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CENTENNIAL PARK
FLYING-FOX CAMP MANAGEMENT PLAN

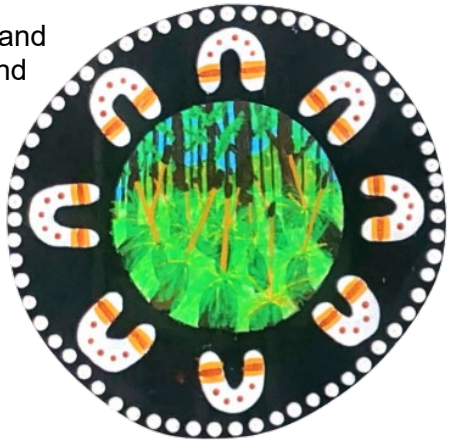
August 2025

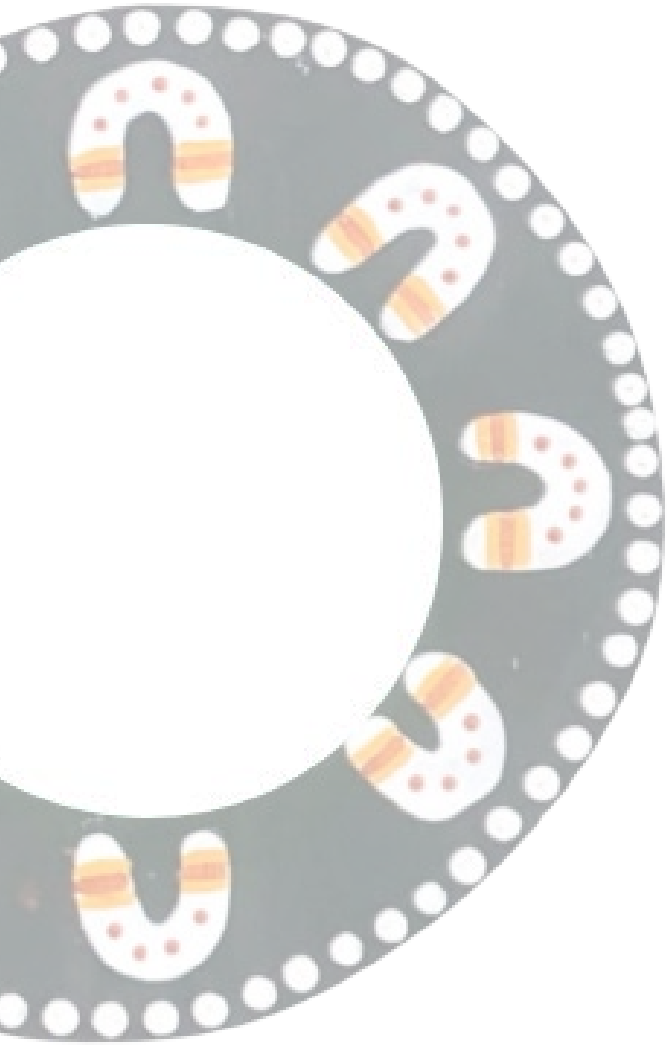
GREATER SYDNEY PARKLANDS

Acknowledgements

Ecosure acknowledge the Traditional Custodians of the lands and waters where we work. We pay deep respect to Elders past and present who hold the Songlines and Dreaming of this Country. We honour and support the continuation of educational, cultural and spiritual customs of First Nations peoples.

We would like to thank Greater Sydney Parklands for their assistance during development of this Flying-fox Camp Management Plan. This Camp Management Plan updates the Camp Management Plan written by Eco Logical Australia Pty Ltd in 2021.





Acronyms and abbreviations

ABLV	Australian bat lyssavirus
BC Act	*Biodiversity Conservation Act 2016* (NSW)
BFF	Black flying-fox (*Pteropus alecto*)
the COP	Flying-fox Camp Management Code of Practice 2018 (NSW)
DCCEEW (Cth)	Department of Climate Change, Energy, the Environment and Water (Commonwealth)
DCCEEW (NSW)	Department of Climate Change, Energy, the Environment and Water (NSW)
EP&A Act	*Environmental Planning and Assessment Act 1979* (NSW)
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth)
GHFF	grey-headed flying-fox (*P. poliocephalus*)
GSP	Greater Sydney Parklands
the Guideline	Referral guidelines for the management actions in grey-headed and spectacled flying-fox camps 2015 (Commonwealth)
HeV	Hendra virus
LGA	Local government area
LRFF	Little red flying-fox (*P. scapulatus*)
MNES	Matters of national environmental significance
NFFMP	National Flying-Fox Monitoring Program
NV Act	*Native Vegetation Act 2003* (NSW)
the Parklands	Centennial Park, Moore Park, and Queens Park
the Plan	Flying-fox Camp Management Plan
the Policy	Flying-fox Camp Management Policy 2015 (NSW)
SEPP	State Environment Planning Policy

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1 Introduction

The Centennial Park Flying-Fox Camp Management Plan (the Plan) provides Greater Sydney Parklands (GSP) with a framework to manage community amenity while conserving the flying-foxes and their habitat within Centennial Park (Figure 1). This Plan updates the previous plan written in 2021 (Eco Logical 2021).

This Plan focuses on the Centennial Park camp and includes a range of short- and long-term options to support the camp in situ, to minimise conflict between humans and flying-foxes, foster awareness, and conserve flying-foxes and the critical ecosystem services they provide.

The Plan has been prepared in accordance with the New South Wales (NSW) Flying-fox Camp Management Policy 2015 (the Policy), administered by the NSW Department of Climate Change, Energy, the Environment and Water (DCCEEW).

Objectives of this Plan are to:

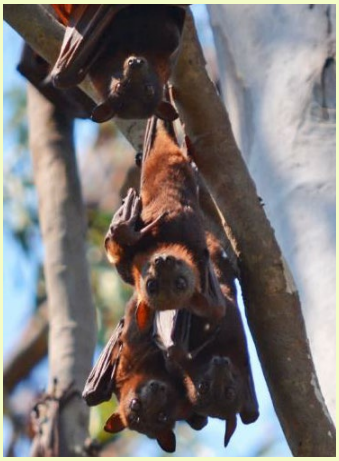
- guide management of the Centennial Park flying-fox camp in accordance with the NSW Flying-fox Camp Management Policy and the NSW Flying-fox Camp Management Code of Practice 2018
- protect and maintain the Centennial Park flying-fox camp
- enhance amenity of the Park
- minimise current and future impacts to the community
- improve community understanding and appreciation of flying-foxes including their ecological role
- clearly define roles and responsibilities for management actions and ensure actions are in accordance with relevant legislation.

2 Flying-fox species in Sydney

There are four flying-fox species that inhabit mainland Australia, three of which have been recorded within the Sydney area: black flying-foxes (*Pteropus alecto*; BFF), grey-headed (*P. poliocephalus*; GHFF), and little-red flying-foxes (*P. scapulatus*; LRFF). Flying-foxes are keystone species for their critical role in long-distance pollination and seed dispersal, which is particularly important over fragmented landscapes. Flying-foxes forage at night on pollen, nectar, and fruit and roost during the day in large groups called camps.

Camp sites in the Sydney area can be occupied continuously to rarely and the number of flying-foxes can fluctuate significantly on a daily, seasonal, or annual basis. Over 20 flying-fox camps occur across the Sydney region (Figure 2), these form part of the network of camps that flying-foxes move between across eastern and northern Australia (Welbergen et al. 2020). A tracking study found that GHFF readily moved between camps in the Sydney region and moved from the Sydney region across most of the species' distribution, e.g. south to Melbourne, west to Dubbo, and north to Bundaberg (Welbergen et al. 2020). Further information on flying-foxes and their ecology can be found in Table 1 and Appendix 1.

Table 1 Summary of flying-fox ecology

Grey-headed flying-fox	Black flying-fox	Little red flying-fox
		
		
Grey-headed flying-foxes typically roost communally within cooler, wet forests (e.g. gullies, wetlands). They forage on the fruit and blossoms of native and introduced plants, including orchard species at times. Typically they feed within 15 km of their roost and can travel up to 300 km between roosts in a single night.	Black flying-foxes occur across the north and east of Australia. BFF have spread further south over recent decades. BFF forage on fruit and blossoms, including orchard species at times. Typically they feed within 15 km of their roost and roost beside water (e.g. rainforest gullies, coastal forests and mangroves).	Little red flying-fox have the most nomadic distribution, strongly influenced by food availability. Generally, this species moves to Cape York to breed, returning to the southern sites during summer. Typically they feed within 25 km of their roost, foraging almost exclusively on nectar and pollen.

Maps source: Atlas of Living Australia

2.1 Flying-fox in urban areas

Flying-foxes appear to be roosting and foraging in urban areas more frequently. An analysis of the National Flying-fox Monitoring Program (NFFMP) data found that of the 310 GHFF camps identified, 59% were in urban land use, 23% agricultural, and seven percent in protected areas (e.g. national park) (Timmiss et al. 2021). Furthermore, higher densities of camps occurred in areas with greater human population densities (up to ~4000 people per km^2) (Timmiss 2017). There are many possible drivers for this urbanising trend (e.g. Tait et al. 2014):

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

Figure 1 Centennial Parklands flying-fox camp

Greater Sydney Parklands

PR9039 Centennial Parklands Flying-fox Management Plan

Maximum camp extent

Core camp extent

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Job number: PR9039
Revision: 0
Author: TD
Date: 14/07/2025

0 25 50 100
Metres

GDA2020
Datum: GDA2020
Units: Degree

Figure 2 Regional context of Centennial Parklands flying-fox camp, NSW

Greater Sydney Parklands

PR9039 Centennial Parklands Flying-fox Management Plan

- Centennial Park flying-fox camp
- Flying-fox camp
- Inactive flying-fox camp
- LGA boundary

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2.2 Legislation overview

Flying-foxes are protected native wildlife that provide a critical ecological role in seed dispersal and pollination (TSSC 2001; see Appendix 1). The GHFF is listed as vulnerable to extinction at State and Commonwealth levels. The main threat to flying-foxes in NSW is clearing native vegetation. This threatening process removes roosting and breeding habitat and limits the availability of natural food resources, particularly winter-spring feeding habitat in north-eastern NSW.

Centennial Park is owned by the Centennial Park and Moore Park Trust and managed by Greater Sydney Parklands, a NSW government agency governed by the *Centennial Park and Moore Park Trust Act 1983* and the *Greater Sydney Parklands Trust Act 2022*. The management of Centennial Parklands is also guided by the Plan of Management, draft Nature Positive Strategy, Conservation Management Plan and Centennial Park Master Plan 2040.

There is a range of legislation and policy that governs how flying-foxes and their habitat can be managed. Key legislation specific to flying-fox camp management is summarised in Table 2 (further detail in Appendix 2).

Level	Instrument	Relevance to the Plan
Commonwealth	*Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)	Approval under the *Environment Protection and Biodiversity Conservation Act 1999* may be required for any action likely to impact a Matter of National Environmental Significance e.g. nationally threatened species (such as the GHFF) or ecological communities, world heritage sites, wetlands of international importance. The Referral guideline for management actions in GHFF and spectacled flying-fox (*P. conspicillatus*) camps (DoE 2015) specifies requirements for camp management, and when referral is required. This legislation only applies if GSP management aimed to reduce or remove GHFF roosting habitat.
State	Flying-fox Camp Management Policy 2015 (the Policy)	The Policy specifies which actions are permissible without NSW DCCEEW approval, with actions categorised as Level 1, Level 2, or Level 3. The Policy specifies a hierarchical approach to management based on the principle of using the lowest form of intervention. This Plan is aligned with the Policy.
	Biodiversity Conservation Act 2016 (BC Act) and Flying-fox Camp Management Code of Practice 2018	Camp management activities not specified as 'routine camp management' in the Policy require the landholder to obtain a licence under the BC Act. Managers of public land (e.g. GSP and Council) are able to undertake some actions on that land without the need for a licence, provided they are done in accordance with the Flying-fox Camp Management Code of Practice 2018. Private landholders will still require a licence.
	Local Government Act 1993	Provides a framework for local government to act in an effective, efficient, environmentally responsible and open manner, and encourages community participation in Council affairs.
	National Parks and Wildlife Act 1974	Provides for the conservation of nature, objects, places, or features of cultural value. Approval may be required if actions are likely to impact any of these values.
	Prevention of Cruelty to Animals Act 1979	It may be an offence under the *Prevention of Cruelty to Animals Act 1979* if there is evidence of animal torment or suffering as a result of management.
	Environmental Planning and Assessment Act 1979	Sets the framework for appropriate management and conservation of resources for the community and environment. Development control plans under the *Environmental Planning and Assessment Act 1979* should consider appropriate provisions for development near a flying-fox camp, and to protect flying-fox habitat.
	Centennial Park and Moore Park Trust Act 1983 and the *Greater*	These acts set the core governance, functions, and provisions for the management and conservation of Centennial Parklands.

Level	Instrument	Relevance to the Plan
	Sydney Parklands Trust Act 2022	
	State Environmental Planning Policy (SEPP) - Biodiversity and Conservation 2021 - Resilience and Hazards 2021	Land managers require approval under the BC Act to cut down, fell, root, kill, poison, ringbark, burn, or otherwise destroy vegetation, or lop or otherwise remove a substantial part of the vegetation to which the Biodiversity and Conservation SEPP applies. Land managers require approval under the BC Act for areas on the Coastal Wetlands and Littoral Rainforests Area Map if any activity is designated development and therefore subject to a higher level of assessment and public exhibition. Coastal wetlands occur within Centennial Park; under Section 2.8 the consent authority must be satisfied that the activity will not significantly impact on the coastal wetland.
Local	Randwick Local Environmental Plan (2012) and Development Control Plan (2013)	Randwick City Council has a Local Environmental Plan and Development Control Plan to guide planning decisions on development and land use within the LGA, including the NSW managed Centennial Park.

2.2.1 Nationally important roosts

As a Commonwealth-listed species, the GHFF meets the criteria of matters of national environmental significance (DoE 2013). The Centennial Park camp is classified as a nationally important GHFF roost. To be considered a nationally important GHFF roost, it must have had more than one influx of 10,000 GHFF within the last 10 years, and/or have been occupied by more than 2,500 GHFF permanently or seasonally for the last 10 years. These criteria are stated in the 'Referral guideline for management actions in grey-headed and spectacled flying-fox camps' (the Guideline) (DoE 2015).

3 Potential conflict with flying-foxes and their camps

Flying-foxes in urban areas can come into conflict with the community where their camps neighbour residential dwellings and businesses (Table 3). Conflict can also occur at foraging sites, many kilometres from a camp. This Plan aims to provide GSP with management actions to reduce impacts on visitors and businesses/events within the Park.

