of MNES will be minimised and managed to provide a good conservation outcome at Macarthur Gardens North.

**Table 1: Additional information requested to inform this assessment**

| Information Requested by DotEE | Section |
|---|---|
| 1. Referral information, Planning and Conservation Measures<br>a. Clarify all zoning arrangements currently applying to the proposed development area and any proposed offset areas<br>b. Discuss difference in protection provided for offset sites<br>c. Outline any requirements imposed or expected by other government agencies | **Section 2** and **3** |
| 2. Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest (CPW) – Critically Endangered. Specifically;<br>a. Mapping showing patches of CPW within and adjacent to the site, including those that are to be retained and cleared and buffer zones<br>b. Potential changes to fire regimes<br>c. Potential introduction of pests and diseases, increased runoff and fertiliser / herbicide runoff, changes to hydrology, potential edge effects<br>d. Management measures for retained areas of CPW<br>e. Address threat abatement plans including potential introduction of *Phytophthora cinnamomi* | **Section 5** |
| 3. *Anthochaera phrygia* (Regent Honeyeater) – critically endangered<br>Please provide the following:<br>a. Mapping showing Regent Honeyeater habitat currently present or adjacent to the development site, patches to be cleared and retained in and adjacent to the development site and proposed buffer zones<br>b. Management measures proposed for retained areas of habitat and associated buffer zones<br>c. Potential impacts likely to occur, include how likely and why | **Section 6** |

| Information Requested by DotEE | Section |
|---|---|
| d. Any potential changes to fire regimes<br>e. Potential introduction of pest species and diseases<br>f. Increased runoff from fertilisers, herbicides, pesticides or contaminants<br>g. Changes to hydrology<br>h. Increased presence of domestic cats and dogs<br>i. Address any threat abatement plans for the species | |
| 4. *Lathamus discolor* (Swift Parrot) –critically endangered. Please undertake / provide the following:<br>a. Mapping showing Swift Parrot habitat currently present or adjacent to the development site, patches to be cleared and retained in and adjacent to the development site and proposed buffer zones<br>b. Targeted survey over 8 days including information regarding survey effort, and likelihood that the species would utilise the site<br>c. Potential changes to fire regimes<br>d. Potential introduction of pest species and diseases<br>e. Increased runoff from fertilisers, herbicides, pesticides or contaminants<br>f. Changes to hydrology<br>g. Increased presence of domestic cats and dogs<br>h. Address any threat abatement plans for the species<br>i. Management measures proposed for retained areas of habitat and associated buffer zones | **Section 6** |
| 5. *Pteropus poliocephalus* (Grey-headed Flying-fox)- vulnerable. Please provide the following:<br>a. Mapping showing Grey-headed Flying-fox habitat currently present or adjacent to the development site, patches to be cleared and retained in and adjacent to the development site and proposed buffer zones<br>b. Potential changes to fire regimes<br>c. Potential introduction of pest species and diseases<br>d. Habitat loss and how that would affect winter forage resources available to the species<br>e. Management measures proposed for retained areas of habitat and associated buffer zones | **Section 6** |
| 6. *Litoria aurea* (Green and Golden Bell Frog) - vulnerable<br>Please provide / undertake the following:<br>a. Undertake targeted survey in line with the Survey Guidelines for Australia's Threatened Frogs – EPBC Act Survey Guidelines 6.3 (2010). If present provide a population estimate. If not detected assess the likelihood that GGBF may be present<br>b. Mapping showing Green and Golden Bell Frog habitat currently present or adjacent to the development site, patches to be cleared and retained in and adjacent to the development site and proposed buffer zones<br>c. Discuss possible and expected impacts to GGBF including the following:<br>i. Introduction of pest species, diseases or other introduced plants / animals<br>ii. Increased runoff, fertiliser, herbicide, pesticide or other contaminants<br>iii. Changes to hydrology / decreases in water flows | **Section 6** |

| Information Requested by DotEE | Section |
|---|---|
| iv. Increased presence of domestic cats and dogs or urban based pests i.e. foxes and rodents<br>v. Habitat loss and its potential impacts<br>vi. Extent to which the creek realignment would impede potential recolonization of nearby sites<br>d. Address any relevant threat abatement plans<br>e. Management measures proposed for retained areas of habitat and associated buffer zones | |
| 7. *Pimelea spicata* (Spiked Rice Flower) – endangered. Please undertake / address the following:<br>a. Targeted surveys through all areas of potential habitat on and immediately adjacent to the proposed action site<br>b. Mapping showing potential habitat on and immediately adjacent to the site, areas surveyed, potential habitat to be cleared and retained and areas to be retained but likely to be subject to disturbance<br>c. Discussion on the possible or expected impacts to potential or known Spiked Rice Flower habitat including<br>i. Proposed clearing of the species habitat<br>ii. Potential changes to fire regimes<br>iii. Potential introduction of pests, diseases or other introduced plants / animals<br>iv. Increased runoff and fertiliser, herbicide or pesticide<br>v. Changes to or reduction in water flows<br>d. Address any relevant threat abatement plans<br>e. Management measures proposed for retained areas of habitat and associated buffer zones | **Section 7** |
| 8. Proposed mitigation and avoidance measures including but not limited to:<br>a. Reasons measure are considered appropriate<br>b. Assessment of alternative development layouts which avoid or reduce direct and indirect impacts to matters of NES<br>c. Assessment of expected or predicted effectiveness of the mitigation measures and the likely difference in conservation outcomes produced by current land zoning protections and mitigation measures and associated costs | **Section 8** |
| 9. Outcome based conditions. If you wish to pursue outcomes-based conditions under the Outcomes-based Conditions Policy (2016) and Outcomes-based Condition Guidance (2016), please provide information on the outcomes to be achieved for matters of national environmental significance. | **N/A** |
| 10. Offsets. Provide detail of proposed offsets and specific impact to any MNES you propose to offset including how the offset package meets the requirements of the EPBC Act Offsets Policy or how it meets an endorsed state offsets policy | **Section 9** |
| 11. Economic and social matters including costs, consideration of different scales where relevant, specific dollar values where relevant. | **Section 11** |

| Information Requested by DotEE | Section |
|---|---|
| 12. Environmental Record of Person(s) proposing to take the action: any proceedings under Commonwealth, State or Territory law for the protection of the environment or conservation and sustainable use of natural resources against the person proposing to take the action. | **Section 10** |

# 2 Introduction

## 2.1 Proponent

The designated proponent for the Macarthur Gardens North development for the purposes of referral, assessment and approval under the EPBC Act is Landcom.

Landcom is a State Owned Corporation who work in conjunction with the private sector to produce housing and communities. Landcom aim to develop affordable housing whilst considering the Government's social, environmental and economic objectives.

The NSW Government is taking action to improve housing affordability across the state, particularly in Sydney where the challenge is the greatest. Landcom is focused on supporting this government priority and delivering the local infrastructure to help new communities grow and thrive. Landcom unlocks surplus or underutilised government-owned sites or large institutional land holdings to create vibrant urban places with housing choices, community facilities, open spaces and access to services.

The contact person for the environmental assessment of the proposed action is:

**Mr Steve Zhou**
Development Manager
Landcom
(02) 4927 7438
szhou@landcom.nsw.gov.au

## 2.2 Site description

Macarthur Gardens North is located within the Campbelltown Local Government Area (LGA), in the southwest of the Greater Sydney region. The land, Lot 1097 DP 1182558, is in Macarthur, west of the Macarthur Station (**Figure 1**). The site is currently zoned as a deferred matter under the Campbelltown Local Environmental Plan (LEP) 2015, Macarthur Regional City Centre. It was previously zoned as 10(a) Regional Comprehensive Centre. Under the Greater Macarthur 2040 plan, the site is not zoned but marked for low rise residential development.

Macarthur Gardens North is centrally located, abutting Macarthur Railway Station, Gilchrist Drive, Macarthur Shopping Centre, Western Sydney University, Campbelltown TAFE and numerous retail and ancillary services in the area. A new residential development is currently being built to the west, east and north. This development is called Macarthur Heights and is around 40% complete. There is an existing pedestrian bridge which crosses the railway corridor and pathway running through the site. This links the Macarthur railway station to the University and TAFE. The Masterplan for the site includes this pathway.

The site contains one large patch of remnant native vegetation (**Figure 2**). Some areas of native vegetation in the site contains regrowth with small areas of cleared land which shows signs of ongoing disturbance associated with historical agricultural land uses since the 1960's. The native vegetation along Bow Bowing Creek contains a more complex age structure than the surrounding native vegetation. Bow Bowing Creek has been heavily disturbed and contains a high level of weed invasion and infestation of *Gambusia holbrooki* (Plague Minnow). Bow Bowing Creek runs through the site and joins Keanes Gully about 4 km to the west. The native vegetation in the site is isolated from other local patches due to the surrounding development and transport infrastructure.

## 2.3 Proposed action

Landcom, the proponent, are proposing to develop 9.80 ha of the 18.50 ha of land for residential purposes. The proposed development is for residential purposes and is the last stage of the Macarthur Regional Centre Masterplan. The development would include the regeneration and dedication of 8.72 ha of open space which would be delivered to Council.

Macarthur Gardens North is a residential development with open space embellishment. The residential aspects for the development will contribute towards the housing demand within the South West Sydney region. The existing Macarthur Gardens North to the south of the rail line is complete. The Macarthur Gardens North is the next and final stage of the masterplan.

The proposed action seeks approval to complete the Bow Bowing Creek realignment and restoration works, early site establishment work and residential subdivision. This report has been written to consider the overall (total) impact on the site environmental values for all phases of work and is based on the preferred indicative layout plan shown in **Figure 3**. The project contributes towards the Greater Macarthur Priority Growth Area, and more locally the Macarthur Gardens North Regional Masterplan. The anticipated date to commence the proposed action is late 2019.

## 2.4 Reliability of information

Information utilised in the preparation of this report has been prepared by suitably qualified and experienced consultants, peer reviewed assessments and journals or prepared and reviewed by state or commonwealth government. The information utilised in this document is considered fit for purpose and of a nature appropriate for the assessment of impacts relating to Macarthur Gardens North.

## 2.5 Development footprint

The proposed development footprint is the result of a series of design reiterations based on ecological survey efforts conducted by Travers Bushfire and Ecology (2016; 2017b) and ELA (2018) with the goal of reducing impacts to areas of environmental value. For example, the layout of the proposed stormwater basin in the western portion of the site has been modified to retain a portion of native vegetation to minimise habitat loss (**Figure 3**).

The preferred indicative development layout includes space for the following:

- About 9.80 ha of general residential: comprising townhouses and multi storey apartment buildings, some retail and commercial and potential student accommodation and over 55's year old accommodation within walking distance to the Macarthur train station and Western Sydney University
- a medium density superlot containing a minimum of 411 dwellings with 241 of these to be residential and remaining yield to be medium density, a ground level commercial premises and underground parking
- Environmental Conservation: realignment of Bow Bowing creek and re-establishment of 1.03 ha vegetated riparian corridor which will include bushland management and revegetation, construction of cycle ways, pedestrian bridges, seats, signage and rain gardens. Works will also include creek line stabilisation and construction of weirs, pools and riffles as required. The creek realignment is considered necessary to manage stormwater flows and mitigate flooding for upstream and adjacent urban development that drains through the Bow Bowing Creek corridor.
- a park and open spaces to encourage active living, walking and cycling

- landscaped boulevards with tree lines footpath areas. The landscape philosophy seeks to reflect the environmental ideals of Landcom to create a landscape that reflects a contemporary lifestyle and enhances the scenic and visual qualities of the area through the implementation of a design guidelines and landscape treatments within the development.
- Stormwater: the western boundary of the site will contain a stormwater basin. This Basin is one of three basins and is part of the adjacent Macarthur Heights development. The structure will control flood events along the Bow Bowing Creek corridor by restricting the upstream stormwater flows. The structure will hold flood waters then release the stormwater in a controlled manner to prevent downstream flooding. The basin on the western boundary is a circular depression that holds stormwater, it has concrete stormwater structures that control the flows and will be landscaped with native vegetation once constructed.
- Roads, access ways, and parking: The street network within the site is to be consistent with Campbelltown Council's Engineering Design Specification and street network principles including the establishment of a permeable network that is based on a modified grid system, and encourage walking and cycling and reduce travel distances. A pedestrian and cycle network will link areas within the site to provide convenient, efficient and safe use for the community, within and beyond the site. The objective is to create a network that encourages residents to walk or cycle, in preference to using motor vehicles.
- Asset Protection Zones (APZs): The development will be carried out in a way to ensure prevention of loss of life and property due to bushfires. APZs are to be located wholly within the precinct, and would incorporate roads in some cases onto the lots. All residential and commercial development would need to be built to the relevant Bushfire Attack Level.
- The re-alignment and revegetation of Bow Bowing Creek would act as a buffer to the change of use associated with the subdivision on adjacent lands. The re-alignment and revegetation of Bow Bowing Creek would include the management of the land under a Vegetation Management Plan which would increase the amount of native vegetation in the area, and improve the condition of the vegetation to be retained.

## 2.6 Retention areas

Two retention areas are proposed between the realigned Bow Bowing Creek and the rail line and to the east of the stormwater detention basin (**Figure 3**). The retention areas (0.87 ha) would abut the future Bow Bowing Creek corridor. About 1.03 ha of CPW would be revegetated along the future riparian corridor realignment. This would result in 1.90 ha of CPW to be conserved / revegetated in the site. The retention areas will be effectively conserved and managed through the Vegetation Management Plan (Travers Bushfire and Ecology 2019). The VMP includes restoration and maintenance programs which will be implemented to ensure that bushland and habitat enrichment works achieve nominated performance targets. Specifically, the realignment of Bow Bowing creek will involve the re-establishment of an 80m wide vegetated riparian corridor (1.03 ha) which will include bushland management and revegetation. Works will also include creek line stabilisation and construction of weirs, pools and riffles as required.

## 2.7 Alternatives to taking the proposed action

There are no alternative locations, time frames or activities that form part of the referred action.

The proposed action on the site is part of the larger Macarthur Regional Centre Masterplan and this area is the last development stage of the masterplan. It contains flood mitigation works for the Bow Bowing Creek catchment and these works are required under Voluntary Planning Agreements with Campbelltown Council and necessary to ensure the surrounding lands are not put at risk due to flooding. As a result,

significant works are required in this location and no other viable alternatives are achievable. The location of the creek re-alignment and reshaping, drainage works and associated impact area are in response to the existing topography and the required channel widths to carry predicted floodwaters.

The creek realignment allows the integration of residential development onto the site. There is limited opportunity to relocate the residential development to other areas within the site without causing significant loss in yield or further disturbance to Bow Bowing Creek.

The development of the land is important to meet the social and economic needs for Sydney's continued growth, development of the site is strategically important considering its close proximity to the University, TAFE, Campbelltown CBD and commercial centres, and Sydney's train network.

The south west of Sydney has been identified as a key residential growth centre by the NSW Department of Planning and Infrastructure. Macarthur Gardens North resides in a key strategic location and will contribute to the socioeconomic needs of the growth centres with a minimum of 411 additional dwellings. The site has been identified as being suitable for development due to historic clearing of much of the onsite vegetation from previous and current disturbances. The site is therefore a preferable area to provide for residential and recreational development that will help to accommodate the growing population within the Western Sydney region.

