Final

# Eastern Grey Kangaroo Management Strategy: Craigieburn West Precinct Structure Plan (PSP 1068), Craigieburn

Prepared for

**Victorian Planning Authority (VPA)**

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# CONTENTS

# 1 INTRODUCTION

## 1.1 Background

Ecology and Heritage Partners Pty was engaged by the Victorian Planning Authority (VPA) to develop a Kangaroo Management Strategy (KMS) that will allow for the coordinated management of Eastern Grey Kangaroo *Macropus giganteus* (referred to in this plan as 'EGKs') across the Craigieburn West Precinct Structure Plan (PSP) as development progresses (Figure 1).

The Craigieburn West PSP is located approximately 30 kilometres north-west of Melbourne's CBD along the western edge of Melbourne's Urban Growth Boundary (UGB). The precinct covers an area of approximately 564 hectares and is comprised primarily of agricultural farmland and rural living.

The Craigieburn West PSP is bound by the Lindum Vale Precinct Structure Plan to the north, the Craigieburn Precinct Structure Plan to the east, the Greenvale Precinct Structure Plan to the south, while the land to the west is primarily undeveloped and falls outside of the UGB.

Previous assessments have been undertaken to determine the population size, extent and movement directions of Eastern Grey Kangaroos residing within the PSP and identify the key risks posed to these populations (Ecology and Heritage Partners 2020).

## 1.2 Consultation

To ensure that accurate and implementable management practices are being proposed, Ecology and Heritage Partners undertook stakeholder consultation with the following stakeholders, including:

- Victorian Planning Authority;
- Department of Environmental, Land, Water and Planning (DELWP);
- Hume City Council; and,
- Melbourne Water.

The consultation was undertaken to ensure that the feasibility assessment in Section 5.3 included consideration to the management priorities of those stakeholders who are responsible for managing the land within the PSP and the land neighbouring the PSP.

## 1.3 Objectives

The key objective of the KMS is to provide guidance on the best practice management actions that will need to be implemented by individual developers during the development of the Craigieburn West Precinct, so that risks to human safety and the welfare of the existing Eastern Grey Kangaroo population within the Precinct can be appropriately managed. The KMS is standalone document that is referenced in Schedule 12 to Clause 37.07 of the Urban Growth Zone. This strategy focuses on providing developers and landowners with a clear and concise decision-making framework which will determine whether they require an Abridged, Standard or Detailed KMP.

Although a population of Eastern Grey Kangaroo may persist in the Craigieburn West Precinct during and at the completion of the development of the precinct, the in-situ conservation of a population of Eastern Grey Kangaroo in the future is not an objective of the KMS. The reason for this is that based on the proposed Craigieburn West PSP, and the fact that the land will change from a rural / peri urban setting to an urban area (i.e. urban development) there will be a significant reduction in the availability and accessibility of any remaining habitat for the species. Additionally, the reality is that the future development of the precinct will result in additional barriers (i.e. housing, roads and urban infrastructure) that will restrict the dispersal of Eastern Grey Kangaroos within and outside of the precinct, thus significantly compromising the long-term viability of the population(s) in the future. Any residual population within the precinct after the development will require ongoing and intense management, and most likely require invasive population control techniques (e.g. culling, fertility control or relocation / translocation). Indeed, this is consistent with urban areas around Melbourne and other regions where extant populations have and continue to require ongoing management.

## 1.4 Study Area

The study area is located within the northern growth corridor and comprises the entire Craigieburn West PSP.

A Conservation Area (CA29) established under the BCS is located in the northern section of the study area (DEPI 2013, page 107) (i.e. north of Craigieburn Road) and supports a resident population of the nationally significant Golden Sun Moth.

The study area is bound by several main roads including Mickleham Road and Mt Ridley Road, and is intersected in the middle by Craigieburn Road. Mickleham Road abuts the entirety of the western boundary and it is considered a high risk, heavy traffic road. It is currently a two-lane road however, upgrades are currently planned to increase the width to a six-lane, duel carriage arterial. Mt Ridley Road abuts the northern boundary and is considered a moderate risk road. Craigieburn Road, which runs east to west through the middle of the study area, is also considered as a medium risk, heavy traffic road. It is currently a two-lane road, but upgrades have been planned to increase the width to four lanes (Major Road Projects 2019). Low risk roads such as Whites Lane and Olivers Road extend northward and westward respectively along the eastern boundary of the northern section, while Dunhelen Lane extends east of Mickleham Road allowing access into the conference centre.

### 1.4.1 Current EGK conditions

Two distinct populations of EGKs were identified during the previous site assessment consisting of approximately 130 individuals each (Figure 2). No north-south movement of EGKs was observed between these two populations. The first population (referred to as the 'northern population') was located north of Craigieburn Road and was distributed widely across the land south of Conservation Area 29. EGKs from this population were also observed to the east of the PSP within the currently undeveloped land of the Craigieburn R2 PSP.

The population of EGKs to the south (referred to as the 'southern population') were primarily clustered in the south-east corner of the PSP and the adjoining land to the south and east where large amounts of protective habitat, food and water resources were present.

### 1.4.2 Current EGK movement

There was no north-south movement of EGKs observed during the population surveys. Movement between the north-south populations may still occur when EGKs are more active. EGK movement out of the PSP is generally expected be westward across Mickleham Road and northward across Mt Ridley Road as development progresses. Encroaching development to the south and east (outside of the PSP) will not allow EGK movement in these directions as these areas are already or will be developed over the next few years. There remains a risk that EGKs may become land-locked in the south-east corner of the study area If development to the west inhibits their movement northward or westward across Mickleham Road.

### 1.4.3 Expected Lifetime of Development

Development within the Craigieburn West PSP is expected to commence in 2022 and is expected to take approximately 20-25 years to complete dependent on various factors.

### 1.4.4 Current Land Ownership Boundaries

The study area consists of 18 separate land holdings, varying from developers and places of worship to private landowners. A summary of land parcel boundaries is provided below (Table 1).

**Table 1.** Land parcel boundaries

| Parcel # | Parcel SPI | Parcel # | Parcel SPI |
|---|---|---|---|
| 1 | 1\TP423679 | 21 | 1\LP55516 |
| 2 | 1\TP951293 | 22 | 2\LP55516 |
| 3 | 3\PS301908 | 23 | 1\PS411432 |
| 4 | 2\PS736443 | 24 | 2\PS411432 |
| 5 | 1\PS736443 | 25 | 1\TP340316 |
| 6 | 2\PS301908 | 26 | 1\TP957913 |
| 7 | 1\LP97698 | 27 | 2\LP129504 |
| 8 | 1\PS445746 | 28 | 1\LP129504 |
| 9 | 2\LP37205 | 29 | 3\LP129504 |
| 10 | 2\PS445746 | 30 | 4\LP129504 |
| 11 | 3\LP97698 | 31 | 5\LP129504 |
| 12 | 1\TP950200 | 32 | 1\TP828863 |
| 13 | 1\TP341413 | 33 | 2\TP828863 |
| 14 | 1\LP212349 | 34 | 6\LP129504 |
| 15 | 1\TP222329 | 35 | 7\LP129504 |
| 16 | 1\TP558734 | 36 | 1\TP612993 |
| 17 | 1\LP39373 | 37 | 8\LP129504 |
| 18 | 1\LP53210 | 38 | 1\PS333257 |
| 19 | 2\LP53210 | 39 | 1\PS333257 |
| 20 | 3\LP53210 | | |

# 2 CURRENT SITE CONDITIONS

## 2.1 Pre-development Conditions

Previous site assessments have been undertaken within the study area (Ecology and Heritage Partners 2020) to determine the extent of the existing EGK population within the PSP and movement patterns (Figure 2) Habitat features includes protective habitat and water points have also been identified (Figure 3).

The below table summarising the results of the ecological features identified within the study area during the previous Kangaroo Assessment report.

**Table 3**. Summary of pre-development site conditions

| Feature | Results |
|---|---|
| Population Density | A maximum of 285 kangaroos were recorded within the study area during one survey event using a Direct Observation Count method.<br>Two distinct populations of EGKs were observed within the study area over three survey days, a northern population and a southern population split by Craigieburn Road. Both populations appeared to be approximately the same size. |
| Watering Points | 38 water bodies and 4 drainage lines/creeks are located evenly across the study area including:<br>• farm dams;<br>• water troughs; and,<br>• wetlands.<br>Many of these are permanent and may attract and/or maintain EGK populations during hot or dry periods.<br>A further 19 waterbodies were identified in the immediate area surrounding the PSP. |
| Grazing and Protective Habitat | The study area is largely comprised of suitable grazing habitat.<br>Areas of protective habitat have been previously identified within the Craigieburn West PSP and include:<br>• Conservation Area 29 (CA29)<br>• Patches of River Red-gum along Craigieburn Road<br>• Aitken Creek Corridor and associated wetlands;<br>• Yuroke Creek and associated wetlands; and,<br>• Aitken Conference Centre<br>There is suitable habitat to the west of Mickleham Road (outside the study area), that provides suitable foraging (grassland) and protective habitat for EGKs in the form of scattered trees, shrubs and numerous watering points. |
| Movement Patterns | • There are two populations of EGK within the PSP, the northern population located north of Craigieburn Road and the southern population located south of Craigieburn Road.<br>• Although no movement or exchange of individuals between the two separate population was observed during the site visits, movement may |

| | |
|---|---|
| | occasionally occur between the two populations when EGKs are more active.<br>• The Eastern Grey Kangaroo populations appear to be resident to the Craigieburn West PSP and maintains the ability to access surrounding properties to the north, west, and to a lesser extent, those to the east. |

## 2.2 Future Conditions

As development progresses across the PSP the landscape will become more fragmented, reducing available resources and increases risk of land locking of EGKs. It is highly likely that EGKs that do not become land-locked in the south-east of the study area will be pushed to move westward or northward out of the PSP across Mickleham Road and Mt Ridley Road as available resources are reduced.

### 2.2.1 Key changes

The key changes expected to occur across the PSP during the life of development include:

- Proposed 6 lane upgrade of Mickleham Road;
- Proposed 6 lane upgrade of Mt Ridley Road;
- Proposed 4 lane upgrade of Craigieburn Road;
- Increased urbanisation and fragmentation of existing EGK habitat;
- Removal of food, water and habitat resources for EGKs (Figure 3);
- Increases in the number of internal roads and increased traffic levels throughout the precinct;
- Increases in human activity across the PSP as development progresses;
- Increased interactions between EGKs, humans, vehicles and other animals (dogs) as the precinct becomes more inhabited.

A summary of the risk to both humans and EGKs as development across the PSP commences at provided below (Section 3).

# 3 SUMMARY OF RISKS

## 3.1 Risks to Humans

### 3.1.1 Increased vehicle collisions

Vehicle accidents due to near misses or collisions with EGKs are the one most common and serious kangaroo-related threat to people (Brunton *et al.* 2018). EGK-vehicle interactions are shown to be more common when there is greater movement of EGKs (e.g. during autumn and winter when males are known to segregate) (Coulson *et al.* 2014).

There is an increased risk of vehicle-EGK collisions are development proceeds across the PSP and EGK begin moving into areas of more suitable habitat. Mickleham Road presents the greatest risk to collisions due to its high traffic volume and speed limit. The roads authority has an obligation to assess the risks of vehicle collisions and address these risks accordingly.

### 3.1.2 Aggression

Increased encounters between EGKs and humans or domestic animals may result in EGKs becoming aggressive towards people, usually when individual animals have regular contact with humans (DELWP 2020a). Aggressive interactions are expected to occur more frequently when EGKs are threatened by domestic animals such as dogs or become cornered along fence lines. Although there is little scientific evidence of aggressive interactions between humans and EGKs, and attacks on humans are rare, they attract significant media attention when they do occur (Ballard 2006).

### 3.1.3 Property damage

Development within the PSP may result in EGKs being forced to be move into sub-optimal urbanised areas resulting in an increase in property damage from EGKs. These negative interactions may include physical damage to human property including damage to gardens, fences or other property (Temby 2003). Damage may occur as EGKs move through the area, or during fights between males (Ballard 2006).

## 3.2 Risks to Eastern Grey Kangaroos

### 3.2.1 Land-locking

There is a high potential for land-locking of both populations of EGKs north and south of Craigieburn Road based on the locations of EGK observations and existing residential development. If management is not considered correctly, several impacts to EGKs may arise such as diminishing health and welfare of isolated groups/individuals (i.e. stress from overcrowding and starvation), reduced mobility and reduced availability of palatable food and water resources (DELWP 2018). If not managed correctly, isolated populations can starve, leading to high rates of mortality and/or population crashes. These isolated populations also diminish ecologically significant areas such as Conservation Area 29 via overgrazing. Furthermore, landlocking can

increase human-EGK interactions via vehicular collisions, and the movement of EGKs into built up areas (which may result in injury by dogs and confrontation with humans) (DELWP 2018).

The risk to EGKs becoming land locked varies largely on the sequence of development throughout the study area. They key risk to each population of EGKs is outlined below:

- The highest risk of land-locking to the northern population of EGKs is currently within the undeveloped land to the east within the Craigieburn R2 PSP if land parcel 14, 15 and 16 are developed prior to this land.
- The southern population of EGKs is at risk of being land-locked in The Hills Reserve, directly east of the Aitken Conference Centre (Parcel 39) as development in the south of the PSP progresses.

Although there is significant risk of EGKs becoming land locked within the PSP, it is difficult to determine exactly where these risks will arise as sequences of development are not yet known. The PSP will contain a number of potential movement corridors for EGKs in the form of drainage channels, sport reserves and open space. These movement corridors may be utilised by EGKs when moving throughout the PSP and are discussed further in Section 4.1.3.

### 3.2.2 Mortality from roadkill

EGK-vehicle collisions are one of the major contributors to population decline of kangaroos in urban areas (Brunton *et al.* 2018). These collisions can result in death or injury to vehicle occupants and EGKs (Ang *et al.* 2019). Mickleham Road presents the greatest hazards to the movement of EGKs westward out of the PSP. The development of the PSP will likely result in increased movement of EGKs across Mickleham Road as development continues through the PSP and encroaches into existing EGK habitat. The loss of habitat and food/water sources for EGKs, increased disturbance from development and movement of humans into EGK habitat will increase the pressure on these populations and encourage movement across major roads, therefore increasing the potential for vehicle-EGK collisions.

### 3.2.3 Disturbance from dogs

Increased attacks on EGKs by unrestrained dogs in areas of increased human activity such as along Aitken Creek linear park alignment or other areas of passive open space (Elton Consulting 2019; Brunton *et al.* 2018). As discussed in Section 3.1.2, interactions between EGKs and domestic dogs are more likely to occur if EGKs feel threatened. These interactions are expected to increase as development across the PSP progresses and EGKs move into more urbanised areas that are shared with humans and domestic animals.

### 3.2.4 Starvation, disease and malnutrition

Craigieburn West PSP provides a considerable amount of water and palatable resources throughout its extent, thereby allowing the area to support a large population of EGK. As a result of development, all watering points should be decommissioned and majority of the palatable resources removed, with the exception of lawns, open areas and Conservation Area 29. Resource removal is encouraged to begin prior to development to encourage EGK movement out of the area. When resource removal begins there will likely be an increase in

grazing pressure on remaining areas which can result in an increase in competition between individual EGK and welfare issues. These changes, as a result of development and increase human population within the area, can lead to a range of potential impacts to the welfare of EGKs (Olsen and Low 2006), including:

- Starvation due to lack of food resources (i.e. removal of grassland habitats);
- Increase stress on EGK;
- Exposure to disease, including Phalaris poisoning;
- Malnutrition causing parasite infestations;
- Injury and mortality associated with fence and vehicle collisions; and,
- Increased interactions with humans (i.e. EGKs becoming dependent and possibly aggressive).

## 3.3 Risks to Environment

### 3.3.1 Over-grazing of Conservation Area 29

Conservation Area 29 identified within the BCS is in the northern section of the study area (DEPI 2013, page 107) is a designated nature conservation reserve with the focus on protection of Grassy Eucalypt Woodland and Golden Sun Moth populations.

