

CESSNOCK LOCAL GOVERNMENT AREA

CESSNOCK FLYING-FOX CAMP MANAGEMENT PLAN

March 2020



**Cessnock City Council
NSW Department of Planning,
Industry and Environment**



Prepared by Hunter Joint Organisation of Councils for Cessnock City Council and the NSW Department Industry - Lands & Forestry (now the NSW Department of Planning, Industry and Environment) in 2017. Reviewed and updated by Cessnock City Council in March 2020.



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*Cover photo: Grey-headed Flying-fox (*Pteropus poliocephalus*). Dean Portelli/DPIE*

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Abbreviations

ABLV	Australian bat lyssavirus
BC Act	<i>Biodiversity Conservation Act 2016</i>
BFF	black flying-fox (<i>Pteropus alecto</i>)
The Code of Practice	Flying-fox Camp Management Code of Practice 2018 (NSW)
DEE	Commonwealth Department of the Environment and Energy
DPIE	Department of Planning, Industry and Environment (NSW)
EP&A Act	<i>Environmental Planning and Assessment Act 1979</i> (NSW)
EPA	Environment Protection Authority (NSW)
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i> (Commonwealth)
GHFF	grey-headed flying-fox (<i>Pteropus poliocephalus</i>)
the Guideline	Referral guideline for management actions in grey-headed and spectacled flying-fox camps 2015 (Commonwealth)
HeV	Hendra virus
LGA	local government area
LGNSW	Local Government NSW
LRFF	little red flying-fox (<i>Pteropus scapulatus</i>)
MNES	matters of national environmental significance
NPWS	National Parks and Wildlife Service (NSW)
PEPs	protection of the environment policies
the Plan	Cessnock Flying Fox Camp Management Plan
POEO Act	<i>Protection of the Environment Operations Act 1997</i> (NSW)
the Policy	Flying-fox Camp Management Policy 2015 (NSW)
SEPPs	State Environmental Planning Policies
SIS	species impact statement
TEC	threatened ecological community

1 Overview

1.1 History of Plan Development

The East Cessnock Flying-fox Camp Management Plan was originally developed in partnership with the community, state and local government as a tool for the management of the East Cessnock Flying-fox camp. The Plan continues to be facilitated by Council on behalf of the Land Managers, and was originally compiled by Hunter Councils Environment Division, utilising the NSW Office of Environment and Heritage's (OEH) *'Flying-fox Camp Management Plan Template 2016'* and input from Council, OEH, responses from Community Consultation and key stakeholders.

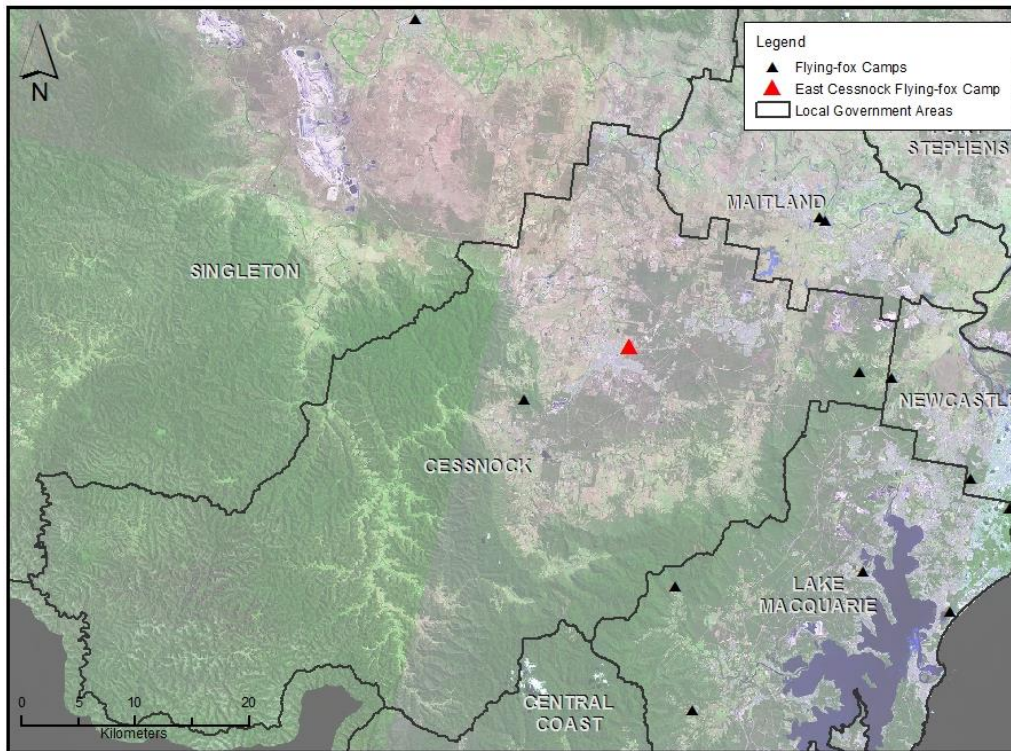
The Plan was originally developed as part of a Hunter Regional project that has developed Flying-fox Camp Management Plans for Central Coast Council, Mid Coast Council, Muswellbrook Council, Singleton Council, Port Stephens Council and Upper Hunter Shire Council. Participating in this project has enabled strong alignment with the actions of other Councils and the creation of active working relationships with these Councils, so that if any management action undertaken affects the roosting behaviour of Flying-foxes in one jurisdiction, a network of land management / ecology specialists can notify neighbouring Councils of any possible increased Flying-fox movements.

1.2 Purpose of the Plan

Cessnock City Council (Council) was awarded a number of grants for flying fox projects in mid-2019, under the Flying-fox Grant Program 2019. Part of this grant money was to allow Council to review and update the adopted East Cessnock Flying-fox Camp Management Plan. As part of the review, the scope of the Plan was expanded to cover any new Flying-fox camps that may form on public land within the Cessnock Local Government Area (LGA). Accordingly, Council amended to the title of the plan to the *'Cessnock Flying-Fox Camp Management Plan'* (the Plan). The review also involved updating the Plan to be more consistent with the NSW Department of Planning, Industry & Environment's (DPIE) updated *'Flying-fox Camp Management Plan Template 2019'*.

The purpose of this Plan is to undertake appropriate camp management in accordance with the Flying-fox Camp Management Policy 2015 (NSW) (hereafter referred to as the Policy). The Plan will enable appropriate land management as per NSW legislation to reduce the impact of Flying-fox camps on Cessnock residents. The Plan is operational for a period of 10 years (2017 - 2027) and will be reviewed and updated periodically during this time. The Plan addresses the known camps, one of which is causing community concern, but will also be applicable in the event of Flying-foxes establishing new camps on public lands within the LGA.

There are three (3) identified Flying-fox camps known to exist in the Cessnock LGA (Refer to **Figure 1**), with only the East Cessnock Camp currently occupied. The Blackhill and Millfield camps have not been occupied since at least 2012. Unlike the East Cessnock Camp, these two historic camps are located on private land in less populated, rural parts of the LGA. The management measures outlined in this Plan, only apply to the East Cessnock Flying-fox Camp and any new camps that may become established on public land, during the period that this Plan is operational.

Figure 1: Location of Flying-fox Camps within the LGA

1.3 Objectives

Cessnock City Council, DPIE, and the NSW Department of Education have developed this Plan to provide a clear framework for the management of the East Cessnock Flying-fox Camp and any new camps that may become established on public lands within the LGA.

The objectives of the Plan are to:

- minimise impacts to the community, while conserving flying-foxes and their habitat
- enable land managers and other stakeholders to use a range of suitable management responses to sustainably manage flying-foxes

The Plan provides details on the camps, Flying-fox species and ecology, community inputs, management opportunities and an agreed set of management actions designed to achieve the above stated objectives. The objectives of the Plan are consistent with the Policy.

1.4 Roles and Responsibilities

For any new camps that form on Public Lands within the LGA, the roles and responsibilities would be similar to those outlined below for the East Cessnock Flying-fox Camp. There are a number of organisations that have either a responsibility or role, in the management of issues related to the East Cessnock Flying-fox Camp.

NSW Department of Planning, Industry and Environment

The NSW Department of Planning, Industry and Environment (Crown Lands) is the primary land owner responsible for managing the East Cessnock site and subsequently final decisions about how to manage the flying-foxes occupying Crown Land, fall with this Department.

The Biodiversity & Conservation Division (BCD) is responsible for administering the *Biodiversity Conservation Act 2016* (BC Act), and for ensuring the impact of any action affecting threatened species is properly assessed. Any application by Crown Lands under the BC Act to disrupt the flying-foxes roosting site (the camp) would be assessed by the BCD.

Cessnock City Council

The East Cessnock Flying-Fox Camp at times extends onto Cessnock City Council managed land (Akira Avenue Park), and as the representative organisation of the local community Cessnock City Council plays an active role in developing management actions for the site. The Plan is being facilitated by Council on behalf of the Land Managers.

NSW Department of Education

The Cessnock East Public School is adjacent to the camp and on occasion has had flying-foxes in its boundary trees. The school is an interested stakeholder in the Plan and community engagement and will be responsible for any proposed management actions within the school grounds.

Wildlife Rehabilitators



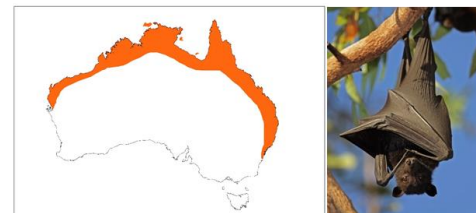
Injured or distressed flying-foxes are rescued and cared for by licenced wildlife rehabilitators.

2 Flying-Foxes in Cessnock

2.1 Flying-fox Species in Cessnock

There are three species that have been recorded at the East Cessnock Flying-fox Camp (refer to **Table 1**). The Plan refers to the three species, except when specifically addressing the threatened species, the Grey-headed Flying-fox. Further information on each of these species can be found in **Appendix 1**.

Table 1: Flying-fox species Recorded in Cessnock

Species	Range and Photo	Status
Grey-headed Flying-fox (<i>Pteropus poliocephalus</i>)		Listed as Vulnerable under <i>Environment Protection & Biodiversity Conservation Act 1999</i> and <i>Biodiversity Conservation Act 2016</i>
Little Red Flying-fox (<i>Pteropus scapulatus</i>)		-
Black Flying-fox (<i>Pteropus alecto</i>)		-

2.2 East Cessnock Flying-fox Camp

Flying-foxes are wild animals and highly dynamic in their migratory movements, search for food and selection process for suitable roosting habitat. There is very little understanding on how or why Flying-foxes select certain roosting areas, but research suggests that food shortages, and proximity to secure food sources and human settlements are significant factors. The number and size of Flying-fox camps is constantly changing throughout NSW. Council is aware of three (3) Flying-fox camps in the LGA, only one (1) of which is currently occupied. The following section provides information on the currently occupied, East Cessnock Flying Fox Camp (last occupancy 2019).

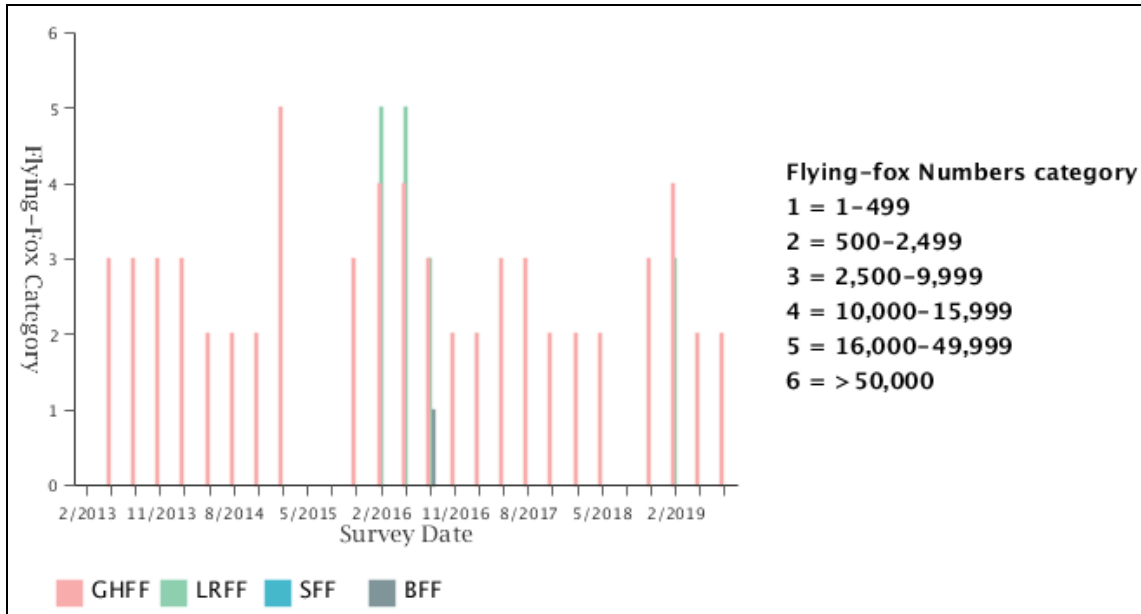
The two remaining historical camps, being Blackhill and Millfield have not been occupied since at least 2012. These two (2) camps are located on privately owned land in more rural parts of the LGA. The management actions outlined in this plan do not apply to the Blackhill or Millfield historical camps. However, the Plan does apply to any new Flying-fox camps that form on public lands within the LGA.

The East Cessnock Flying-fox Camp is predominantly located on Crown Land between Maitland Road and Old Maitland Roads, but at times has expanded into neighbouring land managed by Cessnock City Council i.e. Akira Avenue Park and the Crown Land to the south-eastern side of Maitland Road. Additionally, the Camp extends to the boundary with the Cessnock East Public

School and animals have been found within school grounds. This site has been identified as a permanent Flying-fox maternal roost camp, since 2011.

The CSIRO Census results for the East Cessnock Flying-Fox Camp as at 13 November 2019 are shown on **Figure 2**.

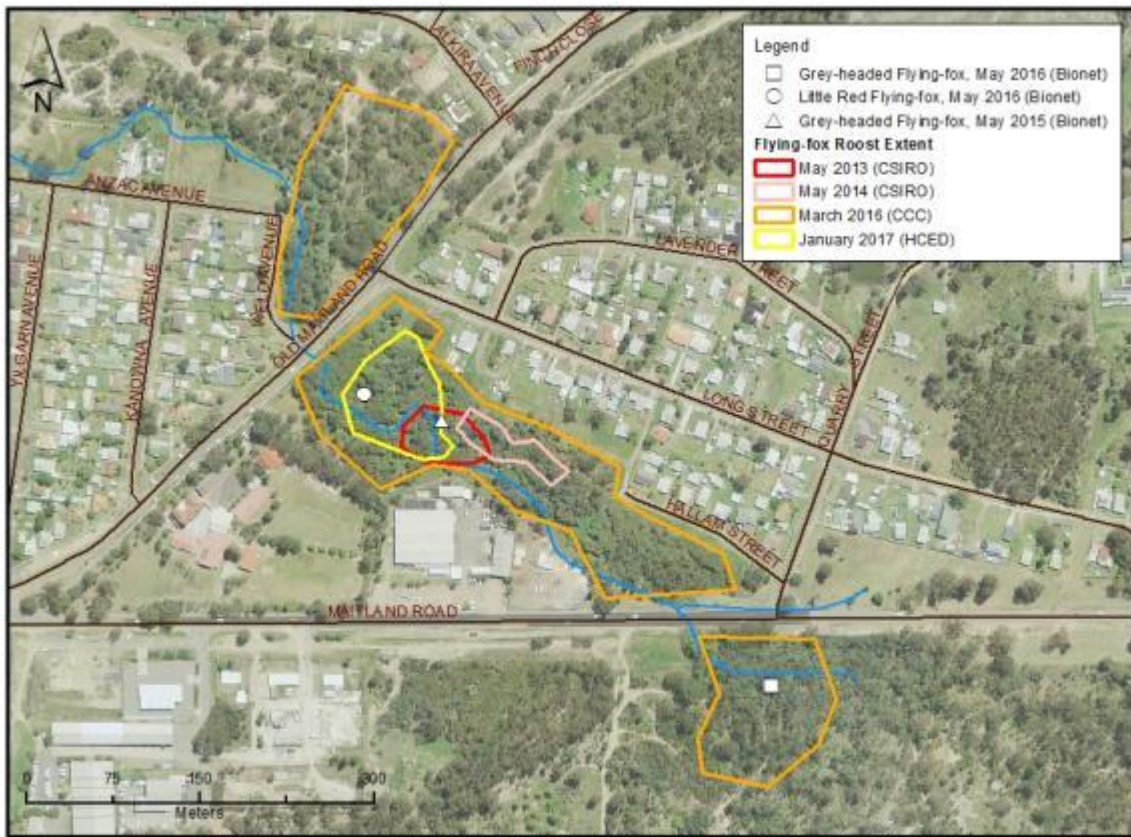
Figure 2: CSIRO Census results for the East Cessnock Flying Fox Camp



Grey-headed flying-foxes first visited the East Cessnock site in late 2011 and the site has been seasonally occupied since this time. The appearance of Grey-headed flying-foxes at the site in 2011 correlated with food shortages in other areas of the Hunter, so this may be an important refuge site. Little Red Flying-foxes arrived in December 2015 and left in August 2016. This is the first time this species has been recorded on site. The Little Red Flying-foxes generally occupied the centre of the Camp and from February 2016 through to May 2016 their population increased to in excess of 35,000 individuals. During this period, the occupation of the area by Little Red flying-foxes forced the existing 12,000 Grey Headed Flying-foxes to occupy Council managed, Akira Avenue Park and the Crown Land on the south-eastern side of Maitland Road (for the first time). Following the Little Red's departure from the site, the Grey Headed Flying-foxes returned to the original occupancy area.

The maximum known previous extent of the camp is shown on **Figure 3**. This area is not always fully occupied at any one time; and at times the Camp has been completely vacant.

Figure 3: East Cessnock Flying-fox Camp boundary (and historical Flying-fox roosting extent based on CSIRO Census results)



Vegetation Communities

A Vegetation Assessment of the Camp (including field surveys) was undertaken by MJD Environmental on behalf of Council in October 2019. This Vegetation Assessment identified the presence of four vegetation communities within the East Cessnock Flying Fox Camp. **Table 2** outlines the vegetation communities observed within the Camp. One (1) of the four (4) communities is commensurate with an Endangered Ecological Community (EEC) listed under the BC Act.

Table 2: Vegetation Communities at East Cessnock Flying-fox Camp (MJD Environmental, 2019)

Vegetation Map Unit (Bell 2008)	Vegetation Community (REMS Unit)	EEC	Plant Community Type (PCT)
108 Paperbark Depression Forest	N/A	-	1726: Flax-leaved Paperbark – Tall Sedge shrub land of the Sydney Basin
14h Riparian Apple – Grey Gum Dune Forest	14 Wollombi Redgum-River Oak Forest	-	1557: Rough-barked Apple – Forest Oak – Grey Gum grassy woodland on sandstone ranges of the Sydney Basin
17c Lower Hunter Beyer's Ironbark Low Forest	17 Lower Hunter Spotted Gum Ironbark Forest	Lower Hunter Spotted Gum – Ironbark Forest in the Sydney Basin and NSW North Coast Bioregions (EEC under the BC Act)	1592: Spotted Gum – Red Ironbark – Grey Gum shrub – grass open forest of the Lower Hunter
17a Lower Hunter Spotted Gum Red Ironbark Forest			

The Flying-fox colony predominantly favours the Paperbark Depression Forest towards the centre of the site. The distribution of the vegetation communities found at the camp are provided in the Vegetation Assessment Report in **Appendix 2**.

Flying-fox Habitat

Roosting Areas

Dominant and preferred roosting vegetation within the Flying Fox Camp includes mature *Melaleuca linariifolia* and *Casuarina glauca*. Flying Foxes predominantly roost in Melaleucas on site, Grey Headed Flying-foxes were observed roosting within a confined area on the western side of the reserve over the natural waterbody. The dense and swampy under-storey vegetation appears to provide protection and cooler temperatures with the soil holding some moisture (due to an ephemeral creek running through the site).

The average height of the Melaleuca trees is around 15m, and the Rough Barked Apple trees are taller at almost 25m, which provide a dense mid-storey that enables the flying-foxes to move up and down the trees depending on the prevalent weather conditions.

Foraging Areas

The number of flying-foxes present in a camp is primarily driven by the amount and quality of food available in the local area, relative to that available within migration distance (Tidemann 1999; Eby 1991; Roberts et al 2012). Flying-foxes typically feed within 20 km of their roost (Tidemann 1999), and digital maps of feeding habitat for Grey-headed Flying-foxes have been used to summarise feeding resources within 20 km of the East Cessnock camp (Eby and Law 2008).

Approximately 55% of land within 20 km of the East Cessnock site supports native forests and woodlands in patches ranging in size from small remnants to extensive tracts in conservation reserves and state forests. Less than 3% of native vegetation has been identified as rainforest containing fruiting trees and vines known to be consumed by flying-foxes. Rainforest fruits in these habitats provide highly restricted feeding opportunities for the animals during late summer and autumn. By contrast, flowering trees visited by the flying-foxes occur in >95% of the forested land within 20km of East Cessnock. This resource includes large tracts of some of the most productive vegetation types for nectar-feeding animals found in south east Australia, notably Spotted Gum-Ironbark forests (Eby and Law 2008).

Fifteen species of trees in the flower diet of Grey-headed flying-foxes occur within feeding range of the East Cessnock camp (refer to **Table 3**). They vary considerably in the amount of nectar they secrete, the frequency and duration of flowering, their seasonal flowering schedules and the area of distribution. Interactions between these characteristics determine their influence on the size and species composition of the population of flying-foxes roosting at East Cessnock.

In general, a high proportion of diet species distributed across a wide area flower from late spring to autumn. The diversity of this resource base supports a consistent presence of animals in the warmer months despite variations in the species that flower in any year. Population size should fluctuate considerably in relation to nectar abundance. In years when the widely-distributed and productive Broad-leaved Ironbark flowers well (approximately 40% of years), the number of animals present in late spring and summer should be inflated. More frequent flowering of Turpentine should also attract relatively large numbers of flying-foxes during spring.

However, the most dramatic shifts in population size at East Cessnock are driven by the flowering patterns of Spotted Gum. This is the most common species of tree in the lower Hunter. It produces abundant nectar for periods of up to 6 months, starting as early as late January and continuing into winter (Law and Chidel 2007). Mass flowering events occur approximately once every 4 years, and sparse flowering occurs more frequently (Pook et al. 1997; B. Dowling pers comm). Large numbers of both Grey-headed Flying-foxes and Little Red Flying-foxes migrate to the Hunter Valley in response to mass flowerings of Spotted Gum, traveling distances of several hundred kilometres (Eby 1991) and flying-fox camps in Sydney diminish in size or empty when these events occur.

Native vegetation in the area is unlikely to support populations through winter in years when the Spotted Gum doesn't flower due to the highly-restricted distribution of diet plants that flower in those months. Nonetheless, it is possible for over-wintering populations to be supported by urban plantings, particularly in years of wide-spread food scarcity in native forests.

Table 3: Characteristics of flowering trees in the diet of Grey-headed Flying-foxes that occur within 20 km of the East Cessnock camp. Nectar abundance is scored in 4 categories from 0 to 1; the approximate frequency of flowering is also scored in 4 categories relating to % of years; duration of flowering is scored in months. Species likely to play a significant role in determining the number of flying-foxes present in the camp, as assessed by nectar abundance and area of distribution, are highlighted in grey. Species found in <1% of native vegetation have been excluded. See Eby and Law (2008) for further details.

Species	Common Name	% Area of Native Vegetation	Flowering Characteristics			Bi-monthly Flowering Schedule					
			Nectar Abundance	Frequency (% yrs)	Duration (mth)	Dec-Jan	Feb-Mar	Apr-May	Jun-Jul	Aug-Sep	Oct-Nov
<i>Corymbia maculata</i>	Spotted Gum	60%	1	0.25	4-6		X	X	X		
<i>Eucalyptus fibrosa</i>	Broad-leaved Ironbark	45%	0.7	0.4	2	X					X
<i>E. saligna</i>	Sydney Blue Gum	15%	0.7	0.7	1	X	X				
<i>Syncarpia glomulifera</i>	Turpentine	25%	0.5	0.7	2					X	X
<i>Angaphora costata</i>	Smooth-barked Apple	20%	0.3	0.4	1						X
<i>A. floribunda</i>	Rough-barked Apple	10%	0.5	0.4	1	X					
<i>C. gummifera</i>	Red Bloodwood	5%	1	0.4	2	X	X				
<i>E. amenoides</i>	White Mahogany	10%	0.3	0.7	1	X					X
<i>E.deanei</i>	Mountain Blue Gum	10%	0.7	0.7	1	X	X				
<i>E. moluccana</i>	Grey Box	5%	0.3	0.7	2		X				
<i>E.parramattensis</i>	Parramatta Gum	5%	0.5	0.4	2	X					
<i>E/pilularis</i>	Blackbutt	2%	1	0.4	2	X	X				
<i>E. punctata</i>	Large-fruited Grey Gum	55%	0.3	0.7	1	X	X				
<i>E. siderophloia</i>	Grey Ironbark	10%	1	0.7	2	X					X
<i>E.terticornis</i>	Forest Red Gum	10%	1	1	2					X	X
						10	7	1	1	2	6

Overflow Roosting Areas

A number of potential roosting habitat species (native and exotic) have been identified and are summarised in **Table 4**. The potential flying fox camp overflow areas are shown in **Figure 4**.

Table 4: Description of Potential Roosting Overflow Locations

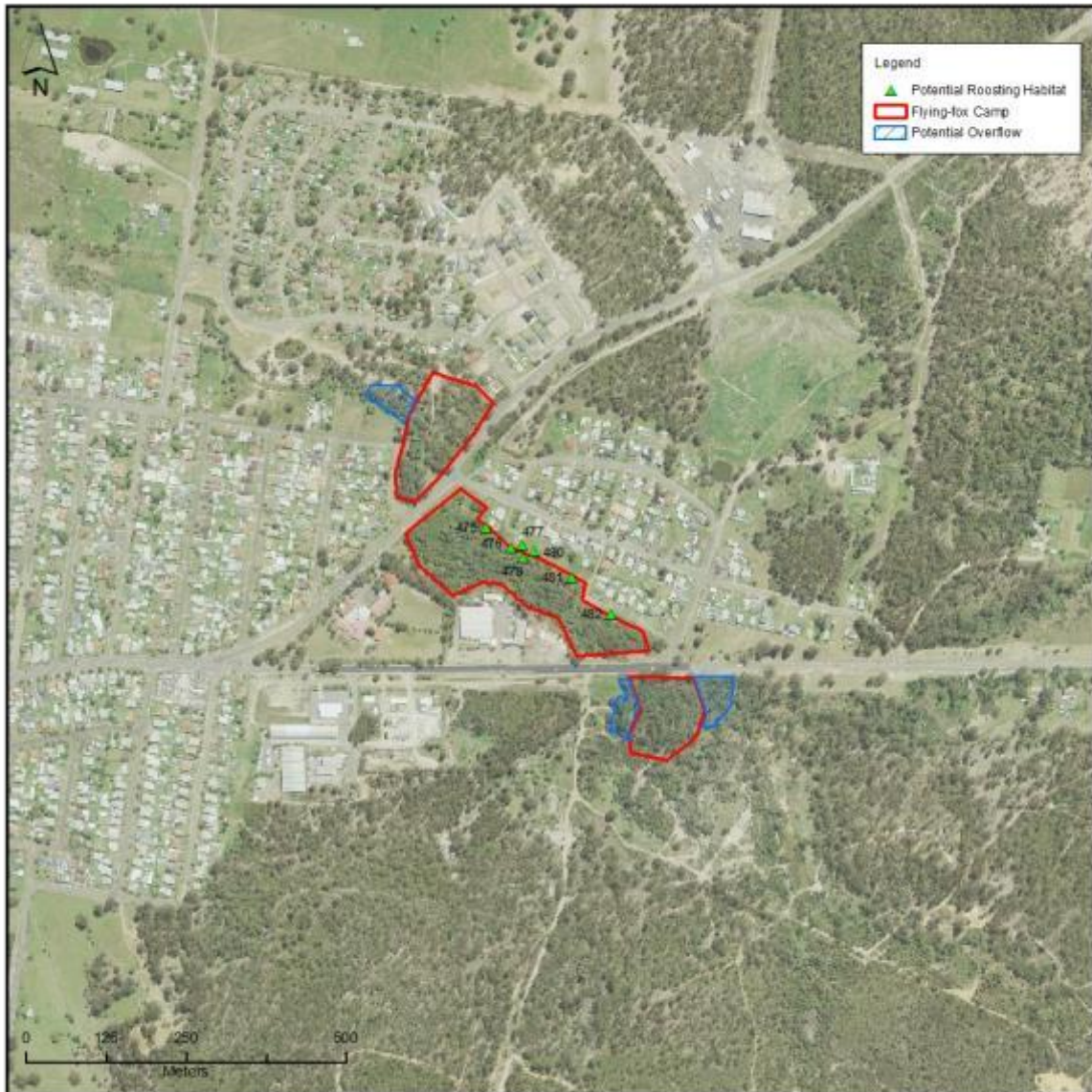
Site Number	Species	Roosting/foraging habitat and condition	Roosting/foraging habitat/impact on residential areas and schools
475	<i>Angophora floribunda</i> along periphery of reserve and defoliated <i>Melaleuca linariifolia</i>	The site is approximately 20 metres has been defoliated by Little Reds.	Flying foxes may roost closer to residential areas, when the camp is at capacity
476	Poplar Tree	Mature Poplar Tree on Crown Land adjacent to the property boundary	Flying Foxes known to roost in the tree when camp is at full capacity
477	Poplar Tree	Mature Poplar trees on Private property	Potential roosting habitat on private land
477	Camphor Laurel	Potential roosting habitat. Scattered Camphor Laurel throughout reserve core. Spread of Camphor Laurels on the periphery of the reserve likely	Potential roosting habitat when Camphor Laurels reach maturity.
478	<i>Melaleuca linariifolia</i> and <i>Melaleuca spp.</i>	Potential roosting habitat - mature and established Paperbarks	Approximately 60 metres from reserve to dwelling
480	<i>Eucalyptus tereticornis</i>	Foraging habitat important winter flowering tree	Approximately 10 metres from the property boundary
481	<i>Eucalyptus fibrosa</i> and <i>Melaleuca nodosa</i> dominant	Foraging habitat on periphery of the reserve. Unlikely Flying Foxes will feed on species at the Camp site	<i>Eucalyptus fibrosa</i> approximately 10 metres from the back property boundary.
481	<i>Angophora floribunda</i> and <i>Melaleuca linariifolia</i>	Flying Foxes have roosted throughout this section of the reserve causing visible defoliation. The trees on the periphery of the reserve a currently too small to support roosting.	Located approximately 15 metres from the northern property boundary

It is likely that in the event of large Flying-fox numbers returning to the site, the camp would continue expanding through the bushland at the southern end of the existing Camp, with little fracturing, but this is not certain, as Flying-foxes are wild animals, and not enough is known about their preferences for roosting activities.