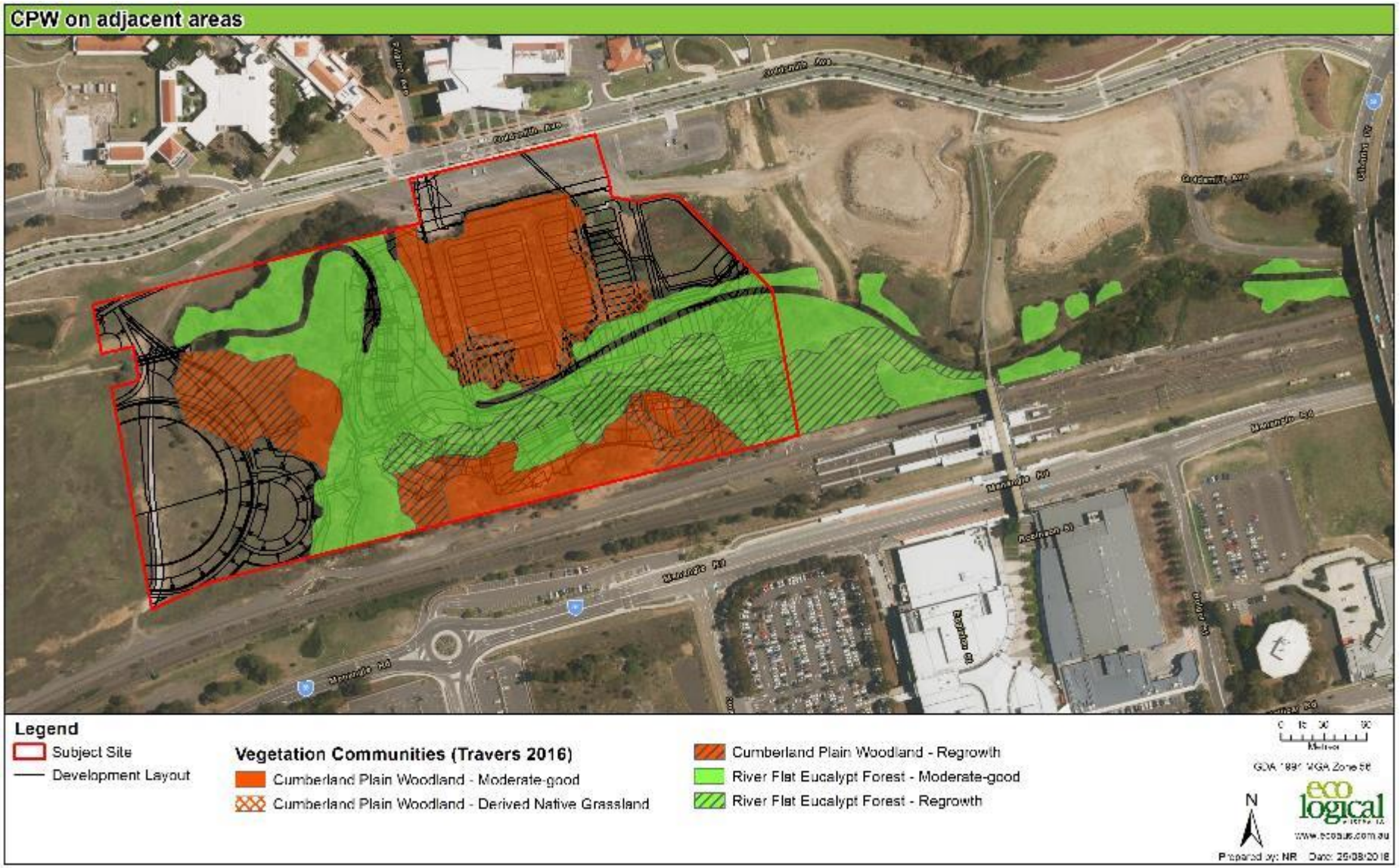


**Figure 2: Vegetation communities within the site (Travers 2016)**


**Figure 3: CPW proposed as retention areas in the site**

# 3 Legislation and assessment

## 3.1 State legislation

The NSW *Environmental Planning and Assessment Act 1979* (EP&A Act) is the principal planning legislation that relates to the MGN development. It provides a framework for the overall environmental planning and assessment of development proposed action. Various legislative instruments, such as the NSW *Threatened Species Conservation Act 1995* (TSC Act), *Water Management Act 2000* (WM Act) and *Rural Fires Act* 1997 are integrated with EP&A Act and have been reviewed separately.

A substantial array of legislation, policies and guidelines apply to the site as listed below;

- *Biodiversity Conservation Act 2016* (BC Act)
- Bushfire Environment Assessment Code 2003
- *Catchment Management Act* 1989
- *Contaminated Land Management Act* 1997
- *Environmental Planning and Assessment Act 1979* (EP&A Act)
- *Heritage Act 1977*
- *Local Government Act 1993* (LG Act)
- *Local Government Amendment (Ecologically Sustainable Development) Act 1997*
- *National Parks and Wildlife Act 1974* (NPW Act)
- *Native Vegetation Conservation Act 1997*
- *Noxious Weeds Act 1993*
- *Protection of the Environment Operations Act 1997* (POEO Act)
- *Rural Fires Act 1997 (*RF Act)
- *Soil Conservation Act 1938*
- *Water Management Act 2000* (WM Act)

## 3.2 Planning instruments

### 3.2.1 Campbelltown City Council Local Environmental Plan (2015)

The Campbelltown Council Local Environmental Plan (LEP) 2015 is the principal planning instrument for the Campbelltown LGA. The LEP aims to make local environmental planning provisions for land within the City of Campbelltown in accordance with the relevant standard environmental planning instrument under section 33A of the EP&A Act. The LEP applies to all land within the Campbelltown LGA. The site is currently zoned as a deferred matter under the LEP. It was previously zoned as 10(a) Regional Comprehensive Centre.

### 3.2.2 Macarthur Precinct Plan (DP&E 2017)

Macarthur is planned as a precinct for renewal. The renewal of this precinct is being guided by the Macarthur Precinct Plan which aims to create a new local community for the greater Macarthur area.

### 3.2.3 Glenfield to Macarthur Urban Renewal Corridor (DP&E 2018)

The Glenfield to Macarthur Urban Renewal Corridor is planned to better connect homes, jobs and open space to the surrounding train stations. This would assist in mobilising the additional people who would be housed in the Macarthur precinct.

### 3.2.4 Western City District Plan (Greater Sydney Commission)

The Western City District Plan has been prepared to guide the implementation of a Metropolis of Three Cities. The plan is to be implemented over a 20 year period to enhance liveability, productivity and sustainability.

### 3.2.5 Metropolis of Three Cities (Greater Sydney Commission)

The Metropolis of Three Cities is the plan for developing Sydney's future residential, commercial and business hubs. The site forms part of Macarthur which is located within the Western Parklands City. The plan sets a 40 year version and establishes a 20 year plan to manage growth and change within Greater Sydney.

## 3.3 Stakeholder engagement and consultation

Consultation has been undertaken with Council and the Department of Planning, Infrastructure and Environment (DPIE). Relevant public authorities have been consulted as part of the planning process. The proposed action sits within the Greater Macarthur Priority Growth Area and has been advertised publicly within the plan. Landcom has engaged Austral Archaeology to assess the Aboriginal artefacts within the site. An application for a controlled activity approval to the NSW Office of Water has been submitted to conduct activities within 40 m of Bow Bowing Creek.

# 4 Macarthur Gardens North Matters of National Environmental Significance

## 4.1 Survey summary

A total of 15 biometric plots were conducted and a list of all species recorded. Additionally, key diagnostic features and condition thresholds (including patch size, foliage cover and perennial understorey vegetation) were utilised to delineate areas of EPBC Act listed Cumberland Plain Woodland (DEWHA 2010).

Habitat searches and opportunistic sightings for reptiles, diurnal birds and molluscs was undertaken. Targeted survey for Green and Golden Bell Frog, arboreal mammals and microchiropteran and mega bats was undertaken by Travers Bushfire and Ecology.

## 4.2 Literature and data review

Under the EPBC Act, actions that have, or are likely to have, a significant impact on a Matter of National Environmental Significance (Matter of NES) requires approval from the Australian Government Minister of the Environment (the Minister). An assessment of Matter of NES relevant to the proposed action was conducted prior to the referral of the proposed action using:

- literature review, including a search of the DotEE Protected Matters Search Tool.
- EPBC Act Referral, Macarthur Gardens North (ELA 2017)
- Previous reports for the site (Travers Bushfire and Ecology 2016 – 2019).

As part of the initial referral an online EPBC Act protected matters database search was conducted for an area incorporating the Macarthur Gardens North development site and a 10 km site buffer area. A total of 47 threatened species and seven threatened ecological communities (TEC) were identified through this search. These species and TECs are listed in the original referral document along with an assessment of the likelihood of occurrence. This assessment was undertaken using database or other records, presence or absence of suitable habitat, features of the development site, results of field surveys and professional judgement. The following terms denoting the likelihood of occurrence were assigned to each threatened species and TECs:

- “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.

A further analysis of the likely level of impact of the development was presented for all species and communities assigned a likelihood of occurrence of “known”, “likely” or “potential”. There was one known critically endangered ecological community (CPW), five threatened fauna species, three migratory species and two threatened flora species considered as having potential to utilise the site:

- *Anthochaera phrygia* (Regent Honeyeater) – critically endangered
- *Apus pacificus* (Fork-tailed Swift) – migratory under CAMBA, JAMBA & RoKAMBA
- *Chalinolobus dwyeri* (Large-eared Pied Bat) - vulnerable

- *Hirundapus caudacutus* (White-throated Needle-tail) – migratory under CAMBA, JAMBA & RoKAMBA
- *Lathamus discolor* (Swift Parrot) – critically endangered
- *Litoria aurea* (Green and Golden Bell Frog) – vulnerable
- *Pimelea spicata* (Spiked Rice-flower) - endangered
- *Pomaderris brunnea* (Brown Pomaderris) - vulnerable
- *Pteropus poliocephalus* (Grey-headed Flying-fox) - vulnerable
- *Rhipidura rufifrons* (Rufous Fantail) – migratory under the Bonn Convention.

## 4.3 Field survey

A summary of initial field surveys conducted by Travers Bushfire and Ecology prior to the submission of the referral is in **Table 2**. Field survey focused on validating vegetation community type, condition and extent as well as a habitat assessment and targeted survey for threatened species and migratory fauna identified as likely to utilise the site in the literature and data review.

### 4.3.1 Vegetation validation

Flora survey was undertaken on 19 and 20 July 2016 by Travers Bushfire and Ecology. A random meander search was undertaken in accordance with Cropper (1993) to create a broad species list.

Fifteen 20x20m / 50x20m floristic transect plots were assessed within vegetated portions of the site consistent with the BioBanking Assessment Methodology (BBAM) on the expectation that a BioBanking application may be required. Field survey was also designed to validate EPBC Act vegetation community type, extent and condition as well as target threatened species and migratory fauna listed under the EPBC Act, regarded as 'known', 'likely' or with the 'potential' to occur in the site. The following information was collected at each of the fifteen full floristic plots:

- Stratum (and layer): stratum and layer in which each species occurs
- Growth form: growth form for each recorded species
- Species name: scientific name and common name
- Percent projected foliage cover of the understorey strata and exotic vegetation

Targeted threatened flora survey followed the DEWHA (2010) guidelines for surveying threatened species (DEC 2004). This included random meanders throughout the site. Targeted searches for *Pimelea spicata* were also undertaken during the random meander searches and whilst undertaking transect plot surveys.

### 4.3.2 Threatened fauna survey

A summary of the fauna survey effort is described in **Table 2** and **Appendix C**.

**Table 2: Fauna survey effort (Travers Bushfire and Ecology 2016)**

| Fauna Group | Date | Weather conditions | Survey techniques | Survey effort / time (24hr) |
|---|---|---|---|---|
| Diurnal birds | 6/7/16<br>7/7/16<br>29/7/16 | 3/8 cloud, mod NW wind, no rain, temp 15ºC<br>8-5/8 cloud, no wind, showers, temp 12-15ºC<br>0/8 cloud, no wind, no rain, temp 7-18ºC | Diurnal opportunistic<br>Diurnal opportunistic<br>Diurnal opportunistic | 4hrs 55min 1205 – 1700<br>5hrs 20min 0830 – 1350<br>2hrs 0715 - 09155 |

| Fauna Group | Date | Weather conditions | Survey techniques | Survey effort / time (24hr) |
|---|---|---|---|---|
| Nocturnal birds | 6/7/16 | 5/8 cloud, no wind, no rain, temp 13ºC | Spotlighting<br>Call playback | 2hrs 50min 1700 – 1950<br>Commenced at 1800 |
| Arboreal mammals | 6/7/16 | 5/8 cloud, no wind, no rain, temp 13ºC | Spotlighting | 2hrs 50min 1700 - 1950 |
| Terrestrial mammals | 6/7/16 | 5/8 cloud, no wind, no rain, temp 13ºC | Spotlighting | 2hrs 50min 1700 - 1950 |
| Bats | 6/7/16 | 5/8 cloud, no wind, no rain, temp 13ºC | Spotlighting<br>Anabat SD-2 & SM4BAT (Passive monitoring) x2 | 2hrs 50min 1700 – 1950<br>Overnight from 1700 |
| Reptiles | 6/7/16<br>7/7/16 | 3/8 cloud, mod NW wind, no rain, temp 15ºC<br>8-5/8 cloud, no wind, showers, temp 12-15ºC | Habitat search, opportunistic<br>Habitat search, opportunistic | 4hrs 55min 1205 – 1700<br>5hrs 20min 0830 - 1350 |
| Amphibians | 6/7/16 | 5/8 cloud, no wind, no rain, temp 13ºC | Spotlighting & call identification | 2hrs 50min 1700 - 1950 |
| Molluscs | 6/7/16<br>7/7/16 | 3/8 cloud, mod NW wind, no rain, temp 15ºC<br>8-5/8 cloud, no wind, showers, temp 12-15ºC | Habitat search<br>Habitat search | 4hrs 55min 1205 – 1700<br>5hrs 20min 0830 - 1350 |
| Targeted Green and Golden Bell Frog | 23/10/17 | 0/8 cloud, light - no wind, no rain, temp 17-15ºC | Targeted survey (incuding habitat searches, call pay back, spotlighting) following 16.8mm of rainfall in the three days prior | 1hr 15min 1930 - 2045 |

### 4.4 Survey limitations

Targeted survey for the Green and Golden Bell Frog was not conducted in accordance with the survey guidelines (DEWHA 2010). Whilst not expected to occur, further survey for Green and Golden Bell Frog was recommended to be undertaken during the breeding period (September-January) when the species is most easily identified by call. The survey was conducted in October 2017 following 16.8 mm of rain as part of an expert report (Travers Bushfire and Ecology 2017b). The expert report concluded that the site was unlikely to support any Green and Golden Bell Frog individuals and is unlikely to be of any importance to the population. No further survey was recommended.

Original survey for *Pimelea spicata* conducted on 19 and 20 July 2016 by Travers Bushfire and Ecology were not conducted when the species was known to be in flower. A reference population was not checked prior to survey. Further survey by ELA on 24 August 2018 was conducted when the species was in flower.

## 4.5 Results

### 4.5.1 Vegetation communities

The results of the survey conducted by Travers Bushfire and Ecology 2016 identified Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest (CPW) in the site. This is likely to be significantly affected by the proposed action (**Figure 2**).

### 4.5.2 Flora, fauna and migratory species

Travers Bushfire and Ecology targeted survey did not identify any threatened flora, fauna or migratory species in the site during survey and no further survey was recommended. The referral concluded that the proposed action was unlikely to constitute a significant impact on any Matters of NES.

## 4.6 Additional information requirements

The submission of the referral concluded that a significant impact on any threatened flora, fauna or migratory species was unlikely to occur as a result of the proposed action. Following the submission of the referral, DotEE determined that the proposed action may significantly impact five Matters of NES in addition to CPW (EPBC Ref: 2017/8029).

DotEE requested additional targeted survey for the following three Matters of NES:

- *Lathamus discolor* (Swift Parrot)
- *Litoria aurea* (Green and Golden Bell Frog)
- *Pimelea spicata* (Spiked Rice-flower).

DotEE also requested further information for the following two Matters of NES:

- *Anthochaera phrygia* (Regent Honeyeater)
- *Pteropus poliocephalus* (Grey-headed Flying-fox).

Additional survey methodology, results and potential impacts to these five Matters of NES and CPW are discussed in chapters **5**, **6** and **7**.

# 5 Vegetation communities

Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest (CPW) is the only Matter of NES under the relevant controlling provision (listed threatened species and communities [section 18 &18A]) that, following extensive survey has been identified at the site. Landcom has focused on the preservation and improvement of the CPW on site throughout the planning process for the development.