The movement of EGKs into this area as development within the PSP progresses will likely lead to overgrazing of the area. Overgrazing by overabundant EGKs populations has been shown to reduce vegetation cover, composition and diversity result in the degradation of habitats that are important for conservation purposes, including a reduction in Golden Sun Moth numbers (EPSDD 2017; TMS, 2010; Van Dyck and Strahan, 2008). Impacts to grassy vegetation within CA29 would compromise the management objectives for the conservation area. Furthermore, damage to native understorey may also affect grassland species, such as Golden Sun Moth and may prevent tree regeneration thereby affecting regenerating communities such as Plains Grassy Woodland (DELWP 2015b).

## 3.4 Future Risks

As development within the precinct progresses the risks to EGKs and humans may change and intensify. Although it is difficult to determine the exact changes that may occur, several predictable future risks are outlined below.

### 3.4.1 Future conditions and hazards

Predicted future changes to conditions and hazards within the precinct include:

- Urban development resulting in land-locking of EGKs;
- Increases in the number of internal roads and increased traffic levels throughout the precinct;
- Proposed 6 lane upgrade of Mickleham Road;

- Proposed 6 lane upgrade of Mt Ridley Road;
- Proposed 4 lane upgrade of Craigieburn Road;
- Reduced availability of palatable food and water sources for urban development; and,
- Development causing EGKs to move into areas with increased human activity.

### 3.4.2 Future changes to EGK population and movement

Although EGKs may exist within the development following completion, this is considered highly unlikely due to the extensive removal of food/water sources and the expected increase in human density. The removal of extensive areas of the palatable resources (i.e. open grassland) and watering points will most likely result in a reduction of EGKs population in the study area.

Although it is difficult to determine EGK movement patterns across the life of development within the Precinct as development sequences are not known, some general assumptions can be made:

- EGKs are expected to move out of the PSP as available resources (food, water and shelter) are removed. Movement will occur northward across Mt Ridley Road and westward across Mickleham Road.
- There is a risk of the northern population of EGKs becoming land locked in the undeveloped land to the east within the Craigieburn R2 PSP if land parcel 14, 15 and 16 are developed before this land.
- The northern population of EGK may utilise the Aitken Creek drainage channel and other open space to move through and out of the PSP as development encroaches into their available habitat.
- The southern population of EGKs is at risk of being land-locked in The Hills Reserve, directly east of the Aitken Conference Centre (Parcel 39) as development in the south of the PSP progresses.

Upon completion of construction within the PSP it would be expected that there are no EGKs remaining in the study area. Movement of EGKs throughout the precinct will be drastically reduced due to urban development increasingly fragmenting the landscape. Several new roads are also proposed to bisect the precinct further reducing EGK movement and increasing the risks of EGK-vehicle collisions. As the human population within the precinct increases EGKs are likely to be dissuaded from remaining due to growing survival pressures including increased human activity, reduction in available food and water resources and reduced habitat cover.

## 3.5 Risk Assessment Matrix

A risk-based assessment has been undertaken to identify the potential threat the planned future development of the PSP poses on the existing EGK population and associated habitats.

An assessment of impacts on key risks considered likely to occur within the PSP has been adopted in accordance with the principles of risk management described in AS/NZS 3100:2009 Risk management – principles and guidelines, and its companion documents HB 436:2013 Risk management guidelines companion to AS/NZS 3100:2009 and HB 203:2012 Managing environment-related risk.

The adopted framework involved the following steps:

- Establish context. Set the context for the risk-based assessment through the identification and definition of values.
- Identify potential impacts and issues. Review potential effects and the identification of possible causes of changes to environmental values.
- Consequence analysis. Assess the consequences of identified effects assuming the effective implementation of risk reduction through elimination, mitigation and management. The criteria for determining the consequence of impacts are outlined below (Table 4). In some instances, the consequence criteria may produce inconsistent designations (i.e. an impact may be assessed as widespread but readily reversible). In these instances, the technical specialists used their professional judgement to determine the overall consequence on the ecological value.
- Frequency analysis. Estimate the frequency or likelihood of a change to environmental values occurring assuming the effective implementation of risk reduction. The criteria for determining the likelihood of impacts are outlined below (Table 4).
- Analyse residual risk. Analyse the risk of change to environmental values occurring using qualitative or quantitative techniques that define risk as follows: Risk = Consequence x Likelihood. The risk evaluation matrix is provided below.
- Risk reduction. Identify risk reduction controls and measures (avoidance, mitigation and management measures).

The results of the risk assessment are provided in below.

**Table 4:** Qualitative criteria for likelihood and consequence

| Descriptor | Description |
|---|---|
| **Likelihood** | |
| 1 - Almost Certain | A hazard, event and pathway exist, and harm has occurred in similar scenarios and is expected to occur more than once over the duration of the development within the PSP. |
| 2 - Likely | A hazard, event and pathway exist, and harm has occurred in similar scenarios and is likely to occur at least once over the duration of the development within the PSP. |
| 3 - Possible | A hazard, event and pathway exist, and harm has occurred in similar scenarios and may occur over the duration of the development within the PSP. |
| 4 - Unlikely | A hazard, event and pathway exist, and harm has occurred in similar scenarios but is unlikely to occur over the duration of the development within the PSP. |
| 5 - Rare | A hazard, event and pathway are theoretically possible on this project and has occurred to a limited extent in similar scenarios but is not anticipated over the duration of the development within the PSP. |
| **Consequence** | |
| Negligible/Very Low | Where impacts from development will not result in any impacts to Humans, EGK or the environment. Negligible impacts are localised and temporary in nature, with no noticeable consequences |

| Descriptor | Description |
|---|---|
| Minor | Where a risk from development will not adversely affect Humans, EGK or the environment, provided standard Kangaroo Management Plans are implemented. Minor impacts are noticeable but localised to the project footprint and short-term in nature. They can be effectively mitigated through standard Kangaroo Management Plan controls. Values affected by Minor impacts are generally recognised as being important at a local or regional level. |
| Moderate | Moderate impacts directly or indirectly affect EGK, Humans or the environment within the broader project locality and are short or moderate term in nature. Impacts can be ameliorated with specific Kangaroo Management Plan controls. |
| High | Occurs when proposed activities are likely to exacerbate threatening processes, result in landlocking of EGK and increase interactions with Humans. High impacts are substantial and significant changes that affect Humans, EGK or the environment within the project locality and are moderate to long-term in nature. Impacts are potentially irreversible and avoidance through appropriate design responses or the implementation of specific Kangaroo Management Plan controls is required. |
| Major | Arises when an impact will potentially cause irreversible or widespread harm to an EGK, Humans or the environment that is irreplaceable because of its uniqueness or rarity. Major impacts are significant or irreversible changes that affect the Humans, EGK or the environment. |

**Table 5:** Risk Evaluation Matrix

| | | Increasing Likelihood | | | | |
|---|---|---|---|---|---|---|
| | | Rare | Unlikely | Possible | Likely | Almost Certain |
| Consequence | Negligible/Very Low | Very Low | Very Low | Very Low | Low | Moderate |
| | Minor | Very Low | Low | Low | Moderate | Moderate |
| | Moderate | Low | Low | Moderate | High | High |
| | High | Low | Moderate | High | Major | Major |
| | Major | Moderate | High | Major | Major | Major |

**Table 6:** Risk Assessment Results.

| Risk | Potential Consequence(s) | Risk Assessment Matrix Score | | | Management Options to Minimise Risk |
|---|---|---|---|---|---|
| | | Humans | Kangaroos | Environment | |
| **Risks to Humans** | | | | | |
| Increased vehicle collisions | • Death of human(s)<br>• Death of EGKs<br>• Damage to vehicles | Major | Major | Very Low | • Staged development<br>• Virtual fencing<br>• Road signage<br>• Exclusion fencing<br>• EGK population control |
| Aggression | • EGKs becoming aggressive towards humans<br>• Injury/death to humans<br>• Dog-EGK interactions | High | High | N/A | • Staged development<br>• Controlling development directions across PSP<br>• Exclusion fencing<br>• Removal of food and water resources<br>• Informative signage<br>• Community awareness and education |
| Property damage | • Damage to human property including gardens and fences | Low | Moderate | Low | • Staged development<br>• Exclusion fencing |
| **Risks to Eastern Grey Kangaroos** | | | | | |
| Land-locking | • Starvation due to lack of resources<br>• Disease from overcrowding<br>• Increase in adverse human-EGK interactions.<br>• Increase in adverse human-dog interactions<br>• Overgrazing of resources if available habitat is decreased. | High | Major | Low | • Staged development<br>• Exclusion fencing<br>• Controlling development direction of the PSP<br>• Culling<br>• Translocation<br>• Population monitoring |
| Mortality from roadkill | • Increased movement across major roads resulting in death/injury to EGKs. | Moderate | Major | Low | • Staged development<br>• Exclusion fencing<br>• Culling<br>• Translocation<br>• Population monitoring |
| Disturbance from dogs | • Increase attacks on EGKs by unrestrained dogs | Moderate | High | Low | • Staged development<br>• Exclusion fencing<br>• Informative signage |

| Risk | Potential Consequence(s) | Risk Assessment Matrix Score | | | Management Options to Minimise Risk |
|---|---|---|---|---|---|
| | | Humans | Kangaroos | Environment | |
| | • Increased Dog-EGK interactions<br>• Injury/death to EGKs or dogs<br>• Increased human-EGK interactions | | | | • Community awareness and education |
| Starvation, disease and malnutrition | • Increase road crossings<br>• Increased encroachment into residential areas<br>• Increase human – EGK interactions<br>• Increased dog – EGK interactions<br>Increased impacts to potential biodiversity values | Moderate | Major | Low | • Staged development<br>• Exclusion fencing<br>• Translocation<br>• Culling |
| **Risks to Environment** | | | | | |
| Over-grazing of Conservation Area 29 | • Adverse impacts to biodiversity values (Conservation Area 29) | N/A | N/A | High | • Exclusion fencing<br>• Translocation<br>• Culling |

# 4 POTENTIAL MANAGEMENT ACTIONS

The following section outlines several management actions that may be implemented across the PSP to mitigate the risks to EGKs and humans. A feasibility and constraints assessment have been undertaken to determine the effectiveness of each proposed action. Successful management actions will need to be realistic and cost-effective, as well as socially acceptable.

## 4.1 Potential Management Options

General PSP wide management recommendations are broad scale actions that can be implemented across the majority of the PSP to mitigate the risk to both humans and EGKs as development progresses. These management actions would need to be implemented by a responsible authority such as local council, roads authority or the developer. The implementation of these potential management options will need to be determined at the time of development and be based on the current site conditions at that time.

The following sections provide broad scale recommendations that if implemented would contribute to reducing the risks of adverse human-EGK interactions, including vehicle collisions as EGKs move westward out of the PSP. These recommendations are primarily focused on Mickleham Road which presents the greatest risk to EGKs attempting to move out of the PSP. Consideration of the listed management actions below is strongly encouraged in order to mitigate these future risks.

### 4.1.1 Controlling Development Directions

Due to the size of the precinct and the large amount of available habitat both within, and surrounding, the study area, it is recommended that the study area is developed in a sequential manner where possible. While the assessment recognises the low feasibility of staged or preferential release of the development, the avoidance to land-locking EGKs with minimal human intervention remains a primary goal. Staged development throughout the precinct would be the most effective method to ensure risks to EGKs are minimised and populations are able to easily disperse out of the study area. This method would enable EGKs to disperse via a logical, sequential manner through and beyond the study area and into suitable habitat to the west and the north of the study area, thereby reducing the potential for landlocking and adverse interactions between humans and kangaroos. This approach will also minimise any potential animal welfare issues (starvation, stress etc.) that may arise from land-locking, and herding of EGKs, which may be encountered in urban growth zone areas where construction occurs in a haphazard manner.

#### *4.1.1.1 Staged Development*

Staging development allows for developers to set the order of a subdivision and can minimise the risk of landlocking EGKs at the individual development level. It is recommended that new development aims to abut existing development in neighbouring land and developers are encouraged to coordinate development directions to minimise risks of landlocking (DELWP 2015b). Staged development should also take into consideration EGK movement patterns and provide exit routes that allow EGK movement into adjoining land and not towards nearby roads or other hazards (DELWP 2015b).

A site-specific Kangaroo Management Plan must address specific staged development plans for each development within the PSP.

### 4.1.2 Exclusion Fencing

Exclusion fencing is a highly effective method for controlling EGK for short, moderate of long-term periods. Exclusion fencing scenarios are provided in the table below (Table 7).

**Table 7:** Exclusion fencing information.

| Exclusion Fencing Type | Description | Example Scenario |
|---|---|---|
| Fencing of construction or staged areas | The erection of exclusion fencing for the short to moderate term gives developers control of kangaroo movement during the life of individual developments, provided that the fencing is managed to an appropriate standard, by excluding EGK from the construction or staged area while also being relatively cost-effective. | For a development that is divided into separate stages, each stage should be fenced prior to construction beginning. This will allow any EGK present within the area to move out of the development and attempt to prevent landlocking within the landscape. Exclusion fencing requirements will be dependent on the landscape context (i.e. neighbouring developments, roads etc.) at the time of development commencing. |
| Fencing adjacent to roads where feasible | Fencing along sections of road adjacent to landholdings preceding construction to avoid road mortality and to restrict EGK accessing the development area from the surrounding landscape. | Where a development is being constructed adjacent to a major road, such as Mickleham Road, Craigieburn Road or Mt Ridley Road, the aspect immediately adjacent to the road should be fenced to prevent EGK-vehicle collisions. Developments that exist adjacent to such roads should consider staging their development from the road and into the PSP. |
| Fencing of Conservation Area 29 | The long-term implementation of exclusion fencing will allow for the protection of the Conservation reserve against overgrazing and prevention against providing refuge to EGK during the development of the surrounding area. | Fencing of ecological values to be retained within the study area will limit the amount of harbour and resources available for EGK. This will also prevent EGK from returning into the PSP. |

#### *4.1.2.1 Exclusion Fencing Requirements*

Fencing must be in accordance with the definition of fencing in DELWP's Guide to preparing a kangaroo management plan for Melbourne's growth corridors (2015, pp. 26 - 27). The use of fencing with kangaroo proof features to restrict EGK movement must:

- Be chain-link (cyclone) fencing or deer mesh (also known as K wire);
- Not be ring-lock-style fencing (which is an entanglement hazard);
- Be high-tensile, heavy galvanised wire;
- Be at least 1.9 m high (deer mesh is produced in this size);
- Have no barbs;
- Have no loose or open wires; and,

- Be completely free of holes and gaps in, and under, the fence to stop the kangaroos trying to escape, and to stop them being injured.

It is not feasible to install exclusion fencing across large areas of the PSP as it is costly to install and maintain. It also poses risks to animal welfare as excluding populations that are over-abundant may lead to mass starvation (DELWP 2017). Exclusion fencing will be most feasible to implement at the site-specific scale during the development of individual land parcels/estates.

Fencing the boundary of the PSP could pose risks to animal welfare via excluding populations that are over-abundant may lead to animal starvation (DELWP 2017). As such, Approval from DELWP (in the form of a KMP) is required before installing exclusion fencing on any land parcel that will alter EGK behaviour or movement. While it is not feasible to install exclusion fencing around the boundaries of the PSP on aspects that are adjacent the major roads, it is feasible to approach this style of fencing on a smaller, development by development scale. All developments that are bordered by a major road should consider fencing the aspect facing the road prior to construction commencing, and independent of the developments staging.

### 4.1.3 Movement Corridors

The Craigieburn West PSP will contain a number of linear corridors, open spaces and parks (Figure 6) that may facilitate the movement of EGKs throughout the precinct and into the broader landscape while construction is occurring. While not designed for EGK movement, it is likely they will be used by EGKs as development progresses throughout the PSP and available habitat/open space is reduced.