Table 3 Potential conflict associated with flying-foxes roosts

Issue	Details
Noise	A highly sociable and vocal animal, the activity heard from flying-foxes at roosts includes courting, parenting, and establishing social hierarchy. Noise is often most disturbing pre-dawn, and during the breeding season (e.g. during mating March/April, and pup rearing in spring/summer).
Odour	Flying-foxes use pheromones to communicate with each other, which is the source of the characteristic musky smell around their roosts and some foraging trees. Several factors affect odour detectability and intensity, such as the number of flying-foxes, time of year, weather conditions, wind direction, and site characteristics. Odour may be more intense at roosts during the breeding and rearing season as female flying-foxes use scent to find their pups after foraging, and males regularly mark their territories (Wagner 2008). Likewise, odour is stronger after rain as males remark branches in their territories.
Faecal droppings / damage to property	Flying-foxes have an extremely fast digestive process with only 12-30 minutes between eating and excreting (SEQ Catchments 2012). Given that flying-foxes regularly forage 20 km from their roost (Welbergen et al. 2020) and establish new roosts within 600 m – 6 km when dispersed (Roberts et al. 2021), attempting to relocate a roost will not reduce this impact. As such, faecal drop impacts are best managed at an individual property level. Faecal droppings can cause health concerns, reduced amenity, create a slip hazard, requires time and resources to clean, and can damage paint if not promptly removed.
Health & safety concerns	All animals carry bacteria and other microorganisms in their guts, some of which are potentially pathogenic to other species including humans. Key human and animal health risks associated with flying-foxes are Australian bat lyssavirus (ABLV) and Hendra virus (HeV); the latter being particularly important for flying-fox roosts located in close proximity to horse paddocks. Excluding those people whose occupations require contact with bats, such as wildlife carers and vets, human exposure to ABLV and HeV and frequency of infection is extremely rare. Health risks can be effectively mitigated through education, protocols, personal protective equipment (PPE), and basic hygiene measures (see Appendix 3).
Damage to vegetation	Large numbers of roosting flying-foxes can damage vegetation by stripping leaves and breaking branches, which can pose a serious human safety hazard. While damage can be problematic, most native vegetation is resilient and generally recovers well (e.g. casuarina and eucalypts), and flying-foxes naturally move within and between roosting sites allowing vegetation to recover.
Loss of amenity	Loss of amenity refers to the reduced or ceased use of flying-fox roost areas resulting from flying-fox impacts (e.g. noise, odour, health concerns). This can occur on private and/or public land, and often results in negative relationships between community members/residents and flying-foxes.
Flying-foxes and aircraft	Flying-foxes are large (up to 1 kg) animals that transit in large numbers at relatively low altitudes. Consequently, in terminal airspace, where aircraft are also operating at low altitudes, they may present a significant risk to air safety particularly prior to first light and post last light, daily. If large influxes of flying-foxes transit across airfields, considerations must be made to prioritise human and aircraft safety.
Protecting flying-foxes and other fauna	Along with anthropogenic impacts (e.g. land clearing), climate-driven impacts such as heat-stress events, droughts, bushfires, and flooding, can greatly impact flying-fox populations and habitat. In 2019-20 summer alone, an estimated 72,000 flying-foxes perished in 40 camps across Victoria, NSW, Australian Capital Territory, and South Australia (Mo et al. 2021). As such, protection of flying-foxes and their habitat needs to be a primary consideration in any flying-fox management plan.

4 Camp assessment

The Centennial Park flying-fox camp context, history, ecological values, and sensitive receptors are outlined in Table 4. Sensitive receptors are those locations that host people and/or animals where risks need to be managed. Sensitive receptors include schools, childcare centres, hospitals, helipads and airports, and equine facilities. Identifying sensitive receptors is necessary with regards to any management actions that could inadvertently cause the camp to splinter to undesirable or sensitive locations surrounding the camp.

Table 4 Centennial Park roost information

Category	Description
Land zone	Centennial Parklands are zoned RE1 Public Recreation under the Randwick Local Environment Plan 2023.
Land tenure	The Centennial Parklands is located on Crown Land and within the City of Sydney, Randwick, Waverley, and Woollahra LGAs, and includes Centennial Park, Moore Park, and Queens Park (the Parklands). The camp is located on Crown Land (Lot 1723 on DP45644) and is managed by the Centennial Park and Moore Park Trust.
Surrounding area and activities	Surrounding areas, including wetlands, reserves and sports ovals are available for public use including recreation, events and venue hire.
Roost description	The camp is located in an area of Centennial Park referred to as Lachlan Swamp, surrounded by vegetation. Lachlan Swamp is bordered by Dickens Drive in the north, Parkes Drive in the west and Grand Drive in the south-east. The camp area covers approximately 5 ha, with fluctuating extents on a seasonal basis (Figure 2). For images of the Centennial Park camp habitat see Figure 3 to Figure 6.
Flying-fox occupancy	First established in February 2010, the camp is possibly a response to a food shortage event that affected large parts of coastal NSW at the time (J. Martin pers. comm.). The population fluctuates throughout the year and is likely subject to the availability of food within the Sydney region. The average population recorded during quarterly counts is ~15,000 GHFF but varies seasonally and annually (e.g. Vanderduys et al. 2024; Figure 7, Figure 8). Small numbers of BFF are usually present (typically ~300; Figure 7). The Centennial Park camp meets the Commonwealth criteria as a nationally important GHFF camp (DoE 2015) (see Appendix 2), as it has: · contained ≥10,000 GHFF in more than one year in the last 10 years, and · been occupied by ≥ 2,500 GHFF permanently or seasonally every year for the last 10 years.
Ecological values	Two threatened fauna species and one flora species have been recorded on site including the GHFF, powerful owl (*Ninox strenua*) listed as vulnerable under the BC Act, and the Sunshine Wattle (*Acacia terminalis* subsp. *terminalis*) listed as endangered under the BC Act and the EPBC Act. Other known occasional visitors include: · sharp-tailed sandpiper (*Calidris acuminata*) - listed as marine and migratory under the EPBC Act · Latham's snipe (*Gallinago hardwickii*) - listed as marine and migratory under the EPBC Act · white-bellied sea-eagle (*Haliaeetus leucogaster*) - listed as vulnerable under the BC Act · large bent-winged bat (*Miniopterus orianae oceanensis*) - listed as vulnerable under the BC Act · freckled duck (*Stictonetta naevosa*) - listed as vulnerable under the BC Act.

Category	Description
Sensitive receptors < 1 km from camp	· Centennial Parklands Equestrian Centre ~770 m north-west of the camp · Royal Randwick Racecourse ~790 m south of the camp · Emanuel School, Randwick ~850 m south-east of the camp · Moriah College ~ 300m east of the camp
Management response to date	GSP has managed the camp through a variety of actions, including: · maintenance of educational signage · various weed and vegetation maintenance actions · plantings of native species to increase roosting habitat area · maintenance of paths and fences · drone surveys to assess tree canopy health · installation of nest boxes for other wildlife species
Stakeholders	· DCCEEW (NSW) · DCCEEW (Cth) · Centennial Parklands Community Trustee Board · Leased/licenced facilities (e.g. Sports Centre) · Community visitors to Centennial Park · Wildlife carers and conservation organisations · Equine facilities (Centennial Park Equestrian Centre, Randwick Racecourse) · Sydney Airport · Researchers and universities.

4.1 Centennial Park flying-fox camp

The Centennial Park flying-fox camp is located in a planted paperbark (*Melaleuca quinquenervia*) swamp known as Lachlan Swamp. The mid-storey and emergent (ground level) vegetation has increased considerably over the past 10 years, supported by native and weed species deposited in the flying-foxes' faeces (Figure 3 to Figure 6). Educational signs are positioned around the camp, including at the viewing walk (Figure 5). The signs advise visitors about flying-fox ecology, ongoing bush regeneration, and relevant health information (e.g. don't handle flying-foxes).

Figure 3 Centennial Park flying-fox camp educational sign[1]

[1] The cover photo of this report shows another educational sign located at the edge of the camp.

Figure 4 Badu ngura Trail at the Centennial Park flying-fox camp

Figure 5 Centennial Park flying-fox viewing area

Figure 6 Centennial Park rehabilitated flying-fox soft-release cage

4.2 Flying-fox impact avoidance

High-risk activities (e.g. maintenance works, events, construction) that could impact flying-foxes, particularly during their breeding cycle (Table 5), are outlined below. Measures to minimise impacts are identified.

4.2.1 Timing

Based on the indicative breeding cycle of GHFF and BFF, the timing of low-, medium-, and high-risk activities and mitigation measures are outlined (Table 5).

High-risk activities are those that result in:

- Sudden, loud noise and intense lighting e.g. sound checks, lasers.
- High-pitched, percussive or vibrational sounds e.g. motorised chainsaws, vegetation chipping, installation/removal of temporary fencing during event bump in and bump out/rock being unloaded.
- Any large plant machinery within visual line of sight of the roost e.g. excavators, elevating work platforms.

These high-risk activities should be avoided in close proximity to the roost during the moderate- to high-risk time of year (i.e. critical breeding season) where possible. Where rescheduling or moving activities is not possible, additional monitoring and activity-specific advice will be required.

Table 5 Indicative breeding cycle for flying-foxes along with management timing; note, the timing of breeding is indicative, out-of-season breeding* can occur and monitoring by a species expert is recommended to avoid impacts

	Grey-headed and black flying-fox		
	Stage	**Risk**	**Management**
Jan		H	Dependent flying-fox pups are present, including during the night (crèching). Limit disturbance where possible.
Feb		H	
Mar		M	
Apr		M	Peak conception is often associated with peak numbers of flying-foxes roosting at the camp. Typically few dependent pups*.
May		L	Typically no dependent flying-fox pups*. Considered the preferred window for management e.g. tree trimming or removal, path construction, etc.
Jun		L	
Jul		L	
Aug		M	Flying-fox pup birthing begins during August. Crèching, pups left to roost in the camp by themselves, may begin from September. Limit disturbance where possible.
Sep		M	
Oct		H	Dependent flying-fox pups are present, including during the night (crèching). Limit disturbance where possible.
Nov		H	
Dec		H	

	GHFF and BFF peak conception
	GHFF and BFF final trimester
	GHFF and BFF peak birthing
	GHFF and BFF crèching (from ~4 weeks of age)
	GHFF and BFF lactation

	Low risk (L) – unlikely to cause impacts, preferred time for management and non-urgent maintenance/construction
	Moderate risk (M) – may cause impacts without sufficient controls, advice required for any activities with high risk of impacts
	High risk (H) – likely to cause impacts without sufficient controls, advice and monitoring required for any activities with high risk of impacts

4.2.1.1 Impact avoidance measures – non-critical breeding period

The following general measures will minimise the potential for flying-fox welfare impacts and apply to all times of year (note, these are in no particular order):

1. Monitoring prior to and during activities with triggers for when management activities must cease as detailed in Section 4.2.2.
2. All activities will be carried out in a sequential manner, beginning at the furthest distance where possible and moving towards the roost, to allow some level of habituation to noise and activity.
3. Initial start-up of equipment as far away from roost as practical; incrementally move equipment towards roost.
4. Chipping of vegetation, if required, is to be undertaken as far away from the flying-fox roost as practical and ideally during the minimal impact months (i.e. May to July). The flying-foxes response to the noise of the chipper (i.e. the impact) to be monitored.
5. Where fencing is being loaded or unloaded, this will be done as far from the roost as possible and noise attenuation is recommended (e.g. matting in the truck tray and foam or similar at unloading points).
6. An exclusion zone of at least 50 m maintained from roosting flying-foxes if temperatures reach or are predicted to reach >36°C, or when stress is likely to already be increased (e.g. severe weather events), or otherwise as approved by a flying-fox expert (Appendix 3).
7. Trees should not be trimmed or felled when flying-foxes are in or within 30 m and/or likely to be harmed in line with the NSW Flying-fox Camp Management Code of Practice 2018 (see Table 7 for more information).
8. Fireworks and lasers/lights at canopy level, carefully managed within 100[2] m of the roost.
9. A flying-fox expert or wildlife carer should be on stand-by to assist if required for activities that may result in unintentional harm.
10. Clear roles and responsibilities of all personnel on site communicated during inductions and daily pre-starts, including the requirement for all staff/contractors to comply with this Plan.
11. All personnel debriefed at the end of each day of works to allow methods to be adapted if required.
12. Personnel will work near the roost quietly in small teams, with electric tools where possible to avoid disturbance.

[2] This distance is a guide; an event specific distance is recommended.

4.2.1.2 Impact avoidance measures – critical breeding period

In addition to general measures outlined in Section 4.2.1.1, the following apply for moderate- and high-risk periods in the breeding cycle (Table 5):

1. If high-risk activities (Section 4.2.1) in roosting areas cannot be timed to avoid critical breeding periods when dependent young are likely to be present for public safety or other unavoidable reasons, this should be identified in the planning process. GSP will work with experts as required to avoid impacts during these times.
2. Based on this advice, works will be managed to avoid impacts noting that stop-work periods are more likely in the critical breeding period.

An exclusion zone of at least 50 m maintained from any tree with dependent young present, unless otherwise approved by a species expert.

4.2.2 Monitoring and stop triggers

Keep internal records to monitor the effectiveness of mitigation measures and inform future planning. At a minimum, data will be collected before, during and after any high-risk management action in a moderate-high risk time of year (Section 4.2.1), including:

- date
- management activity
- management outcome
- observations for flying-fox:
  - estimated number of adults and young (note: occasional evening assessments by a species expert may be required to confirm flight progress of young)
  - roost extent
  - young present
  - behaviour, potential reasons for disturbance if observed and course of action
- notes and general observations.

Signs of stress and risk to dependent young, and the action required for each are presented in Table 6. If any animal appears to be injured/killed as a result of any activity, works will immediately cease and NSW DCCEEW will be notified.

Table 6 Signs that flying-foxes may be stressed or at risk and appropriate mitigation actions

Potential impact	Signs	Action
Stress	Flying-foxes: · panting · located on or within 2 m of the ground · unusual vocalisations · large portion of the camp takes flight (e.g. more than 30%).	Works to cease in the immediate area for the day. Species expert may determine whether work can continue in alternative areas of the site. If an event is in place which cannot be modified, NSW DCCEEW and/or a flying-fox expert contacted for advice.

Potential impact	Signs	Action
Dependent young at risk	Flying-foxes: · adults moving away from dependent young · adults carrying young being disturbed.	Works to cease in the area, and potential need for rescue determined. If dependent young are dropped/abandoned, NSW DCCEEW and/or a flying-fox expert contacted for advice. A fauna spotter catcher recommended to be present during trimming/vegetation management if any other wildlife may be present (e.g. bird nests, possum dreys, hollows). A licensed wildlife carer on stand-by for any event during the rearing season to rescue animals if required.
Injury/death	Flying-foxes: · any animal appears to have been injured/killed on site (including aborted young).	Works to cease immediately, notify NSW DCCEEW AND works to be rescheduled OR works to be adapted sufficiently so that significant impacts (e.g. injury/death) are highly unlikely to occur, as confirmed by NSW DCCEEW and/or a flying-fox expert.