This section of the report outlines the issues relating to CPW at the site and gives an analysis of the long term environmental outcomes throughout and following the proposed development. It provides a description of the community and its remaining distribution and the significance, extent and condition of CPW at the site. As required in the request for additional information (DotEE 15 November 2017), this report also discusses the following:

- potential impacts to CPW from the proposed action
- addresses threat abatement plans
- management measures.

## 5.1 Ecological community description

CPW is a critically endangered ecological community (CEEC) that occurs throughout the drier parts of the Sydney Basin Bioregion within NSW. Under the EPBC Act, the community is characterised broadly by the following structural features:

- a medium-height eucalypt woodland with a lower tree layer, dominated by a *Eucalyptus moluccana* (Grey Box) – *Eucalyptus tereticornis* (Forest Red Gum) canopy;
- an open, low shrub layer dominated by *Bursaria spinosa* (Native Blackthorn) understorey;
- an abundant grassy groundcover comprised of a several different grass species (DEWHA 2010).

The composition of the understorey (shrubby or grassy) can vary depending on the sites disturbance history, such as grazing or farming practices. Fire frequency is also known to affect the structure of associated plant species occurring within the community. Vegetation must also meet condition threshold criteria under the EPBC Act to qualify as CPW, which are outlined in **Table 3**.

**Table 3: Condition Thresholds for Patches that meet the Description for the Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest ecological community**

| Category and rationale | Thresholds |
|---|---|
| **A.** Core thresholds that apply under most circumstances: patches with an understorey dominated by natives and a minimum size that is functional and consistent with the minimum mapping unit size applied in NSW. | Minimum patch size is ≥0.5ha;<br>**AND**<br>≥50% of the perennial understorey vegetation cover is made up of native species |
| **OR** | |

| Category and rationale | Thresholds |
|---|---|
| **B.** Larger patches which are inherently valuable due to their rarity. | The patch size is ≥5ha;<br>**AND**<br>≥30% of the perennial understorey vegetation cover is made up of native species. |
| **OR** | |
| **C.** Patches with connectivity to other large native vegetation remnants in the landscape. | The patch size is ≥0.5 ha;<br>**AND**<br>≥30% of the perennial understorey vegetation cover is made up of native species;<br>**AND**<br>The patch is contiguous with a native vegetation remnant (any native vegetation where cover in each layer present is dominated by native species) that is ≥5ha in area. |
| **OR** | |
| **D.** Patches that have large mature trees or trees with hollows (habitat) that are very scarce on the Cumberland Plain. | The patch size is ≥0.5 ha in size;<br>**AND**<br>≥30% of the perennial understorey vegetation cover is made up of native species;<br>**AND**<br>The patch has at least one tree with hollows per hectare or at least one large tree (≥80 cm dbh) per hectare from the upper tree layer species outlined in the Description and **Appendix A**. |

### 5.1.1 Ecological value of CPW

The ecological value of remnant patches of CPW varies across Western Sydney. Key features that influence the ecological value of CPW include patch size, condition state and connectivity within the landscape.

It is important to understand these features of each remnant as they are known to contribute to the conservation significance of the area (MacNally and Horrocks, 2002). For example, fauna of conservation concern are unlikely to occupy remnants with a degraded understorey even if the size is suitable (Reid 1999). Areas of woodland in better condition generally have a higher greater ecological value by supporting a greater diversity of animals, including birds, reptiles, arboreal mammals and invertebrates.

Habitat connectivity also increases the overall ecological value of an area by building habitat heterogeneity into the landscape. The maintenance of this connectivity is important to ensuring the long-term viability of many populations of flora, fauna and ecological communities by preserving movements and exchanges between habitats that may become fragmented.

Retaining the ecological values of CPW has been key consideration in the design of both the development and conservation lands at Macarthur Gardens North. Principles considered include:

- prioritising retention of CPW in better condition
- focussing restoration efforts to connect the realigned Bow Bowing Creek with the retention areas in the site to decrease the impacts of edge effects and encourage regeneration
- maintaining and enhancing connectivity in the landscape through protection of strategic patches of CPW and re-establishment of CPW in suitable areas.

### 5.1.2 Distribution and extent of the community

The original extent of CPW has been significantly reduced since the introduction of agricultural and urban uses across the Cumberland Plain following European settlement (DECCW 2011). Surveys undertaken by Tozer (2003) coupled with detailed interpretation of colour aerial photography from 1997-1998, determined that only 9% of the original extent (pre-1750) of the community remained with greater than 10% canopy cover, with a further 14% remaining as scattered trees across the landscape (NPWS, 2002a; NPWS, 2002b).

A more recent study by the NSW Scientific Committee and Simpson (2008) re-assessed the status of the community in order to determine changes in distribution since November 1998. Comparing the 1997-1998 mapping undertaken by Tozer (2003) with orthorectified digital photography obtained in 2007, it was found that the remaining extent of the community had declined by approximately 442 ha or around 5.2% of its distribution nine years ago. Such clearing is likely to be a consequence of dispersed, small-scale clearing associated with urban development.

As of 2008, the remaining community existed at around 1,857 fragmented patches with an average patch size of 3.3 ha. These patches are distributed among both private and public lands. The largest remaining patch was 126 ha (NSWSC & Simpson, 2008) located within Scheyville National Park, about 40 km to the north of the site. Security from land clearing is provided for approximately 720 ha of the community through conservation in nature reserves, national parks, state retention areas and regional parks. In 2009, the ecological community occupied a maximum area of approximately 12,300 ha (Threatened Species Scientific Committee 2009).

## 5.2 CPW at Macarthur Gardens North

To adequately evaluate the impact the development will have on the CPW at Macarthur Gardens North it is important to assess various attributes of the vegetation community within the proposed development area. Attributes to be assessed include the diversity and structure of community, vegetation condition and extent (patch size/shape), habitat connectivity and context. These attributes of CPW at Macarthur Gardens North have been determined using a variety of data sources including:

- high resolution digital aerial photographs
- Vegetation of the Cumberland Plain – Vegetation & Core Habitat Mapping (NSW NPWS 2002, 2008)
- targeted field surveys undertaken by Travers Bushfire and Ecology (2016)
- the application of the Biodiversity Certification Assessment Methodology Calculator (discussed further below).

### 5.2.1 Diversity and structure

The canopy of the CPW onsite consisted of *Eucalyptus tereticornis*, *Eucalyptus moluccana* and *Eucalyptus crebra* at a height of between 15-25m and an average projected foliage cover of 20-25%. The mid-storey consisted of *Acacia parramattensis*, *Acacia implexa*, *Bursaria spinosa*, *Acacia decurrens*, *Dodonaea viscosa* and *Allocasuarina littoralis* up to 15m tall and with a projected foliage cover of 10-25%. Within the regrowth areas, there are generally no Eucalypts and the presence of Acacia species dominate, with a higher than average projected foliage cover (~40%) (Travers Bushfire and Ecology 2016).

The most dominant species observed in the groundcover included *Microlaena stipoides*, *Themeda triandra*, *Austrostipa pubescens*, *Aristida vagans*, *Brunoniella pumilio*, *Clematis glycinoides*, *Daviesia ulicifolia*, *Dichondra repens*, *Cheilanthes sieberi*, *Lomandra longifolia*, *Cyperus gracilis*, *Dianella revoluta*, *Oxalis perennans*, *Glycine clandestina*, *Goodenia hederacea* and *Einadia hastata* (Travers Bushfire and Ecology 2016; **Appendix A**).

### 5.2.2 Vegetation condition and extent

CPW is very fragmented in the site and within the locality. Most remnants are poor quality from weed invasion, regrowth or have a fully managed understorey. The natural vegetation throughout almost the entire site is a result of regrowth since the 1960s where historic aerials depict an almost cleared site. Thus, many of the existing trees on site have a smaller girth than a mature forest.

The CPW onsite occurs on higher contours of the site, generally outside of the core riparian area of Bow Bowing Creek. There are three main patches of CPW across the site (**Figure 2** and **Table 4**).

**Table 4: CPW to be affected and retained in the study area**

| CPW condition | Direct impacts (ha) | Retain (indirectly affected) (ha) | Total (ha) |
|---|---|---|---|
| Moderate – good | 1.43 | 0.47 | 1.9 |
| Derived Native Grassland | 0.32 | 0.00 | 0.32 |
| Regrowth | 0.48 | 0.40 | 0.88 |
| Total (ha) | **2.23** | **0.87** | **3.1** |

*Please note, indirectly affected EPBC Act CPW (labelled 'moderate' above will be offset)

Where the CPW occurred as derived native grassland, the canopy and midstorey was absent. The groundcover was comprised of >50% native perennial species typical to CPW groundcover. Where this community occurred as regrowth, the *Eucalyptus* spp. were absent and *Acacia* spp. was dominant. Travers Bushfire and Ecology (2016) determined that all patches of CPW in the site met the EPBC Act definition. The large patch of CPW along the northern boundary of the site met condition class A because:

- the patch is > 0.5 ha
- the perennial understorey contains ≥50% native perennial understorey (Travers Bushfire and Ecology 2016).

The patches of derived native grassland and regrowth also met the EPBC Act definition of the community because they formed part of a larger patch. The larger patch is considered to be the patch comprised of River-flat Eucalypt Forest (4.72 ha) and CPW Moderate – good condition (Travers Bushfire and Ecology 2016).

Historic clearance, damming of the waterways, surrounding development pressure and informal roadways have also resulted in increased levels of sedimentation and nutrient accumulation within the watercourses and drainage depressions within the site. This in turn has encouraged weed proliferation and facilitated a general degradation of biodiversity values within the CPW areas. In this context, the historical and current use of the site has led to a general decline in the site's biodiversity values and the condition of CPW vegetation within it.

The longer-term viability of CPW is expected to experience further threats in the short and longer term due to current and proposed future landuse framework. The main threats are associated with the localised edge effects introduced by surrounding urban development.

*BioMetric assessment and Site Value scores*

The following information provides a broad understanding of the NSW Biobanking Assessment Methodology (BBAM). It is noted this information should be read in conjunction with the Biodiversity Assessment Report (BAR) prepared by Travers Bushfire and Ecology (2017a).

A vegetation condition score for the CPW in the site has been based on BioMetric plot data collected and calculated using the BBAM. This methodology provides a Site Value score out of 100, based on various factors including 10 BioMetric attributes, collected over a nested 20 x 50 m plot. The 10 attributes include:

- Native plant species richness (20 x 20 m plot)
- Native plant projected cover (50 m transect):
  - overstorey
  - midstorey
  - groundcover (grasses, shrubs and other)
- Exotic plant cover (overstorey, midstorey and groundcover) (50 m transect)
- Number of trees with hollows (50 x 20 m plot)
- Overstorey regeneration (entire Vegetation Zone)
- Length of fallen logs (50 m transect)

Other attributes considered by the BBAM when calculating a Site Value score include, native vegetation extant within a 100 ha and 1,000 ha concentric circles, connectivity in the landscape, consideration of State, Regional and Local Biodiversity links and the area of adjacent remnant vegetation.

*Vegetation Types and Zones*

In the BBAM, the basic unit for calculating Site Values are BioMetric Vegetation Types (hereafter, vegetation type), and more concisely the Vegetation Zone (vegetation zone) which are a representation of the type and condition of vegetation found on the ground. Achieving accurate vegetation type and condition mapping across the assessment area is a crucial step in the application of the BBAM, as the 'vegetation zones' are the fundamental stratification units for the majority of the successive analysis.

A vegetation zone is a '*relatively homogenous area consisting of the same vegetation type in the same broad condition state*' (OEH 2014). For the purposes of the BBAM assessment in the site, the CPW vegetation was stratified into three vegetation zones, representing the broad condition state of the vegetation type. These zones for the site were "Moderate to good", "Moderate to good_poor (regrowth)" and "Moderate to good_derived native grassland".

Each vegetation was zone was assessed in the Biobanking Assessment Report (Travers Bushfire and Ecology 2017a) using plot and transect surveys to determine the site value score. The three CPW vegetation zones within the site achieved the following site value scores:

- "Moderate to good" = 52.08/100
- "Moderate to good_poor (regrowth)" = 22.92/100
- "Moderate to good_derived native grassland" = 11.98/100.

To offset impacts to 2.23 ha of CPW, a total of 74 ecosystem credits under the BBAM would be required. Offsets for indirect impacts to 0.87 ha of CPW will also be acquired using the BBAM. It is expected that an additional 33 credits would be required to offset the indirect impacts.

### 5.2.3 Regional significance of CPW at Macarthur Gardens North

There is no CPW immediately adjacent or contiguous with the site. Areas that are contiguous are mostly River-flat Eucalypt Forest in the site which are fragmented themselves mainly due to residential

development, transport infrastructure and historic farming practices. The site is bordered by the rail line, Gilchrist Drive, cleared land and Western Sydney University.

Connectivity does not occur between the CPW in the site and any CPW within the locality. Aerial photography shows that offsite vegetation has been extensively cleared within the locality. The removal of native vegetation has occurred through historic clearing associated with agricultural uses and has occurred more recently as part of the development of the Greater Macarthur Priority Growth Area.

Within this regional context, the site is likely to facilitate the movement of more mobile species, such as birds and bats. However, less mobile species (e.g. ground dwelling species) have extensive barriers that limit their potential for movement through the landscape. These barriers would be exacerbated by the proposed action.

Within the context of the broader Cumberland Plain it is difficult to define the importance of the site given its previous land use and condition. However, some guidance can be provided by considering the remaining extent of CPW within Western Sydney. As outlined previously, remaining areas of CPW exists as around 1,857 fragmented patches with an average patch size of 3.3 ha. This suggests the CPW to be affected in the site represents some of the smaller remnants of the community. Although, taken as a proportion of the total remaining CPW within western Sydney (estimated at 11,054 ha by Tozer (2003)) the site currently supports only 0.02% (3.1 ha) of remnant CPW.

The site currently adjoins existing development and land earmarked for future urban development (**Figure 1**), in Blair Athol, Western Sydney University, Macarthur and throughout the broader Campbelltown LGA. Immediately to the south of the site is the rail corridor and immediately north, Western Sydney University which is likely to increase the edge effects in the form of unauthorised access, illegal dumping, weed invasion and general littering.

The CPW within the site is likely to be highly susceptible to degradation through the aforementioned edge effects due to the small extent of the remaining patch and level of clearing and disturbance expected to occur during the proposed works.

Unauthorised access to the revegetated Bow Bowing Creek is also likely to increase the incidence of illegal burning and inappropriate fire regimes. The installation of appropriate fencing and signage to limit access would minimise the potential impacts to the community associated with unauthorised access.

# 6 Fauna

## 6.1 *Anthochaera phrygia* (Regent Honeyeater)

The Regent Honeyeater is a generalist forager, which mainly feeds on the nectar from a wide range of eucalypts and mistletoes. Key eucalypt species include *Eucalyptus sideroxylon*, *E. melliodora*, *E. blakely*, *E. albens* and *E. robusta*. The Regent Honeyeater also utilises: *Eucalyptus microcarpa*, *E. punctata*, *E. polyanthemos*, *E. moluccana*, *Corymbia robusta*, *E. crebra*, *E. caleyi*, *C. maculata*, *E. mckieana*, *E. macrorhyncha, E. laevopinea*, and *Angophora floribunda*. Nectar and fruit from the mistletoes *Amyema miquelii*, *A. pendula* and *A. cambagei* are also eaten during the breeding season. Habitat critical to the survival of this species includes any breeding or foraging areas where the species is likely to occur and any newly discovered breeding or foraging locations.

There are three known breeding locations within NSW; Bundarra-Barraba, Capertee Valley and Hunter Valley districts (DotE 2016). The foraging habits of the Regent Honeyeater are known to vary considerably each year, to respond to regional flowering patterns of their key feed species. Therefore, they occupy a wide foraging range with a versatile mosaic of foraging resources. This species would not rely on one area for foraging habitat.