These areas will be important to aid in the movement of EGK within the PSP and facilitate migration out of the study area. Aitken Creek has the potential to provide a link for EGKs to move east-west across the northern section of the study area and, if combined with a crossing points or other management options, could provide an essential movement corridor for EGKs, reducing the risk of this population becoming land-locked. If crossing points are established in conjunction with movement corridors (Figure 6) they may facilitate movement of animals out of the PSP across Mickleham Road and Mt Ridley Road in the north. EGKs may be able to move more easily from the PSP as development progresses, reducing the risk of land-locking throughout the development of the precinct.

Linear corridors in the southern section provide connections between the Aitken Hill Conference Centre, the land to the north of Greenvale Reservoir and the surrounding areas. There is potential for another movement corridor be established in the south-west corner of the PSP which may allow a passage for EGK to move westward across Mickleham Road and out of the study area. It is recognised that there is a risk to EGKs crossing roads (e.g. Mickleham Road). Additional management options such as reduced speed limits, warning signs and virtual fencing should also be considered if crossing points are established at these locations.

### 4.1.4 Resource Removal

Resource removal involves the removal or decommissioning of resources that are used by EGKs in order to encourage movement out of an area. Resource removal is focused on the removal of water points, food resources and protective habitat. The proposed removal of native vegetation would need to be undertaken in accordance with Melbourne's Strategic Assessment and the native vegetation retention and removal plan provided in the PSP.

If a population of EGKs is identified to be land locked during pre-development surveys, resource removal should not occur as EGKs will not be able to disperse from the area and there will be an increased risk to both human safety and animal welfare if forced to move into more urbanised areas in search of resources.

Resource removal within each land parcel should occur before development starts so as to discourage EGKs out of the area.

Water Points

Water point removal involves the decommissioning, filling in, removal or fencing of water sources that may be used to EGKs including farm dams, ground tanks or troughs. Water points identified in the land features table (Appendix 1) should be removed/decommissioned prior to the commencement of development.

Although the effectiveness of EGK movement patterns to the closure of water points is inconclusive (LLS 2020) as EGKs may obtain their water needs from grasses (DELWP 2015b) this method is still encouraged as it is a straightforward and non-invasive method to discourage EGKs from an area.

Water point removal should not occur during summer months, or only when there is certainty of alternative water sources close to the site. Removal of water points without alternative options for EGK may lead to animal welfare concerns. Water point removal should also not occur when a population of EGKs is, or becomes, at risk of land-locking.

Food Resources

Eastern Grey Kangaroo predominately feed on green annual grasses with moderate amounts of forb and shrub material (Davis *et al.* 2008; Pahl 2019). The majority of the study area consists of agricultural paddocks containing palatable grasses likely to be utilised by EGKs. When used in conjunction with removal of water points and protective habitat, the removal of palatable grasses and herbs may encourage EGKs to move on from the area and reduce the immediate risk of land-locking. Removal of food resources within each land parcel should involve complete removal as slashing or mowing can be ineffective. Regrowth of food resources will need to be closely monitored as young shoots may attract EGKs back into an area.

Protective Habitat

Protective habitat are areas such as patches of trees and wind rows where EGKs can shelter, rest and are safe from human disturbances. If there is protective habitat within one kilometres EGKs are more likely to be found in that area (DELWP 2015b). Removal of protective habitat such as windrows should be removed to encourage EGK movement out of the area.

Removal of protective habitat should be considered early on prior to development if possible and where permitted to encourage EGKs out of the area.

### 4.1.5 Fauna Sensitive Road Design

Road Signage

Local traffic management aims to reduce the speed limit and traffic volume and to raise driver awareness to the presence of wildlife (VicRoads 2012). These measures include:

- Flashing warning signage;
- Highly visual yellow kangaroo signs; and,
- Reducing speed limits by installing temporary or permanent signage.

While these traffic management are not very effective at reducing wildlife collisions in general (Huijser *et al.* 2015) they can be implemented collectively alongside other forms of management (i.e. exclusion fencing,

virtual fencing or staging development) and should be incorporated on all major roads within the PSP (i.e. Mickleham Road, Craigieburn Road and Mt Ridley Road). Example of flashing warning signage that has been used by the City of Casey in high risk areas (Plate 1).

**Plate 1.** Example of flashing EGK warning signage (City of Casey, 2020)

There is evidence that high speed and increased traffic volume increase the risk of collisions between EGKs and vehicles (Visintin *et al.* 2016). Signage and temporarily reduced speed limits (between dusk and dawn) are recommended along all areas of Mickleham Road, Mt Ridley Road and Craigieburn Road for the length of the study area to attempt to reduce vehicle-EGK collisions. Along Mickleham Road, where EGK are expected over a certain distance, a warning sign should be included that specifies that kangaroos will be found within the next few kilometres (VicRoads 2012). The roads authority (VicRoads) would be responsible for designing signs that are most visible to motorists at dawn and dusk when EGKs are more active (VicRoads 2012).

It is also recommended that the roads authority consider a reduced speed limit of 60 kilometres is also along these roads. A reduced limit of 40 kilometres is recommended within construction areas, outside of arterial roads.

Crossing Points

Crossing points aim to minimise the risk of vehicle-EGK collisions by facilitating EGK movement into suitable habitat to the north and/or west of the study area. Crossing points incorporate a range of different methods such as local traffic management options (signage, reduced speed limits etc) to ensure that drivers are aware of the upcoming hazard and exclusion fencing to ensure that the EGK are crossing at a predetermined point and not randomly crossing the road. Crossing points would need to be assessed further by the responsible roads authority to determine the feasibility in relation to the future upgrades of Mickleham Road and Mt Ridley Road.

Four potential crossing points have been identified – three along Mickleham Road one along Mt Ridley Road (Figure 6). These crossing points are generally associated with linear corridors and aim to promote EGKs to move out of the study area as development progresses. Furthermore, where crossing points have been recommended, exclusion fencing should be incorporated to attempt to direct EGKs to the predetermined crossing point. All crossing points would need to be implemented in conjunction with other local traffic management options, including lower speed limits and kangaroo signs to warn incoming traffic of the potential hazard.

Virtual Fencing

Virtual fencing is a new technology that uses bollards installed along roadsides. It is an active form of road-kill mitigation that is activated at night by approaching vehicles and emit a lashing lighting and sound to repel wildlife from the road. The virtual fences are solar powered units that produce a virtual fence along a roadway and can be set to work from dusk to dawn and aim to alert kangaroos present in the roadside to oncoming traffic (WSS 2018). The internal light sensor on the units detects approaching vehicle headlights and produces an optical or auditory alert which aims to raise the attention of animals, and the lights aim to make animals move away from the road area.

Initial evidence on the effectiveness of virtual fencing is still unclear. One trial in Tasmania noted a reduction in roadkill numbers by as much as 50% in smaller more commonly affected mammal species (Tasmania pademelon, Bennett's wallaby and brush-tailed possum) (Fox *et al.* 2018). However, a similar study along a 4.5 kilometre stretch of Tasmanian highway showed that there is no significant effect of virtual fencing reducing roadkill (Englefield *et al.* 2019).

Virtual fencing trials are also currently being undertaken across Victoria on Phillip Island, City of Casey and Lysterfield where initial anecdotal reports by residents and wildlife carers has been positive.

Virtual fencing should be considered as a potential management option along the length of Mickleham Road if additional management actions such as road signage and exclusion fencing are not effective at minimising EGK-vehicle collisions. Examples of installed virtual fencing bollards are provided below (Plate 2).

**Plate 2.** Example of installed virtual fencing bollard (City of Casey).

### 4.1.6 In-situ Population Management

Although EGKs have been known to persist in pockets of vegetation within urbanised environments (Coulson *et al*. 2014), DELWP discourages in situ management of EGKs in nature conservation areas (i.e. in Conservation Area 29) due to conflict with the primary management objectives of these areas (DELWP 2015b). High densities of EGKs that persist in areas may lead to overgrazing, which has resulted in adverse impacts to biodiversity, including reductions in Golden Sun Moth populations (EPSDD 2017; TMS 2010).

An in-situ population of EGKs persisting within CA29 would not be consistent with the management objectives of this reserve under the BCS (DEPI 2013, page 107). An in-situ population of EGKs in this area may lead to overgrazing, and as outlined above has been shown to adversely impact biodiversity and result in a reduction of Golden Sun Moth numbers (EPSDD 2017; TMS, 2010).

Consultation with Melbourne Water has determined that the land directly south of the Conference Centre will be managed as open space and EGK proof fencing will be installed to prevent EGKs entering their land.

Hilltop Parkland to the east of the PSP may also provide suitable habitat for EGKs to persist, however this population would become land-locked and the risk to EGK welfare (e.g. lack of resources, particularly during low rainfall years) would be significantly high.

An in-situ population of EGKs remaining within the PSP (e.g. open space areas) would likely result in increased EGK-Human interactions. As development proceeds in these areas the likelihood of adverse impacts to both human safety and animal welfare will increase. As such, it is unlikely that given the lack of avalaible habitat and reduction in habitat permeability / connection as a result of the future development (i.e. multiple roads and infrastructure across the PSP), it is unlikely that an in-situ population EGKs will persist in the precinct after development.

### 4.1.7 Population Control

The Office of Conservation Regulator, DELWP, issues Authorities to Control Wildlife (ATCWs) under section 28A of the *Wildlife Act 1975* for the control of kangaroos where they are demonstrated to be damaging pasture, crops or other property or impacting on biodiversity values (DELWP 2020a). Any landowner/developer wishing to control wildlife, including kangaroos, on their property is required to apply for an ATCW (https://www.wildlife.vic.gov.au/managing-wildlife/wildlife-management-and-control-authorisations).

The management techniques for controlling kangaroo populations include translocation, culling and reproductive management. These techniques vary in effectiveness depending on the situation and size of the population being managed. Where non-lethal techniques are ineffective or impractical, lethal control may be necessary. The type of population management action implemented will be heavily influenced by detailed population monitoring surveys to determine the size, health and site-specific conditions in consultation with DELWP.

Population control is unlikely to be required at the individual land parcel level unless EGKs have become land locked (i.e. towards the end of development across the PSP) or an animal welfare issue has arisen such as lack of suitable foraging habitat for EGKs resulting in malnutrition or starvation.

Translocation / relocation

Translocation or relocation is a method that is widely used as a conservation and management strategy for many species and involves the intentional movement of a species by humans from one location to another. While widely used this management option can lead to a significant risk of injury and death of individuals as a direct result of capture, handling and transfer. Furthermore, translocation is generally considered inappropriate for the management of abundant species, such as EGKs, due to the high associated cost, the need to include experts and the requirement of an appropriate release site (Descovich *et al.* 2016).

If EGKs survive the process of translocation, they may attempt to return to their initial home range where translocated individuals often observed seen wandering or moving long distances away from the translocation site thereby exposing them to a range of hazards including collisions with vehicles and attacks by dogs. As such, translocation is largely inappropriate for the management of EGKs within the Craigieburn West PSP and should only be considered in exceptional circumstances where individual or very small populations of EGKs

have become land locked. DELWP generally does not support translocation of EGKs due to these inherit risks (DELWP 2018).

DELWP has developed a policy outlining the requirements for kangaroo translocation (https://www.wildlife.vic.gov.au/managing-wildlife/translocation-of-wildlife).

Culling

Shooting is considered the most effective method to control kangaroos because the animals die quickly, and it reduces the numbers rapidly. Specifically, night shooting has welfare outcomes superior to many other wildlife killing techniques and is considered the most humane approach to culling kangaroos (Hampton and Forsyth 2016).

The lethal control of kangaroos by shooting is done in accordance with the National Code of Practice for the Humane Shooting of Kangaroos and Wallabies (DELWP 2017).

Despite culling being an effective method of EGK control, it should only be undertaken as a last resort when all other management actions have been exhausted.

Community views on culling of EGKs vary. Some studies determined that kangaroo culling was supported when it is was undertaken for animal welfare, harm reduction or conservation reasons (Descovich *et al.* 2016; Mehmet and Simmons 2018). Alternatively, the community is often opposed to EGK culling and it is argued that human convenience or financial cost do not justify culling (Mehmet & Simmons 2018).

Reproductive Management

Reproductive control is an alternative to lethal control and can be implemented when the abundance of EGKs in an area is considered too high (Descovich *et al.* 2016). This method involves the contraception or sterilisation of EGKs and be used in both sexes (Wilson and Coulson 2016; Herbert *et al.* 2004b; 2004c, Woodward *et al.* 2006).

In general, fertility control is too expensive and not effective for large-scale EGK management (Olsen and Low 2006) however implementation may be successful in small, isolated populations that have become land locked during development across the PSP. A study by Wimpenny & Hinds LA (2018) found that sterilisation using GonaCon could be an effective method for fertility control however, the effect on population growth is still unclear.

Reproductive control should only be considered for controlling populations of EGKs that are not in immediate danger of encroaching development and where adequate resources exist for a temporary population of EGKs to persist. On-going monitoring of EGKs would be necessary to determine the effectiveness of reproductive management actions.

Reproductive control is a more humane method of EGK control and should be prioritised over culling or translocation if considered feasible Reproductive control would only be effective if there is no immediate danger to a population of EGKs or if it is considered feasible for an in-situ population to remain in an area. At this stage of the strategy, it is not considered likely that an in-situ population of EGKs will remain within the PSP once development is complete. Implementation of this type of management action would need to be undertaken in consultation with DELWP.

## 4.2 Site-Specific Management Recommendations

Site specific management recommendations should be implemented at the individual development scale and in most cases will be required as part of an individual Kangaroo Management Plan.

Prior to the commencement of development of individual properties, an initial site survey must be undertaken to determine if EGKs are present on a property and/or in surrounding areas, or likely to use habitat resources on a site. Any current risks to EGKs (i.e. land-locking) need to be identified during the initial site survey. If EGKs are identified to be within the land parcel or surrounding areas additional monitoring surveys will be required to determine the extent of EGKs, population size and health. Additional surveys may be required for land locked EGKs. The Decision-making Flowchart (Appendix 2) must be followed to determine potential risks to EGKs in addition to preparing a site specific a KMP.

Kangaroo Management Plans for each property need to be prepared to the satisfaction of DELWP and address the following:

- Be consistent with this Strategy;
- Be in accordance with DELWPs 'Guide to Preparing a Kangaroo Management Plan for Growth Areas in Victoria' (DELWP 2015b); and,
- Include strategies, management actions and contingency planning that will be implemented to minimise animal welfare and human safety risks.

### 4.2.1 Initial Site Assessment

An ecologist must be engaged to conduct an initial presence/absence survey to establish if there are kangaroos in the survey area, or if there is evidence that kangaroos have been in the survey area in the last 12 months. The population survey results from the previous assessment (Figure 2) should also be referred to as a starting point.

The survey area includes:

- The area for which the planning permit application is being made; and,
- Land extending for 1 km in all directions beyond the boundary of the permit application area, including parks, reserves and conservation areas.

### 4.2.2 Population Survey

If the ecologist determines that kangaroos have used the survey area in the last 12 months, they must conduct a population survey to determine:

- The total number of kangaroos, or their estimated abundance (kangaroos per ha)
- The location of the kangaroos
- Notable patterns of movement onto and across the permit application area
- Any evident signs that any kangaroo is diseased or lame
- Any other notable information.

### 4.2.3 Kangaroo Management Plan Preparation

A Kangaroo Management Plan (KMP) will be required for all developments within the PSP however, the type of KMP required will be determined by the Decision-making Flowchart (Section 4.4).

Kangaroo Management Plans will be required for all land parcels at the at the individual development level of the PSP. The Decision-making Flowchart is used to determine the current level of risk to EGKs and provides guidance around the management actions required. Kangaroo Management Plans must be submitted to DELWP for review and approval prior to the commencement of any works. Appendix 3-5 outline the requirements for preparing site specific KMPs.

### 4.2.4 Decision-making Flowchart

The Decision-making Flowchart will walk developers through a series of questions to determine the risks currently posed with EGKs as a result of their development and provide guidance around the necessary steps that must be undertaken to satisfy their planning permit requirements and effectively manage EGKs within their land and the surrounding area.