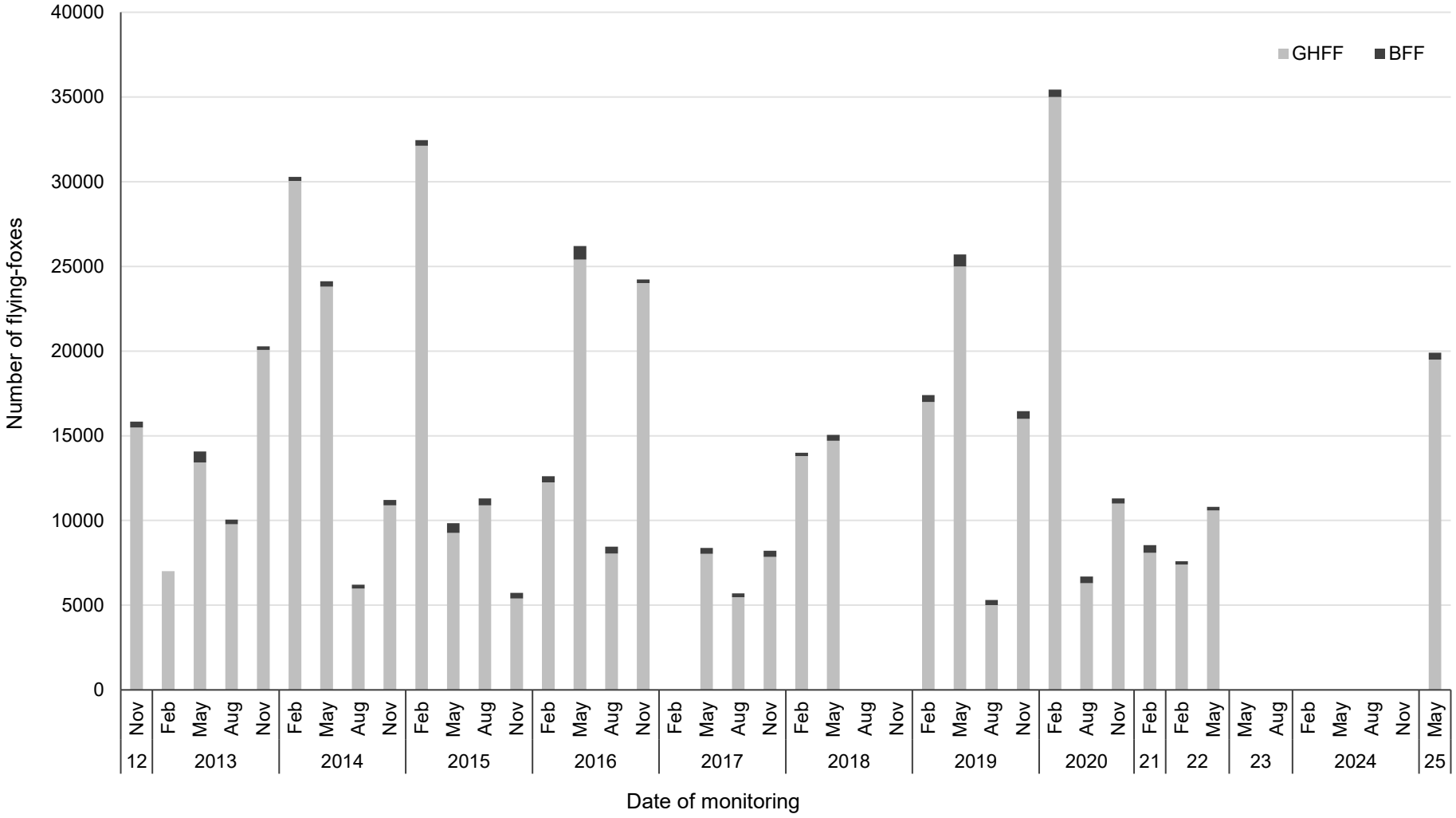


Figure 7 Flying-fox count data (source: national flying-fox monitoring program, GSP, Ecosure) using the diurnal static count method which allows verification of flying-fox species; missing counts did not verify flying-fox species, for count data see Figure 8

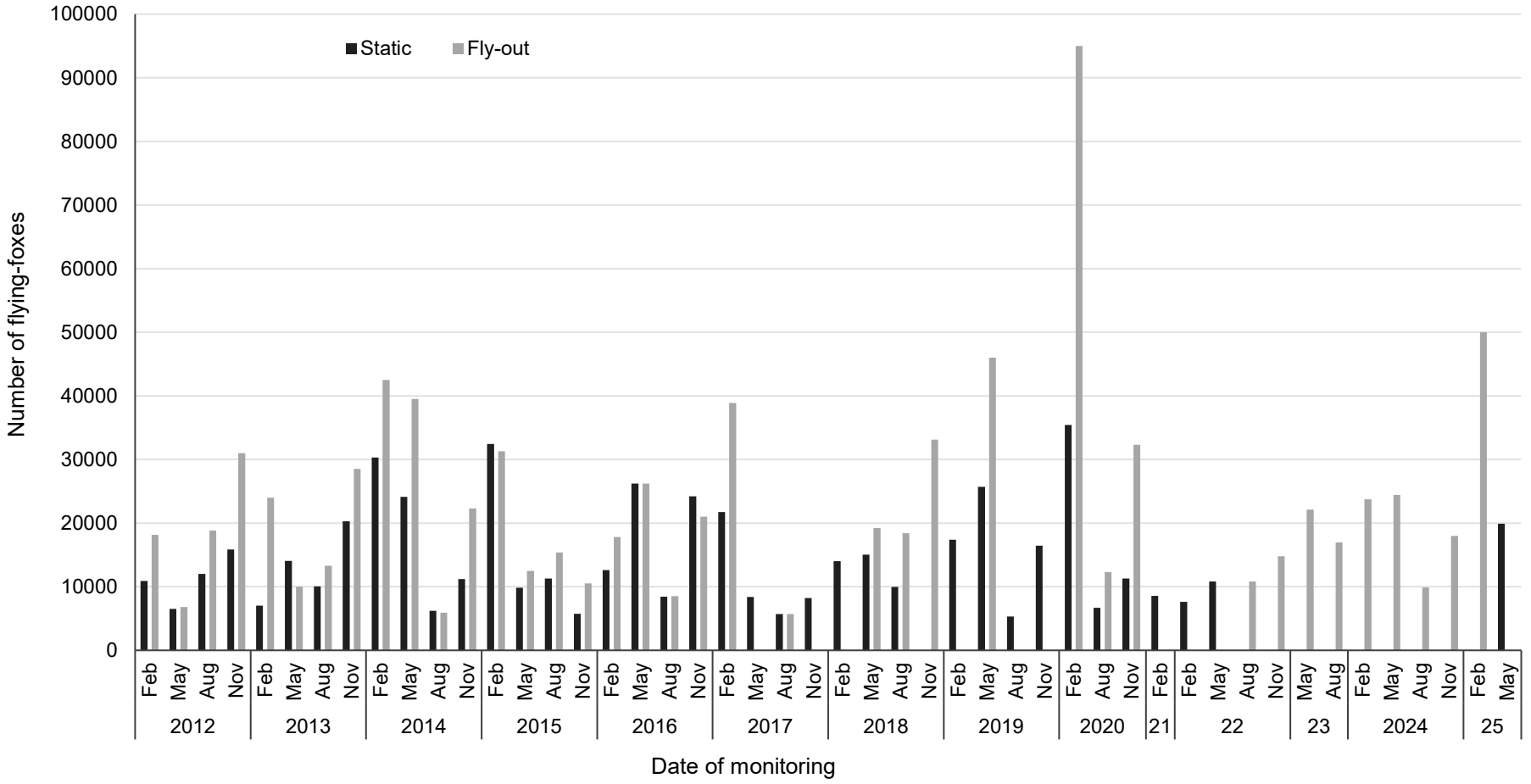


Figure 8 Flying-fox count data (source: national flying-fox monitoring program, GSP, Ecosure); note, diurnal “static” counts estimate the number of flying-foxes visually, generally involving a single observer, the “fly-out” method counts flying-foxes from multiple locations surrounding the camp with multiple observers as they fly out at sunset; counts were missed in 2020 and 2021 due to Covid19

5 Community engagement

This Plan was developed following a site assessment with GSP. Internal consultation has occurred, including through the Community Trustee Boards. Community engagement has previously been undertaken, including in 2021 during the development of the previous Plan. Engagement methods included public exhibition of the draft Plan on the Centennial Parklands website, key stakeholder notifications, and social media posts. Feedback was predominantly received through the GSP website by Parklands volunteers and Sydney Wildlife (a wildlife care group), expressing relatively similar concerns. Feedback included requesting the removal of Canary Island date palm (*Phoenix canariensis*), Cabbage Tree palms (*Livistona australis*), and Cocos palms (*Syagrus romanzoffiana*) from within the camp (see Table 7), the installation of additional visitor signage, successive planting to provide future roost trees (see Table 7, Figure 9), and the management of heat stress events (see Table 7).

6 Management actions

A management options analysis was undertaken to determine the most suitable management actions for the Centennial Park flying-fox camp (Appendix 5). The actions to enhance the Centennial Park camp and reduce impacts are outlined below (Table 7). The actions align with legislation (Section 2.2, Appendix 2, Appendix 5), camp assessment (Section 4), and consultation with GSP. Implementation of management actions must be considerate of approvals potentially required, site values, and in accordance with measures to avoid impacts. Evaluation measures are provided for each action which will be used to evaluate action progress and success. Details of how the Plan and actions will be implemented are in Section 7.

Table 7 Management actions for the Centennial Park camp

Strategy	Action	Details	Approvals required	Timeframe / Progress	Evaluation measure
Impact mitigation	Camp monitoring	Regular monitoring (e.g. monthly or quarterly); information shared with the NSW DCCEEW and NFFMP, including species present and records of camp spatial extents. Drone monitoring can provide more accurate results on camp extent and numbers and should be considered for inclusion in ongoing monitoring.	Animal ethics is not required to undertake fly-out counts and is required for static counts – liaise with NSW DCCEEW. Ethics is not required to monitor the flying-foxes with drones.	Ongoing	Regular monitoring undertaken and data used to inform management and community engagement. Assess the periodic inclusion of thermal drone surveys.
	Routine camp maintenance	Continue routine camp maintenance, including mowing under the canopy of the trees around the Lily Pond as this action deters the flying-foxes from spreading further into these trees (Figure 9, Figure 10). Develop protocols to mitigate operations that may disturb flying-foxes e.g. undertaking night works when the flying-foxes are absent (not during summer). Untimely disturbance can increase impacts to visitors/events through noise and smell and can create flying-fox welfare issues (e.g. dropped pups). Planned tree pruning or removal to ensure that trees and branches can be removed in a controlled manner that avoids harm to flying-foxes.	Implement under the Code of Practice 2018 or a threatened species licence required for protected vegetation.	Ongoing	Enhancement of canopy and mid-storey vegetation to support the camp long-term.

Strategy	Action	Details	Approvals required	Timeframe / Progress	Evaluation measure
		Undertake weed removal, if required, to ensure tree canopy health. Weed management should be staged and mindful of inadvertent dispersal (constituting a Level 3 action) or exacerbating heat stress events (HSE). Increasing numbers of palms, primarily Canary Island date, Cabbage Tree palms, and Cocos palms, have been noted. Concern has been raised about this vegetation, particularly juvenile palms at ground level, injuring (thorns) and/or entangling (in the matrix of fronds) juvenile flying-foxes that come to ground.	Implement under the Code of Practice 2018 or a threatened species licence required for protected vegetation.	Ongoing	Reduced density of priority weed species.
	Alternative habitat creation and succession planning	Flying-fox roosting behaviour damages their roost trees. As such, for long-term sustainability it is recommended to enhance the vegetation in situ and, where possible, plant adjoining future roosting habitat. This may involve converting lawns into gardens within or outside Centennial Park (Figure 9, Figure 11). Consider developing a vegetation management plan with the explicit focus of providing and maintaining habitat for GHFF within Centennial Park. Succession planning should focus on tree and palm safety at the Centennial Park (Figure 12). Replacement plant species selection should consider sustained GHFF roosting habitat and microclimate, in addition to the aesthetic of the park. Succession planting should be prioritised as part of the annual maintenance program. Improvement includes increasing the density of the mid- and upper-canopy and, where possible, expanding the area of available habitat.	No approvals required for protection of current camp habitat.	Short- and long-term	Alternative habitat locations identified and potential to restore habitat investigated.
Community engagement and awareness	Ensure clear and up-to-date information available regarding legislation and human and animal health.	Education should be delivered in the form of events, education programs, night walks, online material and/or hardcopy brochures, and should include up-to-date health information and legislative responsibilities.	No	Short-term and ongoing	Education program: community informed and engaged.
	Keep community informed of flying-fox numbers and up-coming management.	Engagement platforms including new signs at entrances to the Centennial Park, near the flying-fox camp, social media, websites, media release, and digital/hard copy mail (e.g. brochures, fact sheets) will be utilised to maintain awareness and keep the community updated and informed.	No	Short-term and ongoing	Up-to-date information readily available for the community.

Strategy	Action	Details	Approvals required	Timeframe / Progress	Evaluation measure
Avoiding future conflict, conservation	Protocols to manage incidents (e.g. heat stress events)	Collaborate with wildlife care organisations, NSW DCCEEW, and researchers to monitor potential HSEs during predicted hot weather. A heat stress response plan should be regularly updated as new information becomes available. This plan should outline the factors that contribute to HSEs, how to monitor flying-fox stress, the importance of having a camp-specific response plan, roles of personnel attending to HSEs, recovery and response to mortalities, as well as the importance of collecting data on HSEs.	No	Short-term and ongoing	Develop and maintain a heat stress response plan. Ongoing communication with wildlife rescue and care organisations.
	Support flying-fox carers	Support the ongoing rescue and care efforts of local wildlife carers, particularly during flying-fox influxes and HSEs. This includes the soft-release cage for rehabilitated flying-foxes (Figure 6).	No	Ongoing	Strong relationship between flying-fox carers and GSP. Continued support for a flying-fox soft-release cage.
Avoiding future conflict	Support research	Support research, particularly projects which will assist in understanding local flying-fox movements (e.g. GPS tracking) and ways to mitigate impacts on the community (e.g. quantify outcomes of management actions). A priority area of research is to better understand foraging resources in the area to allow proactive management in preparation for future influxes. An example is a genetic analysis of scats to identify forage species.	No.	Long-term and ongoing	GSP up-to-date on contemporary research and relevant outcomes used to inform camp management.
Impact mitigation	Nudging	This tool may be investigated if GHFF expand to roost in undesirable locations within the park or persist in areas of the maximum camp footprint which are deemed undesirable (e.g. The Discovery Centre to the northeast of the camp).	Threatened species licence required.	Long-term	Under specific circumstances, nudging may be investigated in consultation with NSW DCCEEW.

Figure 9 Centennial Parklands flying-fox camp indicative management areas

Greater Sydney Parklands

PR9039 Centennial Parklands Flying-fox Management Plan

- Maintain canopy, weed management
- Planting of canopy and mid-storey, weed management
- Maintain canopy

ecosure
improving ecosystems

Job number: PR9039
Revision: 0
Author: TD
Date: 14/07/2025

0 25 50 100
Metres

GDA2020
Datum: GDA2020
Units: Degree

Figure 10 Lily Pond bridge and canopy trees with mown understorey at the western end of the flying-fox camp

Figure 11 Mown area adjacent to the flying-fox camp

Figure 12 Replacement canopy tree plantings near the Lily Pond bridge

7 Plan evaluation and review

7.1 Plan administration

The Plan will be a living document, informing routine management, and requiring at least an internal annual revision to allow ongoing evaluation of the strategies in Table 5 and assess and prioritise management actions. The following may trigger an earlier review of the Plan:

- completion of a significant action (Level 2 or above)
- changes to relevant policy/legislation
- new management techniques becoming available
- any negative incident associated with roosting or foraging flying-foxes
- dramatic increase in flying-foxes roosting at Centennial Park.

It is recommended that the Plan be updated after five years.

7.2 Monitoring

The GSP will monitor and keep internal records to allow the effectiveness of each management action to be evaluated and inform future planning. Monitoring of the camp will be undertaken (e.g. monthly or quarterly), informing the NFFMP. Weekly monitoring may be conducted as required (e.g. in association with management). Monitoring should determine the extent of the camp as well as its size and composition (e.g. species, breeding). The GSP is encouraged to report this monitoring data to the NSW DCCEEW to inform the NFFMP.

The GSP staff are to ensure management actions and results are recorded to inform future planning. See NSW DCCEEW webpage for datasheets for Level 3 monitoring, evaluating, and reporting on flying-fox camp management actions.

7.3 Reporting

Reports for Level 1 actions that comply with the Plan are not required to be submitted to NSW DCCEEW. Reporting for Level 2 or Level 3 actions are to be submitted to NSW DCCEEW in accordance with the licence criteria. The licence may require, for example, reporting one month after commencement of works and then quarterly in periods where works have occurred. Reporting is to be consistent with the NSW Flying-fox Camp Management Code of Practice 2018 or the stated conditions of the licence. Example information to report includes:

- results of pre- and post-work population monitoring
- any information on new camps that have formed in the area
- further management actions planned to include a schedule of works
- an assessment of how the community responded to the works, including details on the number and nature of customer enquiries before and after the works
- detail on any compensatory planting
- expenditure and contributors
- outcomes from evaluation and review.

7.4 Responsibilities

The GSP is responsible for the implementation and review of the Plan. It is an option to submit the final plan to NSW DCCEEW for review and endorsement under the Code of Practice. The GSP is advised to seek advice from NSW DCCEEW and flying-fox experts as required during the implementation of the Plan.

This Plan does not endorse the community to undertake flying-fox management. The GSP and private landholders will need to comply with the Policy or apply to NSW DCCEEW for a licence. If flying-foxes are being unlawfully and intentionally disturbed, this is to be reported to NSW's Environment Line by calling 131 555.

7.5 Avoid impacts to flying-foxes

Actions outlined in the Plan do not include dispersal. Any on ground works are to be undertaken in accordance with standard measures to avoid impacts (Appendix 8) and in accordance with the NSW Code of Practice and relevant permits. Works outside the Code of Practice require a licence under the BC Act. This aims to ensure the welfare of flying-foxes during proposed works and the safety of personnel working in the camp. With compliant implementation of actions, it is expected that minimal impact to the flying-foxes will occur.

The Code of Practice states:

- no actions during or within the five days after a severe weather event
- no actions during or within 21 days of the end of a heat stress event
- no removal of more than 10% of the vegetation historically occupied
- no removal of tree limbs or trees within 30 m of flying-foxes
- no removal of threatened species or habitat of flying-foxes.

Actions that contravene the Code of Practice require a threatened species licence.

References

Australian Museum 2020, *Little Red Flying-fox*, Australian Museum, <australianmuseum.net.au/little-red-flying-fox>.

Birt, P 2000, 'Summary information on the status of the Grey-headed (*Pteropus poliocephalus*) and Black (*P. alecto*) Flying-Fox in New South Wales', pp.78–86 in *Proceedings of Workshop to Assess the Status of the Grey-headed Flying-fox in New South Wales*, University of Sydney, Sydney NSW.

Churchill, S 2008, *Australian Bats*, Allen and Unwin, Crows Nest, NSW.

Cox, L 2019, 'Flying-foxes found dead and emaciated across eastern Australia as dry weather bites' The Guardian, <https://www.theguardian.com/environment/2019/oct/17/flying-foxes-found-dead-and-emaciated-across-eastern-australia-as-dry-weather-bites>.

Currey, K, Kendal, D, van der Ree, R, Lentini, P 2018, 'Land Manager Perspectives on Conflict Mitigation Strategies for Urban Flying-Fox Camps', *Diversity* 10, 39. https://doi.org/10.3390/d10020039

DCCEEW 2021, *National Recovery Plan for the Grey-headed Flying-fox Pteropus poliocephalus*, Department of Climate Change, Energy, the Environment and Water, Australian Government. https://www.dcceew.gov.au/environment/biodiversity/threatened/publications/recovery/grey-headed-flying-fox.

DCCEEW 2023, *Flying-foxes and national environmental law*, Department of Climate Change, Energy, the Environment and Water, Australian Government, <https://www.dcceew.gov.au/environment/biodiversity/threatened/species/flying-fox-law>.

DELWP 2015, *Flying-foxes*, Department of Environment, Land, Water and Planning, State of Victoria.

Divljan, A, Parry-Jones, K and Wardle, GM 2006, 'Age Determination in the Grey-Headed Flying Fox', *Journal of Wildlife Management* 70, 607-611.

DoE 2015, *Referral guideline for management actions in grey-headed and spectacled flying-fox camps - EPBC Act Policy Statement*, Department of Environment, Australian Government.

DPE 2023, *Flying-foxes*, Department of Planning and Environment, <https://www.environment.nsw.gov.au/topics/animals-and-plants/native-animals/native-animal-facts/flying-foxes>.

DPIE 2021, NSW Code of Practice for Injured, Sick and Orphaned Flying-foxes, <https://www.environment.nsw.gov.au/research-and-publications/publications-search/code-of-practice-for-injured-sick-and-orphaned-flying-foxes>.

Driessen M, Brereton R and Pauza M 2011, '*Status and conservation of bats in Tasmania*', pp.324-336 in Law B, Eby P, Lunney D and Lumsden L (eds), *The Biology and Conservation of Australasian Bats*, Royal Zoological Society of New South Wales, Mosman, NSW.

Eby, P 1991, 'Seasonal movements of Grey-headed Flying-foxes, *Pteropus poliocephalus* (Chiroptera: Pteropodidae) from two maternity roosts in northern New South Wales', *Wildlife Research* 18, 547-559.

Eby, P 2000, '*The results of four synchronous assessments of relative distribution and abundance of Grey-headed Flying-fox* Pteropus poliocephalus', Proceedings from workshop to assess the status of the Grey-headed Flying-fox in New South Wales, pp. 66-77.

Eby, P and Lunney, D 2002, *Managing the Grey-headed Flying-fox Pteropus poliocephalus as a threatened species: a context for the debate*, Royal Zoological Society of New South Wales, NSW.

Eby, P, Sims, R, and Bracks, J 2019, *Flying-fox Foraging Habitat Mapping NSW: a seamless map for assessing temporal and spatial patterns of habitat quality for flying-foxes*. Report to Local Government New South Wales.

Ecosure 2011, 'Hendra Virus Risk Assessment for the Gold Coast Equine Precinct: Residual Risk Report', unpublished report to City of Gold Coast.

Fox, S, Spencer, H and O'Brien, GM 2008, 'Analysis of twinning in flying-foxes (Megachiroptera) reveals superfoetation and multiple-paternity', *Acta Chiropterologica* 10, 271-278.

GeoLINK 2012*, Lorn Flying-fox management strategy,* report prepared for Maitland City Council.

Hall, L and Richards, G 2000, *Flying foxes: Fruit and Blossom Bats of Australia*, UNSW Press, Sydney.

Health Direct 2023, *Australian bat lyssavirus infection (ABLV)',* Australian Government, <https://www.healthdirect.gov.au/australian-bat-lyssavirus-infection>.

Lentini, PE, Kendal, D, Currey, K and Williams KJH, 2020, *A large scale survey of residents living close to flying-fox camps to guide conflict management: preliminary report*, University of Melbourne and University of Tasmania.

MacDonald, S, Bradford, M, McKeown, A, Vanderduys, E, Hoskins, A, and Westcott, D 2021, 'Camp site habitat preferences of the little red flying-fox (*Pteropus scapulatus*) in Qld,' *BioOne* 68, 234-253.

Markus, N 2002, 'Behaviour of the Black Flying-fox *Pteropus alecto*: 2. Territoriality and courtship', *Acta Chiropterologica* 4, 153-166.

Markus, N and Blackshaw, JK 2002, 'Behaviour of the Black Flying-fox *Pteropus alecto*: 1. An ethogram of behaviour, and preliminary characterisation of mother-infant interactions', *Acta Chiropterologica* 4, 137-152.

Markus, N and Hall, L 2004, 'Foraging behaviour of the black flying-fox (*Pteropus alecto*) in the urban landscape of Brisbane, Qld,' *Wildlife Research* 31, 345-355.

McConkey, KR, Prasad, S, Corlett, RT, Campos-Arceiz, A, Brodie, JF, Rogers H and Santamaria, L 2012, 'Seed dispersal in changing landscapes', *Biological Conservation* 146, 1-13. doi:10.1016/j.biocon.2011.09.018

McGuckin, MA and Blackshaw, AW 1991, 'Seasonal changes in testicular size, plasma testosterone concentration and body weight in captive flying-foxes (*Pteropus poliocephalus* and *P. scapulatus*)', *Journal of Reproduction and Fertility* 92, 339-346.

Meade, J, Martin, JM and Welbergen, JA 2021, Fast food in the city? Nomadic flying-foxes commute less and hang around for longer in urban areas, *Behavioral Ecology* 32, 1151-1162. https://doi.org/10.1093/beheco/arab078

Milne, DJ and Pavey, CR 2011, 'The status and conservation of bats in the Northern Territory', in Law, B, Eby, P, Lunney, D and Lumsden, L (eds), *The Biology and Conservation of Australasian Bats*, Royal Zoological Society of NSW, Mosman, NSW, pp. 208-225.

Mo, M and Roache, M 2019, Subsidies for products and services to assist communities living with flying-foxes: Insights from flying-fox subsidy programs in New South Wales, Department of Planning Industry and Environment, NSW Government.

Mo, M, Roache, M, Williams, R, Drinnan, IN and Noël, B 2019, From cleared buffers to camp dispersal: mitigating impacts of the Kareela flying-fox camp on adjacent residents and schools. *Australian Zoologist* 41, 19-41. https://doi.org/10.7882/AZ.2020.002

Mo M, et al. 2022, 'Estimating flying-fox mortality associated with abandonments of pups and extreme heat events during the austral summer of 2019–20,' *Pacific Conservation Biology* 28, 124-139. https://doi.org/10.1071/PC21003

Mo, M, Cross S, Boyd K 2023, Post-release survivorship of 18 years in a hand-reared grey-headed flying-fox (*Pteropus poliocephalus*) revealed by a metal identification band. *Australian Mammalogy* 45, 241-245.

Mo, M, Roache, M, and Demers, MCA 2020, Reducing human-wildlife conflict through subsidizing mitigation equipment and services: helping communities living with the gray-headed flying-fox. *Human Dimensions of Wildlife*, 25, 387-397. https://doi.org/10.1080/10871209.2020.1735580

Mo, M, Meade, J, Roff, A Timmiss, LA, Gibson, R and Welbergen, JA 2024, 'Impact assessment of the Australian 2019–20 megafires on roost sites of the vulnerable grey-headed flying-fox (*Pteropus poliocephalus*)', *Global Ecology and Conservation* 50, e02822. https://doi.org/10.1016/j.gecco.2024.e02822

NSW Health 2024, Hendra Virus, NSW Government, <https://www.health.nsw.gov.au/Infectious/diseases/Pages/hendra.aspx>.

NSW Health 2024, *Rabies and Australian bat lyssavirus infection fact sheet*, NSW Government, <https://www.health.nsw.gov.au/Infectious/factsheets/Pages/rabies-australian-bat-lyssavirus-infection>.

NSW Wildlife Council 2010, *Flying-foxes*, <https://www.nwc.org.au/wp-content/uploads/2016/12/Flying_Fox_Article_June2010.pdf>.

OEH 2015, Flying-fox Camp Management Policy 2015, Office of Environment and Heritage, Sydney. https://www.environment.nsw.gov.au/-/media/OEH/Corporate-Site/Documents/Animals-and-plants/Wildlife-management/Flying-foxes/flying-fox-camp-management-policy-2015-150070.pdf

OEH 2016, Planting to conserve threatened nomadic pollinators in NSW, Office of Environment and Heritage, Sydney. https://www.environment.nsw.gov.au/-/media/OEH/Corporate-Site/Documents/Animals-and-plants/Threatened-species/habitat-restoration-for-threatened-pollinators-160519.pdf

Richards, G 2000, Proceedings of a Workshop to Assess the Status of the Grey-headed Flying-fox in New South Wales. Unpublished report to the NSW Threatened Scientific Committee.

Roberts, B 2005, 'Habitat characteristics of flying-fox roosts in South East Qld, BSc. (Hons.) Thesis, Griffith University, Brisbane.

Roberts, B 2006, 'Management of Urban Flying-fox Roosts: Issues of Relevance to Roosts in the Lower Clarence', NSW, Valley Watch Inc., Maclean.

Roberts, B and Eby, P 2013, 'Review of past flying-fox dispersal actions between 1990–2013', publisher unknown, <www.environment.nsw.gov.au/resources/animals/flying-fox-2014-subs/flyingfoxsub-jenny-beatson-part2.pdf>.

Roberts, BJ, Catterall, CP, Eby, P and Kanowski, J 2012, 'Long-Distance and Frequent Movements of the Flying-Fox *Pteropus poliocephalus*: Implications for Management', *PLOS ONE* 7, e42532.

Roberts, BJ, Mo, M, Roache, M and Eby P, 2021, Review of dispersal attempts at flying-fox camps in Australia, *Australian Journal of Zoology* 68, 254-272.

SEQ Catchments 2012, *Management and Restoration of flying-fox Roosts: Guidelines and Recommendation*s, South East Queensland Catchments Ltd funded by the Australian Government's Caring for Our Country, <www.environment.nsw.gov.au/resources/animals/flying-fox-2014-subs/flyingfoxsub-jenny-beatson-part3.pdf>.

Shinwari, MW, Annand, EJ, Driver, L, Warrilow, D, Harrower, B, Allcock, RJN, Pukallus, D, Harper J, Bingham, J, Kung, N and Diallo, IS 2014, 'Australian bat lyssavirus infection in two horses', *Veterinary Microbiology* 173, 224-231.

Tait J, Perotto-Baldivieso HL, McKeown A and Westcott DA 2014, 'Are flying-foxes coming to town? Urbanisation of the spectacled flying-fox (*Pteropus conspicillatus*) in Australia', *PLOS ONE* 9: e109810.

TSSC 2001, Australian Government, *Pteropus poliocephalus* (Grey-headed Flying-fox). Advice to the Minister for the Environment and Heritage from the Threatened Species Scientific Committee (TSSC) on Amendments to the list of Threatened Species under the *Environment Protection and Biodiversity Conservation Act 1999*. http://www.environment.gov.au/biodiversity/threatened/conservation-advices/pteropus-poliocephalus..

Tidemann, CR and Nelson, JE 2011, 'Life expectancy, causes of death and movements of the grey-headed flying-fox (*Pteropus polioephalus*) inferred from banding', *Acta Chiropterologica* 13, 419-429.

Timmiss, E 2017, 'Spatial factors influencing the establishment and occupancy of roosts of the four mainland Australian flying-fox species (Pteropus spp.)', Honours thesis, University of New South Wales.

Timmiss, L, Martin, J, Murray, N, Welbergen, J, Westcott, D, McKeown, A, Kingsford, R 2021, 'Threatened but not conserved: flying-fox roosting and foraging habitat in Australia', *Australian Journal of Zoology* 68, 226-233.

Vanderduys, EP, Caley, P, McKeown, A, Martin, JM, Pavey, C and Westcott, D 2024, Population trends in the vulnerable Grey-headed flying-fox, *Pteropus poliocephalus*; results from a long-term, range-wide study, *PLOS ONE* 19(3): e0298530. https://doi.org/10.1371/journal.pone.0298530

Vardon, MJ and Tidemann, CR 1999, 'Flying-foxes (*Pteropus alecto* and *P. scapulatus*) in the Darwin region, north Australia: patterns in camp size and structure', *Australian Journal of Zoology* 47, 411-423.

Wagner, J 2008, 'Glandular Secretions of Male Pteropus (Flying-foxes): Preliminary Chemical Comparisons Among Species', *Independent Study Project*.

Webb, N and Tidemann, C 1996, 'Mobility of Australian flying-foxes, Pteropus spp. (Megachiroptera): evidence from genetic variation', *Proceedings of the Royal Society B* 263, 497-502.

Welbergen, JA 2011, 'Fit females and fat polygynous males: seasonal body mass changes in the grey-headed flying fox', *Oecologia* 165, pp. 629-637.

Welbergen, JA, Meade, J, Field HE, Edson, D, McMichael, L, Shoo, LP, Praszczalek, J, Smith, C and Martin, JM 2020, 'Extreme mobility of the world's largest flying mammals creates key challenges for management and conservation', *BMC Biology* 18.

Westcott, DA, Dennis, AJ, Bradford, MG, McKeown, A and Harrington, GN 2008, 'Seed dispersal processes in Australia's Wet Tropics rainforests', in Stork, N and Turton, S, *Living in a dynamic tropical forest landscape*, Blackwells Publishing, Malden, pp. 210–223.

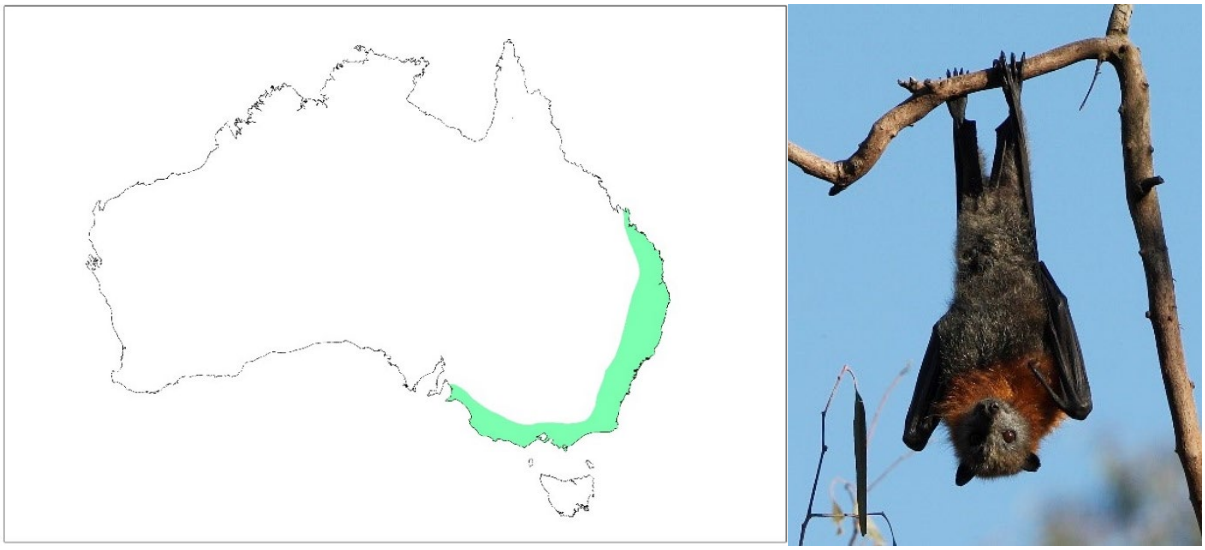
WHA 2019, *Australian bat lyssavirus Fact Sheet*, Wildlife Health Australia, https://wildlifehealthaustralia.com.au/Portals/0/Documents/FactSheets/mammals/Australian_Bat_Lyssavirus.pdf.

WHA 2021, *Hendra virus and Australian wildlife Fact Sheet*, WHA, https://wildlifehealthaustralia.com.au/Portals/0/Documents/FactSheets/Mammals/Hendra_virus_and_Australian_Wildlife.pdf.

Zurbuchen, A, Landert, L, Klaiber, J, Muller, A, Hein, S and Dorn, S 2010, 'Maximum foraging ranges in solitary bees: only few individuals have the capability to cover long-foraging distances', *Biological Conservation* 142, 669-676.

Appendix 1 Species profile

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



Grey-headed flying-fox indicative species distribution (DPE 2023)

The GHFF is found throughout eastern Australia, generally within 200 kilometres of the coast, from Finch Hatton in Queensland to the north to Melbourne, Victoria (DPE 2023). 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 (DPE 2023).

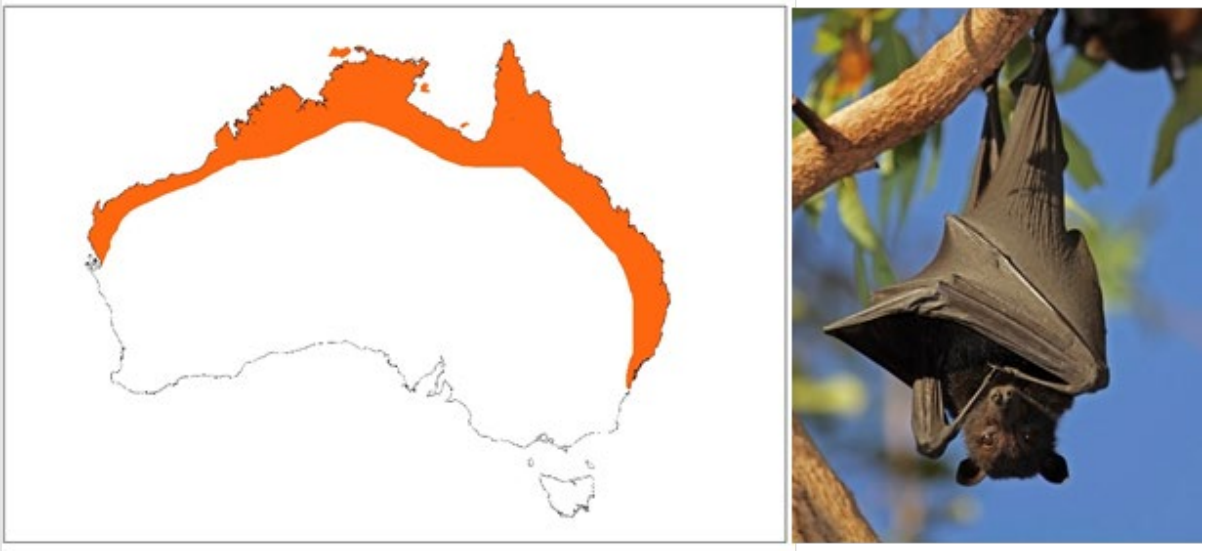
All the GHFF in Australia are regarded as one population that moves around freely within its entire national range (Webb and Tidemann 1996, DCCEEW 2021). GHFF may travel up to 300 kilometres in a single night (Welbergen et al. 2020) with a foraging radius of up to 20 kilometres from their camp (Meade et al. 2021). 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, DCCEEW 2023, Richards 2000). 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) (DECCW 2009). For these reasons it is listed as vulnerable to extinction under NSW and federal legislation.

Black flying-fox (*Pteropus alecto*)



Black flying-fox indicative species distribution (DPE 2023)

The BFF has traditionally occurred throughout coastal areas from Shark Bay in Western Australia, across Northern Australia, down through Queensland and into northern NSW (Churchill 2008). Since it was first described there has been a substantial southerly shift by BFF (Roberts et al. 2012). This shift has consequently led to an increase in indirect competition with the threatened GHFF, which appears to be favouring the BFF (DCCEEW 2021).

The BFF and GHFF foraging behaviour overlaps, feeding on the fruit and blossoms of native and introduced plants (Churchill 2008), 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 km of the camp site (Markus & Hall 2004).

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

Little red flying-fox (Pteropus scapulatus)

Little red flying-fox indicative species distribution (DPE 2023)

This species hasn't been recorded at Centennial Park but has been observed in the Sydney region. The LRFF is widely distributed throughout northern and eastern Australia, with populations occurring across northern Australia and down the east coast into Victoria.

The LRFF forages almost exclusively on nectar and pollen, although will eat fruit at times and occasionally raids orchards (Australian Museum 2020). LRFF often move sub-continental distances in search of sporadic food supplies. The LRFF has the most nomadic distribution, strongly influenced by availability of food resources (predominantly the flowering of eucalypt species) (Churchill 2008), which means the duration of their stay in any one place is generally very short.

Habitat preferences of this species are quite diverse and range from semi-arid areas to tropical and temperate areas, and can include sclerophyll woodland, melaleuca swamplands, bamboo, mangroves and occasionally orchards (Australian Museum 2020). LRFF are frequently associated with other *Pteropus* species. In some colonies, LRFF individuals can number many hundreds of thousands and they are unique among *Pteropus* species in their habit of clustering in dense bunches on a single branch. As a result, the weight of roosting individuals can break large branches and cause significant structural damage to roost trees, in addition to elevating soil nutrient levels through faecal material (SEQ Catchments 2012).

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

Appendix 2 Legislation

State

Flying-fox Camp Management Policy 2015

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

Flying-fox Camp Management Code of Practice 2018

NSW DCCEEW has prepared a Code of Practice under the Biodiversity Conservation Regulation 2017 authorising camp management actions on public land. The code defines standards for effective and humane management of flying-fox camps.

Camp management actions can only be implemented under the Code in accordance with a Camp Management Plan endorsed by the Environment Agency Head (i.e. NSW DCCEEW).

The objective of the code is to enable camp managers to act quickly if flying-fox camps are causing a concern on public land. If camp management actions are consistent with the code, a Biodiversity Conservation licence will not be required.

Biodiversity Conservation Act 2016

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

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

The GHFF is listed as threatened under the BC Act (DPE 2023).

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

a. harm to an animal that is a threatened species, or part of a threatened population

b. the picking of a plant that is a threatened species, or part of a threatened population or ecological community

c. damage to habitat of a threatened species, population or ecological community

d. damage to a declared area of outstanding biodiversity conservation value.

If the NSW DCCEEW assesses a biodiversity conservation licence application and determines that a significant impact is unlikely, a biodiversity conservation licence will be granted (the appendix to the Policy lists standard conditions for flying-fox management approvals).

NSW DCCEEW regulates flying-fox camp management through two options provided to land managers:

- authorisation under the Flying-fox Camp Management Code of Practice for public land managers
- licensing for public and private land managers.

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

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

Local Government Act 1993

The primary purpose of this Act is to provide the legal framework for an effective, efficient and environmentally responsible, open system of local government. Most relevant to flying-fox management is that it also provides encouragement for the effective participation of local communities in the affairs of local government and sets out guidance on the use and management of community land which may be applicable to land which requires management of flying-foxes.

National Parks and Wildlife Act 1974

The *National Parks and Wildlife Act 1974* (NPW Act) provides for the conservation of nature, objects, places or features of cultural value and the management of land reserved under this Act. The Act protects Aboriginal objects and declared Aboriginal Places. An Aboriginal Heritage Impact Permit may be required under this Act to authorise camp management actions that may harm Aboriginal objects or declared Aboriginal Places.

Prevention of Cruelty to Animals Act 1979

It may be an offence under this Act if there is evidence of unreasonable/unnecessary torment associated with management activities. Adhering to welfare and conservation measures provided in the Plan will ensure compliance with this Act.

Environmental Planning and Assessment Act 1979

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

The EP&A Act is administered by the NSW Department of Planning, Housing and Infrastructure. Development control plans under the EP&A Act should consider flying-fox camps so that planning, design, and construction of future land uses is appropriate to avoid future conflict. Development under Part 4 of the Act does not require licensing under the BC Act, however it must be assessed and undertaken in accordance with the provisions of the BC Act.

Where public authorities such as local councils undertake development under Part 5 of the EP&A Act (known as ‘development without consent’ or ‘activity’), assessment and licensing under the BC Act may not be required; however, a full consideration of the development’s

potential impacts on threatened species will be required in all cases.

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

State Environmental Planning Policy (Biodiversity and Conservation) 2021

This policy consolidates 11 previous pieces of NSW legislation, including the SEPP for Vegetation in Non-rural Areas (2017), SEPP Koala Habitat Protection (2020 and 2021), and SEPP No. 19 – Bushland in Urban Areas. The Biodiversity and Conservation SEPP aims to protect the biodiversity values of trees and other vegetation in non-rural areas of the State and encourage the proper conservation and management of natural vegetation that provide habitat for koalas, among other aims. A person must not cut down, fell, uproot, kill, poison, ringbark, burn or otherwise destroy the vegetation, or lop or otherwise remove a substantial part of the vegetation to which the Biodiversity and Conservation SEPP applies without a permit granted by council, or in the case of vegetation clearing exceeding the biodiversity offset thresholds (as stated in Part 7 of the Biodiversity Conservation Regulation 2017), approval by the Native Vegetation Panel.

State Environmental Planning Policy (Resilience and Hazards) 2021

This policy consolidates and replaces several former NSW planning instruments concerned with natural hazards, coastal management and hazardous development, including the SEPP (Coastal Management) 2018, SEPP No. 33 – Hazardous and Offensive Development, SEPP No. 55 – Remediation of Land, and SEPP (Mining, Petroleum Production and Extractive Industries) 2007. The Resilience and Hazards SEPP provides a framework to manage risks associated with natural hazards such as flooding, bush fire, coastal erosion and sea level rise, as well as land contamination and hazardous industries. It also establishes provisions to protect and manage coastal wetlands and littoral rainforests, ensuring development is compatible with the sensitive ecological functions of the coastal zone. The policy aims to improve resilience of communities and the environment by directing development away from areas of unacceptable risk, requiring site remediation where contamination exists, and ensuring hazardous and extractive industries are appropriately located and managed.

Commonwealth

Environment Protection and Biodiversity Conservation Act 1999

The Commonwealth's EPBC Act provides protection for the environment, specifically matters of national environmental significance (MNES). A referral to the Commonwealth DCCEEW is required under the EPBC Act for any action that is likely to significantly impact on an MNES.

Matters of national environmental significance under the EPBC Act that relate to flying-foxes include:

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

The GHFF is listed as a vulnerable species under the EPBC Act, meaning it is an MNES. It is also considered to have a single national population. DCCEEW has developed the Referral

guideline for management actions in GHFF and spectacled flying-fox camps (DoE 2015) (the Guideline) to guide whether referral is required for actions pertaining to the GHFF.

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

- contained ≥10,000 GHFF in more than one year in the last 10 years, or
- been occupied by ≥ 2,500 GHFF permanently or seasonally every year for the last 10 years.

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

Referral will be required if a significant impact to any other MNES is considered likely as a result of management actions outlined in the Plan. Self-assessable criteria are available in the Significant Impact Guidelines 1.1 (DoE 2015) to assist in determining whether a significant impact is likely; otherwise consultation with DCCEEW will be required. If a significant impact is likely, GSP will liaise with the NSW DCCEEW and the Commonwealth DCCEEW.

Mitigation standards:

- The action must not occur if the camp contains females that are in the late stages of pregnancy or have dependent young that cannot fly on their own.
- The action must not occur during or immediately after climatic extremes (HSE, flood event), or during a period of significant food stress.
- Disturbance must be carried out using non-lethal means, such as acoustic, visual, and/or physical disturbance or use of smoke.
- Disturbance activities must be limited to a maximum of 2.5 hours in any 12-hour period, preferably at or before sunrise or at sunset.
- Trees are not felled, lopped, or have large branches removed when flying-foxes are in or near to a tree and likely to be harmed.
- The action must be supervised by a person with knowledge and experience relevant to the management of flying-foxes and their habitat (see Appendix 3), who can identify dependent young and is aware of climatic extremes and food stress events. This person must assess the relevant conditions and advise the proponent whether the activity can go ahead consistent with these standards.
- The action must not involve the clearing of all vegetation supporting a nationally-important flying-fox camp. Sufficient vegetation must be retained to support the maximum number of flying-foxes ever recorded in the camp of interest.

If actions cannot comply with these mitigation measures, referral for activities at nationally important camps is likely to be required.

Appendix 3 Flying-fox expert definition

The following are the minimum required skills and experience which must be demonstrated by a person with experience in flying-fox behaviour (as per Appendix 1 of the Flying-fox Camp Management Plan template, DPE 2019):

Essential:

- Knowledge of flying-fox habitat requirements.
- Knowledge and experience in flying-fox camp management.
- Knowledge of flying-fox behaviour, including ability to identify signs of flying-fox stress.
- Ability to differentiate between breeding and non-breeding females.
- Ability to identify females in final trimester.
- Ability to estimate age of juveniles.
- Experienced in flying-fox population monitoring including static and fly-out counts, demographics and visual health assessments.