### 6.1.1 Application of the Significant Impact Criteria

The application of the significant impact criteria determined that the proposed action is unlikely to constitute a significant impact on the Regent Honeyeater (**Table 5**).

**Table 5: Application of Significant Impact Criteria for the Regent Honeyeater**

| Significant Impact Criteria | Assessment |
|---|---|
| lead to a long-term decrease in the size of a population | No. No breeding habitat would be affected. No individuals were identified during diurnal bird surveys. The site contained a limited number of feed trees typically utilised by this species. Large portions of the potential foraging habitat to be affected consisted of regrowth *Acacia* sp. which is not a feed tree for this species. The proposed action would remove 4.37 ha of marginal foraging habitat. This is unlikely to lead to a long-term decrease in the size of the population given the retention of 1.86 ha of marginal foraging habitat in the site along with the future revegetation of 3.40 along Bow Bowing Creek. |
| Reduce the area of occupancy of a species | No. The Regent Honeyeater has a large area of occupancy stretching from the NSW border with Queensland to Melbourne. There are four known breeding locations which are bordered by subsidiary foraging areas. The Hunter Valley is the closest breeding site. No breeding habitat would be affected and no individuals were identified during diurnal bird surveys. The proposed action would result in the removal of 4.37 ha of marginal foraging habitat. This marginal foraging habitat would form part of a mosaic of foraging resources within the locality and would not be relied upon. The proposed action would also retain 1.86 ha of marginal foraging habitat in the site, with 3.40 ha to be revegetated along Bow Bowing Creek. |
| Fragment an existing population into two or more populations | No. The Regent Honeyeater comprises a single population. The site does not form part of a known breeding site. The removal of 4.37 ha of marginal foraging habitat would not fragment the single population given the small extent of the habitat to be removed and its isolated nature given the surrounding landscape. |

| Significant Impact Criteria | Assessment |
|---|---|
| Adversely affect habitat critical to the survival of the species | No. Habitat critical to the survival of the Regent Honeyeater includes any breeding or foraging areas where the species is likely to occur and any newly discovered breeding or foraging locations. The site does not form part of a breeding location. The site does include marginal foraging habitat. The proposed action would remove 4.37 ha of marginal foraging habitat. The removal of 4.37 ha of marginal foraging habitat is unlikely to adversely affect critical habitat given it would form part of a foraging network, would not be relied upon by this species and is highly fragmented from other foraging resources within the locality. In addition, 1.86 ha of marginal foraging habitat would be retained within the site with 3.40 ha to be revegetated along Bow Bowing Creek. |
| Disrupt the breeding cycle of a population | No. The Regent Honeyeater is known to breed in three distinct locations throughout NSW – the Capertee Valley, Bundarra-Barraba and Hunter Valley regions. The site does not overlap with these breeding sites. The Regent Honeyeater favours creek flats, broad river valleys and wet lowland coastal forests. They tend to build nests in *Casuarina* sp. and *Angophora* sp. The site does not contain the preferred habitat features or suitable breeding trees and would be highly unlikely to become a breeding site. |
| Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline | No. The Regent Honeyeater is known to breed in three distinct locations throughout NSW – the Capertee Valley, Bundarra-Barraba and Hunter Valley regions. The site does not overlap with these breeding sites. The site does include marginal foraging habitat. The proposed action would remove 4.37 ha of marginal foraging habitat. The removal of 4.37 ha of marginal foraging habitat is unlikely to adversely affect critical habitat given it would form part of a foraging network, would not be relied upon by this species and is highly fragmented from other foraging resources within the locality. In addition, 1.86 ha of marginal foraging habitat would be retained within the site with 3.40 ha to be revegetated along Bow Bowing Creek. Therefore, the proposed action is unlikely to impact marginal habitat such that the species is likely to decline. |
| Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat | Domesticated cats may increase as a result of the proposed action. However, given the site is unlikely to be utilised by the species, any increase in the presence of domestic cats would be unlikely to impact this species. |
| Introduce disease that may cause the species to decline | The Recovery Plan does not list any diseases known to, or considered likely to impact the Regent Honeyeater. |
| Interfere with the recovery of the species | The proposed action would be removing marginal, secondary foraging habitat for this species and would only be used on an occasional basis. No known breeding sites or roosting sites would be affected. About 1.86 ha of marginal foraging habitat would be retained with an additional 3.40 ha to be revegetated along Bow Bowing Creek. The proposed action is consistent with the actions of the recovery plan. |

### 6.1.2 Impact conclusion

The site contains 6.7 ha of potential foraging habitat for the Regent Honeyeater in the form of 3.1 ha of CPW and 3.5 ha of River-flat Eucalypt Forest (Travers Bushfire and Ecology 2016). Diurnal bird survey (Travers Bushfire and Ecology 2016) did not detect the Regent Honeyeater during survey. No known breeding sites are present within the site or locality. The Regent Honeyeater has not been recorded within a 10 km radius of the site in the past 20 years. The patches of CPW and River-flat Eucalypt Forest in the site may provide limited foraging resources for this species. The foraging resources within the site would form part of a larger foraging network and would not be relied upon. The Regent Honeyeater would not utilise the site for breeding purposes.

It was determined through the application of the EPBC Act Significant Impact Criteria that the proposed action would be unlikely to constitute a significant impact on the Regent Honeyeater.


**Figure 4: Potential Regent Honeyeater habitat to be affected and retained in the site**

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

The Grey-headed Flying-fox occurs across the coastal belt from Rockhampton, Queensland to Melbourne, Victoria. The distribution and abundance of the species varies during the year due to changes in food availability corresponding to flowering and fruiting events. The species is a nectarivore and fruitivore foraging on a wide range of habitats including rainforests, open forests, closed and open woodlands, Melaleuca and Banksia woodlands. The species occupies a wide foraging range and can travel <50 km in one feeding foray.

This species will alter their roosting behaviour when foraging resources within the locality of their camp are low. A large camp will generally break up into smaller colonies and roost in small groups near the trees they are using for feeding. During winter, there is evidence to suggest that the population migrates to the north coast of NSW and southern Queensland (DotE 2015). This is because these portions of the coast contain feed tree species that flower reliably during this period.

The Grey-headed Flying-fox was identified opportunistically flying over the site (Travers Bushfire and Ecology 2017). There are an additional 22 records for this species within a 10 km radius of the site (OEH 2019). No targeted survey was undertaken for this species. Habitat critical to the survival of the Grey-headed Flying-fox has not been defined as part of the Recovery Plan, however critical habitat could be defined as foraging habitat, migration corridors, stop over points and roosting habitat within the range of available resources (DECCW 2009; DotE 2015).

Travers Bushfire and Ecology (2017) concluded that the species is likely to occupy a camp in proximity to the site. No roosting or breeding individuals have been identified in the site, and it is unlikely to be used for these purposes. The closest known camp is located in between Blaxland Road and Huntley street, 2.5 km north east of the site (DotE 2019). The camp has fluctuated in size over the past 5 years and is currently occupied by 500 – 2,499 individuals (DotE 2019). There are an additional four camps within a 30 km radius of the site:

- Macquarie Fields – 1 – 499 individuals
- Cabramatta – 2,500 – 9,999 individuals
- Clyde – 500 – 2,499 individuals
- Picton – 2,500 – 9,999 individuals (DotE 2019).

The proposed action would:

- remove 4.85 ha of potential foraging habitat
- retain 1.92 ha of foraging habitat
- revegetate an additional 4.6 ha of foraging habitat in the site (note, this includes 1.20 ha of revegetation to riparian woodland that will be completed under a separate VMP (Greening Australia 2015; **Appendix I**))
- manage a total of 6.52 ha of potential foraging habitat for this species through the implementation of VMPs.

Grey-headed Flying-fox within a 30 km radius of the site may use the foraging resources available within the site. The habitat present will not be relied upon as a sole foraging resource for this species, but rather, they will utilise a range of resources within 30 km of their camps. As such, the resources available in the study area form part of a mosaic of resources within the locality.

The retention and revegetation of 6.52 ha of potential foraging habitat for the grey-headed Flying-fox will create a positive outcome through increasing the overall amount of foraging habitat within the site by 1.67 ha. The proposed action will provide a densely vegetated corridor along Bow Bowing Creek which would

incorporate the retention of existing Cumberland Plain Woodland. This corridor will form part of a larger revegetated riparian corridor along the portion of Bow Bowing Creek that extends to the west of the site. This will be revegetated to Cumberland Plain Woodland and River-flat Eucalypt Forest which will provide foraging habitat for this species. Thus, the proposed action will improve the existing foraging habitat and increase the availability of habitat in the locality. The removal of 4.85 ha is not considered significant with respect to the Grey-headed Flying-fox, given the retention and revegetation of 6.52 ha resulting in an increase of foraging habitat available by 1.67 ha.

### 6.2.1 Application of the Significant Impact Criteria

The significant impact criteria were applied with respect to the Grey-headed Flying-fox and concluded that the proposed action is highly unlikely to constitute a significant impact on this species (**Table 6**).

**Table 6: Application of the Significant Impact Criteria to the Grey-headed Flying-fox**

| Significant Impact Criteria | Assessment |
|---|---|
| Lead to a long term decrease in the size of an important population of a species | No. There is one single interbreeding population of the Grey-headed Flying-fox. No known roosting or breeding habitat in the form of camps would be affected. About 4.85 ha of potential foraging habitat would be affected. The closest camp is located 2.5 km to the west of the site, which currently contains 500 – 2,499 individuals. The site would be used occasionally for foraging and would form part of a mosaic of foraging resources throughout the region. The Grey-headed Flying-fox would not rely solely on the resources within the site, given their highly mobile nature and tendency to change foraging behaviours in response to flowering and fruiting events. The proposed action would retain and revegetate 6.19 ha of potential foraging habitat across the site. |
| Reduce the area of occupancy of an important population | No. The Grey-headed Flying-fox is one, single interbreeding population and occupies the coastal belt from Rockhampton to Melbourne. No known roosting or breeding habitat in the form of camps would be affected. The removal of 4.85 ha of marginal foraging habitat is unlikely to reduce the area of occupancy of this species given their large foraging range, retention and revegetation of 6.52 ha of foraging habitat within the site and availability of 32,167 ha of foraging habitat within the locality. In addition, this species is known to utilise a range of foraging resources within a region. This species would not rely solely on the vegetation within the site for foraging purposes. |
| Fragment an existing important population into two or more populations | No. There is a single inter-breeding population in Australia. The proposed action would remove 4.85 ha of potential foraging habitat that would be used occasionally and would form part of a mosaic of resources within the locality. No roosting or breeding habitat in the form of camps would be affected. The foraging resources within the locality would not form a migration stop over point or result in the fragmentation of two areas of potential foraging habitat.<br>The proposed action will retain 1.92 ha and revegetate of 4.60 ha of native vegetation within the site. This will create an increase of potential foraging habitat available by 1.67 ha. The proposed revegetation works would augment and re-establish a contiguous corridor of vegetation throughout the site and onto neighbouring land. Thus, the population would not be fragmented into two or more. |
| Adversely affect habitat critical to the survival of a species | No. Critical habitat is defined as natural habitat that is productive during winter and spring when food bottlenecks have been identified, that is known to support populations of >30,000 individuals within an area of a 30 km radius, productive during the final weeks of gestation, during birth, lactation and conception, productive during |

| Significant Impact Criteria | Assessment |
|---|---|
| | the final stages of fruit development and ripening in commercial crops affected by the Grey-headed Flying-fox and known to support a continuously occupied camp. No breeding or roosting sites were identified within the site. The foraging resources present would not be relied upon and would form part of a larger resource network within the locality. |
| Disrupt the breeding cycle of an important population | No. There is one single interbreeding population of the Grey-headed Flying-fox. No known roosting or breeding habitat would be affected. The species forages widely and would not rely solely on the resources within the site. The removal of 4.85 ha of potential foraging habitat may impact foraging behaviour, however the resourced within the site would be unlikely to solely sustain any juveniles or a camp within the locality. The Grey-headed Flying-fox is known to utilise a range of resources and responds to changes in flowering events throughout the year and in subsequent years. In addition, 6.52 ha of potential foraging habitat would be retained and revegetated in the site. This would increase the amount of potential foraging habitat available, and provide a contiguous corridor through the site. |
| Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline | The proposed action would remove 4.85 ha of potential foraging habitat for this species. No known roosts or breeding habitat in the form of camps would be affected. The Grey-headed Flying-fox is known to forage widely and utilise a range of foraging sites within the locality. Their foraging behaviour responds to fluctuations in flowering and fruiting activity. As such, the potential foraging habitat in the site would not be relied upon by this species, but it would form part of a foraging resource network.<br>The proposed action will retain 1.92 ha and revegetate of 4.60 ha of native vegetation within the site. This will increase the availability and quality of foraging habitat by 1.67 ha. As such, the proposed action is unlikely to cause the species to decline. |
| Result in an invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat | No. The proposed action would remove 4.85 ha of potential foraging habitat for this species. Due to the wide foraging range of this species, the removal of 4.85 ha is unlikely to increase competition from other species such as *Pteropus alecto* (Black Flying-fox). |
| Introduce disease that may cause the species to decline | No. There is one single interbreeding population of the Grey-headed Flying-fox. No known roosting or breeding habitat would be affected. Grey-headed Flying-foxes are known natural reservoirs for the Australian Bat Lyssavirus. The removal of 4.85 ha of potential foraging habitat would be unlikely to cause a competition for resources such that fighting over resources (and thereby increasing contact between infected and non-infected bats) would increase. |
| Interfere substantially with the recovery of the species | No. The proposed action would remove 4.85 ha of potential foraging habitat for this species. The Grey-headed Flying-fox is known to forage widely and would utilise a range of resources within the locality. The proposed action will retain 1.92 ha of potential foraging habitat and revegetate 4.60 ha of potential foraging habitat. The proposed action will result in an increase of potential foraging habitat available by 1.67 ha. Thus, the proposed action is unlikely to interfere with the recovery of the species. |

### 6.2.2 Impact conclusion

The proposed action will remove 4.85 ha of potential foraging habitat. The proposed action will retain 1.92 ha of foraging habitat, revegetate an additional 4.60 ha of foraging habitat and manage a total of 6.52 ha of potential foraging habitat for this species through the implementation of VMPs. Note, the habitat to be managed includes 1.20 ha of revegetation of riparian woodland that will be managed under a separate VMP (Greening Australia 2015). This revegetation forms part of the detention basin that falls within the site. No known Grey-headed Flying-fox camps will be affected as part of the proposed action. It is expected that the foraging resources within the site form part of a large mosaic of foraging habitat, will be used occasionally and will not be relied upon.

The proposed action will create an overall increase in the foraging habitat available by 1.67 ha. This is considered a positive outcome for the species and the temporary loss of 4.85 ha is unlikely to constitute a significant impact with respect to the Grey-headed Flying-fox.


**Figure 5: Potential Grey-headed Flying-fox habitat to be affected and retained in the site**

## 6.3 *Lathamus discolor* (Swift Parrot)

The Swift Parrot breeds in Tasmania during the Australian summer and migrates north as a single population to mainland Australia (NSW, ACT and VIC) during winter. In NSW the Swift Parrot typically forages in forests and woodlands and tends to prefer mature trees. When on mainland Australia this species feeds on flowers and lerps in Eucalyptus spp. and will often forage widely. This species requires hollow bearing trees in proximity to foraging resources that are in flower and producing nectar.

Field survey identified 6.7 ha of potential habitat for the Swift Parrot within the site in the form of 3.1 ha of CPW and 3.5 ha of River-flat Eucalypt Forest (Travers Bushfire and Ecology 2016). It is estimated that seven of the 14 hollow-bearing trees may be removed. All hollows would be inspected before removal using a camera probe by a fauna ecologist. Artificial hollows are proposed for re-installation on retained trees and will be addressed under a nest box management plan. The number of hollows to be replaced with nest boxes would exceed the number being removed.

