

Regional Flying-Fox Management Plan

Environmental Operations
Revised December 2022



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Acknowledgements

Council wishes to thank all contributors and stakeholders involved in the development of this document.

Disclaimer

Information contained in this document is based on available information at the time of writing. All figures and diagrams are indicative only and should be referred to as such. While the Sunshine Coast Regional Council has exercised reasonable care in preparing this document it does not warrant or represent that it is accurate or complete. Council or its officers accept no responsibility for any loss occasioned to any person acting or refraining from acting in reliance upon any material contained in this document.

Acknowledgement of Country

Sunshine Coast Regional Council acknowledges the traditional Country of the Kabi Kabi Peoples and the Jinibara Peoples of the coastal plains and hinterlands of the Sunshine Coast and recognise that these have always been places of cultural, spiritual, social and economic significance. We wish to pay respect to their Elders – past, present and emerging – and acknowledge the important role Aboriginal and Torres Strait Islander people continue to play within the Sunshine Coast Community.

Council is committed to ongoing communications and consultation with the Traditional Owners and the broader Aboriginal and Torres Strait Islander community of the Sunshine Coast in the implementation of the Regional Flying-fox Management Plan.

The Sunshine Coast Regional Flying-fox Management Plan (RFFMP) was endorsed by Sunshine Coast Council in 2016. The major changes included in this 2022 revision included the following:

- Incorporation of new changes to legislation, policy and codes of practice that have been developed by DES since the endorsement of the original RFFMP.
- Refreshed the whole document to ensure acronyms are correct and still relevant.
- Checked and updated hyperlinks as required.
- Checked the status of all roosts currently listed in the RFFMP and changed the category as required.
- Added 20 new roosts that have been reported since the endorsement of the original RFFMP.
- Revised all figures, tables and appendices referenced in the document as required.
- Incorporated discussion of the QUT habitat modelling and the seven key parameters used for that study.
- Other minor changes as required.

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Acronyms

ABLV	Australian bat lyssavirus
BFF	Black Flying-fox
Council	Sunshine Coast Council
DAF	Department of Agriculture and Fisheries
DCCEEW	Department of Climate Change, Energy, the Environment & Water
DES	Queensland Department of Environment and Science
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i>
FFPMP	Flying-fox Property Management Plan
FFRMP	Flying-fox Roost Management Permit
GHFF	Grey-headed Flying-fox
LGA	Local Government Area
LRFF	Little Red Flying-fox
NCA	<i>Nature Conservation Act 1992</i>
NCAR	Nature Conservation (Animals) Regulation 2020
RFFMP	Regional Flying-fox Management Plan
SCC	Sunshine Coast Council
SMP	Species Management Plan
UFFMA	Urban Flying-fox Management Area
VMA	<i>Vegetation Management Act 1999</i>

1. Introduction

In 2013, the Queensland State government devolved rights to local governments and provided them with an as-of right authority under the Nature Conservation Act 1992 (NCA) to manage flying-fox roosts in Urban Flying-fox Management Areas (UFFMA). Council has developed an adaptive RFFMP to address human-wildlife conflict nearby flying-fox roosts in urban areas. This approach is guided by a roost categorisation method and provides a range of clear management options to assist Council in decision-making on how to consistently manage flying-fox conflict and conservation across the region.

Research, monitoring and education are essential components of Council's RFFMP, recognised by experts and the public as a requirement to improve our understanding of flying-foxes and roost management. Research partnerships inform options to both enhance existing habitat opportunities in low-conflict Environmental reserves and increase success of deterrent and mitigation measures in high-conflict roost sites. Routine monitoring ensures informed, evidence-based management approaches can be adopted in response to changes in flying-fox numbers. Education that includes the community will assist with the regions capacity to manage flying-fox conflict issues.

This document meets the requirements of a Flying-Fox Property Management Plan (FFPMP) as approved by the Department of Environment and Science under the Nature Conservation (Administration) Regulation 2006. It is also an attachment to the Conservation Agreement with the Australian Government under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act).

Flying-fox roosts are defined under the Nature Conservation Act 1992 (NCA) as a tree or other place where flying-foxes congregate from time to time for breeding or rearing their young. The literature defines a flying-fox camp as a tree or other place where flying-foxes congregate during the day. For this plan, the term roost is used to describe both of the above.

This document meets the requirements of a Flying-Fox Property Management Plan (FFPMP) as approved by the Department of Environment & Science under the Nature Conservation (Animals) Regulation 2020. It is also an attachment to the Conservation Agreement with the Australian Government under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

2. Background

Over sixty different species of bat occur throughout Australia, most of which feed primarily on insects. However, several species feed predominantly on flowers and fruit and are known as fruit bats or, flying-foxes – due their facial similarity to the European red fox.

Four species of flying-fox are native to mainland Australia and occur primarily in northern and eastern temperate and sub-tropical coastal areas. Three of those four species, the Little red flying-fox (LRFF), the Black flying-fox (BFF) and the Grey-headed flying-fox (GHFF), occur in southeast Queensland and are the subjects of this Plan. The Grey-headed flying-fox is Australia's only endemic flying-fox and is listed as Vulnerable under the EPBC Act.

The fourth Australian species, listed as Endangered under the EPBC Act, is the Spectacled flying-fox. In Queensland it is also listed as Endangered under the *Nature Conservation (Animals) Regulation 2020*. Its range is restricted to north eastern coastal Queensland, islands in the Torres Strait and throughout parts of Papua New Guinea and Southeast Asia.

For individuals of each species the breeding cycle within a colony is synchronous. The lifecycle calendar is almost identical for the GHFF and BFF, but it may vary slightly under certain environmental conditions (See **Figure 1**). The LRFF lifecycle calendar is the reverse of the former two. This is important in terms of Council's management planning and implementation of on-ground works.

Figure 1. Summary of lifecycle stages for local flying-fox species

	January	February	March	April	May	June	July	August	September	October	November	December
BFF	Young flying on their own	Mating territories formed	Conception	Gestation period - Nomadic movement related to food source				Birth – Young carried for 4-5wks				Most young left at camp (crèched)
GHF	Young flying on their own	Mating territories formed	Conception	Gestation period - Nomadic movement related to food source				Birth – Young carried for 4-5wks				Most young left at camp (crèched)
SFF	Most young left at camp (crèched)	Young flying on their own	Mating territories formed	Conception	Gestation period - Nomadic movement related to food source				Birth – Young carried for 4-5wks			
LRFF	Gestation period - Nomadic movement related to food source				Birth – Young carried for 4-5wks				Most young left at camp (crèched)	Young flying on their own	Mating territories formed	Gestation

Key:

Lower likelihood of heavily pregnant or dependant young being present
Some likelihood of heavily pregnant or dependant young being present
High likelihood of heavily pregnant or dependant young being present
Seasonally lower risk of heat stress events
Seasonally higher risk of heat stress events

*this is for general information only and timing of behaviours may differ depending on region and climatic conditions. Flying-fox behaviour should be confirmed by a site visit.

Source: DES Flying-fox Roost Management Guideline 2020

Flying-fox numbers have declined in the last century due to widespread clearing of foraging and roosting habitat, while culling practices across their range have also had an impact. Their choice of urban roosting sites may be linked to historic connections with the site prior to development, and is also influenced by the availability of food within the urban streetscape and backyard plantings.

Managing flying-fox roosts is a key challenge facing the Sunshine Coast community and flying-foxes will always be a part of the Sunshine Coast environment. Forty-one roosts are currently recognised in the local government area (LGA) on a variety of land tenures (See **Table 3**). The majority of these roosts are relatively isolated from residential areas and the potential for land use conflict is fairly low. However, where large roosts occur close to residential areas, the potential for conflict increases as the noise and odour associated with large roosts disrupt the lifestyles of nearby residents.

Sunshine Coast Council (Council) has comprehensively mapped the region for suitable roosting habitat, and classified the habitat into three levels of proximity to building structures within the region:

- Zone A (habitat within 100m of a building structure)
- Zone B (habitat between 100 and 300m of a building structure)
- Zone C (habitat outside of 300m from a building structure)

The proximity levels are based on an understanding that 300m is a sufficient management buffer between residential properties and flying-fox roosts to reduce conflict (Eby, 2009). The proximity mapping is subject to ground truthing.

Flying-foxes play an important role in maintaining Australian native forest ecosystems. As Australia's only known nocturnal long-distance pollinator, flying foxes are critical for the continued existence of many Australian eucalypt species that can only be pollinated at night (Birt 2004). Flying foxes play an important role in maintaining the ecosystem services provided by native forests such as essential habitat for threatened species, acting as carbon sinks, stabilisation of river systems and water catchments and recreational and tourism opportunities worth millions of dollars each year.

3. Purpose of the RFFMP

The purpose of the Regional Flying-Fox Management Plan (RFFMP) is to guide the adaptive management of all flying-fox roosts that occur on council owned/managed land within the Sunshine Coast local government area. The RFFMP will be reviewed every three (3) years or as required.

Council has no management responsibility for flying-fox roosts occurring entirely on private or State-owned and managed land. Where management actions are required on private land, owners must seek advice from the State Government Department of Environment and Science (DES), develop a roost management plan and obtain a Flying-fox Roost Management Permit (FFRMP).

The RFFMP provides a range of management options available to Council for managing flying-fox roosts on Council owned land (freehold) and Council managed (trustee) land. The document also recognises the need for Council participation in a cross-tenure landscape approach to the management of all flying-fox roosts in the Sunshine Coast area. With the knowledge that the three flying-fox species currently found in Southeast Queensland will almost certainly always reside in the region, this document outlines some strategic responses to the management of existing flying-fox roosts and incorporates a proactive and predictive response to possible population movements over time.