Desirable:

- It is strongly recommended that the expert is independent of the Camp Management Plan owner to ensure transparency and objectivity. NSW DCCEEW may be able to help with finding flying-fox experts.
- ABLV-vaccinated (N.B. This is often an essential requirement during management implementation as detailed within the template).
- Trained in flying-fox rescue (N.B. This is often an essential requirement during management implementation as detailed within the template).
- Local knowledge and experience.

Appendix 4 Human and animal health

Flying-foxes, like all animals, carry pathogens that may pose human health risks. Many of these are viruses which cause only asymptomatic infections in flying-foxes themselves but may cause significant disease in humans or other animals that are exposed. In Australia, the most well-defined of these include Australian bat lyssavirus (ABLV) and Hendra Virus (HeV). Specific information on these viruses is provided below.

Excluding those people whose occupations require contact with bats, such as wildlife carers and vets, human exposure to ABLV and HeV, their transmission and frequency of infection is extremely rare. HeV infection in humans requires transfer from an infected intermediate equine host (i.e. close contact with an infected horse) and spread of the virus directly from bats to humans has not been reported.

These diseases are also easily prevented through vaccination, personal protective equipment, safe flying-fox handling (by trained and vaccinated personnel only) and appropriate horse husbandry. Therefore, even though human infection with these agents can be fatal, the probability of infection is extremely low, and the overall public health risk is also judged to be low (Health Direct 2023).

Below is current information at the time of writing. Please refer regularly to NSW Health for up-to-date information on bats and health.

Australian bat lyssavirus

Australian bat lyssavirus is a rabies-like virus that may be found in all flying-fox species on mainland Australia. It has also been found in an insectivorous microbat and it is assumed it may be carried by any bat species. The probability of human infection with ABLV is very low with less than 1% of the flying-fox population being affected (WHA 2019) and transmission requiring direct contact with an infected animal that is secreting the virus. In Australia three people have died from ABLV infection since the virus was identified in 1996 (WHA 2019).

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

Transmission of the virus from bats to humans is through a bite or scratch but may have potential to be transferred if bat saliva directly contacts the eyes, nose, mouth or broken skin. ABLV is unlikely to survive in the environment for more than a few hours, especially in dry environments that are exposed to sunlight (WHA 2019).

Transmission of closely related viruses suggests that contact or exposure to bat faeces, urine or blood does not pose a risk of exposure to ABLV, nor does living, playing or walking near flying-fox roosting areas (DPE 2023).

The incubation period in humans is assumed similar to rabies and variable between two weeks and several years. Similarly, the disease in humans presents essentially the same clinical picture as classical rabies. Once clinical signs have developed the infection is invariably fatal. However, infection can easily be prevented by avoiding direct contact with bats (i.e. handling). Pre-exposure vaccination provides reliable protection from the disease for people who are likely to have direct contact with bats. It is generally a mandatory workplace health and safety requirement that all persons working with bats receive pre-vaccination and have their level of

protection regularly assessed. Like classical rabies, ABLV infection in humans also appears to be effectively treated using post-exposure vaccination and so any person who suspects they have been exposed should seek immediate medical treatment. Post-exposure vaccination is usually ineffective once clinical manifestations of the disease have commenced.

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

- wash the wound with soap and water for at least five minutes (do not scrub)
- contact their doctor immediately to arrange for post-exposure vaccinations.
- If bat saliva contacts the eyes, nose, mouth or an open wound, flush thoroughly with water and seek immediate medical advice.

Hendra virus

Flying-foxes are the natural host for HeV, which can be transmitted from flying-foxes to horses. Infected horses sometimes amplify the virus and can then transmit it to other horses, humans and on two occasions, dogs (WHA 2021). There is no evidence that the virus can be passed directly from flying-foxes to humans or to dogs (NSW Health 2019). Clinical studies have shown cats, pigs, ferrets, and guinea pigs can carry the infection (WHA 2021).

Although the virus is periodically present in flying-fox populations across Australia, the likelihood of horses becoming infected is low and consequently human infection is extremely rare. Horses are thought to contract the disease after ingesting forage or water contaminated primarily with flying-fox urine (WHA 2021).

Humans may contract the disease after close contact with an infected horse. HeV infection in humans presents as a serious and often fatal respiratory and/or neurological disease and there is currently no effective post-exposure treatment or vaccine available for people. The mortality rate in horses is estimated to be 90% (WHA 2021). Since 1994, over 100 horses have died, and four of the seven people infected with HeV have lost their lives (WHA 2021, Australian Government 2022).

Previous studies have shown that HeV spillover events have been associated with foraging flying-foxes rather than camp locations. Therefore, risk is considered similar at any location within the range of flying-fox species and all horse owners should be vigilant. Vaccination of horses can protect horses and subsequently humans from infection (WHA 2021), as can appropriate horse husbandry (e.g. covering food and water troughs, fencing flying-fox foraging trees in paddocks, etc.).

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

Coronaviruses

Coronaviruses are found in bats, birds and other wildlife worldwide. While SARS-CoV-1 (SARS), MERS-CoV (MERS) and SARS-CoV-2 (COVID-19) have caused serious disease in humans, coronaviruses isolated from Australian bats are not closely related to these and no human health implications have been identified (WHA 2020).

General health considerations

Flying-foxes, like all animals, carry bacteria and other microorganisms in their guts, some of which are potentially pathogenic to other species.

Bat urine and faeces should be treated like any other animal excrement. Viruses are not transferred to humans from bat urine or faeces. As with any accumulation of animal faeces (bird, bat, domestic animals), fungi or bacteria may be present in bat droppings or urine. While considered very unlikely, there is a risk of contracting histoplasmosis and leptospirosis through direct contact with flying-fox droppings and urine, i.e. ingestion of fungal spores from bat droppings (histoplasmosis) and contact of infected urine with open cuts/eyes/mouth/nose (leptospirosis). As such, care should be taken when cleaning bat faeces or urine. This includes wetting dried faeces before cleaning or mowing, wearing appropriate PPE and maintaining appropriate hygiene. If disturbing dried bird or bat droppings, particulate respirators should be worn to prevent inhalation of dust and aerosols. See 'Work with bird and bat droppings' for detail.

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

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

Appendix 5 Management options analysis

This section provides an overview of camp management options commonly used in NSW and Australia, which have been considered in the development of the Plan. These are categorised in accordance with the NSW Flying-fox Camp Management Policy 2015 as Level 1: Routine camp management; Level 2: Creation of buffers; Level 3: Camp disturbance or dispersal (Appendix 7). An appraisal, based on this analysis, is provided for options to be either: adopt, investigate, or disregard. Management actions based on this analysis are provided in Section 7.

Management option	Relevant impacts	Cost $-$$$	Advantages	Disadvantages	Suitability for Centennial Park
Level 1 options					
Education and awareness programs	Fear of disease Noise Smell Faecal drop Water contamination	$	Low cost, increasing awareness will help the community understand the ecology of flying-foxes, providing options for landholders to reduce impacts. This is an effective short- and long-term solution. Education can be undertaken on an ongoing basis and in response to community concerns/needs.	Education and advice alone may not mitigate all issues, and on its own may not be acceptable to the community.	Education, advice, and awareness programs are key components of any plan to manage flying-foxes and their camps. Education programs delivered within Centennial Park include education about the ecology and importance of flying-foxes. The GSP has several educational signs installed at the Centennial Park camp (e.g. Figure 3). Signs could include a QR code to GSP's website to provide additional information. The GSP should continue to provide up to date information to the community (website, social media posts, etc.), especially during times of increased numbers of GHFF roosting. This may include notifying the community that part of the Centennial Park (particularly Lachlan Swamp) is closed for a day or a period for visitor safety and/or GHFF welfare. For example, paths are closed to allow cleaning or vegetation management (including planting). Similarly, areas may be closed if large numbers of GHFF are present to reduce disturbing the roosting animals. This action also aims to reduce GHFF disturbance which can shift roosting GHFF to undesirable locations. Appraisal: Adopt.

Management option	Relevant impacts	Cost $-$$$	Advantages	Disadvantages	Suitability for Centennial Park
Camp monitoring	Noise Smell Faecal drop	$	Relatively inexpensive. Allows for an understanding of population dynamics over time which is important to inform community engagement actions. Allows for data to be used to determine the efficacy of management actions.	Not a direct management action that will minimise impacts.	Undertake regular monitoring (e.g. at least quarterly), sharing this information with NSW DCCEEW and the NFFMP. Consistent monitoring allows for the collection of key information. Including: camp extent, number of flying-foxes, seasonal trends, flying-fox demographics (species present, age, breeding), and can assist in informing when management actions can be implemented and allows for data to be collected over time to assess management efficacy. Appraisal: Adopt. Drone monitoring (thermal) could be considered as a complimentary method of obtaining count and camp extent data. Appraisal: Investigate.
Routine camp maintenance	Health/well-being	$$$	This action is not aimed at managing flying-foxes, it allows the landholder to undertake routine maintenance at or near the flying-fox camp (in line with the Policy). Examples of routine camp management actions are provided in the Policy. Note, weed removal has the potential to reduce habitat at a camp and reduce numbers of roosting flying-foxes.	No disadvantages.	The flying-fox camp is located within a more natural area of the manicured Centennial Park, as such this management action is being implemented to some degree. The budget identified here aims to cover additional arboricultural management and successional replacement planting, and site management including cleaning, planting, and weed management. Protocols should be developed for carrying out operations that have the potential to disturb flying-foxes, which can increase impacts such as noise and smell, and create a flying-fox welfare issue. Any weed removal should be staged and mindful of disturbance or exacerbating the potential for HSEs. Appraisal: Adopt.

Management option	Relevant impacts	Cost $-$$$	Advantages	Disadvantages	Suitability for Centennial Park
Alternative habitat creation	Noise Smell Faecal drop Health/wellbeing	$$$	If successful in attracting flying-foxes away from high-conflict areas, dedicated habitat in low conflict areas will mitigate most impacts and help flying-fox conservation. Rehabilitation of degraded habitat that is likely to be suitable for flying-fox use could be a more practical and a faster approach than habitat creation. Improving potential alternative camp habitat should be part of a medium-to long-term plan.	Long-term (~5-10 years for roost tree growth) approach so cannot be undertaken quickly, previous attempts to attract flying-foxes to a new site have not been known to succeed.	Alternative habitat creation within another part of Centennial Park or the Randwick LGA is not recommended. Enhancing and expanding the vegetation within and adjacent to the current camp footprint is recommended. Appraisal: Disregard.
Provision of artificial roosting habitat	Noise Smell Faecal drop Health/wellbeing	$$$$$	Artificial roosting habitat could be considered to supplement vegetation damaged by large numbers of flying-foxes.	No guarantee that flying-foxes would use artificial habitat, but collaborating with a researcher on varying design options would increase the likelihood of success.	Not enough evidence at this stage to adopt. This may be a tool in the future following experimental research into design, evaluation, and construction. Appraisal: Disregard.
Protocols to manage incidents	Health/wellbeing Fear of disease	$	Low cost will reduce actual risk of negative human/pet– flying-fox interactions, promotes conservation of flying-foxes, can be undertaken quickly.	Will not mitigate amenity impacts but will reduce fear of disease.	Community education regarding disease risk to humans and pets. GSP to maintain/develop (where required) standard internal procedures for operations, response to HSEs, and other potential incidents. Appraisal: Adopt.

Management option	Relevant impacts	Cost $-$$$	Advantages	Disadvantages	Suitability for Centennial Park
Support flying-fox carers	Health/wellbeing Flying-fox welfare	$	Low cost, fosters relationship between GSP and wildlife carers, can decrease risk of negative human/pet/flying-fox interactions with early intervention of carer support during HSEs, food shortages, etc.	Will not mitigate amenity impacts.	Maintain good working relationship and support flying-fox carers, especially during times of increased likelihood of HSEs and during pupping and crèching periods. Appraisal: Adopt.
Research	Noise Smell Faecal drop Health/wellbeing	$-$$$	Support research that improves understanding and more effectively mitigates impacts. Develop understanding of local flowering.	Generally cannot be undertaken quickly, management trials may require cost input.	Stay up-to-date with contemporary research and review the Plan as required. Analysis of scats to assess foraging species. Monitoring the timing, distribution, and extent of flowering across the park and LGA. Drone surveys provide increased accuracy over ground count methods. GPS tracking movements in your area would inform community engagement and an assessment of foraging habitat. Appraisal: Investigate.
Appropriate land-use planning	Noise Smell Faecal drop Health/wellbeing	$	Suitable planning for future development will reduce potential for future conflict.	Will not mitigate current impacts.	Not relevant. Appraisal: Disregard.
Do nothing	Nil	Nil	No resource expenditure.	Will not mitigate impacts and would not be considered acceptable by impacted members of the community.	Not appropriate. Appraisal: Disregard.
Level 2 options					
Buffers through vegetation modification (implement	Noise Smell Health/wellbeing	$$	Any vegetation modification should be done using a staged approach, with the aim of changing native vegetation	Modifying vegetation can increase visibility into the camp and noise issues for neighbouring residents which may create further conflict.	Currently not relevant. Future shifts in the camp area, associated with increased numbers of GHFF, may result with conflict where roosting occurs adjacent to venues (e.g. The Discovery Centre) or in undesirable locations. Removal

Management option	Relevant impacts	Cost $-$$$	Advantages	Disadvantages	Suitability for Centennial Park
under the Code of Practice 2018)			as little as possible and only if flying-foxes' use of this vegetation is directly affecting residents.	Vegetation removed too quickly could cause inadvertent movement to less desirable locations within/adjoining a camp or dispersal of a camp.	of trees to create a buffer is not recommended (see below). Appraisal: Disregard.
Buffers through visual deterrents, canopy-mounted sprinklers	Noise Smell Health/wellbeing Damage to vegetation	$$$$	Successful creation of a buffer will reduce impacts, promotes flying-fox conservation, can be undertaken quickly, options without vegetation removal may be preferred by the community.	May impact the site, buffers will not generally eliminate impacts, maintenance costs may be significant, often logistically difficult, limited trials so likely effectiveness unknown.	Currently not relevant. Canopy-mounted sprinklers may be useful to deter GHFF spreading to conflict areas (e.g. venues). The use of canopy-mounted sprinklers is recommended compared with a vegetative buffer. For more detail on canopy-mounted sprinklers see Appendix 5. Appraisal: Investigate (as required).
Level 3 options					
Nudging	All	$$$$$	Can encourage flying-foxes to shift away from high conflict areas next to residential areas.	May lead to inadvertent dispersal and splintering of the camp if not done at the correct time, frequency, or duration.	This option could be appropriate to deter flying-foxes roosting in undesirable locations (e.g. The Discovery Centre), however this currently isn't an issue. Appraisal: Disregard.
Active dispersal	All (generally appropriate for amenity impacts only)	$$$$$	If successful can mitigate all impacts at that site. It is important to note that the outcomes of dispersal are generally temporary, and repeat dispersal is likely to be required as flying-foxes attempt to re-establish the camp. This may be seasonally, annually, or more regularly.	Dispersal is rarely successful without significant vegetation removal or ongoing effort and excessive. See Appendix 7 for further information of dispersal attempts.	This option is not supported by GSP. Any impacts are to be managed through Level 1 or Level 2 options. Appraisal: Disregard.

Appendix 6 Management options

Level 1 actions: routine camp management

Education and awareness programs

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

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

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

The likelihood of improving community understanding of flying-fox issues is high. However, the extent to which that understanding will help alleviate conflict issues is probably less so. Extensive education for decision-makers, the media and the broader community may be required to overcome negative attitudes towards flying-foxes.

It should be stressed that a long-term solution to the issue resides with better understanding flying-fox ecology and applying that understanding to careful urban planning and development.

An education program may include components shown below.

Property modification

The managers of land on which a flying-fox camp is located could promote or encourage the adoption of certain actions on properties adjacent to or near the camp to minimise impacts from roosting and foraging flying-foxes. Actions may include:

- Create visual/sound/smell barriers with fencing or hedges. To avoid attracting flying-foxes, species selected for hedging should not produce edible fruit or nectar-exuding flowers, should grow in dense formation between 2–5 m (Roberts 2006) (or be maintained at less than five metres). Vegetation that produces fragrant flowers can assist in masking camp odour where this is of concern.
- Manage foraging trees (i.e. plants that produce fruit/nectar-exuding flowers) within properties through pruning/covering with bags or wildlife friendly netting, early removal of fruit, or tree replacement.
- Cover vehicles, structures, and clothes lines where faecal contamination is an issue, or remove washing from the line before dawn/dusk.
- Move or cover eating areas (e.g. BBQs and tables) within close proximity to a camp or foraging tree to avoid contamination by flying-foxes.
- Install double-glazed windows, insulation and use air-conditioners when needed to reduce noise disturbance and smell associated with a nearby camp.

- Include suitable buffers and other provisions (e.g. covered car parks) in planning of new developments.
- Turn off lighting at night which may assist flying-fox navigation and decrease fly-over impacts.
- Consider removable covers for swimming pools and ensure working filter and regular chlorine treatment.
- Appropriately manage rainwater tanks, including installing first-flush systems.
- Avoid disturbing flying-foxes during the day as this will increase camp noise.

The cost would be borne by the person or organisation who modifies the property.

Odour neutralising

Odour neutralising systems (which modify odour-causing chemicals at the molecular level rather than just masking them) are commonly used in contexts such as waste management, food processing, and water treatment. They have the potential to be a powerful tool for managing odour impacts associated with flying-foxes. Two trials have been undertaken that utilised two different odour-neutralising systems. The indoor system uses a Hostogel™ pot containing a gel-based formula for neutralising indoor odour. These are inexpensive, only require replacement every few months, and may be sufficient to mitigate odour impacts in houses affected by flying-fox camps. Initial results suggest there may be a positive localised effect in reducing flying-fox odour within homes. This option may be useful for affected residents (particularly those directly adjacent to the camp), as residents could choose whether or not they wish to have a gel-pot in their living space and can simply put the lid back on the pot when the odour is not impacting on them.

The outdoor system consists of a Vapourgard™ unit that dispenses an odour-neutralising vapour through diffuser pipes that are installed on boundary fences. A trial was undertaken in April – June 2021 with the participation of residents living near a flying-fox camp at Porter Park, Sunshine Coast. The system followed a predetermined schedule (alternating on / off cycles) for 9 weeks and residents were asked to rate the flying-fox odour every day throughout the trial.

The trial identified that the odour-neutralising technique has the potential to be effective. However, objective results were difficult to obtain due to the significant negative experience of residents as a consequence of the large influxes of flying-fox numbers during the trial. If future trials confirm this technique is effective, the odour-neutralising system could be installed at one or more camps where odour impacts have been reported.

Approval to use this method is required from the NSW DCCEEW.

Routine camp maintenance and operational activities

Examples of routine camp management actions are provided in the Code of Practice. Approval (e.g. a licence) or endorsement of the Plan by NSW DCCEEW is required. Routine camp management actions include:

- removal of tree limbs or whole trees that pose a genuine health and safety risk, as determined by a qualified arborist
- weed removal, including removal of removal of environmental weeds and priority weeds under the NSW *Biosecurity Act 2015*
- trimming of understorey vegetation

- the planting of vegetation
- minor habitat augmentation for the benefit of the roosting animals
- mowing of grass and similar grounds-keeping actions that will not create a major disturbance to roosting flying-foxes
- application of mulch or
- removal of leaf litter or other material on the ground.

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

Revegetation and land management to create alternative habitat

This management option involves revegetating and managing land to create alternative flying-fox roosting and foraging habitat through improving and extending existing low-conflict camps or developing new roosting habitat in areas away from human settlement. The GSP to recommended to enhance the vegetation within and surrounding the existing camp extent and increase forage trees within the Park.

Selecting new sites and attempting to attract flying-foxes to them has had limited success in the past, and ideally habitat at known camp sites would be dedicated as a flying-fox reserve. Foraging trees planted amongst and surrounding camp trees (excluding in/near horse paddocks) may help to attract flying-foxes to a desired site. Ideally, any alternative habitat creation should consider NSW Government's 'Planting to conserve threatened nomadic pollinators in NSW' (OEH 2016) and include appropriate species for site-specific conditions and ecological communities.

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

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

Provision of artificial roosting habitat

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

Protocols to manage incidents

This management option involves implementing protocols for managing incidents or situations specific to particular camps. Such protocols may include monitoring at sites within the vicinity of aged care or childcare facilities, management of compatible uses such as dog walking or sites susceptible to HSEs (when the camp is subjected to extremely high temperatures leading to flying-foxes changing their behaviour and/or dying).

The following is an example for emergency tree works: if an unforeseen tree failure poses an immediate risk to public safety, flying-foxes, infrastructure and/or adjacent properties then works must be done to the minimum extent necessary to prevent the immediate risk e.g. by removing a dangerous limb but leaving it in place on the ground for removal at a later time. The NSW DCCEEW will be notified that the works are going ahead, as soon as practicable, preferably before works commence.

Participation in research

This management option involves participating in research to improve knowledge of flying-fox ecology to address the large gaps in our knowledge about flying-fox habits and behaviours and why they choose certain sites for roosting. Further research and knowledge sharing at local, regional, and national levels will enhance our understanding and management of flying-fox camps. A key knowledge gaps exists around local foraging behaviour within the Parklands and surrounding Councils' LGA. Similarly, a key knowledge gaps exists around the implementation of management actions. Rigorous evaluation of the outcomes of management actions are encouraged, this includes collecting detailed data "before management actions are implemented.

Do nothing

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

Level 2 actions: in-situ management

Buffers

Buffers can be created through vegetation removal and/or the installation of permanent/semi-permanent deterrents.

Previous studies have recommended that vegetation buffers consisting of habitat not used by flying-foxes, should be 300 m or as wide as the site allows to mitigate amenity impacts for a community (SEQ Catchments 2012). Buffers need to take into consideration the variable use of a camp by flying-foxes within and across years, including large, seasonal influxes of flying-foxes.

Buffers through vegetation removal

Vegetation removal aims to alter the area of the buffer habitat sufficiently so that it is no longer suitable as a camp. The amount required to be removed varies between sites and camps, ranging from some weed removal to removal of most of the canopy vegetation.

Any vegetation removal should be done using a staged approach, with the aim of removing as little native vegetation as possible. This is of particular importance at sites with other values (e.g. ecological or amenity), and in some instances the removal of any native vegetation will not be appropriate. Thorough site assessment will inform whether vegetation management is suitable (e.g. can impacts to other wildlife and/or the community be avoided?).

Removing vegetation can also increase visibility into the camp and noise issues for neighbouring residents which may create further conflict.

Suitable experts should be consulted to assist selective vegetation trimming/removal to minimise vegetation loss and associated impacts. The importance of under- and mid-storey

vegetation in the buffer area for flying-foxes during HSEs also requires consideration.

Buffers without vegetation removal

Permanent or semi-permanent deterrents can be used to make buffer areas unattractive to flying-foxes for roosting, without the need for vegetation removal. This is often an attractive option where vegetation has high ecological or amenity value.

While many deterrents have been trialled in the past with limited success, there are some options worthy of further investigation:

Visual deterrents – Visual deterrents such as plastic bags, fluoro vests (GeoLINK 2012), and balloons (Ecosure, pers. comm.) in roosting trees have shown to have localised effects, with flying-foxes deterred from roosting within 1–10 m of the deterrents. The type and placement of visual deterrents would need to be varied regularly to avoid habituation. Potential for litter pollution should be considered and managed when selecting the type and placement of visual deterrents. In the absence of effective maintenance, this option could potentially lead to an increase in rubbish in the natural environment.

Noise emitters on timers – Noise needs to be random, varied and unexpected to avoid flying-foxes habituating. As such these emitters would need to be portable, on varying timers and a diverse array of noises would be required. It is likely to require some level of additional disturbance to maintain its effectiveness, and ways to avoid disturbing flying-foxes from desirable areas would need to be identified. This is also likely to be disruptive to nearby residents.

Smell deterrents – For example, bagged python excrement hung in trees has previously had a short-term localised effect (GeoLINK 2012). The smell of certain deterrents may also impact nearby residents, and there is potential for flying-foxes to habituate.

Canopy-mounted water sprinklers – This method has been effective in deterring flying-foxes during dispersals (Ecosure personal experience), and current trials in Queensland are showing promise for keeping flying-foxes out of designated buffer zones. This option can be logistically difficult (installation and water sourcing) and may be cost-prohibitive. Design and use of sprinklers need to be considerate of animal welfare and features of the site. For example, misting may increase humidity and exacerbate HSEs, and overuse may impact other environmental values of the site. Further information regarding canopy-mounted sprinklers is detailed below.

Screening plants – A ‘screen’ can be created by planting a row of trees along the edge of a camp, with the aim of reducing visual impacts associated with flying-foxes. This technique can be particularly useful in cases where residents can suffer extreme reactions triggered by the mere sight of flying-foxes.

Note that any deterrent with a high risk of causing inadvertent dispersal may be considered a Level 3 action.

<u>Canopy-mounted sprinklers</u>

Installation of canopy-mounted sprinklers (CMS) requires approval from NSW DCCEEW, this tool can be used to create a buffer by deter flying-foxes from roosting. CMS can be installed either:

- without any camp tree trimming/removal or

- accompanied by selective camp tree trimming/removal.

Canopy-mounted sprinklers installed by Sunshine Coast Council (source: National Flying-fox Forum 2016, Ecosure).

Canopy-mounted sprinklers may be designed to be operated by residents; this requires clear guidelines on sprinkler use. To date, CMS have been successful at other locations at discouraging flying-foxes from roosting in the buffer zone and enabling residents to have more control over flying-foxes near their properties.

Canopy-mounted sprinklers can be installed and effectively operated without the need for any vegetation removal, as long as the vegetation is not so thick as to restrict the extent of water spray. If vegetation thinning is required to allow sprinklers to operate effectively in some areas, approval may be required under relevant legislation.

Water pressure must be firm so it is sufficient to deter flying-foxes, however, must not risk injuring flying-foxes (or other fauna) or knocking an animal from the tree. Water misting should be minimised as this is unlikely to deter flying-foxes and could exacerbate HSE effects. Flying-fox heat stroke generally occurs when the temperature reaches 42°C, however, can occur at lower temperatures in more humid conditions. Given that humidity is likely to increase with water in the environment, sprinklers may need to be turned off in higher temperatures (e.g. >30°C) to avoid exacerbating heat stress (N.B. NSW DCCEEW has funded research through Western Sydney University to determine if sprinklers increase humidity and potential heat stress impacts; results should be considered for sprinkler usage).

Sprinklers should release a jet of air prior to water, as an additional deterrent and to cue animals to move prior to water being released. The intention of the sprinklers is to make the buffer unattractive, and effectively ‘train’ individuals to stay out of the buffer area. If installed, sprinklers should be programmed to operate on a random schedule and in a staggered manner (i.e. not all sprinklers operating at the same time, to avoid excessive disturbance). Each activation should be for approximately 30-45 seconds per sprinkler. Each sprinkler should be activated up to five times between 0630 and 1600 avoiding critical fly-in or fly-out periods. To avoid flying-foxes habituating to the stimuli, sprinklers should only be operated by residents when flying-foxes are within range. Sprinkler settings would also need to account for

seasonal changes (e.g. not in the heat of the day during summer when they may be an attractant, and/or could increase humidity and exacerbate heat events). Individual sprinklers may also need to be temporarily turned off depending on location of creching young, or if it appears likely that animals will be displaced to undesirable locations.

Infrastructure should ideally be designed to accommodate additional sprinklers should they be required in the future. Sprinklers should be designed and attached in a way that allows for future maintenance, replacement, and sprinkler head adjustments, with consideration given to vandalism if located in a publicly accessible area.

Level 3 actions: disturbance or dispersal

Nudging

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

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

Dispersal

Dispersal aims to encourage a flying-fox camp to move to another location. Dispersing flying-foxes may be achieved in two ways:

- actively disturbing the camp pre-dawn as flying-foxes attempt to return from nightly foraging
- passively, by removal of all roosting habitat.

Dispersal via disturbance has been shown to reduce concerns and improve amenity in the short-term, however, camps are usually recolonised, and the conflict remains (Roberts & Eby 2013, Currey et al. 2018, Roberts et al. 2021). Data from these and more recent studies show that in 95% of cases, dispersal did not reduce the number of flying-foxes from the local area (Roberts et al. 2021). For further information on the effectiveness of dispersal attempts in Australia, see Appendix 7. Note, dispersals require long-term management to maintain no roosting. Consequently, this method requires significant initial financial investment and long-term financial and organisational commitment.

Despite the risks associated with dispersal, there are some situations where camp dispersal may be considered. 'Passive' or 'active' is described further below.

Passive dispersal

Removing vegetation in a staged manner can be used to passively disperse a camp, by gradually making the habitat unattractive so that flying-foxes will disperse of their own accord over time with little stress (rather than being more forcefully moved with noise, smoke, etc.). This is less stressful to flying-foxes, and greatly reduces the risk of splinter colonies forming in other locations (as flying-foxes are more likely to move to other known sites within their camp network when not being forced to move immediately, as in active dispersal).

Generally, a significant proportion of vegetation needs to be removed in order to achieve dispersal of flying-foxes from a camp or to prevent camp re-establishment. For example, flying-foxes abandoned a camp in Bundall, Queensland once 70% of the canopy/midstorey and 90% of the understorey had been removed (Ecosure 2011). Ongoing maintenance of the site is required to prevent vegetation structure returning to levels favourable for colonisation by flying-foxes. Importantly, at nationally important camps (Appendix 2), sufficient vegetation must be retained to accommodate the maximum number of flying-foxes recorded at the site.

This option may be preferable in situations where the vegetation is of relatively low ecological and amenity value, and alternative known permanent camps are located nearby with capacity to absorb the additional flying-foxes. While the likelihood of splinter colonies forming is lower than with active dispersal, if they do form following vegetation modification there will no longer be an option to encourage flying-foxes back to the original site. This must be carefully considered before modifying habitat.

There is also potential to make a camp site unattractive by removing access to water sources. However, at the time of writing this method had not been trialled so the likelihood of this causing a camp to be abandoned is unknown. It would also likely only be effective where there are no alternative water sources in the vicinity of the camp.

Active dispersal through disturbance

Dispersal is more effective when a wide range of tools are used on a randomised schedule with animals less likely to habituate (Ecosure pers. obs. 1997–2015). Each dispersal team member should have at least one visual and one aural tool that can be used at different locations on different days (and preferably swapped regularly for alternate tools). Exact location of these and positioning of personnel will need to be determined on a daily basis in response to flying-fox movement and behaviour, as well as prevailing weather conditions (e.g. wind direction for smoke drums).

Active dispersal will be disruptive for nearby residents given the timing and nature of activities, and this needs to be considered during planning and community consultation.

This method does not explicitly use habitat modification as a means to disperse the camp, however if dispersal is successful, some level of habitat modification should be considered. This will reduce the likelihood of flying-foxes attempting to re-establish the camp and the need for follow-up dispersal as a result. Ecological and aesthetic values will need to be considered for the site, with options for modifying habitat the same as those detailed for buffers above.

Early dispersal before a camp is established at a new location

This management option involves monitoring local vegetation for signs of flying-foxes roosting in the daylight hours and then undertaking active or passive dispersal options to discourage the animals from establishing a new camp. Even though there may only be a few animals initially using the site, this option is still treated as a dispersal activity, however it may be simpler to achieve dispersal at these new sites than it would in an established camp. It may also avoid considerable issues and management effort required should the camp be allowed to establish in an inappropriate location.

It is important that flying-foxes feeding overnight in vegetation are not mistaken for animals establishing a camp.

Maintenance dispersal

Maintenance dispersal refers to active disturbance following a successful dispersal to prevent

the camp from re-establishing. It differs from initial dispersal by aiming to discourage occasional over-flying individuals from returning, rather than attempting to actively disperse animals that have been recently roosting at the site. As such, maintenance dispersal may have fewer timing restrictions than initial dispersal, provided that appropriate mitigation measures are in place.

Unlawful activities

Culling

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

Appendix 7 Dispersal summary results

Multiple studies have clearly demonstrated the long-term ineffectiveness of flying-fox camp dispersals. Dispersal via disturbance has been shown to reduce concerns and improve amenity in the short-term, however, camps are usually recolonised, and the conflict remains (Roberts & Eby 2013, Currey et al. 2018, Roberts et al. 2021).

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

- In all cases, dispersed animals did not abandon the local area[3].
- In 16 of the 17 cases, dispersals did not reduce the number of flying-foxes in the local area.
- Dispersed animals did not move far (in approx. 63% of cases the animals only moved < 600 m from the original site, contingent on the distribution of available vegetation). In 85% of cases, new camps were established nearby.
- In all cases, it was not possible to predict where replacement camps would form.
- Conflict was often not resolved. In 71% of cases, conflict was still being reported either at the original site or within the local area years after the initial dispersal actions.
- Repeat dispersal actions were generally required (all cases except where extensive vegetation removal occurred).
- The financial costs of all dispersal attempts were high, ranging from tens of thousands of dollars for vegetation removal to hundreds of thousands for active dispersals (e.g. using noise, smoke, etc.).

Ecosure, in collaboration with a Griffith University, researched outcomes of management in Queensland between November 2013 and November 2014. An overview of findings[4] is summarised below.

- There were attempts to disperse 25 separate camps in Queensland (compared with nine camps between 1990 and June 2013 analysed in Roberts & Eby (2013)). Compared with the historical average (less than 0.4 camps/year) the number of camp dispersed in the year since the framework was introduced has increased by 6250%.
- Dispersal methods included fog[5], birdfrite, lights, noise, physical deterrents, smoke, extensive vegetation modification, water (including cannons), paintball guns and helicopters.
- The most common dispersal methods were extensive vegetation modification alone and extensive vegetation modification combined with other methods.
- In nine of the 24 camps dispersed, dispersal actions did not reduce the number of flying-foxes in the LGA.
- In all cases, it was not possible to predict where new camps would form.

[3] Local area is defined as the area within a 20 km radius of the original site = typical feeding area of a flying-fox.
[4] This was based on responses to questionnaires sent to councils; some did not respond and some omitted responses to some questions.
[5] Fog refers to artificial smoke or vapours generated by smoke/fog machines. Many chemical substances used to generate smoke/fog in these machines are considered toxic.

- When flying-foxes were dispersed, they did not move further than 6 km away.
- As at November 2014 repeat actions had already been required in 18 cases.
- Conflict for the council and community was resolved in 60% of cases, but with many councils stating they feel this resolution is only temporary.
- The financial costs of all dispersal attempts were considerable, regardless of methods used, ranging from $7,500 to more than $400,000 (with costs ongoing).

Additional research investigating the effectiveness of dispersal attempts (Roberts et al. 2021) has shown similar findings which are summarised below:

- In 95% of cases, dispersal did not reduce the number of flying-foxes from the local area.
- Of the 48 camp dispersals attempted, only 23% were deemed a success at reducing conflict with communities, and this generally only occurred after extensive destruction of camp habitat.
- No project with a budget less than A$250,000 was deemed successful.
- Repeat actions were required in 58% of cases, some for months and years following the initial activities.
- In 88% of cases, replacement camps were established within 1 km of the original camp, transferring conflict to neighbouring communities.

Appendix 8 Standard measures to avoid impacts to flying-foxes

The following mitigation measures will be complied with at all times during implementation of any activities within or immediately adjacent to a camp. It is acknowledged that some of these measures may not be able to be applied or adhered to for works such as emergency tree removals.

- All personnel will be appropriately experienced, trained, and inducted. Induction will include each person's responsibilities under this Plan.
- All personnel will be briefed prior to the action commencing each day and debriefed at the end of the day.
- Works will cease and NSW DCCEEW consulted in accordance with the 'stop work triggers' section of the Plan (below).
- Large crews will be avoided where possible.
- The use of loud machinery and equipment that produces sudden impacts/noise will be limited. Where loud equipment (e.g. chainsaws) is required, they will be started away from the camp and allowed to run for a short time to allow flying-foxes to adjust.
- Activities that may disturb flying-foxes at any time during the year will begin as far from the camp as possible, working towards the camp gradually to allow flying-foxes to habituate.
- Any activity likely to disturb flying-foxes so that they take flight will be avoided during the day during the sensitive GHFF/BFF birthing period (i.e. when females are in final trimester or the majority are carrying pups, generally August – December) and avoided altogether during crèching (generally November/December to February).
- Where works cannot be done at night after fly-out during these periods, it is preferable they are undertaken in the late afternoon close to or at fly-out. If this is also not possible, a person experienced in flying-fox behaviour will monitor the camp for at least the first two scheduled actions (or as otherwise deemed to be required by that person) to ensure impacts are not excessive and advise on the most appropriate methods (e.g. required buffer distances, approach, etc.).
- NSW DCCEEW will be contacted if LRFF are present between March and October or are identified as being in final trimester / with dependent young as LRFF breeding is uncharacteristic in New South Wales and may also affect management action timing.
- Non-critical maintenance activities will ideally be scheduled when the camp is naturally empty, or after fly-out if there are no creching young within the camp. Where this is not possible (e.g. at permanently occupied camps) they will be scheduled for the best period for that camp (e.g. when the camp is seasonally lower in numbers and breeding will not be interrupted, or during the non-breeding season, generally May to July).
- Works will not take place in periods of adverse weather including strong winds, sustained heavy rains, extreme heat, in cold temperatures or during periods of likely population stress (e.g. food shortages). Wildlife carers will be consulted where required to determine whether the population appears to be under stress.
- Works will be postponed on days predicted to exceed 35°C (or ideally 30°C), and for one day following a day that reached ≥35°C. If an actual HSE has been recorded at the camp or at nearby camps, a rest period of several weeks will be scheduled to

allow affected flying-foxes to fully recover. See the NSW Government website for more information on responding to heat stress in flying-fox camps.

- Evening works may commence after fly-out. Noise generated by the works should create a first stage disturbance, with any remaining flying-foxes taking flight. Works should be paused at this stage to monitor for any remaining flying-foxes (including crèching young, although December – February should be avoided for this reason) and ensure they will not be impacted. All Level 1 and 2 works (including pack-up) will cease by 0100 to ensure flying-foxes returning early in the morning are not inadvertently dispersed. Works associated with Level 3 actions may continue provided flying-foxes are not at risk of being harmed.
- If impacts at other sites are considered, in NSW DCCEEW's opinion, to be a result of management actions under this Plan, assistance will be provided by the proponent to the relevant land manager to ameliorate impacts. Details of this assistance are to be developed in consultation with NSW DCCEEW.
- Ensure management actions and results are recorded to inform future planning.

Human safety

The following measures are minimum requirements to ensure human health and safety during the implementation of flying-fox management activities. It is up to the land manager and contractors to conduct a risk assessment and determine health and safety requirements prior to works.

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

All Level 2 and 3 actions

Prior to works

- Residents adjacent to the camp will be individually notified one week prior to on-ground works commencing. This will include information on what to do if an injured or orphaned flying-fox is observed, a reminder not to participate in or interfere with the program, and details on how to report unusual flying-fox behaviour/daytime sightings. Relevant contact details will be provided (e.g. Program Coordinator). Resident requests for retention of vegetation and other concerns relating to the program will be taken into consideration.
- Where the Plan is being implemented by council, information will be placed on council's website along with contact information.
- The Department will be notified at least 48 hours before works commence.
- A protocol for flying-fox rescue, in accordance with the NSW Code of Practice for Injured, Sick and Orphaned Flying-foxes (DPIE 2021), will be developed including

contact details of rescue and rehabilitation organisations. This protocol will be made available to all relevant staff, residents and volunteers prior to the action commencing.

- A licenced wildlife carer trained in flying-fox rescue and appropriately vaccinated will be notified prior to beginning works in the event that rescue/care is required.

Monitoring

A flying-fox expert (identified in Appendix 3) will undertake an on-site population assessment prior to, during works and after works have been completed, including:

- number of each species
- ratio of females in their final trimester
- approximate age of any pups present including whether they are attached or likely to be crèched
- visual health assessment
- mortalities.
- Counts will be done at least:
- once immediately prior to works
- daily during works
- immediately following completion
- one month following completion
- 12 months following completion.

During works

- A flying-fox expert will attend the site as often as NSW DCCEEW considers necessary to monitor flying-fox behaviour and ensure compliance with the Plan and the Policy. They must also be able to identify pregnant females, flightless young, individuals in poor health and be aware of climatic extremes and food stress events. This person will assess the relevant conditions and advise the supervisor/proponent whether the activity can go ahead.
- Deterrents in buffer areas will be assessed by a flying-fox expert so those that may cause inadvertent dispersal (e.g. CMS) are not used during fly-in.
- At least one flying-fox rest day with no active management will be scheduled fortnightly, preferably weekly. Static deterrents (e.g. CMS) may still be used on rest days.

Vegetation trimming/removal (if required)

- Dead wood and hollows will be retained on site where possible as habitat.
- Vegetation chipping/mulching is to be undertaken as far away from roosting flying-foxes as possible (at least 100 m).
- Vegetation removal will not involve the clearing of all vegetation supporting a nationally important flying-fox camp. Sufficient vegetation will be retained to support the maximum number of flying-foxes ever recorded in the camp.

Canopy vegetation trimming/removal (if required)

Prior to works

- Trees to be removed or lopped will be clearly marked (e.g. with flagging tape) prior to works commencing, to avoid unintentionally impacting trees to be retained.

During works

- Any tree lopping, trimming or removal is undertaken under the supervision of a suitably qualified arborist (minimum qualification of Certificate III in Horticulture (Arboriculture) who is a member of an appropriate professional body such as Arboriculture Australia).
- Trimming will be in accordance with relevant Australian Standards (e.g. AS4373 Pruning of Amenity Trees), and best practice techniques used to remove vegetation in a way that avoids impacting other fauna and remaining habitat.
- No tree in which a flying-fox is roosting will be trimmed or removed. Works may continue in trees adjacent to camp trees only where a person experienced in flying-fox behaviour assesses that no flying-foxes are at risk of being harmed. A person experienced in flying-fox behaviour is to remain on site to monitor, when canopy trimming/removal is required within 50 m of roosting flying-foxes.
- While most females are likely to be carrying young (generally September – January) vegetation removal within 50 m of the camp will only be done in the evening after fly-out, unless otherwise advised by a flying-fox expert.
- Tree removal as part of management will be offset at a ratio of at least 2:1.

Bush regeneration

- All works will be carried out by suitably qualified and experienced bush regenerators (i.e. Landcare groups), with at least one supervisor knowledgeable about flying-fox habitat requirements (and how to retain them for Level 1 and 2 actions) with experience working under a camp, or having been trained in working under a camp.
- Vegetation modification, including weed removal, will not alter the conditions of the site such that it becomes unsuitable flying-fox habitat for Level 1 and 2 actions.
- Weed removal should follow a mosaic pattern, maintaining refuges in the mid- and lower storeys at all times.
- Weed control in the core habitat area will be undertaken using hand tools only (or in the evening after fly-out while crèching young are not present).
- Species selected for revegetation will be consistent with the habitat on site, and in buffer areas or conflict areas should be restricted to small shrubs/understorey species to reduce the need for further camp tree management in the future.

Additional mitigation measures for any activity at a nationally important grey-headed flying-fox camp

In addition to those detailed above, the following measures are required for any activity other than routine camp management (Level 1 actions) at a nationally important GHFF camp. In circumstances where mitigation standards are not applied, significant impacts are likely, and the proposed action is more likely to require referral under the EPBC Act.

- No Level 2 or 3 actions will occur if the camp contains females that are in the late stages of pregnancy or have dependent young that cannot fly on their own (generally August to February).
- Disturbance activities will be limited to a maximum of 2.5 hours in any 12-hour period, preferably at or before sunrise or at sunset. Disturbance activities can be defined as any activity, other than routine activities, that disturbs the camp and therefore this may apply to both Level 2 and 3 activities.
- The action will not involve the clearing of all vegetation supporting a nationally important flying-fox camp. Sufficient vegetation will be retained to support the maximum number of flying-foxes ever recorded in the camp of interest.

Stop work triggers

Management activities in or near camps will cease and will not recommence without consulting NSW DCCEEW if:

- any of the animal welfare triggers occur on more than two days during the program, such as unacceptable levels of stress (see table below)
- there is a flying-fox injury or death
- a new camp/camps appear to be establishing
- impacts are created or exacerbated at other locations
- there appears to be potential for conservation impacts (e.g. reduction in breeding success identified through independent monitoring)
- standard measures to avoid impacts cannot be met.
- Management may also be terminated at any time if:
- unintended impacts are created for the community around the camp
- allocated resources are exhausted.

Welfare trigger	Signs	Action
Unacceptable levels of stress	If any individual is observed: · panting · saliva spreading · located on or within two metres of the ground	Works to cease for the day
Fatigue	In situ management · more than 30% of the camp takes flight · individuals are in flight for more than five minutes · flying-foxes appear to be leaving the camp	In situ management Works to cease and recommence only when flying-foxes have settled* / move to alternative locations at least 50 m from roosting animals
	· Dispersal · low flying · laboured flight · settling despite dispersal efforts	Dispersal Works to cease for the day

Welfare trigger	Signs	Action
Injury/death	· a flying-fox appears to have been injured/killed on-site (including aborted foetuses) · any flying-fox death is reported within one kilometre of the dispersal site that appears to be related to the dispersal · loss of condition evident	Works to cease immediately and the Department notified Rescheduled Adapted sufficiently so that significant impacts (e.g. death/injury) are highly unlikely to occur, as confirmed by an independent expert (see Appendix 3) Stopped indefinitely and alternative management options investigated.
Reproductive condition	· females in final trimester · dependent/crèching young present	Works to cease immediately and the Department notified Rescheduled Stopped indefinitely and alternative management options investigated.

*maximum of two unsuccessful attempts to recommence work before ceasing for the day.

Revision History

Revision No.	Revision date	Details	Prepared by	Reviewed by	Approved by
00	16/07/2025	Centennial Park Flying-Fox Camp Management Plan - Draft	James Binkhorst, Senior Ecologist Tegan Dinsdale, Ecologist	Dr John Martin, Senior Ecologist	Heather Richards, Senior Environmental Scientist
01	26/08/2025	Centennial Park Flying-Fox Camp Management Plan	Veronica Hutchison, Ecologist	Dr John Martin, Senior Ecologist	

Distribution List

Copy #	Date	Type	Issued to	Name
1	26/08/2025	Electronic	Greater Sydney Parklands	Zach Muldoon
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