### 6.3.1 Targeted survey

Diurnal bird survey during winter did not detect the species (Travers Bushfire and Ecology 2016). Additional targeted survey for the Swift Parrot was conducted by ELA ecologists Alex Gorey, Danielle Adams-Bennet and Rodney Armistead 17 April 2018 to 30 May 2018. The survey was conducted in accordance with the Survey Guidelines for Australia's Threatened Birds (DEWHA 2010). The site was initially surveyed to identify areas of potential foraging habitat. This included mapping the condition, extent and structure of Cumberland Plain Woodland and River-flat Eucalypt Forest in the site. Potential foraging habitat was defined as areas of Cumberland Plain Woodland or River-flat Eucalypt Forest containing mature *Eucalyptus* spp.

Targeted survey was conducted over eight days throughout the mainland foraging season (March – July) for a total of 20 person hours (**Table 7**). Potential foraging habitat in the site was traversed by two ELA ecologists with seven surveys occurring at dawn and one at dusk. Surveys were conducted to coincide with the time at which the Swift Parrot is most behaviourally active and likely to be utilising the resources within the site (DEWHA 2010). The site was traversed slowly on foot with periods of stationary listening and observation. All birds that were observed or heard foraging, flying over heard or roosting in the site were noted (**Appendix B**).

**Table 7: Targeted Swift Parrot survey date, time and weather conditions**

| Survey date | Survey time | Temperature (min °C) | Temperature (max °C) | Rainfall (mm) |
|---|---|---|---|---|
| 17 April 2018 | 7 am – 8.15 am | 11.8 | 24.85 | 0 |
| 20 April 2018 | 7.16 am – 8.40 am | 12.5 | 28.1 | 0 |
| 23 April 2018 | 6.50 am – 8.15 am | 11.6 | 26.7 | 0 |
| 24 April 2018 | 6.45 am – 8.05 am | 11.1 | 27.4 | 0 |
| 27 April 2018 | 7 am – 8.15 am | 13.5 | 22.6 | 0 |
| 3 May 2018 | 7.05 am – 8.24 am | 8.2 | 27.8 | 0 |
| 10 May 2018 | 3.45 pm – 5.07 pm | 7.3 | 24.8 | 0.4 |
| 30 May 2018 | 7.50 – 9.05 am | 10.1 | 18.1 | 0.2 |

### 6.3.2 Results

No Swift Parrots were heard or observed in the site during the survey period (**Appendix B**).

### 6.3.3 Application of the Significant Impact Criteria

The Significant Impact Criteria was applied to the Swift Parrot and concluded that the proposed action would not constitute a significant impact on this species.

**Table 8: Application of the significant impact criteria to the Swift Parrot**

| Significant Impact Criteria | Assessment |
|---|---|
| lead to a long-term decrease in the size of a population | No. The habitat within the site is considered marginal for the species. No individuals were identified during survey. The species would not rely on the site, are highly mobile and would utilise a range of foraging resources |
| Reduce the area of occupancy of a species | No. The habitat within the site is considered marginal for the species. No individuals were identified during survey. The species would not rely on the site, are highly mobile and would utilise a range of foraging resources. |
| Fragment an existing population into two or more populations | No. There is one single interbreeding population of the Swift Parrot. The proposed action would not impact any known breeding habitat. The species would not rely on the site, are highly mobile and would utilise a range of foraging resources. |
| Adversely affect habitat critical to the survival of the species | Habitat critical to the survival of the species refers to areas that are necessary: for activities such as foraging, breeding, roosting or dispersal, for the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the ecological community, such as pollinators), to maintain genetic diversity and long term evolutionary development or for the reintroduction of populations or recovery of the species or ecological community. The proposed action would not impact any known breeding habitat. The species would not rely on the site, are highly mobile and would utilise a range of foraging resources. |
| Disrupt the breeding cycle of a population | The Swift Parrot breeds in Tasmania during summer and migrates to the mainland during winter. Therefore, no breeding habitat would be affected as part of the proposed action. The species would not rely on the site, are highly mobile and would utilise a range of foraging resources. |
| Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline | The Swift Parrot breeds in Tasmania during summer and migrates to the mainland during winter. Therefore, no breeding habitat would be affected as part of the proposed action. The species would not rely on the site, are highly mobile and would utilise a range of foraging resources. |
| Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat | Invasive species which pose a threat to the Swift Parrot include those which increase competition for food and nesting resources such as the Noisy Miner. The subject site contains fragmented, marginal foraging habitat in an area that is located in a densely populated urban pocket of Sydney. As such, species like the Noisy Miner are already in abundance in these areas due to their preference for open areas. The proposed |

| Significant Impact Criteria | Assessment |
|---|---|
| | action would not increase the presence of the Noisy Miner or other nectivorous species likely to be a threat to the Swift Parrot. |
| Introduce disease that may cause the species to decline | The Swift Parrot is susceptible to Psittacine Beak and Feather Disease (PBFD). Increases in stress caused by competition for food and roosting resources can increase the impacts of PBFD on the population. No known breeding sites would be affected and only marginal foraging habitat which would not be relied upon. |
| Interfere with the recovery of the species | The recovery actions are outside the scope of this assessment. |

### 6.3.4 Impact conclusion

The Swift Parrot relies on a range of *Eucalyptus* spp. of which only one is present in the site; *Eucalyptus tereticornis* (OEH 2011). The species is known to prefer large, mature trees that provide a more reliable source of foraging habitat. Isolated patches of potential foraging habitat in urban areas are considered marginal and would be used opportunistically to compensate for a lack of natural foraging resources (OEH 2011). These patches are only marginal due to the aggressive species such as *Acridotheres tristis* (Common Myna) that are likely to outcompete native species. The site is surrounded by urban development and contains a limited number of mature *Eucalyptus tereticornis*. Some species, including the exotic *Acridotheres tristis* (Common Myna) and the native *Manorina melanocephala* (Noisy Miner) that are known to aggressively outcompete other native birds was also identified in the site (DotEE 2014). The Noisy Miner was abundant within the site and observed during every survey effort foraging mostly on the mature trees within the site (**Appendix B**).

Given the species was not identified during targeted survey and the abundance of aggressive bird species, limited number and diversity of feed tree species and mature tree species the site is highly unlikely to provide foraging habitat for the Swift Parrot.

The proposed action would lead to the loss of 4.37 ha of potential foraging habitat for this species, however, a large portion of the removed vegetation is for stream realignment works which will include revegetation and conservation management. The cumulative loss of localised fauna habitat will be minimised through restoration measures post creek realignment, translocation and nest box installation. Weed control, which will be introduced with a Vegetation Management Plan post construction, will improve retained and restored vegetation, thus maintaining potential habitat.

It was determined through the application of the EPBC Act Significant Impact Criteria that the proposed action would be unlikely to constitute a significant impact on the Swift Parrot.


**Figure 6: Potential Swift Parrot habitat to be affected and retained in the site**

## 6.4 *Litoria aurea* (Green and Golden Bell Frog)

The Green and Golden Bell Frog occurs throughout Victoria and New South Wales. Vegetation clearance and habitat fragmentation has led to species decline, resulting in eight key populations within the Sydney region, and a range of transient sites (DEC 2005). No key populations or transient populations are located within the site. There are two records for this species since 1980 along a tributary of Biriwiri Creek in Blair Athol (**Figure 12**). The species was recorded in 2013 and 2015 (OEH 2018). The records are located about 2 km east of the site, however there is significant residential development and transport infrastructure between the site and the recorded locations. There are no habitat corridors between the site and Blair Athol and population dispersal between the two sites is highly unlikely.

### 6.4.1 Targeted survey

ELA Ecologists Alex Gorey and Rod Armistead undertook a habitat stratification assessment of potential Green and Golden Bell Frog habitat in the site and adjacent areas. Dip netting was undertaken at numerous survey points along the length of Bow Bowing Creek to search for *Gambusia holbrooki* (Plague Minnow) and any tadpoles or egg clutches. Survey was conducted on 17 April 2018 for a total of 6 person hours and focused on the lengths of Bow Bowing Creek that contained flowing water (**Figure 11**). The drainage swale beyond the eastern boundary of the site previously identified by Travers Bushfire and Ecology was also surveyed for potential habitat features (**Figure 11**).

The habitat stratification assessment aimed at determining whether the site was likely to provide breeding, foraging or basking habitat for the Green and Golden Bell Frog. The habitat stratification assessment assessed the following:

- is the water body ephemeral or still
- water depth
- pollution present
- sand or rock substrate
- shade levels
- presence of *Gambusia holbrooki* (Plague Minnow) – assessed through dip netting along Bow Bowing Creek
- grassy areas or complex woodland structure adjacent to water body
- clumps of emergent macrophytes present
- sheltering opportunities present.

### 6.4.2 Results

No Green and Golden Bell Frog individuals or egg clutches were identified during the survey. The site contains limited resources for this species (**Table 9**).

**Table 9: Green and Golden Bell Frog Habitat Stratification assessment results**

| Site | Habitat description | Breeding habitat | Foraging habitat | Refuge / Basking habitat | Likelihood of occurrence |
|---|---|---|---|---|---|
| 1 | • man-made grassy swale with large areas of bare dirt<br>• some *Typha australis* present<br>• connected to storm water drain upstream and piped at two points<br>• isolated from neighbouring vegetation to the east and north<br>• some vegetation present to the west and south with large grassy areas in between | • no shade present<br>• no water present<br>• man-made rock substrate<br>• low levels of pollution | • no fringing vegetation<br>• grassy areas extremely limited with expansive areas of bare dirt<br>• nearest fringing vegetation about 150 m to the west of the swale which is highly disturbed with large areas of fill, dominated by exotic groundcover species | • no sheltering opportunities present (no rocks, woody debris, rubbish present) | • highly unlikely to provide sheltering, foraging or basking habitat given lack of sheltering opportunities, recent construction of the swale, deficiency of connections to water bodies in Blair Athol<br>• unlikely to provide breeding habitat given isolation from Blair Athol population, recent construction of drainage swale, absence of previous records. and absence of basking, sheltering and foraging habitat |
| 2 | • natural creekline with areas of erosion<br>• high level of weed invasion<br>• disturbance from *Oryctolagus cuniculus* (European Rabbit) and *Vulpes vulpes* (Red Fox)<br>• some patches of *Typha australis* present<br>• piped at two points | • ephemeral and still sections<br>• *Gambusia holbrooki* present throughout all still pools of water<br>• depth varying from 1 cm – 1 m<br>• very heavily shaded along entire length of Bow Bowing Creek | • limited grassy areas<br>• woodland with complex structure adjacent along length of creekline<br>• high level of weed invasion<br>• some clumps of emergent macrophytes however not consistent along entire creek | • some sheltering opportunities in the form of rocks, woody debris and rubbish | • unlikely to provide sheltering, foraging or basking habitat given heavy shading and limited grassy areas<br>• highly unlikely to provide breeding habitat given presence of *Gambusia holbrooki*, isolation from Blair Athol population, absence of previous records. and absence of basking, sheltering and foraging habitat |
| 3 | • drainage line with large culvert<br>• dominated by *Typha australis* | • heavy shade<br>• no water present<br>• low levels of pollution | • limited grassy areas<br>• woodland dominated by *Acacia* sp. and grassy understory | • some sheltering opportunities in the form of rocks, woody debris and rubbish | • unlikely to provide sheltering, foraging or basking habitat given heavy shading, lack of recent records (since 1980) and isolated nature from Blair Athol<br>• highly unlikely to provide breeding habitat given absence of water bodies either ephemeral or still, lack of records, lack of sheltering, basking or refuge habitat and lack of hydrological or vegetative connections to the Blair Athol records |

### 6.4.3 Application of the Significant Impact Criteria

The Significant Impact Criteria was applied with respect to the Green and Golden Bell Frog and concluded that the proposed action is highly unlikely to constitute a significant impact on this species (**Table 10**).

**Table 10: Application of Significant Impact Criteria to the Green and Golden Bell Frog**

| Significant Impact Criteria | Assessment |
|---|---|
| Lead to a long term decrease in the size of an important population of a species | No. The closest records for the GGBF is in Blair Athol, about 2 km east of the site. There are no recent records (since 1980) in the site. There are no hydrological or vegetative links between Blair Athol and the site that would enable any individuals to utilise the site as a satellite foraging site. Further, the habitat in the site is highly unlikely to provide foraging, basking, refuge or breeding habitat due to the high level of disturbance in some areas, presence of *Gambusia holbrooki*, absence of recent records and isolated nature of the site. The proposed action would be unlikely to lead to a long term decrease in the population. |
| Reduce the area of occupancy of an important population | The site does not support a known important population of the Green and Golden Bell Frog. The site is unlikely to have capacity to support a population of Green and Golden Bell Frog given the absence of records in the site, presence of *Gambusia holbrooki* in Bow Bowing Creek, extensive history of disturbance along the adjacent drainage swale and absence of ideal basking, foraging, and sheltering habitat. The population located at Blair Athol is highly unlikely to utilise the site given the lack of hydrological or vegetative links between the sites. The proposed action is unlikely to reduce the area of occupancy of an important population. |
| Fragment an existing important population into two or more populations | The site does not support a known important population of the Green and Golden Bell Frog. The population located at Blair Athol is highly unlikely to utilise the site given the lack of hydrological or vegetative links between the sites. The proposed action is unlikely to fragment an existing important population into two or more. |
| Adversely affect habitat critical to the survival of a species | The site is not considered critical habitat for the species given the absence of records, unsuitability of foraging, breeding, basking and sheltering habitat and absence of hydrological or vegetative linkages to the known population at Blair Athol. The site is unlikely to have capacity to support a population of Green and Golden Bell Frog given the absence of records in the site, presence of *Gambusia holbrooki* in Bow Bowing Creek, extensive history of disturbance along the adjacent drainage swale and absence of ideal basking, foraging, and sheltering habitat. The proposed action is unlikely to adversely affect habitat critical to the survival of the Green and Golden Bell Frog. |
| Disrupt the breeding cycle of an important population | The Green and Golden Bell Frog relies on shallow, ephemeral, < 1 m deep, are unshaded and free of predatory fish. Of the areas identified as potential habitat for this species, all areas were heavily shaded, contained *Gambusia holbrooki* and in some areas were >1 m deep. The site is highly unlikely to have the capacity to support any breeding individuals and therefore would be unlikely to disrupt the breeding cycle on an important population. |
| Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that | The site is unlikely to have capacity to support a population of Green and Golden Bell Frog given the absence of records in the site, presence of *Gambusia holbrooki* in Bow Bowing Creek, extensive history of disturbance along the adjacent drainage swale and absence of ideal basking, foraging, and sheltering habitat. There are no |

| Significant Impact Criteria | Assessment |
|---|---|
| the species is likely to decline | hydrological or vegetative links to Blair Athol that would enable the known population to expand and use the site for breeding purposes. The proposed action would be unlikely to decrease the availability or quality of habitat such that the species is likely to decline. |
| Result in an invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat | *Gambusia holbrooki* has already invaded this species habitat, which significantly decreases the viability of the site to support any breeding Green and Golden Bell Frogs. |
| Introduce disease that may cause the species to decline | The site does not support a known important population of the Green and Golden Bell Frog. The proposed action would not result in potential movement of the Chytrid Fungus from any known areas to the site. |
| Interfere substantially with the recovery of the species | The site is unlikely to have capacity to support a population of Green and Golden Bell Frog given the absence of records in the site, presence of *Gambusia holbrooki* in Bow Bowing Creek, extensive history of disturbance along the adjacent drainage swale and absence of ideal basking, foraging, and sheltering habitat. There are no hydrological or vegetative links to Blair Athol that would enable the known population to expand and use the site for breeding purposes. The proposed action would be unlikely to decrease the availability or quality of habitat such that the species is likely to decline. The proposed action is unlikely to substantially interfere with the recovery of the species. |

### 6.4.4 Impact conclusion

The site is highly unlikely to provide habitat for this species or have the capability to support a population (**Figure 8** and **Figure 9**). It is highly unlikely to act as a satellite foraging, basking or sheltering site for individuals within the locality. The results of the habitat stratification are tabulated in **Table 9**.