It is acknowledged that undertaking some level of site restoration within the current Camp boundary, so the site can accommodate large numbers of animals, should reduce the possibility of camp expansion or splintering, and the increased impact on a broader range of the community.

The continued maintenance of the Asset Protection Zone is recommended, not only to protect houses from threat of fire, but to reduce any direct impacts on the households from the roosting Flying-foxes.

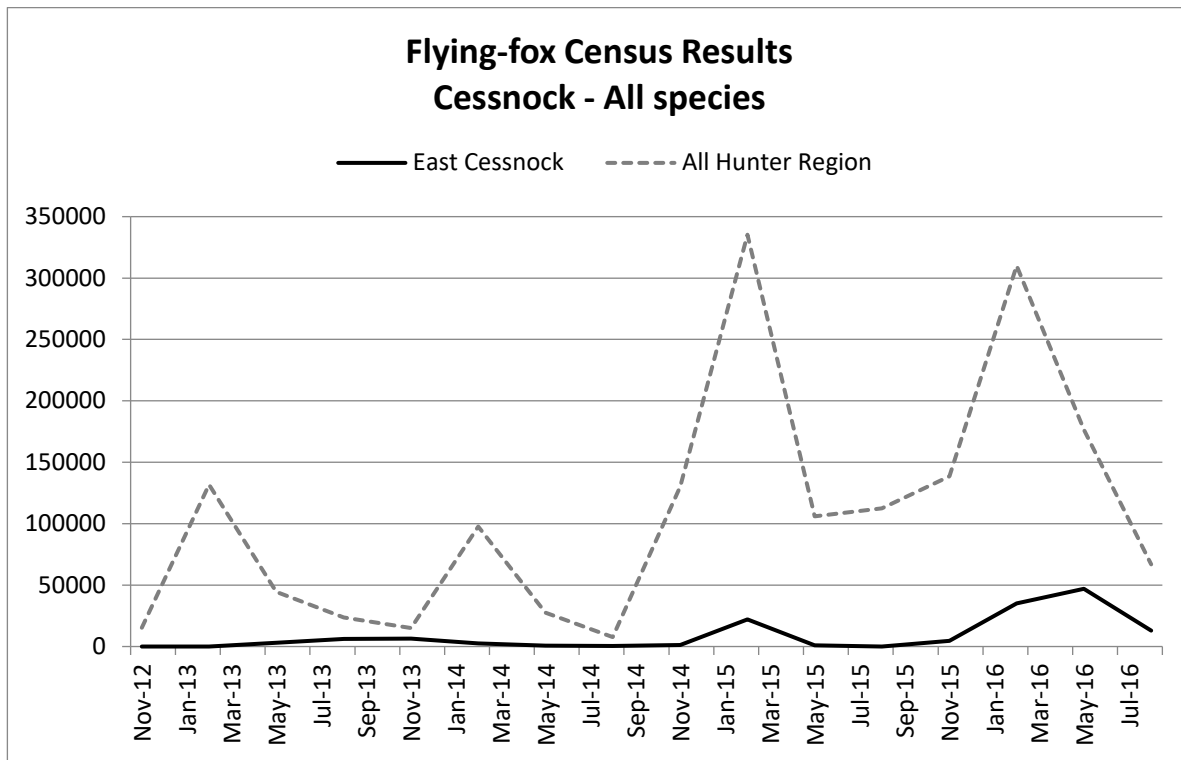
Figure 4: Potential Flying-fox Camp overflow areas based on vegetation and proximity to water



Flying-fox Population at the East Cessnock Flying-fox Camp

Figure 5 shows the numbers of the three species of Flying-fox and the population in the broader Hunter Region.

Figure 5: Graph of Flying-fox census results for the East Cessnock Flying-fox Camp compared to the Region (source: CSIRO National Flying-fox census)



The location and extent of the camp has changed over time. The Flying-foxes appear to have a preference to roost in the Melaleuca trees within the widest part of the Camp. A small number of animals have also been observed roosting in Rough Barked Apple trees.

Due to the Asset Protection Zone maintained on the reserve, the closest roosting animals are to private property is 15-20m, with most animals roosting further than 50m from properties.

Land Tenure, Zoning and Land Use

Details of the land tenure surrounding the camp is shown in **Figure 6**. The majority of the camp is located on Crown Land. Council owns the small portion of the camp located north of Old Maitland Road (i.e. Akira Avenue Park).

The land zoning related to the East Cessnock Flying-fox Camp is complex, with the Camp extent moving across multiple land tenure and zoning categories. The Camp is predominantly located on land zoned Light Industrial with overflow areas designated as either Public Recreation or Rural Landscape. **Figure 7** shows the current land zoning for the East Cessnock Flying-fox Camp and surrounds.

Figure 6: Land tenure of the East Cessnock Flying-fox Camp and surrounds

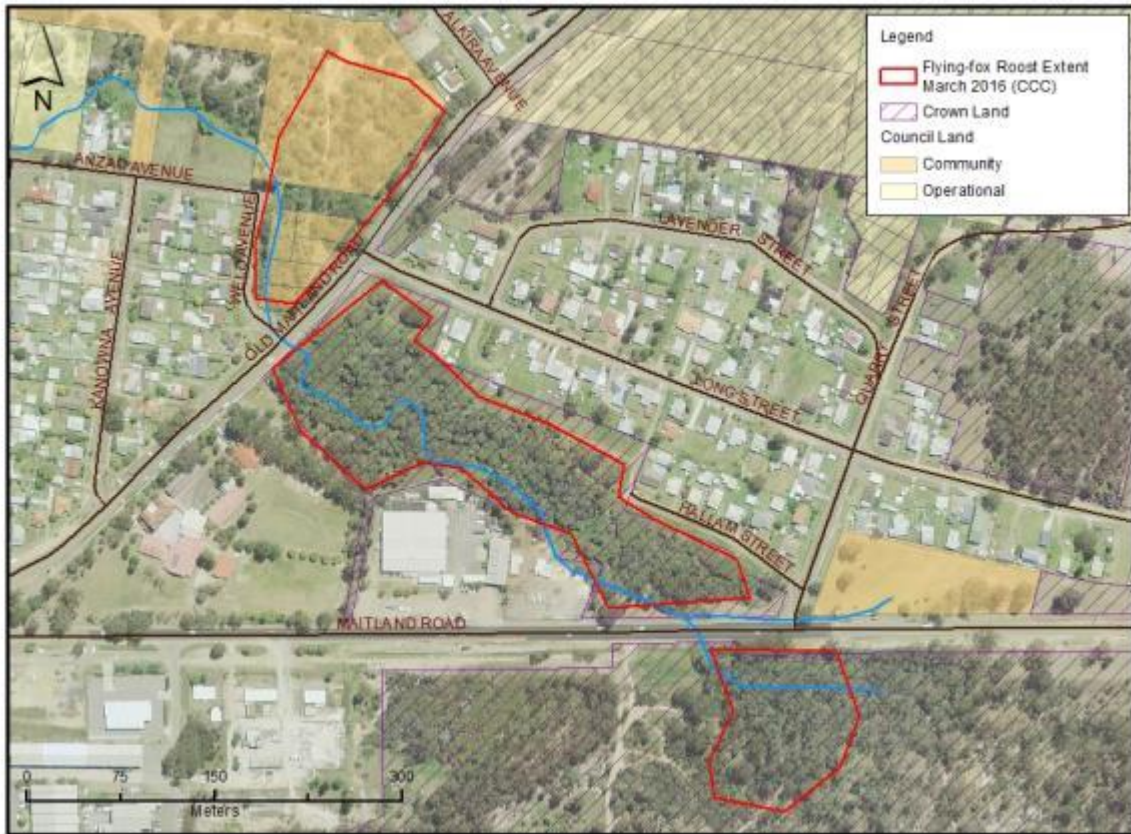
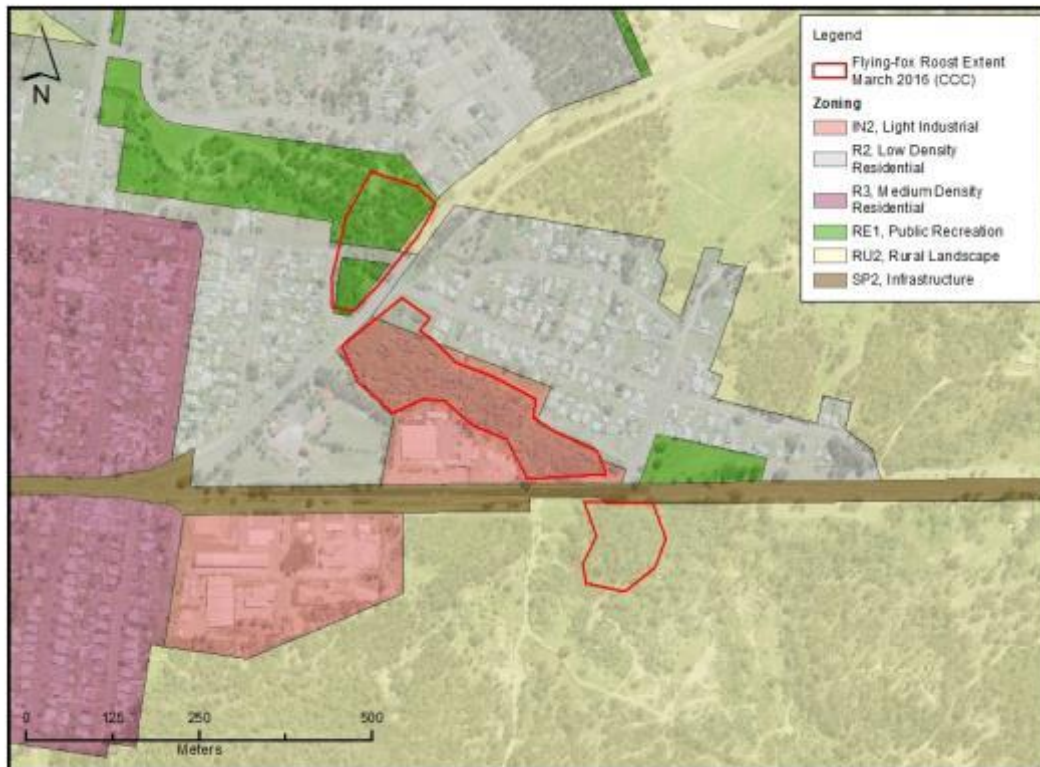
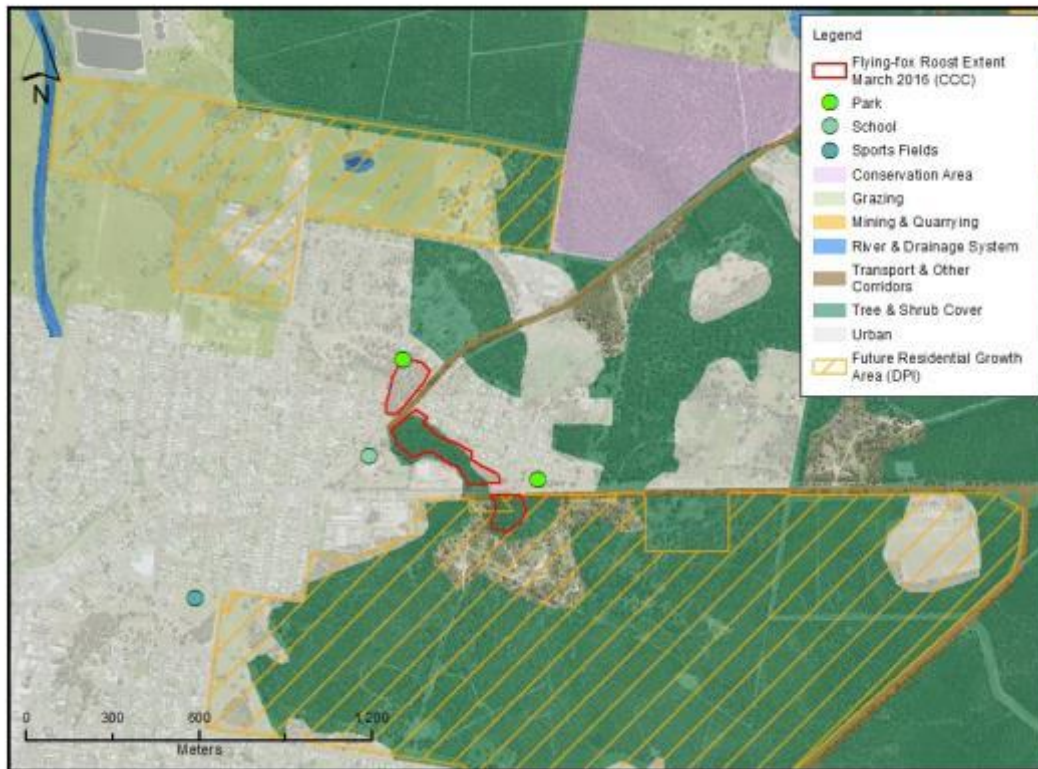


Figure 7: Land zoning of the area surrounding the East Cessnock Flying Fox Camp



The Camp is predominantly located on Crown land adjacent to residential developments and a school, details of the surrounding land use shown on **Figure 8**.

Figure 8: Land Use of area surrounding the East Cessnock Flying-fox Camp



Community Interests and Issues Related to the Camp

Flying-foxes were first noted in East Cessnock in 2011. Although no complaints were lodged at that time, Council staff first noted the animals being present in November, and primarily being located between 1 Long Street and Cessnock East Public School.

Council first received correspondence on the issue in January 2012 and the complainant specifically noted the impact of faeces on property, and in swimming pools.

During 2012-16, a relatively small number of community complaints were received, all were forwarded to the Department of Industry – Lands & Forestry (now DPIE) for action. In April 2012 a Notice of Motion was moved by Council to contact the State Member, Clayton Barr and Federal Member, Joel Fitzgibbon and “ask for their assistance with the problem developing at East Cessnock regarding the Bats and how our Council can help relieve the area of these animals without breaking any laws”.

It is acknowledged there is a section of the community that does not want Flying-foxes roosting in the reserve, and during 2016, three separate attempts were made to start fires in the reserve with the express aim of dispersing the animals, all attempts failed and were responded to by the local Fire Brigade.

The following list is a collation of the issues related to the camp that have been reported by the community. The list has been compiled from information collected via a range of reporting and consultation methods. Further discussion about community engagement efforts and outcomes can be found in **Section 4**.

Reported issues include:

- noise as flying-foxes depart or return to the camp
- noise from the camp during the day
- flying-foxes hanging close to the pathway between Long Street and the school (reports have been received about children walking into the road to avoid the animals)
- faecal drop on outdoor areas, cars and washing lines

- smell
- fear of disease
- health and/or wellbeing impacts (e.g. associated with lack of sleep, anxiety)
- reduced general amenity
- damage to vegetation
- increased need for bush regeneration and associated costs
- impacts on other fauna species
- impacts on businesses
- property devaluation

The majority of issues recorded are related to Long Street and Hallam Street.

Not all of the community regards the Flying-fox Camp in a negative light, with a number of comments being received through recent community engagement suggesting the following issues should be considered by the Council and the DPIE (Crown Lands).

- Threatened species in need of protection
- Plant more trees elsewhere so they do not have to be so close to residential dwellings
- Education is required for community to understand ecological significance of Flying-foxes
- Flying-foxes are nomadic and will move on in their own time.
- Provide vital seed and pollen dispersal across the landscape

Management Activities to Date

In response to the community concern, the following activities were undertaken by various stakeholders.

Cessnock City Council

In February and March 2015 the community directly affected by the Camp collectively sent 24 letters to Council noting the impact the Camp was having on the community. The issue and letters were addressed by Council and the Mayor met with residents. The matter was subsequently referred to the former Department of Industry - Lands & Forestry, as the Authority responsible for the management of the land where the Camp is located. Following this meeting, Council sent out a media release with information on the issue and the action taken.

Cessnock City Council, until April 2016, had referred all enquiries and complaints from community members regarding the East Cessnock Camp to the former Department of Industry -Lands & Forestry (at their request). Council had, up until that time, lobbied on numerous occasions to State and Federal governments seeking assistance for the community through the development of a Camp Management Plan by the land manager (Crown Lands).

Late 2016, Cessnock City Council, with the support from the former NSW Department of Industry – Lands & Forestry (now DPIE) successfully applied for State Government Funding to develop a Flying-fox Camp Management Plan for the East Cessnock Camp. The Plan was adopted in 2017 and has been operational since this time. As part of the 2019 review and update of the Plan, Council opted to extend the Plan to cover any new camps that may become established on Public Lands within the LGA.

In 2019, Cessnock City Council received a number of grants under the Flying-Fox Grant Program which was facilitated by Local Government NSW. Two of the grants were for subsidy funding, Council received a total of \$15,000 to facilitate subsidy funding for residents towards the purchase and installation of air conditioners. Council also received a total of \$15,000 to facilitate subsidy funding for residents to put towards the purchase of clothes dryers. Council is currently reviewing the applications received for these subsidies.

NSW Department of Planning, Industry and Environment (Crown Lands)

Crown Lands maintains an Asset Protection Zone (APZ) adjacent to Long and Hallam Streets as part of fire management requirements. The APZ is slashed twice per year to reduce the risk of bush fire impacting upon adjoining residential property. In January 2015, a minor extension (widening) to the APZ adjoining 2 Hallam St occurred, involving the removal of undergrowth and a tree.

The Department continues to respond and investigate complaints pertaining to the Reserve including dangerous tree complaints, bush fire complaints and weed complaints.

NSW Department of Education / Cessnock East Public School

Staff and students have undergone professional development training related to Flying-foxes to increase understanding of the species and why they roost in trees near the school grounds. To date the Flying-foxes have only encroached on the school grounds for a short period in January 2016 when no students were on site, so there has been no requirement for direct management activities to limit impacts on the grounds.

2.3 Potential New Camps in the Cessnock LGA (or Unknown Existing Camps)

Any new Flying-fox camps that are established on **Public Lands** within the Cessnock LGA, will fall under the controls of this Plan and any management activities required to be undertaken will be drawn from the management actions included in **Table 12**.

3 Context

3.1 Flying-fox Population Statistics

Scientific Committee Recommendation for Listing as a Nationally Vulnerable Species

Advice to the Federal Minister for the Environment and Heritage from the Threatened Species Scientific Committee (TSSC) on Amendments to the list of Threatened Species under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) recommended Grey Headed Flying-foxes should be listed as Vulnerable due to the decline in the National Population over the preceding years¹.

The Committee noted population size data obtained by fly-out count surveys contain a degree of error that is difficult to quantify (related to the survey methodology; and the comparability of the survey results for the purpose of calculating trends in population size or species abundance). Fly-out counts are acknowledged by the scientific community to be the best method currently available of obtaining reliable and reproducible estimates of abundance (if not actual population counts) for flying-foxes. The available data for 1989 and 1998-2001 has been obtained using the same survey techniques that are widely acknowledged to be appropriate for estimating the abundance of this species.

The surveys of 1998-2001 have been much more comprehensive than the 1989 survey in terms of the number of roosts and extent of geographical range included. Despite the significantly increased knowledge of the species roost sites and survey effort, the estimates of abundance obtained indicate a decline in the abundance of the species. Using the maximum estimate from the 1998-2001 surveys (400,000) and the minimum estimate of abundance in 1989 (566,000), the rate of decline since 1989 has been in the order of 30%.

A number of experts commented that the projected habitat clearance in northern NSW is the primary ongoing threat to Grey-headed Flying-foxes. One expert stated that annually reliable winter resources are limited in distribution to a narrow coastal strip in northern NSW and Queensland². These coastal areas are targeted for intensive residential development to cater for a projected 25% increase in the human population over the next decade. It was this argument that convinced the Editorial Panel of the Bat Action Plan to identify Grey-headed Flying-foxes as vulnerable.

The data available from the fly-out counts conducted should be regarded as estimates of abundance, rather than precise population counts.

3.2 Regional Context

The Hunter & Central Coast Region is home to 58 known Flying-fox Camps (refer to **Figure 9**), 53 of which have been observed with Flying-foxes roosting in them since 2012. It is highly likely that there are additional Camps throughout the vegetated areas (private land and National Parks / State Forest) of the region that are well away from human settlements and are currently unaccounted for in the CSIRO National Flying-fox Camp Census.

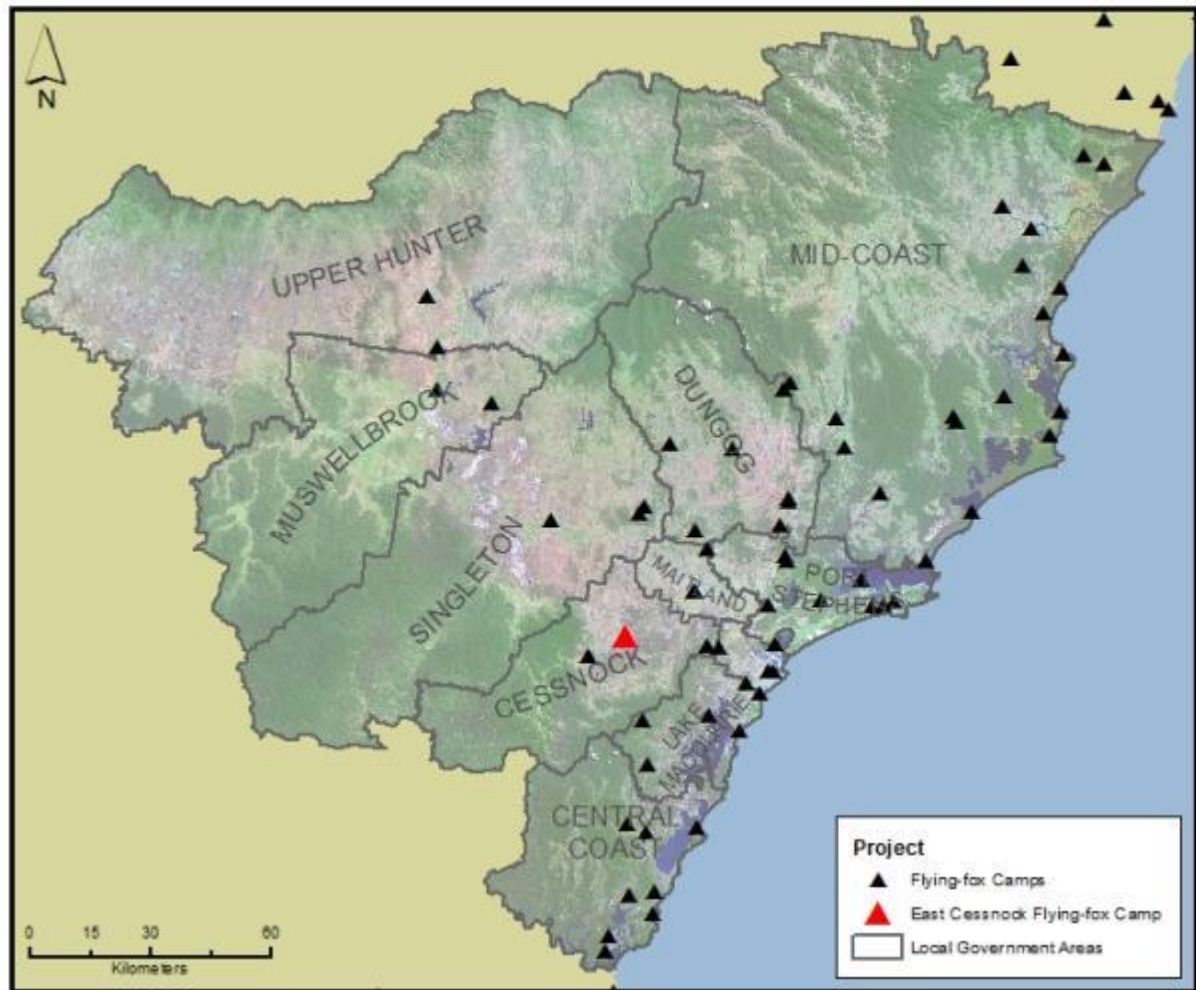
The 2013 "*Grey-headed Flying-fox Management Strategy for the Lower Hunter*" developed by GEOLink stated that in the lower Hunter there were 6 Camps considered critical to Flying-fox survival in the Lower Hunter (these being: Millfield, Martinsville, Morisset, Blackbutt Reserve, Anna

¹ <http://www.environment.gov.au/biodiversity/threatened/conservation-advice/pteropus-poliocephalus>, accessed 27 March 2017.

² Paragraphs 2.46 and 2.47 from: Parliament of the Commonwealth of Australia (2017), *Living with fruit bats, Inquiry into flying-fox management in the eastern states*, House of Representatives Standing Committee on the Environment and Energy

Bay, Medowie and Tocal). None of these Critical sites are managed via a Camp Management Plan and are currently not subject to conflict with Human settlements.

Figure 9: Known Flying-fox Camps throughout the Hunter & Central Coast region



The 2013 Strategy also stated that a further six Camps (Black Hill, Belmont, Glenrock, Hannan Street, Italia Road and Raymond Terrace) were not critical to the survival of grey-headed flying-foxes in the Lower Hunter. Changes in Flying-fox roosting patterns in recent years have resulted in the Black Hill and Hannan Street camps no longer being utilised. The Raymond Terrace Camp is now listed as a Nationally Significant site given the number of Flying-foxes now utilising the site for roosting and mating / maternity activities.

During 2012-2017 Flying-fox roosting patterns changed rapidly throughout the region, with a number of previously important Camps now being abandoned, and small Camps becoming much more significant for roosting and breeding of Flying-foxes. The development of local Camp Management Plans, and a Regional Strategy will assist Councils to address community concerns and assist in reducing the possibility of new areas of conflict arising from increased development within the Hunter Region.

Ongoing research into Flying-fox behaviours appears to indicate that food shortages precede the abandonment of traditional camps, and the creation of new camps. Following the 2010 Flying-fox food shortage, the number of Camps in Sydney increased from 7 to 22. Occupancy of these new camps did not appear to reduce when food supply increased, suggesting that once roosting and feeding patterns change, the roosting behaviour has been adapted and in most cases does not revert back to previous behaviours. This has also been played out in the Hunter region.

Overall the location and scale of Flying-fox Camps in NSW has changed significantly since 2002, when Camps were mostly found in the North of the State. In 2015, following both food shortages,

and preferred food flowering events, the Flying-fox populations spread both South and west, with a number of new camps being created inland and on the NSW South Coast. Since 2015, the majority of new Camps created have been in vegetated areas quite close to human populations.

Regional Flying-fox Foraging Preferences

Flying-foxes have a preference for different native plants for food foraging, diet plants in the region are productive in each bi-month, although species richness varies through the year (refer to **Table 5**). Broad seasonal patterns in the number of productive species are in keeping with other regional areas (Eby & Law 2008). The greatest proportion of dietary species flower in Dec /Jan (14 spp, 52%) and species richness reaches low levels from late autumn to early spring (4 spp, 15%).

Table 5: Bi-monthly flowering phenologies of GHFF diet plants found in the Lower Hunter region (source: Geolink 2013)

Species	Dec-Jan	Feb-Mar	Apr-May	Jun-Jul	Aug-Sep	Oct-Nov
<i>Angophora costata</i>						X
<i>A. floribunda</i>	X					
<i>Banksia integrifolia</i>			X	X	X	
<i>Corymbia eximia</i>						X
<i>C. gummifera</i>		X				
<i>C. maculata</i>		X	X	X		
<i>Eucalyptus acmenoides</i>	X					X
<i>E. albens</i>				X	X	
<i>E. amplifolia</i>						X
<i>E. botryoides</i>	X					
<i>E. camaldulensis</i>	X					
<i>E. deanii</i>	X	X				
<i>E. fibrosa</i>	X					X
<i>E. longifolia</i>			X			
<i>E. moluccana</i>		X				
<i>E. paniculata</i>	X					X
<i>E. parramattensis</i>	X					
<i>E. pilularis</i>	X	X				
<i>E. piperita</i>	X					
<i>E. punctata</i>	X	X				
<i>E. resinifera</i>	X	X				
<i>E. robusta</i>			X	X		
<i>E. saligna</i>	X	X				
<i>E. siderophloia</i>	X					X
<i>E. tereticornis</i>					X	X
<i>M. quinquenervia</i>		X	X			
<i>S. glomulifera</i>					X	X

Based on the information included in **Table 5**, there are only 6 species of tree that flower in winter that are preferential food sources for Flying-foxes, as such these species should be subject to protection to assist with Flying-fox survival in the region.

Additionally, a large number of fruit trees are preferred feed trees for Flying-foxes, with 38 species of rainforest trees and lianas in the fruit diet of Grey Headed Flying-foxes fall within the Lower Hunter region (refer to **Table 6**). The regional list comprises members of 27 families and 31 genera. Four genera are represented by more than one species. The most species rich genus is *Ficus* (6 spp.).

Table 6: Fruits in the diet of GHFF that occur in the Lower Hunter region (source: Geolink 2013)

Family Name	Species Name	Common Name
GYMNOSPERMAE		
Podocarpaceae	<i>Podocarpus elatus</i>	Plum Pine
ANGIOSPERMAE		
Apocynaceae	<i>Melodinus australis</i>	Southern Melodinus
Arecaceae	<i>Archontophoenix cunninghamiana</i>	Bangalow Palm
	<i>Livistona australis</i>	Cabbage Palm
Avicenniaceae	<i>Avicennia marina</i>	Grey Mangrove
Caprifoliaceae	<i>Sambucus australasica</i>	Yellow Elderberry
Chenopodiaceae	<i>Rhagodia candolleana</i>	Seaberry Saltbush
Cunoniaceae	<i>Schizomeria ovata</i>	Crabapple
Ebenaceae	<i>Diospyros pentamera</i>	Myrtle Ebony
Ehretiaceae	<i>Ehretia acuminata</i>	Koda
Elaeocarpaceae	<i>Elaeocarpus obovatus</i>	Hard Quandong
	<i>E. reticulatus</i>	Blueberry Ash
Escalloniaceae	<i>Polyosma cunninghamii</i>	Featherwood
Icaciniaceae	<i>Pennantia cunninghamii</i>	Brown Beech
Meliaceae	<i>Melia azedarach</i>	White Cedar
Monimiaceae	<i>Hedycarya angustifolia</i>	Native Mulberry
Moraceae	<i>Ficus coronata</i>	Creek Sandpaper Fig
	<i>F. fraseri</i>	Sandpaper Fig
	<i>F. macrophylla</i>	Moreton Bay Fig
	<i>F. obliqua</i>	Small-leaved Fig
	<i>F. rubiginosa</i>	Rusty Fig

Based on the foraging modelling, and that the East Cessnock Camp is only populated periodically, the Camp will experience significant food shortages during the winter months each year and is the likely cause of the animals leaving the site each winter. The chance of large (short term) population increases in January – to April due to flowering events should be expected.

If Council wanted to reduce possible impacts on Flying-foxes due to food shortages in Winter months (and potentially reduce conflict with residents due to Flying-foxes foraging in back yards) the opportunity exists to undertake planting and restoration of reserves that support winter flowering plant species, such as *Banksia integrifolia*, *Casurina maculata*, *Eucalyptus albens*, and *Eucalyptus robusta*.

Management Actions at other Flying-fox Camps

There are 58 known Flying-fox Camps across the region, with occupation of the camps varying each season and across each year.

All Councils in the Hunter & Central Coast are currently³ proceeding on the basis that Flying-fox management activities will not include Level 3 actions (dispersal or culling). There is an active understanding amongst Council staff and senior managers that any move to disperse Flying-foxes from one Camp will undoubtedly place stress on other Camps in the region, or more likely (based on research on previous dispersal activities) create a splinter Camp nearby and ultimately cause a new residential area to be in conflict with the Flying-foxes.

The region, Local Councils, Hunter Local Land Services, DPIE and wildlife rehabilitators worked together to develop regionally consistent community engagement and education products in the hope that this can assist residents to understand why the Flying-foxes are in the region, how long they will stay on their migration, and ways that people can manage their property and level of

³ Correct as at time of Camp Management Plan development

interaction with them. Further information and resources produced as part of this project can be found at littleaussiebat.com.au.

4 Community Engagement

Cessnock City Council undertook a comprehensive community engagement process in the facilitation of the Plan. Details of the community engagement are provided below.

4.1 East Cessnock Flying Fox Steering Group

Following Council's resolution to facilitate the development of the plan a formal request to the former Department of Industry – Lands & Forestry (now DPIE) and former NSW Office of Environment and Heritage (OEH) (now DPIE) was made to participate in the process. In addition Cessnock East Primary School, the NSW Department of Education (as a land manager) were invited to participate in the group. An initial meeting was convened in April 2016 to scope the project and identify desired outcomes. A number of subsequent meetings were held to progress the development of the plan and various others were invited to participate. The East Cessnock Camp Management Plan Steering Group consists now of the following regular participants;

- Former Department of Industry - Lands & Forestry (now DPIE) is the primary land manager. Development of the Camp management plan is a collaboration between the department and Council.
- Former NSW Office of Environment and Heritage (now DPIE) – holds management and conservation responsibility over Grey Headed Flying-foxes
- Cessnock East Public School – Adjacent to site and needs to manage impacts and safety of students.
- NSW Department of Education – State Government Department responsible for management of schools
- Bat Support Group – wildlife carers that respond to calls of animal welfare
- Resident representative – adjacent property owner directly impacted by the Flying-fox colony
- Cessnock City Council - has responsibilities to the community and environment of the area for which it is responsible in accordance with *the Local Government Act 1993*. Council is also responsible for administering local laws, plans and policies, and appropriately managing assets (including land) for which it is responsible.

The group have met to discuss a range of issues surrounding the camp, provide direction on the implementation of Flying-fox engage survey (to maximise community participation), identify matters for consideration of the Plan.

4.2 Stakeholders / Interest Groups

There are a range of other stakeholders / Interest Groups who are directly or indirectly affected by the East Cessnock flying-fox camp, or who are interested in its management, these are shown in **Table 7**.

Table 7: Interested Stakeholders

Stakeholder / Interest Groups	Interest / Reported Impacts
All community members	Affected by location of Camp and roosting and foraging of animals.
Residents living in the Cessnock area directly impacted by the camp	Directly affected by roosting animals
Business owners	Affected by location of Camp and roosting and foraging of animals.
Civic leaders and influencers (including local, state and federal politicians)	Civic leaders need to be responsive to community concerns and manage legislative risk through Councils management activities.
Indigenous community	Significance of flying-foxes in local indigenous heritage
Hospitals / medical practices / Dept. of Health	Interested in human health issues related to flying-fox / human contact.
Equine facilities and vets	Equine facility managers and local vets should be aware of Hendra virus risk and appropriate mitigation measures. Where feasible, all horse owners within 20 km of the camp should be included in such communications.
Orchardists and fruit growers	Fruit growers may be impacted by flying-foxes raiding orchards.
Airports	Airport managers have a responsibility to reduce the risk of wildlife-aircraft strike.
Wildlife rehabilitators and conservation organisations Wildlife rehabilitators and conservation organisations have an interest in flying-fox welfare and conservation of flying-foxes and their habitat.	Bat Support Group - aims to work peacefully and positively with the community, land managers and government bodies to enable bats to live and thrive in the region. Provides support to bats through: Promotion, Protection, Information, Nurture and Conservation activities. Hunter Wildlife Rescue – involved in census counts and responding to heat stress events LandCare groups – involved in habitat rehabilitation Bird Observer Groups – provide data on flowering gum events – indicates possible arrival of flying-foxes Landholders interested in wildlife conservation and habitat creation/ rehabilitation
Researchers/CSIRO Researchers have an interest in flying-fox behaviour, biology and conservation.	CSIRO – manages national flying-fox monitoring program
Media <ul style="list-style-type: none"> • Regional / local • Hunter Valley News • Cessnock Advertiser • Newcastle Morning Herald • ABC Local Radio • 2NUR FM 	Work proactively with local media to deliver timely and correct information to the Cessnock East community.
Local Government NSW (LGNSW) LGNSW is an industry association that represents the interests of councils in NSW.	The Flying-Foxes Grants Program has been established to help councils manage flying-fox camps in their areas, consistent with the Policy.
Fire & Rescue NSW	Protection of Camp from fire. Development of suitable guidelines relating to responding to fires in Flying-fox Camps

4.3 Engagement Methods

Extensive effort was made to engage with the community regarding the East Cessnock flying-fox camp, specifically to:

- understand the issues directly and indirectly affecting the community
- raise awareness within the community about flying-foxes
- correct misinformation and allay fears
- share information and invite feedback about management actions and responses to date
- seek ideas and feedback about possible future management options
- invite people to join advisory and/or planning committees.

The types of engagement undertaken included:

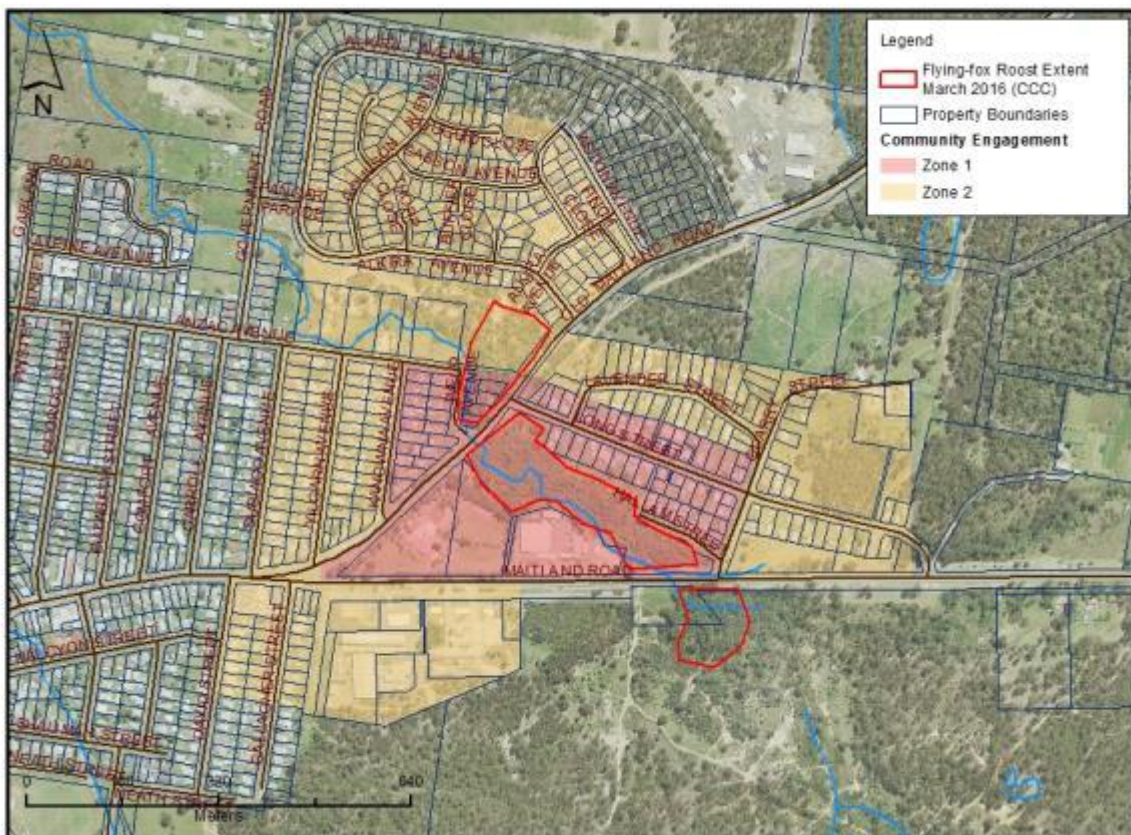
- promotion of contact details of responsible officers

- FAQ for frontline Council, OEH and DPI staff (now DPIE)
- telephone conversations (record issues and complaints)
- direct contact with adjacent residents including letters, brochures, fact sheets and emails
- face-to-face meetings and telephone calls with adjacent residents / kitchen table discussions/ one to one and small groups / open house
- online survey (Flying-fox Engage)
- media (radio, television, print, social media) / managed by CCC / OEH (DPIE) / consistent messaging from both organisations
- brochures and other educational material / OEH developed materials (now DPIE) / NSW Health Fact Sheets
- CCC website pages and links
- on-site signage where appropriate
- face-to-face opportunities in shopping centres, community centres and community events (listening posts, information stalls)
- targeted presentations to relevant associations and community environment groups

The “Flying-fox Engage ” online survey was the key engagement tool to enable Council to receive direct feedback from the community on their experiences of living near Flying-foxes and the values they place on them. This also provided some insight to Council on the management actions they would find acceptable to be employed on the site.

To assist Council to understand where different responses were coming from (i.e. determine if concerns of residents closer to the Camp are different from those further away) the zones were established as shown in **Figure 10**. Details of the analysis of responses are provided in **Section 4.4**.

Figure 10: Flying-fox Engage Survey zones to map responses



4.4 Community Feedback on Management Options

The main community feedback related to the development of the Camp Management Plan was received through the Flying-fox Engage online survey program.

Flying-fox Engage is an innovative engagement decision support system. The online consultation tool was launched on the 31 August 2016 with the website www.flyingfoxengage.com/eastcessnock remaining open for submissions until 17 October 2016.

During this consultation period the Flying-fox Engage website received 227 valid submissions.

The tool employs a relatively simple survey methodology that poses 12 questions to users, the responses to these questions then produces a ranked list of preferred management options that reflect the values of the survey respondent. The list is then able to be interrogated by the user to manually reorder the preferred list. Collated responses to the survey questions are summarised in **Table 8**.

Table 8: Collated responses to the questions posed in the Flying Fox Engage online survey

Question	Responses										
How important is it to you that the flying-fox camp management option reduces the impact of noise and odour from flying-foxes roosting at the camp on nearby residents?	<p>How important is it to you that the flying-fox camp management option reduces the impact of the flying-fox excrement on the property of nearby residents?</p> <table border="1"> <tr> <td>8%</td> <td>7%</td> <td>7%</td> <td>9%</td> <td>69%</td> </tr> <tr> <td>not at all important</td> <td>slightly important</td> <td>moderately important</td> <td>very important</td> <td>extremely important</td> </tr> </table>	8%	7%	7%	9%	69%	not at all important	slightly important	moderately important	very important	extremely important
8%	7%	7%	9%	69%							
not at all important	slightly important	moderately important	very important	extremely important							
How important is it to you that the flying-fox camp management option does not move the flying-fox camp to other areas that may also be near residents or businesses?	<p>How important is it to you that the flying-fox camp management option ensures the risk of disease transmission remains low?</p> <table border="1"> <tr> <td>7%</td> <td>6%</td> <td>5%</td> <td>9%</td> <td>73%</td> </tr> <tr> <td>not at all important</td> <td>slightly important</td> <td>moderately important</td> <td>very important</td> <td>extremely important</td> </tr> </table>	7%	6%	5%	9%	73%	not at all important	slightly important	moderately important	very important	extremely important
7%	6%	5%	9%	73%							
not at all important	slightly important	moderately important	very important	extremely important							
How important is it to you that the flying-fox camp management option has a low financial cost to residents living near the flying-fox camp?	<p>How important is it to you that the flying-fox camp management option has a low financial cost to Council ratepayers?</p> <table border="1"> <tr> <td>9%</td> <td>8%</td> <td>11%</td> <td>9%</td> <td>63%</td> </tr> <tr> <td>not at all important</td> <td>slightly important</td> <td>moderately important</td> <td>very important</td> <td>extremely important</td> </tr> </table>	9%	8%	11%	9%	63%	not at all important	slightly important	moderately important	very important	extremely important
9%	8%	11%	9%	63%							
not at all important	slightly important	moderately important	very important	extremely important							

Question	Responses																				
<p>How important is it to you that the flying-fox camp management option can be implemented quickly?</p> <table border="1"> <tr> <td>11%</td> <td>9%</td> <td>11%</td> <td>9%</td> <td>60%</td> </tr> <tr> <td>not at all important</td> <td>slightly important</td> <td>moderately important</td> <td>very important</td> <td>extremely important</td> </tr> </table>	11%	9%	11%	9%	60%	not at all important	slightly important	moderately important	very important	extremely important	<p>How important is it to you that the flying-fox camp management option provides a long-term solution?</p> <table border="1"> <tr> <td>5%</td> <td>1%</td> <td>6%</td> <td>10%</td> <td>78%</td> </tr> <tr> <td>not at all important</td> <td>slightly important</td> <td>moderately important</td> <td>very important</td> <td>extremely important</td> </tr> </table>	5%	1%	6%	10%	78%	not at all important	slightly important	moderately important	very important	extremely important
11%	9%	11%	9%	60%																	
not at all important	slightly important	moderately important	very important	extremely important																	
5%	1%	6%	10%	78%																	
not at all important	slightly important	moderately important	very important	extremely important																	
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A quick assessment of the responses suggest that people are being directly affected by noise, smell, and faecal drop and they would like these impacts to stop, but don't want to see other areas of the community faced with their issues, and don't want to see direct costs to them or significant costs to Council to undertake management actions.

Based on the responses to the questions, Flying-fox Engage was able to rank the various management options that match the responses. Details of the preferred management actions before and after re-ranking is provided in **Table 9**.

Table 9: Top 10 Community ranked Management Options based on Flying-fox Engage responses

Rank	Initial Result (values based ranking)	Re-ranked result (emotion based ranking)
1	Education, advice and feedback programs - Level 1 off-site, supporting action	Education, advice and feedback programs - Level 1 off-site, supporting action
2	Subsidising property modification to reduce the impacts of flying-foxes - Level 1 management action	Subsidising property modification to reduce the impacts of flying-foxes - Level 1 management action
3	Health and safety guidelines to manage incidents related to the camp - Level 1 off-site, supporting action	Culling flying-foxes to reduce numbers at a camp site
4	Guidelines for carrying out operations adjacent to camps - Level 1 off-site, supporting action	Do Nothing - Level 1 management action
5	Subsidising services to reduce the impacts of flying-foxes - Level 1 management action	Health and safety guidelines to manage incidents related to the camp - Level 1 off-site, supporting action
6	Revegetate and manage land to create alternative flying-fox habitat - Level 1 management action	Active dispersal of a flying-fox camp using disturbance - Level 3 management action
7	Research to improve knowledge of flying-fox ecology - Level 1 off-site, supporting action	Actively nudging the camp to a nearby location using disturbance - Level 2 management action
8	Routine maintenance to improve the condition of the site - Level 1 management action	Guidelines for carrying out operations adjacent to camps - Level 1 off-site, supporting action
9	Do Nothing - Level 1 management action	Passive dispersal of a flying-fox camp through changing water management - Level 3 management action
10	Land-use planning - Level 1 off-site, supporting action	Research to improve knowledge of flying-fox ecology - Level 1 off-site, supporting action

As shown in **Table 9**, initial values based ranking suggests the community would be comfortable with only Level 1 actions (those actions that provide limited impact on the animals and community, and have reduced costs). Yet after the ability to re-rank preferences so they no longer match their values, Culling (an illegal activity) and other Level 3 Actions are moved higher on the preference list.

When considering just those residents within 300m of the Camp (directly impacted), the responses are provided in **Table 10**.

Table 10: Top 10 ranked Management Options based on Flying-fox Engage responses from directly affected residents

Rank	Initial Result (values based ranking)	Re-ranked result (emotion based ranking)
1	Health and safety guidelines to manage incidents related to the camp - Level 1 off-site, supporting action	Buffers without vegetation removal - Level 2 management action
2	Research to improve knowledge of flying-fox ecology - Level 1 off-site, supporting action	Early dispersal before a camp is established at a new location - Level 2 management action
3	Guidelines for carrying out operations adjacent to camps - Level 1 off-site, supporting action	Do Nothing - Level 1 management action
4	Routine maintenance to improve the condition of the site - Level 1 management action	Passive dispersal of a flying-fox camp through changing water management - Level 3 management action
5	Revegetate and manage land to create alternative flying-fox habitat - Level 1 management action	Health and safety guidelines to manage incidents related to the camp - Level 1 off-site, supporting action
6	Land-use planning - Level 1 off-site, supporting action	Subsidising services to reduce the impacts of flying-foxes - Level 1 management action
7	Subsidising services to reduce the impacts of flying-foxes - Level 1 management action	Passive dispersal of a flying-fox camp through selective vegetation removal - Level 3 management action
8	Early dispersal before a camp is established at a new location - Level 2 management action	Guidelines for carrying out operations adjacent to camps - Level 1 off-site, supporting action
9	Education, advice and feedback programs - Level 1 off-site, supporting action	Subsidising property modification to reduce the impacts of flying-foxes - Level 1 management action
10	Subsidising property modification to reduce the impacts of flying-foxes - Level 1 management action	Revegetate and manage land to create alternative flying-fox habitat - Level 1 management action

It is noted that the values based responses from directly affected residents saw almost all of the preferred responses as Level 1 actions. After re-ranking, some level 2 and 3 options were moved higher in the preference list, but culling was not included, nor were dispersal activities ranked as high as with the broader community views.

The results from this engagement activity were utilized by Cessnock City Council, the former Department of Industry – Lands & Forestry and OEH when developing the Management Actions that will be employed at the East Cessnock Flying-fox Camp.

5 Legislation and Policy

5.1 State Legislation

Flying Fox Camp Management Policy 2015

The *Flying-fox Camp Management Policy 2015* (the Policy) has been developed to empower land managers, principally local councils, to work with their communities to manage flying-fox camps effectively. It provides the framework within which the Department will make regulatory decisions. In particular, the Policy strongly encourages local councils and other land managers to prepare Camp Management Plans for sites where the local community is affected.

Biodiversity Conservation Act 2016

The Biodiversity Conservation Act 2016 (BC Act) replaced the Threatened Species Conservation Act 1995 on 25 August 2017.

The purpose of the BC Act includes the conservation of biodiversity at the bioregional and state scales. Under this Act, a person who harms or attempts to harm an animal of a threatened species, an animal that is part of a threatened ecological community, or a protected animal, is guilty of an offence.

The grey-headed flying-fox is listed as threatened under the BC Act (see also Why the grey-headed flying-fox is listed as threatened).

A biodiversity conservation licence under Part 2 of the BC Act may be required if the proposed action is likely to result in one or more of the following:

- a. harm to an animal that is a threatened species, or part of a threatened population
- b. the picking of a plant that is a threatened species, or part of a threatened population or ecological community
- c. damage to habitat of a threatened species, population or ecological community
- d. damage to a declared area of outstanding biodiversity conservation value.

If the Department assesses a biodiversity conservation licence application and determines that a significant impact is unlikely, a biodiversity conservation licence will be granted.

The Department regulates flying-fox camp management through two options provided to land managers:

- authorisation under the [Flying-fox Camp Management Code of Practice](#) for public land managers
- licensing for public and private land managers.

The Code of Practice provides a defense under the BC Act for public land managers, as long as camp management actions are carried out in accordance with the Code of Practice.

Proposed actions that would otherwise constitute an offence under the BC Act can be authorised under another law.

Prevention of Cruelty to Animals Act 1979

It may be an offence under this Act if there is evidence of unreasonable/unnecessary torment associated with management activities.

Environmental Planning and Assessment Act 1979

The objects of the Environmental Planning and Assessment Act 1979 (EP&A Act) are to encourage proper management, development and conservation of resources, for the purpose of the social and economic welfare of the community and a better environment. It also aims to share responsibility for environmental planning between different levels of government and promote public participation in environmental planning and assessment.

The EP&A Act is administered by the Department of Planning, Industry and Environment.

Development control plans under the Act should consider flying-fox camps so that planning, design and construction of future developments is appropriate, to avoid future conflict.

Development under Part 4 of the Act does not require licensing under the BC Act.

Where public authorities such as local councils undertake development under Part 5 of the EP&A Act (known as 'development without consent' or 'activity'), assessment and licensing under the BC Act may not be required; however, a full consideration of the development's potential impacts on threatened species will be required in all cases.

Where flying-fox camps occur on private land, landowners are not eligible to apply for development under Part 5 of the EP&A Act. Private landowners should contact council to explore management options for camps that occur on private land.

5.2 Commonwealth

Environment Protection and Biodiversity Conservation Act 1999

The Commonwealth's Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) provides protection for the environment, specifically matters of national environmental significance (MNES). A referral to the Commonwealth Department of the Environment and Energy (DEE) is required under the EPBC Act for any action that is likely to significantly impact on an MNES.

MNES under the EPBC Act that relate to flying-foxes include:

- world heritage sites (where those sites contain flying-fox camps or foraging habitat)
- wetlands of international importance (where those wetlands contain flying-fox camps or foraging habitat)
- nationally threatened species and ecological communities.

The grey-headed flying-fox (GHFF) is listed as a vulnerable species under the EPBC Act, meaning it is an MNES. It is also considered to have a single national population. DEE has developed the Referral guideline for management actions in GHFF and SFF4 camps (DoE 2015) (the Guideline) to guide whether referral is required for actions pertaining to the GHFF.

The Guideline defines a nationally important GHFF camp as one that has either:

- contained $\geq 10,000$ GHFF in more than one year in the last 10 years
- been occupied by more than 2500 GHFF permanently or seasonally every year for the last 10 years.

Provided management at nationally important camps follows the mitigation standards below, DEE has determined that a significant impact on the population is unlikely, and referral is not likely to be required.

⁴ spectacled flying-fox (*P. conspicillatus*)

Referral will be required if a significant impact to any other MNES is considered likely as a result of management actions outlined in the Plan. Self-assessable criteria are available in the Significant Impact Guidelines 1.1 (DoE 2013) to assist in determining whether a significant impact is likely; otherwise consultation with DEE will be required.

Mitigation standards

- The action must not occur if the camp contains females that are in the late stages of pregnancy or have dependent young that cannot fly on their own.
- The action must not occur during or immediately after climatic extremes (heat stress event⁵, cyclone event⁶), or during a period of significant food stress⁷.
- Disturbance must be carried out using non-lethal means, such as acoustic, visual and/or physical disturbance or use of smoke.
- Disturbance activities must be limited to a maximum of 2.5 hours in any 12-hour period, preferably at or before sunrise or at sunset.
- Trees are not felled, lopped or have large branches removed when flying-foxes are in or near to a tree and likely to be harmed.
- The action must be supervised by a person with knowledge and experience relevant to the management of flying-foxes and their habitat, who can identify dependent young and is aware of climatic extremes and food stress events. This person must assess the relevant conditions and advise the proponent whether the activity can go ahead consistent with these standards.
- The action must not involve the clearing of all vegetation supporting a nationally important flying-fox camp. Sufficient vegetation must be retained to support the maximum number of flying-foxes ever recorded in the camp of interest.

These standards have been incorporated into mitigation measures detailed in Section 9.2. If actions cannot comply with these mitigation measures, referral for activities at nationally important camps is likely to be required.

⁵ A 'heat stress event' is defined for the purposes of the Australian Government's [Referral guideline for management actions in GHFF and SFF camps](#) as a day on which the maximum temperature does (or is predicted to) meet or exceed 38°C.

⁶ A 'cyclone event' is defined as a cyclone that is identified by the Australian Bureau of Meteorology (www.bom.gov.au/cyclone/index.shtml).

⁷ Food stress events may be apparent if large numbers of low body weight animals are being reported by wildlife carers in the region.

6 Flying-fox Ecology and Threats

6.1 Ecological Role

Flying-foxes are considered 'keystone' species given their contribution to the health, longevity and diversity among and between vegetation communities. These ecological services ultimately protect the long-term health and biodiversity of Australia's bushland and wetlands. In turn, native forests act as carbon sinks (Roxburgh et al. 2006), provide habitat for other animals and plants, stabilise river systems and catchments, add value to production of hardwood timber, honey and fruit (e.g. bananas and mangoes; Fujita 1991), and provide recreational and tourism opportunities worth millions of dollars each year (DES 2018). Further information on Flying-fox ecology and threats to flying-foxes is provided in **Appendix 3**.

6.2 Flying-foxes and Heat Stress

Heat Stress affects Flying-foxes when temperatures reach 42 degrees or more. Over the past two decades, a number of documented heat stress events have resulted in significant Flying-fox mortality.

There is conflicting advice about how or whether to intervene during a heat stress event at a Flying-fox camp, it should be noted that human presence in a camp at such times can increase the stress and activity level of Flying-foxes present potentially leading to greater harm. Any response to a heat stress event should be undertaken as an organised and monitored response. It is recommended that data is collected after the heat stress event and provided to scientists able to analyse the data and the help BCD share best practices management techniques as they are developed.

To intervene during a heat stress event, one must be licensed to rehabilitate fauna under NSW legislation. Any licence must specifically endorse the person or group as being able to care for Flying-foxes.

When ambient temperatures rise above 35 degrees, Flying-foxes tend to alter their behaviour to reduce exposure to heat. A range of behaviours may be exhibited, depending on multiple variables in their environment. The impacts of heat stress events are likely to vary site by site and can depend on conditions in the preceding days. Ambient temperature alone may thus not be a sound indicator of a heat stress event. Flying-fox behaviour may provide more reliable information. As flying-foxes experience heat stress, they are likely to exhibit a series of behaviours indicating progressive impact of that stress including:

- Clustering or clumping;
- Panting;
- Licking wrists and wing membranes; and
- Descending to lower levels of vegetation or to the ground.

Some of these behaviors may occur outside of a heat stress event.

7 Human and Animal Health

Flying-foxes, like all animals, carry pathogens that may pose human health risks. Many of these are viruses that cause only minor infections with no clinical signs in flying-foxes themselves, but may cause significant disease in other animals that are exposed. In Australia the most well-defined of these include Australian bat lyssavirus (ABLV), Hendra virus and Menangle virus. Specific information on these viruses is provided in **Appendix 4**.

Outside of an occupational cohort, including wildlife carers and vets, human exposure to these viruses is extremely rare and similarly, transmission rates and incidence of human infection are very low. In addition, Hendra virus infection in humans apparently requires transfer from an infected intermediate equine host and direct transmission from bats to humans has not been reported. Thus, despite the fact that human infection with these agents can be fatal, the probability of infection is extremely low, and the overall public health risk is judged to be low (Qld Health 2016).

Direct contact with faecal material should be avoided and general hygiene measures taken to reduce the low risk of gastrointestinal and other disease. Contamination of water supplies by any animal excreta (birds, amphibians and mammals such as flying-foxes) poses a health risk to humans. Household tanks should be designed to minimise potential contamination, such as using first flush diverters to divert contaminants before they enter water tanks. Trimming vegetation overhanging the catchment area (e.g. the roof of a house) will also reduce wildlife activity and associated potential contamination. Tanks should also be appropriately maintained and flushed, and catchment areas regularly cleaned to remove potential contaminants.

7.1 Disease and Flying-fox Management

A recent study at several camps before, during and after disturbance (Edson et al. 2015) showed no statistical association between Hendra virus prevalence and flying-fox disturbance; however, the consequences of chronic or ongoing disturbance and harassment and its effect on Hendra virus infection were not within the scope of the study and are therefore unknown.

The effects of stress are linked to increased susceptibility and expression of disease in both humans (AIHW 2012) and animals (Henry & Stephens-Larson 1985; Aich et al. 2009), including reduced immunity to disease. Therefore, it can be assumed that management actions that may cause stress (e.g. dispersal), particularly over a prolonged period or at times where other stressors are increased (e.g. food shortages, habitat fragmentation, etc.), are likely to increase the susceptibility and prevalence of disease within the flying-fox population, and consequently the risk of transfer to humans.

Furthermore, management actions or natural environmental changes may increase disease risk by:

- forcing flying-foxes into closer proximity to one another, increasing the probability of disease transfer between individuals and within the population
- resulting in abortions and/or dropped young if inappropriate methods are used during critical periods of the breeding cycle. This will increase the likelihood of direct interaction between flying-foxes and the public, and potential for disease exposure
- adoption of inhumane methods with the potential to cause injury which would increase the likelihood of the community coming into contact with injured/dying flying-foxes.

The potential to increase disease risk should be carefully considered as part of a full risk assessment when determining the appropriate level of management and the associated mitigation measures required.

8 Camp Management Options

The NSW Flying-fox Camp Management Policy 2015 and Camp Management Plan Template 2019 provide details on acceptable management activities to manage and mitigate human / bat conflict at Camp Sites. The management actions are grouped into three levels, these are discussed below.

8.1 Level 1 Actions - Routine Camp Management

Education and Awareness Programs

This management option involves undertaking a comprehensive and targeted flying-fox education and awareness program to provide accurate information to the local community about flying-foxes.

Such a program would include managing risk and alleviating concern about health and safety issues associated with flying-foxes, options available to reduce impacts from roosting and foraging flying-foxes, an up-to-date program of works being undertaken at the camp, and information about flying-fox numbers and flying-fox behaviour at the camp.

Residents should also be made aware that faecal drop and noise at night is mainly associated with plants that provide food, independent of camp location. Staged removal of foraging species such as fruit trees and palms from residential yards, or management of fruit (e.g. bagging, pruning) will greatly assist in mitigating this issue. Approval from Council may be required for the removal of some trees.

Collecting and providing information should always be the first response to community concerns in an attempt to alleviate issues without the need to actively manage flying-foxes or their habitat. Where it is determined that management is required, education should similarly be a key component of any approach.

Property Modification without Subsidies

The managers of land on which a flying-fox camp is located would promote or encourage the adoption of certain actions on properties adjacent or near to the camp to minimise impacts from roosting and foraging flying-foxes (note that approval may be required for some activities, refer to Section 4 for further information):

- Create visual/sound/smell barriers with fencing or hedges. To avoid attracting flying-foxes, species selected for hedging should not produce edible fruit or nectar-exuding flowers, should grow in dense formation between two and five metres (Roberts 2006) (or be maintained at less than five metres). Vegetation that produces fragrant flowers can assist in masking camp odour where this is of concern.
- Manage foraging trees (i.e. plants that produce fruit/nectar-exuding flowers) within properties through pruning/covering with bags or [wildlife friendly netting](#), early removal of fruit, or tree replacement.
- Cover vehicles, structures and clothes lines where faecal contamination is an issue, or remove washing from the line before dawn/dusk.
- Move or cover eating areas (e.g. barbecues and tables) that are close to a camp or foraging tree to avoid droppings by flying-foxes.
- Install double-glazed windows, insulation and use air-conditioners when needed to reduce noise disturbance and smell associated with a nearby camp.
- Follow horse husbandry and property management guidelines provided at the [Hendra virus webpage](#) (DPIE 2019d).
- Include suitable buffers and other provisions (e.g. covered car parks) in planning of new developments.
- Consider removable covers for swimming pools and ensure working filters and regular chlorine treatment.
- Appropriately manage rainwater tanks, including installing first-flush systems.

- Avoid disturbing flying-foxes during the day as this will increase camp noise.

The cost would be borne by the person or organisation who modifies the property; however, opportunities for funding assistance (e.g. environment grants) may be available for management activities that reduce the need to actively manage a camp.

Property modification subsidies

Fully funding or providing subsidies to property owners for property modifications may be considered to manage the impacts of the flying-foxes. Providing subsidies to install infrastructure may improve the value of the property, which may also offset concerns regarding perceived or actual property value or rental return losses.

The level and type of subsidy would need to be agreed to by the entity responsible for managing the flying-fox camp.

Service Subsidies

This management option involves providing property owners with a subsidy to help manage impacts on their property and the lifestyle of residents. The types of services that could be subsidised include clothes washing, cleaning outside areas and property, car washing or power bills. Rate reductions could also be considered.

Critical thresholds of flying-fox numbers at a camp and distance to a camp may be used to determine when subsidies would apply.

Routine Camp Maintenance and Operational Activities

Examples of routine camp management actions are provided in the Policy. These include:

- removal of tree limbs or whole trees that pose a genuine health and safety risk, as determined by a qualified arborist
- weed removal, including removal of terrestrial and aquatic weeds under the Commonwealth *Biosecurity Act 2015*, or species listed as undesirable by a council
- trimming of understorey vegetation or the planting of vegetation
- minor habitat augmentation for the benefit of the roosting animals
- mowing of grass and similar grounds-keeping actions that will not create a major disturbance to roosting flying-foxes
- application of mulch or removal of leaf litter or other material on the ground.

Protocols should be developed for carrying out operations that may disturb flying-foxes, which can result in excess camp noise. Such protocols could include limiting the use of disturbing activities to certain days or certain times of day in the areas adjacent to the camp and advising adjacent residents of activity days. Such activities could include lawn-mowing, using chainsaws, whipper-snippers, using generators and testing alarms or sirens.

Revegetation and Land Management to Create Alternative Habitat

This management option involves revegetating and managing land to create alternative flying-fox roosting habitat through improving and extending existing low conflict camps or developing new roosting habitat in areas away from human settlement.

Selecting new sites and attempting to attract flying-foxes to them has had limited success in the past, and ideally, habitat at known camp sites would be dedicated as a flying-fox reserve. However, if a staged and long-term approach is used to make unsuitable current camps less attractive, while concurrently improving appropriate sites, it is a viable option (particularly for the transient and less selective LRFF). Supporting further research into flying-fox camp preferences may improve the potential to create new flying-fox habitat.

When improving a site for a designated flying-fox camp, preferred habitat characteristics detailed in **Sections 2 & 3** should be considered.

Foraging trees planted amongst and surrounding roost trees (excluding in/near horse paddocks) may help to attract flying-foxes to the desired site. They will also assist with reducing foraging impacts in residential areas. Consideration should be given to tree species that will provide year-round food, increasing the attractiveness of the designated site. Depending on the site, the potential negative impacts to a natural area will need to be considered if introducing non-indigenous plant species.

The presence of a water source is likely to increase the attractiveness of an alternative camp location. Supply of an artificial water source should be considered if unavailable naturally; however, this may be cost-prohibitive.

Potential habitat mapping using camp preferences (see **Sections 2 & 3**) and suitable land tenure can assist in initial alternative site selection. A feasibility study would then be required prior to site designation to assess the likelihood of success and determine the warranted level of resource allocated to habitat improvement.

Provision of artificial roosting habitat

This management option involves constructing artificial structures to augment roosting habitat in current camp sites or to provide new roosting habitat. Trials using suspended ropes have been of limited success as flying-foxes only used the structures that were very close to the available natural roosting habitat. It is thought that the structure of the vegetation below and around the ropes is important.

Protocols to manage incidents

This management option involves implementing protocols for managing incidents or situations specific to particular camps. Such protocols may include 'bat watch' patrols at sites that host vulnerable people, management of pets at sites popular for walking dogs, or preparation for heat stress incidents (when the camp is subjected to extremely high temperatures leading to flying-foxes changing their behaviour and/or dying).

Participation in research

This management option involves participating in research to improve knowledge of flying-fox ecology to address the large gaps in our knowledge about flying-fox habits and behaviours and why they choose certain sites for roosting. Further research and knowledge sharing at local, regional and national levels will enhance our understanding and management of flying-fox camps.

Appropriate land use planning

Land use planning instruments may be able to be used to ensure adequate distances are maintained between future residential developments and existing or historical flying-fox camps. While this management option will not assist in the resolution of existing land use conflict, it may prevent issues for future residents.

Property acquisition

Property acquisition may be considered if negative impacts cannot be sufficiently mitigated using other measures. This option will clearly be extremely expensive; however, is likely to be more effective than dispersal and in the long-term may be less costly.

Do nothing

The management option to 'do nothing' involves not undertaking any management actions in relation to the flying-fox camp and leaving the situation and site in its current state.

8.2 Level 2 Actions - In-situ Management

Creation of buffers can be effective as management actions to nudge flying-fox populations away from urban settlements. The intention is to create a physical or visual separation from the camp

and actively manage vegetation structure and composition to discourage flying-foxes from roosting close to built areas. Actions include:

- clearing or trimming canopy trees at the camp boundary to create a buffer
- disturbing animals at the boundary of the camp to encourage roosting away from human settlement; and
- Noise attenuation fencing.

8.3 Level 3 Actions – Disturbance or Dispersal

Nudging

Noise and other low-intensity active disturbance restricted to certain areas of the camp can be used to encourage flying-foxes away from high conflict areas. This technique aims to actively 'nudge' flying-foxes from one area to another, while allowing them to remain at the camp site.

Unless the area of the camp is very large, nudging should not be done early in the morning as this may lead to inadvertent dispersal of flying-foxes from the entire camp site. Disturbance during the day should be limited in frequency and duration (e.g. up to four times per day for up to 10 minutes each) to avoid welfare impacts. As with dispersal, it is also critical to avoid periods when dependent young are present (as identified by a flying-fox expert).

Dispersal

Dispersal aims to encourage a camp to move to another location, through either disturbance or habitat modification.

There is a range of potential risks, costs and legal implications that are greatly increased with dispersal (compared with in situ management as above). These include:

- impact on animal welfare and flying-fox conservation
- splintering the camp into other locations that are equally or more problematic
- shifting the issue to another area
- impact on habitat value
- effects on the flying-fox population, including potential increase in disease susceptibility and associated public health risk
- impacts to nearby residents associated with ongoing dispersal attempts
- excessive initial and/or ongoing effort and financial investment required
- negative public perception and backlash
- unsuccessful management requiring multiple attempts, which may exacerbate all of the above.

Dispersal activities are typically unsuccessful as outlined in **Appendix 5**.

8.4 Unlawful Activities

Culling

Culling is addressed here as it is often raised by community members as a preferred management method; however, culling is contrary to the objects of the BC Act and will not be permitted as a method to manage flying-fox camps.

Culling is not considered a viable Camp Management action as it is:

- not a preferred management option by the majority of the Cessnock community,
- scientifically ineffective (due to the mobility of the species); and

- it is illegal.

8.5 Site-specific analysis of camp management options

Table provides details on the various management options available, an assessment of cost and effectiveness of the action to address the various conflict issues. The Table also provides details of the assessment undertaken by DPIE – Crown Lands and Cessnock City Council as to the suitability of the actions to be included in the Camp Management Plan. **Section 8.6** provides details of the management actions that will be undertaken through the implementation of the Plan.

Table 11: Analysis of management options

Management Option	Relevant Impacts	Cost	Advantages	Disadvantages	Suitability Determination
Level 1 Actions					
Education and awareness programs	Fear of disease Noise Smell Faecal drop	\$	Low cost, promotes conservation of FFs, contributes to attitude change which may reduce general need for camp intervention, increasing awareness and providing options for landholders to reduce impacts can be an effective long-term solution, can be undertaken quickly, will not impact on ecological or amenity value of the site.	Education and advice itself will not mitigate all issues, and may be seen as not doing enough.	This action was deemed suitable. Responses from Flying Fox Engage indicated a strong desire from the community for more information on Flying Foxes.
Property modification (e.g. car cover, pool cover, clothesline cover, air conditioners, double glaze windows, etc.)	Noise Smell Faecal drop Health/wellbeing Property devaluation Lost rental return	\$-\$\$	Property modification is one of the most effective ways to reduce amenity impacts of a camp without dispersal (and associated risks), relatively low cost, promotes conservation of FFs, can be undertaken quickly, will not impact on the site, may add value to the property.	May be cost-prohibitive for private landholders, unlikely to fully mitigate amenity issues in outdoor areas.	This action was deemed suitable for residents adjacent to the Camp
Fully-fund/subsidise property modification	Noise Smell Faecal drop Health/wellbeing Property devaluation Lost rental return	\$-\$\$	Potential advantages as per property modification, but also overcomes issue of cost for private landholders.	Costs to the land manager will vary depending on the criteria set for the subsidy including proximity to site, term of subsidy, level of subsidy. Potential for community conflict when developing the criteria, and may lead to expectations for similar subsidies for other issues.	This action has limited applicability due to funding constraints. Should funding become available, this option can be further explored. This was the second preference from Flying Fox Engage survey.
Service subsidies (e.g. rate rebates, access to water gurney, etc.)	Noise Smell Faecal drop Health/wellbeing Property devaluation Lost rental return	\$-\$\$	May encourage tolerance of living near a camp, promotes conservation of FFs, can be undertaken quickly, will not impact on the site, would reduce the need for property modification.	May be costly across multiple properties and would incur ongoing costs, may set unrealistic community expectations for other community issues, effort required to determine who would receive subsidies.	Due to lack of funding, this option is not suitable in the short term. Should funding become available in the longer term, this action will be reconsidered.

Management Option	Relevant Impacts	Cost	Advantages	Disadvantages	Suitability Determination
Routine camp management	Health/wellbeing	\$	Will allow property maintenance, likely to improve habitat, could improve public perception of the site, will ensure safety risks of a public site can be managed. Weed removal has the potential to reduce roost availability and reduce numbers of roosting FFs. To avoid this, weed removal should be staged and alternative roost habitat planted, otherwise activities may constitute a Level 3 action. Weeding should only be undertaken when the camp is empty or when Flying-fox numbers are low (generally May to July).	Will not generally mitigate amenity impacts for nearby landholders.	This action was deemed suitable. Weed removal should be staged and alternative roost and understory habitat planted, otherwise weeding activities may constitute a Level 3 action. Weeding should be undertaken when the camp is empty or when Flying-fox numbers are low (generally May to July).
Revegetation and Land Management to Create Alternative Habitat	All	\$-\$\$	If successful in attracting FFs away from high conflict areas, will assist in mitigating all impacts, generally low cost, can be undertaken quickly, and promotes FF conservation.	Takes time for alternative habitat to become established enough to provide suitable Flying-fox roosting habitat	This action was deemed suitable. Council is currently preparing to engage a consultant to prepare a habitat augmentation plan for the area south-east of Maitland Road.
Provision of artificial roosting habitat	All	\$-\$\$	If successful in attracting FFs away from high conflict areas, artificial roosting habitat in low conflict areas will assist in mitigating all impacts, generally low cost, can be undertaken quickly, promotes FF conservation.	Would need to be combined with other measures (e.g. buffers/alternative habitat creation) to mitigate impacts, previous attempts have had limited success.	This action was not deemed suitable
Protocols to manage incidents	Health/wellbeing	\$	Low cost, will reduce actual risk of negative human/pet-FF interactions, promotes conservation of FFs, can be undertaken quickly, will not impact the site.	Will not generally mitigate amenity impacts.	This action will be included as a risk management response by all responsible land managers
Research	All	\$	Supporting research to improve understanding may contribute to more effectively mitigating all impacts, promotes FF conservation.	Generally cannot be undertaken quickly, management trials may require further cost input.	This action was deemed more suitable to be included in a regional strategy or plan
Appropriate land-use planning	All	\$	Likely to reduce future conflict, promotes FF conservation. Identification of degraded sites that may be suitable for long-term rehabilitation for FFs could facilitate offset strategies should clearing be required under Level 2 actions.	Will not generally mitigate current impacts, land-use restrictions may impact the landholder.	This action was deemed suitable
Property acquisition	All for specific property owners Nil for broader community	\$\$\$	Will reduce future conflict with the owners of acquired property.	Owners may not want to move, only improves amenity for those who fit criteria for acquisition, very expensive.	This action was not deemed suitable due to excessive cost

Management Option	Relevant Impacts	Cost	Advantages	Disadvantages	Suitability Determination
Do nothing	Nil	Nil	No resource expenditure.	Will not mitigate impacts and unlikely to be considered acceptable by the community.	Due to commitment of Land Managers and Council, this action is not suitable, despite being ranked No. 4 by Flying Fox Engage responses.
Level 2 Actions					
Buffers through vegetation removal	Noise Smell Health/wellbeing Property devaluation Lost rental return	\$-\$	Will reduce impacts, promotes FF conservation, can be undertaken quickly, limited maintenance costs.	Will impact the site, may not reduce some impacts such as odour, vegetation removal may not be favoured by the community.	This action was deemed suitable, however its applicability to the East Cessnock site is limited due to the presence of Endangered Ecological Communities /Threatened Species and existing land uses.
Buffers without vegetation removal (visual deterrents such as bright colours, smell deterrents such as python excrement, noise emitters, and canopy sprinklers)	Noise Smell Health/wellbeing Damage to vegetation Property devaluation Lost rental return	\$\$	Successful creation of a buffer will reduce impacts, promotes FF conservation, can be undertaken quickly, options without vegetation removal may be preferred by the community.	May impact the site, buffers will not generally eliminate impacts, maintenance costs may be significant, often logistically difficult, limited trials so likely effectiveness unknown.	This action was deemed suitable, however its applicability to the East Cessnock site is limited due to established land use patterns.
Level 3 Actions					
Nudging	All	\$\$-\$\$\$	If nudging is successful this may mitigate all impacts.	Costly, FFs will continue attempting to recolonise the area unless combined with habitat modification/ deterrents.	Not deemed suitable due to excessive cost.

Management Option	Relevant Impacts	Cost	Advantages	Disadvantages	Suitability Determination
Passive dispersal through vegetation management	All at that site but not generally appropriate for amenity impacts only (see Section 8)	\$\$- \$\$\$	If successful can mitigate all impacts at that site, compared with active dispersal: less stress on FFs, less ongoing cost, less restrictive in timing with ability for evening vegetation removal.	Costly, will impact site, risk of removing habitat before outcome known, potential to splinter the camp creating problems at other locations (although less than active dispersal), potential welfare impacts, disturbance to community, negative public perception, unknown conservation impacts, unpredictability makes budgeting and risk assessment difficult, may increase disease risk (see Section 7.1), potential to impact on aircraft safety.	Not deemed suitable due to the nature of the vegetation (Endangered Ecological Community), the likelihood of shifting the problem onto another section of the community, and cost
Passive dispersal through water management	All at that site but not generally appropriate for amenity impacts only (see Section 8)	\$\$- \$\$\$	Potential advantages as per with passive dispersal through vegetation removal, however likelihood of success unknown.	Potential disadvantages as per passive dispersal through vegetation removal, however likelihood of success unknown.	Not deemed suitable for the site due to the impacts on threatened vegetation communities
Active dispersal	All at that site but not generally appropriate for amenity impacts only (see Section 8)	\$\$\$	If successful can mitigate all impacts at that site, often stated as the preferred method for impacted community members.	May be very costly, often unsuccessful, ongoing dispersal generally required unless combined with habitat modification, potential to splinter the camp creating problems in other locations, potential for significant animal welfare impacts, disturbance to community, negative public perception, unknown conservation impacts, unpredictability makes budgeting and risk assessment difficult, may increase disease risk (see Section 7.1), potential to impact on aircraft safety.	Not deemed suitable due to excessive cost and low likelihood of success.
Early dispersal before a camp is established at a new location	All at that site	\$\$- \$\$\$	Potential advantages as per other dispersal methods, but more likely to be successful than dispersal of a historic camp.	Potential disadvantages as per other dispersal methods, but possibly less costly and slightly lower risk than dispersing a historic camp. Potential to increase pressure on FFs that may have relocated from another dispersed camp, which may exacerbate impacts on these individuals.	Not applicable to this Camp, however the plan should address the potential likely sites that may be established in the future.

8.6 Planned Management Approach

The planned management actions included in **Table 12** have been determined after consideration of community views, ecological requirements and legislative / policy controls. The Actions have been grouped into the major thematic areas of:

- Governance
- Routine Management
- Infrastructure
- Restoration & Rehabilitation
- Monitoring
- Flying-fox Species Management
- Resident Assistance
- Community Education

The actions included in **Table 12** are directly linked to the management actions discussed in **Table 11**, but have been directly tailored to actions that will be planned for implementation at the East Cessnock Flying-fox Camp or any new camps that are created on public lands, depending on conditions and funding provision. Responsibility for the implementation of these actions will be shared across the various land managers as required; details of these responsibilities are included in the table.

Table 12: Management Actions

Action ID	Issue	Actions & guidelines	Responsibility	Trigger / Catalyst for commencement	Budget
1. Resident Assistance					
1.1	Car / Clothes-line / swimming pool covers / high pressure cleaners	Provision of these items based upon selection criteria during times of high population occupancy	Cessnock City Council	More than 25,000 Flying-foxes roosting in camp	This was funded under the Flying-Fox Grants Program in 2017/18. Dependent on external funding
1.2	Air conditioners and clothes dryer subsidies	Provision of these items based upon selection criteria	Cessnock City Council	Availability of external funding	In 2019 Council received a total of \$30,000 to subsidize the purchase of these items for residents living in close proximity to the camp. Dependent on external funding. -
1.3	Assistance with costs for tree removal – waiving Council Tree Removal Application Fee	Based on limited species, and proximity to camp	Cessnock City Council	More than 25,000 Flying-foxes roosting in camp and all tree removals have been undertaken with the appropriate sg1 licence	Unknown

Action ID	Issue	Actions & guidelines	Responsibility	Trigger / Catalyst for commencement	Budget
1.4	Financial assistance with s91 licence fees	Only applicable to properties based upon selection criteria including proximity to camp and safety requirements.	Cessnock City Council	More than 25,000 Flying-foxes roosting in camp.	Unknown
1.5	Waiving DA application fees for carports and garages	Only applicable to properties based upon selection criteria including proximity to camp and safety requirements.	Cessnock City Council	More than 25,000 Flying-foxes roosting in camp	Unknown
2. Community Education					
2.1	Advice on backyard vegetation management	Advice on which trees residents may wish to remove (introduced or naturalised foraging species such as Cocos Palms, Poplars and Silky Oaks) Advice on trees to plant if residents want to encourage bats to forage in their properties. Advice on native fragrant trees that will assist to screen smells from Camp	Cessnock City Council Hunter Joint Organisation of Councils	Included in Regional Flying-fox educational kit	Funded through NSW Environmental Trust 2017-19
2.2	Health and disease management	Develop consistent regional information regarding health concerns	DPIE (BCD) New England Health Hunter Joint Organisation of Councils	Included in Regional Flying-fox educational kit	Funded through NSW Environmental Trust 2017-19
2.3	Lifecycle and nomadic timing of bat arrival	Develop consistent regional information regarding Flying-fox nomadic behaviour	DPIE (BCD) Hunter Joint Organisation of Councils	Included in Regional Flying-fox educational kit	Funded through NSW Environmental Trust 2017-19
2.4	Implement Regional Flying-fox educational kit	Develop a community education kit to assist residents to understand Flying-fox movement patterns and reduce conflicts with Camps	Hunter Joint Organisation of Councils Cessnock City Council	completed	Funded through NSW Environmental Trust 2017-19
2.5	How to manage dead or injured Flying-foxes	Information on who to call when sick, injured or dead Flying-foxes are seen	Wildlife Carer Group Cessnock City Council	Immediate action required	Within existing budget
3. Restoration & Rehabilitation					
3.1	Assess native recruitment potential away from boundary	Assessment of vegetation condition improvement in core of site, to make boundary less attractive for roosting (seek to plant <i>Casuarina glauca</i>)	Works to be authorised by DPIE – Crown Lands.	No defined trigger due to long term nature of actions	Unknown – no specific budget. Applications for funding may be submitted by DPIE - Crown Lands or third parties (with consent) for environmental restoration works under the Crown Reserves Improvement Fund (CRIF)

Action ID	Issue	Actions & guidelines	Responsibility	Trigger / Catalyst for commencement	Budget
3.2	Rehabilitation of damaged areas (from Flying-fox occupation)	Removal of damaged vegetation and establishment of replacement vegetation.	Works to be authorised by DPIE – Crown Lands	Death or permanent damage to numerous trees.	Unknown (dependant on tree size and location)
3.3	Plant appropriate foraging species in areas of the Camp away from residential properties	strategically plant endemic foraging habitat trees away from residential areas along the southern side of the reserve.	Works to be authorised by DPIE – Crown Lands	No defined trigger due to long term nature of actions	Unknown – and no specific budget. Applications for funding may be submitted by DPIE – Crown Lands or third parties (with consent) for environmental restoration works under the Crown Reserves Improvement Fund (CRIF)
4. Infrastructure					
4.1	Signage	Interpretive Signage	Cessnock City Council / Stakeholder Group	Dependent upon delivery of Regional Flying-fox education project and funding availability	Signage was installed at East Cessnock Flying Fox Camp in 2018.
4.2	Footpath management	Risk of persons walking on to road rather than along footpath due to Flying-fox proximity.	Cessnock City Council	Camp Encroachment on Old Maitland Road	Unknown
5. Flying-fox Species Management					
5.1	Flying-fox carer response	Respond to calls of injured or dead Flying-foxes	Wildlife Rehabilitators	Resident calls, natural disasters	Within existing budget
5.2	Carer alerts (notification of upcoming events, e.g. management activities, heat stress, etc.)	Notification of residents and Carers of any events that will impact on Camp Site or Flying-fox population.	DPIE (BCD) Cessnock City Council	As required	Within existing budget
5.3	Animal Care in heat stress events	Follow guidelines set by DPIE about what intervention is allowable	DPIE (BCD) Cessnock City Council Rural Fire Service	As required	Within existing budget
6. Routine Management					

Action ID	Issue	Actions & guidelines	Responsibility	Trigger / Catalyst for commencement	Budget
6.1	Weed Control	Noxious and environmental weed control throughout the Camp area - targeting exotic tree species known to act as potential roosting and foraging habitat (e.g. Camphor Laurel as most on site are immature or have not reached maximum height). Weed removal should be staged and alternative roost and understory habitat planted, otherwise activities may constitute a Level 3 action. Weeding should only be undertaken when the camp is empty (generally May to July).	Works to be authorised by DPIE – Crown Lands	As needed	Dependant on funding from DPIE / state grants
6.2	Fire Management	Hazard reduction planning and maintenance	DPIE – Crown Lands	Existing responsibility, to be completed as per approved Department program	Within existing bush fire budget
6.3	Dangerous Trees	Assessments for potentially dangerous trees	DPIE – Crown Lands	When reported	Within existing budget
6.4	Buffer (Asset Protection Zones) Maintenance	Assessed as part of Bushfire risk.	DPIE – Crown Lands	Ongoing as per approved Department program	Within existing bush fire budget
6.5	Mowing	Routine mowing in and around camp and school	East Cessnock Public School	As needed	Within existing budget
6.6	Cleaning of Excrement	Use of high pressure water cleaners to remove faecal matter from school grounds	East Cessnock Public School	Undertaken on school grounds as required	Within existing budget
7. Monitoring					
7.1	Flying-fox Census	Quarterly Flying-fox animal counts to assist with determining likely national population	CSIRO	Quarterly monitoring as part of National Program	Funded by CSIRO
7.2	Wildlife / Rehabilitation carer data collection	Collection and provision of count information, and other data collected when responding to calls	Wildlife Carer Group	As responding to issues at the Camp	NA
7.3	Hunter Bird Observers data collection	Collection and provision of count information, and other data collected	Hunter Bird Observers	When aware of flowering event that may signal an increase in flying-fox population	NA
7.3	Cessnock City Council management data	Collection and dissemination of data related to Flying-foxes, and vegetation that may impact on local or regional Flying-fox populations	Cessnock City Council	As made aware of issues	Within existing budget
8. Governance					

Action ID	Issue	Actions & guidelines	Responsibility	Trigger / Catalyst for commencement	Budget
8.1	Land Use Planning	Review Land Use Planning provisions that impact on the Camp site (e.g. Re-zoning the site from an industrial zone to an appropriate environmental zone, DCP)	Cessnock City Council	Incorporating into Standard Planning Review processes	NA
8.2	Camp Management Plan review	Review periodically	Stakeholder Group	Undertake next review in 2024	NA
8.3	Protocol Development	Fire	Fire & Rescue NSW	To be developed immediately if not already in place	NA
		Heat Stress	Office of Environment & Heritage / Wildlife Carers		
		Community Response to dead / injured animals	Wildlife Carers		
		School	East Cessnock Public School		
		Hospital	New England Health		
		Equine	Hunter Local Land Services		
		Viticulture	Vigneron Association		

Stop Work Triggers

The management program will cease and will not recommence or progress to subsequent levels without consulting DPIE if:

- any of the animal welfare triggers occur on more than two days during the program, such as unacceptable levels of stress
- there is a flying-fox injury or death
- a new camp/camps appear to be establishing
- impacts are created or exacerbated at other locations
- there appears to be potential for conservation impacts (e.g. reduction in breeding success identified through independent monitoring)
- standard measures to avoid impacts (detailed in Section 8.2) cannot be met.

Management may also be terminated at any time if:

- unintended impacts are created for the community around the camp
- allocated resources are exhausted.

9 Assessment of Impacts to Flying-Foxes

9.1 Flying-fox Habitat to be Affected

Based on the actions included in **Table 1**, it is expected there would be little to no negative impacts on the Flying-fox population that utilises the East Cessnock Flying-fox Camp or any newly established camps on public land.

The majority of actions approved in this Camp Management Plan are considered Level 1 (routine management actions), as the Land Managers have determined the cost and ongoing issues with level 3 management actions including nudging, dispersal or culling are inappropriate for the East Cessnock Site or any newly established camps on public land. Level 3 Actions such as camp disturbance or dispersal and will not be undertaken whilst this current Camp Management Plan is in force.

It is expected that if funding can be secured for restoration and rehabilitation (where there is a demonstrated need) the quality and condition of the site will increase, and encourage flying-foxes to move away from the margins of the site and nearby residential properties. The plan also provides for ongoing maintenance of the Asset Protection Zone (buffer) to residences located along the site boundary. These measures can be implemented at a time when flying-foxes are not present, and therefore will not disturb or harm individual flying-foxes.

Due to the presence of an Endangered Ecological Community, and being in proximity to a number of observed threatened species (in addition to the Grey Headed Flying-fox), further assessment of significance should be undertaken prior to any physical works being implemented on site.

9.2 Standard Measures to Avoid Impacts

All Management Activities

The following mitigation measures will be complied with at all times during Plan implementation:

- All personnel will be appropriately experienced, trained and inducted. Induction will include each person's responsibilities under this Plan.
- All personnel will be briefed prior to the action commencing each day and debriefed at the end of the day.
- Works will cease and the Department consulted in accordance with the 'stop work triggers' section of the Plan.
- Large crews will be avoided where possible.
- The use of loud machinery and equipment that produces sudden impacts/noise will be limited. Where loud equipment (e.g. chainsaws) is required they will be started away from the camp and allowed to run for a short time to allow flying-foxes to adjust.
- Activities that may disturb flying-foxes at any time during the year will begin as far from the camp as possible, working towards the camp gradually to allow flying-foxes to habituate.
- Any activity likely to disturb flying-foxes so that they take flight will be avoided during the day during the sensitive GHFF (i.e. when females are in their final trimester or the majority are carrying pups, generally August – December) and avoided altogether during crèching (generally November/December to February).
- Where works cannot be done at night after fly-out during these periods, it is preferable they are undertaken in the late afternoon close to or at fly-out. If this is also not possible, a person experienced in flying-fox behaviour will monitor the camp for at least the first two scheduled actions (or as otherwise deemed to be required by that person) to ensure impacts are not excessive and advise on the most appropriate methods (e.g. required buffer distances, approach, etc.).

- The Department will be contacted immediately if Little Red Flying-Foxes are present between March and October or are identified as being in their final trimester/with dependent young.
- Non-critical maintenance activities (including weeding) will ideally be scheduled when the camp is naturally empty. Where this is not possible (e.g. at permanently occupied camps) they will be scheduled for the best period for that camp (e.g. when the camp is seasonally lower in numbers and breeding will not be interrupted, or during the non-breeding season, generally May to July).
- Works will not take place in periods of adverse weather including strong winds, sustained heavy rains, extreme heat, cold temperatures or during periods of likely population stress (e.g. food shortages). Wildlife carers will be consulted to determine whether the population appears to be under stress.
- Works will be postponed on days predicted to exceed 35°C (or ideally 30°C), and for one day following a day that reached $\geq 35^{\circ}\text{C}$. If an actual heat stress event has been recorded at the camp or at nearby camps, a rest period of several weeks will be scheduled to allow affected flying-foxes to fully recover. See the webpage about [Responding to heat stress in flying-fox camps](#).
- Evening works may commence after fly-out. Noise generated by the works should create a first stage disturbance, with any remaining flying-foxes taking flight. Works should be paused at this stage to monitor for any remaining flying-foxes (including crèching young, although December – February should be avoided for this reason) and ensure they will not be impacted. All Level 1 and 2 works (including pack-up) will cease by 0100 to ensure flying-foxes returning early in the morning are not inadvertently dispersed. Works associated with Level 3 actions may continue provided flying-foxes are not at risk of being harmed.
- If impacts at other sites are considered, in the Department's opinion, to be a result of management actions under this Plan, assistance will be provided by the proponent to the relevant land manager to ameliorate impacts. Details of this assistance are to be developed in consultation with the Department.
- Any proposed variations to works detailed in the Plan must be approved, in writing, by the Department before any new works occur.
- The Department may require changes to methods or cessation of management activities at any time.
- Ensure management actions and results are recorded to inform future planning. See the webpage about [Monitoring, evaluating and reporting on flying-fox camp management actions](#).

Human Safety

It is the responsibility of the land manager and contractors to conduct a risk assessment and determine workplace health and safety requirements; however, minimum requirements are provided below.

- All personnel to wear protective clothing including long sleeves and pants; additional items such as eye protection and a hat are also recommended. People working under the camp should wash their clothes daily. Appropriate hygiene practices will be adopted such as washing hands with soap and water before eating/smoking.
- All personnel who may come into contact with flying-foxes will be vaccinated against ABLV with current titre.
- A wash station will be available on-site during works along with an anti-viral antiseptic (e.g. Betadine) should someone be bitten or scratched.
- Details of the nearest hospital or doctor who can provide post-exposure prophylaxis will be kept on-site.

10 Evaluation and Review

The Plan will have a scheduled review next in 2024, which will include evaluation of management actions against measures shown in **Table 12**.

The following will trigger a reactive review of the Plan:

- Flying-fox population in excess of 80,000 animals (counted utilising approved CSIRO monitoring methodology)
- changes to relevant policy/legislation
- new management techniques becoming available
- outcomes of research that may influence the Plan
- incidents associated with the camp.

Results of each review will be included in reports to Council, and the DPIE (BCD).

If the Plan is to remain current, a full review including stakeholder consultation and expert input will be undertaken in the final year of the Plan's life prior to being re-submitted to DPIE (BCD).

11 Plan administration

This Camp Management Plan has been developed in partnership by Cessnock City Council, DPIE, and the NSW Department of Education. As land managers and the organisations responsible for servicing the local community, the Plan will be jointly managed by all parties as detailed below.

11.1 Monitoring of the camp

Cessnock City Council and DPIE – Crown Lands will continue to assist the CSIRO to undertake their quarterly Flying-fox census activities. Wildlife rehabilitators can access the site as required to attend to the animals, and record information of relevance to Council, DPIE (BCD) and CSIRO.

Additional monitoring and data collection will occur as opportunities arise.

11.2 Reporting

Quarterly reports (following publication of the CSIRO Census Count) will be developed by Cessnock City Council and provided to Council and DPIE – Crown Lands providing details on management activities at the site, and the Flying-fox population during the quarter.

11.3 Funding commitment

Cessnock City Council, DPIE – Crown Lands and the Department of Education, all have responsibilities to ensure appropriate funding is available to undertake management actions included in this plan. The Plan will operate from 2017 – 2027 and therefore each organisation should ensure ongoing funding, and forward planning for management actions be included in their annual budget development.

It is expected that an annual work plan, including budget items will be developed by the project team and implemented as required.

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Appendix 1 - Flying-fox Species Profiles

Flying-fox Species utilising the East Cessnock Camp

Three species of Flying-fox have been observed roosting at the Cessnock East Flying-fox Camp, details on each species follows.

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

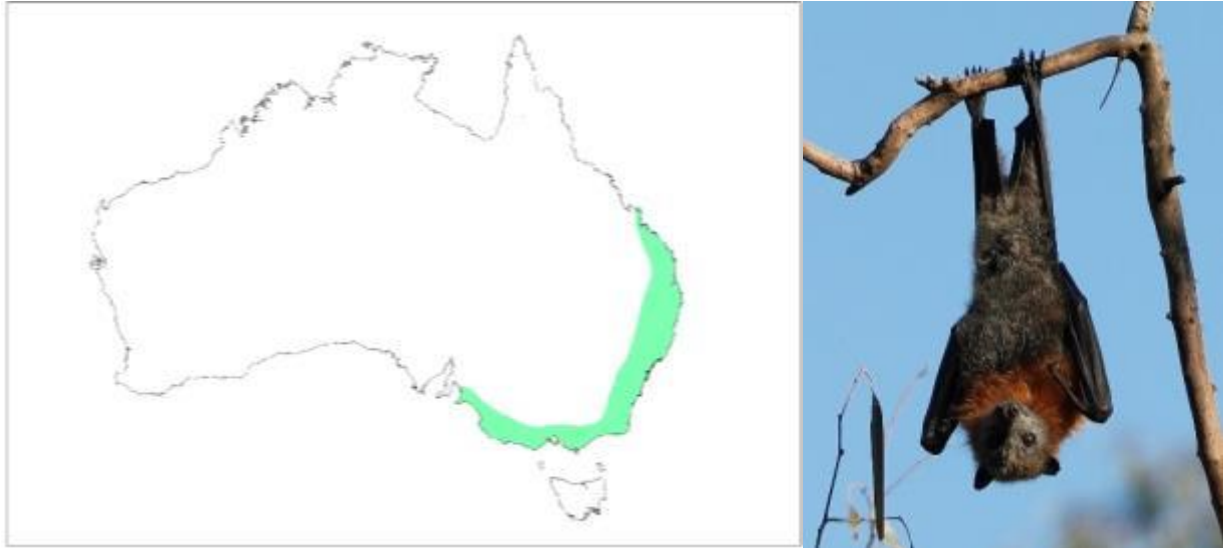


Figure 1: *Grey-headed flying-fox indicative species distribution, adapted from OEH 2015*

The grey-headed flying-fox (GHFF) (Figure 1) is found throughout eastern Australia, generally within 200 kilometres of the coast, from Finch Hatton in Queensland to Melbourne, Victoria (OEH 2015d). This species now ranges into South Australia and has been observed in Tasmania (DoE 2016a). It requires foraging resources and camp sites within rainforests, open forests, closed and open woodlands (including melaleuca swamps and banksia woodlands). This species is also found throughout urban and agricultural areas where food trees exist and will raid orchards at times, especially when other food is scarce (OEH 2015a).

All the GHFF in Australia are regarded as one population that moves around freely within its entire national range (Webb & Tidemann 1996; DoE 2015). GHFF may travel up to 100 kilometres in a single night with a foraging radius of up to 50 kilometres from their camp (McConkey et al. 2012). They have been recorded travelling over 500 kilometres over 48 hours when moving from one camp to another (Roberts et al. 2012). GHFF generally show a high level of fidelity to camp sites, returning year after year to the same site, and have been recorded returning to the same branch of a particular tree (SEQ Catchments 2012). This may be one of the reasons flying-foxes continue to return to small urban bushland blocks that may be remnants of historically-used larger tracts of vegetation.

The GHFF population has a generally annual southerly movement in spring and summer, with their return to the coastal forests of north-east NSW and south-east Queensland in winter (Ratcliffe 1932; Eby 1991; Parry-Jones & Augee 1992; Roberts et al. 2012). This results in large fluctuations in the number of GHFF in NSW, ranging from as few as 20% of the total population in winter up to around 75% of the total population in summer (Eby 2000). They are widespread throughout their range during summer, but in spring and winter are uncommon in the south. In autumn they occupy primarily coastal lowland camps and are uncommon inland and on the south coast of NSW (DECCW 2009).

There is evidence the GHFF population declined by up to 30% between 1989 and 2000 (Birt 2000; Richards 2000 cited in OEH 2011a). There is a wide range of ongoing threats to the survival of the GHFF, including habitat loss and degradation, deliberate destruction associated with the

commercial horticulture industry, conflict with humans, infrastructure-related mortality (e.g. entanglement in barbed wire fencing and fruit netting, power line electrocution, etc.) and competition and hybridisation with the BFF (DECCW 2009). For these reasons it is listed as vulnerable to extinction under NSW and federal legislation (see Section 4).

Little red flying-fox (*Pteropus scapulatus*)



Figure 2: *Little red flying-fox indicative species distribution, adapted from OEH 2015a*

The little red flying-fox (LRFF) (Figure 2) is widely distributed throughout northern and eastern Australia, with populations occurring across northern Australia and down the east coast into Victoria.

The LRFF forages almost exclusively on nectar and pollen, although will eat fruit at times and occasionally raids orchards (Australian Museum 2010). LRFF often move sub-continental distances in search of sporadic food supplies. The LRFF has the most nomadic distribution, strongly influenced by availability of food resources (predominantly the flowering of eucalypt species) (Churchill 2008), which means the duration of their stay in any one place is generally very short.

Habitat preferences of this species are quite diverse and range from semi-arid areas to tropical and temperate areas, and can include sclerophyll woodland, melaleuca swamplands, bamboo, mangroves and occasionally orchards (IUCN 2015). LRFF are frequently associated with other *Pteropus* species. In some colonies, LRFF individuals can number many hundreds of thousands and they are unique among *Pteropus* species in their habit of clustering in dense bunches on a single branch. As a result, the weight of roosting individuals can break large branches and cause significant structural damage to roost trees, in addition to elevating soil nutrient levels through faecal material (SEQ Catchments 2012).

Throughout its range, populations within an area or occupying a camp can fluctuate widely. There is a general migration pattern in LRFF, whereby large congregations of over one million individuals can be found in northern camp sites (e.g. Northern Territory, North Queensland) during key breeding periods (Vardon & Tidemann 1999). LRFF travel south to visit the coastal areas of south-east Queensland and NSW during the summer months. Outside these periods LRFF undertake regular movements from north to south during winter–spring (July–October) (Milne & Pavey 2011).

Black flying-fox (*Pteropus alecto*)



Figure 3 *Black flying-fox indicative species distribution (adapted from DPIE 2019a)*

The black flying-fox (BFF) (Figure 3) has traditionally occurred throughout coastal areas from Shark Bay in Western Australia, across northern Australia, down through Queensland and into New South Wales (Churchill 2008; DPIE 2019a). Since it was first described there has been a substantial southerly shift by the BFF (Webb & Tidemann 1995).

They forage on the fruit and blossoms of native and introduced plants (Churchill 2008; DPIE 2019a), including orchard species at times.

BFF are largely nomadic animals with movement and local distribution influenced by climatic variability and the flowering and fruiting patterns of their preferred food plants. Feeding commonly occurs within 20 kilometres of the camp site (Markus & Hall 2004).

BFF usually roost beside a creek or river in a wide range of warm and moist habitats, including lowland rainforest gullies, coastal stringybark forests and mangroves. During the breeding season, camp sizes can change significantly in response to the availability of food and the arrival of animals from other areas.

Appendix 2 – East Cessnock Flying-Fox Camp Vegetation Assessment Report



East Cessnock Flying Fox Camp Vegetation Assessment Report

Prepared for
Cessnock City Council

Final V2 / November 2019

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DOCUMENT STATUS

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Approval for use:



Adam Cavallaro

20 November 2019

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EXECUTIVE SUMMARY

MJD Environmental was engaged by Cessnock City Council to conduct a Vegetation Assessment of the East Cessnock Flying Fox Camp, Cessnock, NSW. This Vegetation Assessment seeks to inform future management actions of vegetation required within the East Cessnock Flying Fox Camp. These actions include vegetation management and resulting licenses if necessary, weed control, and to guide future actions. This vegetation assessment will also be used to inform a revegetation and habitat augmentation program in the southern end of the study area (south of Maitland Rd).

The vegetation field assessment found:

- Four vegetation communities (Bell 2008), three PCTs and one TEC:

Vegetation Mapp Unit (Bell 2008)	Plant Community Type (PCT)	TEC	Area (ha)
108 Paperbark Depression Forest	1726: Flax-leaved Paperbark - Tall Sedge shrubland of the Sydney Basin	N/A	3.38
14h Riparian Apple - Grey Gum Dune Forest	1557: Rough-barked Apple - Forest Oak - Grey Gum grassy woodland on sandstone ranges of the Sydney Basin	N/A	9.89
17c Lower Hunter Beyer's Ironbark Low Forest	1592: Spotted Gum - Red Ironbark - Grey Gum shrub - grass open forest of the Lower Hunter	Lower Hunter Spotted Gum – Ironbark Forest in the Sydney Basin and NSW North Coast Bioregions (EEC under the BC Act)	1.46
17a Lower Hunter Spotted Gum Red Ironbark Forest			0.40

- A total of 72 native flora and 37 exotic species;
- A total of five WoNs including four vine species and one woody species;
- A total of 22 Biosecurity Weeds including eight vine species, 11 woody species, two grass species & one other species;
- Majority of weed species abundance and cover occur within PCT 1726: *Flax-leaved Paperbark - Tall Sedge shrubland* followed by PCT 1557: *Rough-barked Apple - Forest Oak - Grey Gum grassy woodland*. These weed species were found to be smothering and out competing native plant species;
- Access tracks occur throughout PCT 1592: *Spotted Gum - Red Ironbark - Grey Gum shrub - grass open forest* and PCT 1557: *Rough-barked Apple - Forest Oak - Grey Gum grassy woodland* contributing to the degradation of remnant native vegetation;
- High concentrations of the roosting Grey-headed Flying Fox have resulted in a high mortality rate of the canopy species, with the remaining individuals exhibiting signs of stress and damage;
- Where the canopy is lacking or has been severely impacted by the Flying Fox, a high weed presence was observed;
- No hollow bearing trees; and
- Five *Eucalyptus parramattensis* subsp. *decadens* listed as *Vulnerable* under the State Biodiversity Conservation Act and the Federal Environment Protection and Biodiversity Conversation Acts.

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APPENDICES

Appendix A Flora List	
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GLOSSARY OF TERMS AND ABBREVIATIONS

Term/ Abbreviation	Meaning
BC Act	Biodiversity Conservation Act
Bio Act	Biosecurity Act
CCC	Cessnock City Council
DoEE	Commonwealth Department of the Environment and Energy
DPIE	Department Planning, Industry and Environment
EEC	Endangered Ecological Community
EPA Act	NSW Environmental Planning and Assessment Act 1979
EPBC Act	Commonwealth Environment Protection and Biodiversity Conservation Act 1999
ha	hectare
Native Vegetation	Native vegetation includes all the vegetation that is indigenous to Australia, covering individuals as well as communities that existed prior to European Settlement.
OEH	Former NSW Office of Environment and Heritage
Weed	Non native plant species that have moved into areas of native vegetation.

1 Introduction

MJD Environmental was engaged by Cessnock City Council to conduct a Vegetation Assessment of the East Cessnock Flying Fox Camp, Cessnock. The Flying Fox Camp is located within Lots 1A, 2A, 3A, 4A, 5A DP 4924, Lot 311 DP 566724, Lot 7002 DP 1122236, Lot 174 DP 755215 & Lot 7302 DP 1137271 Cessnock, NSW, (Refer to **Figure 1**), hereafter referred to as the 'study area'.

1.1 Aims & Objectives

The aim of the Vegetation Assessment is to inform future management actions of vegetation required within the East Cessnock Flying Fox Camp Management Plan. These actions include:

- vegetation management and resulting licenses if necessary
- weed control, and to guide future actions (if vegetation is determined to be degrading etc.)

The information will also be used to inform a revegetation and habitat augmentation program in the southern end of the study area (south of Maitland Rd).

The objectives are as follows:

- Detailed EEC determination for vegetation communities;
- Vegetation condition assessment;
- Weed mapping throughout the nominated study area (noxious and environmental);
- Vegetation condition and cover abundance of growth form and weeds (noxious and environmental) and non-natives;
- Hollow bearing tree count; and
- Habitat assessment.

1.2 Site Particulars

The following nomenclature has been used in this report (Refer to **Figure 1**):


- Study Area – Refers to Lots 1A, 2A, 3A, 4A, 5A DP 4924, Lot 311 DP 566724, Lot 7002 DP 1122236, Lot 174 DP 755215 & Lot 7302 DP 1137271

Locality	The Study Area is situated in Cessnock NSW.
Land Title	Lots 1A, 2A, 3A, 4A, 5A DP 4924, Lot 311 DP 566724, Lot 7002 DP 1122236, Lot 174 DP 755215 & Lot 7302 DP 1137271
LGA	Cessnock City Council
Area	Study Area – 16.18ha (approx.)
Zoning	The Study Area is currently predominantly zoned IN2 Light Industrial followed by RE1 Public Recreation, RU2 Rural Landscape and R2 Low Density Residential (DPE 2018). The Camp encompasses Council owned Akira Avenue Park (between Akira Ave and Anzac Ave) and the Crown Land to the south-eastern side of Maitland Road. The East Cessnock Flying-fox Camp is predominantly located on the Long St Crown Reserve (adjacent to residential developments and a school), but at times has expanded into neighbouring land managed by Cessnock City Council. Additionally, the Camp extends to the boundary with the Cessnock East Public School and animals have been recorded roosting within school grounds.
Boundaries	The Study Area is bound to the north, west and east by existing residential development. To the south, Maitland Rd, followed by unoccupied Rural Landscape.
Current Land Use	The land currently contains undeveloped vegetated lands (Tree & Shrub Cover) including wetland areas, public recreation areas (Akira Avenue Park) and unoccupied rural landscape.
Topography	The land is generally flat throughout the study area with a distinctive depression within the core of Long St Crown Reserve. The land varied between 73-79m ASL.



East Cessnock Flying Fox Camp
FIGURE 1: SITE LOCATION

Legend

 Study Area



Meters

1:8,000



Aerial: LPI WMS Imagery (accessed 14/10/2019) |
 Data: MJD Environmental, LPI (2019) |
 Datum/Projection: GDA 1994 MGA Zone 56 | Date:
 14/10/2019 | Version 1 | GIS\19068 - Vegetation
 Assessment Flying Fox Camp, East Cessnock |
 This plan should not be relied upon for critical
 design dimensions.

2 Methodology

The vegetation assessment was undertaken to confirm and describe flora and vegetation communities present within the study area. A modified Biodiversity Assessment Method (BAM) Floristic Plot was utilised to collect data to identify vegetation within the study area.

2.1 Database searches

A review of ecological information was undertaken to provide context and understanding of ecological values occurring within the study area. Information reviewed included:

- Online database searches involving a 10-km buffer around the study area were undertaken from the NSW BioNet Atlas (Accessed 14th October 2019); and
- Commonwealth Protected Matters of National Significance online search tool initially on 14th October 2019.

The searches provided a current list of potentially occurring threatened flora and fauna and migratory species under both the BC Act and EPBC Act.

2.2 Vegetation Survey

2.2.1 Plot Surveys

A modified Biodiversity Assessment Method (BAM) Floristic Plot was utilised to collect data to identify vegetation within the study area.

The following methods were used to inform the vegetation survey associated with the Vegetation Assessment:

- Broad vegetation identification, delineation and stratification into vegetation zones carried out by detailed random meander methods (Cropper 1993);
- Collection of plot/transect based full floristic data as per Section 5 of the BAM, recording the following;
 - Identification of all flora species to genus where identification attributes were present;
 - Composition, Structure, modified Function attributes within 20x20m plots;
 - modified Function attributes within 20x20m plots (Tree stem class, HTE, Litter).
- Collection of study area landscape attributes that included, landform, aspect, soil type, detailed descriptions of the vegetation condition, current land use and the impacts currently observed within the study area.

2.2.2 Rapid Data Point Survey

Rapid Data Point Surveys of 10x10m were carried out to gain a better understanding of the vegetation within the study area. This method was used to verify heterogeneity across vegetation communities. Attributes collected included species and cover abundance.

2.2.3 Opportunistic Threatened Flora Observations

No formal threatened flora survey was undertaken for threatened species. The study area was traversed by two MJD Environmental ecologists (9th October 2019) for the purposes of producing a description of native vegetation present and to assess the potential for threatened flora species to occur within the study area. Threatened flora assessment was informed by a random meander survey covering the whole study area. (Refer to **Table 3**).

A full compilation of flora species recorded during survey is provided as **Appendix 2**.

2.2.4 Vegetation Condition Assessment

The condition of the vegetation was assessed during vegetation/floristic surveys through opportunistic observation and random meandering. Vegetation condition assessment was also recorded during weed mapping density surveys.

2.3 Weed Density Mapping

A weed assessment walkover was conducted on 9th October 2019 over the entire study area by an MJD Environmental ecologist. Surveys were undertaken over the entirety of the study area to map any Weeds of National Significance (WoNs) and weeds listed under the Biosecurity Act 2015. Digital mapping was utilised within the study area using GLO™ 2 GLONASS GPS and a handheld Android tablet. Weed density polygons were further refined using aerial photographic interpretation 0.075m resolution imagery. Areas of significant weed patches were mapped and placed in density categories of

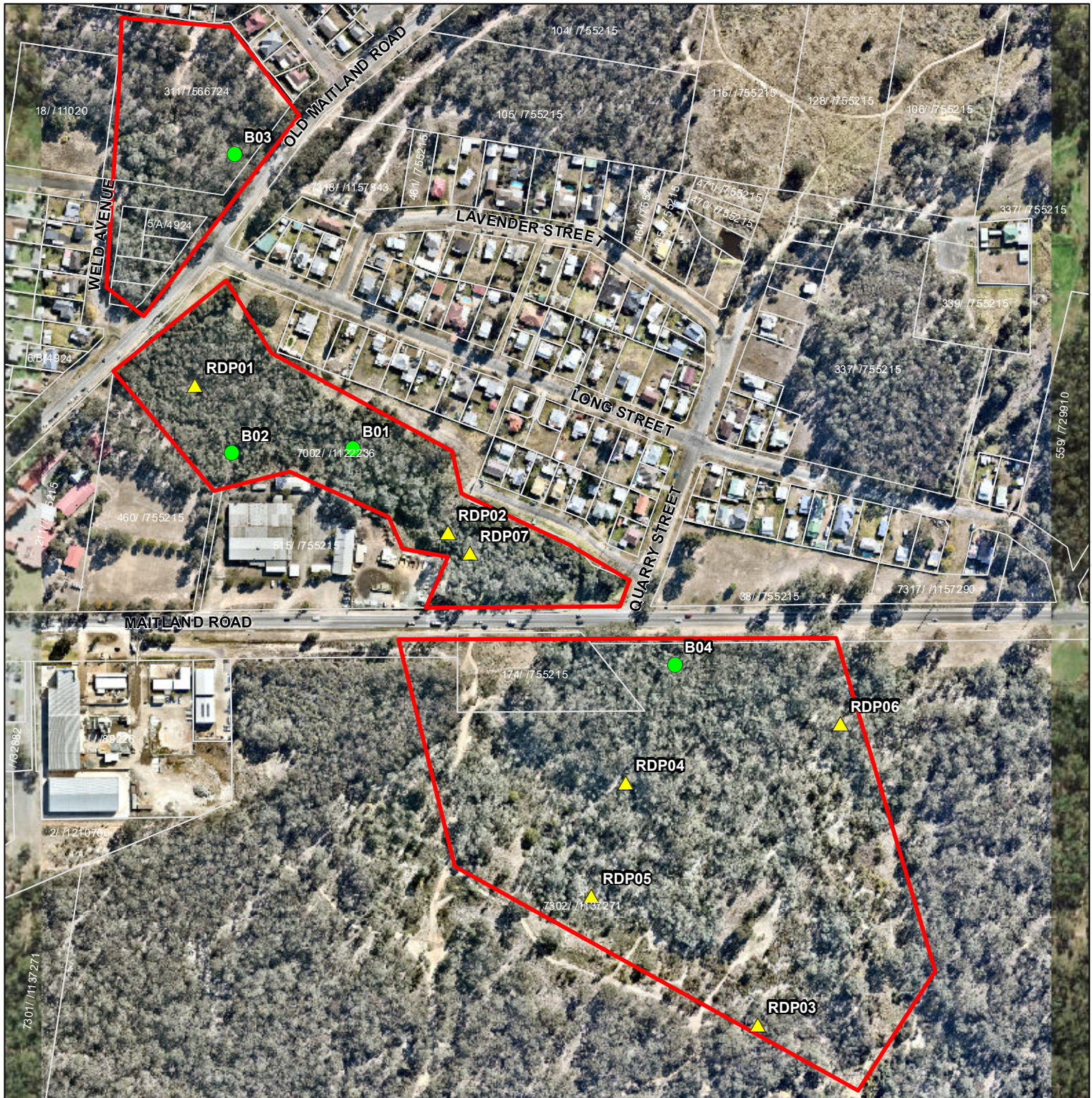
- <5%
- 5-15%
- 15-30%
- 30-50%
- 50-70%
- >70%

Weed species were also noted and further categorised into growth form of 'Vines' & 'Woody'.

2.4 Habitat Assessment

An assessment of the relative habitat value present within the study area was undertaken. This assessment focused primarily on the identification of specific habitat types and resources in the study area favoured by known threatened species from the locality. The assessment also considered the potential value of the study area (and surrounds) for all major guilds of native flora and fauna. Habitat assessment included:

- presence, size and types of tree hollows;
- presence of rocks, logs, caves, rocky outcrops, leaf litter, overhangs and crevices;
- vegetation complexity, structure and quality;
- presence of freshwater or estuarine aquatic habitats, noting permanency;
- connectivity to adjacent areas of habitat;
- extent and types of disturbance;
- presence of foraging opportunities such as flowering eucalypts, fruits, seeds or other nectar bearing native plants; and
- presence and abundance of various potential prey species.



East Cessnock Flying Fox Camp
FIGURE 2: SURVEY EFFORT

0 62.5 125 250

Meters

1:4,400



Legend

- BAM Plot
- ▲ Rapid Plot
- Study Area
- Cadastral Boundaries



Aerial: NearMap (2019) | Data: MJD Environmental, LPI (2019) | Datum/Projection: GDA 1994 MGA Zone 56 | Date: 14/10/2019 | Version 1 | GIS\19068 - Vegetation Assessment Flying Fox Camp, East Cessnock | This plan should not be relied upon for critical design dimensions.

2.5 Survey Team and Effort

Surveys were carried out over a single day by MJD Environmental staff Adam Cavallaro and Phoebe Smith.

2.6 Survey Weather Conditions

Table 1 Weather conditions

Date	Min Temp (°C)	Max Temp (°C)	Rain (mm)	Wind (km/h) 9am / 3pm	Sunrise-Sunset
9 October 2019*	5.2	20.9	0	SW 17 to SSE 24	0622-1902

<http://www.bom.gov.au/climate/dwo/201910/html/IDCJDW2027.201910.shtml>

<http://www.ga.gov.au/bin/geodesy/run/sunrisenset>

3 Results

3.1 Flora Species

In total 109 flora species were recorded within the study area during surveys undertaken by MJD Environmental. Flora species detected within the study area included 37 exotic species and 72 native species. (Refer to **Appendix 1**)

3.2 Vegetation Communities

A total of four vegetation communities have been recorded and mapped within the Study Area. Of these one is commensurate with a Threatened Ecological Community (TEC) listed under the BC Act 2016. (Refer to **Figure 3**).

The following table outlines the vegetation communities observed within the study area, survey effort and area of occupation.

Table 2 Vegetation communities

Vegetation Map Unit (Bell 2008)	Vegetation Community (REMS Unit)	TEC	Plant Community Type (PCT)	Area (ha)
108 Paperbark Depression Forest	N/A	-	1726: Flax-leaved Paperbark - Tall Sedge shrubland of the Sydney Basin	3.38
14h Riparian Apple - Grey Gum Dune Forest	14 Wollombi Redgum-River Oak Forest	-	1557: Rough-barked Apple - Forest Oak - Grey Gum grassy woodland on sandstone ranges of the Sydney Basin	9.89
17c Lower Hunter Beyer's Ironbark Low Forest	17 Lower Hunter Spotted Gum Ironbark Forest	Lower Hunter Spotted Gum – Ironbark Forest in the Sydney Basin and NSW North Coast Bioregions (EEC under the BC Act)	1592: Spotted Gum - Red Ironbark - Grey Gum shrub - grass open forest of the Lower Hunter	1.46
17a Lower Hunter Spotted Gum Red Ironbark Forest				0.40

Paperbark Depression Forest



Plate 1: Paperbark Depression Forest

Area 5.58ha

Description

The Paperbark Depression Forest is the dominant vegetation community within the lower elevations of the study area.

This vegetation community is characterised by an open to closed canopy of *Melaleuca linariifolia* (Flax-leaved Paperbark) with the occasional emergent of *Angophora floribunda* (Rough-barked Apple). The canopy varies in foliage cover as a result of the occupation of the study area by the Flying Fox. The areas in which obvious high concentrations of the Flying Fox have been roosting has resulted in a high mortality rate of the canopy species, with the remaining individuals exhibiting signs of stress and damage.

The midstorey has a very low species diversity primarily juvenile *Melaleuca linariifolia* species and the occasional *Melia azedarach* (White Cedar) where a closed canopy occurs.

The groundlayer density and species diversity is typically dependent on the level of soil moisture present or in some instances wetland like depressions supporting a high sedge and macrophyte foliage cover.

The groundlayer vegetation where a persistent canopy exists and soil moisture is low to moderate is primarily made up of *Gahnia clarkei* (Tall Saw Sedge), *Carex appressa* (Tall Sedge) with the fern cover of *Hypolepis muelleri* (Harsh Ground Fern). Very few other species were observed in these areas due to the high densities of the sedge species.

The lower depressions where water appears to permanently reside, native species observed were commonly associated with coastal floodplain wetlands. There are two main depressions within the central part of the study area where species such as *Machaerina articulata* (Jointed Twig-rush), *Carex appressa*, *Cypress gunnii*, *Persicaria decipiens* (Slender Knotweed) and *Triglochin* spp. (Arrowgrass) were observed. These areas are often bordered by *Melaleuca linariifolia*.

It is of note that where there is a lack of canopy, native ground species are generally in very low abundance with only common species (*Gahnia clarkei*) observed scattered amongst the high density of weed species.

The native vine *Parsonsia straminea* (Common Silkpod) was observed scattered throughout this area.

Where the canopy is lacking or has been severely impacted by the Flying Fox, a high weed presence was observed. The high threat woody weed species *Ligustrum sinense* (Small-leaved Privet) and *Cinnamomum camphora* (Camphor Laurel) dominate these areas with *Solanum mauritianum* (Tobacco Bush), *Ligustrum lucidum* (Large-leaved Privet) and *Cestrum parqui* (Green Cestrum) scattered throughout. In addition, *Asparagus asparagoides* (Bridal Creeper) and *Tradescantia fluminensis* (Trad) were observed in the lower ground stratum (Refer to **Figures 4-8**).

Weeds were observed in the closed canopy areas at lower densities with additional weed species observed such as *Rubus fruticosus* agg. (Blackberry) and *Lonicera japonica* (Japanese Honeysuckle).

Canopy Layer	To 12m with a 10- 60% Projected Foliage Cover (PFC). Dominant species <i>Melaleuca linariifolia</i> and <i>Angophora floribunda</i> .
Ground Cover	Up to 2m with a PFC. of 20-75%. The groundcover layer was characterised by a predominant sedge and macrophyte layer of <i>Gahnia clarkei</i> , <i>Carex appressa</i> , <i>Baumea articulata</i> , <i>Persicaria decipiens</i> and the fern <i>Hypolepis muelleri</i>

Plant Community Type Determination

PCT Name	1726 Flax-leaved Paperbark - Tall Sedge shrubland of the Sydney Basin
Vegetation Formation	KF_CH9 Forested Wetland
Vegetation Class	Coastal Swamp Forest
Species relied upon for Id of vegetation type	<i>Melaleuca linariifolia</i> , <i>Carex appressa</i> , <i>Juncus usitatus</i> , <i>Entolasia marginata</i> (Bordered Panic).
Threatened Ecological Community	N/A
%cleared of PCT	41% cleared (BioNet Vegetation Classification 2019)
Justification of assigning PCT	The PCT assignment of 1726 to the vegetation within the subject land is based on the following key attributes: <ul style="list-style-type: none"> ▪ Key diagnostic species within the canopy is present within remnant vegetation observed within the study area: the groundcover does also present some key diagnostic species.

Riparian Apple -Grey Gum Dune Forest



Plate 2: Riparian Apple- Grey Gum Dune Forest

Area 9.89ha

Description

The vegetation described as Riparian Apple -Grey Gum Dune Forest is primarily found in the southern parcel of the study area (Regrowth variant) and very narrow patch just north of Maitland Rd.

The canopy is dominated by *Angophora floribunda* with a sub-dominance of *Eucalyptus punctata* (Grey Gum). The vegetation consists of young to moderately aged cohorts of canopy trees which appears to be a result of regrowth/revegetation of formerly cleared lands. There is the very occasional mature *E. punctata* present in the southern lands.

The midstorey is generally characterised by re-establishing vegetation with dense pockets of native midstorey scattered across the study area. The vegetation south of Maitland Rd has a low diversity of mid storey species that consist of *Acacia parvipinnula* (Silver-stemmed Wattle), *Bursaria spinosa* (Blackthorn), *Melaleuca nodosa* (Prickly-leaved Paperbark), *Breynia oblongifolia* (Coffee Bush), *Acacia longifolia* subsp. *longifolia* (Sydney Golden Wattle) and a very low abundance of *Persoonia linearis* (Narrow-leaved Geebung) and *Jacksonia scoparia* (Dogwood).

There is a very small patch of this vegetation north of Maitland Rd that consist of a midstorey of *Bursaria spinosa*, *Banksia spinulosa* (Hairpin Banksia), *Breynia oblongifolia*, *Jacksonia scoparia* and *Acacia longifolia* subsp. *longifolia*.

The groundcover varies in density and species richness with most of the southern area having a rather homogenous persistent cover of *Lomandra longifolia* (Spiny-headed Mat-rush), *Gahnia aspera* (Rough Saw-sedge), *G. clarkei*, *Imperata cylindrica* (Blady Grass), *Entolasia stricta* (Wiry Panic) and *Dianella revoluta* subsp. *revoluta* (Blueberry Lily).

The groundcover in the central area consists of *Gahnia clarkei*, *Pteridium esculentum* (Common Bracken), *Imperata cylindrica* and *Lobelia purpurascens* (Whiteroot).

There are a number of exotic species spread throughout this community, including; *Lantana camara* (Lantana), *Ligustrum sinense*, *L. lucidum*, *Olea europaea* subsp. *cuspidata* (African Olive), *Cinnamomum camphora*, *Lonicera japonica*, *Chloris gayana* (Rhodes Grass) and *Rubus fruticosus* agg. (Refer to **Figures 4-8**).

Canopy Layer	To 15m with a 25- 40% Projected Foliage Cover (PFC). Dominant species <i>Angophora floribunda</i> with a sub-dominance of <i>Eucalyptus punctata</i> .
Midstorey Layer	To 5m with a 10- 30% Projected Foliage Cover (PFC). Dominant species <i>Acacia parvipinnula</i> , <i>Bursaria spinosa</i> , <i>Melaleuca nodosa</i> , <i>Breynia oblongifolia</i> , <i>Acacia longifolia</i> subsp. <i>longifolia</i>
Ground Cover	Up to 1.5m with a PFC. of 20-75%. The groundcover layer was characterised by a predominant sedge and macrophyte layer of <i>Lomandra longifolia</i> , <i>Gahnia aspera</i> , <i>G. clarkei</i> , <i>Imperata cylindrica</i> , <i>Entolasia stricta</i> and <i>Dianella revoluta</i> subsp. <i>revoluta</i>

Plant Community Type Determination

PCT Name	1557: Rough-barked Apple - Forest Oak - Grey Gum grassy woodland on sandstone ranges of the Sydney Basin
Vegetation Formation	KF_CH2A Wet Sclerophyll Forests (grass sub-formation)
Vegetation Class	Northern Hinterland Wet Sclerophyll Forest
Species relied upon for Id of vegetation type	<i>Angophora floribunda</i> , <i>Eucalyptus punctata</i> , <i>Bursaria spinosa</i> , <i>Personia linearis</i> , <i>Breynia oblongifolia</i> <i>Themeda triandra</i> , <i>Microlaena stipoides</i> and <i>Pteridium esculentum</i>
Threatened Ecological Community	N/A
%cleared of PCT	35% cleared (BioNet Vegetation Classification 2019)
Justification of assigning PCT	<p>The PCT assignment of 1557 to the vegetation within the subject land is based on the follow key attributes:</p> <ul style="list-style-type: none"> ▪ Key diagnostic species within the canopy are present within remnant vegetation observed within the study area. The midstorey is often lacking but where it still persists key species are present: the groundcover does also present with all key diagnostic species. ▪ The study area is located predominantly within the Beresfield soil landscape with northern sections located with the Shamrock Hill soil landscape. Both of these landscapes have an association with the lithology noted in the PCT description.

Lower Hunter Beyer's Ironbark Low Forest



Plate 3: Lower Hunter Beyer's Ironbark Low Forest

Area 1.46ha

Description

The vegetation observed in the northern section of the study area is characterised by a relatively low-density canopy cover of *Eucalyptus beyeriana* (Beyer's Ironbark) and *E. punctata*. Other less frequently observed species include *Eucalyptus moluccana* (Grey Box). The canopy is predominantly a young to moderately aged cohort with a juvenile cohort re-establishing in the area. It is evident that this area has been cleared in the past.

The mid-storey varies from very dense regrowth to a sparse cover. Midstorey species observed in this vegetation include *Acacia elongata* (Swamp Wattle), *A. falcata* (Hickory Wattle), *Melaleuca nodosa*, *Bursaria spinosa* and *Callistemon pinifolius* (Pine-leaved Bottlebrush). There is also a sub-shrub layer of *Grevillea montana*, *Pimelea linifolia* (Slender Rice-flower), *Daviesia ulicifolia* (Gorse Bitter Pea) and *Melaleuca thymifolia* (Thyme Honey-myrtle).

Where the mid-storey and sub-shrub layer is less prevalent it has provided opportunity for a predominantly grassy understorey to established. Species observed include; *Themeda triandra* (Kangaroo Grass), *Aristida warburgii* *A. ramosa* (Purple Wiregrass), *Dianella longifolia* (Blue Flax-Lily), *Lomandra confertifolia* (Mat-rush) and *L. multiflora* (Many-flowered Mat-rush).

There are only a very small number and density of exotic species spread throughout that include *Lantana camara*, *Ipomoea indica* (Purple Morning Glory) and *Asparagus asparagoides* (Refer to **Figures 4-8**).

Canopy Layer To 12m with a 15- 25% Projected Foliage Cover (PFC). Dominant species *Eucalyptus beyeriana* and *Eucalyptus punctata*.

Midstorey Layer	To 5m with a 10- 30% Projected Foliage Cover (PFC). Dominant species <i>Acacia parvipinnula</i> , <i>A. falcata</i> , <i>Melaleuca nodosa</i> , <i>Breynia oblongifolia</i> and <i>Daviesia ulicifolia</i>
Ground Cover	Up to <1m with a PFC. of 20-75%. The groundcover layer was characterised by a predominant sedge and macrophyte layer of <i>Grevillea montana</i> , <i>Themeda triandra</i> , <i>Imperata cylindrica</i> , <i>Entolasia stricta</i> and <i>Lomandra confertifolia</i>

Plant Community Type Determination

PCT Name 1592: Spotted Gum - Red Ironbark - Grey Gum shrub - grass open forest of the Lower Hunter

Vegetation Formation KF_CH5A Dry Sclerophyll Forests (Shrub/grass sub-formation)

Vegetation Class Hunter-Macleay Dry Sclerophyll Forest

Species relied upon for Id of vegetation type *Eucalyptus beyeriana*, *Eucalyptus punctata*, *Daviesia ulicifolia*, *Bursaria spinosa*, *Themeda triandra*, *Microlaena stipoides*, *Joycea pallida*, *Lomandra multiflora*, *Lobelia purpurascens* and *Glycine clandestina*.

Threatened Ecological Community PCT 1592 is commensurate with *Lower Hunter Spotted Gum Ironbark Forest in the Sydney Basin Bioregion* which is listed as an Endangered Ecological Community under the *Biodiversity Conservation Act 2016*

%cleared of PCT 44% cleared (BioNet Vegetation Classification 2019)

Justification of assigning PCT The PCT assignment of 1592 regarding vegetation within the study area is based on the follow key attributes:

- Key diagnostic species within the canopy are present within remnant vegetation observed within the study area. The midstorey is often lacking but where it still persists key species are present: the groundcover does also present with all key diagnostic species.
- The study area is located predominantly within the Beresfield soil landscape with northern sections located with the Shamrock Hill soil landscape. Both of these landscapes have an association with the lithology noted in the PCT description.
- The study area is within the Lower Hunter and is located within flats in the landscape.

Lower Hunter Spotted Gum Red Ironbark Forest



Plate 4: Lower Hunter Spotted Gum Red Ironbark Forest

Area 0.4ha

Description

The vegetation observed as narrow bands along the edge of the Paperbark Depression Forest is characterised by a relatively moderate density canopy cover of *Eucalyptus fibrosa* (Red Ironbark), *E. punctata* with the occasional occurrence of the threatened species *E. parramattensis* subsp. *decadens* (Parramatta Red Gum) (western edge). The canopy is predominantly a young to moderately aged cohort with a juvenile cohort re-establishing in the area. The areas appear to be a transition zone between lower damp areas and the increasing elevations observed on each side of the study area.

The mid-storey is generally dense with a persistent cover of *Melaleuca decora* and *M. nodosa* regrowth. There are a small number of other mid storey species present in these areas that include *Acacia parvipinnula*, *Breynia oblongifolia*, *Bursaria spinosa* and *Denhamia silvestris* (Narrow-leaved Orangebark)

The ground layer is rather sparse where the mid-storey and sub-shrub layer is less prevalent it has provided opportunity for a more grassy understorey to establish. Species observed include; *Themeda triandra*, *Aristida warburgii*, *A. ramosa*, *Dianella longifolia*, *Lomandra confertifolia* and *L. multiflora*.

There are only a very small number of exotic species spread throughout this area including; *Lantana camara* (Lantana) and *Asparagus Asparagoides* (Bridal Creeper) (Refer to **Figures 4-8**).

Canopy Layer To 15m with a 20- 30% Projected Foliage Cover (PFC). Dominant species *Eucalyptus fibrosa* with a sub-dominance of *Eucalyptus punctata*.

Midstorey Layer To 5m with a 10- 30% Projected Foliage Cover (PFC). Dominant species *Acacia parvipinnula*, *Melaleuca decora*, *Melaleuca nodosa*, *Breynia oblongifolia*,

Ground Cover Up to <1m with a PFC. of 5-10%. The groundcover layer was characterised by a predominant of grasses and sedges *Themeda triandra*, *Aristida warburgii* A. *ramosa*, *Dianella longifolia*, *Lomandra confertifolia* and *L. multiflora*.

Plant Community Type Determination

PCT Name 1592: Spotted Gum - Red Ironbark - Grey Gum shrub - grass open forest of the Lower Hunter

Vegetation Formation KF_CH5A Dry Sclerophyll Forests (Shrub/grass sub-formation)

Vegetation Class Hunter-Macleay Dry Sclerophyll Forest

Species relied upon for Id of vegetation type *Eucalyptus fibrosa*, *Eucalyptus punctata*, *Daviesia ulicifolia*, *Bursaria spinosa*, *Themeda triandra*, *Microlaena stipoides* and *Aristida vagans*

Threatened Ecological Community PCT 1592 is commensurate with *Lower Hunter Spotted Gum Ironbark Forest in the Sydney Basin Bioregion* which is listed as an Endangered Ecological Community under the *Biodiversity Conservation Act 2016*

%cleared of PCT 44% cleared (Bionet 2018)

Justification of assigning PCT The PCT assignment of 1592 to the vegetation within the subject land is based on the follow key attributes:

- Key diagnostic species within the canopy are present within remnant vegetation observed within the study area. The midstorey is often lacking but where it still persists key species are present: the groundcover does also present with all key diagnostic species.
- The study area is located predominantly within the Beresfield soil landscape with northern sections located with the Shamrock Hill soil landscape. Both of these landscapes have an association with the lithology noted in the PCT description.
- The study area is within the Lower Hunter and is located within flats in the landscape.

3.2.1 Significant Vegetation Communities

The following section outlines the justification for the determination that vegetation communities within the study area that are commensurate with Threatened Ecological Communities listed under the Biodiversity Conservation Act against the scientific determination, listing advice and identification guidelines

Lower Hunter Spotted Gum Ironbark Forest in the Sydney Basin and NSW North Coast Bioregions

Is the site in the central or lower Hunter Valley?

Yes, the study area is located within Cessnock LGA situated within the lower Hunter Valley.

Is the vegetation open forest or woodland or consist of a dense thicket of saplings?

Yes, the vegetation is considered a young open forest/woodland with a grassy understorey. The mid-storey varies from very dense regrowth thickets of species including *Melaleuca nodosa*, *M. decora* and *Acacia* spp. to a sparse cover. Where the mid-storey and sub-shrub layer is less prevalent it has provided opportunity for a predominantly grassy understorey to establish.

Does the tree layer contain Spotted Gum or Broad-leaved Ironbark?

Yes, *Eucalyptus fibrosa* (Red Ironbark) is a dominant species in one area of this mapped community. Although, the area mapped as *Lower Hunter Beyer's Ironbark Low Forest* does not comprise Spotted Gum or Broad-leaved Ironbark, instead this area has a dominance of *Eucalyptus beyeriana* and *Eucalyptus punctata*. However, the vegetation community shares affinities with LHSGIF including location and species composition.

3.3 Significant Flora Results

A single threatened flora species was observed within the study area during vegetation surveys - the BC and EPBC Act listed Vulnerable *Eucalyptus parramattensis* subsp. *decadens*. A total of five individuals were recorded (Refer to **Figure 3**).

3.4 Current Vegetation Conditions

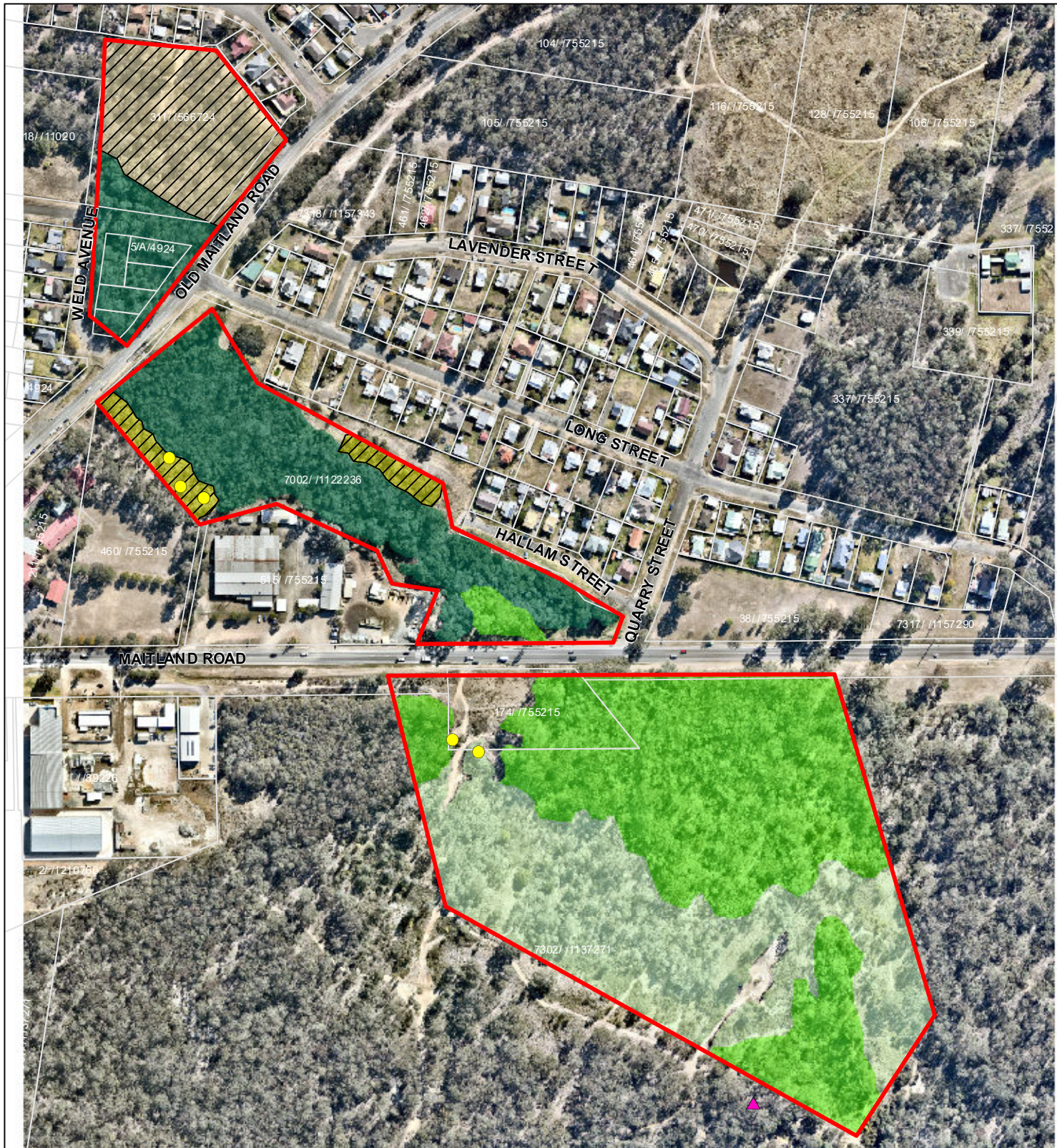
The current condition of the study area is well-vegetated land parcels with moderate levels of disturbance primarily due to its location within an urban area. The study area is approximately 16.18ha in size comprising four separate vegetation communities that have undergone historic disturbance including weed invasion, land clearing and human disturbance (e.g. tracks, rubbish dumping and edge effects from nearby urban and industrial development). The study area is primarily disturbed land with a young to semi mature native canopy cover and disturbed understorey. Scattered weed infestations occur throughout the study area, particularly within PCT 1726: *Flax-leaved Paperbark – Tall Sedge shrubland*, and the northern portion of PCT 1557: *Rough-barked Apple-Forest Oak – Grey Gum grassy woodland on sandstone ridges* (Refer to **Figure 3**), found to be smothering and out competing native plant species (Refer to **Figures 4-8**). Pedestrian and vehicle access tracks occur throughout PCT 1592: *Spotted Gum – Red Ironbark – Grey Gum shrub – grass open forest (E. beyeriana variant)* and PCT 1557: *Rough-barked Apple-Forest Oak – Grey Gum grassy woodland on sandstone ridges* contributing to the degradation of remnant native vegetation. Additionally, as discussed previously in **Section 3.2**, foliage cover is absent in areas of high roosting concentrations of the Flying Fox resulting in a high mortality rate of the canopy species. Where the canopy is lacking or has been severely impacted by the Flying Fox, a high weed presence was observed.

3.5 Connectivity & Habitat Assessment

The study area is located within a fragmented landscape at the urban interface, where connectivity is limited due to roads, residential housing, industrial areas and cleared residential lots. The wider

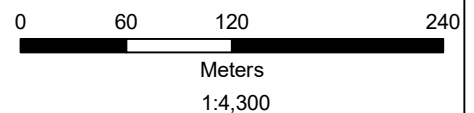
landscape is moderately vegetated and eventually connects to Werakata National Park through a mosaic of roads and cleared lands.

The canopy comprises *Eucalyptus*, *Angophora* and *Melaleuca* species which provide habitat attributes such as foraging resources for arboreal mammals, *Chiropteran* species (including *Megachiropteran* and *Microchiropteran* species), and bird species that use the area while moving through the broader landscape that rely on nectar, seed and other vegetative food sources within the community. It should be noted a family of *Pomatostomus temporalis temporalis* (Grey-crowned Babblers) listed as *Vulnerable* under the BC Act were observed adjacent to the study area's southern boundary (Refer to **Figure 3**). The *Myrtaceae* species observed within the study area had at least three age cohorts, however no hollows or nests were detected during the ecological surveys. The central portion of the study area, particularly within PCT 1726: *Flax-leaved Paperbark – Tall Sedge shrubland* comprises dense patches of midstorey vegetation and sections of dense groundcover providing good foraging potential and shelter for small ground dwelling fauna. PCT 1726: *Flax-leaved Paperbark – Tall Sedge shrubland* also withholds permanent freshwater providing potential habitat for amphibians and aquatic dependent fauna (Refer to **Figure 3**).



East Cessnock Flying Fox Camp

FIGURE 3: PLANT COMMUNITY TYPES, THREATENED ECOLOGICAL COMMUNITIES, AND THREATENED SPECIES



Legend

- Eucalyptus parramattensis subsp. decadens
- ▲ Grey Crowned Babbler
- Study Area
- Cadastral Boundaries
- Lower Hunter Spotted Gum - Ironbark Forest (Endangered)
- 1557: Rough-barked Apple - Forest Oak - Grey Gum grassy woodland on sandstone ranges
- 1592: Spotted Gum - Red Ironbark - Grey Gum shrub - grass open forest
- 1592: Spotted Gum - Red Ironbark - Grey Gum shrub - grass open forest (*E. beyeriana* variant)
- 1726: Flax-leaved Paperbark - Tall Sedge shrubland
- 1557: Rough-barked Apple - Forest Oak - Grey Gum grassy woodland on sandstone ranges (Revegetation)



MJD Environmental

Aerial: NearMap (2019) | Data: MJD Environmental, LPI (2019) | Datum/Projection: GDA 1994 MGA Zone 56 | Date: 15/11/2019 | Version 2 | GIS\19068 - Vegetation Assessment Flying Fox Camp, East Cessnock | This plan should not be relied upon for critical design dimensions.

3.6 Weed Mapping Results

3.6.1 Weed Species Present

Weed Species

Based on the site inspection, the following weed species were observed within the study area:

Table 3 Weed species present

Vines	Woody	Other
<ul style="list-style-type: none"> ▪ <i>Anredera cordifolia</i> Madeira Vine 	<ul style="list-style-type: none"> ▪ <i>Ageratina adenophora</i> Crofton Weed 	<ul style="list-style-type: none"> ▪ <i>Bryophyllum</i> spp. Mother of Millions
<ul style="list-style-type: none"> ▪ <i>Araujia sericifera</i> Moth Vine 	<ul style="list-style-type: none"> ▪ <i>Cestrum parqui</i> Green Cestrum 	<ul style="list-style-type: none"> ▪ <i>Chloris gayana</i> Rhodes Grass
<ul style="list-style-type: none"> ▪ <i>Asparagus asparagoides</i> Bridal Creeper 	<ul style="list-style-type: none"> ▪ <i>Cinnamomum camphora</i> Camphor Laurel 	<ul style="list-style-type: none"> ▪ <i>Cortaderia</i> species Pampas Grass
<ul style="list-style-type: none"> ▪ <i>Asparagus plumosus</i> Climbing Asparagus Fern 	<ul style="list-style-type: none"> ▪ <i>Lantana camara</i> Lantana 	<ul style="list-style-type: none"> ▪ <i>Eragrostis curvula</i> African Lovegrass
<ul style="list-style-type: none"> ▪ <i>Ipomoea indica</i> Morning Glory (Purple) 	<ul style="list-style-type: none"> ▪ <i>Ligustrum lucidum</i> Large-leaved Privet 	<ul style="list-style-type: none"> ▪ <i>Sida rhombifolia</i> Paddy's Lucerne
<ul style="list-style-type: none"> ▪ <i>Lonicera japonica</i> Japanese Honeysuckle 	<ul style="list-style-type: none"> ▪ <i>Ligustrum sinense</i> Small-leaved Privet 	<ul style="list-style-type: none"> ▪ <i>Verbena bonariensis</i> Purple Top
<ul style="list-style-type: none"> ▪ <i>Rubus fruticosus aggregate</i> Blackberry 	<ul style="list-style-type: none"> ▪ <i>Ochna serrulata</i> Ochna 	<ul style="list-style-type: none"> ▪ <i>Verbena rigida</i> Veined Verbena
<ul style="list-style-type: none"> ▪ <i>Tradescantia fluminensis</i> (Wandering Jew) 	<ul style="list-style-type: none"> ▪ <i>Olea europaea subsp. cuspidata</i> African Olive 	
	<ul style="list-style-type: none"> ▪ <i>Senna pendula var. glabrata</i> Cassia 	
	<ul style="list-style-type: none"> ▪ <i>Solanum mauritianum</i> Tobacco Bush 	
	<ul style="list-style-type: none"> ▪ <i>Tecoma stans</i> Yellow Bells 	

Weeds of National Significance

Weeds of National Significance (WoNS) are the highest priority species targeted for sustained nationally coordinated action under the Australian Weeds Strategy. This strategy provides for national management to eradicate WoNS species from parts of the country where Australia's productive capacity & natural ecosystems are affected.

Each WoNS has a strategic plan that outlines strategies and an action required to control the weed and identifies those responsible for each action. Individual landowners and managers are ultimately responsible for managing WoNS species. State and territory governments are responsible for overall legislation and administration.

Of the weed species occurring within the study area (Refer to **Table 3**), the following are listed as WoNS:

- *Anredera cordifolia* (Madeira Vine)
- *Asparagus asparagoides* (Bridal Creeper)
- *Asparagus plumosus* (Climbing Asparagus Fern)
- *Lantana camara* (Lantana)
- *Rubus fruticosus aggregate* (Blackberry)

(Commonwealth of Australia 2018)

Biosecurity Act -Weeds

The NSW Biosecurity Act 2015 replaces the repealed Noxious Weeds Act as of July 2017. The new Act establishes a General Biosecurity Duty as well as several key management tools to allow for effective, risk-based management of biosecurity matters (Refer to **Table 4**).

Applicable to all species determined either State level priority weeds (by NSW DPI) or Regional listed priority weeds (by Hunter Local Land Services), the General Biosecurity Duty requires that “any person [landholder] who deals with a biosecurity matter and has a biosecurity duty to ensure that, so far as is reasonably practicable, the biosecurity risk is prevented, eliminated or minimised.” Commensurate with this requirement, the Hunter Regional Strategic Weed Management Plan categorises specific management objectives to demonstrate compliance in relation to priority weeds occurring in the Hunter Local Land Services Region.

Table 4 Regulatory tools of the Biosecurity Act

Regulatory Tool	Description
General Biosecurity Duty	All plants are regulated with a general biosecurity duty to prevent, eliminate or minimise any biosecurity risk they may pose. Any person who deals with any plant, who knows (or ought to know) of any biosecurity risk, has a duty to ensure the risk is prevented, eliminated or minimised, so far as is reasonably practicable.
Prohibited Matter	Biosecurity matter listed in Schedule 2, Part 1 of the <i>NSW Biosecurity Act 2015</i> , for the purpose of preventing entry of that matter into NSW or a part of NSW. Prohibited matter relevant to the region is listed in Appendix A1.1 of this plan. Prohibited matter includes weeds nationally targeted for eradication and presently not in NSW.
Control Order	Establishes one or more control zones and related measures to prevent, eliminate, minimise or manage a biosecurity risk or impact. Control orders are for managing weeds under approved eradication programs and last for five years (or can be renewed for longer-term eradication programs). Weed Control Order 2017 (Part 6, Division 1), under the <i>NSW Biosecurity Act 2015</i> , will include weeds that are subject to a Control Order for the purpose of eradication. Further Control Orders will be proposed, as needed, to address subsequent eradication campaigns.
Biosecurity Zone	Aims at containment of a species and provides for ongoing strategic management in a defined area of the state. A Biosecurity Zone specifies the measures that must be taken in the defined area to manage the weed. Species may also be subject to strategic responses tailored by the region, either within the zone or outside it.
Mandatory Measures Regulation	Requires parties to take specific actions with respect to weeds or carriers of weeds. Mandatory Measures are defined in the regulations and include prohibition on certain dealings - including Weeds of National Significance (WoNS) (Division 8 Clause 33), Parthenium weed carriers - machinery and equipment (Division 8, Clause 35), and duty to notify of importation of plants into the state (Division 8, Clause 34).
Regional Recommended Measures	Aims to provide regional specific measures for each Local Land Services Region.
Prohibited Dealings	Must not be imported into the State or Sold.

High Threat Exotics

The Biodiversity Assessment Method (BAM) is established under the NSW Biodiversity Conservation Act 2016 which assesses ‘high threat weeds’ or ‘high threat exotic plant cover’ as plant cover composed of vascular plants not native to Australia that if not controlled will invade and out compete native plant species plant cover composed.

Exotic Species Observed

Site inspection/assessment recorded a total of 26 weed species listed under the NSW Biosecurity Act 2015 presented in **Table 5** below.

Table 5 Weed species legislative status

Species	Common Name	Area	Biosecurity Act 2015	WoNs	HTE
<i>Ageratina adenophora</i>	Crofton Weed	All of NSW	General Biosecurity Duty		Yes
<i>Anredera cordifolia</i>	Madeira Vine	All of NSW	General Biosecurity Duty, Prohibition on dealings	Yes	Yes
<i>Araujia sericifera</i>	Moth vine	All of NSW	General Biosecurity Duty		Yes
<i>Asparagus asparagoides</i>	Bridal Creeper	All of NSW	General Biosecurity Duty, Prohibition on dealings	Yes	Yes
<i>Asparagus plumosus</i>	Climbing Asparagus Fern	All of NSW	General Biosecurity Duty, Prohibition on dealings	Yes	Yes
<i>Bryophyllum</i> spp.	Mother of Millions	All of NSW & Hunter	General Biosecurity Duty, Regional Recommended Measure*		Yes
<i>Cinnamomum camphora</i>	Camphor Laurel	All of NSW	General Biosecurity Duty		Yes
<i>Cestrum parqui</i>	Green Cestrum	All of NSW & Hunter	General Biosecurity Duty, Regional Recommended Measure**		Yes
<i>Chloris gayana</i>	Rhodes Grass	-	-		Yes
<i>Cortaderia</i> spp.	Pampas Grass	All of NSW & Hunter	General Biosecurity Duty, Regional Recommended Measure****		Yes
<i>Eragrostis curvula</i>	African Lovegrass	All of NSW	General Biosecurity Duty		Yes
<i>Ipomoea indica</i>	Morning Glory (Purple)	All of NSW	General Biosecurity Duty		Yes
<i>Lantana camara</i>	Lantana	All of NSW & Hunter	General Biosecurity Duty, Prohibition on dealings	Yes	Yes
<i>Ligustrum lucidum</i>	Large-leaved Privet	All of NSW	General Biosecurity Duty		Yes
<i>Ligustrum sinense</i>	Small-leaved Privet	All of NSW	General Biosecurity Duty		Yes
<i>Lonicera japonica</i>	Japanese Honeysuckle	All of NSW	General Biosecurity Duty		Yes
<i>Ochna serrulata</i>	Ochna	All of NSW	General Biosecurity Duty		Yes
<i>Olea europaea</i> subsp. <i>cuspidata</i>	African Olive	All of NSW	General Biosecurity Duty, Regional Recommended Measure***		Yes
<i>Rubus fruticosus</i> spp. aggregate.	Blackberry	All of NSW & Hunter	General Biosecurity Duty, Prohibition on dealings & Regional Recommended Measure**	Yes	Yes

<i>Senna pendula</i> var. <i>glabrata</i>	Cassia	All of NSW	General Biosecurity Duty		Yes
<i>Sida rhombifolia</i>	Paddy's Lucerne	-	-		
<i>Solanum mauritianum</i>	Tobacco Bush	All of NSW	General Biosecurity Duty		
<i>Tecoma stans</i>	Yellow Bells	All of NSW	General Biosecurity Duty		Yes
<i>Tradescantia fluminensis</i>	Wandering Jew	All of NSW	General Biosecurity Duty		Yes
<i>Verbena bonariensis</i>	Purple Top	-	-		
<i>Verbena rigida</i>	Veined Verbena	-	-		

*Land managers should mitigate the risk of new weeds being introduced to their land. Land managers should mitigate spread from their land. The plant should not be bought, sold, grown, carried or released into the environment. Land managers reduce impacts from the plant on priority assets.

**Land managers should mitigate the risk of new weeds being introduced to their land. Land managers should mitigate spread from their land. The plant should not be bought, sold, grown, carried or released into the environment. Land managers reduce impacts from the plant on priority assets.

***Land managers mitigate the risk of the plant being introduced to their land. Land managers reduce impacts from the plant on priority assets. Land managers prevent spread from their land where feasible. The plant or parts of the plant are not traded, carried, grown or released into the environment.

****Whole region: The plant should not be bought, sold, grown, carried or released into the environment. Core infestation area: Land managers should mitigate spread from their land. Land managers to reduce impacts from the plant on priority assets.

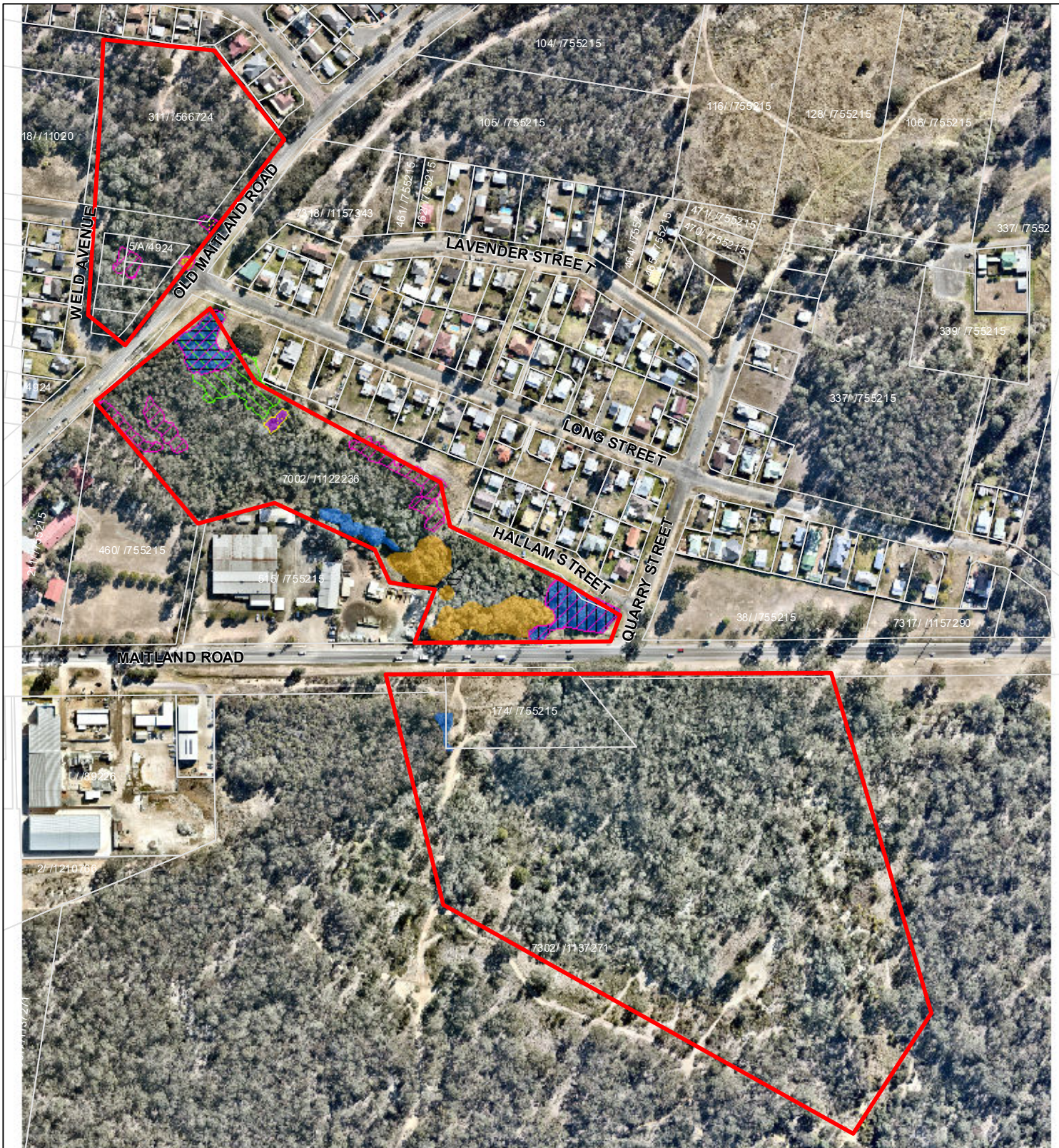
3.6.2 Significant Weed Locations

Overall, high density weed patches occur within PCT 1726: *Flax-leaved Paperbark – Tall Sedge shrubland* (Refer to **Figure 6**). This is likely a result of the impacts the Grey-headed Flying-Fox are having on the canopy of the vegetation coupled with the favourable conditions of moisture and fertility within the soil.

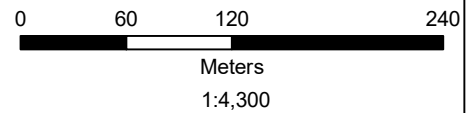
Vines – The majority of the exotic vine species occur as moderately dense patches throughout PCT 1726: *Flax-leaved Paperbark – Tall Sedge shrubland* and along the edges of this vegetation community (Refer to **Figures 4 & 7**). The most common exotic vine species occurring within the study area is *Asparagus asparagoides* (Bridal Creeper), occurring as high dense patches around the edges of PCT 1726: *Flax-leaved Paperbark – Tall Sedge shrubland* and along the APZ and access tracks. A large patch of *Rubus fruticosus* agg. (Blackberry) occurs within an old easement within this vegetation community. High dense patches of *Lonicera japonica* (Japanese Honeysuckle) occur within the northern corner of the community as well as sporadic patches spread throughout this vegetation community. *Araujia sericifera* (Moth Vine) occurs as scattered patches throughout this vegetation community, while *Anredera cordifolia* (Madeira Vine) was found in one small patch within the central portion of this community.

Woody – The majority of woody weed species occur as very dense patches throughout PCT 1726: *Flax-leaved Paperbark – Tall Sedge shrubland* and 1557: *Rough-barked Apple-Forest Oak – Grey Gum grassy woodland on sandstone ridges*, commonly occurring along the riparian areas (Refer **Figures 5 & 8**). The most common species occurring includes *Ligustrum sinense* (Small-leaved Privet) followed by *Cinnamomum camphora* (Camphor laurel). Notably, a moderately dense patch of *Olea europaea* subsp. *cuspidata*, *Ligustrum sinense* and *Cinnamomum camphora* exist within the northern edge of the Riparian Apple- Grey Gum Dune Forest. *Cestrum parqui* (Green Cestrum) is also scattered at quite high densities throughout the Paperbark Depression Forest.

Grass – The high threat exotic *Chloris gayana* (Rhodes Grass) was prevalent throughout the 1557: *Rough-barked Apple-Forest Oak – Grey Gum grassy woodland on sandstone ridges*, however since it is not listed under the Biosecurity Act, this species was not mapped.



East Cessnock Flying Fox Camp
FIGURE 4: VINE WEEDS

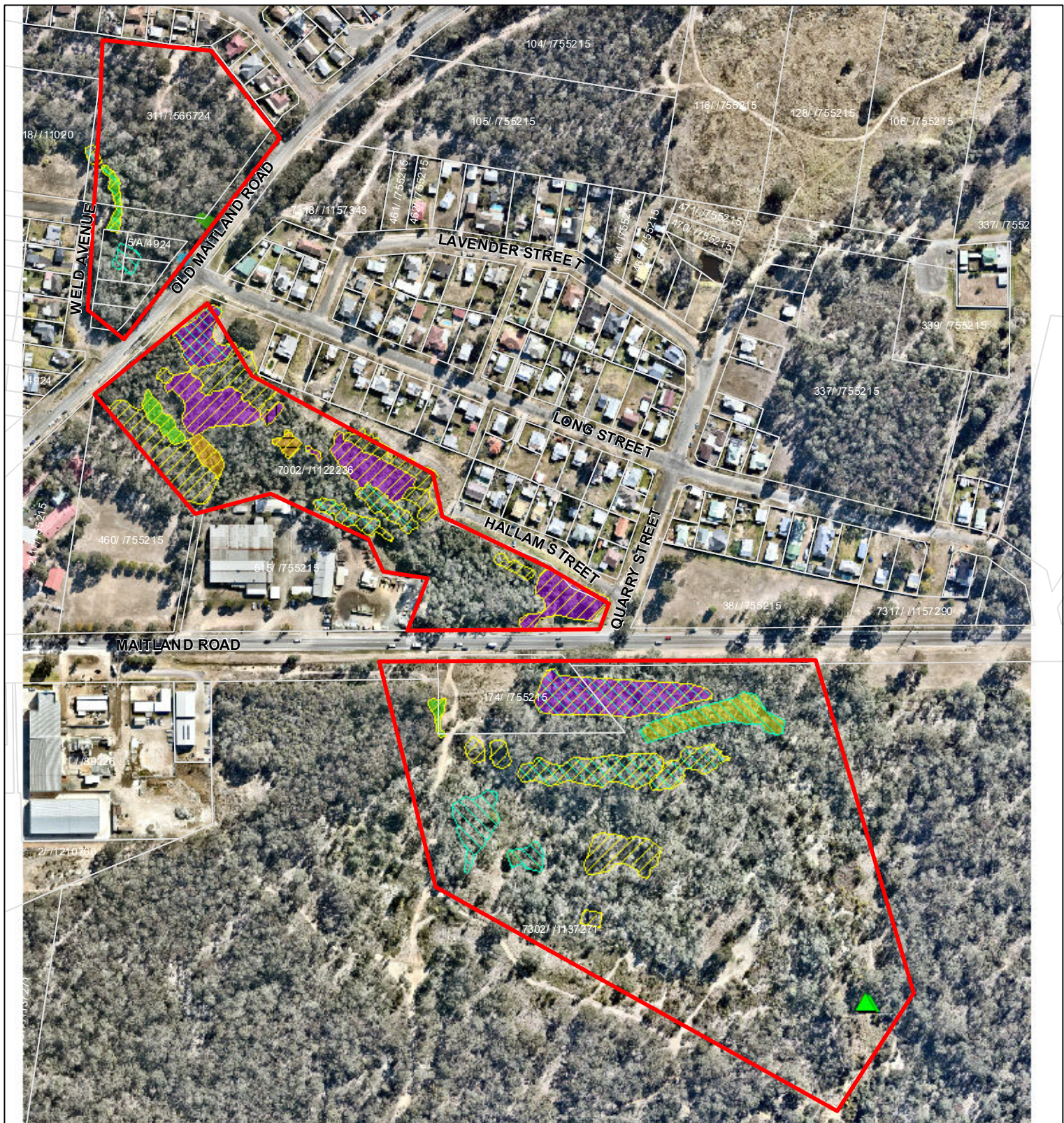


Legend

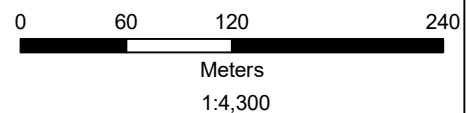
- Study Area
- Cadastral Boundaries
- Lonicera japonica* (Japanese Honeysuckle)
- Asparagus plumosus* (Climbing Asparagus Fern)
- Ipomea indica* (Morning Glory, Purple)
- Tradescantia flumensis* (Wandering Dew)
- Asparagus asparagoides* (Bridal Creeper)
- Anredera cordifolia* (Maderia Vine)
- Araujia sericifera* (Moth Vine)
- Rubus fruticosus* agg. (Blackberry)















Aerial: NearMap (2019) | Data: MJD Environmental, LPI (2019) | Datum/Projection: GDA 1994 MGA Zone 56 | Date: 15/11/2019 | Version 2 | GIS\19068 - Vegetation Assessment Flying Fox Camp, East Cessnock | This plan should not be relied upon for critical design dimensions.



East Cessnock Flying Fox Camp
FIGURE 5: WOODY WEEDS

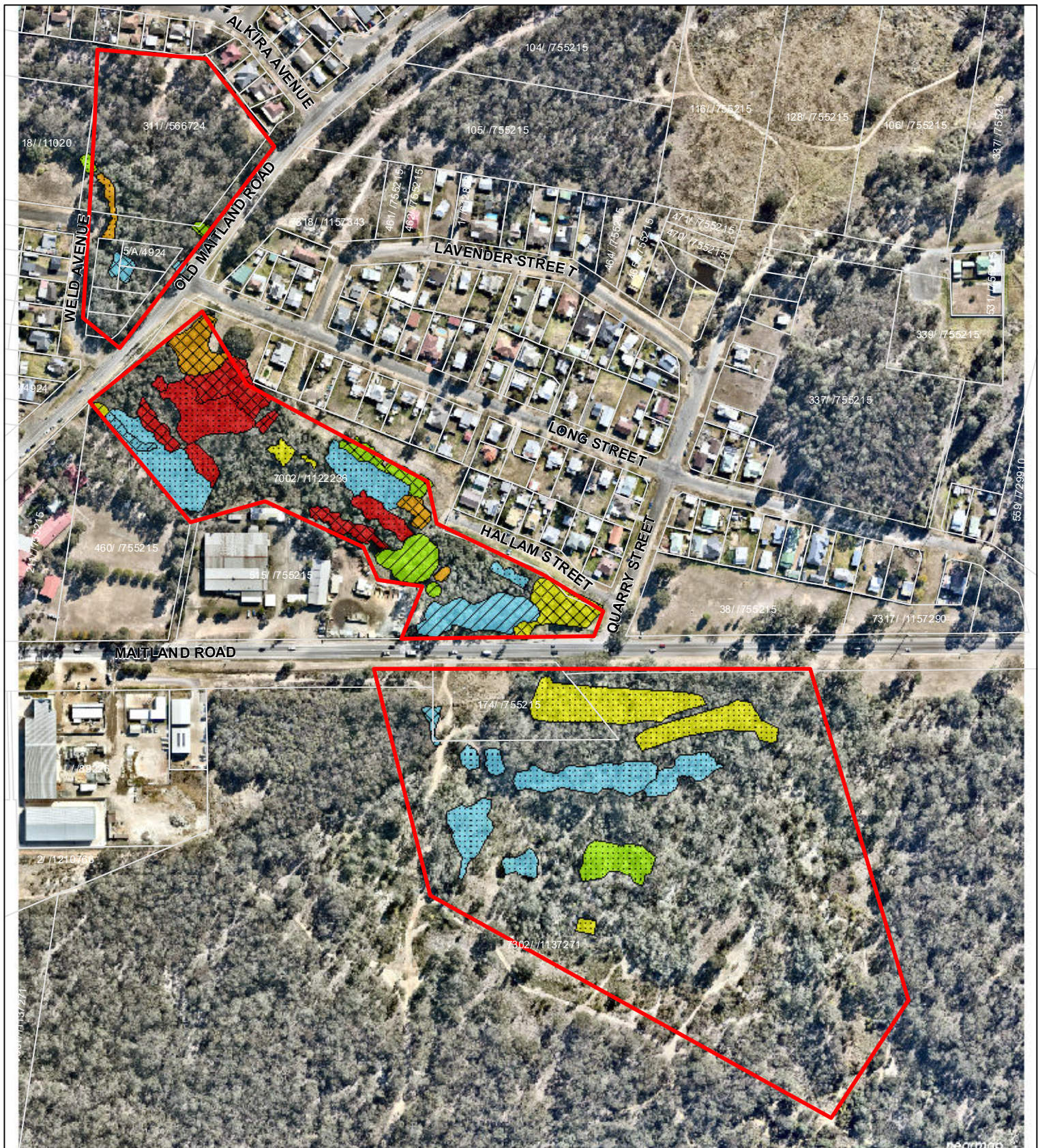


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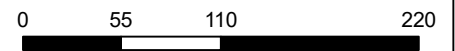
-  *Cortaderia spp.* (Pampas Grass)
-  Study Area
-  Cadastral Boundaries
-  *Cinnamomum camphora* (Camphora Laurel)
-  *Ligustrum lucidum* (Large-Leaved Privet)
-  *Solanum mauritianum* (Tobacco Bush)
-  *Ligustrum sinense* (Small-Leaved Privet)
-  *Cestrum parqui* (Green Cestrum)
-  *Lantana camara* (Lantana)
-  *Ochna serrulata* (Ochna)
-  *Olea europaea subsp. cuspidata* (African Olive)
-  *Senna pendula var. glabrata* (Senna)



Aerial: NearMap (2019) | Data: MJD Environmental, LPI (2019) | Datum/Projection: GDA 1994 MGA Zone 56 | Date: 15/11/2019 | Version 2 | GIS\19068 - Vegetation Assessment Flying Fox Camp, East Cessnock | This plan should not be relied upon for critical design dimensions.



East Cessnock Flying Fox Camp
FIGURE 6: WEED DENSITY - ALL



Meters

1:4,200

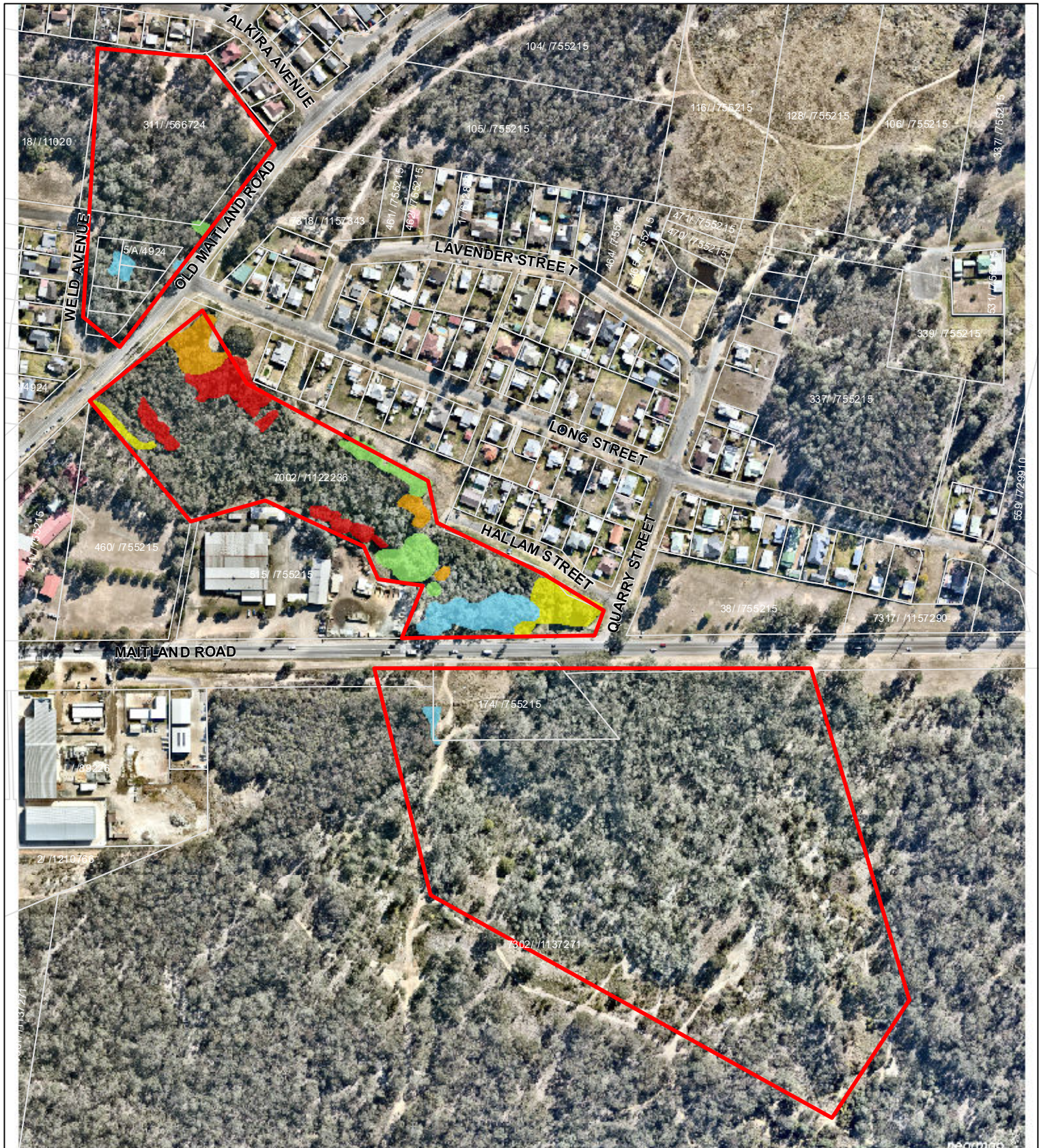


Legend

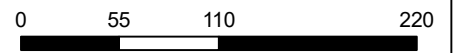
Study Area	Weed Density
Cadastral Boundaries	5 - 15%
Weed Types	15 - 30%
Vines	30 - 50%
Woody	50 - 70%
Woody & Vines	> 70%



Aerial: NearMap (2019) | Data: MJD Environmental, LPI (2019) | Datum/Projection: GDA 1994 MGA Zone 56 | Date: 15/11/2019 | Version 2 | GIS\19068 - Vegetation Assessment Flying Fox Camp, East Cessnock | This plan should not be relied upon for critical design dimensions.



East Cessnock Flying Fox Camp
FIGURE 7: WEED DENSITY - VINES



Meters

1:4,200



Legend

Study Area

Cadastral Boundaries

Vine Weeds Density

5 - 15%

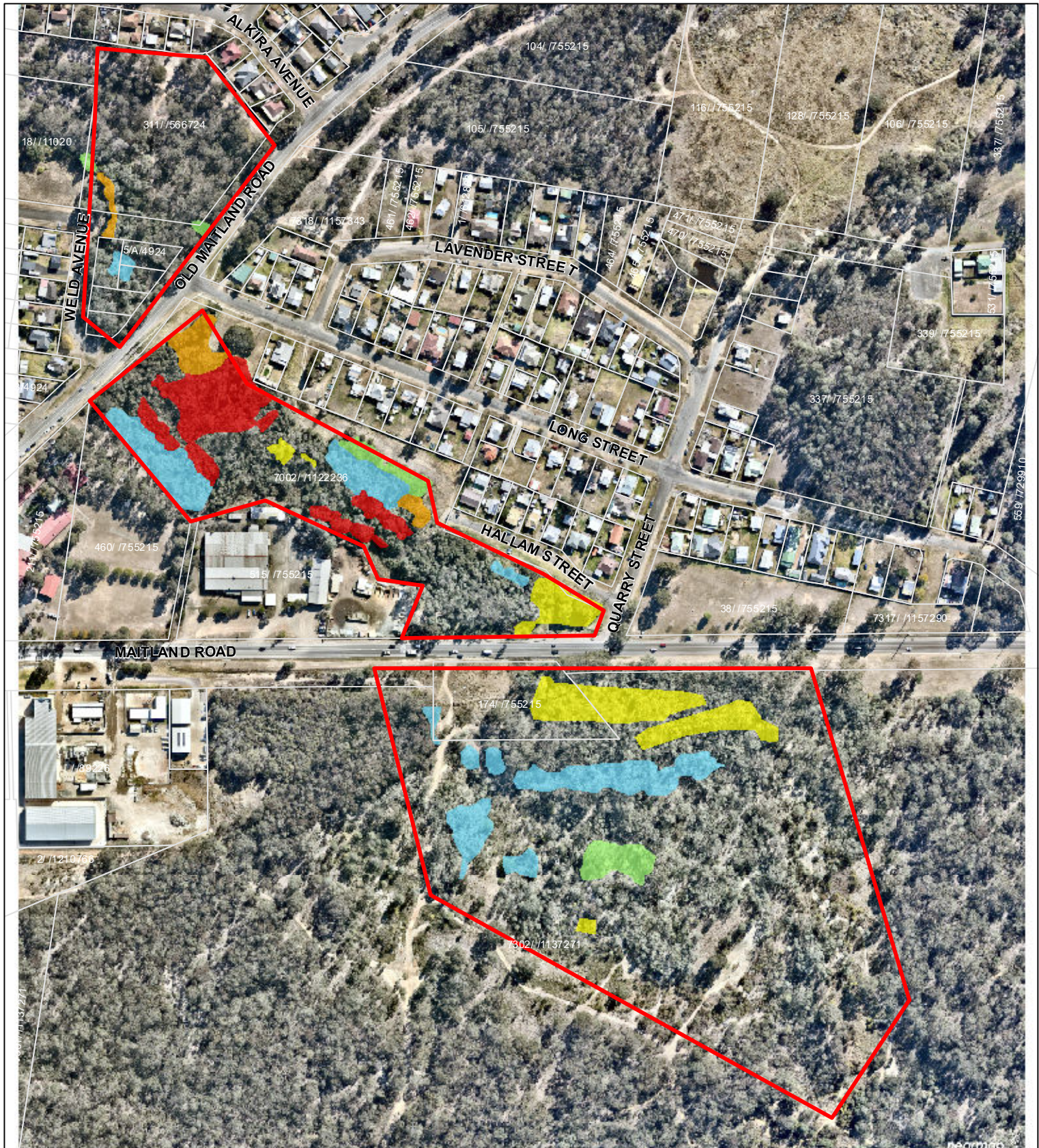
15 - 30%

30 - 50%

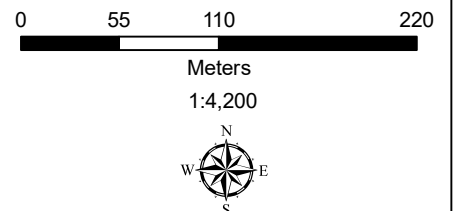
50 - 70%



Aerial: NearMap (2019) | Data: MJD Environmental, LPI (2019) | Datum/Projection: GDA 1994 MGA Zone 56 | Date: 15/11/2019 | Version 2 | GIS\19068 - Vegetation Assessment Flying Fox Camp, East Cessnock | This plan should not be relied upon for critical design dimensions.



East Cessnock Flying Fox Camp
FIGURE 8: WEED DENSITY - WOODY



Legend

- Study
 - Cadastral Boundaries
- Woody Weeds Density**
- 5 - 15%
 - 15 - 30%
 - 30 - 50%
 - 50 - 70%
 - > 70%



Aerial: NearMap (2019) | Data: MJD Environmental, LPI (2019) | Datum/Projection: GDA 1994 MGA Zone 56 | Date: 15/11/2019 | Version 2 | GIS\19068 - Vegetation Assessment Flying Fox Camp, East Cessnock | This plan should not be relied upon for critical design dimensions.

4 Conclusion

MJD Environmental was engaged by Cessnock City Council to conduct a Vegetation Assessment of the East Cessnock Flying Fox Camp, Cessnock, NSW. This Vegetation Assessment seeks to inform future management actions of vegetation required within the East Cessnock Flying Fox Camp. These actions include vegetation management and resulting licenses if necessary, weed control, and to guide future actions. This vegetation assessment will also be used to inform a revegetation and habitat augmentation program in the southern end of the study area (south of Maitland Rd).

The vegetation field assessment found:

- Four vegetation communities (Bell 2008), three PCTs and one TEC:

Vegetation Mapp Unit (Bell 2008)	Plant Community Type (PCT)	TEC	Area (ha)
108 Paperbark Depression Forest	1726: Flax-leaved Paperbark - Tall Sedge shrubland of the Sydney Basin	N/A	3.38
14h Riparian Apple - Grey Gum Dune Forest	1557: Rough-barked Apple - Forest Oak - Grey Gum grassy woodland on sandstone ranges of the Sydney Basin	N/A	9.89
17c Lower Hunter Beyer's Ironbark Low Forest	1592: Spotted Gum - Red Ironbark - Grey Gum shrub - grass open forest of the Lower Hunter	Lower Hunter Spotted Gum – Ironbark Forest in the Sydney Basin and NSW North Coast Bioregions (EEC under the BC Act)	1.46
17a Lower Hunter Spotted Gum Red Ironbark Forest			0.40

- A total of 72 native flora and 37 exotic species;
- A total of five WoNs including four vine species and one woody species;
- A total of 22 Biosecurity Weeds including eight vine species, 11 woody species, two grass species & one other species;
- Majority of weed species abundance and cover occur within PCT 1726: *Flax-leaved Paperbark - Tall Sedge shrubland* followed by PCT 1557: *Rough-barked Apple - Forest Oak - Grey Gum grassy woodland*. These weed species were found to be smothering and out competing native plant species;
- Access tracks occur throughout PCT 1592: *Spotted Gum - Red Ironbark - Grey Gum shrub - grass open forest* and PCT 1557: *Rough-barked Apple - Forest Oak - Grey Gum grassy woodland* contributing to the degradation of remnant native vegetation;
- High concentrations of the roosting Grey-headed Flying Fox have resulted in a high mortality rate of the canopy species, with the remaining individuals exhibiting signs of stress and damage;
- Where the canopy is lacking or has been severely impacted by the Flying Fox, a high weed presence was observed;
- No hollow bearing trees; and
- Five *Eucalyptus parramattensis* subsp. *decadens* listed as *Vulnerable* under the State Biodiversity Conservation Act and the Federal Environment Protection and Biodiversity Conversation Acts.

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Appendix 1 Flora List

Family	Scientific Name	Common Name	B1	B2	B3	B4	RDP1	RDP2	RDP3	RDP4	RDP5	RDP6	RDP7
Apocynaceae	<i>*Araujia sericifera</i>	Moth Vine	X	X									
	<i>Parsonia straminea</i>	Common Silkpod			X		X						
Asteraceae	<i>*Ageratina adenophora</i>	Crofton Weed	X										
	<i>*Bidens pilosa</i>	Cobbler's Pegs										X	
	<i>Chrysocephalum apiculatum</i>	Common Everlasting			X								
	<i>*Conyza</i> spp.	Fleabane						X					
Asparagaceae	<i>*Asparagus aethiopicus</i>	Ground Asparagus		X									
	<i>*Asparagus asparagoides</i>	Bridal Creeper	X	X			X			X			X
	<i>*Asparagus plumosus</i>	Climbing Asparagus Fern											
Basellaceae	<i>*Anredera cordifolia</i>	Madeira Vine											
Bignoniaceae	<i>*Tecoma stans</i>	Yellow Bignonia											
Caprifoliaceae	<i>*Lonicera japonica</i>	Japanese Honeysuckle											X
Celastraceae	<i>Denhamia silvestris</i>	Narrow-leaved Orangebark		X	X								
Chenopodiaceae	<i>Einadia hastata</i>	Berry Saltbush		X									
Commelinaceae	<i>*Tradescantia fluminensis</i>	Wandering Jew					X						
Convolvulaceae	<i>*Ipomoea indica</i>	Morning Glory (Blue)											
Crassulaceae	<i>*Bryophyllum delagoense</i>	Mother of Millions											
Cyperaceae	<i>Carex appressa</i>	Tall Sedge	X				X	X					
	<i>Cyperus gunnii</i> subsp. <i>gunnii</i>							X					
	<i>Gahnia aspera</i>	Rough Saw-sedge								X	X		
	<i>Gahnia clarkei</i>	Tall Saw-sedge	X			X	X	X					X
	<i>Machaerina articulata</i>	Jointed Twig-rush						X					
Dennstaedtiaceae	<i>Hypolepis muelleri</i>	Harsh Ground Fern	X				X	X					
	<i>Pteridium esculentum</i>	Gurgi (Cadigal)					X				X		X
Ericaceae (Epacridoideae)	<i>Leucopogon juniperinus</i>	Prickly Beard-heath											
Fabaceae (Caesalpinioideae)	<i>*Senna pendula</i> var. <i>glabrata</i>	Senna					X						
Fabaceae (Faboideae)	<i>Chorizema parviflorum</i>	Eastern Flame Pea			X								
	<i>Daviesia ulicifolia</i>	Gorse Bitter Pea			X				X				
	<i>Glycine clandestina</i>				X								
	<i>Glycine tabacina</i>				X								
	<i>Hardenbergia violacea</i>	False Sarsaparilla			X								
	<i>Jacksonia scoparia</i>	Dogwood										X	
	<i>Viminaria juncea</i>	Golden Spray											X
Fabaceae (Mimosoideae)	<i>Acacia elongata</i>	Swamp Wattle			X								
	<i>Acacia falcata</i>	Hickory Wattle			X								
	<i>Acacia filicifolia</i>	Fern-leaved Wattle		X					X				
	<i>Acacia longifolia</i> subsp. <i>longifolia</i>	Sydney Golden Wattle			X					X	X	X	X
	<i>Acacia parvipinnula</i>	Silver-stemmed Wattle				X					X	X	
Juncaceae	<i>Juncus usitatus</i>										X		
Juncaginaceae	<i>Triglochin</i> spp.							X					
Lauraceae	<i>Cassytha glabella</i>				X								

Family	Scientific Name	Common Name	B1	B2	B3	B4	RDP1	RDP2	RDP3	RDP4	RDP5	RDP6	RDP7
	<i>*Cinnamomum camphora</i>	Camphor laurel	X			X	X						X
Lobeliaceae	<i>Lobelia purpurascens</i>	Whiteroot	X		X								X
	<i>Lomandra confertifolia</i>	Mat-rush		X		X			X				
Lomandraceae	<i>Lomandra longifolia</i>	Spiny-headed Mat-rush			X	X			X	X	X		
	<i>Lomandra multiflora</i> subsp. <i>multiflora</i>	Many-flowered Mat-rush			X								
Malvaceae	<i>*Pavonia hastata</i>				X								
	<i>*Sida rhombifolia</i>	Paddy's Lucerne	X	X									
Meliaceae	<i>Melia azedarach</i>	White Cedar	X				X						
Moraceae	<i>*Morus alba</i>	White Mulberry	X										
	<i>Angophora floribunda</i>	Rough-barked Apple	X			X	X			X	X	X	X
	<i>Callistemon pinifolius</i>	Pine-leaved Bottlebrush		X	X								
	<i>Eucalyptus beyeriana</i>	Beyer's Ironbark			X				X				
	<i>Eucalyptus fibrosa</i>	Red Ironbark		X									
	<i>Eucalyptus parramattensis</i> subsp. <i>decadens</i> (V)	Earp's Gum		X									
Myrtaceae	<i>Eucalyptus punctata</i>	Grey Gum			X	X			X	X		X	X
	<i>Eucalyptus tereticornis</i>	Forest Red Gum			X								
	<i>Leptospermum parviflorum</i>				X								
	<i>Leptospermum polygalifolium</i> subsp. <i>polygalifolium</i>	Tantoon							X		X		X
	<i>Melaleuca decora</i>			X									
	<i>Melaleuca nodosa</i>	Prickly-leaved Paperbark		X	X						X		
	<i>Melaleuca linariifolia</i>	Budjur (Gadigal)	X	X			X	X					
	<i>Melaleuca thymifolia</i>	Thyme Honey-myrtle			X								
Ochnaceae	<i>*Ochna serrulata</i>	Mickey Mouse Plant				X	X						
	<i>*Ligustrum lucidum</i>	Large-leaved Privet	X				X						
Oleaceae	<i>*Ligustrum sinense</i>	Small-leaved Privet	X	X		X	X	X		X	X	X	
	<i>*Olea europaea</i> subsp. <i>cuspidata</i>	African Olive								X		X	
Oxalidaceae	<i>Oxalis chnoodes</i>											X	
Phormiaceae	<i>Dianella revoluta</i> var. <i>revoluta</i>	Blueberry Lily		X	X				X	X	X		
Phyllanthaceae	<i>Breynia oblongifolia</i>	Coffee Bush		X	X	X							
Pittosporaceae	<i>Bursaria spinosa</i> subsp. <i>spinosa</i>	Blackthorn			X								
	<i>Pittosporum undulatum</i>	Sweet Daphne		X									
Plantaginaceae	<i>*Plantago lanceolata</i>	Plantain			X								
	<i>*Andropogon virginicus</i>	Whiskey Grass				X					X		
	<i>Aristida ramosa</i>	Purple Wiregrass			X								
	<i>Aristida warburgii</i>				X								
Poaceae	<i>*Avena barbata</i>	Bearded Oats	X										
	<i>*Chloris gayana</i>	Rhodes Grass							X			X	
	<i>*Cortaderia selloana</i>	Pampas Grass											
	<i>Cynodon dactylon</i>	Common Couch			X	X							
	<i>*Ehrharta erecta</i>	Panic Veldt Grass		X									
	<i>Entolasia stricta</i>	Wiry Panic	X	X						X			
	<i>*Eragrostis curvula</i>	African Lovegrass											

Family	Scientific Name	Common Name	B1	B2	B3	B4	RDP1	RDP2	RDP3	RDP4	RDP5	RDP6	RDP7
	<i>Eragrostis brownii</i>	Brown's Lovegrass			X								
	<i>Eragrostis</i> spp.								X				
	<i>Imperata cylindrica</i> var. <i>major</i>	Blady Grass			X							X	X
	<i>Microlaena stipoides</i> var. <i>stipoides</i>	Weeping Grass	X	X		X				X	X		
	<i>Oplismenus aemulus</i>	Australian Basket Grass	X										
	* <i>Paspalum dilatatum</i>	Paspalum				X							
	<i>Rytidosperma pallidum</i>	Redanther Wallaby Grass			X								
	* <i>Setaria parviflora</i>					X							
	<i>Themeda triandra</i>	Kangaroo Grass			X								
Polygonaceae	<i>Persicaria decipiens</i>	Slender Knotweed						X					
	<i>Persicaria hydropiper</i>	Water Pepper						X					
	<i>Rumex</i> spp.		X										
Proteaceae	<i>Banksia spinulosa</i> var. <i>collina-spinulosa intergrade</i>	Hairpin Banksia											X
	<i>Grevillea montana</i>				X								
	<i>Persoonia linearis</i>	Narrow-leaved Geebung									X		
Pteridaceae	<i>Cheilanthes sieberi</i> subsp. <i>sieberi</i>	Poison Rock Fern		X	X				X				
Ranunculaceae	<i>Clematis aristata</i>	Old Man's Beard		X		X				X			
Rosaceae	* <i>Rubus fruticosus</i> aggregate.	Blackberry						X					X
	* <i>Cestrum parqui</i>	Green Cestrum	X				X						
Solanaceae	* <i>Solanum mauritianum</i>	Tobacco Bush	X				X						
	* <i>Solanum nigrum</i>	Blackberry Nightshade		X									
Thymelaeaceae	<i>Pimelea linifolia</i> subsp. <i>linifolia</i>	Slender Rice-flower			X								
Typhaceae	<i>Typha orientalis</i>	Broadleaf Cumbungi						X					
	* <i>Lantana camara</i>	Lantana											
Verbenaceae	* <i>Verbena bonariensis</i>	Purple Top	X										
	* <i>Verbena rigidus</i>	Veined Verbena											
Vitaceae	<i>Cayratia clematidea</i>	Native Grape					X						

Appendix 3 – Flying Fox Ecology and Threats

Ecological role

Flying-foxes make a substantial contribution to ecosystem health through their ability to move seeds and pollen over long distances (Southerton et al. 2004). This directly assists gene movement in native plants, improving the reproduction, regeneration and viability of forest ecosystems (DEE 2019b). Some plants, particularly *Corymbia* spp., have adaptations suggesting they rely more heavily on nocturnal visitors such as bats for pollination than daytime pollinators (Southerton et al. 2004).

Grey-headed flying-foxes may travel 100 kilometres in a single night with a foraging radius of up to 50 kilometres from their camp (McConkey et al. 2012) and have been recorded travelling over 500 kilometres in two days between camps (Roberts et al. 2012). In comparison bees, another important pollinator, move much shorter foraging distances of generally less than one kilometre (Zurbuchen et al. 2010).

Long-distance seed dispersal and pollination make flying-foxes critical to the long-term persistence of many plant communities (Westcott et al. 2008; McConkey et al. 2012), including eucalypt forests, rainforests, woodlands and wetlands (Roberts et al. 2006). Seeds that are able to germinate away from their parent plant have a greater chance of growing into a mature plant (DES 2018). Long-distance dispersal also allows genetic material to be spread between forest patches that would normally be geographically isolated (Parry-Jones & Augee 1992; Eby 1991; Roberts 2006). This genetic diversity allows species to adapt to environmental change and respond to disease pathogens. Transfer of genetic material between forest patches is particularly important in the context of contemporary fragmented landscapes.

Flying-foxes are considered 'keystone' species given their contribution to the health, longevity and diversity among and between vegetation communities. These ecological services ultimately protect the long-term health and biodiversity of Australia's bushland and wetlands. In turn, native forests act as carbon sinks (Roxburgh et al. 2006), provide habitat for other animals and plants, stabilise river systems and catchments, add value to production of hardwood timber, honey and fruit (e.g. bananas and mangoes; Fujita 1991), and provide recreational and tourism opportunities worth millions of dollars each year (DES 2018).

Flying-foxes in urban areas

Flying-foxes appear to be roosting and foraging in urban areas more frequently. There are many possible drivers for this, as summarised by Tait et al. (2014):

- loss of native habitat and urban expansion
- opportunities presented by year-round food availability from native and exotic species found in expanding urban areas
- disturbance events such as drought, fires, cyclones
- human disturbance at non-urban roosts or culling at orchards
- urban effects on local climate
- refuge from predation
- movement advantages, e.g. ease of manoeuvring in flight due to the open nature of the habitat or ease of navigation due to landmarks and lighting.

Under threat

Flying-foxes roosting and foraging in urban areas more frequently can give the impression that their populations are increasing; however, the grey-headed flying-fox is in decline across its range and in 2001 was listed as vulnerable by the NSW Government through the *Threatened Species Conservation Act 1995* (now BC Act).

At the time of listing, the species was considered eligible for listing as vulnerable, as counts of flying-foxes over the previous decade suggested the national population had declined by up to 30%. It was also estimated the population would continue to decrease by at least 20% in the next three generations given the continuation of the current rate of habitat loss, culling and other threats.

The main threat to grey-headed flying-foxes in New South Wales is clearing or modification of native vegetation. This removes appropriate roosting and breeding sites and limits the availability of natural food resources, particularly winter–spring feeding habitat in north-eastern NSW. The urbanisation of the coastal plains of south-eastern Queensland and northern NSW has seen the removal of annually-reliable winter feeding sites, which is continuing.

There is a wide range of ongoing threats to the survival of the grey-headed flying-fox, including:

- habitat loss and degradation
- conflict with humans (including culling at orchards)
- infrastructure-related mortality (e.g. entanglement in barbed wire fencing and fruit netting, power line electrocution, etc.)
- exposure to extreme natural events such as cyclones, drought and heatwaves.

Flying-foxes have limited capacity to respond to these threats and recover from large population losses due to their slow sexual maturation, low reproductive output, long gestation and extended maternal dependence (McIlwee & Martin 2002).

Camp characteristics

All flying-foxes are nocturnal, typically roosting during the day in communal camps. These camps may range in number from a few to hundreds of thousands, with individual animals frequently moving between camps within their range. Typically, the abundance of resources within a 20 to 50-kilometre radius of a camp site will be a key determinant of the size of a camp (SEQ Catchments 2012). Many flying-fox camps are temporary and seasonal, tightly tied to the flowering of their preferred food trees; however, understanding the availability of feeding resources is difficult because flowering and fruiting are not reliable every year, and can vary between localities (SEQ Catchments 2012). These are important aspects of camp preference and movement between camps and have implications for long-term management strategies.

Little is known about flying-fox camp preferences; however, research indicates that apart from being in close proximity to food sources, flying-foxes choose to roost in vegetation with at least some of the following general characteristics (SEQ Catchments 2012; Eco Logical Australia 2018):

- closed canopy >5 metres high
- dense vegetation with complex structure (upper, mid- and understorey layers)
- within 500 metres of permanent water source
- within 50 kilometres of the coastline or at an elevation <65 metres above sea level
- level topography (<5° incline)
- greater than one hectare to accommodate and sustain large numbers of flying-foxes.

Optimal vegetation available for flying-foxes must allow movement between preferred areas of the camp. Specifically, it is recommended that the size of a patch be approximately three times the area occupied by flying-foxes at any one time (SEQ Catchments 2012).

Appendix 4 – Additional Human and Animal Health Information

Flying-fox camps in public places, such as parks, school grounds and residential areas can sometimes raise concerns for community members about possible health risks. Human infections with viruses borne by flying-foxes are very rare. There is no risk of being infected with these viruses as long as people do not come into physical contact with flying-foxes.

Australian bat lyssavirus

Australian Bat Lyssavirus (ABLV) is a rabies-like virus that may be found in all flying-fox species on mainland Australia. It has also been found in an insectivorous microbat and it is assumed it may be carried by any bat species. The probability of human infection with ABLV is very low with less than 1% of the flying-fox population being affected (DPI 2017) and transmission requiring direct contact with an infected animal that is secreting the virus. In Australia, three people have died from ABLV infection since the virus was identified in 1996 (NSW Health 2015).

Domestic animals are also at risk if exposed to ABLV. In 2013, ABLV infections were identified in two horses (Shinwari et al. 2014). There have been no confirmed cases of ABLV in dogs in Australia; however, transmission is possible (McCall et al. 2005) and consultation with a veterinarian should be sought if exposure is suspected.

Transmission of the virus from bats to humans is through a bite or scratch but may have potential to be transferred if bat saliva directly contacts the eyes, nose, mouth or broken skin. ABLV is unlikely to survive in the environment for more than a few hours, especially in dry environments that are exposed to sunlight (NSW Health 2015).

Transmission of closely related viruses suggests that contact or exposure to bat faeces, urine or blood does not pose a risk of exposure to ABLV, nor does living, playing or walking near bat roosting areas (NSW Health 2015).

The incubation period in humans is assumed similar to rabies and variable between two weeks and several years. Similarly, the disease in humans presents essentially the same clinical picture as classic rabies.

Once clinical signs have developed the infection is invariably fatal; however, infection can easily be prevented by avoiding direct contact with bats (i.e. handling).

Pre-exposure vaccination provides reliable protection from the disease for people who are likely to have direct contact with bats, and it is generally a mandatory workplace health and safety requirement that all persons working with bats receive pre-exposure vaccination and have their level of protection regularly assessed. Like classic rabies, ABLV infection in humans also appears to be effectively treated using post-exposure vaccination and so any person who suspects they have been exposed should seek immediate medical treatment. Post-exposure vaccination is usually ineffective once clinical manifestations of the disease have commenced.

If a person is bitten or scratched by a bat they should:

- wash the wound with soap and water for at least five minutes (**do not scrub**)
- contact their doctor immediately to arrange for post-exposure vaccinations.

If bat saliva contacts the eyes, nose, mouth or an open wound, flush thoroughly with water and seek immediate medical advice.

Hendra virus

Flying-foxes are the natural host for Hendra virus, which can be transmitted from flying-foxes to horses. Infected horses sometimes amplify the virus and can then transmit it to other horses,

humans and on two occasions, dogs (DPI 2018). There is no evidence that the virus can be passed directly from flying-foxes to humans or to dogs (Halim et al. 2015). Clinical studies have shown cats, pigs, ferrets and guinea pigs can carry the infection (DPI 2018).

Although the virus is periodically present in flying-fox populations across Australia, the likelihood of horses becoming infected is low and consequently, human infection is extremely rare. Horses are thought to contract the disease after ingesting forage or water contaminated with urine from an infected flying-fox (CDC 2014).

Humans may contract the disease after close contact with an infected horse. Hendra virus infection in humans presents as a serious and often fatal respiratory and/or neurological disease and there is currently no effective post-exposure treatment or vaccine available for people. The mortality rate in horses is greater than 70% (DPI 2018). Since 1994, more than 100 horses have died (Degeling et al. 2018) and four of the seven infections in humans were fatal (Goldspink et al. 2015).

Previous studies have shown that infections of horses have been associated with foraging flying-foxes rather than camp locations. Therefore, risks are considered similar at any location within the range of flying-fox species and all horse owners should be vigilant. Vaccination of horses can protect horses and subsequently humans from infection (DPI 2018), as can appropriate horse husbandry (e.g. covering food and water troughs, fencing flying-fox foraging trees in paddocks, etc.).

Although all human cases of Hendra virus to date have been contracted from infected horses and direct transmission from bats to humans has not yet been reported, particular care should be taken by select occupational groups that could be uniquely exposed. For example, persons who may be exposed to high levels of Hendra virus via aerosol of heavily contaminated substrate should consider additional personal protective equipment (PPE), e.g. respiratory filters, and potentially dampening down dry dusty substrate.

Menangle virus

Menangle virus (also known as bat paramyxovirus no. 2) was first isolated from stillborn piglets from a NSW piggery in 1997. Little is known about the epidemiology of this virus, except that it has been recorded in flying-foxes, pigs and humans (Field 2002; Kirkland 2017). The virus caused reproductive failure in pigs and severe febrile (flu-like) illness in two piggery workers employed at the same Menangle piggery where the virus (Field 2002). The virus is thought to have been transmitted to the pigs from flying-foxes via an oral-faecal matter route (Kirkland 2017). Flying-foxes had been recorded flying over the pig yards prior to the occurrence of disease symptoms. The two infected piggery workers made a full recovery, and this has been the only case of Menangle virus recorded in Australia.

General health considerations

Flying-foxes, like all animals, carry bacteria and other microorganisms in their guts, some of which are potentially pathogenic to other species. Direct contact with faecal material should be avoided and general hygiene measures taken to reduce the low risk of gastrointestinal and other diseases.

Contamination of water supplies by any animal excreta (birds, amphibians and mammals such as flying-foxes) poses a health risk to humans. Household tanks should be designed to minimise potential contamination, such as using first-flush diverters to divert contaminants before they enter water tanks. Trimming vegetation overhanging the catchment area (e.g. the roof of a house) will also reduce wildlife activity and associated potential contamination. Tanks should also be appropriately maintained and flushed, and catchment areas regularly cleaned to remove potential contaminants.

Public water supplies are regularly monitored for harmful microorganisms and are filtered and disinfected before being distributed. Management plans for community supplies should consider whether any large congregation of animals, including flying-foxes, occurs near the supply or catchment area. Where they do occur, increased frequency of monitoring should be considered to ensure early detection and management of contaminants.

Appendix 5 – Dispersal Results Summary

Roberts and Eby (2013) summarised 17 known flying-fox dispersals between 1990 and 2013, and made the following conclusions:

- In all cases, dispersed animals did not abandon the local area⁸.
- In 16 of the 17 cases, dispersals did not reduce the number of flying-foxes in the local area.
- Dispersed animals did not move far (in approx. 63% of cases the animals only moved <600 metres from the original site, contingent on the distribution of available vegetation). In 85% of cases, new camps were established nearby.
- In all cases, it was not possible to predict where replacement camps would form.
- Conflict was often not resolved. In 71% of cases, conflict was still being reported either at the original site or within the local area years after the initial dispersal actions.
- Repeat dispersal actions were generally required (all cases except where extensive vegetation removal occurred).
- The financial costs of all dispersal attempts were high, ranging from tens of thousands of dollars for vegetation removal to hundreds of thousands for active dispersals (e.g. using noise, smoke, etc.).

Ecosure, in collaboration with a Griffith University Industry Affiliates Program student, researched outcomes of management in Queensland between November 2013 and November 2014 (the first year since the current Queensland state flying-fox management framework was adopted on 29 November 2013).

An overview of findings⁹ is summarised below.

- There were attempts to disperse 25 separate roosts in Queensland (compared with nine roosts between 1990 and June 2013 analysed in Roberts and Eby (2013)). Compared with the historical average (less than 0.4 roosts/year) the number of roosts dispersed in the year since the framework was introduced has increased by 6250%.
- Dispersal methods included fog¹⁰, birdfrite, lights, noise, physical deterrents, smoke, extensive vegetation modification, water (including cannons), paintball guns and helicopters.
- The most common dispersal methods were extensive vegetation modification alone and extensive vegetation modification combined with other methods.
- In nine of the 24 roosts dispersed, dispersal actions did not reduce the number of flying-foxes in the LGA.
- In all cases, it was not possible to predict where new roosts would form.
- When flying-foxes were dispersed, they did not move further than six kilometres away.
- As at November 2014 repeat actions had already been required in 18 cases.
- Conflict for the council and community was resolved in 60% of cases, but with many councils stating they feel this resolution is only temporary.
- The financial costs of all dispersal attempts were considerable, regardless of methods used, ranging from \$7500 to more than \$400,000 (with costs ongoing).

⁸ Local area is defined as the area within a 20-kilometre radius of the original site = typical feeding area of a flying-fox.

⁹ This was based on responses to questionnaires sent to councils; some did not respond and some omitted responses to some questions.

¹⁰ Fog refers to artificial smoke or vapours generated by smoke/fog machines. Many chemical substances used to generate smoke/fog in these machines are considered toxic.