Refer to Appendix 2 for the Decision-making Flowchart.

## 4.3 Feasibility Assessment of Management Actions

A feasibility assessment has been undertaken to identify the most implementable management practices within the PSP (Table 8). The assessment looks at the acceptability (i.e. Is the management method supported by the wider community, is it ethical, is it supported by science and consistent with legislation and State policy)

The below table rates each management option based on their effectiveness, strengths and weaknesses to provide a feasibility score (i.e. high, medium or low).

Table 8. Feasibility assessment of potential management actions.

| Management Action | Risks Mitigated | Effectiveness | Strengths | Weaknesses | Acceptability | | Feasibility |
|---|---|---|---|---|---|---|---|
| Controlling Development Directions of the PSP | • Land-locking<br>• EGK-Human Interactions<br>• EGK-Vehicle collisions<br>• Starvation | Staging has been shown to be highly successful at mitigating potential impacts (i.e. land-locking) to kangaroos at the individual development level. | • Very controlled, cost-effective method for proactively managing risks to EGKs.<br>• Would require little on ground implementation. | • Responsible authority has little to no power to control timing or direction of development across the PSP. | Community | ☑ | Low |
| | | | | | Ethically | ☑ | |
| | | | | | Scientifically | ☑ | |
| Staged Development | • Land-locking<br>• EGK-Human Interactions<br>• EGK-Vehicle Interactions<br>• EGK-Dog Interactions<br>• Starvation | Highly effective at the individual development phase. | • Minimal human intervention. | • Needs to be implemented within other management options (resource removal, exclusion fencing etc). | Community | ☑ | High |
| | | | | | Ethically | ☑ | |
| | | | | | Scientifically | ☑ | |
| Exclusion Fencing | • Land-locking<br>• EGK-Human Interactions<br>• EGK-Vehicle Interactions<br>• EGK-Dog Interactions<br>• Starvation<br>• Overgrazing of conservation areas | Highly effective at the individual development scale.<br><br>Has the potential to reduce EGK movement patterns and therefore minimises the risk of roadkill when crossing busy roads. | • Effective way to exclude EGKs for specific areas and control/restrict movement into high risk areas. | • Expensive to establish and maintain across large areas.<br>• When implemented incorrectly can landlock kangaroos. | Community | ☑ | Moderate |
| | | | | | Ethically | ☑ | |
| | | | | | Scientifically | ☑ | |

| Management Action | Risks Mitigated | Effectiveness | Strengths | Weaknesses | Acceptability | | Feasibility |
|---|---|---|---|---|---|---|---|
| Movement Corridors | • Land-locking<br>• Starvation<br>• Overgrazing of conservation areas | Effective method for allowing EGK movement through and out of the PSP as development progresses. | • Movement corridors and open spaces already exist within the PSP.<br>• No additional cost required to implement.<br>• Would require little on ground implementation. | • Needs to be implemented with other management options (excludion fencing, fauna sensitive road design).<br>• May result in increased movement of EGKs across busy roads. | Community | ☑ | High |
| | | | | | Ethically | ☑ | |
| | | | | | Scientifically | ☑ | |
| Removing Resources | • Land-Locking<br>• EGK-Human Interactions | Highly effective at the individual development scale when implemented alongside exclusion fencing. | • Cost effective.<br>• Proven and effective management action.<br>• Minimal human intervention. | • Can increase risk to EGK welfare if too many resources are removed and EGKs are forced to compete for resources or move into sub-optimal habitat.<br>• Used in conjunction within other management options such as fencing.<br>• Regrowth needs to be closely monitored as young shoots may attract EGKs<br>• Slashing ineffective, complete removal advised.<br>• Removal of any native vegetation needs to be in line with the Victorian Governments | Community | ☑ | High |
| | | | | | Ethically | ☑ | |
| | | | | | Scientifically | ☑ | |

| Management Action | Risks Mitigated | Effectiveness | Strengths | Weaknesses | Acceptability | | Feasibility |
|---|---|---|---|---|---|---|---|
| | | | | Biodiversity Conservation Strategy. | | | |
| Road Signage | • Human/EGK Interactions<br>• Vehicle/EGK Collisions | Can be effective for reducing risk of collisions if paired with other management options. Increased signage and speed limit reductions likely to assist it risk mitigating especially in areas with high speed and high traffic volume. | • Existing examples of successful implementation by other councils (i.e. City of Casey). | • Can be costly to maintain if damaged (i.e. vehicle collisions with signs)<br>• Does not deter EGK from crossing roads.<br>• Not effective at reducing wildlife collisions if implemented alone. | Community | ☑ | High |
| | | | | | Ethically | ☑ | |
| | | | | | Scientifically | ☑ | |
| Crossing Points | • Vehicle/EGK Collisions<br>• Human/EGK Interactions<br>• EGK mortality | May provide an effective strategy for managing risk by focusing on select locations. EGK movement will be easier to predict and manage. | • Cost-effective method controlling EGK movement patterns.<br>• Allows greater control over EGK movement when crossing busy roads.<br>• Utilising existing open spaces and movement corridors. | • May funnel/heard EGKs across certain points.<br>• Potential to confuse or disorientate EGKs.<br>• Cannot guarantee crossing points will be utilised by EGKs.<br>• EGKs may become trapped within the road reserve increasing risk of vehicle collisions. | Community | ☑* | Moderate |
| | | | | | Ethically | ☑* | |
| | | | | | Scientifically | ☑* | |

| Management Action | Risks Mitigated | Effectiveness | Strengths | Weaknesses | Acceptability | | Feasibility |
|---|---|---|---|---|---|---|---|
| Virtual Fencing | • Human/EGK Interactions<br>• Vehicle/EGK Collisions | Little scientific evidence has been published at this stage however initial indications are that this is an effective method (anecdotal evidence from wildlife carers, Tasmania study on smaller mammals) | • Comparatively much cheaper than installing culverts or overpasses.<br>• Have the potential to dramatically reduce EGK collisions. Demonstrated that it can be established<br>• Existing examples of successful implementation by other councils (i.e. City of Casey).<br>• Insurance claims from EGK-vehicle collisions may be costing more than the cost to install virtual fencing. | • Can be costly to maintain if damaged (i.e. vehicle collisions with bollards).<br>• New technology with little scientific evidence on effectiveness at this stage. | Community | ☑ | Moderate |
| | | | | | Ethically | ☑ | |
| | | | | | Scientifically | ✖ | |
| In-situ Population Management | • Starvation<br>• Overgrazing of conservation areas | Can be effective when accompanied by a monitoring and management program | • Ecosystem services provided by EGKs remaining in an area.<br>• Positive community views of co-existing with native wildlife.<br>• May be a better environmental outcome. | • Requires frequent monitoring of EGK populations.<br>• Additional management actions may be required to control population.<br>• Enough habitat required to be maintained to support a population of EGKs.<br>• Increased risk of EGK-human interactions<br>• Can be costly to manage and monitor in-situ population in perpetuity. | Community | ☑ | Low |
| | | | | | Ethically | ☑ | |
| | | | | | Scientifically | ☑ | |

| Management Action | Risks Mitigated | Effectiveness | Strengths | Weaknesses | Acceptability | | Feasibility |
|---|---|---|---|---|---|---|---|
| Translocation / relocation | • Land locking<br>• Starvation | Can result in high mortality rates of individuals due to darting and the stress. Has a many associated animal welfare and biodiversity concerns. Only a viable method when the necessary criteria are met (DELWP 2018). | • Non-lethal<br>• Community approved | • Kangaroo Myopathy;<br>• Misplaced or wandering individuals;<br>• High associated cost;<br>• Expertise required;<br>• Labour intensive;<br>• Requirement of release sites;<br>• If the recipient site is close to the original site, it could need to be fenced, to stop kangaroos moving back to the original site. | Community | ☑ | Low |
| | | | | | Ethically | ✖ | |
| | | | | | Scientifically | ✖ | |
| Culling | • Land Locking<br>• EGK-Human Interactions<br>• EGK-Vehicle Interactions<br>• EGK-Dog Interactions<br>• Starvation | Effective when following the guidelines established by DELWP and the associated animal welfare principles (DELWP 2018). | • Removes the populations completely from the study area. | • Expertise/professionals required<br>• Carcass disposal required<br>• Public consultation may be required as part of the process.<br>• Community contention around culling where there is a lack of understanding. | Community | ☑* | High |
| | | | | | Ethically | ☑* | |
| | | | | | Scientifically | ☑ | |
| Reproductive Management | • Management of population numbers. | Most effective on small or isolated populations or where an in-situ population is maintained. | • More socially acceptable method of population control. | • More resource intensive than other management options. | Community | ☑ | Low |

| Management Action | Risks Mitigated | Effectiveness | Strengths | Weaknesses | Acceptability | | Feasibility |
|---|---|---|---|---|---|---|---|
| | | Treatment may not be 100% effective if new individuals move into area and will be dependent on population size and proportion of population that is sterilised. | | • Can only be implemented if EGKs immediately threatened by encroaching development.<br>• High associated cost<br>• Expertise required<br>• Labour intensive<br>• Repeat treatments may be required. | Ethically | ☑ | |
| | | | | | Scientifically | ☑ | |

☑* - accepted if done correctly (i.e. culling is ethically accepted if conducted by trained professionals)

## 4.4 Summary of the Potential Management Actions

A summary of the potential management actions that may be implemented across the PSP, their timing and who the potential responsible authority for implementing each action will be (Table 9).

Table 9. Summary of potential management actions.

| Management Action | Description | Timing | Possible Responsible Authority |
|---|---|---|---|
| Controlling Development Directions | Controlling overall directions of development across the entire PSP in a manner that allows EGKs to disperse from the area and reduces risks of land-locking or other welfare issues. | Pre-development/development phase | Council/VPA |
| Staged Development | The planning and construction of each stage of the potential subdivision in a particular order in an attempt to avoid land locking EGKs. | Pre-development/development phase | Developer/Landowner |
| Exclusion Fencing | Installing fencing to exclude EGKs from construction/high risk areas. Adopting fence designs that minimise wildlife injury can improve animal welfare and in turn reduce ongoing infrastructure damage. | Pre-development phase | Developer/Landowner |
| Movement Corridors | Open space corridors and parks/reserve which will provide dispersal options for EGKs when moving through and out of the PSP as construction commences. | To be implemented as part of the PSP. | N/A |
| Resource Removal | Removal/ fencing off all water points, food and protective habitat. | Pre-development/development phase | Developer/Landowner |

| Management Action | Description | Timing | Possible Responsible Authority |
|---|---|---|---|
| Road Signage | Installing high visibility/flashing warning signs and reducing vehicle speed on roads with high EGK numbers to mitigate collision risk. | Pre-development/development phase | Council/Roads authority |
| Crossing Points | Establishing pre-defined points in conjunction with existing movement corridors which can be utilised by EGKs when moving out of the PSP across high risk areas (i.e. Mickleham Road). | Pre-development/development phase | Council/Roads authority/Developer |
| Virtual Fencing | Roadside bollards using automatic sensor light and sound to repel wildlife and mitigate collision risk when vehicles approach. | Pre-development phase (potentially Implemented during upgrade of Mickleham Road) | Council/Roads authority |
| In-situ Population Management | Maintaining a resident population of EGKs within the PSP during and after completion of development within the PSP by allowing them to utilising local parks, reserves and drainage channels. | Development/Post-development phase | Council/DELWP/Parks Victoria |
| Translocation / Relocation | Live capture and relocation of EGKs out of the PSP and another area of suitable habitat. | Development/Post-development phase | Developer/Landowner |
| Culling | The culling of landlocked kangaroos when all other management actions are exhausted. | Development/Post-development phase | Developer/Landowner |

| Management Action | Description | Timing | Possible Responsible Authority |
|---|---|---|---|
| Reproductive Management | Non-lethal population management technique primarily focused on sterilisation of EGKs to reduce overall population numbers. | Development/Post-development phase | Developer/Landowner |

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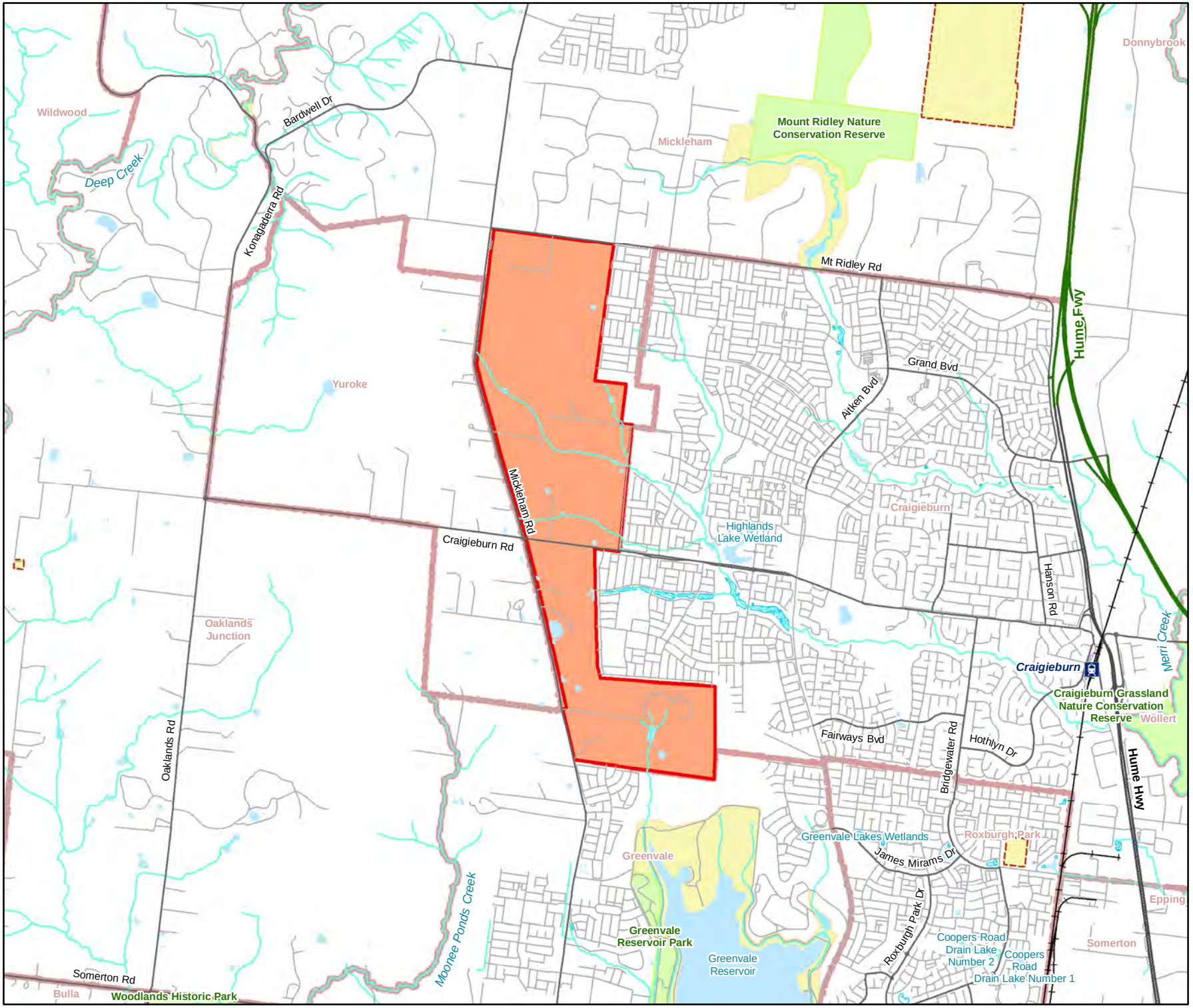
# FIGURES




## Legend

- Study Area
- Railway
- Freeway
- Major Road
- Collector Road
- Minor Road
- Minor Watercourse
- Permanent Waterbody
- Land Subject to Inundation
- Wetland/Swamp
- Parks and Reserves
- Commonwealth Land
- Crown Land
- Localities