*Gambusia holbrooki* is a predatory fish that feeds on tadpoles and egg clutches. The presence of *Gambusia holbrooki* is an indicator that breeding amphibians are unlikely to utilise an area for breeding purposes (**Figure 10**). The Green and Golden Bell Frog has not been recorded within the site within the last 38 years (BioNet searches conducted for data from 1980 to 13 August 2018). Given that the nearest known record is in Blair Athol which is separated from the site by residential development and transport infrastructure it is unlikely that any individuals would utilise the site as a satellite foraging, basking or refuge site. There are no hydrological links between Blair Athol and the site.

The records for the species at Blair Athol are on a grassed area near the fringe of a farm dam. Biriwiri Creek is mapped as running from the dam to the upstream portion of Bow Bowing Creek. A review of aerial photography and the hydroline data (NRAR 2018) identifies the following:

- Biriwiri Creek is downstream from Bow Bowing Creek, meaning water flows from Bow Bowing Creek to Biriwiri Creek
- the portion of Biriwiri Creek in the Blair Athol site looks to be managed grassland
- a large portion of Biriwiri Creek is piped to run under existing roads, residential and industrial development to the point where it meets Bow Bowing Creek
- Bow Bowing Creek from the Biriwiri Creek junction to Farrow Road is a concrete stormwater drain

- the remaining length of Bow Bowing Creek is either concreted and piped or a degraded creek line.

For Biriwiri Creek to function as a hydrological connection to the site, a vast and extensive flooding event would need to occur that would enable the movement of individuals, egg clutches or tadpoles from the find site across about 375 m of managed grass to the nearest stormwater inlet. The individuals would then need to enter an underground piped portion of the creekline. This is highly unlikely given that the Green and Golden Bell Frog is homeothermic and requires sunlight and warmth to breed and survive. The flooding event would then need to be able to push enough water upstream that the individuals, egg clutches or tadpoles travel about 3.5 km upstream through more underground, piped portions. Thus, Biriwiri Creek is not considered to function as a hydrological connection to the site. It is highly unlikely that any individuals at the Blair Athol population could use the site as breeding, foraging or basking.

Consideration of the Expert Report prepared by Travers Bushfire and Ecology (2017b) and additional survey conducted by ELA concluded that the site is highly unlikely to provide breeding, foraging, basking or sheltering habitat for this species (**Table 9**).

The significant impact criteria has been applied to the Green and Golden Bell Frog and concluded that the proposed action would not significantly impact upon this species (**Table 10**).

**Figure 7: Green and Golden Bell Frog survey site adjacent to the site, recently constructed drainage line and swale**

**Figure 8: Green and Golden Bell Frog survey site, central portion of Bow Bowing Creek**

**Figure 9: Dry portion of Bow Bowing Creek**

**Figure 10: *Gambusia holbrooki* identified along Bow Bowing Creek**

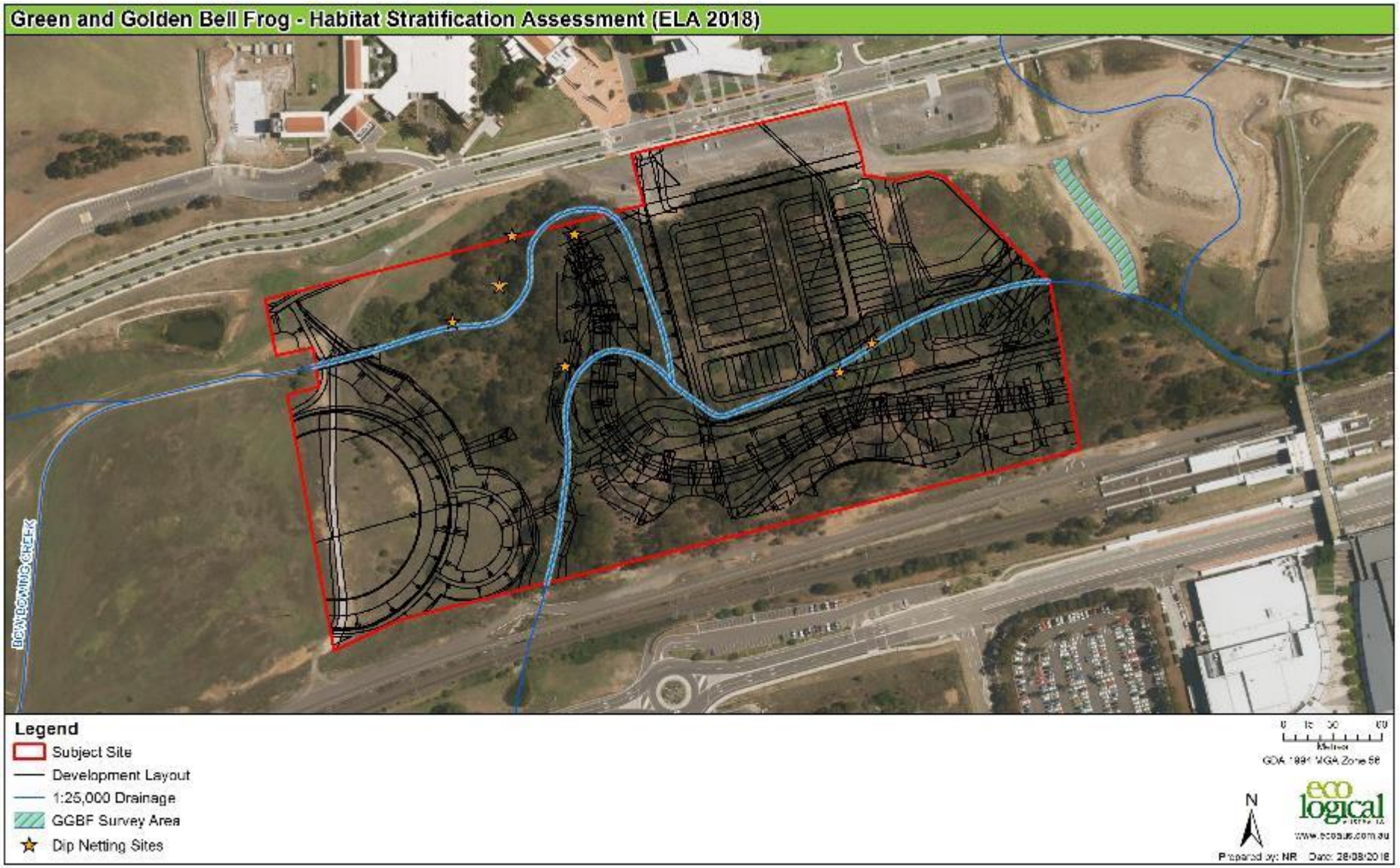


**Figure 11: Green and Golden Bell Frog habitat stratification survey area and dip netting sites**


**Figure 12: Green and Golden Bell Frog records at Blair Athol and hydroline data**

# 7 Flora

One flora species, *Pimelea spicata* (Spiked Rice-flower) was considered as having potential to occur in the site.

## 7.1 *Pimelea spicata* (Spiked Rice-flower)

*Pimelea spicata* has a scattered distribution, occurring in two disjunct locations in the Cumberland Plain and Illawarra region. In Western Sydney it occurs on undulating topography of well-structured clay soils deriving from Wianamatta Shale. The species occurs in areas of Cumberland Plain Woodland or areas that were once Cumberland Plain Woodland (DEC 2005). The species appears to respond well to low levels of disturbance over time and has the capability of re-sprouting from a tap root following disturbance. However, consistent disturbance can decrease the viability of re-sprouting from the tap root. This species prefers habitat with an open canopy which allows sunlight to reach the groundcover layer (DEC 2005).

There are 18 records for the species since 1980 (OEH 2018). There are no records within the site, with the closest record located 1 km to the north near the Hume Highway entry off the Northern Road. There is also a known population within the Mt Annan Botanical Gardens and in the Lakeside Golf Club, Camden off Raby Road.

## 7.2 Targeted survey

Targeted survey for this species has occurred over several survey periods. Travers Bushfire and Ecology conducted targeted survey on 19 and 20 July 2016 utilising the random meander method and during biometric plots. No individuals were found. Further targeted survey was conducted by ELA ecologists Rodney Armistead and Alex Gorey (**Table 11** and **Figure 16**). Indicative potential habitat was identified as areas of Cumberland Plain Woodland within the site (**Figure 15**). Some portions of the site contained large areas of fill. These areas were excluded from survey.

A reference population at Lakeside Golf Club was checked prior to conducting all surveys. The reference population was in flower during surveys conducted on 24 August 2018 (**Figure 13** and **Figure 14**).

**Table 11: Targeted *Pimelea spicata* surveys conducted by ELA 2018 in the site**

| Survey date | Survey effort | Survey methodology | Flowering (yes / no) | Areas surveyed |
|---|---|---|---|---|
| 17 April 2018 | 3 hours | Random meander | N | CPW |
| 20 April 2018 | 6 hours | Random meander / parallel transects | N | CPW |
| 23 April 2018 | 3 hours | Random meander | N | CPW |
| 24 April 2018 | 3 hours | Random meander | N | CPW |
| 27 April 2018 | 3 hours | Random meander | N | CPW |
| 3 May 2018 | 3 hours | Random meander | N | CPW |
| 10 May 2018 | 3 hours | Random meander | N | CPW |
| 30 May 2018 | 3 hours | Random meander | N | CPW |
| 24 August 2018 | 3 hours | Parallel transects | Y | CPW |

## 7.3 Results

No *Pimelea spicata* individuals were identified in the Macarthur Gardens North site during the survey periods. Although areas mapped as moderate – good Cumberland Plain Woodland and River-flat Eucalypt Forest as potential habitat (Travers Bushfire and Ecology 2016), these areas are considered unlikely to support any *Pimelea spicata* individuals and the site is highly unlikely to contain any potential habitat for this species.

## 7.4 Application of the Significant Impact Criteria to *Pimelea spicata*

The Significant Impact Criteria was applied to *Pimelea spicata* and concluded that the proposed action would not constitute a significant impact on this species.

**Table 12: Application of the Significant Impact Criteria to *Pimelea spicata***

| Significant Impact Criteria | Assessment |
|---|---|
| Lead to a long term decrease in the size of an important population of a species | The site is unlikely to support a population of *Pimelea spicata*, given the absence of records, results of targeted survey and level of site disturbance. No individuals have been identified in the site during two targeted surveys. There are no historical records for the species within the site (OEH 2018). The proposed action is unlikely to decrease the size of an important population. |
| Reduce the area of occupancy of an important population | *Pimelea spicata* occurs in Cumberland Plain Woodland in areas of low – moderate shade. The site overlaps with the known distribution of the species, however, the site is unlikely to support a population of *Pimelea spicata*. The species has never been recorded in the site (OEH 2018) and two recent targeted surveys did not identify the species. One survey was conducted when the species was in flower. In addition, the site is unlikely to support a population given the intensive and ongoing history of disturbance and high level of shading that occurs throughout the patches of moderate – good Cumberland Plain Woodland in the site. The species is well represented in Mt Annan Botanical Gardens and at Lakeside Golf Club. Therefore, the proposed action is unlikely to reduce the area of occupancy of an important population. |
| Fragment an existing important population into two or more populations | No. The two closest known populations are located at Mt Annan Botanical Gardens and at Lakeside Golf Club. The site is surrounded by areas of cleared land, transport infrastructure and Western Sydney University. There is no vegetative link capable of spreading seed from either of these areas to the site. Further, the site is unlikely to support a population given the intensive and ongoing history of disturbance and high level of shading that occurs throughout the patches of moderate – good Cumberland Plain Woodland in the site. The proposed action is unlikely to result in the fragmentation of an existing population into two or more. |
| Adversely affect habitat critical to the survival of a species | No. The site is unlikely to support a population given the intensive and ongoing history of disturbance and high level of shading that occurs throughout the patches of moderate – good Cumberland Plain Woodland in the site. Coupled with the lack of records and no individuals identified during targeted survey, the site is unlikely to contain tap roots of the species that would re-sprout. The proposed action is unlikely to adversely affect habitat critical to the survival of the species. |
| Disrupt the breeding cycle of an important population | Seed dispersal of *Pimelea spicata* is relatively unknown. It is known to re-sprout from the tap root. This can occur at any time but is more likely to occur after low levels of disturbance. High and consistent levels of disturbance discourage and eventually inhibit re-sprouting from the tap root. Given the extensive history of disturbance |

| Significant Impact Criteria | Assessment |
|---|---|
| | throughout the site and lack of records, the site is unlikely to support any *Pimelea spicata* habitat or tap roots and therefore the proposed action would be unlikely to disrupt the breeding cycle of an important population. |
| Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline | No. The site is unlikely to contain potential habitat capable of supporting a population given the intensive and ongoing history of disturbance in the site. Further, this species is known to prefer a more open woodland. The high level of shading that occurs throughout the patches of moderate – good Cumberland Plain Woodland decreases the suitability of this habitat. The site is unlikely to provide habitat for *Pimelea spicata* and therefore, the proposed action is unlikely to decrease the extent of the species habitat such that it is likely to decline. |
| Result in an invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat | *Pimelea spicata* prefers a more open, sunny woodland and therefore overcrowding of the mid-storey layer with exotic flora species can increase shading and be harmful to this species. The site already contains exotic species in the midstorey level and is significantly shaded throughout a majority of the patch. Further, the site is unlikely to contain potential habitat capable of supporting a population given the intensive and ongoing history of disturbance. The proposed action is unlikely to result in an invasive species becoming established. |
| Introduce disease that may cause the species to decline | There are no known diseases that are likely to impact *Pimelea spicata.* |
| Interfere substantially with the recovery of the species | No. No *Pimelea spicata* has been historically recorded in the site (OEH 2018) and two recent targeted surveys did not identify the species. The moderate – good Cumberland Plain Woodland in the site is unlikely to provide suitable habitat for this species, given the ongoing disturbance history. This specie is known to re-sprout from the tap root, however ongoing disturbance severely decreases the viability of re-sprouting from the tap root over time. There are two well preserved populations of this species at Mt Annan Botanical Gardens and Lakeside Golf Club. The site is surrounded by areas of cleared land, transport infrastructure and Western Sydney University. There is no vegetative link capable of spreading seed from either of these areas to the site. Therefore, the proposed action is unlikely to substantially interfere with the recovery of the species. |

## 7.5 Impact conclusion

*Pimelea spicata* is known to re-sprout from tap roots stored in the seed bank. Re-sprouting from the seed bank does not appear to be dependent on disturbance, with studies showing re-sprouting can occur at any time and is a common occurrence (DEC 2005). This would suggest that if *Pimelea spicata* tap roots were present in the seed bank there is a high chance that they would have re-sprouted prior to, or since the initial survey conducted by Travers Bushfire and Ecology at the site. In addition, *Pimelea spicata* typically has high growth periods during the winter months (DEC 2005). Travers Bushfire and Ecology survey was conducted in July 2016, with another winter season occurring prior to ELA's targeted survey and with further survey conducted by ELA in winter 2018, whilst the species was in flower. The chance of re-sprouting from the tap root coupled with high growth periods in winter would suggest that if the species was present within the site it is likely to have been identified during targeted survey.

However, the level of ongoing disturbance in the site would suggest that tap roots are unlikely to be present. Periods of high, ongoing disturbances are highly likely to decrease the viability of any tap roots present in the seed bank and inhibit the ability of re-sprouted individuals to mature to the point where they can produce and distribute seedlings. Individuals require approximately 1.5 – 2 years of undisturbed growth to produce and disperse seed (DEC 2005).

The site has undergone consistent and high levels of disturbance since the 1960's associated with agriculture and infrastructure supporting neighbouring developments. The age of the *Acacia* spp. regrowth varies from saplings to individuals 15 – 20 years old. This suggests that some seed bank regeneration and re-sprouting has occurred, and *Pimelea spicata*, if present, would have likely re-sprouted in the past 15 – 20 years. Thus, the site is unlikely to provide any habitat for *Pimelea spicata*.

The proposed action would remove 2.23 ha of moderate – good condition Cumberland Plain Woodland. However, these patches are unlikely to provide habitat and therefore the proposed action is unlikely to impact any potential *Pimelea spicata* habitat or individuals.

The EPBC Act Significant Impact Criteria was applied to *Pimelea spicata* and determined that the proposed action is unlikely to constitute a significant impact on this species.

**Figure 13: *Pimelea spicata* at Lakeside Golf Club reference site on 24 August 2018**

**Figure 14: *Pimelea spicata* in flower at Lakeside Golf Club 24 August 2018**


**Figure 15: Indicative *Pimelea spicata* habitat within the site**


**Figure 16: *Pimelea spicata* targeted survey effort in the site**

# 8 Impact avoidance and mitigation

The Department of the Environment and Energy's policy states impacts to Matters of NES should be avoided where possible. Where complete avoidance is not possible, appropriate mitigation measures should be implemented to prevent or minimise direct and indirect impacts of the action on Matters of NES. The proposed development at Macarthur Gardens North has incorporated a range of strategies to avoid and mitigate impacts to CPW. These are detailed below.

## 8.1 Avoidance of direct impacts to CPW

**Key reiterations throughout the ILP design process**

The initial indicative layout plan (ILP) included removal of all CPW on the site to accommodate housing, stormwater infrastructure and the realignment of Bow Bowing Creek. The ILP went through several iterations to maximise the amount of CPW that could be retained on site. This aimed to retain patches of CPW in moderate – good condition that could form part of the future realigned Bow Bowing Creek corridor.

**Avoidance of CPW**

The areas that have been designated as development lands have been chosen to, where possible, avoid and minimise impacts to CPW. Preliminary field investigations by Travers Bushfire and Ecology (2016) and subsequent redesign of the development layout reduced the clearance of CPW by about 0.87 ha with about 1.03 ha of CPW to be revegetated along the future Bow Bowing Creek corridor. This would increase the viability of the conserved vegetation by increasing the vegetative link of the two patches to be retained. The following principles were followed in selecting development land:

- avoid CPW by maximising use of structurally limited areas such as Derived Native Grassland and regeneration
- consideration of CPW viability and potential for recovery
- maximise options for revegetation along the future Bow Bowing Creek corridor
- avoid loss of good quality CPW
- improve connectivity.

In the context of the Macarthur Gardens North site, the development of the Indicative Layout Plan (ILP) recognises the necessity to realign Bow Bowing Creek. Currently, the creekline is severely degraded and weedy with significant areas of erosion occurring. The works are also necessary to upgrade the creek to support increased stormwater flow from the surrounding development. This would lead to a loss of CPW, however the creek would be revegetated once the realignment is complete. Given the essential nature of the works and the need to realign the corridor as close as possible to its natural alignment, complete avoidance has not been achievable.

**Direct impacts to CPW**

The proposed development would result in the direct loss of approximately 2.23 ha of CPW in the site. On a regional scale this loss of 2.23 ha of CPW represents less than 0.02% of the total remaining Cumberland Plain Woodlands community (based on extant vegetation areas calculated in Tozer, 2003).

About 0.87 ha of the community would be retained and manage as conservation lands in the site. The areas of the community proposed for retention have been strategically chosen to form part of a larger future riparian corridor that would traverse the site. Although the patches would be temporarily isolated

from other areas of the community, this would ultimately increase the size and viability of CPW in the site. This outcome is considered better suited to the urban development context in which the site is located.

**Indirect impacts to CPW**

The proposed action may indirectly impact 0.87 ha of CPW within lands adjacent to the development footprint. Indirect impacts may include:

- weed invasion
- sedimentation, erosion and runoff
- rubbish dumping
- noise, dust and light spill.

These lands would form conservation lands within the site and would be retained and managed under a VMP. The implementation of a VMP would minimise the potential indirect impacts associated with the proposed action.

**Buffers to CPW**

Buffers to retained threatened ecological communities are recommended when a change in use of land is occurring in adjacent areas. The aim of the buffer is to manage the risk of damage resulting from indirect impacts that are likely to occur as a result of the change in land use adjacent to the threatened ecological community. The actions within the buffer zone must not have a significant impact to the threatened ecological community.

With respect to the proposed action, the application of a 30 m buffer is not required. While a change of use to the land will occur for the portion of the site subject to residential development, the land that would fall within the 30 m buffer is proposed for retention and revegetation as part of the creek re-alignment. This will create a positive change by establishing and maintaining a vegetated buffer between the change in use and the Cumberland Plain Woodland to be retained. Revegetation of this buffer does not constitute a significant impact to the Cumberland Plain Woodland to be retained. This buffer will be managed as part of the VMP and will effectively mitigate indirect impacts that may impact the Cumberland Plain Woodland to be retained. Management of the buffer will include revegetation to Cumberland Plain Woodland and River-flat Eucalypt Forest, weed management, augmentation of habitat through the placement of logs and sedimentation and erosion control measures.

## 8.2 Mitigation and minimisation of indirect impacts to CPW

About 2.23 ha of CPW within the site would be removed, leaving a patch along the southern boundary and patch along the western boundary for conservation purposes, totalling 0.87 ha. The required mitigation measures will be focused on preventing and minimising indirect impacts from the development on these patches of CPW, whilst providing adequate environmental management controls within the development footprint prior to, during and after construction. These patches would eventually be linked through the realignment and revegetation of Bow Bowing Creek which would create a large, contiguous patch of the community.

Landcom propose to offset their impact to CPW by purchasing credits under the BioBanking scheme. The BAR concluded that 74 ecosystem credits would be required to offset the direct impacts to CPW of the proposed action (Travers Bushfire and Ecology 2017a). Additional credits will be purchased through the BioBanking Scheme to offset the 0.87 ha of CPW that would be indirectly affected. It is expected that an additional 33 credits would be required to offset the indirect impacts. Landcom are committed to purchasing their credits from a government body or agency and are actively seeking out credit

opportunities. Securing offsets would be a condition of approval and works could not commence until the offsets have been secured. It is expected that the offsets would also meet the EPBC Act definition of the community.

The CEMP would be prepared in accordance with requirements 1.1 to 1.10, Schedule 1 of the BS45, Development Consent 1571/2015/DA-SW and the controlled activity approval (yet to be issued). The VMP has been prepared in accordance with requirements 1.1 to 1.10, Schedule 1 of the BS45 development Consent 1571/2015/DA-SW and would be updated to remain consistent with the controlled activity approval (yet to be issued). The VMP also includes all sediment and erosion control measures to be implemented during the works. The VMP would form part of the CEMP that would act as the overarching management plan for the site. Mitigation and impact minimisation measures would be implemented through the preparation and / or implementation of the following:

*Vegetation Management Plan*

A Vegetation Management Plan (VMP, Travers Bushfire and Ecology 2019) has been prepared to guide the realignment and revegetation of Bow Bowing Creek and management of the conservation zones in the site. This would ensure that the revegetation of the creek is consistent with the vegetation type Cumberland Plain Woodland (DEWHA 2009) and that indirect impacts to the retention areas are temporary and negligible. The VMP would include:

- management zones for revegetation, flora species list and planting densities for groundcover, midstorey and canopy per zone
- identify weed species for removal, removal technique and management frequency
- tree protection zones and exclusion zones (if relevant)
- plant material salvage including hollows or logs and translocation including seed collection
- discussion of potential impacts from stormwater and waste management with specific controls for nutrient tolerant species
- soil preparation, enhancement or treatment methods
- activities to be utilised to promote restoration relevant to the site
- implementation timeframe and schedule
- performance criteria for each management zone
- monitoring and reporting requirements
- consistency or consideration with other documents, legislation or plans
- photo monitoring points.

*Environment Management Plan*

An Environment Management Plan (EMP) would be prepared. The EMP would be in operation prior to, during and post construction. The EMP would include the following:

- Planning requirements
- Environmental site plan
- Complaints recording template
- Sediment and erosion control measure
- Pre-start measures
- Weekly environmental inspection checklist
- Implementation and operation.

*Pre-start measures*

Detailed pre-start measures will be developed and included in the EMP. This will include requirements for ensuring the required controls are in place prior to construction, marking/fencing vegetation for retention and pre-clearance ecological surveys.

*Fencing retention areas*

Rural fencing will be installed along the perimeter of the remnant CPW with the objectives of controlling entry to the area and to protect the community.

Fencing will surround the areas of conserved CPW allowing only access for parkland managers and emergency vehicles, with signage to provide community awareness of the importance of the CPW. Gates will be included within the fence-lines to allow operational/management access and emergency services access. The fencing design is dependent on its location within the final design of development and as such, the specific fence will depend on the position. At a minimum, the fencing will consist of a rural style fence and gate. The rural fencing is expected to consist of treated timber posts set into concrete flooring and star picket steel posts spaced typically 3 m apart with 4 strands of strained galvanised fencing wire running between.

*Weed and pest management*

Detailed weed and pest management plans will be developed prior to construction as key components of the EMP. These plans will detail management requirement prior to, during and after construction in both the development and retention areas.

*Soil and water management*

A Soil and Water Management Plan will be designed and implemented for the proposed works in accordance with appropriate guidelines for managing urban stormwater, for example, Soils and Construction: Managing Urban Stormwater 4th Edition (Landcom 2004). Stormwater runoff will be controlled within the development to minimise nutrient and contaminant escape to surrounding lands.

*Lighting controls*

The potential for added light impacts will be addressed through a range of control measures on the lighting to be used within the residential area, including;

- ensuring the development complies with the Australian Standard 4282 – Control of the obtrusive effects of outdoor lighting, which provides recommended limits for lighting.
- incorporating a lighting strategy which prescribes limits on lights for various areas, such as;
    - Prioritising low level lighting bollards – down facing light type to minimise light spill, and reduce potential impacts on fauna movements.
    - Post top overhead street lighting to be used facing down with minimal spill into adjacent areas.
    - Building lighting to be shielded and facing down, or only upon areas that require illumination.
    - Lighting to be set on timers where appropriate, and/or set on sensor switches.
    - Lighting to be located as far as possible from retention areas
    - Position and directional lighting to be located near the retention area where deemed necessary but oriented away from the retention area and back into the development where suitable.
    - Utilise features such as signs and walls to hide light sources from view.

*Fauna clearance surveys and retention of dead timber and hollow bearing trees*

Fauna clearance surveys should be undertaken for:

- *Meridolum corneovirens* (Cumberland Plain Land Snail)
- any hollow dwelling fauna
- any fauna known to make nests in the canopy of trees (if nests are present).

All hollow bearing trees requiring removal will be identified prior to construction commencing. The felling of hollow bearing trees should be supervised by a suitably qualified ecologist and where appropriate sectionally lopped by a suitably qualified tree climber and crane to minimise impacts to any hollow dwelling fauna. Hollows should be salvaged for future use in the riparian corridor and retention areas. Where hollows cannot be retained, habitat boxes will be installed at a 2:1 ratio. This should occur in areas of CPW to be retained on the site.

The base of all trees and woody debris in areas of moderate – good CPW will be searched for Cumberland Plain Land Snails. Clearance surveys will be undertaken after a moderate period of rainfall, at dawn and five days and one day prior to the commencement of any disturbance on site. Relocation of any individuals found should occur either within the conservation lands (if suitable) or at another suitable location to be discussed with OEH. Dead timber and hollows from the development areas will be relocated to the retention areas or the future Bow Bowing Creek corridor, as appropriate.

*Waste management controls*

All reasonable steps will be taken by Macarthur Developments to remove waste deposited by others within the site during the development stages. This has already begun with the area fenced off from the neighbouring University carpark. Construction waste management measures will be developed prior to construction by Macarthur Developments or their contractors as a component of the Construction Environment Management Plan.

*Street tree species*

Where appropriate, trees species that typically occur in CPW should be planted.

### 8.3 Parties responsible for implementation

The management and mitigation measures are the responsibility of Macarthur Developments. Macarthur Developments will be required to be undertake all mitigation measures prior, during and post construction. The contractors will be chosen through a tender process which will likely take into account each tenderers:

- experience with bushland conservation and management (previous environmental records)
- sustainability and efficiency
- cost
- availability of equipment.

# 9 Offset strategy

## 9.1 Required offsets

The EPBC Act Offsets Policy requires residual significant impacts to MNES to be offset. The proposed development has implemented a number of measures to avoid and mitigate impacts to CPW, however, 2.23 ha of this vegetation community is proposed to be directly affected as part of the development.

Impacts to Matters of NES were formally assessed under the BBAM and a Biodiversity Assessment Report (BAR) (Travers Bushfire and Ecology 2017a) was prepared to inform the offset requirements for impacts to CPW at the site. The BioBanking Statement (BS45) (OEH 2018; **Appendix F**) issued for the direct impacts states that 74 ecosystem credits for CPW (ME020/HN528/PCT849) are required to offset the impact to 2.23 ha of CPW in the site. Additional offsets for the 0.87 ha of CPW to be indirectly affected will be offset using the same methodology and would require 33 credits. It is understood the DotEE have endorsed the BBAM process as a suitable means to deliver offsets. This is the proposed methodology to offset impacts to Matters of NES at the site.

A total of 107 Biobanking credits (74 direct impacts and 33 indirect impacts) are required to be retired for the project (BS45). To provide context, the retirement of 107 credits is equivalent to approximately 10.7 ha of CPW offset (based on an average of 10 credits per hectare). The credits must/will be sourced from the Cumberland – Sydney Metro IBRA region or any IBRA subregion that adjoins the sub-region in which the proposed action is occurring. The BioBanking Statement also includes further conditions beyond the retirement of credits (**Appendix F**).

Landcom are seeking a conditioned approval for the proposed action that requires Landcom to source, secure and retire credits under the BioBanking Scheme. Landcom intend to purchase credits from a Government body such as a local Council, Office of Strategic Lands or the Mt Annan Australian Botanic Gardens or Western Sydney Parklands or a private BioBanking credit holder. Landcom are monitoring tenders and expressions of interest in the search for available credits.

Landcom has monitored the Public Biobanking credit register for the past 12months and recognise there is a shortage of CPW credits. In the event of the unavailability of CPW credits, Landcom propose to retire the credits with the BioBanking Trust. This will be a last resort to retire credits so Landcom can develop the site and achieve its strategic objectives and meet the NSW governments housing delivery objectives. It is intended that Landcom would source, secure and retire the required credits in 2019.

It's noted the Western Sydney Airport will significantly influence the availability of CPW credits within the IBRA region/sub region over the next few years. They recently issued an expression of interest to acquire credits for the airport development. This is the same time when Landcom intends to retire credits for the Macarthur Gardens North development.

## 9.2 On-site retention areas

Of the 3.1 ha of CPW at Macarthur Gardens North, 34 % would be retained within the designated retention areas which are contiguous with a further 1.03 ha of native vegetation. These areas would be retained and managed under a Vegetation Management Plan and have been strategically chosen for conservation lands as they will form part of the patch of CPW that will be revegetated along Bow Bowing Creek.

# 10 Monitoring and reporting

## 10.1 Monitoring requirements

Monitoring is to be undertaken as part of the implementation of the VMP and CEMP. Additional monitoring in association with the Controlled Activity Approval may be required. VMP monitoring would occur periodically to determine the status of the CPW community, and assess the effectiveness of the plan. Photographs will be taken at photo-points at pre-determined locations and in identified directions at the retention area prior to management, within 12 months of the commencement date and then at least every 12 months thereafter. The purpose of the photographs is to show changes over time. Photographs should be taken at approximately the same direction, location, height and time of day (during daylight hours). All photographs must be dated, stating their direction and identified with their locations.

An inspection of the retention areas must be undertaken by suitable environmental or bush regeneration contactors in accordance with a 'Site inspection and monitoring schedule'. Inspections are to occur at predetermined intervals starting from the commencement of management. Monitoring of the future offset site would also be required.

Landcom will complete, or cause to be completed, an annual report for five years using an annual reporting template. The report will detail all management actions undertaken, any incidents or events that have adversely affected the biodiversity values at the retention areas, include all required photographs, results of inspections, and results on monitoring.

Monitoring and reporting associated with the CEMP would ensure that indirect impacts to retained areas through runoff and sedimentation, access, rubbish dumping and spread of weeds is not occurring.

# 11 Social and economic factors

The Metropolis of Three Cities (DP&E 2017) provides a guide for growth and change for the Sydney metropolitan area up to the year 2036. By 2036 it is envisioned that half of Sydney's population will live in Western Sydney, and will need to generate 760,000 additional jobs. Coupled with this is the reality that as Sydney's population is growing, the average household size is falling, creating demand for more—but smaller, more affordable homes. The SMP estimates that Sydney will need 770,000 additional homes by 2036—a 46% increase on the city's current ~1.7 million homes. MGN resides within a key strategic location and will have a considerable contribution to the socioeconomic needs of the Western Sydney growth centres.

The proposed development is for residential purposes and is the last stage of the Macarthur Regional Centre Masterplan. The development would include the regeneration and dedication of 8.72 ha of open space which would be delivered to Council. The proposed action would also involve critical works to Bow Bowing Creek to allow for the creek to accommodate the increased storm water flow likely to occur from the surrounding development.

Macarthur Gardens North will create numerous employment opportunities, both throughout development, and in the longer term for activities such as the management of the retention areas and residential landscaping. It is expected that the dwellings will house a population of over 3000, which is expected to increase the demand for industry within the region. This, in term, will further increase employment opportunities.

# 12 Conclusion

## 12.1 Potential impacts to Matters of NES

Landcom are proposing to develop 9.8 ha of land between Gilchrist Drive and Macarthur Railway Station. The proposed development is for residential purposes, stormwater infrastructure and critical creek realignments and is the last stage of the Macarthur Regional Centre Masterplan. The proposed action would directly impact 2.23 ha of CPW and indirectly impact 0.87 ha of CPW in the site. This is likely to constitute a significant impact to this Matter of NES.

Travers Bushfire and Ecology conducted extensive flora and fauna survey throughout the site. No matters of NES other than CPW were identified. Following the submission of the referral, DotEE requested additional information which has been included in this documentation (EPBC Ref: 2017/8029). As part of this preliminary documentation, extensive survey has been conducted throughout the site including targeted survey for the following Matters of NES:

- *Lathamus discolor* (Swift Parrot)
- *Litoria aurea* (Green and Golden Bell Frog)
- *Pimelea spicata* (Spiked Rice-flower).

Additional consideration of impacts has been applied to:

- *Anthochaera phrygia* (Regent Honeyeater)
- *Pteropus poliocephalus* (Grey-headed Flying-fox).

No Swift Parrot, Green and Golden Bell Frogs or *Pimelea spicata* was identified in the site during survey. The survey concluded that the site would not provide potential habitat for *Pimelea spicata* or the Green and Golden Bell Frog.

The site is considered marginal habitat for the Regent Honeyeater, Grey-headed Flying-fox and Swift Parrot, however these species would not rely on the site. The Significant Impact Criteria was applied to these five Matters of NES and concluded that the proposed action would be unlikely to constitute a significant impact.

## 12.2 Conservation and impact mitigation

Two patches of moderate – good condition CPW would be retained onsite and managed as retention areas. Offsetting the 2.23 ha of CPW to be removed would be offset under the BioBanking offsetting scheme through purchasing 74 ecosystem credits for ME020/HN528/PCT 849. An additional 33 credits would be purchased to offset 0.87 ha of CPW that would be indirectly affected. Travers Bushfire and Ecology 2017a). Landcom is currently searching for credits from a reputable supplier under this scheme. Works within the site would not commence until offsets have been secured. The planning and design objectives of the Macarthur Gardens North development aims for a positive conservation outcome for CPW. The ILP aims to retain patches of moderate to good condition CPW within the site and to restore CPW within the site.This has followed the hierarchical principles of;

- first, avoid losses and protect biodiversity in situ
- second, mitigate impacts to the greatest reasonable extent
- third, offset remaining impacts as a last resort.

As outlined in this report, this outcome involves:

- in the context of the site, the development layout has been iterative and based on the recognition of the site's inherent biodiversity values. This has also considered the necessary works to realign Bow Bowing Creek to accommodate increased stormwater flowers expected from the increase in neighbouring development. There is no alternative to this action.
- realignment of Bow Bowing Creek and future revegetation of the creek to CPW resulting in 1.03 ha of CPW along the future corridor
- the retention and assisted regeneration of the greatest extent of CPW possible, prioritising patches with better ecological value, potential for higher connectivity and community longevity within the footprint, and providing management with a focus on regeneration for areas of degraded woodland.
- ensuring that any unavoidable removal of CPW is offset in accordance with the EPBC Offsets Assessment Guide 2012.
- sourcing of credits from a reputable supplier to offset the impacts of the proposed action, understanding that this would require a conditional approval.

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# Appendix A - Flora species list (EPBC CPW characteristic species) in the site

| Scientific name | Common name |
|---|---|
| *Acacia decurrens* | Black Wattle |
| *Acacia falcata* | Sally Wattle |
| *Acacia implexa* | Hickory Wattle |
| *Acacia parramattensis* | Parramatta Wattle |
| *Angophora floribunda* | Rough-barked Apple |
| *Angophora subvelutina* | - |
| *Aristida ramosa* | Wire Grass |
| *Aristida vagans* | Three-awn Speargrass |
| *Breynia oblongifolia* | Coffee Bush |
| *Brunoniella australis* | Blue Trumpet |
| *Bursaria spinosa* | Native Blackthorn |
| *Centella asiatica* | Indian Pennywort |
| *Cheilanthes sieberi* | Poison Rock-fern |
| *Chloris truncata* | Windmill Grass |
| *Clematis glycinoides* | - |
| *Corymbia maculata* | Spotted Gum |
| *Cymbopogon refractus* | Barbed Wire Grass |
| *Cyperus gracilis* | Slender Sedge |
| *Daivesia ulicifolia* | Gorse Bitter Pea |
| *Desmodium varians* | Slender Tick-trefoil |
| *Dichondra repens* | Kidney Weed |
| *Dodonaea viscosa* | Sticky Hop-bush |
| *Einadia hastata* | Berry Saltbush |
| *Einadia nutans* subsp. *linifolia* | Climbing Saltbush |
| *Einadia polydonoides* | - |
| *Eucalyptus amplifolia* | Cabbage Gum |
| *Eucalyptus crebra* | Narrow-leaved Ironbark |
| *Eucalyptus eugenioides* | Thin-leaved Stringybark |

| Scientific name | Common name |
|---|---|
| *Eucalyptus moluccana* | Grey Box |
| *Eucalyptus tereticornis* | Forest Red Gum |
| *Euchiton sphaericus* | - |
| *Geranium homeanum* | - |
| *Geranium solanderi* var. *solanderi* | Native Geranium |
| *Glycine clandestina* | Twining Glycine |
| *Glycine tabacina* | Glycine Pea |
| *Hardenbergia violacea* | False Sarsparilla |
| *Hypericum gramineum* | Small St Johns Wort |
| *Indigofera australis* | Native Indigo |
| *Juncus usitatus* | - |
| *Lomandra filiformis* | Wattle Mat-rush |
| *Lomandra multiflora* | Many-flowered Mat-rush |
| *Microlaena stipoides* var. *stipoides* | Weeping Grass |
| *Oxalis perennans* | - |
| *Plectranthus parviflorus* | - |
| *Pratia purparescens* | Whiteroot |
| *Rytidosperma caespitosum* | Ringed Wallaby Grass |
| *Rytidosperma racemosum* | - |
| *Solanum prinophyllum* | Forest Nightshade |
| *Themeda triandra* | Kangaroo Grass |
| *Veronica plebeia* | Creeping Speedwell |

# Appendix B - Targeted Swift Parrot survey species list

| Scientific Name | Common Name | Native / Exotic |
|---|---|---|
| *Acridotheres tristis* | Common Myna | E |
| *Alisterus scapularis* | Australian King Parrot | N |
| *Cacatua galerita* | Sulphur-crested Cockatoo | N |
| *Cacatua sanguinea* | Little Corella | N |
| *Columba livia domestica* | Feral Pigeon | E |
| *Corvus coronoides* | Australian Raven | N |
| *Cracticus tibicen* | Australian Magpie | N |
| *Cracticus torquatus* | Grey Butcherbird | N |
| *Dacelo novaeguineae* | Laughing Kookaburra | N |
| *Delichon urbicum* | House Martin | N |
| *Egretta novaehollandiae* | White-faced Heron | N |
| *Eolophus roseicapillus* | Galah | N |
| *Eopsaltria australis* | Eastern Yellow Robin | N |
| *Grallina cyanoleuca* | Magpie Lark | N |
| *Hirundo neoxena* | Welcome Swallow | N |
| *Macropygia amboinensis* | Brown-cuckoo Dove | E |
| *Malurus cyaneus* | Superb Fairy Wren | N |
| *Manorina melanocephala* | Native Miner | N |
| *Ocyphaps lophotes* | Crested Pigeon | N |
| *Platycercus eximius* | Eastern Rosella | N |
| *Psephotus haematonotus* | Red-rumped Parrot | N |
| *Psophodes olivaceus* | Eastern Whipbird | N |
| *Pycnonotus jocosus* | Red-whiskered Bulbul | N |
| *Rhipidura leucophrys* | Willy Wagtail | N |
| *Sericornis frontalis* | White-browed Scrub Wren | N |
| *Threskiornis moluccus* | White Ibis | N |
| *Trichoglossus chlorolepidotus* | Scaly-breasted Lorikeet | N |
| *Trichoglossus haematodus* | Rainbow Lorikeet | N |

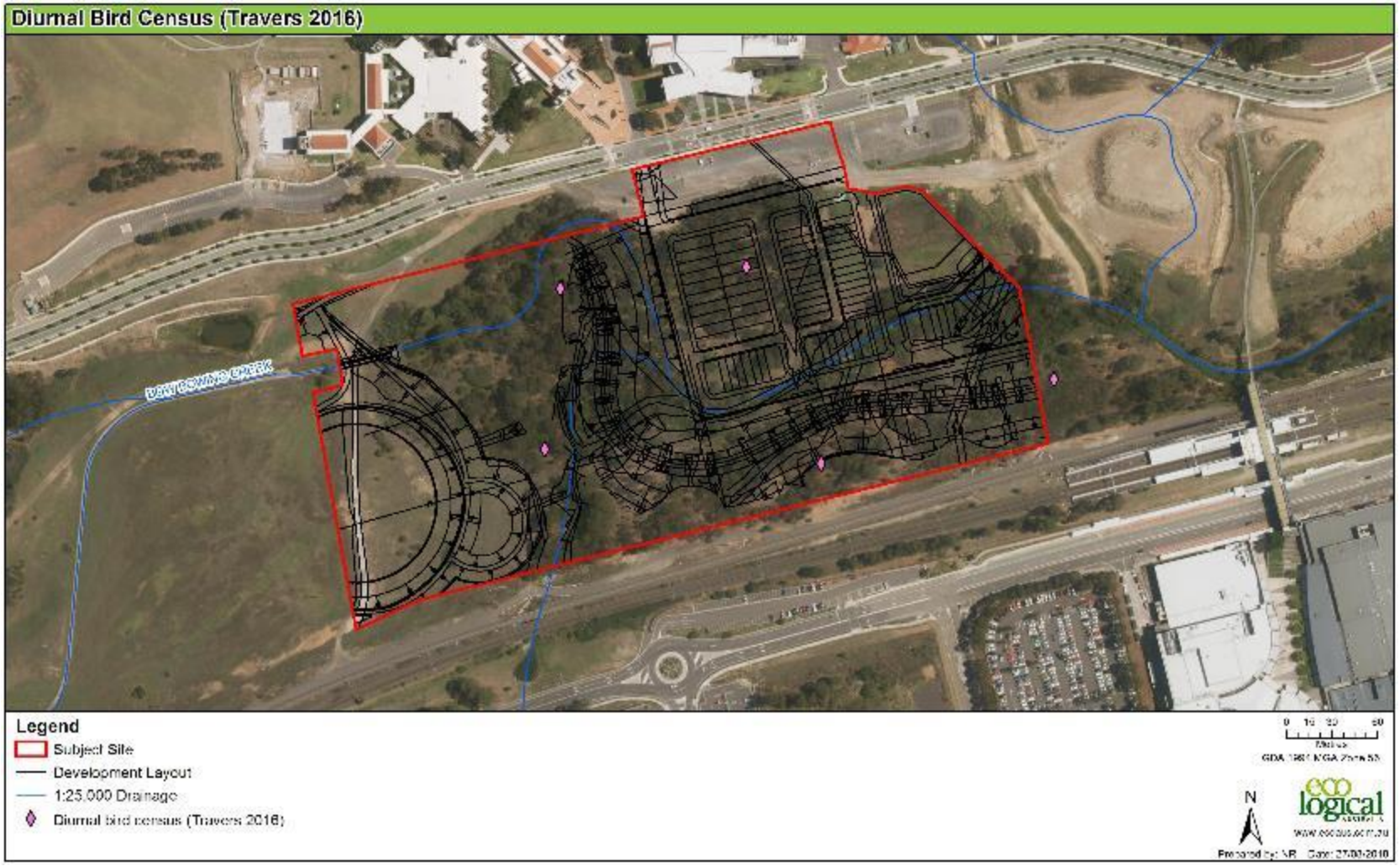
| | | |
|---|---|---|
| *Vanellus miles* | Masked Lapwing | N |

| Species | 17 April 2018 | 20 April 2018 | 23 April 2018 | 24 April 2018 | 27 April 2018 | 3 May 2018 | 10 May 2018 | 30 May 2018 |
|---|---|---|---|---|---|---|---|---|
| Common Myna | O | | | | | | | O |
| Australian King Parrot | O | O | W | O | O | O | O | O |
| Sulphur-crested Cockatoo | W | O | W | W | O | W | O | O |
| Little Corella | | | O | O | O | | | O |
| Feral Pigeon | O | | | | | | | |
| Australian Raven | W | W | O | W | W | W | O | O |
| Australian Magpie | O | W | O | W | O | W | O | O |
| Grey Butcherbird | | W | | O | O | | | W |
| Laughing Kookaburra | | W | | | O | | | |
| House Martin | | | | | O | | | |
| White-faced Heron | | O | | | | | | |
| Galah | O | | | O | O | O | | |
| Eastern Yellow Robin | | | | | W | | | |
| Magpie Lark | | | | W | | W | O | |
| Welcome Swallow | O | | | | | | | |
| Brown-cuckoo Dove | | | O | | | | | |
| Superb Fairy Wren | | | | O | O | O | | |
| Native Miner | O | O | O | W | O | O | O | W |
| Crested Pigeon | | O | | | | | O | |
| Eastern Rosella | O | W | W | W | | W | O | O |
| Red-rumped Parrot | O | | O | O | O | W | W | |

| Species | 17 April 2018 | 20 April 2018 | 23 April 2018 | 24 April 2018 | 27 April 2018 | 3 May 2018 | 10 May 2018 | 30 May 2018 |
|---|---|---|---|---|---|---|---|---|
| Eastern Whipbird | | | | | | W | | O |
| Red-whiskered Bulbul | | | | | | | | W |
| Willy Wagtail | | W | | W | | | | |
| White-browed Scrub Wren | O | | | W | | | O | O |
| White Ibis | | | | | | | O | |
| Scaly-breasted Lorikeet | | | | O | | | | O |
| Rainbow Lorikeet | O | O | O | O | O | O | O | O |
| Masked Lapwing | | | | | W | | | |

*Key: O = observed, W = heard*

# Appendix C - Travers Bushfire and Ecology (2016) Diurnal bird survey effort



# Appendix D - Flora and Fauna Assessment report (Travers Bushfire and Ecology 2016)

# Appendix E - BioBanking Assessment Report (Travers Bushfire and Ecology 2017a)

# Appendix F - BioBanking Statement (OEH 2018)

# Appendix G - Expert GGBF Report (Travers Bushfire and Ecology 2017b)

# Appendix H - Travers Bushfire and Ecology Vegetation Management Plan (2019)

# Appendix I - Greening Australia Vegetation Management Plan 2015

# Appendix J - EPBC Referral (ELA 2017)

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