At Ordinary Meeting OM17/2, Council endorsed that non-lethal, active dispersal of flying-fox roosts would only be performed as a last resort option and primary intervention actions be aimed at in-situ management of roosts.

4. Objectives of the RFFMP

With consideration to the above, this plan is guided by the following key objectives:

- to address and manage the concerns of residents experiencing lifestyle impacts associated with living in close proximity to large or problematic flying-fox roosts on Council owned/managed land;
- to develop flying-fox management strategies consistent with legislative obligations;
- to increase community understanding and appreciation of the essential ecological role of flying-foxes and the need for conservation efforts;
- to develop information management strategies to ensure community access to accurate and up to date information relating to perceived health risks;
- to increase our understanding of flying-fox behaviour through monitoring and research and ensure management practices align with most recent knowledge;
- to develop achievable flying-fox conservation strategies to protect the three species found in the Sunshine Coast LGA; and
- to identify and where possible prevent future residential/flying-fox land use conflict issues

5. Legislative Framework

Australian Government

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) is the Australian Government's central piece of environmental legislation that provides for the protection and management of nationally threatened species. Of the three species occurring in the Sunshine Coast LGA, GHFF are listed as Vulnerable under the EPBC Act.

In September 2015, the *Referral guideline for management actions in grey-headed and spectacled flying-fox camps* was released. Under the guideline, each species is considered to occur as a single national population covering its entire range. A network of nationally important camps has been identified based on the following criteria:

- Contain $\geq 10,000$ Grey-headed flying-foxes in more than one year in the last 10 years, or
- Has been occupied by more than 2,500 Grey-headed flying-foxes permanently or seasonally every year for the last 10 years.

Under the guideline, referral will only be required for actions that are not carried out in accordance with the guideline's mitigation standards or a state or territory standard that achieves the same outcome. In the Sunshine Coast LGA, the Dunning st, Kolara opark and Pecan Park roosts are currently identified as nationally important camps under the guideline.

Council is required under the EPBC Act to ensure any flying-fox management activity that may impact on nationally threatened ecological communities, RAMSAR wetlands, fauna and flora is subject to a determination (permit) from the Department of Climate Change, Energy, the Environment & Water (DCCEEW).

State Government

All flying-foxes and their roosting habitat are protected in Queensland under the *Nature Conservation Act 1992* (NCA) and the Nature Conservation (Animals) Regulation 2020 (NCAR) and are listed as 'least concern' wildlife under the NCAR.

With the addition of Section 61 of the NCAR, Councils have been given an 'as of right' authority to manage flying-fox roosts on Council owned (freehold) or Council managed (trustee) land, and on private land—subject to landholder consent, within defined Urban Flying-fox Management Areas (UFFMAs). However, management for GHFF must also comply with Commonwealth legislation.

Queensland government legislation change allows Councils to:

- a) destroy a flying-fox roost;
- b) drive away, or attempt to drive away, a flying-fox from a flying-fox roost;
- c) disturb a flying-fox in a flying-fox roost.

Any landowners can conduct low impact activities (as defined under section 62(1) of the NCAR) on private land without approval provided it is done in accordance with the *Code of Practice – Low impact activities affecting flying-fox roosts*. Anyone other than Council intending to destroy or disperse a flying-fox roost are required to apply for a flying-fox roost management permit (FFRMP) issued by the Queensland Department of Environment and Science (DES) to manage flying-fox roosts irrespective of the roost location.

Under the NCA and the *Vegetation Management Act 1999* (VMA) Council is also required to ensure any flying-fox management activity does not impact on state listed vegetation communities, flora and fauna. Any threatened fauna and flora; Endangered and Of Concern vegetation communities impacted by an action will be subject to a Species Management Plan (SMP) and / or Vegetation Clearing Exemption Permit approved by DES.

Management activities must be done in compliance with the *Code of Practice – Ecologically sustainable management of flying-fox roosts* and the *Flying-Fox Roost Management Guidelines* developed under section 174A of the NCA. The *Flying-fox Roost Management Guideline* provides Council's with additional information that may assist decision making and management of flying-fox roosts. The RFFMP has been developed to comply with this Code of Practice, a copy of which may be viewed here: https://www.qld.gov.au/__data/assets/pdf_file/0008/221021/cp-wl-ff-roost-management.pdf

Outside a UFFMA, Councils require a Flying-fox Property Management Plan to undertake flying-fox management works. Council may be granted three-year approval following endorsement of the Regional Flying-Fox Management Plan by DES.

The Flying-fox Property Management Plan permits Council to manage flying-fox roosts on Council owned (freehold) and Council managed (trustee) land over the entire LGA for a three-year period and is subject to the approval conditions listed in **Appendix 2**.

The *Animal Care and Protection Act 2001* provides for animal welfare. Measures detailed in **Appendix 3** of this plan will ensure compliance with this legislation.

Local Government

This Regional Flying-fox Management Plan is Sunshine Coast Council's endorsed management plan.

6. Stakeholders

The management of flying-foxes involves a range of stakeholders with varying roles in relation to regulation, protection, management capacity and responsibility. The following key stakeholders are listed below with details of their respective roles in relation to flying-fox management.

Department Climate Change, Energy, the Environment & Water (DCCEEW) (Australian Government)

The DCCEEW has the regulatory responsibility for the protection of federally listed species through administration of the EPBC Act. Under the *Referral guideline for management actions in grey-headed and spectacled flying-fox camps*, any action defined as having a significant impact on a nationally important camp requires approval from the Australian Government Minister for the Environment.

Queensland Department of Environment and Science (DES) (State Government)

The DES is responsible for administering the NCA and associated Regulations in Queensland. DES is the regulating authority for flying-fox management in Queensland and is directly responsible for the management of flying-fox colonies on State and privately-owned land. Under the *Code of Practice – Ecologically sustainable management of flying-fox roosts*, local government is required to notify DES two business days prior to commencement of any flying-fox roost management actions.

Sunshine Coast Council (Local Government)

Council has the responsibility for land use planning, management of public land and care of community wellbeing. Council has discretionary responsibility for the management of flying-fox colonies on Council owned (freehold) and Council managed (trustee) land. Council is also well placed to assist the community through education and information dissemination relating to flying-fox issues across the broader region and may undertake management on private land subject to landholder consent.

1.

Biosecurity Queensland

Biosecurity Queensland, within the Department of Agriculture & Fisheries (DAF), is responsible for coordinating the State Government's efforts to prevent, respond to and recover from diseases such as, Hendra virus and Australian bat lyssavirus.

Queensland Health

Queensland Health is responsible for the response to outbreaks of notifiable diseases, including Australian bat lyssavirus and Hendra virus, in the human population. In the event of such outbreaks, Queensland Health works closely with Biosecurity Queensland and other relevant stakeholders.

Flying-fox Rescue/Care Groups

In addition to care services provided by local veterinarians and the Australia Zoo Wildlife Hospital, the Sunshine Coast has two rescue organisations dedicated to the care and rehabilitation of Flying-foxes. Bat Rescue Inc. provides a care and rescue service for the entire Sunshine Coast Region. Bat Rescue Inc. is supported by Flying-fox Rescue Release Noosa Inc. who provides a rescue and soft-release site for flying-foxes rehabilitated on the Sunshine Coast.

Both groups have a high level of expertise within their membership. Ongoing consultation with these groups can assist Council in formulating and acquitting appropriate management actions in relation to roost management.

General Community

Community stakeholders can be defined as:

- Primary affected residents: those whose properties closely adjoin a flying-fox roost or have a colony located on their own land (within 100m of the outside of a roost);
- Secondary affected residents: those who are indirectly affected by the presence of a flying-fox roost in moderate proximity to their property (between 100m and 300m of the outside of a roost), and
- General community: those residents not particularly affected by flying-foxes either directly or indirectly.

Where needed, customer service requests can be utilised as a measure of demand within these groupings, to indicate community concern or request for action.

Where a Council endorsed management action is to be completed on private land, Council must have the written consent of the landholder prior to undertaking action.

7. Regional Overview

The extensive loss of native forests for agriculture and urban development has had a significant impact on food availability for flying-foxes throughout most of their range. A 1993 study documented a loss of approximately two thirds of Southeast Queensland's continuous native vegetation (Catterall & Kingston, 1993). The loss included an almost 90% reduction of the region's *Melaleuca quinquenervia* forests, which serves as a primary source of winter food for nectar feeding flying-foxes.

There are forty-one currently recognised flying-fox roosts within the Sunshine Coast LGA. The colonies are located on a mix of land tenures, including seven on privately owned, nine on State owned, twenty-two on Council owned and three on shared private and Council owned land (See **Table 3**).

Flying-fox roosts in coastal Southeast Queensland usually (but not always) occur in vegetation with the following characteristics (SEQ Catchments 2011):

- **A closed canopy at least 5m high**
Grey-headed and Black flying-foxes do not necessarily require a closed canopy and have frequently been recorded in favoured roosts containing dead trees or trees with quite extensive canopy damage.
- **Upper, mid and understorey layers**
All three storeys are thought to play an important role in microclimatic regulation in addition to providing other unique benefits. The elevated position of the upper storey provides cooling benefits and protection from terrestrial predators. The mid storey is thought to be critical in terms of regulating humidity and temperature and providing additional protection during extreme weather conditions. The understorey is thought to be critical to the maintenance of vital microbial action and the restriction of movement of animals and people that might otherwise disturb the roost.
- **Suitable vegetation at least one hectare in size**
Sites of less than 1ha may be occupied on a temporary basis by a small colony.
- **Dense vegetation within 500m of a creek, river or dam**
- **Level topography (<5° incline)**
- **Within nightly commuting distance of sufficient food resources (usually within 20km)**

Depending on the availability of food trees around the roost, individuals may travel up to 50km resulting in a 100km round trip. Smaller commuting distances in some areas have been recorded.

Results of habitat modelling undertaken by the Queensland University of Technology QUT has suggested further refined habitat requirements (Saint et al 2018):

- Low elevation, low slope and vicinity to water courses and mangroves increases habitat suitability.
- Suitability is higher with shorter forest perimeters, and median canopy height of approximately 5 – 17 metres were found to be most suitable for flying-fox roosts.
- A distance of approximately 7.5m from food sources appears to be the most suitable for flying-fox roosts.
- As forest perimeter, elevation and slope decrease, the suitability of an area for flying-fox roosting increases.

8. Flying-fox Ecology

Flying-fox species are essential for the maintenance of healthy forest diversity. They disperse the pollen and seeds of plants they visit during their foraging trips, and in this way make a significant contribution to the reproductive and evolutionary processes of forest and woodland communities. Their ability to move freely among habitat types allows them to transport genetic material across fragmented, degraded and urban landscapes. Flying-foxes are Australia's only known nocturnal long distance pollinator, which is critical for the continued existence of many Australian eucalypt species that only flower at night (L Hall, pers comm. 20 March 2015).

Conservation of flying-foxes and their role as pollinators within the natural landscape benefits other fauna and many plants and vegetation communities, including many listed as threatened under state and federal legislation. Their role as forest pollinators is suggested to be economically important for the commercial forestry industry, which utilises native forestry stock to replenish commercial supplies, and for industries dependent on forestry products including apiculture (beekeeping).

Flying-foxes are highly adapted for activity at night with well-developed physical characteristics and senses for finding their food, including a strong sense of smell and large eyes particularly suited for recognising colour at night.

Extensive vegetation clearing in the past has reduced the area of habitat available to flying-foxes, forcing them to seek out remaining areas of suitable habitat, including remnant bushland in urban areas. Where this bushland borders residential areas, coexistence between humans and flying-foxes can be difficult.

It is anticipated that the loss of flying-fox habitat will continue and remnant bushland in urban areas will become increasingly important as habitat for flying-foxes and a range of other native animals. The combination of habitat loss and the effects of climate change disrupting flowering patterns will serve to increase encounters between flying-foxes and humans.

Urban encroachment into areas historically used by flying-foxes is thought to be a factor influencing a colony's choice of roost sites in urban areas. Fidelity to historic roosting sites and

the availability of urban foraging opportunities has resulted in increased conflict between flying-foxes and the general community.

8.1 The role of flying-fox roosts

Flying-fox roosts serve a number of functions. Their primary purpose is to provide suitable resting habitat within nightly commuting distance of food sources. They are also sites of information exchange and social behaviours such as those associated with reproduction and maternal care.

For several weeks in late spring and summer, roosts provide refuge during the day for lactating females and their young. During the night roosts are a safe refuge for flightless young while adults depart to feed.

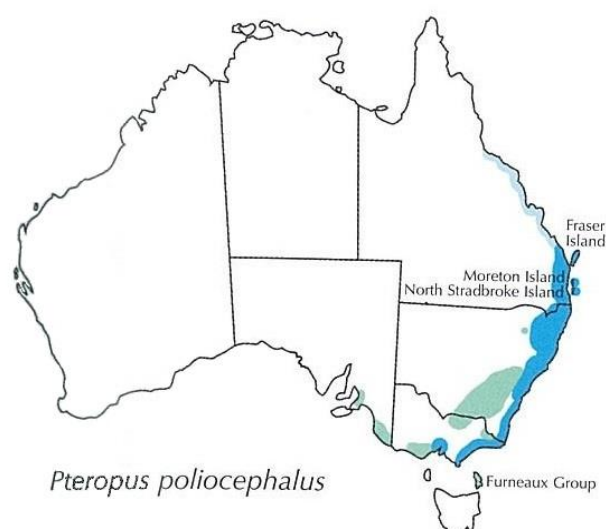
Roosts are highly socially structured. The majority of roost trees are occupied by mixed groups of adults which comprises of a single male, who scent-marks and defends a territory shared by one or more females and their dependent young. The roosting positions of individual animals are highly consistent and animals return to the same branch of a tree over many weeks or months. Some GHFF are known to occupy a single area within a roost for several years, while others may return to the same branch of a tree after having migrated over large distances. Flying-foxes often have a strong connection to roost sites and can be extremely resistant to relocation efforts.

Locations of roosts are often stable through time and several well-documented roosts have histories of use that exceed 100 years. Flying-foxes have well-developed spatial memories to assist them in utilising their complex habitats, enabling individuals to remember the locations of roosts and associated feeding sites. Little red flying-foxes appear to also establish ephemeral sites which are used for short periods and not revisited.

Flying-foxes may impact the vegetation at a roost site through the death of some trees and the damage and defoliation of others. Such damage is site specific and is a consequence of the simultaneous intensive use of large numbers of flying-foxes. While such damage can be substantial it is localised and offset by the vital ecological services they provide in relation to pollination and seed dispersal in Australian forests.

8.2 Grey-headed flying-fox *Pteropus poliocephalus*

Figure 2: Distribution of the Grey-headed flying-fox



Map sourced from Van Dyck, S. & Strahan, R. 2008. Image J.O'Connor.



The Grey-headed flying-fox is a canopy feeding nectarivore and frugivore endemic to the east coast of Australia. All the Grey-headed flying-foxes in Australia are regarded as one population that moves around freely within its entire national range (Webb & Tidemann 1996). GHFF can travel as far as 50km in a single night in their search for food, resulting in a round trip as great as 100km. They have also been recorded travelling up to 400km in one night when moving from one roost to another (Eby 1991).

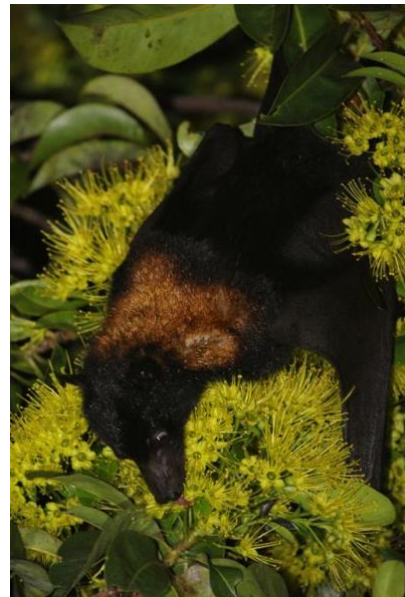
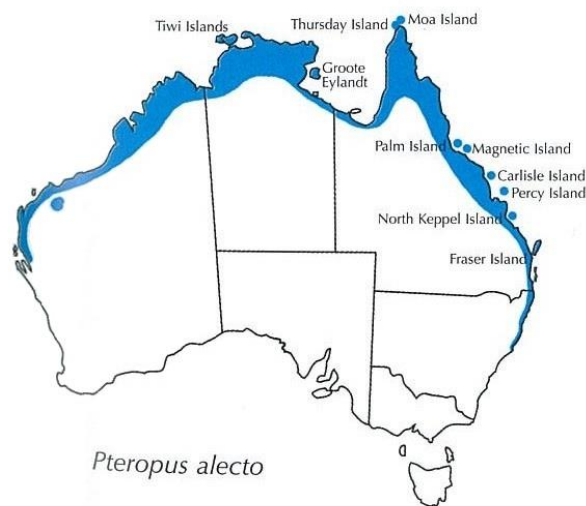
In the late 1920s the recorded range of the GHFF extended from Rockhampton in central Qld to Mallacoota on Australia's south east coast (Ratcliffe 1931). In subsequent years their numbers have diminished and their range has shifted south by around 500km, resulting in their current absence from Rockhampton and the establishment of permanent roosts in Melbourne and Adelaide. Like the other *Pteropus* species, the GHFF is protected under Queensland's *Nature Conservation Act 1992*. Due to their declining numbers, the GHFF is also listed as Vulnerable under the *EPBC Act*.

GHFF generally show a high level of fidelity to roosting sites, returning year after year to the same site, and have even been recorded returning to the same branch of a particular tree. 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.

Their primary food source is the blossom of *Eucalyptus* sp. But they will also utilise the blossoms and fruits of some rainforest trees, native and introduced species in the urban landscape. They will also feed on commercial orchard fruits and the direct killing of the GHFF in orchards is thought to be a contributing factor in its population decline (Vardon & Tidemann 1995).

8.3 Black flying-fox *Pteropus alecto*

Figure 3: Distribution of the Black flying-fox



Map sourced from Van Dyck, S. & Strahan, R. 2008. Image J. O'Connor

Black flying-foxes are native to Australia (NSW, QLD, NT and WA), Papua New Guinea and parts of Indonesia. In Australia they are found mostly around the northern coast and inland wherever permanent water is found in rivers.

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. They are intelligent and highly social animals that roost together in large numbers at a roost during the day, then feed individually or in small groups at night.

Feeding commonly occurs within 20km of the roost site but can extend as far as 50km. In urban areas of Queensland they may disperse to feed as little as 8km from their roost site, depending if appropriate food is available (Eby 1991).

BFF usually roost beside a creek or river in a wide range of warm and moist habitats, including lowland rainforest gullies, coastal stringybark forests and mangroves. They usually establish their roosts in tall and reasonably dense vegetation, and are not deterred by the proximity of human habitats.

Roost sites may be permanent or temporary and can range in size from hundreds up to tens of thousands of individuals. During the breeding season roost sizes can change significantly in response to the availability of food and the arrival of animals from interstate.

In addition to a wide range of native fruits (including quandongs, ficus and lillypillys), they also exploit exotic and cultivated species such as bananas, stone fruit and mangoes (Markus & Hall 2004). However, research has shown that cultivated fruits are not a preferred food source and is utilised only in times of native food scarcity (Parry-Jones & Augee 1992). A range of exotics also serve as alternative food sources, including Cocos palms and Chinese elm.

8.4 Little red flying-fox *Pteropus scapulatus*

Figure 4: Distribution of the Little red flying-fox.

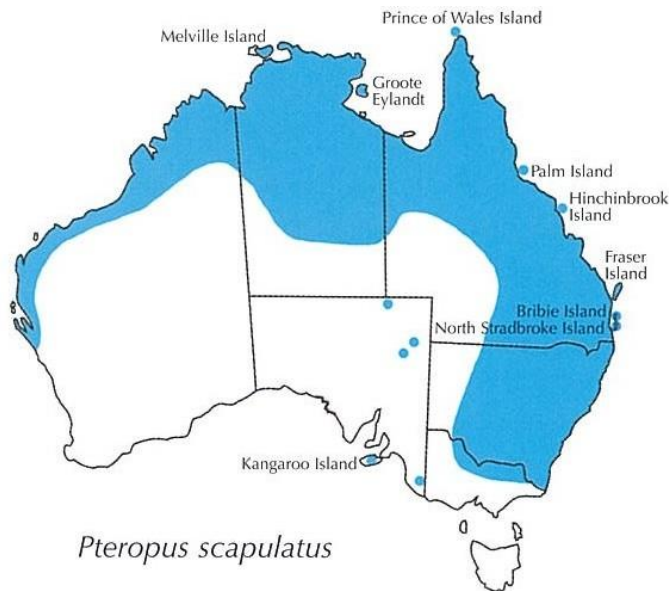
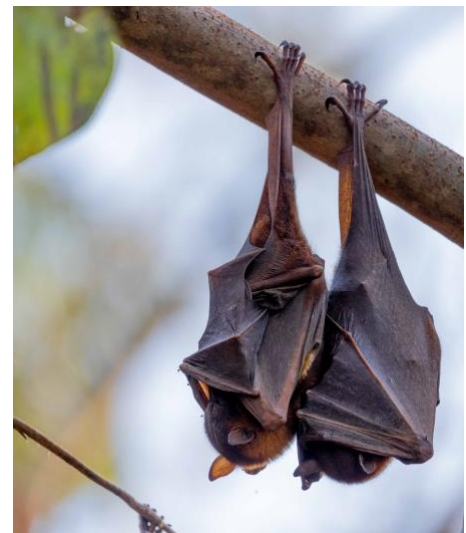


Image sourced from Van Dyck, S. & Strahan, R. 2008. Image: J O'Connor



The Little red flying-fox has an almost exclusively nectarivorous diet. They are highly nomadic and their movements are closely correlated with the flowering regimes of eucalypts, their main food source.

They are frequently associated with other *Pteropus* species, although the duration of their stay in a roost is often shorter. For example, 2,500 LRFFs joined a small colony of BFF at the Goonawarra Street roost in 2010 but only stayed at the site for one month. Throughout its

range, populations within an area can fluctuate widely and roost occupation can be for as little as 10 days or as long as 10 months.

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.

Through its foraging movements within and between forests, the LRFF provides an essential pollination and seed dispersal service to many bioregional ecosystems. A number of factors are thought to be impacting the LRFF, including habitat destruction and altered fire regimes, both of which influence the availability of nectar.

In the tropical north during the LRFF mating season in early summer, roosts can reach up to 1 million individuals.

9. Community Concerns

Complaints about flying-fox roosts usually relate to excessive odour and noise, mess from faeces staining walls, driveways, washing or parked cars along with other issues such as damage to domestic fruit trees, constraints on opening windows etc. Community concerns also include the loss of property values; the impact on the psychological wellbeing of residents exposed to the persistent impacts of living in close proximity to flying-fox roosts and the subsequent deterioration of the amenity of the home.

Importantly one of the most significant concerns raised by residents relates to the potential human health risks from Australian Bat Lyssavirus (ABLV) and Hendra Virus.

Council has actively sought advice from Queensland Health to quantify the degree of risk of becoming infected with ABLV; Queensland Health has advised that this risk is very low. It is estimated that in Australia less than one per cent of free-living bats carry ABLV (Queensland Health 2015). The virus can be transmitted from bats to humans when infected bat saliva enters the human body, usually by a bite or scratch, but also by getting bat saliva in the eyes, nose or mouth (mucous membrane exposure) or onto a pre-existing break in the skin (Queensland Health 2015). It is unlikely the virus can survive outside the bat for greater than a few hours (Queensland Health 2013). Three people have died from ABLV infections in Australia since 1996 (Queensland Health 2015).

Queensland Health strongly recommends that any flying-fox, dead or alive, should not be touched. Preventative and post exposure vaccination is available to high risk individuals including vets and wildlife carers.

Queensland Health advises that flying-foxes are the natural host for Hendra Virus, which can be fatal to humans. The virus can spread from flying-foxes to horses, horses to horses and, rarely, from horses to humans. It is thought that horses may contract Hendra virus infection from eating matter recently contaminated with flying-fox urine, saliva or birth products. Spread to other horses is possible wherever horses have close contact with body fluids of an infected horse. There is no evidence of human to human transmission.

Queensland Health has also advised that a range of health conditions may be contracted through ingestion of the urine and faecal matter of a range of domestic and native animals, including flying-foxes.

In recognition of residents' concerns, the Council has facilitated several forums between regulatory bodies including Queensland Health, Biosecurity Queensland, DES and residents. These forums allowed residents access to accurate information, advice and highlighted the role and position of all regulatory bodies in relation to the complex issue of flying-fox management.

For further information concerning human health risks and flying-foxes go to the Queensland Health (<http://www.health.qld.gov.au>) and Biosecurity Queensland (<https://www.daf.qld.gov.au/business-priorities/biosecurity>) websites.

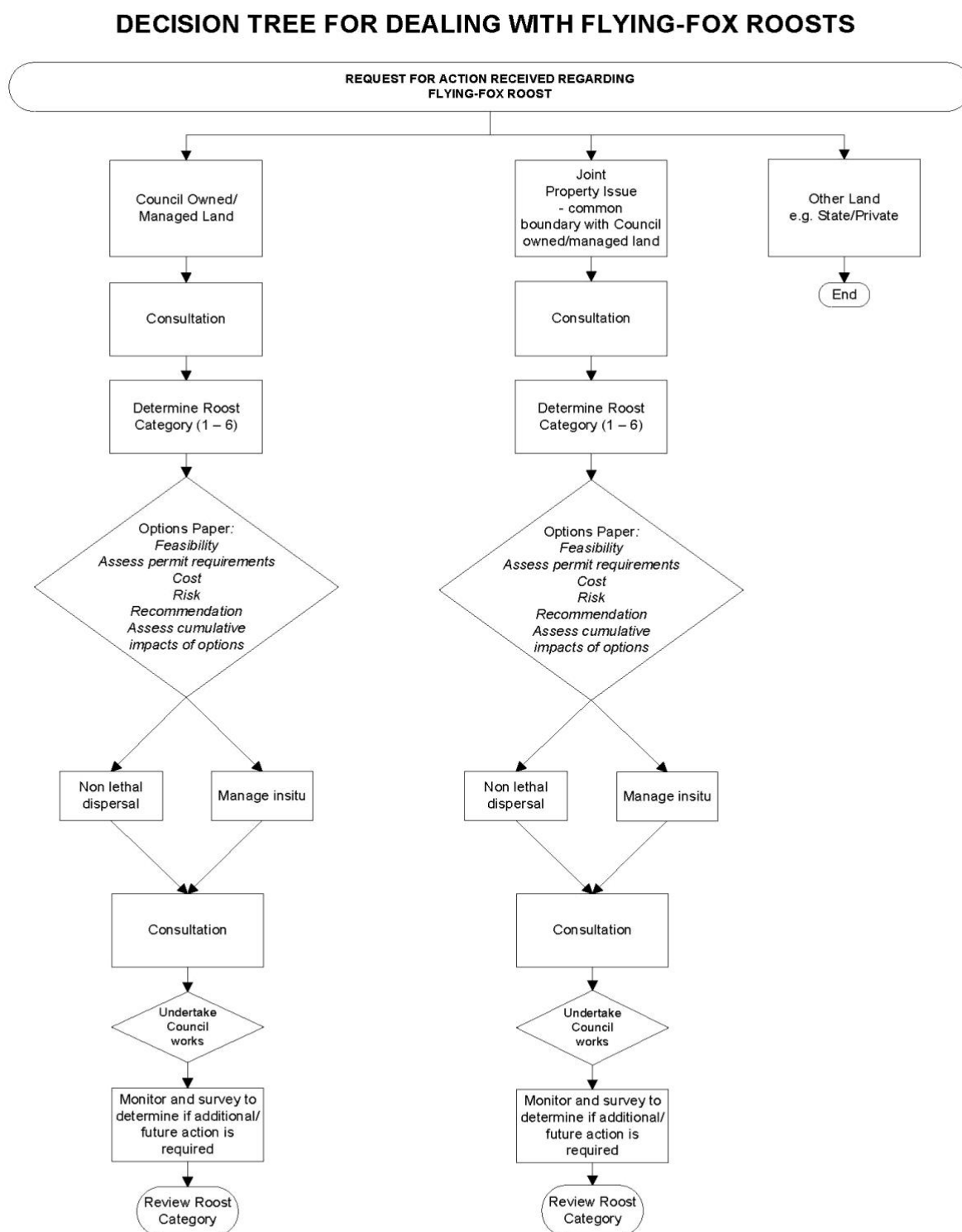
10. Decision Support Tool

In recent years Council has received an increasing number of complaints in relation to seven flying-fox roosts found within urban areas of the Sunshine Coast region. Most complaints relate to excessive odour and noise, mess from faeces and the perceived human health risk.

In managing these complaints, Council recognises the need to be responsive to the social and economic needs of the community, while responding to environmental due diligence requirements for the protection of flying-foxes and the essential ecosystem services they provide.

At its General Meeting of 18 October 2011, Council noted a decision support tool to assist Council staff in relation to customer requests relating to flying-fox colonies (see Fig 5 & Table 2). The tool was prepared as a short term measure pending the development of this Management Plan.

Figure 5: Decision Support Tool for Flying-fox Management



Note:

1. DEHP is the regulating authority in relation to flying-fox management in Queensland.
2. Assess permit requirements includes State & Commonwealth assessment process.

11. Flying-fox Management Options

Council has an as-of-right authority to manage flying-fox roosts with a designated UFFMA. A suite of management options are available, although not necessarily appropriate, for the management of flying-fox roosts in the Sunshine Coast region. A range of options are defined in the table below (see **Table 1**) and are discussed in further detail in **Appendix 7**. All management options listed comply with the *Code of Practice – Ecologically sustainable management of flying-fox roosts*.

Table 1: Management Options for Flying-fox Roosts

Management option	Definition
1.No on-ground management	Leave all current flying-fox roosts undisturbed; no active management or impact mitigation.
2.Deliver environmental education	Deliver environmental/flying-fox community education.
3.Disperse flying-foxes by habitat modification	Modify habitat with vegetation trimming or removal to render the roost unattractive to flying-foxes as a roost.
4.Disperse/discourage flying-foxes by active non-destructive disturbance	Disperse or discourage flying-foxes from problematic roosts through a variety of non-destructive disturbance techniques, including: • Smoke, water sprinklers • Visual deterrents such as imitation predators and bright lights • Noise from commercial and improvised products.
5.Early intervention option before a roost is established at locations identified as unsuitable	Monitor Council reserves to allow early detection of signs of a new roost establishment or return to an unsuitable site. Seek to undertake non-lethal dispersal to discourage roost establishment. Early intervention would include 'nudging' the roost away from conflict area.
6.Offer incentives or compensation to residents seriously impacted by roosts.	Consider offering financial benefits to residents seriously affected by the proximity of flying-fox roosts, e.g. rate reductions, provision of cleaning services. Modify buildings around problematic roosts to alleviate the lifestyle impact on affected residents. These could include the construction of sound and odour barriers, provision of covers over outdoor living areas.
7.Provision of artificial roosting habitat	Construct artificial structures within a roost to provide additional roosting opportunities away from residences.
8.Attract flying-foxes to alternative habitat	Identify and enhance alternative habitat to encourage flying-foxes to leave problematic sites.
9.Participate in research to improve knowledge of flying-fox ecology	There are large gaps in our knowledge of flying-fox ecology and roost site selection. Further research and knowledge sharing at local, regional and national levels may enhance our understanding and management of flying-fox roosts.
10. Utilise planning instruments to avoid land use conflicts at identified flying-fox roosts	Incorporate appropriate development buffers around known flying-fox roosts that are currently used by flying-foxes or have historically been known to be used by flying-foxes.
11. Establish buffer areas to prevent future problems with known roost sites	Develop on-ground buffers around existing or historically known flying-fox roosts that are currently appropriately placed but have the potential to become less favourable due to future residential development.
12. Develop and implement community education initiatives	Develop or make educational material available to provide clear and accurate information about flying-fox ecology, perceived health risks and other pertinent flying-fox information.
13. Vacate role as trustee at problematic roosts on State owned land in Council's trusteeship	Council can vacate its role as trustee by forwarding signed notice of resignation to the Minister Under Section 50 of the <i>Land Act</i> .
14. Enhance habitat at existing low conflict roosts.	Increase service level where colonies exist in Council reserves that have a low potential for community/flying-fox conflict.
15. 'Nudge' flying-foxes into a more suitable roost habitat using deterrents	This alternative method is not listed in section 2.4.6 of the Code of Practice. Therefore, the nudging management option requires an application to DES for a Flying-fox Roost Management Permit
16. Introduce measures to reduce roost impact on adjoining landholders.	Deliver opportunities to alleviate impact of roosts on affected neighbouring properties through a variety of means, e.g. odour neutralizing trial, resident resilience sessions, acoustic fencing.

12. Flying-fox Management Actions

A range of management actions are drawn from the list of options provided above in **Table 1**. The actions described in the following section apply to different roost categories. These categories (1-6) ensure management actions are adaptable and best suited to address the variable environmental and social characteristics of each roost site.

12.1 Roost categories

For the purpose of this Plan, flying-fox roosts in the Sunshine Coast LGA have been classified into six management categories based on a combination of a site's potential to generate community/flying-fox conflict and Council's land management responsibilities (See roost categorisation tool in **Figure 5**).

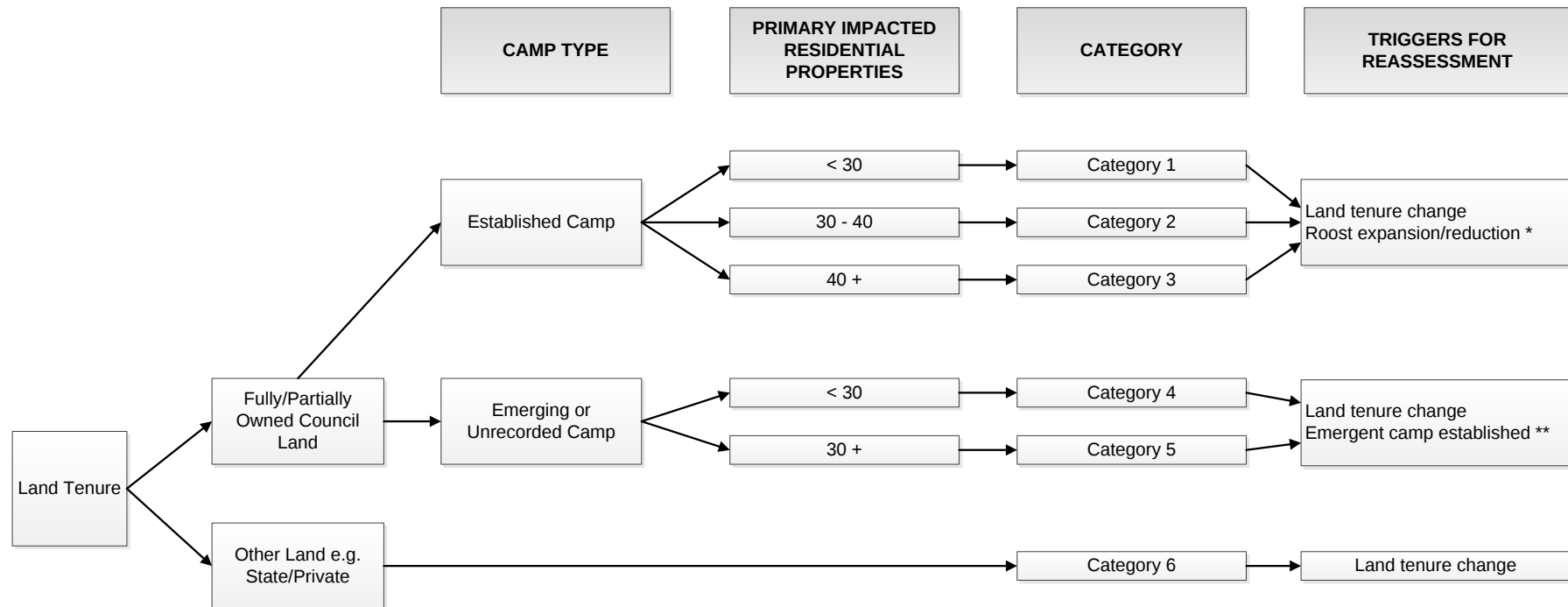
Within each of the categories a range of possible management actions will provide a toolbox from which to choose the most appropriate site-specific response (See **Table 2**).

It is important to note that due to the mobile nature of flying-foxes and the resulting fluidity of colony sizes and locations, an assigned management category may need to be amended if circumstances significantly change. The decision support tool will guide the process of reassessment.

For any proposed active dispersal intervention for recognised flying-fox roosts, an options paper detailing the costs, risks and feasibility will be presented to Council for its consideration and endorsement prior to any action being undertaken. Further, any on-ground management action involving habitat modification or dispersal will be undertaken in accordance with the methods outlined in **Appendix 1** of this document.

Figure 6: Roost Categorisation Tool

Roost Categorisation Tool



* Roost expansion/reduction may alter the number of primary impacted residential properties, which in some circumstances may necessitate amendment of the roost management category.

** Roost will be considered as established when Flying-foxes have returned to the site in two consecutive years and/or rearing of young is occurring at the roost.

Table 2: Summary of possible management actions for each roost category

Category	Description	Management Options
Category 1	Roosts located fully or partially on Council managed land that has a low potential for community/flying-fox conflict.	Minimal Intervention: • Deliver environmental/flying-fox community education. • Participate in research into flying-fox ecology. • Investigate use of planning instruments to avoid future conflict. In Situ Management: • Establish buffer around existing roosts to alleviate future problems. • Provision of artificial roosting habitat. • Increase on-ground service level to enhance habitat value.
Category 2	Roosts located fully or partially on Council managed land that has a moderate potential for community/flying-fox conflict.	Minimal Intervention: • Deliver environmental/flying-fox community education. • Monthly monitoring program. • Participate in research into flying-fox ecology. In Situ Management: • Establish buffer around existing roosts to alleviate future problems. • Provision of artificial roosting habitat. Non-lethal Dispersal ('Nudging' ONLY) • Early intervention option (after temporary/seasonal absence from roost).
Category 3	Roosts located fully or partially on Council managed land that has a high potential for community/flying-fox conflict.	• Pending funding availability, invite impacted landholders to apply for Flying-fox Amenity Impact Reduction (FAIR) Grant. Minimal Intervention: • Deliver environmental/flying-fox community education. • Monthly monitoring program. • Officers to prepare a site-specific options paper discussing potential management options for roosts within this category (as per Figure 5 Decision Tree). • Options paper will be presented to the divisional councillor for a final decision on the recommended action. In Situ Management: • Establish buffer and/ or infrastructure around roosts to alleviate future problems. Non-lethal Dispersal: • Early intervention option (after temporary/seasonal absence from roost).

		• Disperse flying-foxes through habitat modification (non-lethal). • Disperse flying-foxes through active disturbance (non-lethal).
Category 4	Emerging, previously unrecorded roosts on Council owned or managed land that have a low potential for community/flying-fox conflict if a roost becomes established on the site.	Minimal Intervention: • Deliver environmental/flying-fox community education. • No on-ground management. • Participate in research into flying-fox ecology. • Investigate use of planning instruments to avoid future conflict. In Situ Management: • Establish buffer areas around existing roosts to alleviate future problems. • Provision of artificial roosting habitat. • Undertake works to enhance habitat value.
Category 5	Emerging, previously unrecorded roosts on Council managed land that have a moderate or high level of community/flying-fox conflict if a roost becomes established on the site.	Minimal Intervention: • Deliver environmental/flying-fox community education. • Non-lethal Dispersal: • Early intervention option.
Category 6	Roosts located on private or State government managed land.	Minimal Intervention: • Deliver environmental/flying-fox community education. • Investigate use of planning instruments to avoid future conflict. • Advise resident of public agency responsible for management.

12.2 Management Actions proposed for each roost

The following principles underpin the management actions summarised below for the 41 known roosts within the Sunshine Coast Council (SCC) area.

- complaints regarding flying-fox colonies in urban areas are primarily dealt with through community education. Community engagement in environmental education through will be applied as an action for all flying-fox roosts in the SCC area;
- any considerations to relocate or disperse a flying-fox colony will be based on a comprehensive assessment of the situation;
- the relocation or dispersal of a flying-fox roost will only be considered as a last option; and
- Alternative roosting sites must be available before any attempt to relocate a flying-fox roost is approved. *(Note: Council would have little or no influence over where a disturbed colony chooses to relocate. There are many unsuitable sites in the urban footprint that could cause greater conflict than the original roost).*
- Adaptive management of roost categories whereby any given roost may be reassessed and assigned a different category and associated management. Review of roost categories has been applied as an action for all flying-fox roosts in the SCC area as required.
- Management actions must be done in accordance with animal welfare and conservation guidelines described in **Appendix 3** of this document. This includes cessation triggers for any action and a list of impact mitigation strategies such as the timing of an action in relation to roost occupation and breeding cycles.

Table 3 describes management actions, rationale and site-specific discussion for each roost based on its assigned category. The table is current at the time of development of this plan and is subject to change as roosts are reclassified into higher or lower management categories.

Table 3 – Management Actions

Note that the following roost categories are current as of November 2022. Roost categories can change as flying-fox populations move or landscape circumstances change. For regularly updated roost categories and related information, refer to BatMap on council's website <http://www.sunshinecoast.qld.gov.au>

Management Action	Management Details/History	Management Frequency	Person Responsible
All Roosts			
Disseminate flying-fox environmental information through a variety of educational programs.	- To enhance long term acceptance of flying-foxes via non-invasive management techniques - Provide opportunity to engage sections of the community affected by flying-foxes - To enhance community appreciation of flying-fox ecology and management complexities	Ongoing	Environmental officers
Review roost category (As per Figure 6)	To provide for adaptive management	As required	Project Manager
Participate in research into flying-fox ecology and human/flying-fox conflict.	To increase knowledge of flying-foxes	As opportunities arise	Project Manager & external partners
Category 1 Roosts			
Mary Cairncross Scenic Reserve, Maleny Background – Roost is seasonally occupied along the palm forest within the reserve where it is unlikely to cause conflict. The roost was established in 2016 and was occupied by flying-foxes each year until 2020. The average yearly population was ~2,250 in both 2016 and 2017, but dropped to 500 – 1,000 in 2018 and 2019, and just 50 in 2020. In June 2021, 45 flying-foxes were recorded at the roost but no more were recorded for the remainder of the year. This is now considered an historic roost that is classified as low conflict.			
- Undertake monthly monitoring - Participate in FF ecology research - Increase on-ground service level to enhance habitat value if required	This site is unlikely to cause conflict with nearby residents due to the large buffer distance. If vegetation degradation is observed, the roost may need to be reclassified and an early intervention strategy implemented. The high human visitation to MCSR provides an opportunity for the installation of interpretive signage.	Ongoing	Environmental officers

Provide interpretive/educational signage			
Alex Forest, Alexandra Headland Background – Roost was established in 2020 and is monitored monthly. Anecdotal evidence from council suggests this site may have been inhabited periodically for several years before being formally reported in 2020. The average yearly population was just over 100 flying-foxes in 2020 and a little over 300 flying-foxes in 2021. The roost is primarily occupied by BFF, with around 4% GHFF in 2021. If additional action is required, refer to Table 2 for recommended category actions and/or Fig 6 to reassess roost category.			
Undertake monthly monitoring program	To accurately monitor fluctuations in flying-fox population size at site; to assess the outcome of management actions; and to provide adaptive management where necessary	Ongoing	Contractor / Project manager
Aragorn Bushland Reserve, Maroochydore (partially incorporates Stella Maris School) Background – The roost is primarily located on private property (Stella Maris school grounds), with periodic small spillovers onto Council managed reserve. The school manages the risks associated with the colony's proximity as they manage all other risks on the school site. However, as a stakeholder, Council will continue to engage with the school's administration and DES to monitor and address community impacts. Council endorsed a decision to disperse this roost and undertake vegetation management to establish buffers and manage the understorey. As a nationally significant roost for GHFF, council has the State and Commonwealth permits in place to undertake the vegetation management component (completed mid 2014). The site is also the subject of a Commonwealth referral to pursue the Council endorsed decision to disperse flying-foxes. The roost may have been occupied earlier than 2011 prior to the commencement of formal assessments. The roost population peaked in 2012 but declined consistently from 2013 – 2017. The population increased slightly in 2018 and 2019 before declining to its lowest in 2020. Flying-foxes have been absent from this site since March 2020. A history of actions for the site are included below. If roost is re-colonised and additional action is required, refer to Table 2 for recommended category actions and/or Fig 6 to reassess roost category.			
Prepare a site-specific options paper	Discuss mitigation actions to reduce impacts to the nearby community and provide information to the public through publication of options paper on the council website	Completed May 2013	Contractor / Council web page Project manager
Present options paper and Council report to Sunshine Coast Council.	To obtain Council resolution for flying fox management and secure funding prior to submission to the State and Commonwealth for permit approval.	Completed May 2013	Project Manager
Continue joint monitoring and liaison with DES and Stella Maris School.	To facilitate joint management of this colony via effective communication between State and Local governments and private landholders.	Ongoing	Stella Maris school / DES / Project Manager
Participate in joint feasibility investigation if the school chooses to initiate application for dispersal or other on-ground action	- To investigate whether a dispersal is likely to be feasible at this site by considering all costs of the project and likely success - To present results of feasibility study to relevant stakeholders - To provide effective joint management of this roost via good communication between State and Local governments and private landholders	Ordinary meeting: May 2013	Stella Maris school / Project Manager

Establish buffer around existing roost via tree removal, a low-intensity prescribed burn and woody weed removal.	To Increase the distance between residents and flying-fox roosts and reduce the impacts of noise and odour.	Veg modification: Complete Jun 2014. Outcomes assessed March 2015	Project manager / Environmental officers Project Manager
Undertake non-lethal dispersal using active disturbance	To disperse flying foxes from the site.	Completed 2015	Project Manager
Implement early intervention management actions if the colony attempts to recolonise following dispersal	Prevents the re-establishment of the roost and continuation of conflict situation.	Completed	Project Manager
Undertake monthly monitoring program	To accurately monitor fluctuations in flying-fox population size at site; to assess the outcome of management actions; and to provide adaptive management where necessary	Monthly from November 2013	Contractor / Project manager
Cassia, Coolum Beach Background – The roost was established in 2011 with an annual average of 250 flying-foxes, which peaked in 2013 at just over 1,800. Two non-lethal dispersals were undertaken in May and July 2014 following receipt of State and Commonwealth Government permits. The establishment of vegetated buffers was considered impractical as the entire width of the reserve (approx. 40 – 50m wide) is less than what is considered an effective buffer. Except for a small population of BFF occurring in August 2014, the site has been vacant since July 2014. If the roost is re-colonised and additional action is required, refer to Table 2 for recommended category actions and/or Fig 6 to reassess roost category. Although listed as a separate roost, the same flying-foxes are likely using this roost and the Elizabeth St Drain (established after the 2014 dispersal) interchangeably.			
Undertake non-lethal dispersal using active disturbance	- To disperse flying foxes from the site using noise, smoke and intense lighting for up to three hours before sunrise - To present and discuss outcomes of dispersal at Sunshine Coast Council meeting	Dispersals: May & Jul 2014. Outcomes meeting: Apr 2015	Project manager / Environmental officers
Implement early intervention management actions if the colony attempts to recolonise or a splinter camp is formed nearby.	Prevents the re-establishment of the roost and continuation of conflict situation.	As required	Project manager / Environmental officers
Undertake monthly monitoring program	To accurately monitor fluctuations in flying-fox population size at site and to assess the outcome of management actions and provide adaptive management where necessary	Monthly from November 2013	Contractor / Project manager

Undertake weed management to discourage flying-fox roosting.	To discourage the return of flying-fox roosting in the reserve.	Ongoing	Council officers
Kawana State College, Bokarina Background – Colony established on site in 2020. While it is located on a council managed drainage reserve, the roost can only be accessed through the school grounds. There are currently no management actions required. However, if circumstances change, refer to Table 2 for recommended category actions and/or Fig 6 to reassess roost category.			
McArthur Park, Kuluin Background – Roost established in 2018 and increased from an average yearly population of ~1,000 flying-foxes to ~6,000 in 2020. The proportion of GHFF has increased from zero in 2018 to more than two thirds in 2020. The roost was not occupied in 2021. If additional action is required, refer to Table 2 for recommended category actions and/or Fig 6 to reassess roost category.			
Include site in monthly monitoring.	Inclusion in monthly monitoring schedule may assist council to respond to potential issues before they arise.	Ongoing	Contractor / Project manager
Undertake weed management to discourage flying-fox roosting.	To discourage roosting in sections of the reserve most likely to result in human/flying-fox conflict.	Ongoing	Council officers
Undertake tree trimming/removal.	To increase the distance between residents and flying-fox roost	Completed	Project manager / Environmental officers
Install interpretive/information signage at roost site.	To increase communication and information for residents.	Completed	Project manager
Develop options paper	Discuss mitigation actions to reduce impacts to the nearby community and to provide information to the public through council website.	Completed	Project manager
Hardie Buzacott, Moffat Beach Background – flying-foxes were absent from the site between Oct 2007 and April 2011. Since then numbers have fluctuated between 70 and 10,200 with numbers more often lower than 1,500. The BFF were the most numerous in 2007, with an average of 3,000 individuals recorded. This trend was reported across most years, with the exception of 2013, 2016 and 2019, when the LRFF were the most abundant species at the roost. The GHFF had the lowest average population count across all years and was reported in extremely low numbers in 2012 and 2016. The core roost area occurs in an industrial estate on the southern side of Tooway Creek and the eastern end of the southern side of reserve. The colony has been known to move to the northern side of the creek which is adjacent to a residential area. If additional action is required, refer to Table 2 for recommended category actions and/or Fig 6 to reassess roost category.			
Prepare a site-specific options paper	Discuss mitigation actions to reduce impacts to the nearby community and provide information to the public through publication of options paper on the council website	Draft completed Jan 2015	Contractor / Project manager
Undertake monthly monitoring program	To accurately monitor fluctuations in flying-fox population size at site; to assess the outcome of management actions; and to provide adaptive management where necessary	Monthly from November 2013	Contractor / Project manager

Undertake weed management to enhance habitat values.	Increased on-ground weed management will enhance general habitat and support flying-foxes in low conflict section of the reserve.	Ongoing	Council officers
McDonalds Rd, Peachester Background – This roost is located partially on Council Reserve (Cahills Scrub Environmental Reserve) and private land. The private landholder is sympathetic to the roost being located on their land. Apart from the dissemination of environmental education, there is currently no management actions required. However, if circumstances change, refer to Table 2 for recommended category actions and/or Fig 6 to reassess roost category.			
Dunning St, Palmwoods Background – The roost was established in 2012 with an average annual population of 500 flying-foxes and peaked in 2014 with an average yearly population of almost 1,200 animals. 19% of the roost is located on Council land, with the remainder on multiple private land tenures. This roost is typically occupied for more than half of the year from September to June since 2011. Flying-foxes establish as heavily pregnant and rear young at this roost. Monitoring indicates that the site has been unoccupied since April 2014. When occupied, the roost population has been a mix of both GHFF and BFF. If additional action is required, refer to Table 2 for recommended category actions and/or Fig 6 to reassess roost category.			
Prepare a site-specific options paper	Discuss mitigation actions to reduce impacts to the nearby community and provide information to the public through publication of options paper on the council website	Completed May 2014	Contractor / Project manager
Establish buffer around existing roost through selective roost tree removal or mitigating effects of noise and odour at residential boundary	To Increase the distance between residents and flying-fox roosts to reduce the impacts of noise and odour.	Completed July 2014	Project manager / Environmental officers
Undertake understory weed management	For the purpose of modifying habitat to make some sections less desirable for flying-foxes.	Complete 2014	Contractor / Project manager
Implement early intervention management actions if the colony vacates the site and attempts to recolonise	This may prevent the re-establishment of a roost to reduce conflict, while minimising harm to flying-foxes in comparison to the harmful impact of dispersing an established roost.	As required	Project Manager
Undertake monthly monitoring program	To accurately monitor fluctuations in flying-fox population size at site; to assess the outcome of management actions; and to provide adaptive management where necessary.	Monthly from November 2013	Contractor Project manager

Vidler Crt, Landsborough Background – Anecdotal reports indicate that the roost has been occupied since 1965. However, accurate and consistent monitoring only began in 2010. The average yearly roost population typically ranges between ~1,500 and 2,500 individuals, with occasional peaks to almost 4,000 (2013) and troughs to less than 1,000 (2016). The number of flying-foxes was almost zero in 2020, and no flying-foxes were recorded in 2021. The GHFF was the most common species at this roost across most years, however, in 2020 the BFF made up 58% of the roost. The LRFF was only recorded at this roost in 2019. Provision of a buffer around the flying-fox roost may prevent future land use conflict with existing residents and if development occurs adjacent to the site. If additional action is required, refer to Table 2 for recommended category actions and/or Fig 6 to reassess roost category.			
Prepare a site-specific options paper	Discuss mitigation actions to reduce impacts to the nearby community and provide information to the public through publication of options paper on the council website	Completed September 2014	Contractor / Council web page Project manager
Establish buffer through selective roost tree removal within 20m adjacent to impacted properties.	To Increase the distance between residents and flying-fox roost on southern boundary to reduce the impacts of noise and odour.	Completed Mar 2015	Project manager / Environmental officers
Investigate construction of a Noise Attenuation Wall in suitable areas	To reduce the impacts of noise and odour to adjacent residents	If required	Project manager / contractor
Non-lethal dispersal may be considered if all other actions fail.	To minimise degradation from buffer vegetation removal—this is constrained by the topography and narrow linear shape of the reserve.	As required	Project Manager
Undertake monthly monitoring program	To accurately monitor fluctuations in flying-fox population size at site; to assess the outcome of management actions; and to provide adaptive management where necessary.	Monthly from November 2013	Contractor / Council web page Project manager
Undertake weed management and selective revegetation to enhance habitat values.	Increased on-ground weed management will enhance general habitat and support flying-foxes in low conflict section of the reserve.	Ongoing	Council officers
Tallangatta St, Nambour Background – The roost was first officially monitored in 2010, with an average annual population of ~7,500 flying-foxes in both 2010 and 2011. No flying-foxes were recorded at the roost from 2012 to 2019, after which time a large group of LRFF moved into the roost, with an average yearly population of ~29,000 in 2020 and ~22,000 in 2021. An early intervention option is recommended for this site at first signs of recolonisation.			
Prepare a site-specific options paper	Discuss mitigation actions to reduce impacts to the nearby community and provide information to the public through publication of options paper on the council website	As required	Contractor / Council web page Project manager
Present options paper and Council report to Sunshine Coast Council	To obtain Council resolution for flying fox management and secure funding prior to submission to the State and Commonwealth for permit approval.	As required	Project Manager
Implement early intervention management actions if the colony attempts to recolonise	This may prevent the re-establishment of a roost to reduce conflict, while minimising harm to flying-foxes in comparison to the harmful impact of dispersing an established roost.	As required	Project Manager

William Doig, Kureelipa. Background – The roost was established in 2020, with an average yearly population of 50 flying-foxes in 2020 and 1,600 in 2021. There were no LRFF recorded at this roost for either year. There were no recorded BFF in 2020 but there was an average of 144 BFF in 2021. The GHFF increased from 50 individuals in 2020 to an average of 1,445 individuals in 2021 and were the dominant species for this roost. If further action is required, refer to Table 2 for recommended category actions and/or Fig 6 to reassess roost category.			
Include site in monthly monitoring	New roost recorded in 2021. Inclusion in monthly monitoring schedule may assist council to respond to potential issues before they arise.	Ongoing	Council officers
Undertake weed control and revegetation to enhance habitat value	Increased on-ground weed management will enhance the habitat value at the roost site.	Ongoing	
Category 2 Roosts			
Emerald Woods, Goonawarra Dve, Mooloolaba Background – The roost was formally recorded in 2010, although adjacent residents report flying-foxes at the site in low numbers over the past 20 years. Community/flying-fox conflict occurred in 2010 when 2,500 LRFFs moved in for one month. The population is relatively small in most years, with a typical yearly average population of approximately 500 flying-foxes. In 2021, 30,609 (mostly LRFFs) were recorded at the roost. The composition of the roost varied markedly between 2010 and 2020, but the BFF was frequently the most abundant species until 2018, after which the LRFF was the most abundant. The GHFF was not recorded in 2013 and remained in relatively low numbers across the remaining years. In 2020, the GHFF made up 20% of the roost., which was their highest numbers between 2010 and 2020. Historical management actions are documented below.			
Prepare a site-specific options paper	Discuss mitigation actions to reduce impacts to the nearby community and provide information to the public through publication of options paper on the council website	Completed August 2014	Contractor / Project manager
Establish Buffer through selective roost tree removal around site perimeter (10-30m.	To increase the distance between residents and flying-fox roosts, resulting in reduced impacts of noise and odour. First stage 10m buffer in 2014 and 30m buffer behind 27 Candlewood Cl in Sep 2015.	Completed	Project manager / Environmental officers
Trial of Canopy mounted sprinklers	To discourage roosting to increase the distance between residents and flying-fox roost.	Installed September 2015	Project manager / Environmental officers
Include in monthly monitoring program	To monitor flying-fox population size; assess the outcome of management actions and inform adaptive management if required; allow early detection of new or returning colony to facilitate early intervention strategies.	Monthly from November 2013	Contractor / Project manager
Undertake weed management and selected revegetation to discourage flying-fox roosting.	To discourage roosting in sections of the reserve most likely to result in human/flying-fox conflict.	Ongoing	Council officers

Pecan Park, Maleny Background – Roost established in 2019 and is regarded as a nationally significant maternity site for GHFF. The average yearly overall population has increased from ~5,000 in 2019 to almost 10,000 in 2021. The GHFF makes up the majority of the roost population (~2/3 to 4/5). There are no records of LRFF at this roost. If additional action is required, refer to Table 2 for recommended category actions and/or Fig 6 to reassess roost category.			
Install interpretive/information signage at roost site.	To increase communication and information for residents.	Pending	Project officer
Include site in monthly monitoring	Relatively new roost and inclusion in monthly monitoring schedule may assist council to respond to potential issues before they arise.	Ongoing	Council officers
Buderim Pines Bushland Conservation Reserve, Buderim Background – Roost established in 2019 and is monitored monthly. The maximum number of individuals recorded at any one time was 1,770 individuals. The GHFF was the most abundant species in 2019 but made up less than 50% of the roost composition in 2020. If additional action is required, refer to Table 2 for recommended category actions and/or Fig 6 to reassess roost category.			
Include site in monthly monitoring	Relatively new roost and inclusion in monthly monitoring schedule may assist council to respond to potential issues before they arise.	Ongoing	Council officers
Trial of Canopy mounted sprinklers	To discourage roosting to increase the distance between residents and flying-fox roost.	Completed	Project manager / Environmental officers
Undertake weed management to discourage flying-fox roosting.	To discourage roosting in sections of the reserve most likely to result in human/flying-fox conflict.	Ongoing	Council officers
Albany St Park, Sippy Downs Background – Roost established in 2020 and is subject to monthly monitoring. The average yearly population of flying-foxes was around 6,500 in 2020, but only 400 in 2021. The majority of flying-foxes in 2021 were LRFF, with a small number of BFF in both 2020 and 2021. If additional action is required, refer to Table 2 for recommended category actions and/or Fig 6 to reassess roost category			
Include site in monthly monitoring	Relatively new roost and inclusion in monthly monitoring schedule may assist council to respond to potential issues before they arise.	Ongoing	Council officers
Category 3 Roosts			
Elizabeth Street Drain, Coolool Background – Established in September 2014 after dispersal activities and vegetation modification of Cassia Ave. Two non-lethal dispersal attempts have been undertaken in May and July 2015. Flying foxes returned after short absences. Some vegetation management has been undertaken to reduce the overhanging roost trees to neighbouring private residences. A history of actions for the site is included below. The population peaked in 2016 with an average yearly population of just over 2,500 flying-foxes. The site returned to typical numbers, with an average yearly population of approx. 700 flying-foxes. The trees within the main roost were illegally poisoned in 2017, which may account for the decrease in population from 2017 to 2021. Located only 350 -400m from the Cassia roost, it is likely that the same flying-foxes are using the two roosts interchangeably.			
Prepare a site-specific options paper	Discuss mitigation actions to reduce impacts to the nearby community and provide information to the public through publication of options paper on the council website. Options paper to address Cassia	Complete	Project manager / Contractor

	and Elizabeth St drains together.		
Undertake weed management to discourage flying-fox roosting.	To discourage roosting in sections of the reserve most likely to result in human/flying-fox conflict.	Ongoing	Council officers
Establish buffer through selective roost tree removal within 15m adjacent to impacted properties	To increase the distance between residents and flying-fox roosts, resulting in reduced impacts of noise and odour.	Completed March 2015	Project manager / Environmental officers
Non-lethal dispersal using active disturbance	- To disperse flying-foxes from the site using noise, smoke and intense lighting for up to three hours before sunrise - Initially regarded as a splinter camp from the Cassia Ave roost. Dispersals were conducted as this was an undesirable location. Two breeding seasons have now occurred at this site and by definition is now regarded as a roost.	Dispersals: May 2015 & July 2015	Project manager / Environmental officers
Trail of canopy mounted sprinklers	To discourage roosting to increase the distance between residents and flying-fox roost.	As required	Project manager
Include site in monthly monitoring	Inclusion in monthly monitoring schedule may assist council to respond to potential issues before they arise. Since newly established as splinter group from nearby Cassia roost, weekly monitoring from Sep 2014, then monthly from Aug 2015.	Weekly 2014 complete. Monthly from August 2015	Contractor / Project manager
Andrea Ahern Bushland Park, Battery Hill Background – Roost established in 2017 and monthly monitoring is undertaken. The roost is located in a residential area in a high conflict location. There has been an increase in the average yearly number of flying-foxes at the roost since 2017. Between 2017- and 2019 the roost was primarily used by BFF. However, in 2020 and 2021, the roost was made up of mostly GHFF. If additional action is required, refer to Table 2 for recommended category actions and/or Fig 6 to reassess roost category.			
Include site in monthly monitoring	Relatively new roost and inclusion in monthly monitoring schedule may assist council to respond to potential issues before they arise.	Ongoing	Council officers
Trial of canopy mounted sprinklers	To discourage roosting to increase the distance between residents and flying-fox roost.	As required	Project manager
Install interpretive/information signage at roost site.	To increase communication and information for residents.	Pending	Project officer
Undertake weed management to discourage flying-fox roosting.	To discourage roosting in sections of the reserve most likely to result in human/flying-fox conflict.	Ongoing	Council officers
Kolara Park, Palmwoods Background – Roost established in 2019 and is a Nationally Significant roost for GHFF. The roost population increased from an average of 3,000 in 2019 to 7,500 in 2021. There have been no LRFF recorded at this roost and the ratio of BFF and GHFF was around 50:50 in 2019 and 2021. In 2020, around two thirds of the colony was comprised of GHFF and the remainder BFF. If additional action is required, refer to Table 2 for recommended category actions and/or Fig 6 to reassess roost category.			

Include site in monthly monitoring	Relatively new roost and inclusion in monthly monitoring schedule may assist council to respond to potential issues before they arise.	Ongoing	Council officers
Install interpretive/information signage at roost site.	To increase communication and information for residents.	As required	Project officer
Undertake weed management to enhance habitat value	Increased on-ground weed management will enhance the habitat value for flying-foxes at a low conflict area within a higher conflict roost.	Ongoing	Council officers
Kuluin Neighbourhood Park, Kuluin Background – The roost was established in 2020 with an average of just over 2,000 flying-foxes in 2020 and almost 2,700 in 2021. All three FF species have occurred at this site in both years, with BFF being the most abundant with an average of ~1,000 to ~2,000 each year. If additional action is required, refer to Table 2 for recommended category actions and/or Fig 6 to reassess roost category.			
Include site in monthly monitoring	Relatively new roost and inclusion in monthly monitoring schedule may assist council to respond to potential issues before they arise.	Ongoing	Council officers
Undertake weed management to discourage flying-fox roosting.	To discourage roosting in sections of the reserve most likely to result in human/flying-fox conflict.	Ongoing	Council officers
Undertake assisted regeneration and revegetation in the eastern side.	The works undertaken on the eastern side of the park are designed to complement work done on the western side by encouraging them to the eastern side with plants flying-foxes like (e.g. <i>Melaleuca quinquenervia</i>).	Ongoing	Council officers
Trail of canopy mounted sprinklers	To discourage roosting to increase the distance between residents and flying-fox roost.	As required	Project manager
Prepare a site-specific options paper	Discuss mitigation actions to reduce impacts to the nearby community and provide information to the public through publication of options paper on the council website	Completed	Project manager / