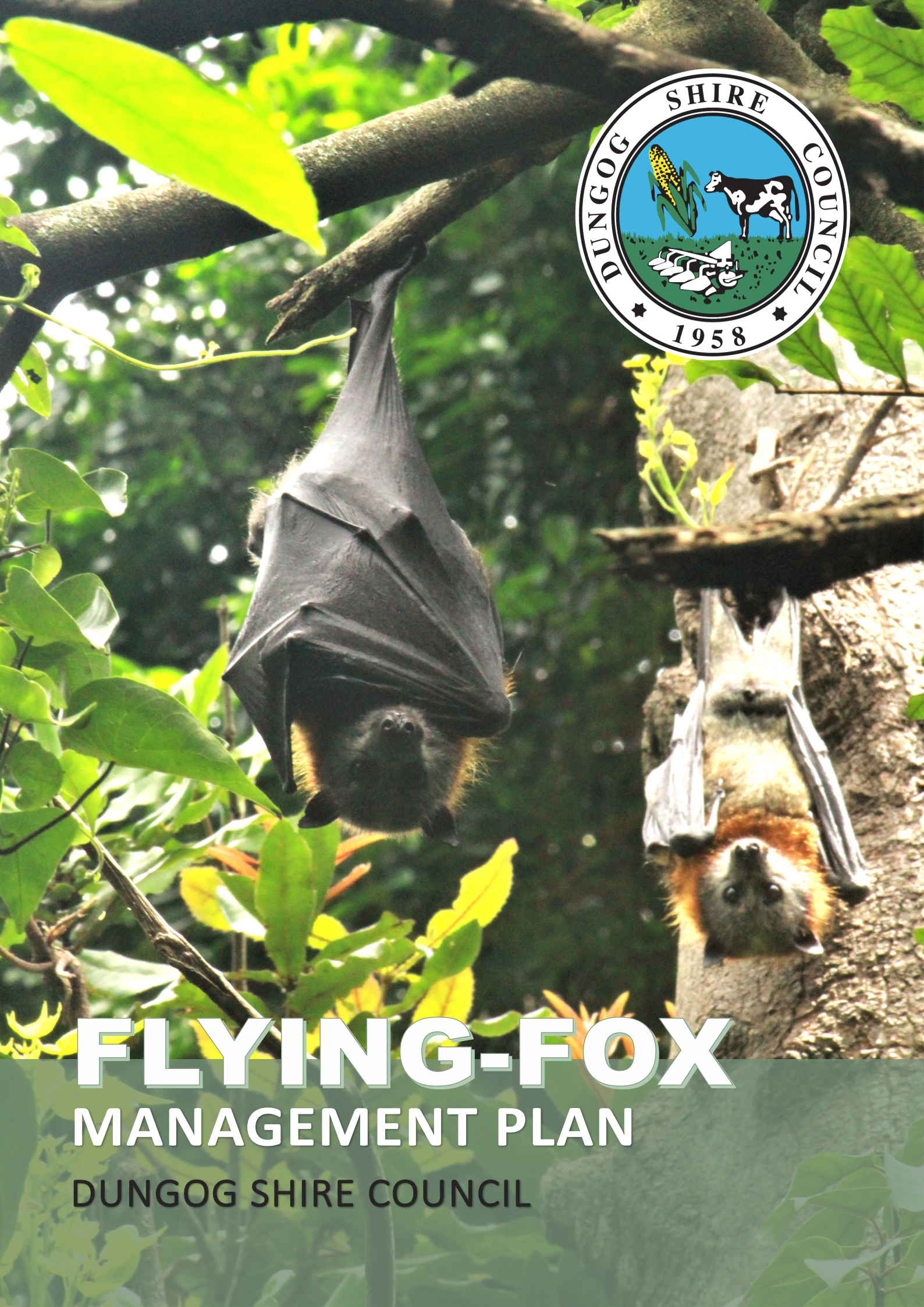

FLYING-FOX
MANAGEMENT PLAN
DUNGOG SHIRE COUNCIL

Document history

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Disclaimer

The Dungog Shire Flying-fox Management Plan (Dungog Shire FFMP) has been compiled in good faith, exercising all due care and attention. The Dungog FFMP has been developed with reference to the information contained in the NSW Department of Planning, Industry and Environment's (DPIE) *Flying-fox Camp Management Plan Template 2019*. Tracks Environment and Planning does not accept responsibility for inaccurate or incomplete information. The information utilised from the *Flying-fox Camp Management Plan Template 2019* is licensed under the Creative Commons Attribution 4.0 International (CC BY 4.0), subject to the exemptions contained in the licence. The legal code for the licence is available at Creative Commons.

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Cover page image: Grey-headed Flying–foxes (credit: M Manning)

Acknowledgements

We acknowledge the contributions of the Dungog Shire Flying-fox Advisory Committee to the development of the Dungog Shire FFMP. Members of the committee include community members (John Van Eyden, Rosemary Wall and Martyn Robinson), DPIE (Pauline Dunne), Local Land Services (Eva Twarkowski), Wildlife In Need of Care (Una Greco) and Dungog Shire Council (Cr Steve Low, Paul Minett).

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We acknowledge input by the NSW DPIE, and consultants Ecosure, in developing the *Flying-fox Camp Management Plan Template 2019*, on which the Dungog Shire FFMP is based. Peggy Eby also provided advice which was included in the *Flying-fox Camp Management Plan Template 2019*.

Acknowledgement of traditional owners

The Dungog Shire FFMP has been prepared for lands that are the traditional country of the Gringai and Worimi people. Dungog Shire Council acknowledges the Gringai and Worimi people as the traditional owners and custodians of this country and pays respect to the generations of Gringai and Worimi people who, for thousands of years, have lived and derived their physical and spiritual needs from the landscape which we all now share.

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Abbreviations

Abbreviation	**Full name**
BFF	Black Flying-fox
Council	Dungog Shire Council
DPIE	Department of Planning, Industry and Environment
FFMP	Flying-fox Management Plan
GHFF	Grey-headed Flying-fox
IAP2	International Association for Public Participation
LEP	Local Environmental Plan
LGA	Local Government Area
LRFF	Little-red Flying-fox

1. Introduction

Nestled in rugged and hilly countryside in the Hunter Region of NSW, Dungog Shire spans a land area of 2248km^2. The landform in Dungog Shire generally decreases in gradient from north to south and includes three principal rivers, the Williams, Paterson and Allyn Rivers. These rivers traverse the Local Government Area (LGA) and flow into the Hunter River to the south of the LGA. A large portion of the LGA is utilised for agricultural purposes, but the northern section includes large areas of rugged wilderness within the Barrington Tops National Park, a listed UNESCO world heritage site as part of the Gondwana Rainforests of Australia. (**Figure 1**)

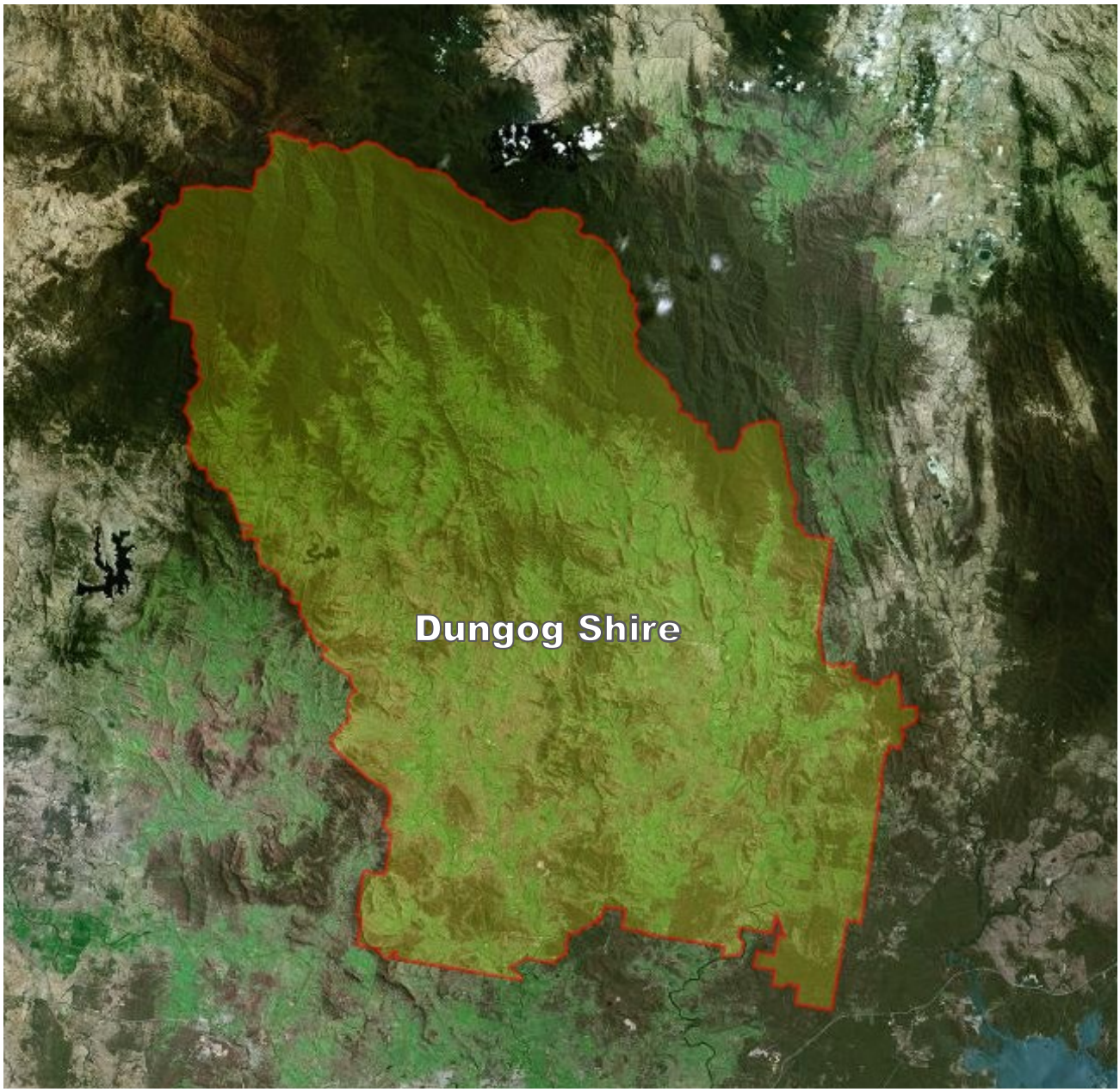


Figure 1: Dungog Shire Local Government Area

Dungog Shire is home to a population of nearly 9000 people (ABS 2016) with major population centres at :

- Dungog
- Martins Creek
- Vacy
- Gresford
- Clarence Town
- Paterson

Flying-foxes are commonly sighted in Dungog Shire as they move between a network of roosting camps located throughout most of eastern and northern Australia. While flying-foxes are highly nomadic they form daytime roosting camps which can vary from a limited number of individuals to thousands of flying-foxes based on the season and/or availability of food resources. Camps may be occupied continuously, annually or irregularly (Roberts 2005). Nine flying-fox camps have been monitored in Dungog Shire since 2012 as part of the Commonwealth Government's National Flying-fox Monitoring Program. While many of the flying-fox camps are located in less populated areas a number are closer to the population centres of Dungog, Gresford and Clarence Town.

Flying-fox camps have the potential to cause impacts on communities, including amenity issues associated with noise, odour, faecal drop, damage to property and vegetation along with potential health risks. However, there are challenges associated with the management of camps including legislative, financial, social and environmental issues along with the temporal and changing nature of flying-fox camp use.

Dungog Shire Council (Council) is committed to assisting communities within the LGA affected by flying-fox impacts. The Dungog Shire Flying-fox Management Plan (FFMP) has been developed to enable Council and other landowners and managers to readily respond to and reduce flying-fox

impacts. The Dungog Shire FFMP outlines the potential management measures to be undertaken within the LGA to address both community impacts from flying-fox camps and to assist in the on-going management and conservation of these species within the Australian environment.

2. Objectives of this Plan

The objectives of the Dungog Shire FFMP are to

1. Minimise impacts from flying-fox camps by providing a reasonable level of amenity for the surrounding community
2. Contribute to the long-term conservation of flying-foxes on a regional/local scale
3. Manage public health and safety risks from flying-fox camps
4. Enable land managers and other stakeholders to manage flying-fox camps economically and sustainably
5. Improve community understanding of flying-foxes, including their ecological role in the environment
6. Facilitate and streamline approval processes to ensure management actions can be undertaken in an efficient manner
7. Implement an adaptive evidence-based approach to flying-fox camp management.

Image: Dungog Shire landscape

3. Flying-foxes in NSW

3.1 Flying-fox species

The habitat range of three of Australia's flying-fox species is located within NSW. These species are:

1. Black flying-fox (*Pteropus alecto)* (BFF)
2. Grey-headed flying-fox (*Pteropus poliocephalus*) (GHFF)
3. Little red flying-fox (*Pteropus scapulatus*) (LRFF)

Table 1 provides a brief overview of the ecology and legal protection status of these three flying-fox species. More information on each of these flying-fox species can be found in **Appendix A**.

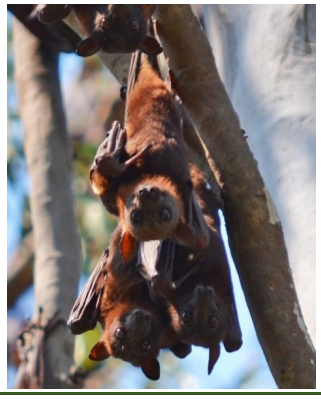
3.2 Flying-fox camp characteristics

All flying-foxes are nocturnal and typically roost during the day in communal camps. Flying-fox numbers within a camp can vary greatly and individual animals frequently move between camps within their range. The abundance of resources within a 20-50km radius of a camp is a key determinant of the size of a camp (SEQ Catchments 2012). Many flying-fox camps are temporary and seasonal and correlate with the flowering of their preferred feeding trees. However, understanding the availability of feeding resources is difficult due to both time and location of flowering and fruiting variability.

Research indicates that apart from being in close proximity to food resources flying-foxes tend to roost or form camps 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.

Table 1: Flying-fox species profiles

Flying-fox species	Range	Species Information
Black flying-fox (*Pteropus alecto)* 		• Almost completely black in colour • Relatively uncommon in NSW, but range appears to be extending south (Webb and Tideman 1995) • Camps in forested areas, often with grey-headed flying-foxes • Feed on rainforest fruits as well as nectar and pollen from native plants (OEH 2019) • **Legal status: Protected species in NSW** under Biodiversity Conservation Act 2016
Grey-headed flying-fox (*Pteropus poliocephalus*) 		• Largest Australian bat • Wingspan up to 1m • Generally found within 200km of coast • Camps generally located within 20km of food source, close to water and in vegetation with dense canopy • Camps are normally long standing with some used for over a century • Feed on nectar and pollen of native trees, but also forage in cultivated gardens and fruit crops (OEH 2020) • Population decline by up to 30% between 1989 and 2000 (Birt 2000) • **Legal status: Listed as vulnerable in NSW** under Biodiversity Conservation Act 2016 and also under Commonwealth Environment Protection and Biodiversity Conservation Act 1999
Little red flying-fox (*Pteropus scapulatus*) 		• Smallest Australian flying-fox • Fly further inland then other flying-fox species • Most widespread species of flying-fox and occupy broad range of habitats • Often share camps with other flying-fox species (DPIE 2020) • Strongly influenced by availability of food resources, particularly flowering of eucalypt species (Churchill 2008) • **Legal status: Protected species in NSW** under Biodiversity Conservation Act 2016

3.3 Legislation and policy

Flying-foxes provide a critical ecological role and contribution to ecosystem health in Australia. Their ability to move seeds and pollen over long-distances (Southerton *et al* 2004) directly assists in gene movement in native plants and improves the viability of forest ecosystems, including eucalypt forests, rainforests and woodlands (Roberts et al 2006). Given their contributions to the health, longevity and diversity of vegetation communities flying-foxes are considered 'keystone' species within the Australian environment.

Due to the integral ecological role they provide flying-foxes are protected native wildlife in NSW (See **Table 1**). As protected species there is a range of policy and legislation that governs how flying-foxes and their habitat may be managed. **Table 2** provides an overview of the key legislation and policies applicable to flying-fox and habitat management in NSW.

Table 2: Key legislation and policies for flying-fox management

Legislation/Policy	Relevance to flying-fox management
NSW STATE LEGISLATION	
Flying-fox Camp Management Policy 2015	• Outlines NSW State Government approach to management of flying-foxes • Defines three levels of management actions for flying-foxes • Provides regulatory framework in which Department of Planning, Industry and Environment (DPIE) will make decisions or approve licenses for management actions
Biodiversity Conservation Act 2016	• Identifies protected native species, including flying-foxes • Identifies threatened native species, including the grey-headed flying-fox, and threatened ecological communities • Part 2 identifies when a biodiversity conservation license is required when undertaking an action that may impact native wildlife or habitat. • Allows regulations (Biodiversity Conservation Regulation 2017) to define management approaches for threatened species or communities • Outlines the biodiversity assessment method for assessment of impacts on threatened species in the development application process
Flying-fox Camp Management Code of Practice 2018	• Approved for flying-fox camp management under Cl 2.9 of the Biodiversity Conservation Regulation 2017. • Facilitates public authorities to undertake low impact camp management actions without the need for a biodiversity conservation license • Defines specific camp management actions that can be undertaken.
Local Government Act 1993	• Defines responsibilities of Councils, including in relation to public land • Outlines plans of management for council owned/managed land

NSW STATE LEGISLATION	
Crown Land Management Act 2016	• Provides for administration and management of Crown Land Reserves • Facilitates appointment of Councils as Crown Land Managers • Requires Councils to prepare plans of management for land they have been appointed as Crown Land Manager.
Environmental Planning and Assessment Act 1979	• Sets framework for landuse planning, including integration of economic, social and environmental considerations • Includes requirements for regional and local planning scales that include protection of threatened species habitat • Local Environmental Plans and development control plans can include provisions in relation to protection of habitat, including reducing development near known flying-fox camps.
Local Land Services Act 2013	• Part 5A includes management of native vegetation in rural areas • Provides for clearing of native vegetation codes
Rural Fires Act 1997	• Provides for preparation and implementation of bushfire management plans, including removal and reduction of fire loads and native habitat • Introduces duty to prevent bush fires on private land, including bushfire hazard reduction certificates • Facilitates removal of native vegetation through the 10/50 Vegetation clearing Code of Practice
Prevention of Cruelty to Animals Act 1979	• Outlines offences for unreasonable/unnecessary torment to animals including any management actions undertaken at flying-fox camps.
COMMONWEALTH LEGISLATION	
Environment Protection and Biodiversity Conservation Act 1999	• Introduces approvals for any actions likely to impact a Matter of National Environmental Significance eg) nationally threatened species such as the grey-headed flying-fox, or ecologically significant areas such as identified wetlands.

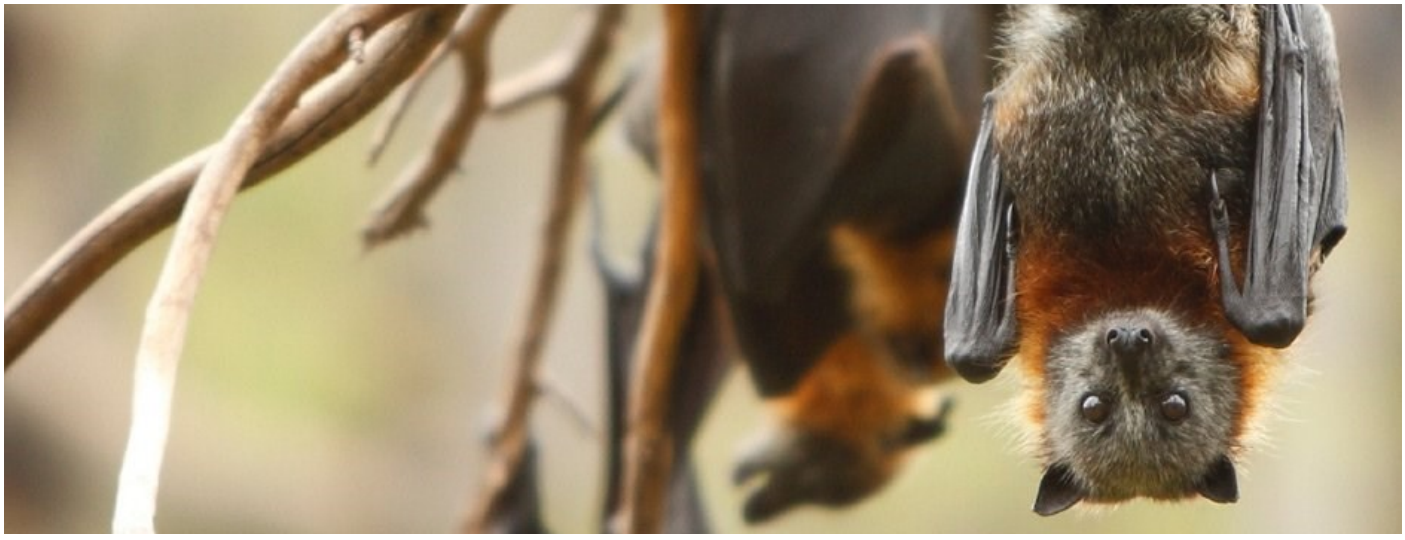


Image : Grey headed flying-fox

4. Flying-foxes in Dungog Shire

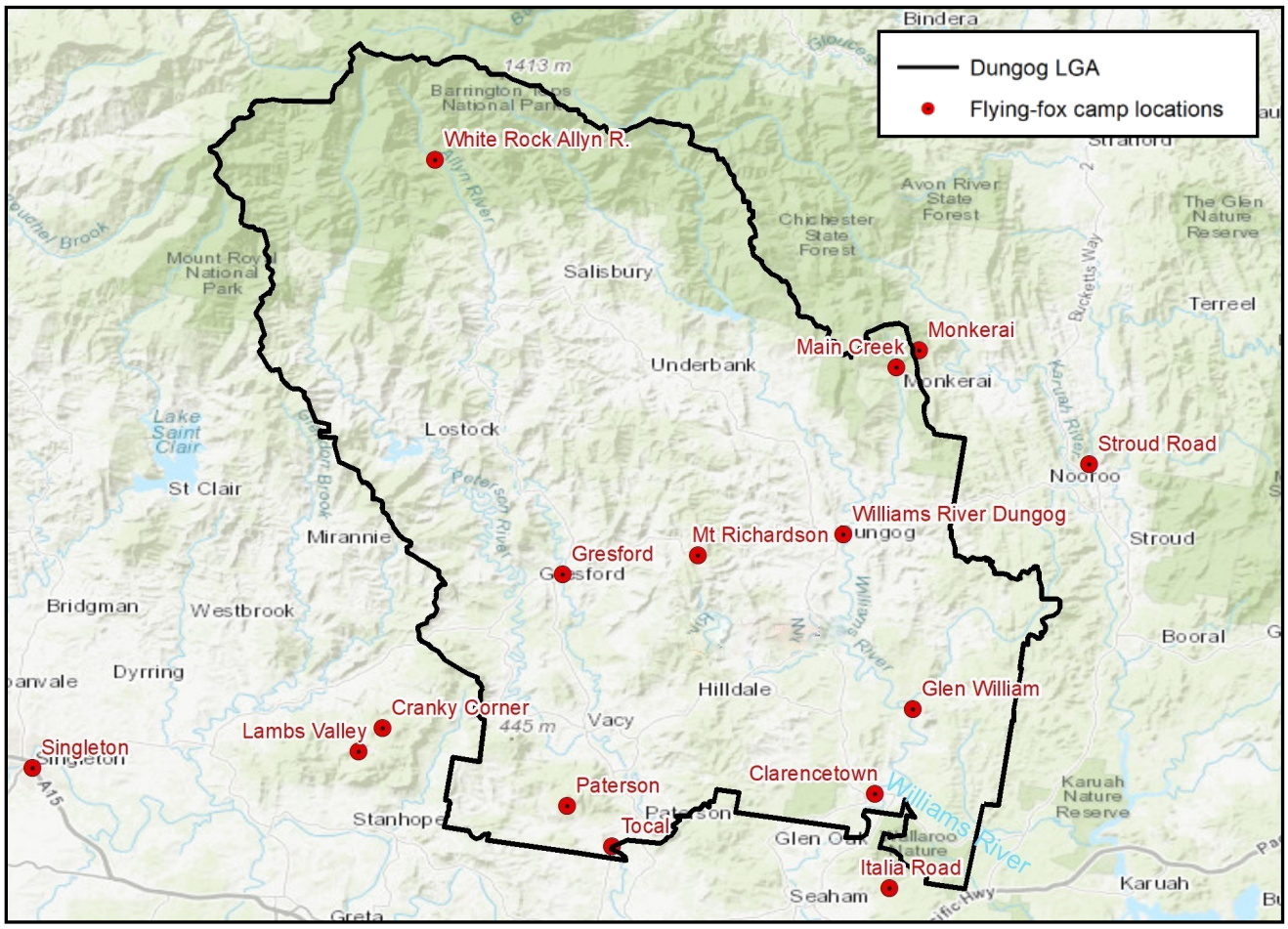


Figure 2: Flying-fox camps within the Dungog Local Government Area and surrounding Council areas.

Flying-fox camps are monitored throughout Australia as part of the Commonwealth Government's National Flying-fox Monitoring Program. Flying-fox camps have been monitored in Dungog Shire since 2012 with nine camps identified within the LGA as part of the program (See **Figure 2**). Flying-fox camps are located throughout the wider Hunter Region and identified camps within surrounding LGAs can also be seen in **Figure 2**.

Two identified camps within the Dungog LGA, Mount Richardson and Paterson, are considered historic camp sites but may potentially become occupied again in the future. Additional flying-fox camps may also be present or intermittently used in Dungog Shire, but have not been identified as part of the National Flying-fox Monitoring Program. A known camp at Caparis/Hilldale is an example of a camp not included as part of the monitoring program.

Dungog LGA consists of a mosaic of natural forested habitat and modified agricultural land. While large areas of forest are located within the north of the LGA pockets of rainforest remain throughout the remainder of the LGA due to historical land clearing practices. These pockets of habitat provide a food supply for flying-foxes and have resulted in camp establishment closer to human settlements.

4.1 White Rock - Allyn River camp

The White Rock- Allyn River flying-fox camp is located within the Chichester State Forest in the north of the LGA. The flying-fox camp occupies a temperate rainforest vegetation community approximately 200m upstream of the Allyn River from the White Rock campground within the State Forest (**Figure 3**). The flying-fox camp is surrounded by large areas of continuous rainforest with dense canopy and understorey vegetation.

The flying-fox camp is located on land managed by the Forestry Corporation of NSW and is a recently established roosting site. While the campground is located nearby no issues in relation to the flying-fox camp have been recorded.

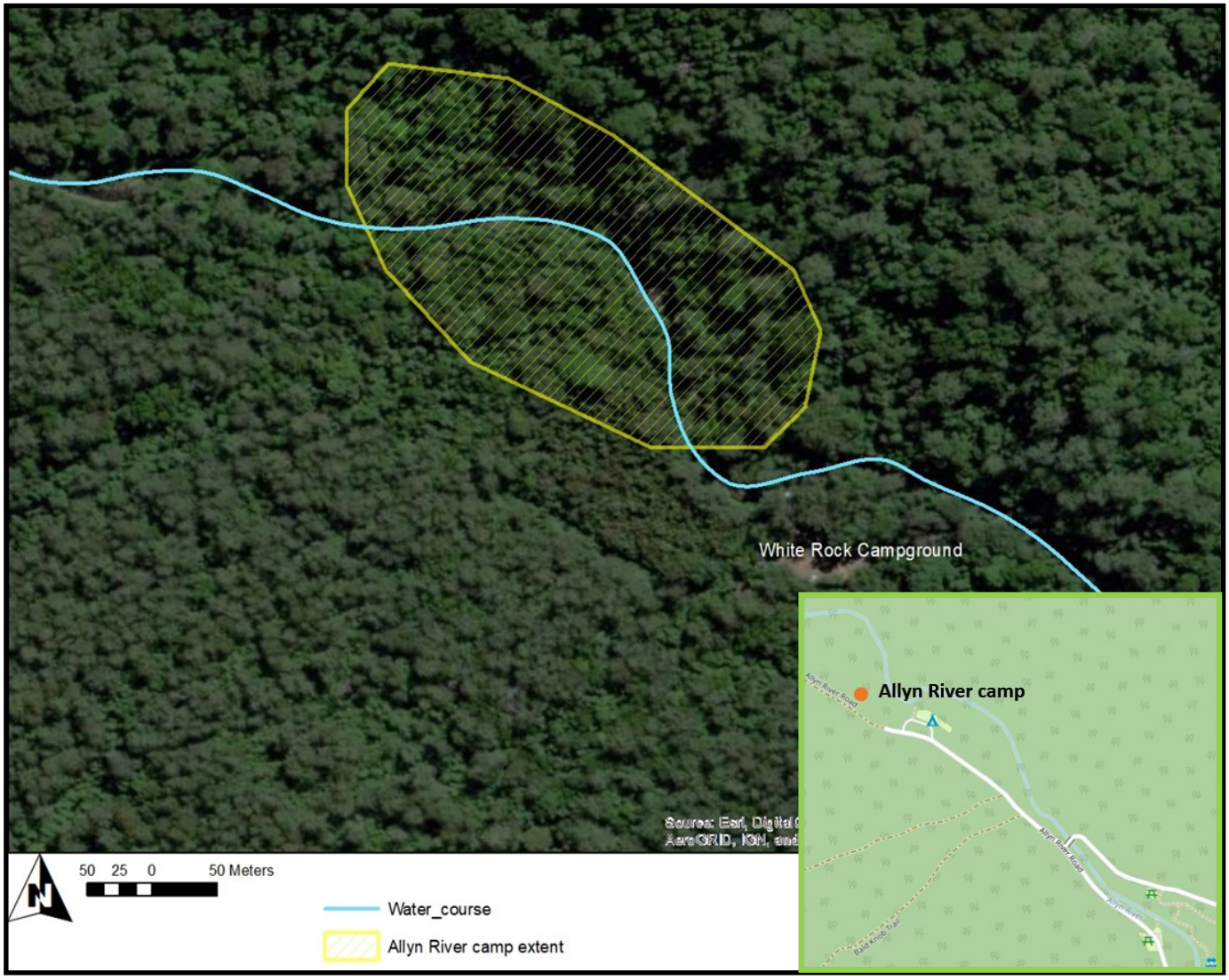


Figure 3: Location of White Rock—Allyn River Flying-fox camp.

The White Rock -Allyn River flying-fox camp was first occupied in 2017 and monitoring has been undertaken since 2019. The core flying-fox camp area is approximately 5.53 ha, but is used intermittently by GHFF as shown in **Figure 4**.

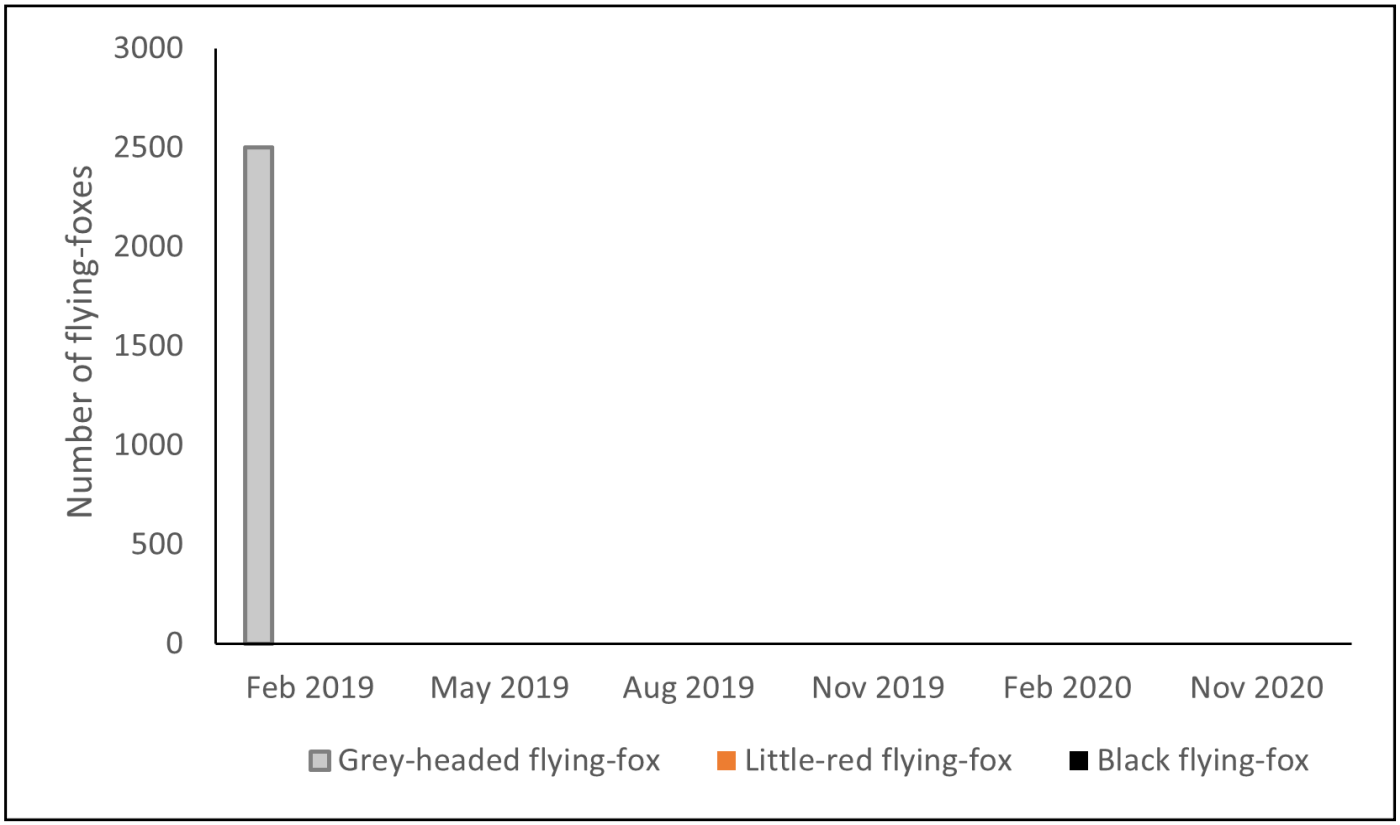


Figure 4: White Rock—Allyn River flying-fox camp size (February 2019- November 2020)

Image: Allyn River

4.2 Main Creek camp

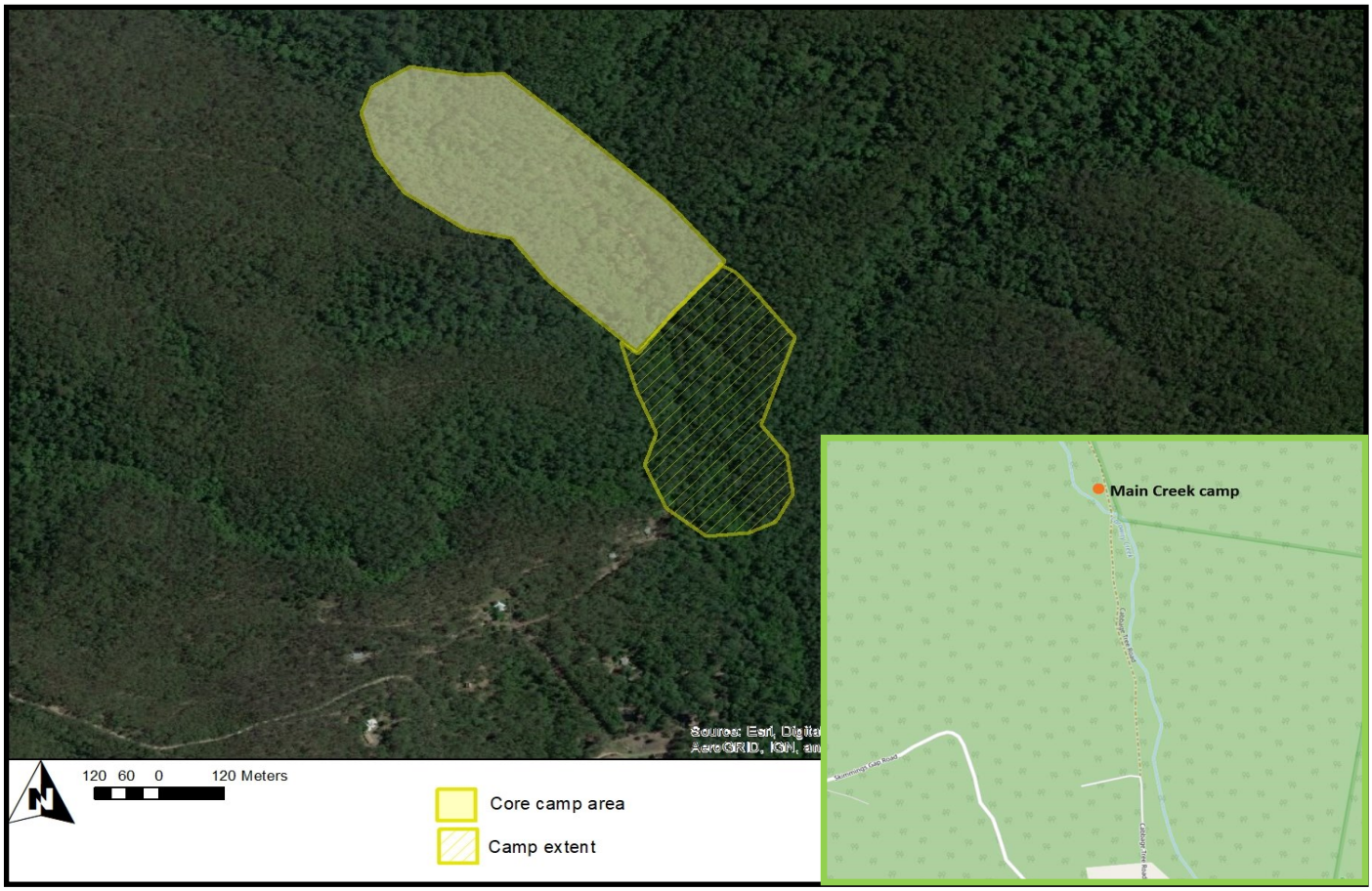


Figure 5: Location of Main Creek flying-fox camp

The Main Creek flying-fox camp is situated approximately 15km north of the Dungog township. Located to the east of Cabbage Tree Road the flying-fox camp is situated within temperate rainforest vegetation near Carowirry Creek. The flying-fox camp is located near the edge of the Chichester State Forest and surrounded by large areas of rainforest and eucalypt forest vegetation, including the Black Bulga State Conservation Area to the east. To the south of the flying-fox camp are a small number of large, private rural allotments including an eco-tourism facility (**Figure 5**).

The Main Creek flying-fox camp has been occupied intermittently since the start of the century with the core camp area approximately 15.21 ha. A nearby flying-fox camp was previously recorded upstream of the present Main Creek camp at Monkerai. The Monkerai camp has not been occupied in the last twenty years and it appears the Monkerai camp has shifted to the present-day Main Creek site.

The Main Creek camp has been monitored since the inception of the Commonwealth Government's National Flying-fox Monitoring Program in 2012. The Main Creek camp is a breeding site for GHFF with camp numbers fluctuating annually (**Figure 6**). GHFF camp numbers have exceeded 12 000 individuals (February 2015), but generally remain at much lower numbers. When flying-fox numbers have been larger the camp has extended south onto privately owned property and occupied an area of approximately 24.18 ha.

While no issues have been recorded from the private owners when the camp boundary has extended south concerns regarding foraging flying-foxes (faecal drop, noise) near residential dwellings within the surrounding valley have been recorded.

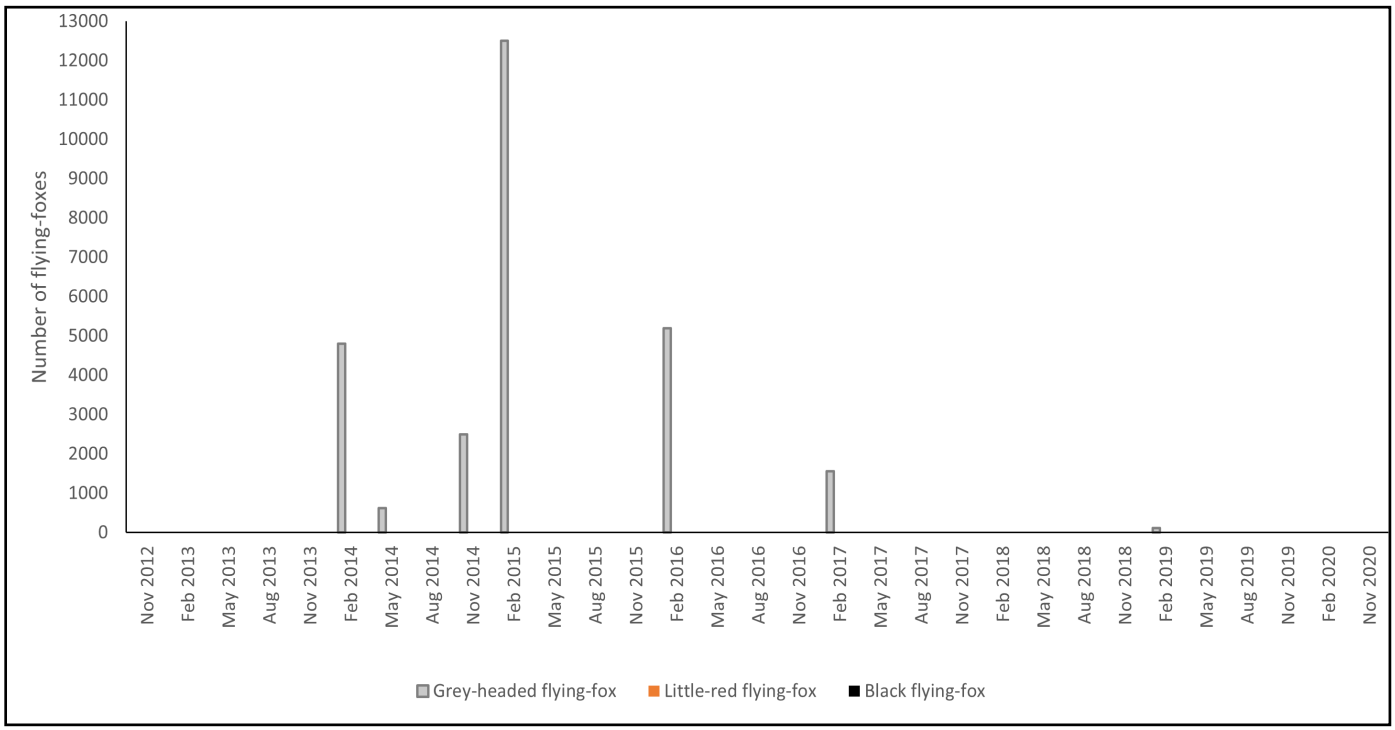


Figure 6: Main creek flying-fox camp size (November 2012- November 2020)

Image: Flying –foxes in flight (credit: N Williams)

4.3 Gresford camp

The Gresford flying-fox camp is located approximately 700m north of the township of East Gresford. The flying-fox camp is located within the riparian area of the Allyn River, to the east of Allyn River Road. The riparian area includes a mix of remnant native River Oak forest (*Casuarina cunninghamiana*) along with planted and exotic vegetation.

The flying-fox camp is primarily located on the southern side of the Allyn River on private property. The private property operates as a horticultural nursery facility. The flying-fox camp has also extended to the northern bank of the Allyn River, which is a privately owned rural property used for rural residential purposes (**Figure 7**). To the west of Allyn River Road are residential properties with the township of East Gresford, population of approximately 300 people, further south.

Figure 7: Location of Gresford flying-fox camp

The Gresford flying-fox camp has been monitored since 2012 and has been occupied on an annual basis (**Figure 8**). The camp is occupied annually by GHFF as a breeding site, but the camp size increased significantly in 2019 due to increased numbers of GHFF and roosting by LRFF. The most recent survey of the camp has shown a roosting camp size of over 8000 individual flying-foxes, which is significantly higher than years prior to 2019. The core camp occupies an area of approximately 0.46 ha, but in recent years has extended to the north and east to occupy an area of 2.02 ha.

The Gresford flying-fox camp has recorded a number of issues including

- Noise and smell from the camp during the day and
- Faecal drop at residential properties

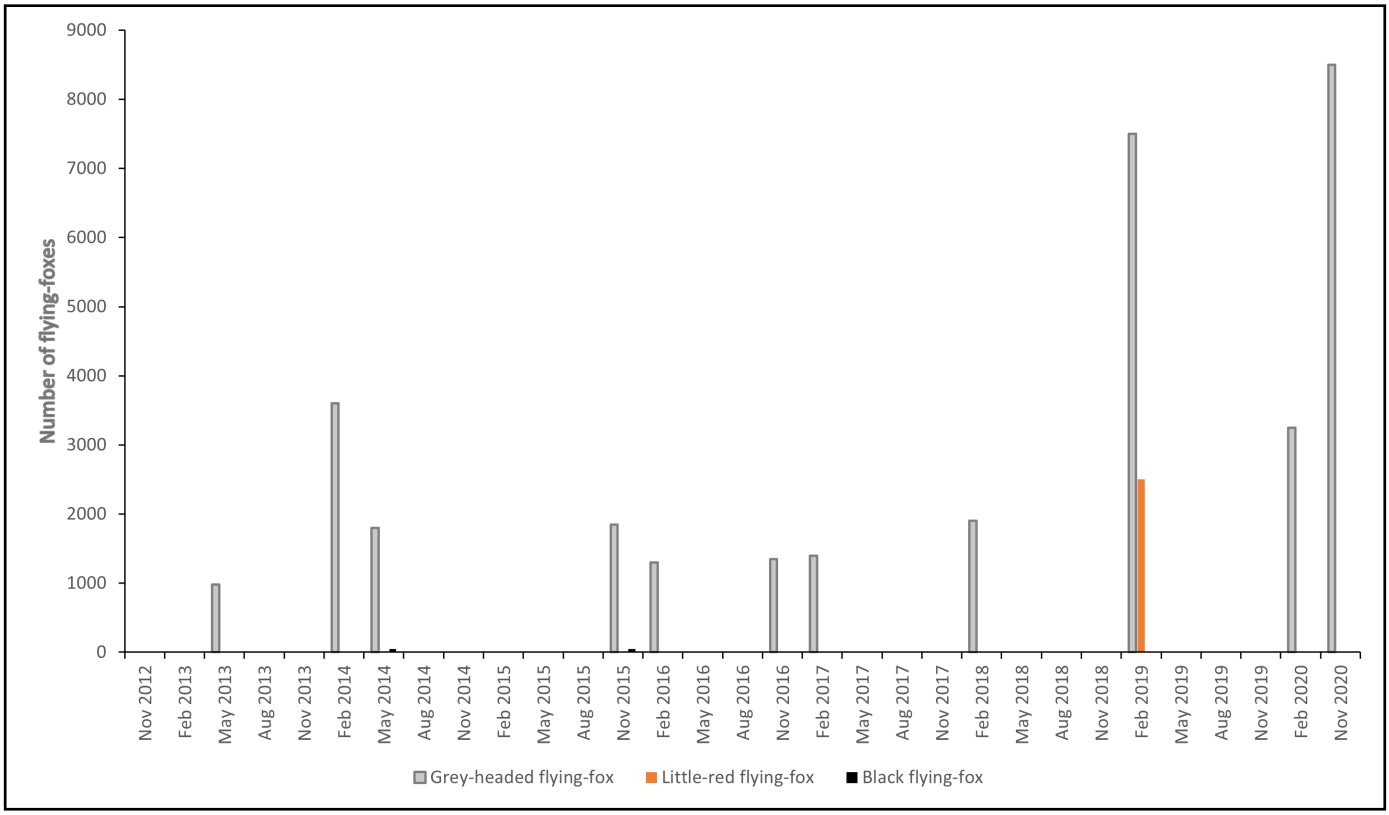


Figure 8: Gresford flying-fox camp size (November 2012- November 2020)

Image: Gresford flying fox camp November 2020 (credit: B Dowling)

4.4 Mount Richardson camp

The Mount Richardson flying-fox camp is located approximately halfway between the townships of Dungog and Gresford. Located to the south of Bingleburra Road the camp is situated within a dry rainforest gully on privately owned property (**Figure 9**). The flying-fox camp is surrounded by large areas of rainforest and eucalypt forest with minimal human settlement nearby.

The Mount Richardson flying-fox camp is considered a historic camp and has not been occupied since the inception of the monitoring program in 2012.

Figure 9: Location of Mount Richardson flying-fox camp

4.5 Dungog (Williams River) camp

The Dungog (Williams River) flying-fox camp is located approximately 700m north of the main Dungog township. The camp is located on a privately owned property to the east of Fosterton Road. The flying-fox camp adjoins the Williams River and occupies an area of 0.66 ha of mainly planted and regenerating riparian vegetation dominated by River Oak (*Casuarina cunninghamiana*) and Weeping Lilly Pilly (*Syzygium floribundum*). The western side of Fosterton Road includes a number of residential dwellings while the eastern side of the road includes residential dwellings to the north of the camp. To the south of the flying-fox camp is a railway, Stroud Hill Road and a public recreation area. A number of industrial operations are also located south-east of the camp (**Figure 10**).

The Dungog (Williams River) camp is a recently established roosting site. However, camps may have been historically further upstream along the Williams River. The flying-fox camp has been occupied by both GHFF and LRFF, but camp numbers have been low. There have been no recorded issues with the camp in the last two years.

Figure 10: Location of Dungog (Williams River) flying-fox camp

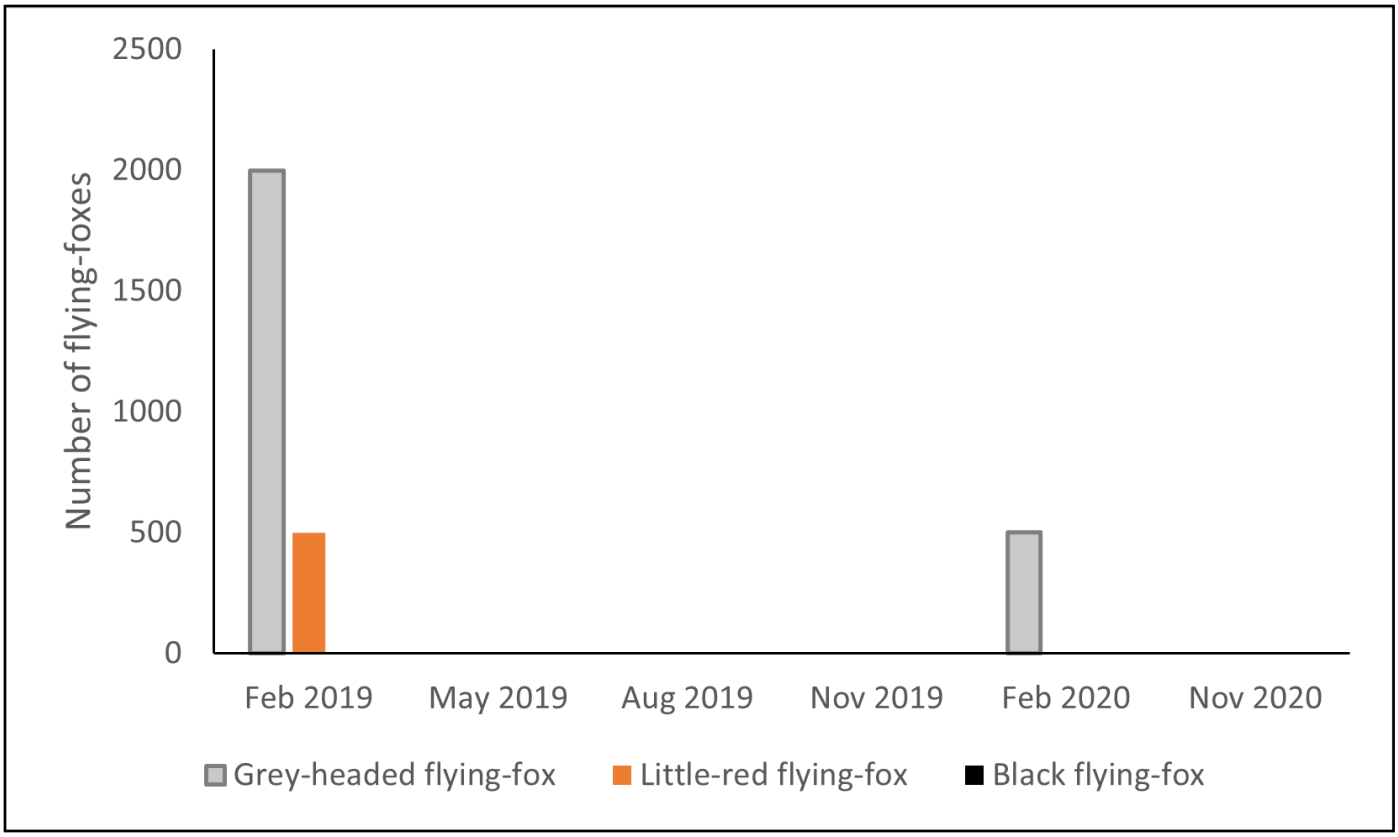


Figure 11: Dungog (Williams River) flying-fox camp size (February 2019- November 2020)

Image: Roosting Flying-fox

4.6 Glen William camp

The Glen William flying-fox camp is located in the hamlet of Glen William, approximately 10km north of Clarence Town. The flying-fox camp is located within the riparian zone at the junction of the Williams River and Black Camp Creek. The camp is located in habitat that consists of a mix of dry rainforest, including Weeping Lilly Pilly (*Syzygium floribundum*) and River Oak (*Casuarina cunninghamiana*) vegetation communities. The flying-fox camp is situated on privately owned property used for agricultural purposes. A church is located approximately 700m to the west of the flying-fox camp while Glen William Public School is located over a kilometre south-west. A poplar plantation is located to the north-west of the camp (**Figure 12**).

Figure 12: Location of Glen William flying-fox camp

The Glen William flying-fox camp is utilised as both a roosting and breeding site by GHFF. While the core camp occupies an area of approximately 1.34 ha flying-fox numbers have fluctuated significantly at the camp with the resultant camp extending to the north and south and occupying an area up to 18.26 ha.

The significant fluctuation in camp size was observed in 2015 and 2016 when the number of flying-foxes exceeded 60000 individuals with over 75000 individuals in February 2015 (**Figure 13**).However, the camp is used intermittently and camp numbers are generally significantly lower then 2015/2016 numbers.

While significant numbers of GHFF have occupied the Glen William camp on occasion no issues have been recorded regarding the flying-foxes.

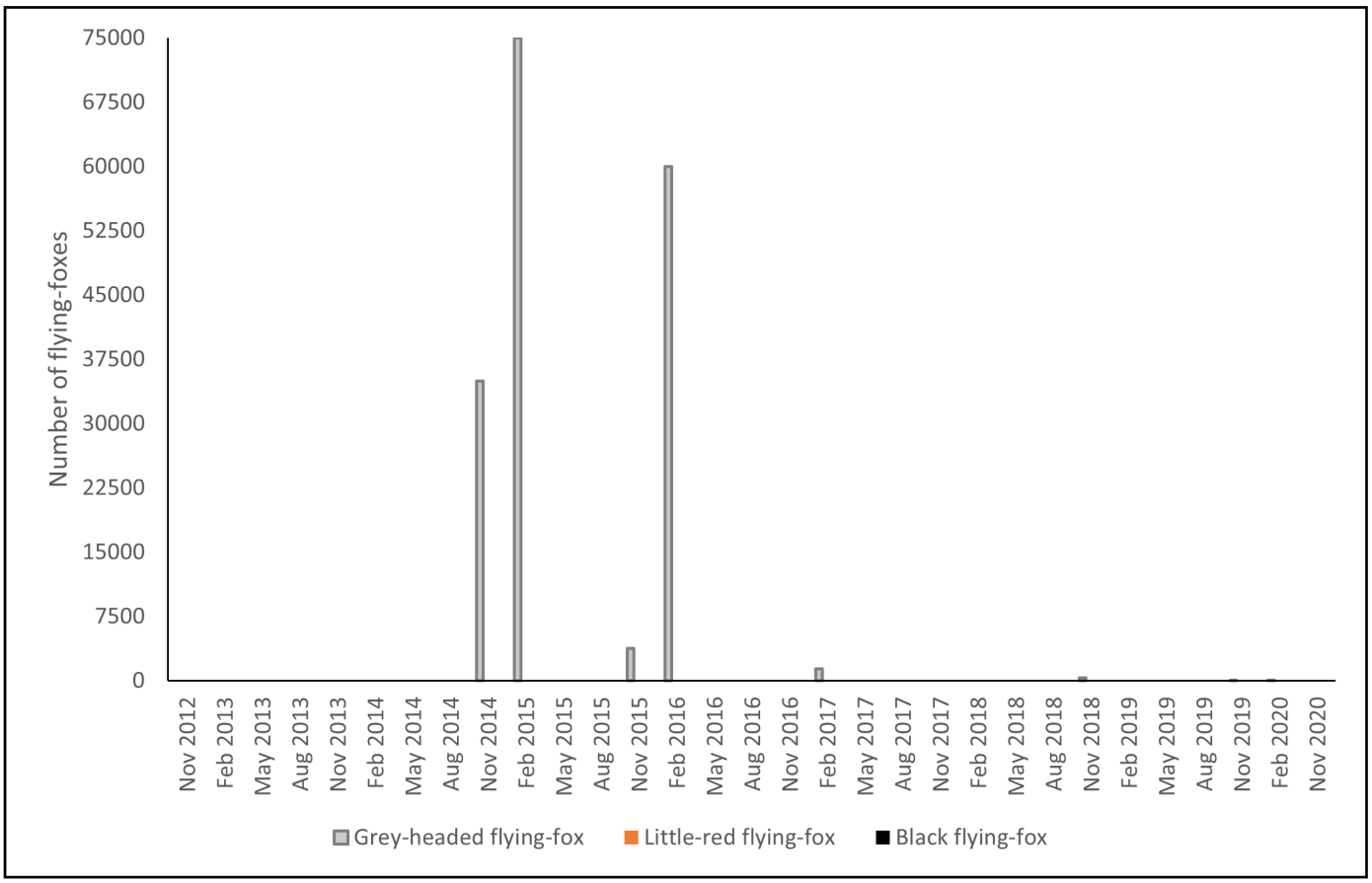


Figure 13: Glen William flying-fox camp size (November 2012- November 2020)

Image: Flying-fox camp (Credit: M Manning)

4.7 Clarence Town camp

The Clarence Town flying-fox camp is located along the Williams River on the north-eastern side of the township of Clarence Town. The flying-fox camp is located within the campgrounds of the Williams River Holiday Park with entrance to the campground off Limeburners Creek Road. The Clarence Town Lions Park is located near the flying-fox camp while residential dwellings along Durham and Russell Streets are to the west of the camp. Larger lot residential properties are located on the opposite side of the Williams River to the north of the flying-fox camp (**Figure 14**).

Figure 14: Location of Clarence Town flying-fox camp

The Clarence Town flying-fox camp was first recorded in 2013 and occupies a core area of approximately 0.58 ha. The core camp area is located within the campground, which is owned and/or managed on behalf of Crown Lands by Council. The flying-fox core camp area is riparian vegetation dominated by River Oak (*Casuarina cunninghamiana*) and the other planted vegetation.

The Clarence Town flying-fox has previously recorded low numbers of flying-foxes, but in early 2020 an influx of both GHFF and LRFF resulted in over 3000 individuals as shown in **Figure 15**.

Figure 15 includes data from the National Flying-fox Monitoring Program, but it is estimated 30000-50000 individual flying-foxes occupied the Clarence Town camp after February 2020. This significant increase in flying-fox numbers resulted in the camp extending into residential properties to the west of the core camp area and to the northern side of the Williams River as shown in **Figure 14**. The most recent survey (November 2020) has shown flying-foxes have migrated from the camp, but the camp numbers can fluctuate significantly.

During the significant increase in camp size in 2020 the following issues were recorded

- Noise from flying-foxes departing or returning to the camp
- Noise from the camp at residential properties
- Flying-foxes overhanging residential properties
- Faecal drop on outdoor areas
- Odour from the camp
- Impact on residential infrastructure/potable water
- Impacts on other native animals

Image : Grey-headed flying fox (credit: M Manning)

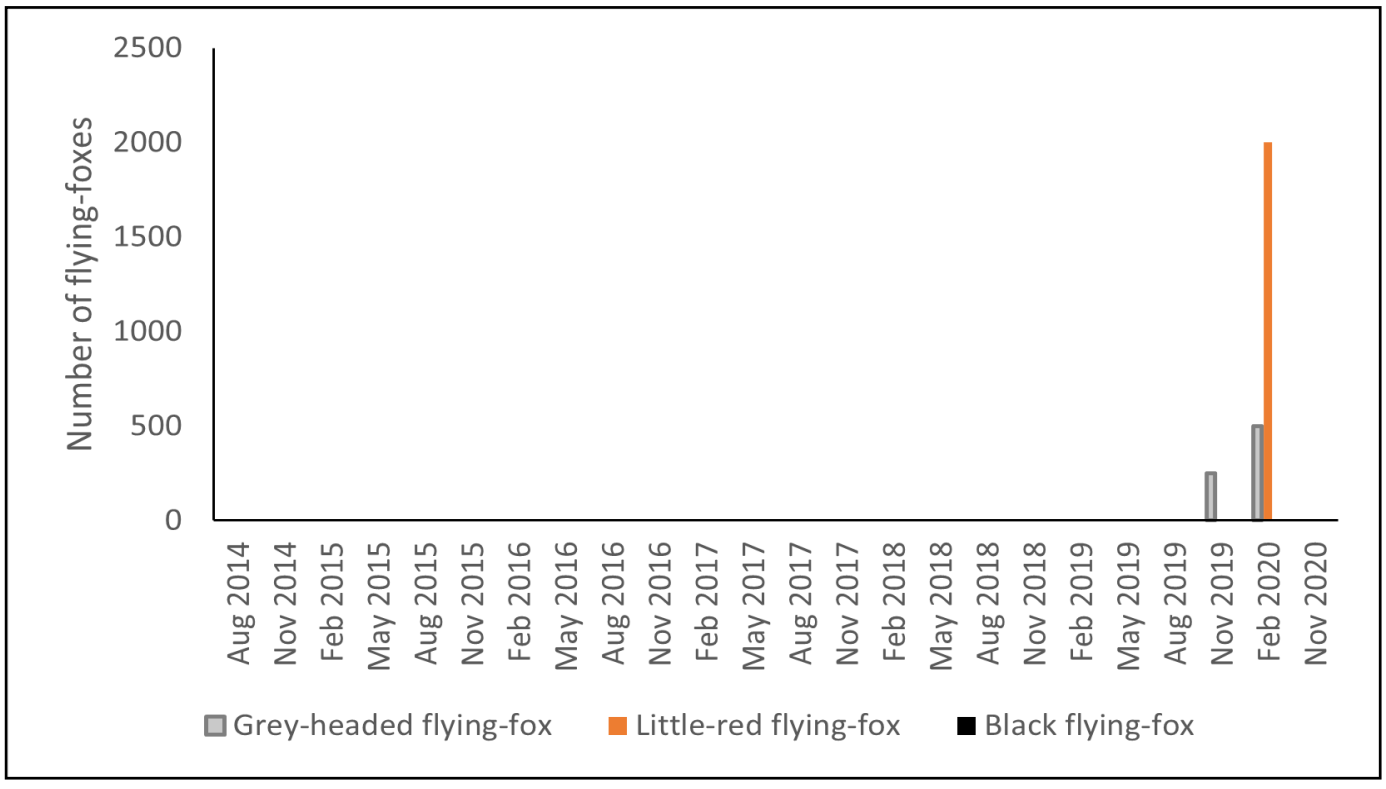


Figure 15: Clarence Town flying-fox camp size (August 2014- November 2020)

4.8 Paterson camp

The Paterson flying-fox camp is located approximately 10km to the west of the township of Paterson. Situated to the west of Cabbage Tree Creek on private property, off Webbers Creek Road, the camp occupies dry rainforest vegetation (**Figure 16**). The camp was established prior to 2000, but has mainly remained unoccupied since and is considered a historic camp.

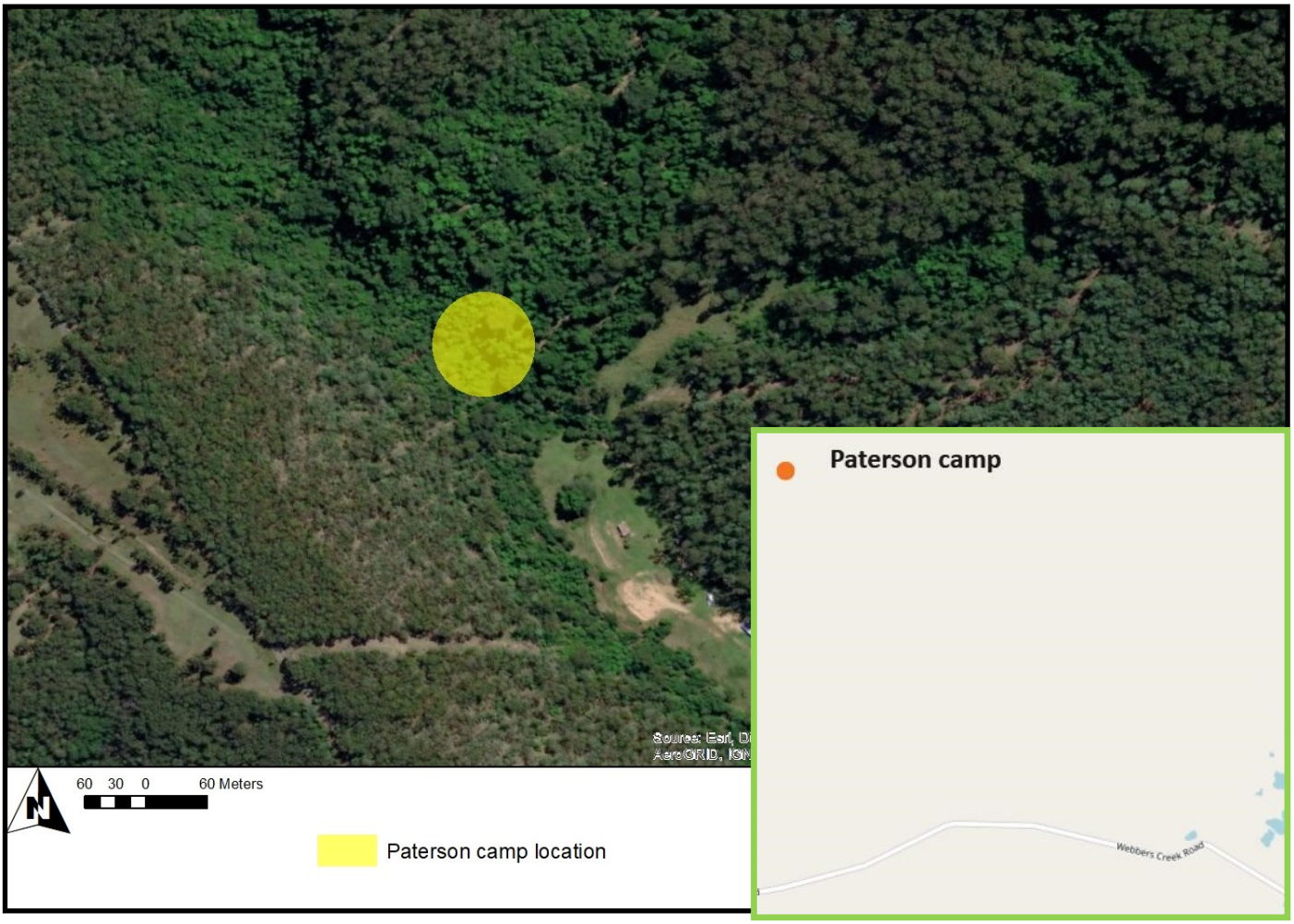


Figure 16: Location of Paterson flying-fox camp

4.9 Tocal camp

The Tocal flying-fox camp is located near the juncture of Webbers Creek and the Paterson River, approximately 2.5km south-west of the township of Paterson. The flying-fox camp is located within the grounds of the Tocal campus operated by the NSW Department of Primary Industries. The core camp area is approximately 450m from the heritage listed Tocal Homestead. The area is surrounded by sparsely occupied rural residential properties (**Figure 17**).

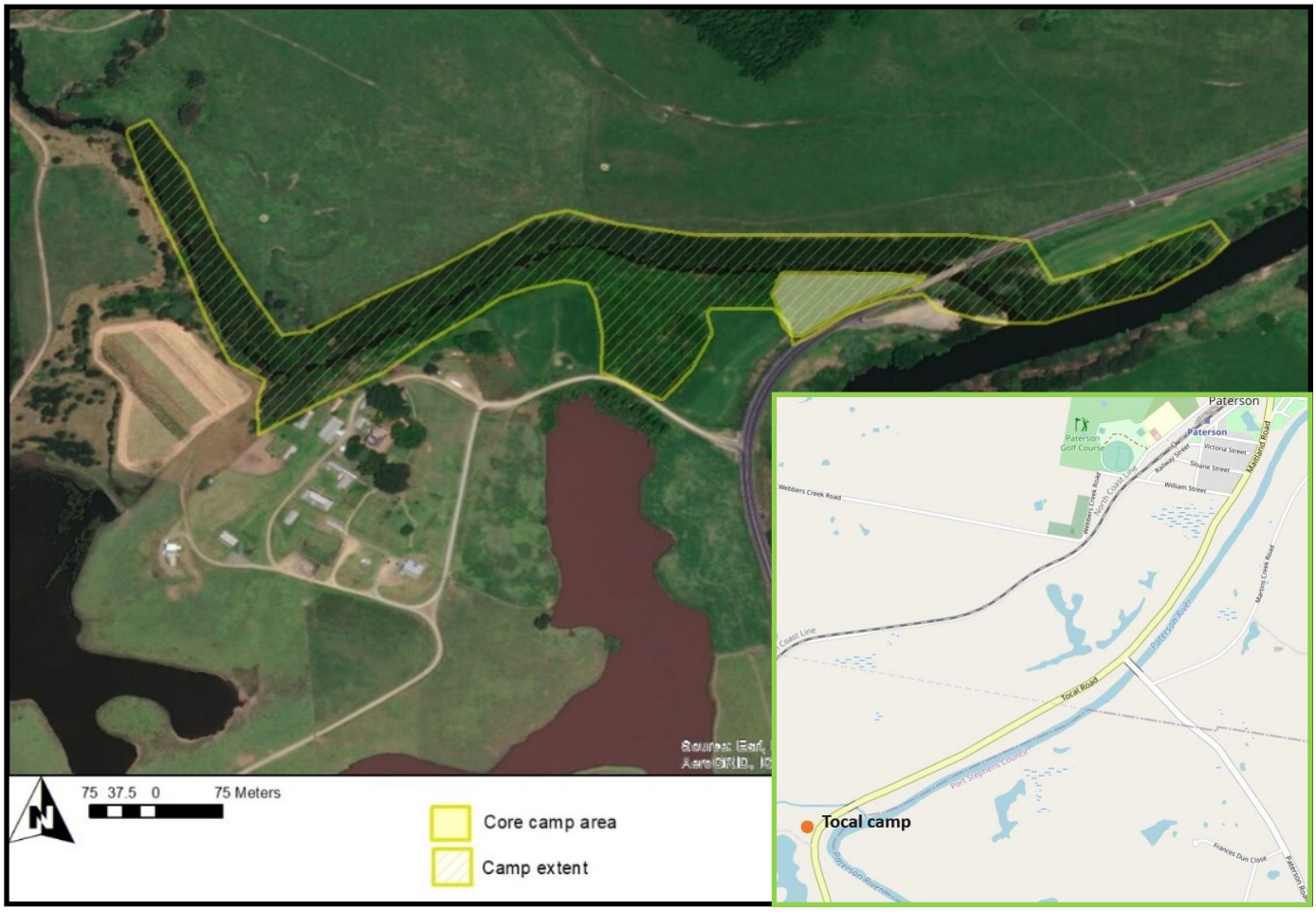


Figure 17: Location of Tocal flying-fox camp.

The Tocal flying-fox camp is located within planted and regenerating rainforest vegetation along Webbers Creek. The camp is primarily situated on the southern bank of Webbers Creek in vegetation dominated by River Oak (*Casuarina cunninghamiana*) with some White Cedar (*Melia azedarach*). The understorey of the vegetation community contains a high level of exotic Balloon Vine (*Cardiospermum grandiflorum*). The Tocal flying-fox camp was first recorded in 2000 and is annually used as a roosting site by GHFF, but has been utilised by all three NSW flying-fox species. The core camp covers an area of 0.58 ha, but when camp numbers fluctuate, as shown in February 2016 (See **Figure 18**) the camp area has extended to the west along Webbers Creek.

The Tocal camp has been monitored since the inception of the Commonwealth Government's National Flying-fox Monitoring Program with the first count in November 2012. Prior to the commencement of the monitoring program, it was recorded that over 250 000 flying-foxes were identified at the Tocal camp in May 2012. This was the largest recorded historical camp size in Dungog LGA and was in response to mass flowering of Spotted Gum *(Corymbia maculatata*) in the area.

Figure 18 shows the recorded Tocal camp size since November 2012. The Tocal flying-fox camp is a breeding site for GHFF and since November 2012 numbers have exceed 15000 individuals in some seasons.

When high numbers of flying-foxes occupy the camp the operation of the Tocal campus has been altered to accommodate the camp range increase. This has included movement of livestock and operation change at the homestead.

Issues with the camp have been confined to the Tocal campus and include

- Smell from the camp at Tocal Homestead
- Noise from the camp at Tocal Homestead.

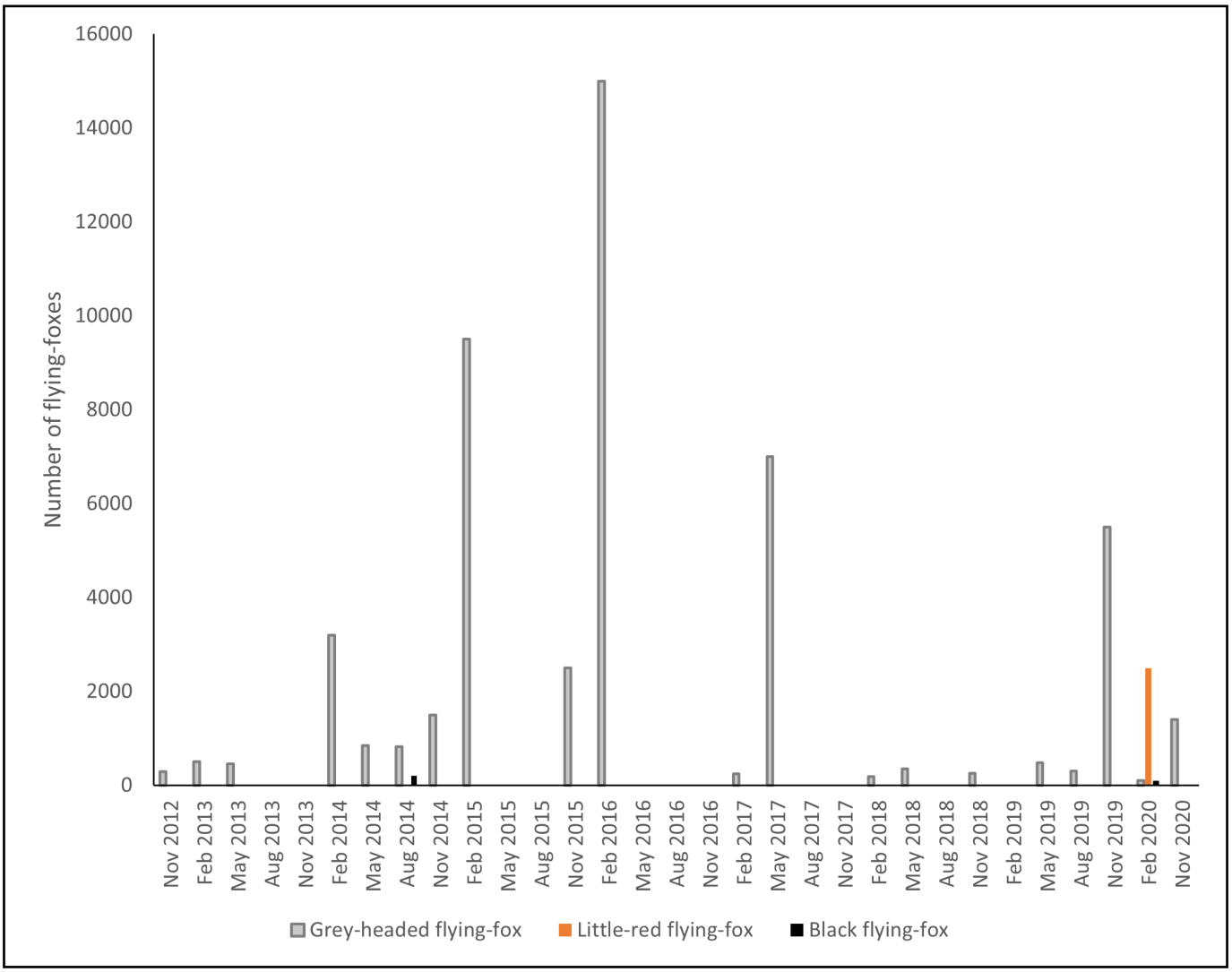


Figure 18: Tocal flying-fox camp size (November 2012- November 2020)

5. Development of the flying-fox management plan

5.1 Flying-fox camp management options

Flying-fox camp management options are categorised into three levels in accordance with the NSW Flying -fox Camp Management Policy (OEH 2015). The three levels of management options include

- Level 1: Routine camp management actions
- Level 2: Creation of buffers
- Level 3: Camp disturbance or dispersal

Table 4 provides a description of the levels of management actions, potential cost of implementation and the advantages/disadvantages of each action.

Culling of flying-foxes is sometimes raised by community members as a preferred management method. However, culling is considered contrary to the objectives of the Biodiversity Conservation Act 2016 and is not permitted as a method to manage flying-fox camps in NSW.

Image: Flying fox camp (credit: M Manning)

Table 4: Analysis of flying-fox camp management actions

Management option	Description	Cost
LEVEL 1 OPTIONS		
Education and awareness programs	Provide accurate information to the community regarding health and safety issues, program of management works at camps and how to reduce impacts from camps. Education opportunities may include 1. Interpretative signage at camps 2. School based educational packages 3. Community information days 4. Webpage educational materials 5. Shows, festivals or stalls.	Low
Property modification	Flying-fox camp land managers promote or encourage adoption of actions to minimise impacts from camp. These actions may include 1. Create visual/sound/odour barriers with fencing or hedges 2. Manage foraging trees through pruning, use of wildlife friendly netting or early removal of fruit 3. Covering vehicles, structures or clotheslines where faecal drop is an issue 4. Move or cover eating areas 5. Install double-glazed windows, insulation or use of air conditioners to reduce noise impacts or odour 6. Include suitable buffers 7. Consider removable covers for swimming pools and ensure filter maintenance is appropriate 8. Management of rainwater tanks including installing first flush systems.	Low-medium
Fund/subsidise property modifications	As per property modifications. Level and type of subsidy would need to be agreed by entity responsible for managing flying-fox camp.	Low-medium
Service subsidies	Provision of monetary subsidy to property owners to help manage impacts on their property. Services that could be subsidised include clothes washing, cleaning outside areas and property, car washing and power bills.	Low-medium

	Advantages	Disadvantages
	• Low cost • Promotes conservation of flying-foxes • Contributes to change of view and general need for camp intervention • Increased awareness of flying-foxes and provides options for landholders to reduce impacts and can be a long-term solution • Time efficient • Will not impact on ecological or amenity value of site.	• Education and advice will not mitigate all issues and may be perceived as not doing enough
	• Effective way to reduce amenity impacts of camp without dispersal • Relatively low cost • Can be undertaken quickly and will not impact the site • Potential addition of value to property.	• Potentially cost prohibitive for private land-owners • Unlikely to fully mitigate amenity issues in outdoor areas
	• Advantages as per property modification • Monetary cost not borne by private landholder	• Cost to land manager dependent on subsidy criteria • Criteria may be viewed as controversial or subjective
	• May encourage tolerance of living near a camp • Promotes conservation of flying-foxes • May be undertaken quickly • Will not impact on the site • Reduced need for property modification	• Costly if applied to a number of properties • Incurs ongoing costs • Criteria required to determine which properties receive subsidies

Management option	Description	Cost
LEVEL 1 OPTIONS		
Routine camp management	Routine actions are provided in the *Flying-fox Camp Management Policy 2015* including 1. Removal of tree limbs or trees that pose a genuine health and safety risk 2. Weed removal, including those listed under the Biosecurity Act 2015, or species listed as undesirable by Council. 3. Trimming of understorey vegetation or understorey planting 4. Minor habitat augmentation 5. Mowing of grass or similar groundskeeping actions 6. Application of mulch or leaf litter	Low
Alternative habitat creation	Revegetating and managing land to create alternative flying-fox roosting habitat through improving or extending low conflict camps or developing new roosting habitat in areas away from human settlements.	Medium-High
Provision of artificial roosting habitat	Construction of artificial structures, such as suspended ropes, to augment roosting habitat in current camps or to provide new roosting habitat.	Low-medium
Incident management protocols	Implementation of protocols for specific camps eg. management of companion animals at site, or protocols during events eg. heat stress events that result in change in flying-fox behavior or mortality.	Low
Additional research	Research to improve knowledge of flying-fox ecology to address knowledge gaps.	Low-High

	Advantages	Disadvantages
	• Allows for property maintenance • Potentially improve habitat • Improved public perception of site • Management of safety risks for public sites • Weed removal may reduce roost availability	• Will not generally mitigate amenity impacts for nearby landholders
	• If successful in attracting flying-foxes to dedicated habitat in low conflict areas impacts may be mitigated • Promotes flying-fox conservation • Rehabilitation of degraded habitat that is suitable for flying-fox use is potentially more practical and faster approach then habitat creation	• Generally high cost • Long-term approach so not undertaken quickly • Previous attempts to attract flying-foxes have low rate of success
	• If successful in attracting flying-foxes to artificial roosting habitat in low conflict areas impacts may be mitigated • Generally low cost • Undertaken quickly • Promotes flying-fox conservation	• Needs to combined with other measures eg. buffers, habitat creation, to mitigate impacts • Previous attempts have low rate of success
	• Low cost • Reduce risk of negative human/pet- flying fox interactions • Promotes flying-fox conservation • Undertaken quickly	• Will not generally mitigate amenity impacts
	• May contribute to more effective mitigation measures • Promotes flying-fox conservation	• Generally not undertaken quickly • Management trials may require additional costs

Management option	Description	Cost
LEVEL 1 OPTIONS		
Appropriate land use planning	Use of planning instruments such as LEP, DCP to ensure adequate distances are maintained between residential developments and camps.	Low
Property acquisition	Purchase of property to reduce impacts from flying-foxes.	High
Do nothing	Not undertaking management actions in relation to camp.	Nil
LEVEL 2 OPTIONS		
Buffers through vegetation removal	Removal of existing vegetation to alter the buffer area so it no longer is suitable as roosting habitat.	Low-Medium
Buffers without vegetation removal	Deterrents used to make buffer area unattractive for flying-fox roosting. Some deterrents have been trialed including 1. Visual deterrents including bags, high visibility vests or balloons 2. Noise emitters on timers 3. Smell deterrents 4. Canopy mounted water sprinklers	Medium
Noise attenuation fencing	Installation of fencing including timber or Perspex materials	Medium

	Advantages	Disadvantages
	• Potentially reduce future conflicts • Identification of appropriate habitat or degraded sites for rehabilitation could facilitate offset strategies	• Will not generally mitigate current impacts • Land use restrictions may impact landholders
	• Reduce future conflicts with owner of acquired property	• Owners may not want to sell property or move • Only improves amenity for properties that fit criteria for acquisition • Very expensive
	• No resource expenditure	• Impacts not mitigated • Community acceptance likely to be low
	• Reduction of impacts • Promotes flying-fox conservation • Undertaken relatively quickly • Limited maintenance costs	• Impact on ecology of site • Will not completely reduce impacts • Vegetation removal may not be favoured by community
	• Successful creation of buffers will reduce impacts • Promotes flying-fox conservation • Undertaken relatively quickly • Option without vegetation removal may be preferred by community	• May impact on ecology of site • Will not completely reduce impacts • Maintenance costs may be significant • Effectiveness currently unknown
	• Potential elimination or significant reduction of noise impacts • Other noise impacts reduced • Limited maintenance costs	• Capital costs high • Impact to visual amenity • Will not eliminate all impacts • May impact on other wildlife

Management option	Description	Cost
LEVEL 3 OPTIONS		
Nudging	Use of noise or other low-intensity disturbance methods to ‘nudge 'flying-foxes from one area to another within the same camp site	Medium-High
Passive dispersal through vegetation management	Encourage a camp to move to another location through removal of vegetation in a staged manner	Medium-High
Passive dispersal through water management	Encourage a camp to move to another location through removal of water source.	Medium-High
Active dispersal	Use of a wide range of tools such as noise, light or smoke to encourage camp to move to another location.	High
Early dispersal before new camp establishment	Monitoring of local vegetation for signs of roosting and undertaking passive or active dispersal options to discourage formation of new camp.	Medium-High

	Advantages	Disadvantages
	• If successful may eliminate impacts	• Costly • Flying-foxes will continue to attempt to recolonise area unless measure combined with habitat deterrents/modification
	• If successful may eliminate impacts • Reduced stress on flying-foxes • Less on-going cost	• Costly • Will impact ecology of site • Risk of removing habitat before outcome known • Potential splintering of camp creating issues at other locations • Potential animal welfare impacts • Negative public perception • Unknown conservation impacts • Unpredictability makes cost budgeting and risk unknown
	• As per passive dispersal through vegetation management	• As per passive dispersal through vegetation management • Likelihood of success unknown
	• If successful can mitigate impacts at site	• Potentially very costly • Often unsuccessful • Ongoing dispersal generally required unless combined with habitat modification • Potential splintering of camp creating issues at other locations • Potential animal welfare impacts • Negative public perception • Unknown conservation impacts • Unpredictability makes cost budgeting and risk unknown
	• As per passive dispersal through vegetation management • More likely to be successful than dispersal of historic camp	• As per passive dispersal through vegetation management • Potential to increase pressure on flying-fox habitat.

5.2 Community engagement

During the development of the Dungog Shire FFMP community input was sought regarding the flying-fox camps located in the LGA. Engagement with the community was undertaken with reference to the best practice principles developed by the International Association for Public Participation Spectrum of Public Participation (IAP2) (See **Figure 19**).

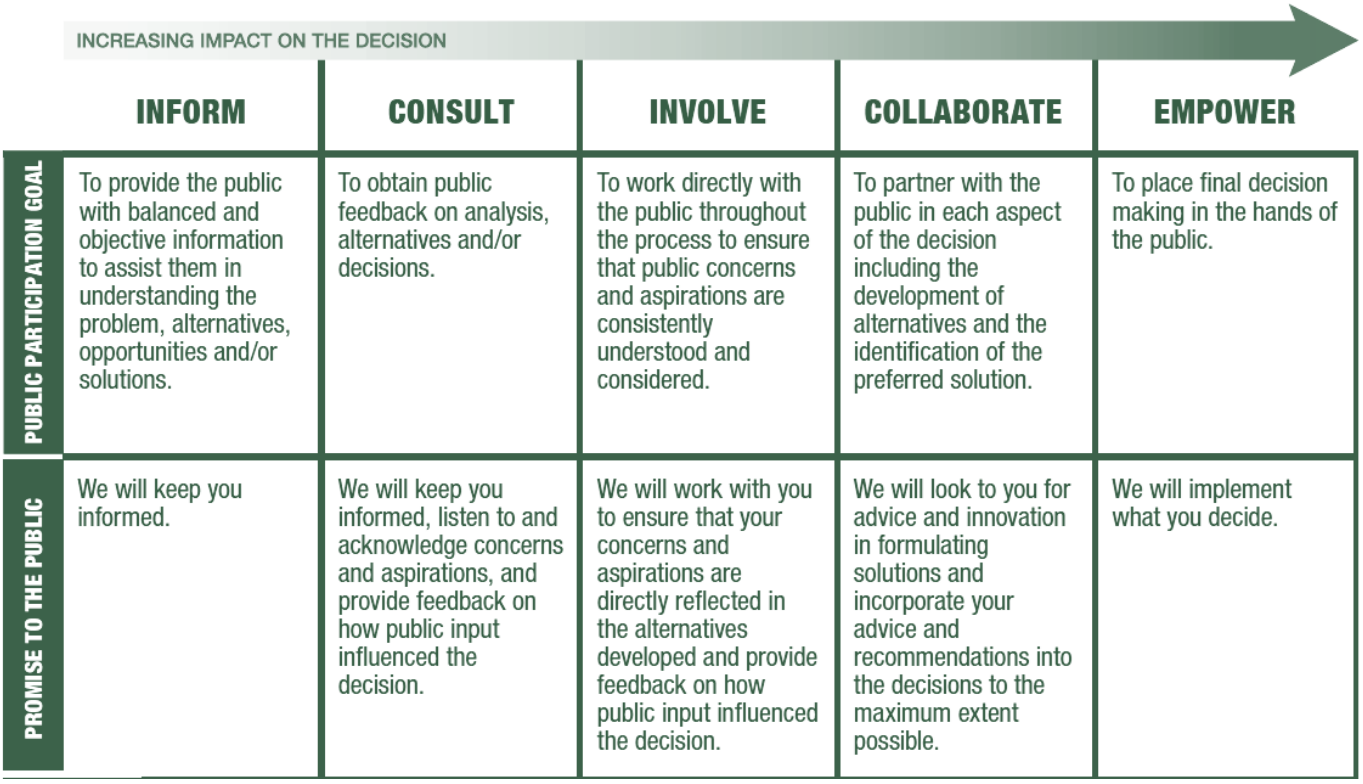


Figure 19: International Association of Public Participation spectrum

IAP2 promotes the values of involving the public in the decision-making process by government. The IAP2 Public Participation Spectrum has been used as a core tool to identify how the community could be involved in the development of the Dungog Shire FFMP.

The engagement process aimed to

- Understand the community's awareness of and concerns regarding flying-fox camps in Dungog Shire
- Seek feedback from the community to identify the most appropriate management actions for flying-fox camps
- Raise awareness in the community about flying-foxes

Table 5 outlines the community engagement methods used during the development of the Dungog Shire FFMP.

Table 5: Community engagement methods for feedback to Dungog Shire Flying-fox Management Plan

Engagement method	Dates	Outcomes	IAP2 type
Council Newsletter (Council happenings)	August 2020	• Announcement of start of flying-fox plan development	Inform
Flying-fox management advisory committee meetings	September 2020-February 2021	• Committee members provide expert advice and community views. • Provide input into engagement process • Review of management plan	Involve
Web page (Council website)	October 2020	• Flying-fox information provided • Direction to on-line survey	Inform, Involve
On-line survey	October 2020 - November 2020	• Community views on flying-foxes and potential management actions	Involve, Consult
Community information sessions	October 2020	• Information provided to community	Inform Involve
Media release (Dungog Chronicle)	October 2020	• Inform community regarding on-line survey and community information sessions	Inform
Social media	October 2020 - November 2020	• Inform community regarding on-line survey and community information sessions	Inform
Public exhibition	24 March 2021 - 30 April 2021	• Provide community feedback on draft FFMP • 4 submissions received	Consult

Promotion of the community information sessions and on-line survey were conducted through local radio interviews with the Dungog Mayor. Promotion of the on-line survey by Flying-fox Engage was also undertaken by distribution of information brochures at select locations in the LGA. These locations included

- The Williams River caravan park at Clarence Town
- Various business operations at Clarence Town

- Various businesses at East Gresford, Vacy and Paterson
- Business operations at Dungog
- Council Administration Building at Dungog

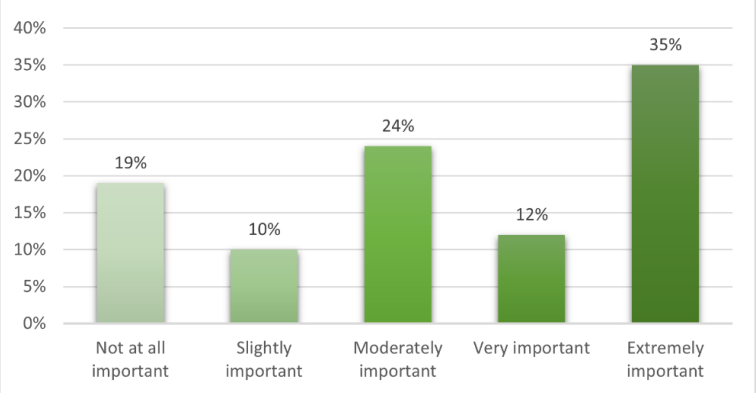
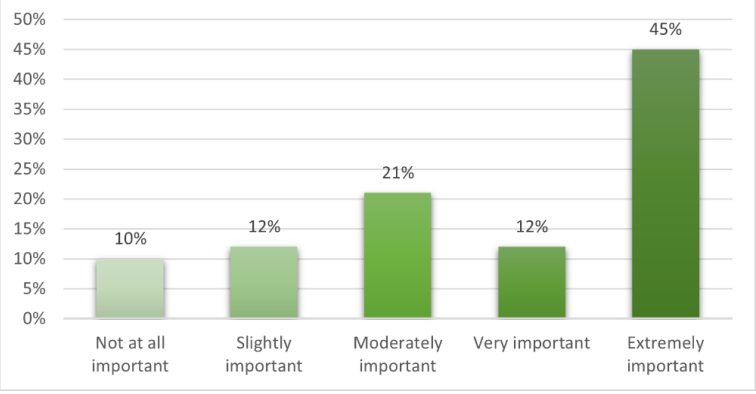
Additional letterbox drops of information brochures were also undertaken at residential properties near the flying-fox camp at Clarence Town.

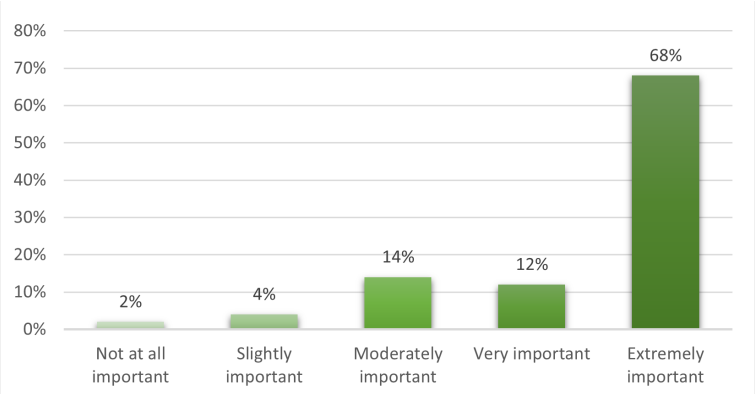
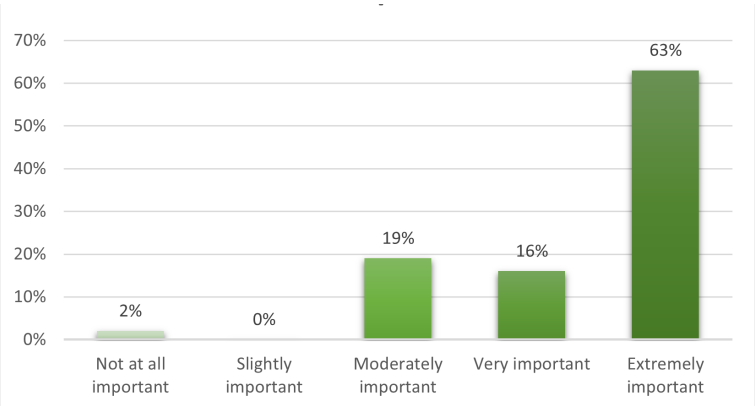
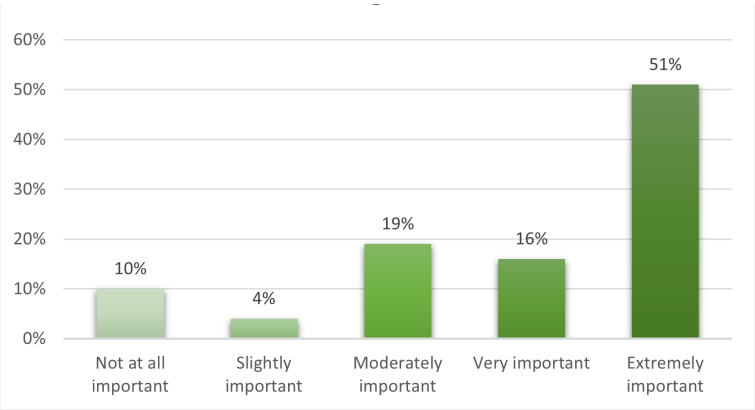
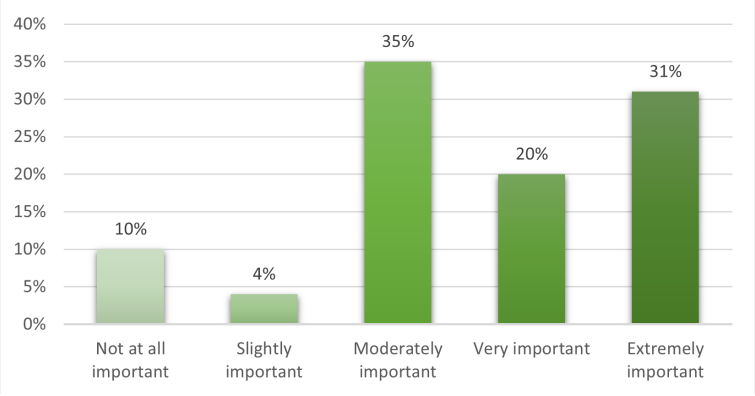
5.3 Community feedback

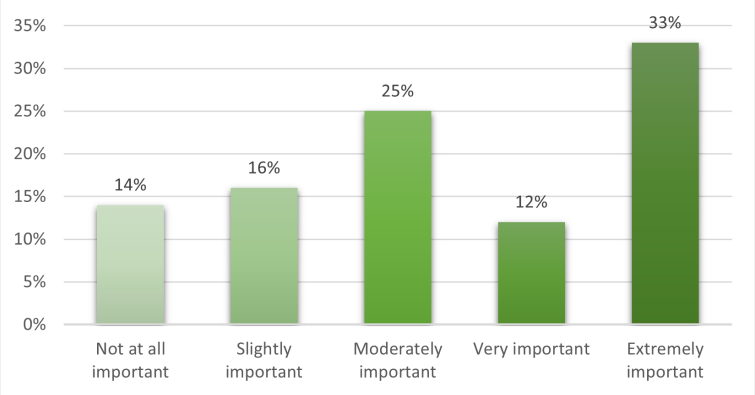
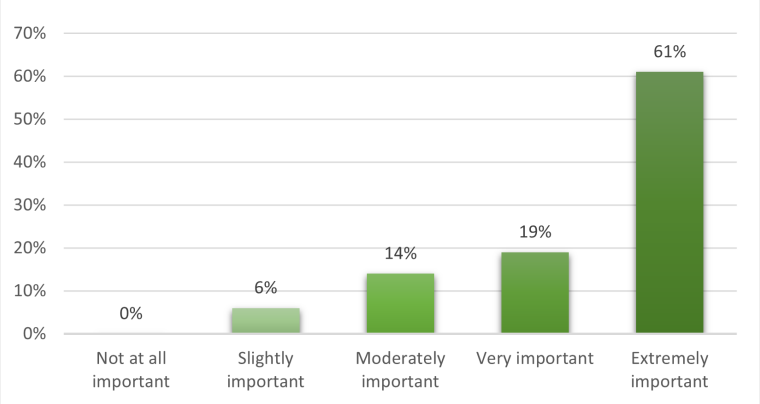
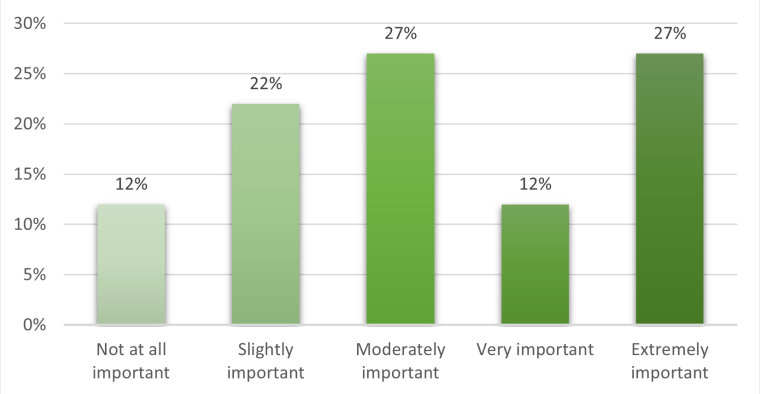
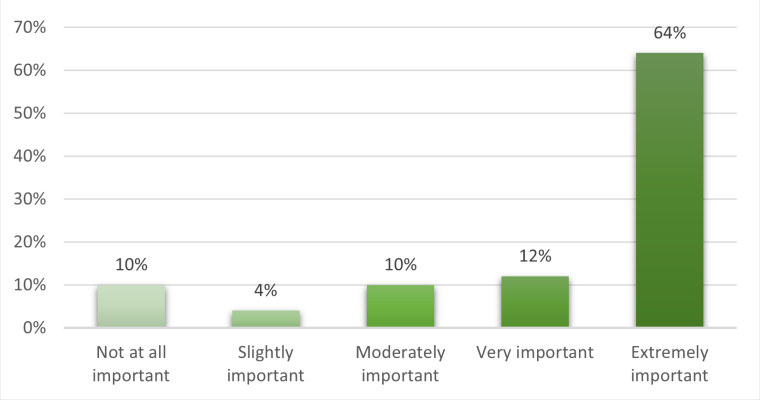
The primary community engagement method used to gain feedback for the development of the Dungog Shire FFMP was received through the Flying-fox Engage on-line survey. The survey was conducted from 19 October to 20 November 2020 in which 51 submissions were received.

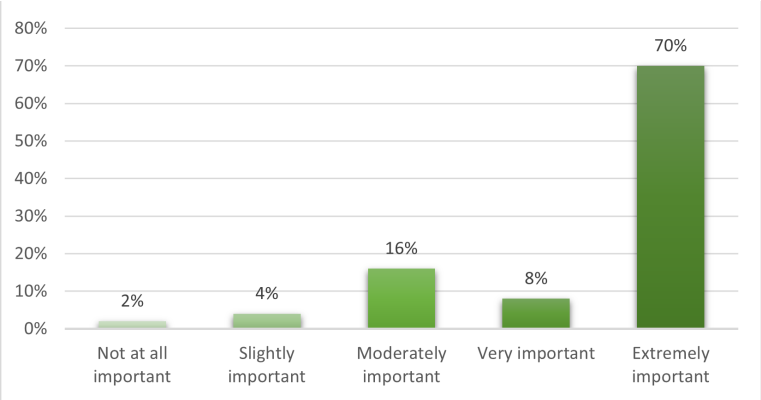
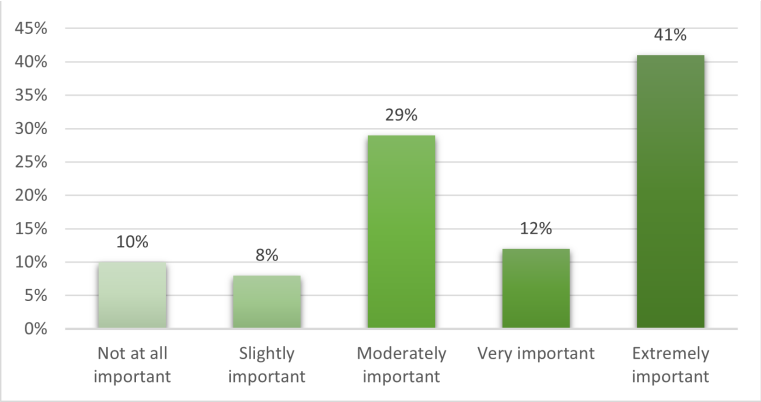
The Flying-fox Engage survey employs a simple survey methodology that poses twelve questions to users. The response to these questions produce a ranked list of preferred management options that reflect the input from the survey respondent. The management options can also be manually reordered (re-ranked) to suit the respondent.

Details of the survey questions and community responses are below.

Question	Survey response
1. 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?	
2. 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?	

Question	Survey response
3. 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?	
4. How important is it to you that the flying-fox camp management option ensures the risk of disease transmission remains low?	
5. How important is it to you that the flying-fox camp management option has low financial cost to residents living near the camp?	
6. How important is it to you that the flying-fox camp management option has a low financial cost to Council ratepayers?	

Question	Survey response
7. How important is it to you that the flying-fox camp management option can be implemented quickly?	
8. How important is it to you that the flying-fox camp management option provides a long-term solution?	
9. How important is it to you that the flying-fox camp management option does not disrupt residents and businesses during implementation?	
10. How important is it to you that the flying-fox camp management option does not harm the flying-foxes?	

Question	Survey response
11. How important is it to you that the flying-fox camp management option does not degrade the natural or ecological values of the site?	
12. How important is it to you that the flying-fox camp management option does not change the visual appeal or recreational opportunities currently undertaken at the site?	

Analysis of the community feedback showed that the impact of flying-fox excrement was greater for residents then odour or noise from flying-fox camps. The community feedback also highlighted that management of flying-camps was to be undertaken with minimal harm to the flying-foxes and the surrounding environment. While financial costs were a consideration the feedback provided indicated any management solution should be thoroughly considered and provide a sustainable long-term solution.

The results from the on-line survey engagement activity were utilised by Dungog Shire Council and other stakeholders to assist in developing the planned management approach for flying-fox camps across the LGA.

Image: Little-red Flying-fox roost (Credit ABC)

The preferred management options before and after re-ranking are set out in **Figure 20**. Provision of flying-fox education and awareness programs was the top preferred option both before and after re-ranking.

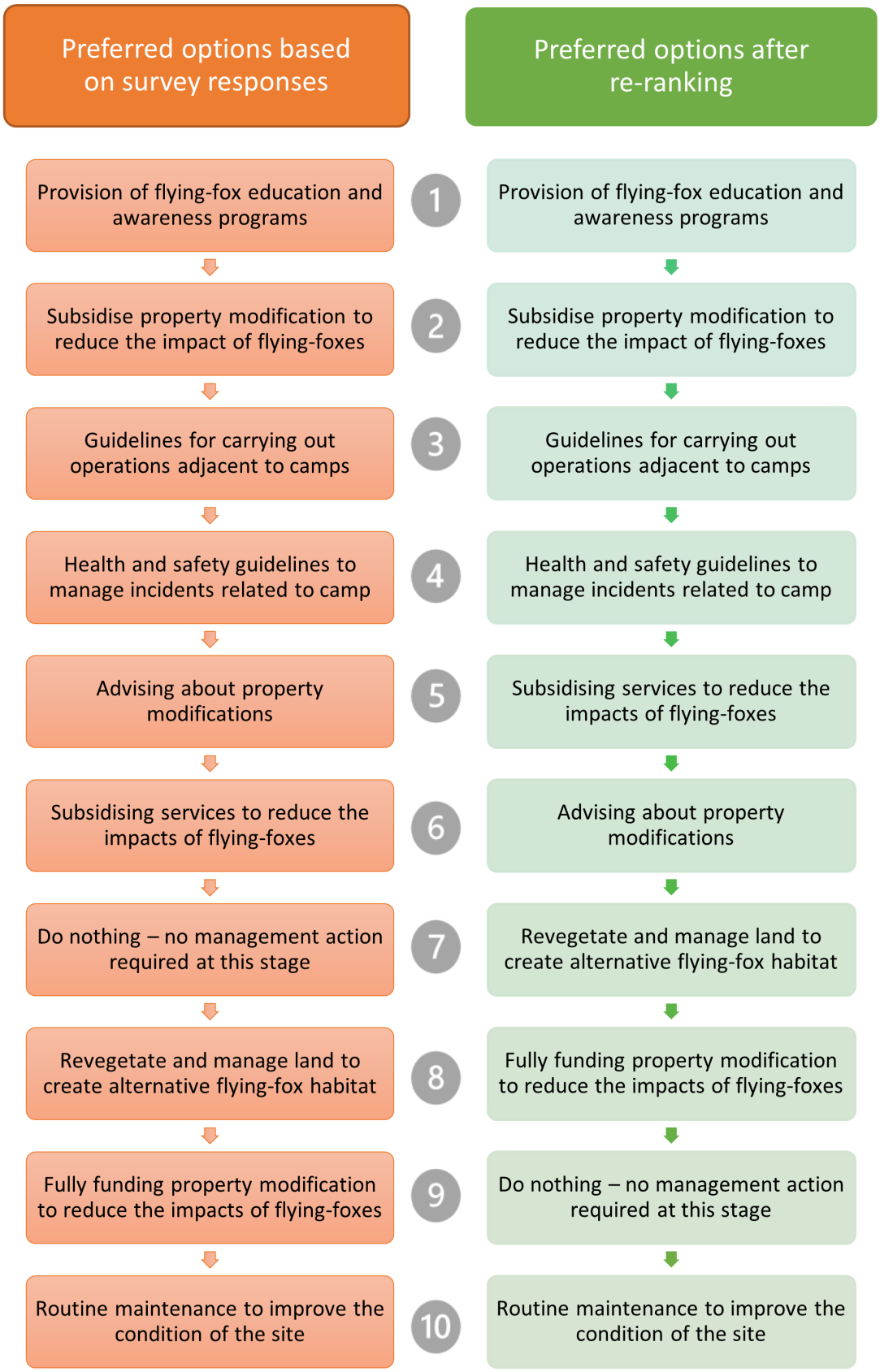


Figure 20: Preferred flying-fox camp management options for Dungog Shire

The survey also asked respondents to nominate whether they resided or owned a business within proximity of the flying-fox camps at Gresford, Clarence Town or Dungog (Williams River). Seven respondents were located within proximity of the Clarence Town camp while the Gresford and Dungog (Williams River) camps had two respondents each.

Figure 21 outlines the top five preferred management options for respondents located near the camps at Gresford, Clarence Town and Dungog (Williams River).

The survey results from respondents located within proximity of the camps showed the top preferred responses as mainly Level 1 actions or low impact actions to the existing camps.

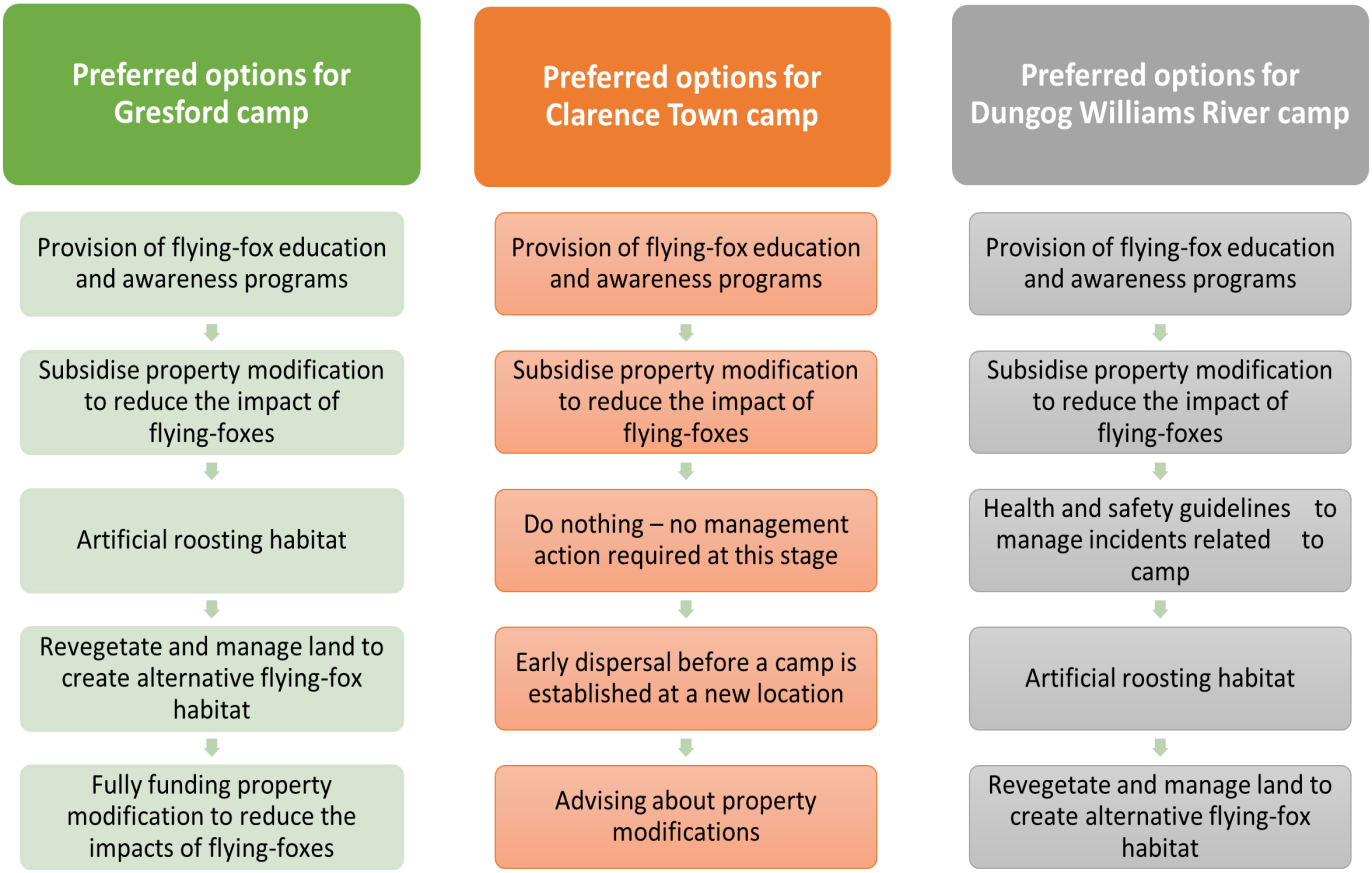


Figure 21: Preferred flying-fox camp management options for residents within proximity of a camp

6. Planned management approach

6.1 Local Government Area management actions

The general management actions to reduce impacts associated with flying-foxes in Dungog Shire are summarised in **Table 6** and are the responsibility of Council in consultation with other stakeholders. These actions have been determined after consideration of community views, environmental requirements and legislative/policy controls. The Dungog FFMP is a five year management document. Therefore, timeframes have been divided into short (1-2 year) and medium (3-5 year) periods for implementation with on-going review and management to occur into the future.

Table 6: Planned management actions for Dungog Shire Local Government Area

MANAGEMENT ACTION	ACTION DETAIL
EDUCATION AND AWARENESS PROGRAM	
Provide current, clear and accurate information to the community regarding flying-fox management including legislative requirements and disease transmission.	Develop a communication and education strategy in consultation with the flying-fox advisory committee to increase awareness of flying-foxes, including ecology and behaviour, and management of roosting camps.
	Enhance the Dungog Shire website to include relevant links and information to legislation and approvals regarding flying-fox management
	Enhance the Dungog Shire website to include education materials and factsheets regarding simple measures to mitigate health impacts and disease transmission from flying-foxes
	Enhance the Dungog Shire website to include information on products and modifications that residents can undertake to reduce flying-fox impacts eg. first-flush diverters, fruit tree netting.
	Meetings of the flying-fox advisory committee to continue to inform education and funding opportunities and identify new or emerging issues
Community informed of flying-fox numbers at camps and up-coming management actions to be undertaken	Dungog Shire website updated to include link to National Flying-fox Monitoring Program
	Engagement platforms, including social media or established email group, used to maintain awareness of management actions and keep the community informed and updated.

Image: Flying fox in flight

COST ESTIMATE (FUNDING SOURCE)	EVALUATION METHOD	TIMEFRAME
$2000-5000 (Council or State Government grant funding)	Communication and education strategy completed	Short
Minimal	Council website updated	Short
Minimal	Council website updated	Short
Minimal	Council website updated	Short
Minimal	Regular meetings of flying-fox advisory committee	On-going
Minimal	Council website updated to include monitoring program	Short
Minimal	Engagement platforms utilised for information distribution	On-going

MANAGEMENT ACTION	ACTION DETAIL
EDUCATION AND AWARENESS PROGRAM	
Provide on-going support for flying-fox management awareness and education.	Allocation of budget in Dungog Shire operational and delivery plans for flying-fox education and awareness project.
Strengthen partnerships with wildlife carer groups and provide education for community regarding distressed/injured flying-foxes	Enhance the Dungog Shire website to include information and contact details for wildlife carers within the LGA
PROPERTY AND SERVICE SUBSIDIES	
Investigate subsidies program for properties affected by flying-fox camps. Subsidies to reduce flying-fox impacts may include: • Vehicle covers • Covers for outdoor eating areas • Covers for swimming pools • Installation of noise reduction window glazing • Cost of energy use for air conditioning • Cleaning of areas where faecal drop is an issue	Subsidy program identifying eligibility criteria for residential/ business properties impacted by flying-fox camp(s)
Investigate purchase and management of high pressure cleaner(s) to be provided/rented to residents to clean areas affected by flying-fox faecal drop.	Dungog Shire to investigate purchase and implementation of high pressure cleaner program to affected residents.
ROUTINE CAMP MANAGEMENT	
Develop protocols and training for Council staff/contractors working in or near flying-fox camps to minimise flying-fox disturbance and impacts for surrounding landowners.	Dungog Shire to develop internal procedure ,in consultation with the flying-fox advisory committee, to minimise disturbance at camps.

COST ESTIMATE (FUNDING SOURCE)	EVALUATION METHOD	TIMEFRAME
$5 000/yr	Budget allocation provided in annual Council operational plan	Short-medium
Minimal	Council website updated with wildlife carer information.	Short
$2000 (State Government Grant funding)	Investigation of subsidy program completed	Medium
$1500 (State Government funding)	Investigation of high pressure cleaner program undertaken and/ or implemented	Medium
$1500 (Council or State Government Grant funding)	Flying-fox camp operational procedure developed.	Short-medium

MANAGEMENT ACTION	ACTION DETAIL
INCIDENT MANAGEMENT PROTOCOLS	
Develop a flying-fox incident or emergency response procedure.	In consultation with relevant organisations Dungog Shire Council to identify roles and responsibilities in developing a response procedure for: • Camps with an influx of flying-foxes • New or emerging camps • Impacts to camps during or after adverse weather events eg. bushfire threat, extreme heat events, including monitoring for potential events. • Decision support tools for camp management
ADDITIONAL RESEARCH	
Participate in local and regional flying-fox monitoring or research including citizen science programs.	Support research that will assist in understanding local flying-fox movements and ways to mitigate impacts from flying-fox camps.
Mapping of potential flying-fox roosting habitat within Dungog LGA	Undertake mapping of vegetation communities that may have potential for flying-fox roosting habitat
APPROPRIATE LAND-USE PLANNING	
Review of the Local Environmental Plan (LEP) to investigate potential flying-fox camp buffers to reduce impacts.	Potential review of land uses and zones around flying-fox camps to identify buffers and reduce potential impacts and conflicts with flying-fox camps.
Review of development control plans to include buffers or retention of native vegetation around flying-fox camps	Review development control plans to include provision of cleared buffers or native vegetation buffers near flying-fox camps
Investigate potential application of flying-fox buffer notations to Section 10.7 certificates under the Environmental Planning and	Investigate potential application of a notation to certificates to highlight presence of flying-fox camp in surrounding area.
Assist in identifying potential flying-fox stewardship sites under the Biodiversity Conservation Act 2016.	Assist private landowners with information regarding biodiversity offsetting and stewardship agreements for flying-fox habitat.

COST ESTIMATE (FUNDING SOURCE)	EVALUATION METHOD	TIMEFRAME
$2000 (Council or State Government Grant funding)	Incident or emergency response procedure completed.	Short-medium
Variable	Support to identified research provided	On-going
High	Potential roosting habitat mapping completed	Medium
Minimal	Review of potential buffers in planning instrument completed	Medium
Minimal	Review of inclusion of buffers within development controls plans completed	Medium
Minimal	Review of potential application to Section 10.7 certificates completed.	Medium
Minimal	Support provided to landowners regarding stewardship agreements.	On-going

6.2 Management actions for individual camps

While **Table 9** outlines general management actions the following tables outline additional management actions for the nine identified flying-fox camps within Dungog Shire. A number of the flying-fox camps are located on private property and the Dungog Shire FFMP does not endorse the community or private landowners to undertake flying-fox management actions without proper consideration of legislative requirements. While Council can assist in helping private landowners achieve the following management actions private landowners will need to comply with the NSW Flying-fox Camp Management Policy 2015 and gain necessary approvals including the potential requirement for a biodiversity conservation licence.

6.2.1 Allyn River camp

The Allyn River flying-fox camp is located approximately 200-300m upstream of White Rock campground within the Chichester State Forest. Located within a heavily vegetated area the flying-fox camp has not surrounding sensitive land uses or receivers and is currently having minimal impact. The Forestry Corporation of NSW is the responsible land manager and on-going management of the flying-fox habitat will be undertaken through the Coastal Integrated Forestry Operations Approval issued to the Forestry Corporation of NSW by the NSW Environment Protection Authority.

As part of the community education and awareness management action it is recommended that the potential installation of educational signage at White Rock campground be undertaken in collaboration with the Forestry Corporation of NSW.

6.2.2 Main Creek camp

The Main Creek camp is located within the boundary of the Chichester State Forest. The flying-fox camp is currently having minimal impact on surrounding land uses and management of the camp will continue through the Coastal Integrated Forestry Operations Approval issued to the Forestry Corporation of NSW by the NSW Environment Protection Authority.

6.2.3 Gresford camp

The Gresford flying-fox camp is located on private property, with both residential and horticultural land uses. While the Dungog FFMP cannot require management actions to be undertaken on private property **Table 10** provides potential management actions to assist in maintaining flying-fox habitat within the locality while reducing potential community impacts from the camp. **Figure 22** provides a visual reference for the actions outlined in **Table 10**.

Table 10: Potential flying-fox management actions for Gresford camp

Management Strategy	Management Action	Action detail	Cost estimate (Funding source)
Alternative habitat creation	Investigate potential planting to the east of existing camp to provide additional habitat away from town centre (see **Figure 22**).	Investigate potential for additional planting within riparian zone to provide roosting and foraging habitat	Unknown at this stage
Buffers through vegetation removal	Investigate a buffer area between the flying-fox camp area and the existing residential/commercial facilities at the property.	Investigate removal of some vegetation to form a buffer between flying-fox camp and the existing buildings on the property.	Unknown at this stage.

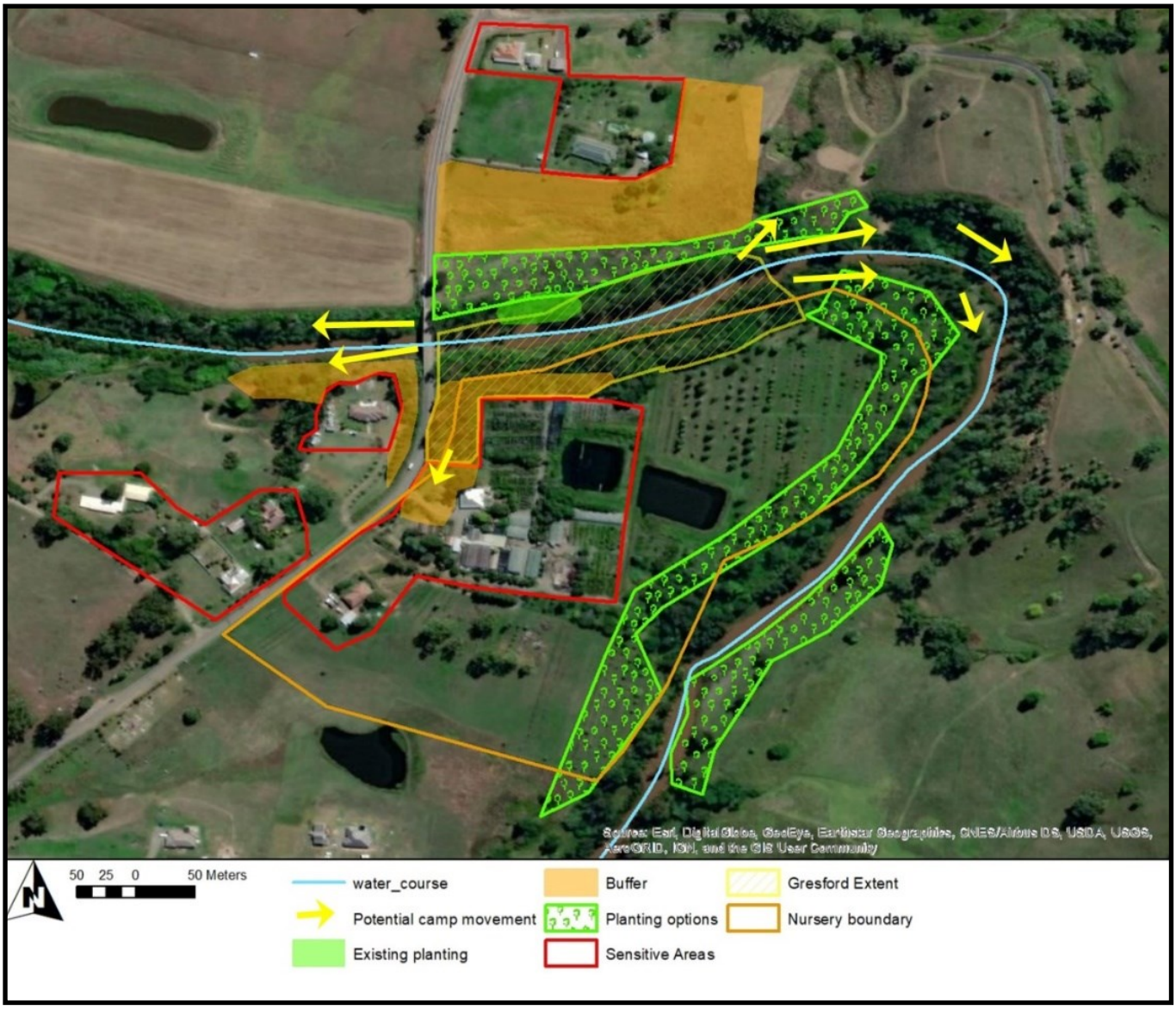


Figure 22: Potential additional flying-fox management actions for investigation at Gresford camp

6.2.4 Mount Richardson camp

The Mount Richardson flying-fox camp is located on private property and has not been occupied for a number of years. Furthermore, no sensitive land uses or receivers are located near the historical camp location. No management actions are currently required for the camp location.

6.2.5 Dungog (Williams River camp)

The Dungog flying-fox camp is located on private property and is a recently formed roosting site. While the Dungog Shire FFMP cannot require management actions to be undertaken on private property **Table 11** provides an additional management action to assist in maintaining flying-fox habitat while reducing potential community impacts from the camp. **Figure 23** provides a visual reference for the action outlined in **Table 11** .

Table 11: Potential flying-fox management action for Dungog (Williams River) camp

Management Strategy	Management Action	Action detail	Cost estimate (Funding source)
Alternative habitat creation	Investigate potential planting to north and east of existing camp to provide additional habitat away from residential properties	Investigate potential for additional planting within riparian zone to provide roosting and foraging habitat	Unknown at this stage (Private or partnership, State Government grant funding)

Image: Cooreei Bridge over Williams River (credit: Cgoodwin)

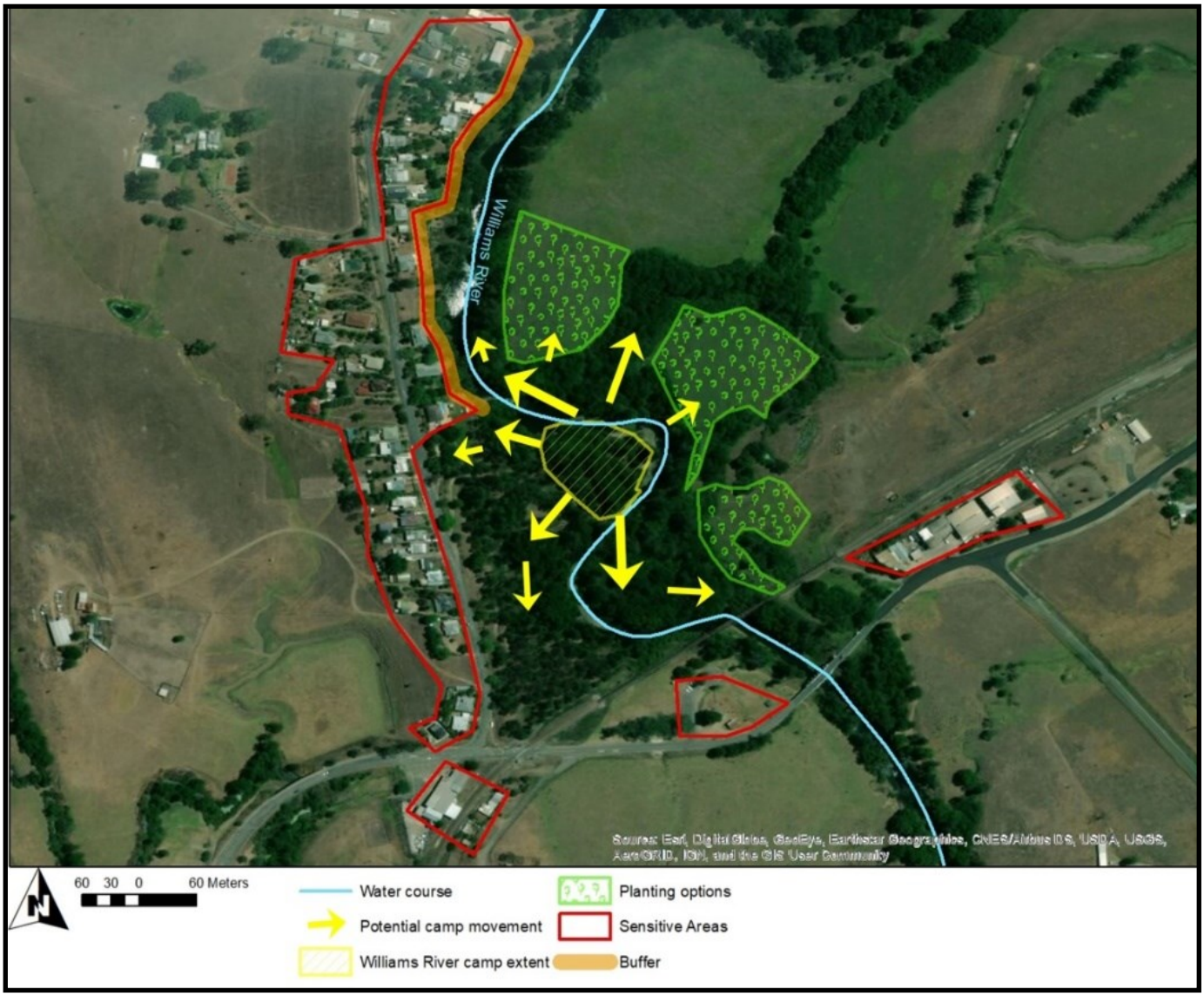


Figure 23: Potential additional flying-fox management action for investigation at Dungog camp

6.2.6 Glen William camp

The Glen William camp is located on private property. While the Dungog Shire FFMP cannot require management actions to be undertaken on private property **Table 12** provides an additional management action to assist in maintaining flying-fox habitat while reducing potential community impacts from the camp. **Figure 24** provides a visual reference for the action outlined in **Table 12.**

Table 12: Potential flying-fox management action for Glen William camp

Management Strategy	Management Action	Action detail	Cost estimate (Funding source)
Alternative habitat creation	Investigate potential planting within riparian zone on the property to provide additional habitat.	Investigate potential for additional planting within riparian zone to provide roosting and foraging habitat	Unknown at this stage (Private or partnership, State Government grant funding)

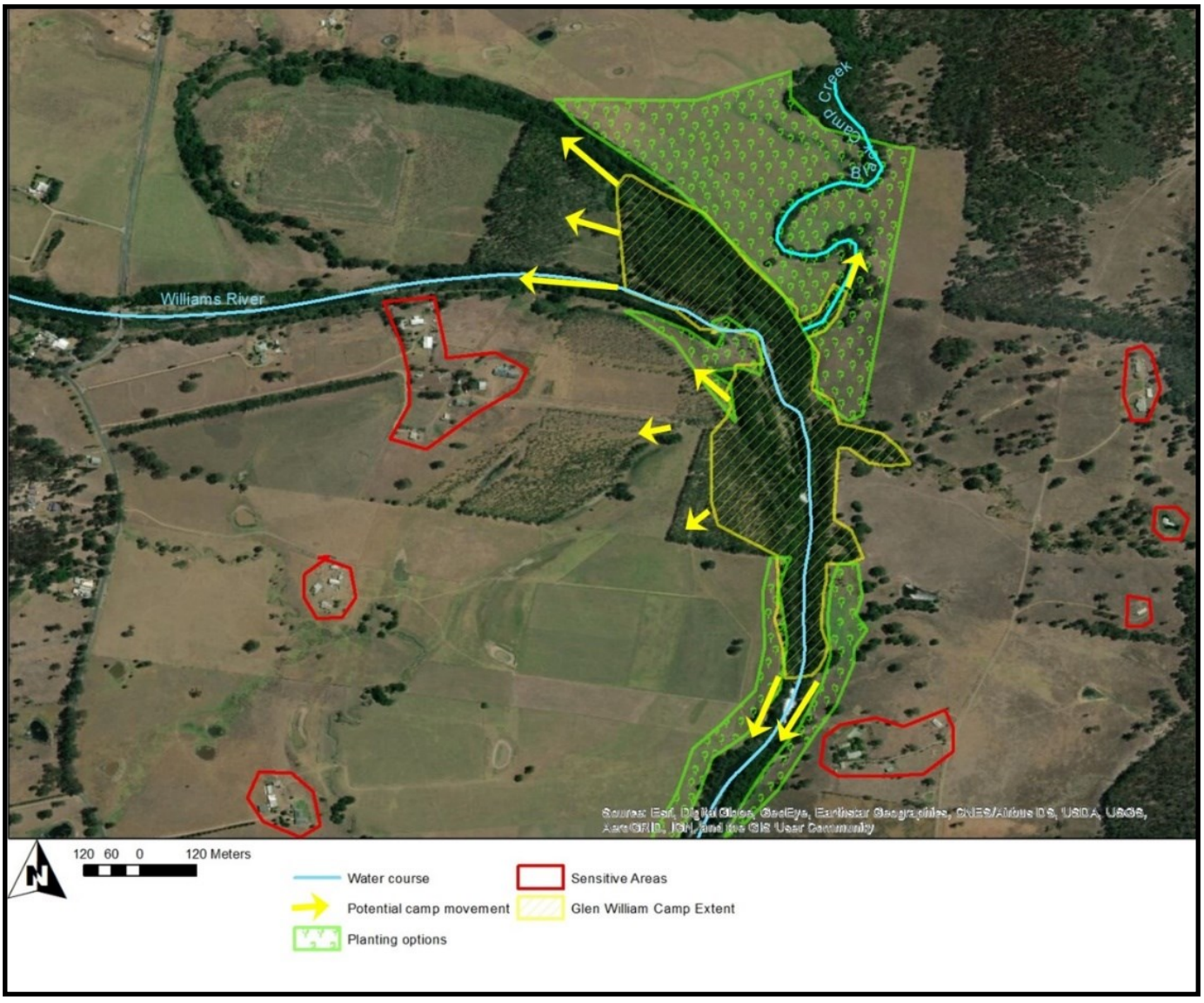


Figure 24: Potential additional flying-fox management actions for investigation at Glen William camp

6.2.7 Clarence Town camp

The Clarence Town flying-fox camp is primarily located on land owned or managed by Dungog Shire Council. In addition to management actions outlined in **Table 9** it is recommended that additional actions outlined below (**Table 13**) be undertaken or investigated to address potential impacts from the flying-fox camp. Due to the variability in the size of the Clarence Town flying-fox camp it must be noted that the actions outlined in **Table 13** will be undertaken dependant on camp size and impact on surrounding properties from the camp. **Figure 25** provides a visual reference for the actions for alternative habitat creation and buffers through vegetation removal outlined in **Table 13**

Table 13: Additional flying-fox management actions for Clarence Town camp

Management Strategy	Management Action	Action detail	Cost estimate (Funding source)
	Prepare and implement a **management plan** for the caravan park facility under the Local Government Act 1993	Management plan and operational plan to incorporate potential measures for flying-foxes including • Educational material for users of the facility • Educational signage • Movement of operational camping areas in response to flying-fox roosting increases • Potential acquisition of areas for new camping sites • Planting of suitable species within core camp area to retain flying-foxes in the core camp.	$10 000 (Council, Crown Land Partnership, State Government grant funding)
Alternative habitat creation	Investigate potential planting within riparian zone along the William River	Investigate potential for additional planting within riparian zone to south -east of the existing camp to provide roosting and foraging habitat away from residential properties	$10 000-$20 000 for investigation (Council, Crown Land Partnership, State Government grant funding)
Buffers through vegetation removal	If required Investigate a buffer area between the flying-fox camp area and the existing residential properties along Durham and Russell Street	Investigate removal of some vegetation to form a buffer between flying-fox camp and the existing residential properties	$10 000 (Council, State Government grant funding)

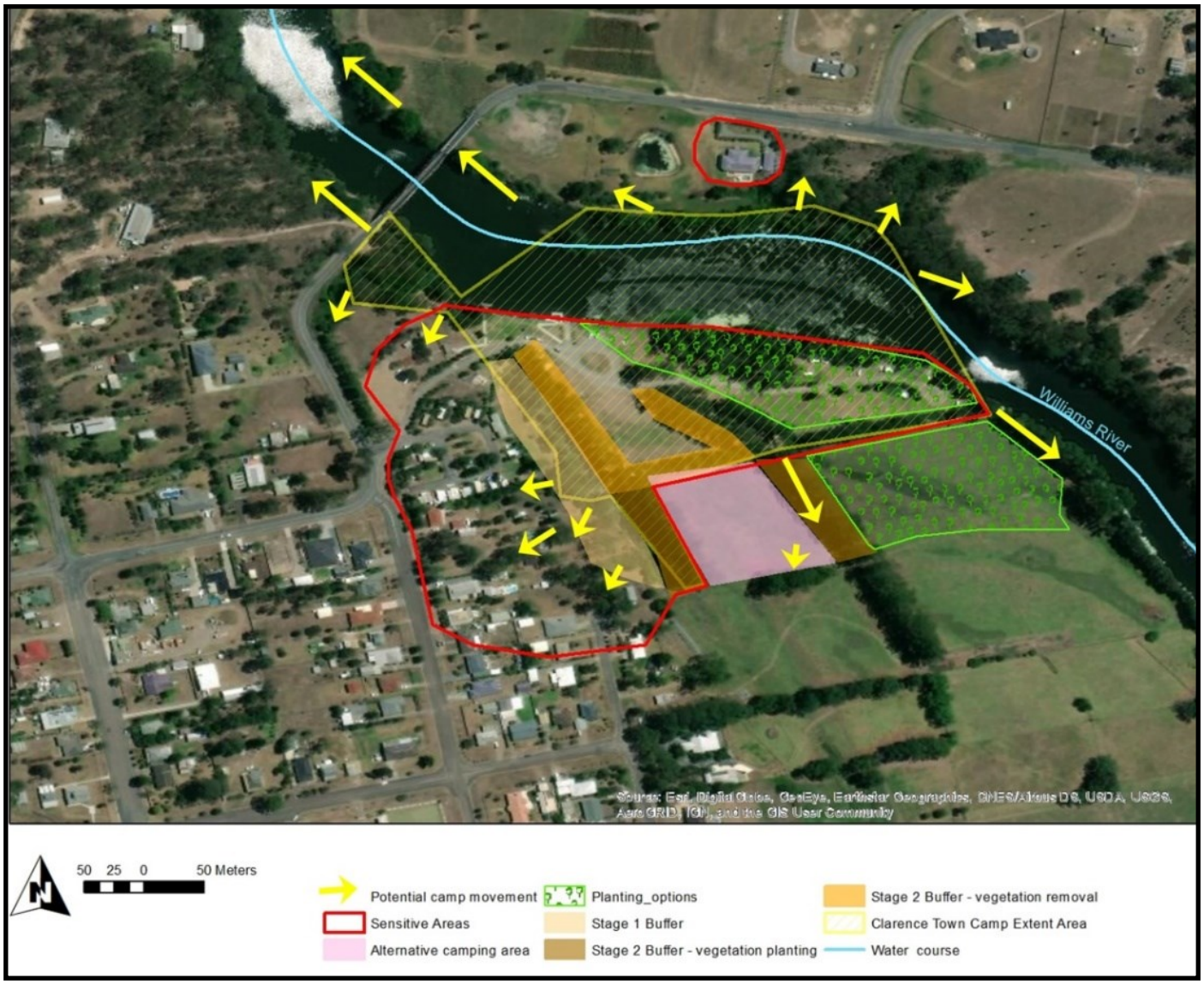


Figure 25: Potential additional flying-fox management actions for investigation at Clarence Town camp

Image: Site of flying fox camp expansion around Williams River (Credit: N Williams)

6.2.8 Paterson camp

The Paterson flying-fox camp is located on private property and has not been occupied for a number of years. Furthermore, no sensitive land uses or receivers are located near the historical camp location. No management actions are currently required for this camp location.

6.2.9 Tocal camp

The Tocal flying-fox camp is located on property owned and managed by the Department of Primary Industries. The flying-fox camp is currently managed through the existing Department of Primary Industries operational and biosecurity plans for the property. **Table 14** provides potential management actions to assist in maintaining flying-fox habitat within the locality while reducing potential community impacts from the camp. **Figure 26** provides a visual reference for the management actions in **Table 14**.

Table 14: Additional flying-fox management actions for Tocal camp

Management Strategy	Management Action	Action detail	Cost estimate (Funding source)
Alternative habitat creation	Investigate potential planting along Webbers Creek to provide additional habitat.	Investigate potential for additional planting within riparian zone to provide roosting and foraging habitat	Unknown at this stage
Buffers through vegetation removal	Investigate a buffer area between the flying-fox camp area and the existing Tocal Homestead facilities.	Investigate removal of some vegetation to form a buffer between flying-fox camp and the existing buildings on the property.	Unknown at this stage.

Image: Tocal Homestead

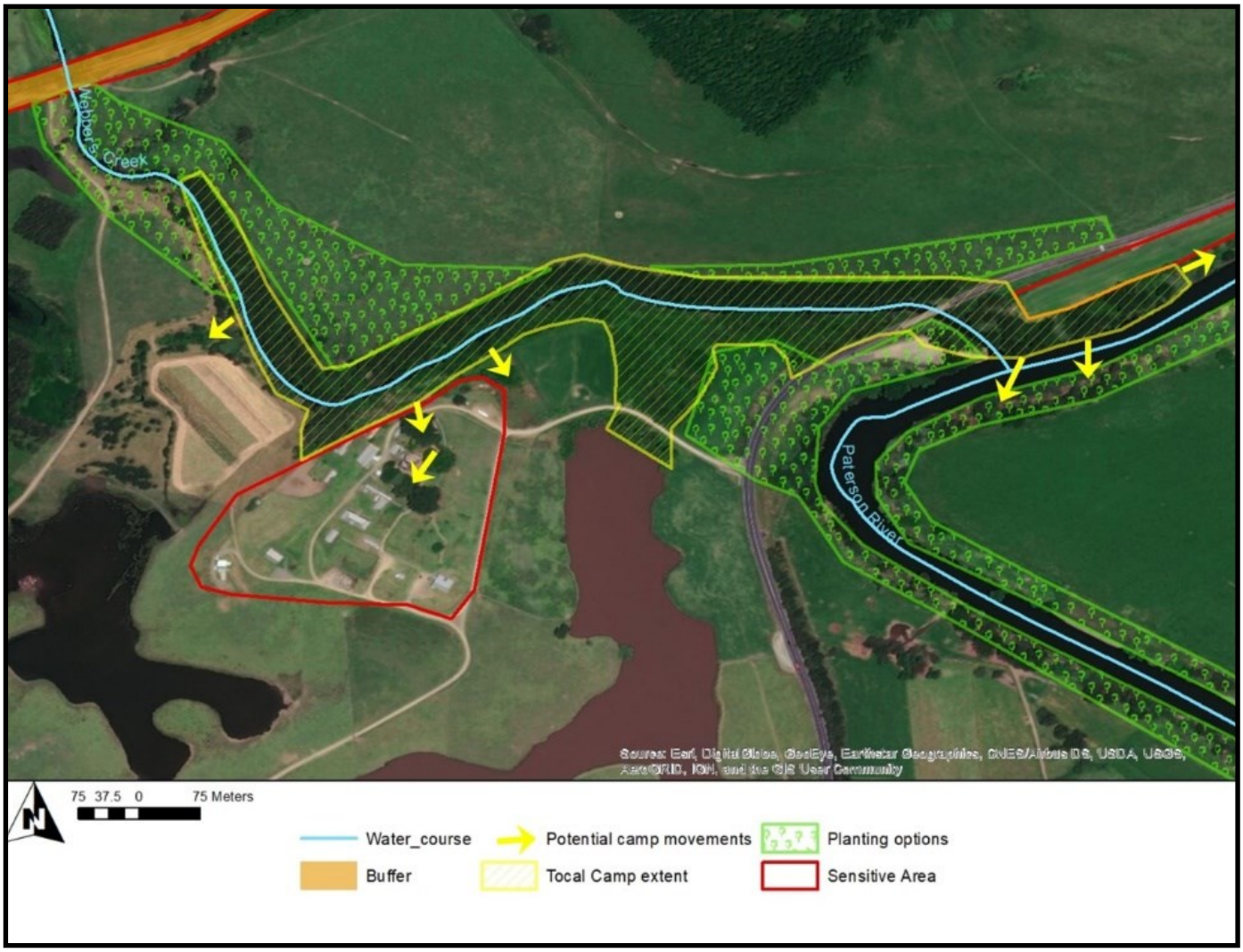


Figure 26: Potential additional flying-fox management actions for investigation at Tocal camp

7. Evaluation and review

The management actions outlined in **Section 6** will be evaluated in accordance with the their individual evaluation methods. The Dungog Shire FFMP will be reviewed annually by Council and the established Flying-fox Advisory Committee. The annual review will assist in the inclusion of appropriate flying-fox management actions within Council operational and delivery plans.

The following will trigger additional review of the FFMP

- Completion of management activities
- Progression to a higher level of management action
- Changes to relevant policies/legislation
- New or more efficient management techniques becoming available
- New research outcomes that may improve or enhance the FFMP
- Incidents associated with any of the flying-fox camps.

The results of any review will be included in reports to Council and DPIE.

If the Plan is to remain current, a full review including stakeholder consultation and expert input will be undertaken in the final year (year 5, 2026) of the Dungog Shire FFMP timeframe prior to being re-submitted to the NSW State Government.

Image: Dungog Shire landscape

8. Administration of Management Plan

8.1 Flying-fox camp monitoring

Council and other stakeholders will continue to assist in undertaking the quarterly surveys for the National Flying-fox Monitoring Program. Additional monitoring and data collection will occur as opportunities arise.

8.2 Reporting

Progress reports and review will be undertaken as outlined in **Section 7** and throughout the term of the FFMP. Reports will be submitted to the Flying-fox Advisory Committee and the elected Council. Any reporting to DPIE will be undertaken in accordance with the requirements of the Flying-fox Camp Management Code of Practice 2018 or licensing conditions.

8.3 Management

The Dungog Shire FFMP has been developed by Council to include the known flying-fox management camps within the LGA. These camps are located across a number of different land tenures including both Government and private ownership. While Council has primary responsibility for management and review of the FFMP only one flying-fox camp is located on Council owned/managed land. Therefore, to ensure a holistic management of camps within the LGA the various landowners and managers are to reference the actions in this plan when seeking to undertake management of camps.

8.4 Adaptive management

The Dungog Shire FFMP is an adaptive document that may be updated as situations change or further research improves understanding of flying-fox behaviour and ecology and the management of community impacts. Flying-fox camps in Dungog Shire will change and new camps may become established. An adaptive management plan allows Council to respond to these changes or unforeseen conflicts as they arise. Council will consult with the State Government regarding any proposed changes to the management plan.

8.5 Funding commitment

Potential funding of management actions is to be undertaken in accordance with the identified funding streams outlined in **Section 6**. The management of flying-foxes in Dungog Shire includes various land tenures and commitment from property owners/land managers is required to fund management actions outlined in the plan.

The *Local Government Act 1993* requires Councils to prepare planning and delivery documents through the Integrated Planning and Reporting Framework. Dungog Shire will investigate potential funding of management actions through the four year delivery program and annual operational plans. The annual operational plan, including budget items will be included and implemented as required.

Dungog Shire will also provide in kind assistance (non-financial where possible) to private landholders to facilitate the management actions on their properties.

Image: Grey headed Flying-fox

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Appendix A

Flying-fox ecology and behaviour

Reproduced from Flying-fox Camp Management Plan Template 2019 by Department of Planning, Industry and Environment

1.1 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).

1.2 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.

1.3 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).

1.4 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).

1.5 Species profiles

1.5.1 Black flying-fox (*Pteropus alecto*)

Figure 1 Black flying-fox indicative species distribution (adapted from DPIE 2019a)

The black flying-fox (BFF) (Figure 1) 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.

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

Figure 2 Grey-headed flying-fox indicative species distribution (adapted from DPIE 2019a)

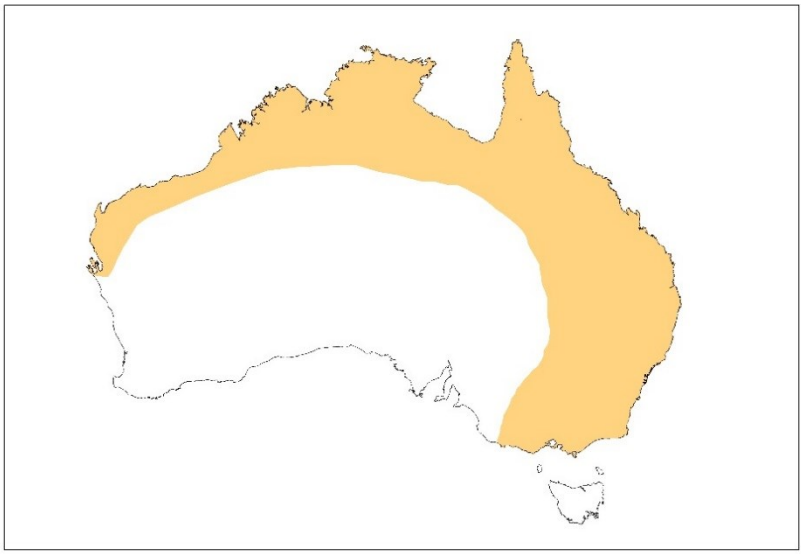
The grey-headed flying-fox (GHFF) (Figure 2) is found throughout eastern Australia, generally within 200 kilometres of the coast, from Finch Hatton in Queensland to Melbourne, Victoria (DPIE 2019c). This species now ranges into South Australia and individual flying-foxes have been reported on the Bass Islands and mainland Tasmania (Driessen et al. 2011). 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 feed in orchards at times, especially when other food is scarce (DPIE 2019a).

All the GHFF in Australia are regarded as one population that moves around freely within its entire national range (Webb and 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 New South Wales, 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 New South Wales (DECCW 2009).

There is evidence the GHFF population declined by up to 30% between 1989 and 2000 (Birt 2000; Richards 2000 cited in DPIE 2019a). There is a wide range of ongoing threats to the survival of the GHFF, including habitat loss and degradation, culling in orchards, conflict with humans, infrastructure-related mortality (e.g. entanglement in barbed wire fencing and fruit netting, and power line electrocution) 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).

1.5.3 Little red flying-fox (*Pteropus scapulatus*)



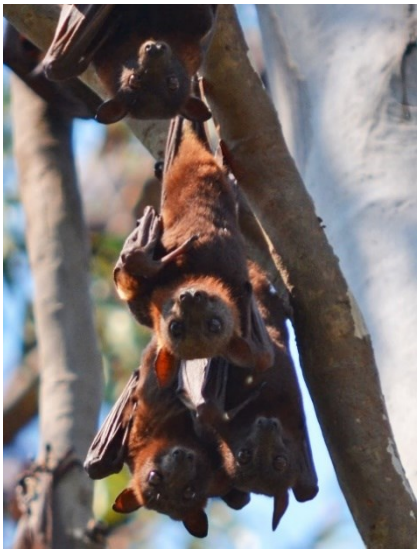


Figure 3 Little red flying-fox indicative species distribution (adapted from DPIE 2019a)

The little red flying-fox (LRFF) (Figure 3) 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 it will eat fruit at times and occasionally feeds in orchards (Australian Museum 2010). LRFF often move very long distances in search of sporadic food supplies. The LRFF is the most nomadic species of flying-fox in New South Wales. They are strongly influenced by the availability of food resources, predominantly the flowering of eucalypt species (Churchill 2008). This 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 (Eby & Roberts 2016). LRFF frequently roost with other flying-fox 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 New South Wales during the summer months. Outside these periods LRFF undertake regular movements from north to south during winter–spring (July–October) (Milne & Pavey 2011).

1.5.4 Reproduction

Black and grey-headed flying-foxes

Males initiate contact with females in January with peak conception occurring around March to April/May; this mating season represents the period of peak camp occupancy (Markus 2002). Young (usually a single pup) are born six months later from September to November (Churchill 2008). The birth season becomes progressively earlier, albeit by a few weeks, in more northerly populations (McGuckin & Blackshaw 1991); however, out of season breeding is common, with births occurring later in the year.

Young are highly dependent on their mother for food and thermoregulation. They are suckled and carried by the mother until approximately four weeks of age (Markus & Blackshaw 2002). At this time, they are left at the camp during the night in a crèche until they begin foraging with their mother in January and February (Churchill 2008) and are usually weaned by six months of age around March. Sexual maturity is reached at two years of age with a life expectancy up to 20 years in the wild (Pierson & Rainey 1992).

As such, the critical reproductive period for GHFF and BFF is generally from August (when females are in their final trimester) to the end of peak conception around April. Dependent pups are usually present from September to March (see Figure 4).

Little red flying-fox

The LRFF breeds approximately six months out of phase with the other flying-foxes. Peak conception occurs around October to November, with young born between March and June (McGuckin & Blackshaw 1991; Churchill 2008) (Figure 4). Young are carried by their mother for approximately one month then left at the camp while she forages (Churchill 2008). Suckling occurs for several months while young are learning how to forage. LRFF generally birth and rear young in temperate areas (rarely in New South Wales).

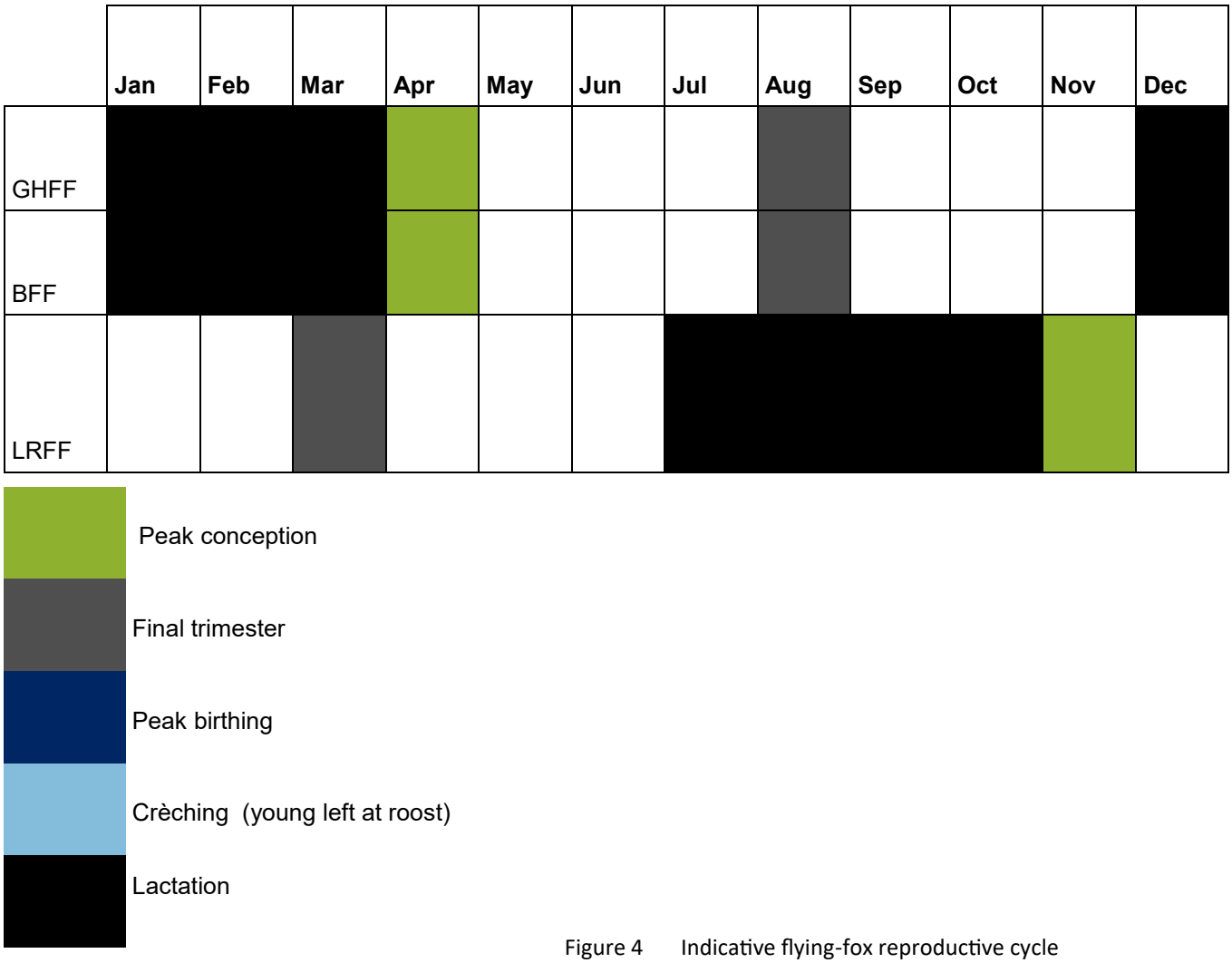


Figure 4 Indicative flying-fox reproductive cycle

Note that LRFF rarely birth and rear young in New South Wales. The breeding season of all species is variable between years and location, and expert assessment is required to accurately determine phases in the breeding cycle and inform appropriate management timing.

Image: Black Flying-fox (credit Andrew Mercer))

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Tracks
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