# Figure 1

**Location of the study area**

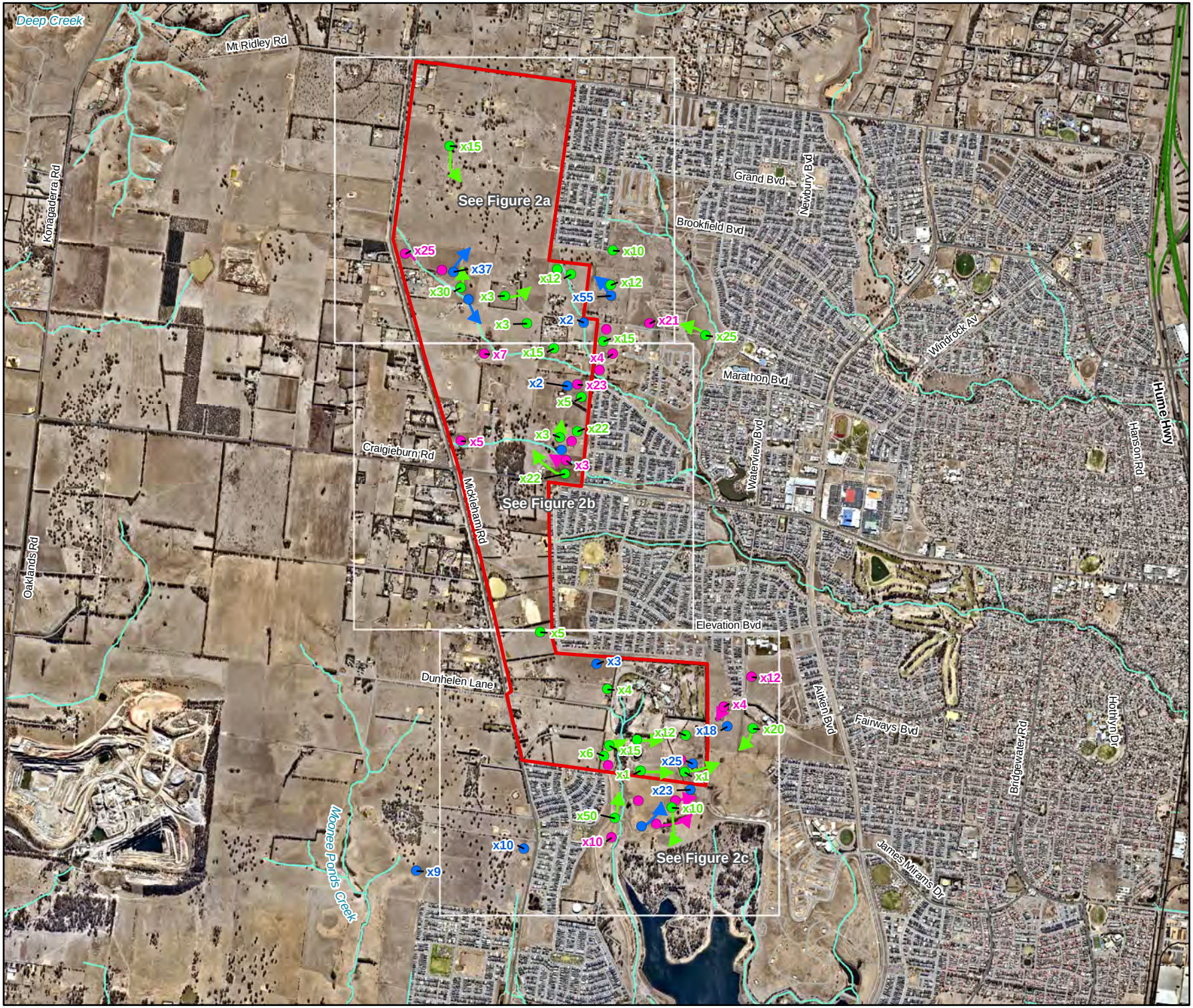
*Kangaroo Management Plan, Craigieburn West Precinct Structure Plan*

N

0 600 1,200

Metres

ecology & heritage partners




## Legend

Study Area

**Survey date:**

- Survey date: 04/06/2019
- Survey date: 05/06/2019
- Survey date: 06/06/2019

**Survey date:**

- Survey date: 04/06/2019
- Survey date: 05/06/2019
- Survey date: 06/06/2019


# Figure 2 Overview

## Kangaroo observations

*Kangaroo Management Plan, Craigieburn West Precinct Structure Plan*

N

0 500 1,000

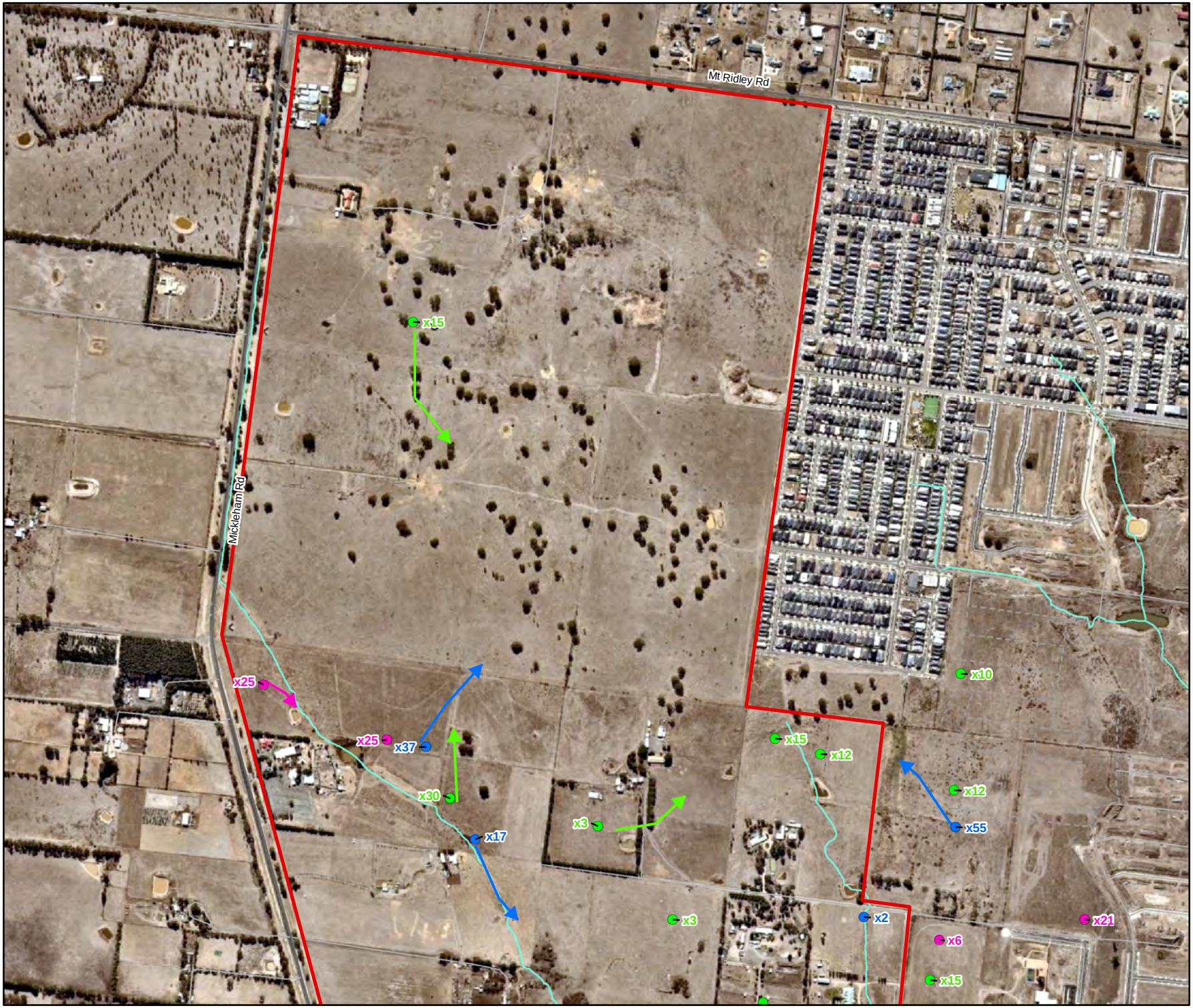
Metres

ecology & heritage partners



14194_Fig02_KangObs_MB 27/10/2020 melsley

Aerial source: Nearmap 2019




## Legend

Study Area

**Survey date:**

- Survey date: 04/06/2019
- Survey date: 05/06/2019
- Survey date: 06/06/2019

**Survey date:**

- Survey date: 04/06/2019
- Survey date: 05/06/2019
- Survey date: 06/06/2019


# Figure 2a

**Kangaroo observations**

*Kangaroo Management Plan, Craigieburn West Precinct Structure Plan*

N

0 150 300

Metres

ecology & heritage partners



14194_Fig02_KangObs_MB 27/10/2020 melsley

Aerial source: Nearmap 2019


## Legend

Study Area

**Survey date:**

- Survey date: 04/06/2019
- Survey date: 05/06/2019
- Survey date: 06/06/2019

**Survey date:**

- Survey date: 04/06/2019
- Survey date: 06/06/2019


# Figure 2b

**Kangaroo observations**

*Kangaroo Management Plan, Craigieburn West Precinct Structure Plan*

N

0 150 300

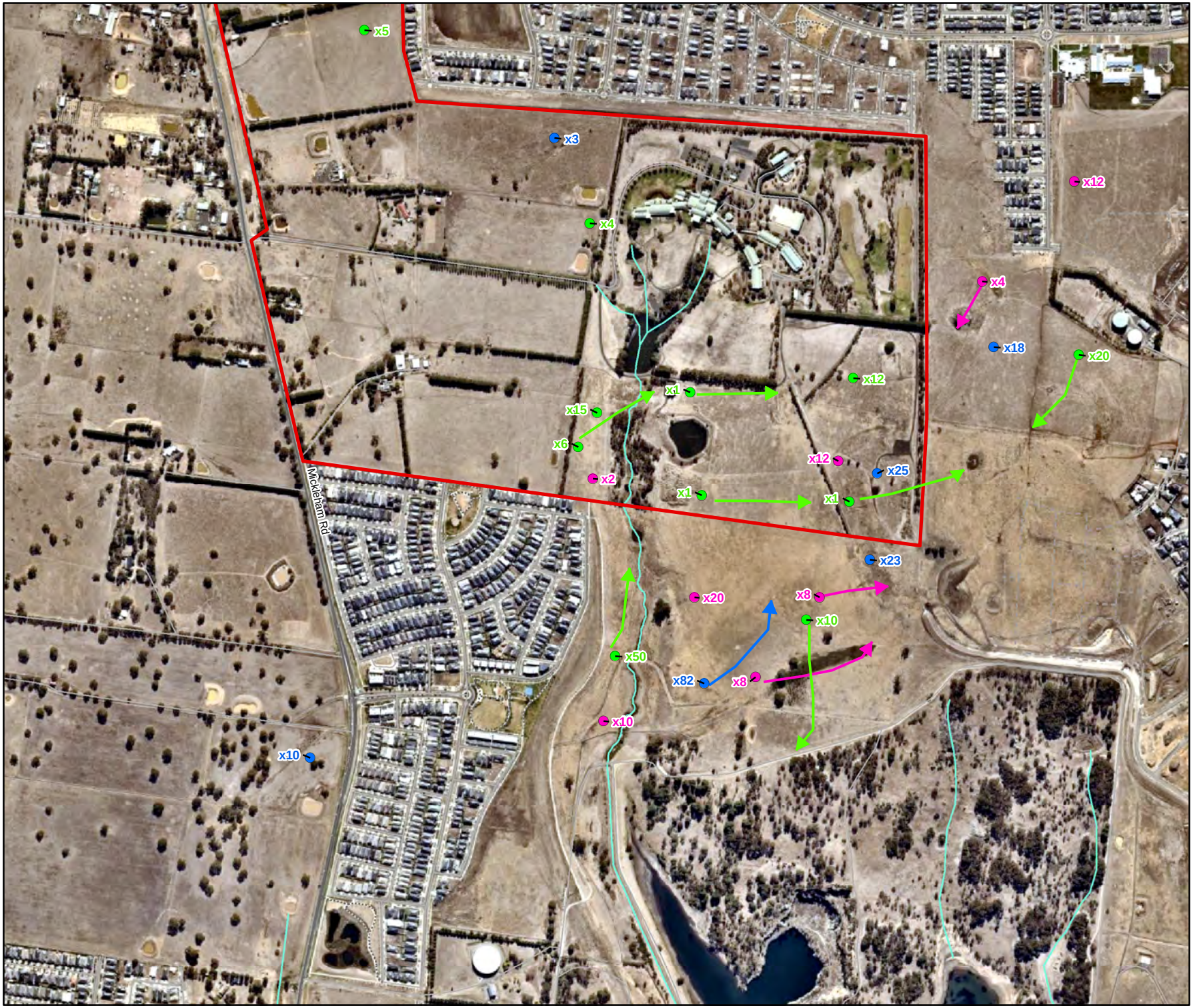
Metres

ecology & heritage partners



14194_Fig02_KangObs_MB 27/10/2020 melsley

Aerial source: Nearmap 2019




## Legend

Study Area

**Survey date:**

- Survey date: 04/06/2019
- Survey date: 05/06/2019
- Survey date: 06/06/2019

**Survey date:**

- Survey date: 04/06/2019
- Survey date: 05/06/2019
- Survey date: 06/06/2019


# Figure 2c

**Kangaroo observations**

*Kangaroo Management Plan, Craigieburn West Precinct Structure Plan*

N

0 150 300

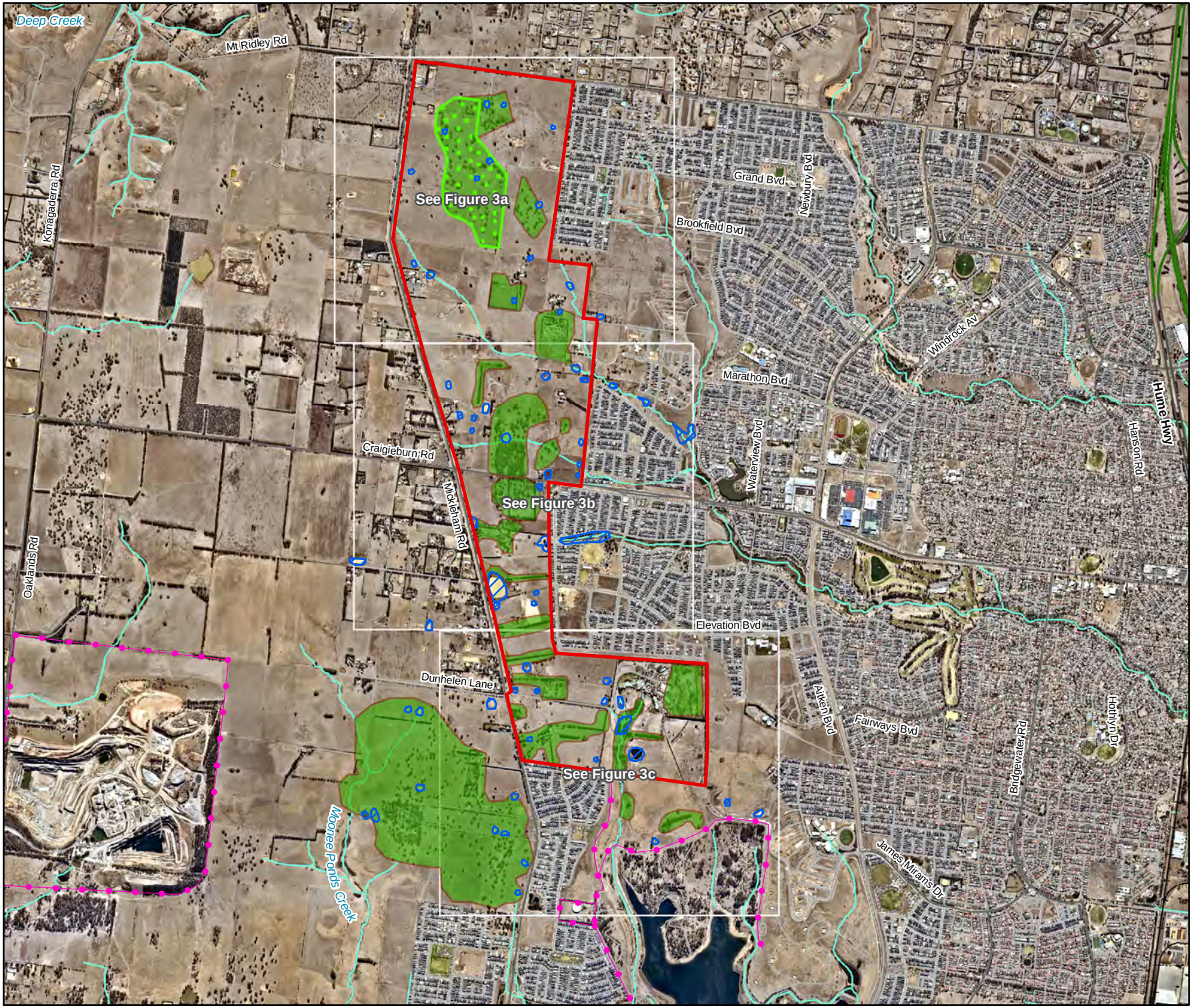
Metres

ecology & heritage partners



14194_Fig02_KangObs_MB 27/10/2020 melsley

Aerial source: Nearmap 2019




## Legend

- Study Area
- BCS Conservation Area
- Protective habitat
- Water points
- Protective fencing


# Figure 3 Overview

## Habitat features

*Kangaroo Management Plan, Craigieburn West Precinct Structure Plan*

N

0 500 1,000

Metres

ecology & heritage partners



14194_Fig03_HabFeat_MB 27/10/2020 melsley

Aerial source: Nearmap 2019


**Legend**

- Study Area
- BCS Conservation Area
- Protective habitat
- Water points


# Figure 3a

## Habitat features

*Kangaroo Management Plan, Craigieburn West Precinct Structure Plan*

N

0 150 300

Metres

ecology & heritage partners



14194_Fig03_HabFeat_MB 27/10/2020 melsley

Aerial source: Nearmap 2019


**Legend**

- Study Area
- Protective habitat
- Water points


## Figure 3b

**Habitat features**

*Kangaroo Management Plan, Craigieburn West Precinct Structure Plan*

N

0 150 300

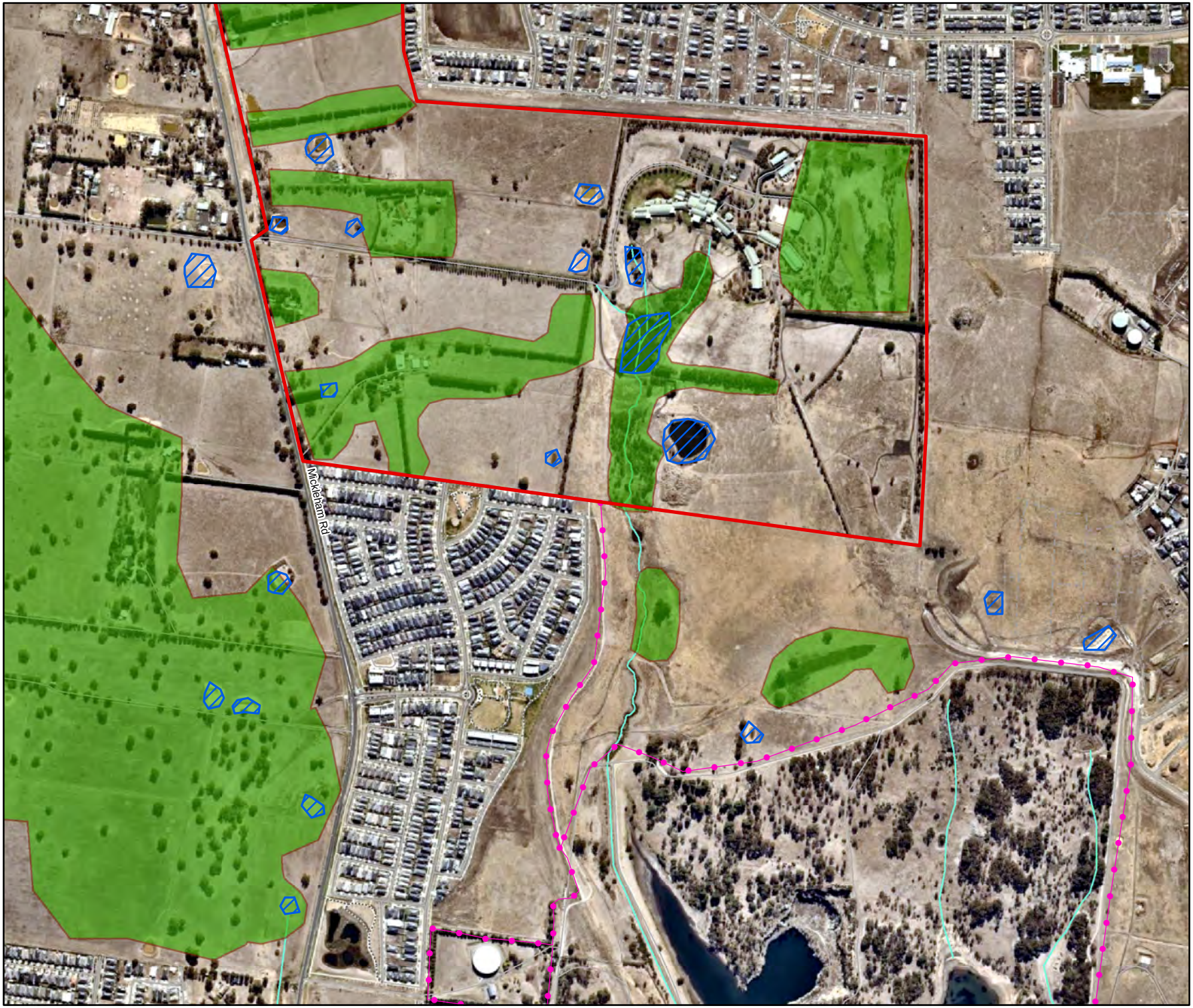
Metres

ecology & heritage partners



14194_Fig03_HabFeat_MB 27/10/2020 melsley

Aerial source: Nearmap 2019




**Legend**

- Study Area
- Protective habitat
- Water points
- Protective fencing


# Figure 3c

## Habitat features

*Kangaroo Management Plan, Craigieburn West Precinct Structure Plan*

N

0 150 300

Metres

ecology & heritage partners



14194_Fig03_HabFeat_MB 27/10/2020 melsley

Aerial source: Nearmap 2019

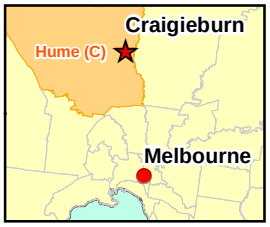

**Figure 4**

**Properties within the study area**

*Kangaroo Management Plan, Craigieburn West Precinct Structure Plan*

**Legend**

- Study Area
- Property boundary (with SPI)




N

0 200 400
Metres



14194_Fig04_Properties_P 27/10/2020 melsley

ecology & heritage partners

Aerial source: Nearmap 2019

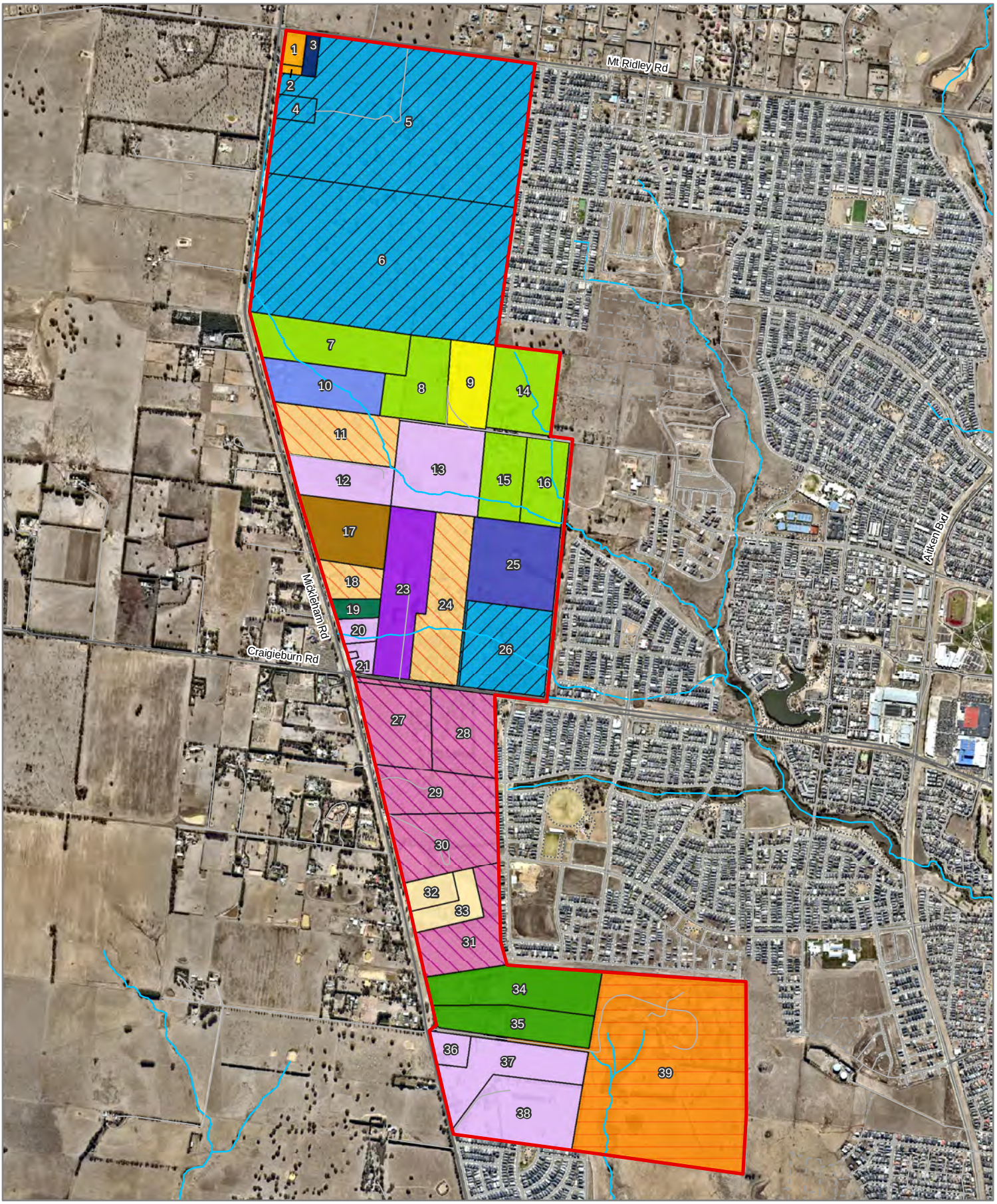



**Figure 5**

**Land ownership boundaries**

*Kangaroo Management Plan, Craigieburn West Precinct Structure Plan*

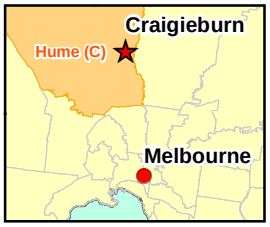
ecology & heritage partners

## Legend

- Study Area

**Property owner (VPA 2019)**

- AK (Aus) Pty Ltd
- Aitken Conference Centre
- Australian Islamic Association
- Buddhist Temple
- Community Centre / Tennis Courts
- Deague Group
- Hawthorn Developments
- Henley
- IRD Developments
- Mickleham Primary
- Pask
- Peet
- Porter Davis
- Private landowner
- Stockland
- Syrian Orthodox Church



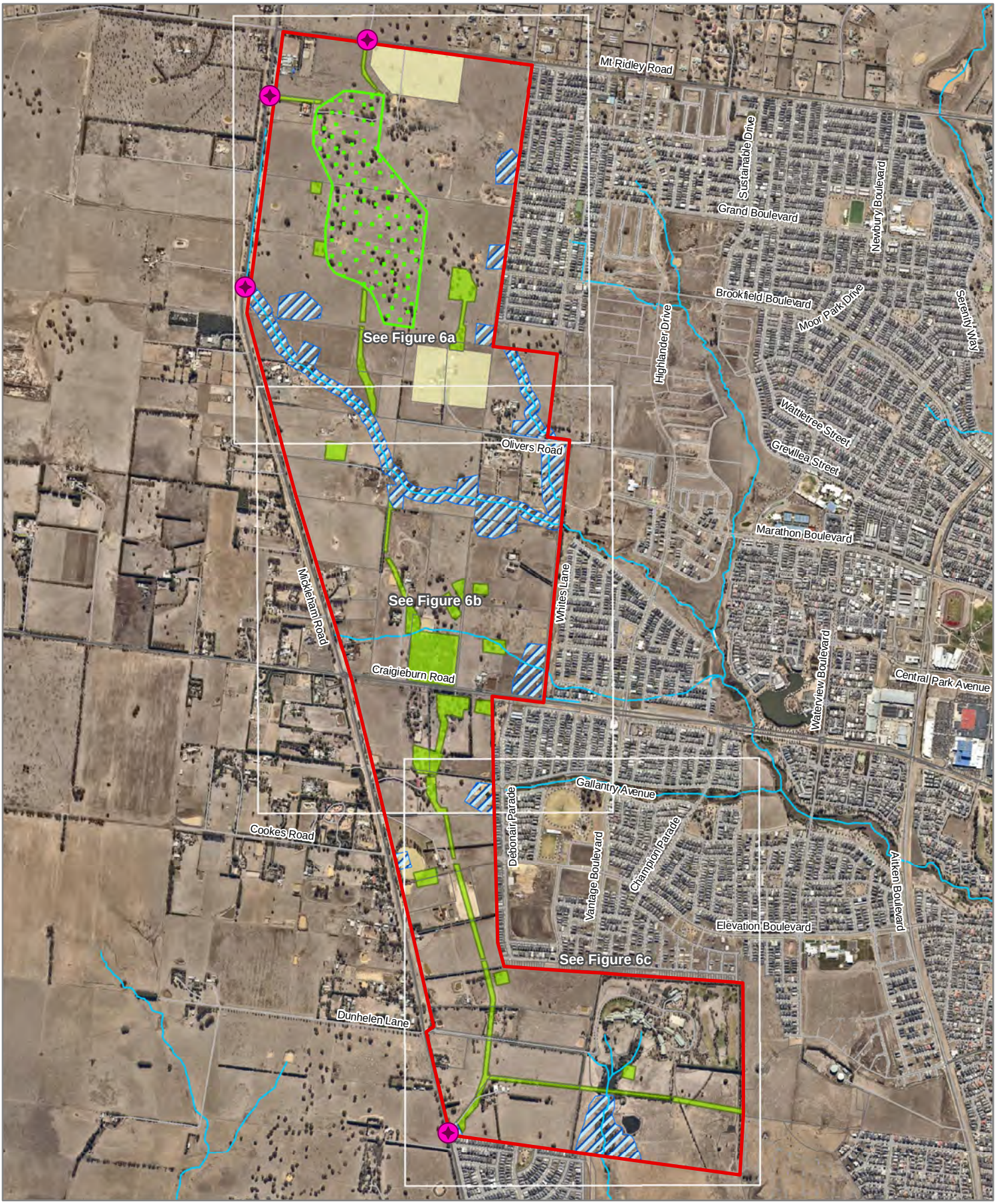

N

0 200 400
Metres



14194_Fig05_LandOwnership_P 27/10/2020 melsley

Aerial source: Nearmap 2019




# Figure 6 Overview

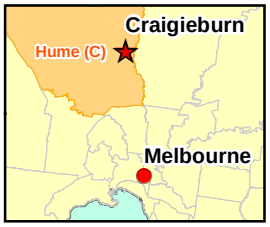
**Open space and movement corridors**

*Kangaroo Assessment for Craigieburn West Precinct Structure Plan, Craigieburn*

ecology & heritage partners

## Legend

- Study Area
- BCS Conservation Area
- Local sports reserve
- Local park
- Waterway and drainage reserve
- Potential kangaroo crossing point




N

0 250 500
Metres



14194_Fig06_MgmtOptions_PMB 21/04/2021 psorensen

Aerial source: Nearmap 2019

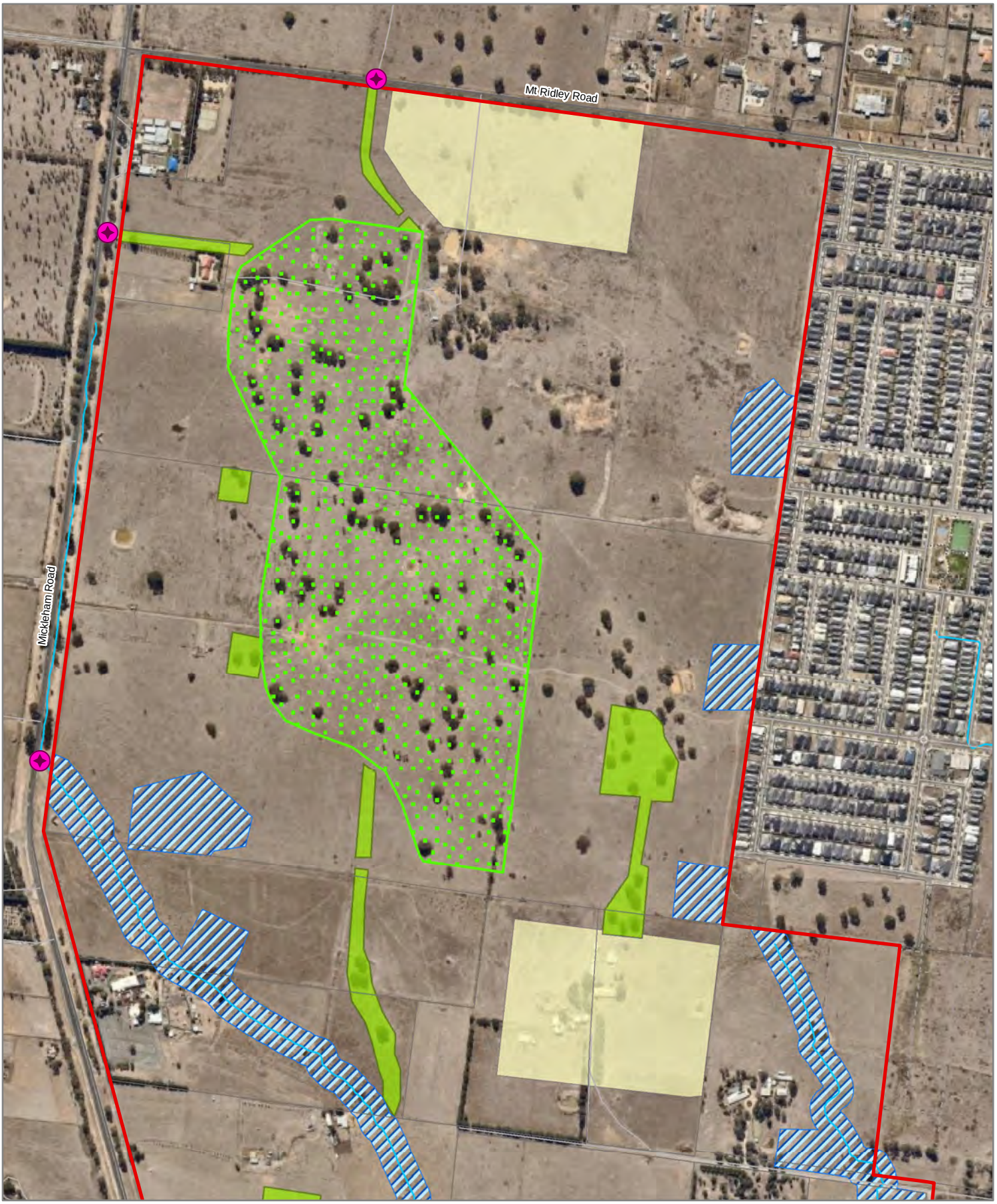



**Figure 6a**

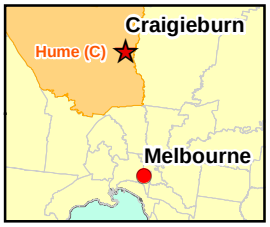
**Open space and movement corridors**

*Kangaroo Assessment for Craigieburn West Precinct Structure Plan, Craigieburn*

ecology & heritage partners

**Legend**

- Study Area
- BCS Conservation Area
- Local sports reserve
- Local park
- Waterway and drainage reserve
- Potential kangaroo crossing point




N

0 90 180

Metres



14194_Fig06_MgmtOptions_PMB 21/04/2021 psorensen

Aerial source: Nearmap 2019

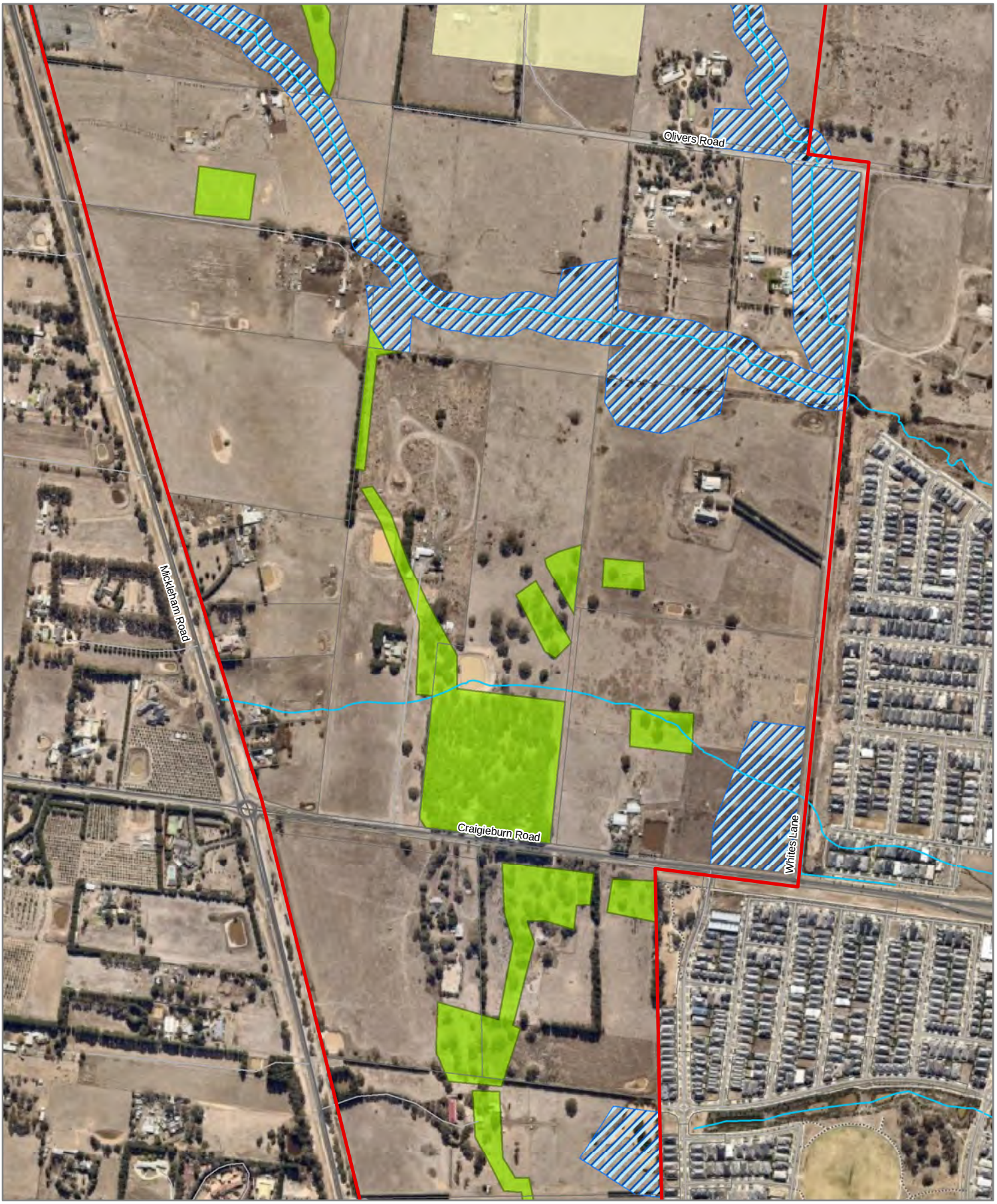


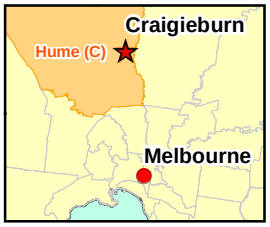

**Figure 6b**

**Open space and movement corridors**

*Kangaroo Assessment for Craigieburn West Precinct Structure Plan, Craigieburn*

**Legend**

- Study Area
- Local sports reserve
- Local park
- Waterway and drainage reserve




N

0 90 180

Metres



14194_Fig06_MgmtOptions_PMB 21/04/2021 psorensen

Aerial source: Nearmap 2019

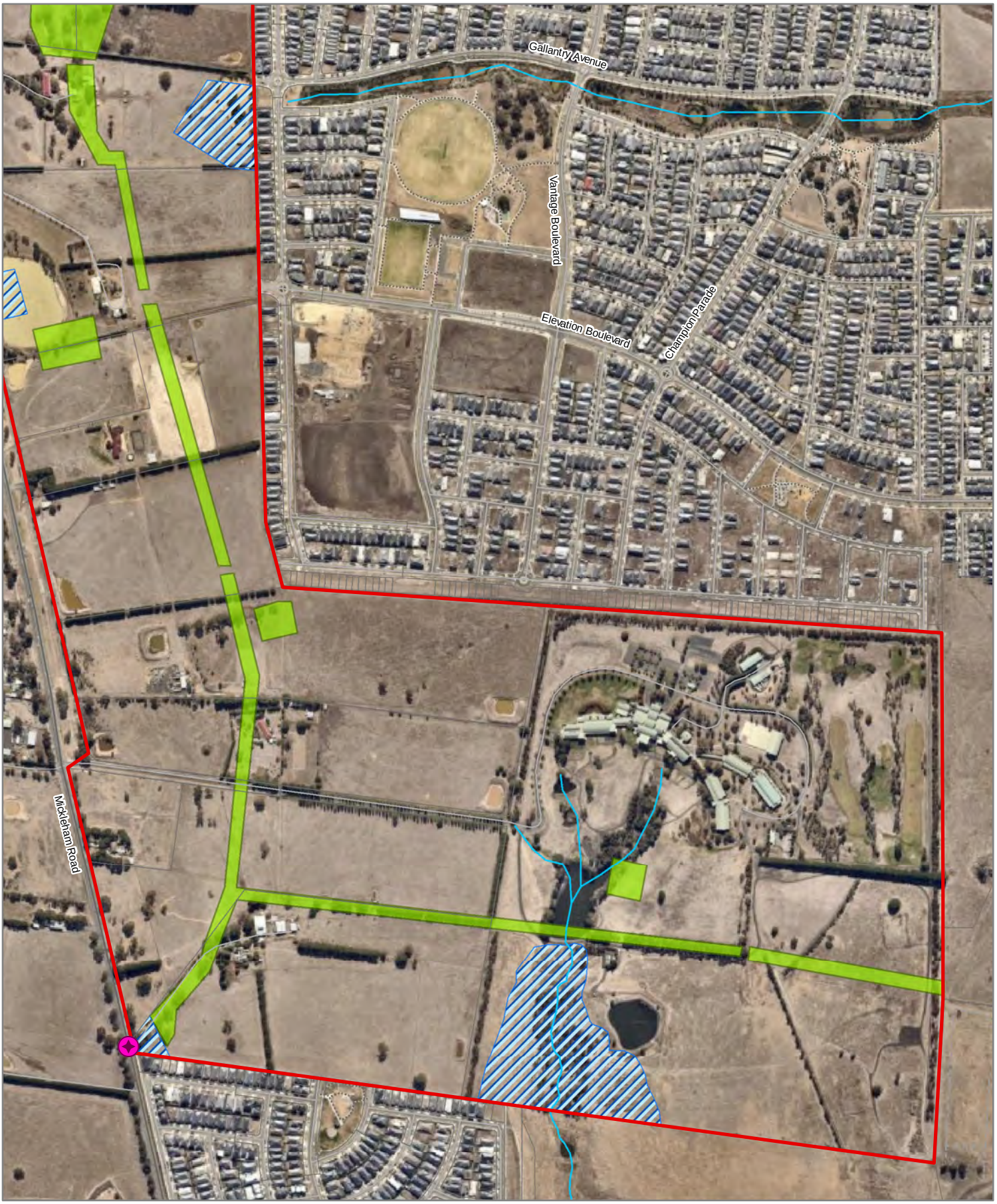


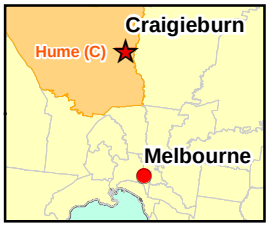

**Figure 6c**

**Open space and movement corridors**

*Kangaroo Assessment for Craigieburn West Precinct Structure Plan, Craigieburn*

**Legend**

- Study Area
- Local park
- Waterway and drainage reserve
- Potential kangaroo crossing point




N

0 90 180

Metres



14194_Fig06_MgmtOptions_PMB 21/04/2021 psorensen

Aerial source: Nearmap 2019

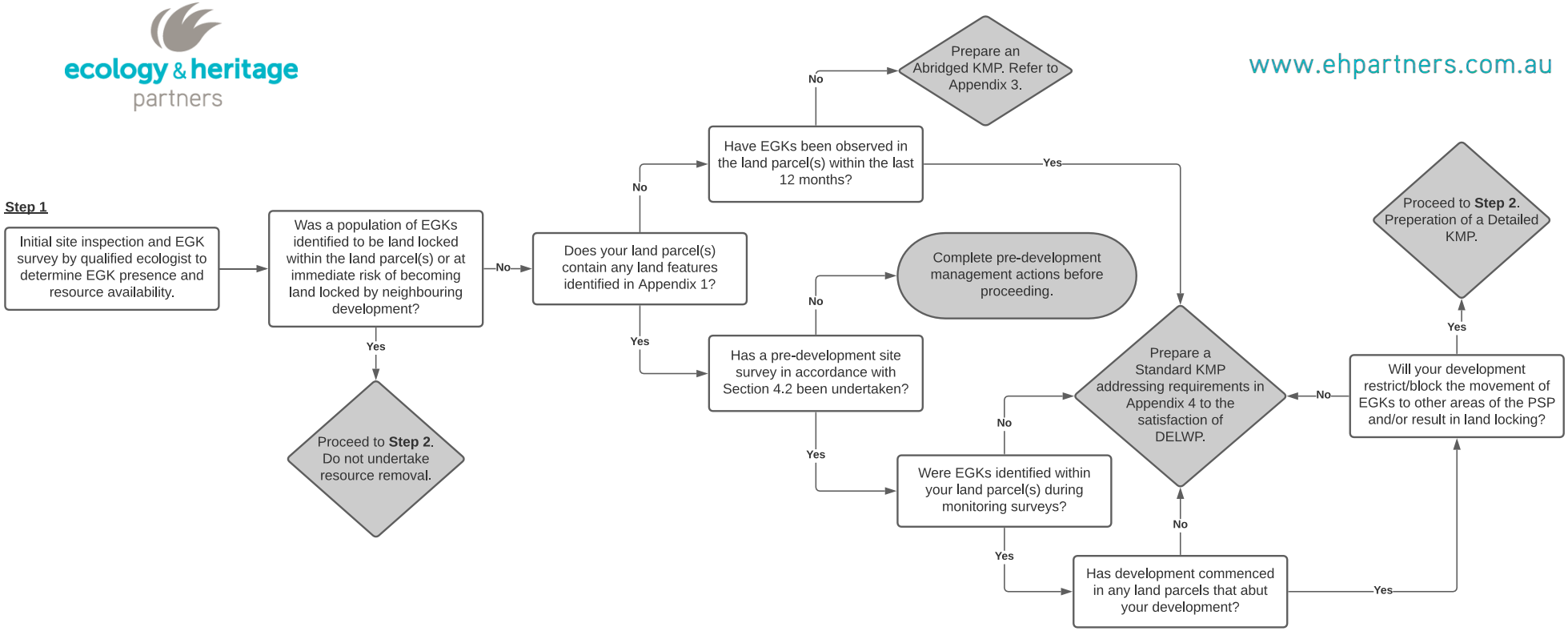
# APPENDIX 1 – EXISTING CONDITIONS TABLE

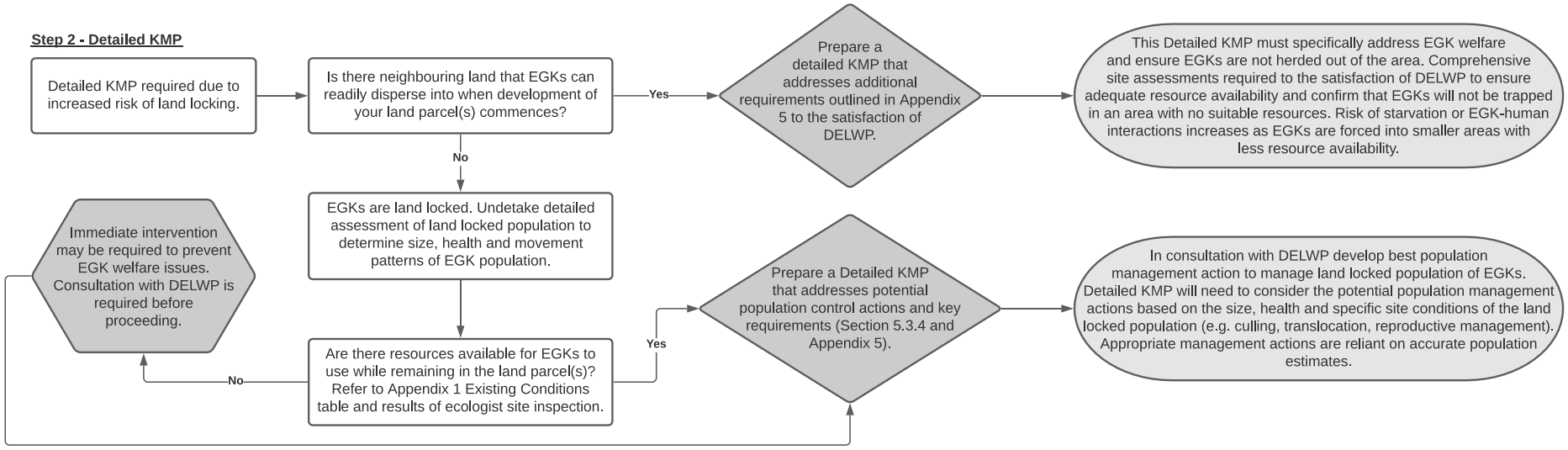
| Parcel # | Parcel SPI | Land Features | Primary Risks |
|---|---|---|---|
| 1 | 1\TP423679 | - | - |
| 2 | 1\TP951293 | - | - |
| 3 | 3\PS301908 | - | - |
| 4 | 2\PS736443 | Conservation Area<br>Protective habitat | Increased EGK-Vehicle Collisions<br>Increased grazing pressure on CA |
| 5 | 1\PS736443 | Conservation Area<br>Water points<br>Grazing habitat<br>Protective habitat | Increased EGK-Vehicle Collisions<br>Increased grazing pressure on CA |
| 6 | 2\PS301908 | Conservation Area<br>Water points<br>Grazing habitat<br>Protective habitat | Increased EGK-Vehicle Collisions<br>Increased grazing pressure on CA |
| 7 | 1\LP97698 | Water points<br>Grazing habitat<br>Protective habitat | Increased EGK-Vehicle Collisions |
| 8 | 1\PS445746 | Water points<br>Grazing habitat<br>Protective habitat | Land locking of EGKs<br>Increased EGK-Human interactions |
| 9 | 2\LP37205 | Water points<br>Grazing habitat<br>Protective habitat | Land locking of EGKs<br>Increased EGK-Human interactions |
| 10 | 2\PS445746 | Water points<br>Grazing habitat<br>Protective habitat | Increased EGK-Vehicle Collisions |
| 11 | 3\LP97698 | Grazing habitat<br>Protective habitat | Increased EGK-Vehicle Collisions |
| 12 | 1\TP950200 | Water points<br>Grazing habitat<br>Protective habitat | Increased EGK-Vehicle Collisions |
| 13 | 1\TP341413 | Water points<br>Grazing habitat<br>Protective habitat | Increased EGK-Vehicle Collisions |
| 14 | 1\LP212349 | Water points<br>Grazing habitat<br>Protective habitat | Land locking of EGKs<br>Increased EGK-Human interactions |

| Parcel # | Parcel SPI | Land Features | Primary Risks |
|---|---|---|---|
| 15 | 1\TP222329 | Water points<br>Grazing habitat<br>Protective habitat | Land locking of EGKs<br>Increased EGK-Human interactions |
| 16 | 1\TP558734 | Water points<br>Grazing habitat<br>Protective habitat | Land locking of EGKs<br>Increased EGK-Human interactions |
| 17 | 1\LP39373 | Water points<br>Grazing habitat<br>Protective habitat | Increased EGK-Vehicle Collisions |
| 18 | 1\LP53210 | Water points<br>Grazing habitat<br>Protective habitat | Increased EGK-Vehicle Collisions |
| 19 | 2\LP53210 | Water points<br>Grazing habitat<br>Protective habitat | Increased EGK-Vehicle Collisions |
| 20 | 3\LP53210 | Water points<br>Potential grazing habitat, looks cropped though<br>Protective habitat | Increased EGK-Vehicle Collisions |
| 21 | 1\LP55516 | Water points<br>Potential grazing habitat, looks cropped though<br>Protective habitat | Increased EGK-Vehicle Collisions |
| 22 | 2\LP55516 | - | Increased EGK-Vehicle Collisions |
| 23 | 1\PS411432 | Water points<br>Grazing habitat<br>Protective habitat | Land locking of EGKs<br>Increased EGK-Human interactions |
| 24 | 2\PS411432 | Water points<br>Grazing habitat<br>Protective habitat | Land locking of EGKs<br>Increased EGK-Human interactions |
| 25 | 1\TP340316 | Water points<br>Grazing habitat<br>Protective habitat | Land locking of EGKs<br>Increased EGK-Human interactions |
| 26 | 1\TP957913 | Water points<br>Grazing habitat<br>Protective habitat | Land locking of EGKs<br>Increased EGK-Human interactions |
| 27 | 2\LP129504 | Water points<br>Grazing habitat<br>Protective habitat | Increased EGK-Vehicle Collisions |
| 28 | 1\LP129504 | Water points<br>Grazing habitat | Land locking of EGKs |

| Parcel # | Parcel SPI | Land Features | Primary Risks |
|---|---|---|---|
| | | Protective habitat | Increased EGK-Human interactions |
| 29 | 3\LP129504 | Water points<br>Grazing habitat<br>Protective habitat | Increased EGK-Vehicle Collisions |
| 30 | 4\LP129504 | Water points<br>Grazing habitat<br>Protective habitat | Increased EGK-Vehicle Collisions |
| 31 | 5\LP129504 | Water points<br>Grazing habitat<br>Protective habitat | Increased EGK-Vehicle Collisions |
| 32 | 1\TP828863 | Water points<br>Grazing habitat | Increased EGK-Vehicle Collisions |
| 33 | 2\TP828863 | Water points<br>Grazing habitat<br>Protective habitat | Increased EGK-Vehicle Collisions |
| 34 | 6\LP129504 | Water points<br>Grazing habitat<br>Protective habitat | Increased EGK-Vehicle Collisions |
| 35 | 7\LP129504 | Water points<br>Grazing habitat<br>Protective habitat | Increased EGK-Vehicle Collisions |
| 36 | 1\TP612993 | Grazing habitat<br>Protective habitat | Increased EGK-Vehicle Collisions |
| 37 | 8\LP129504 | Water points<br>Grazing habitat<br>Protective habitat | Increased EGK-Vehicle Collisions |
| 38 | 1\PS333257 | Water points<br>Grazing habitat<br>Protective habitat | Increased EGK-Vehicle Collisions |
| 39 | 1\PS333257 | Water points<br>Grazing habitat<br>Protective habitat | Land locking of EGKs<br>Increased EGK-Human interactions |

# APPENDIX 2 – DECISION-MAKING FLOWCHART


Step 1
Initial site inspection and EGK survey by qualified ecologist to determine EGK presence and resource availability.
Was a population of EGKs identified to be land locked within the land parcel(s) or at immediate risk of becoming land locked by neighbouring development?
Yes
Proceed to Step 2. Do not undertake resource removal.
No
Does your land parcel(s) contain any land features identified in Appendix 1?
Yes
Has a pre-development site survey in accordance with Section 4.2 been undertaken?
No
Complete pre-development management actions before proceeding.
Yes
Were EGKs identified within your land parcel(s) during monitoring surveys?
No
Have EGKs been observed in the land parcel(s) within the last 12 months?
No
Prepare an Abridged KMP. Refer to Appendix 3.
Yes
Has development commenced in any land parcels that abut your development?
No
Prepare a Standard KMP addressing requirements in Appendix 4 to the satisfaction of DELWP.
Yes
Will your development restrict/block the movement of EGKs to other areas of the PSP and/or result in land locking?
No
Proceed to Step 2. Preperation of a Detailed KMP.
Yes


Step 2 - Detailed KMP
Detailed KMP required due to increased risk of land locking.
Is there neighbouring land that EGKs can readily disperse into when development of your land parcel(s) commences?
Yes
Prepare a detailed KMP that addresses additional requirements outlined in Appendix 5 to the satisfaction of DELWP.
This Detailed KMP must specifically address EGK welfare and ensure EGKs are not herded out of the area. Comprehensive site assessments required to the satisfaction of DELWP to ensure adequate resource availability and confirm that EGKs will not be trapped in an area with no suitable resources. Risk of starvation or EGK-human interactions increases as EGKs are forced into smaller areas with less resource availability.
No
EGKs are land locked. Undetake detailed assessment of land locked population to determine size, health and movement patterns of EGK population.
Are there resources available for EGKs to use while remaining in the land parcel(s)? Refer to Appendix 1 Existing Conditions table and results of ecologist site inspection.
Yes
Prepare a Detailed KMP that addresses potential population control actions and key requirements (Section 5.3.4 and Appendix 5).
In consultation with DELWP develop best population management action to manage land locked population of EGKs. Detailed KMP will need to consider the potential population management actions based on the size, health and specific site conditions of the land locked population (e.g. culling, translocation, reproductive management). Appropriate management actions are reliant on accurate population estimates.
No
Immediate intervention may be required to prevent EGK welfare issues. Consultation with DELWP is required before proceeding.

## Definitions of terms used in flowchart

| Term | Definition |
|---|---|
| Development commencing | The date in which development begins in a given land parcel. |
| DELWP | Department of Environment, Land, Water and Planning |
| EGK | Eastern Grey Kangaroo |
| Herded out | The non-lethal, human induced movement of EGKs out of the area. |
| Land locking | Where kangaroos are 'shut in' completely or almost completely by surrounding development with no way out. |
| Monitoring surveys | Surveys undertaken to monitor the health, location and size of identified populations within the area to inform any necessary contingency management. |
| Neighbouring land | Land immediately adjoining the land parcel in question |
| Population Survey | Conducted if EGKs are identified within the study area over the last 12 months and used to determine the number, location, movement patterns, health and other notable information of the identified EGKs. Refer to Section 4.2 for more information. |
| Resource | Edible grasses or herbs and water points |
| Restrict movement | Where individuals cannot freely move out of the area. |
| Staged development | Staged development is the planning of the order of each stage of a subdivision to avoid landlocking kangaroos. |
| Starvation | The lack of resources resulting in the starvation and eventual death of EGKs. |
| Site inspection | An initial presence/absence survey to establish if there are kangaroos in the survey area, or if there is evidence that kangaroos have been in the survey area in the last 12 months, Refer to section 4.1 for more information. |

# APPENDIX 3 - ABRIDGED KANAGROO MANAGEMENT PLAN

An Abridged Kangaroo Management Plan will only be required for small land parcels where EGKs have not previously been detected or where there are few habitat and food resources. The guideline to preparing kangaroo management plan for Melbourne's growth corridors (DELWP 2015b) provides further clarification around the requirements for an Abridged KMP. An Abridged KMP will address the following:

- Introduction;
- Kangaroo management rationale;
- Site description;
- Survey methodology;
- Plan goals;
- Staged development plan;
- Preventative actions; and,
- Assessment of other preventative options.

All Kangaroo Management Plans must be submitted to DELWP for review and approval before development can commence.

# APPENDIX 4 - STANDARD KANGAROO MANAGEMENT PLAN

A Standard Kangaroo Management Plan will be required in most instances across the PSP where EGKs are not at risk of becoming land locked. The guideline to preparing kangaroo management plan for Melbourne's growth corridors (DELWP 2015b) provides further clarification around the requirements for a standard KMP. A Standard KMP will address the following:

- Introduction;
- Kangaroo management rationale;
- Site description;
- Survey methodology;
- Population survey results;
- Plan goals;
- Staged development plan;
- Management actions;
- Assessment of other management options;
- Monitoring; and,
- Contingency planning.

All Kangaroo Management Plans must be submitted to DELWP for review and approval before development can commence.

# APPENDIX 5 - DETAILED KANGAROO MANAGEMENT PLAN

A Detailed KMP is required when the Decision-making Flowchart has identified a risk of land locking to EGKs. A Detailed KMP must address the requirements of a Standard KMP as well as addressing the following conditions to the satisfaction of the responsible authority:

- A description of the proposed development in context to EGKs observed in the area;
- Feasibility of developing alternative staging plan that may allow EGKs to disperse to neighbouring land or reduce likelihood of EGK-human interactions;
- Description of the potential impacts and risks presented to EGKs and humans;
- Detailed site and population surveys undertaken by a suitably qualified ecologist to determine:
    - Extent of available EGK resources within areas of high land locking risk;
    - Number of EGKs land-locked or at risk of becoming land locked;
    - Health of land locked EGKs;
    - Population structure of land-locked EGKs (e.g. Number of males, females and juveniles); and,
    - EGK movement patterns and any potential corridors out of high-risk areas.
- Mapping showing locations of EGKs, resources and areas where EGKs are land locked;
- Evidence of consultation with neighbouring landowners to determine risks to EGKs and potential mitigation actions (e.g. changing development directions);
    1. Has a KMP been prepared for any neighbouring land parcel?
- Address increased risks to humans and EGK welfare that may arise as a result of land locking EGKs;
- An assessment of potential population management actions for land-locked EGKs (if required);
    2. Culling;
    3. Translocation; and
    4. Reproductive management.
- Consultation with DELWP to determine most appropriate population management action. Outcome will be based on size of population, health and amount of time EGK can persist in the area before development proceeds or available resources are used up.
- 6 monthly monitoring of high-risk populations (i.e. populations that are land locked or at risk of becoming land locked in the immediate future). More regular monitoring may be recommended by the ecologist and/or DELWP based on the risks to EGKs.

All Kangaroo Management Plans must be submitted to DELWP for review and approval before development can commence.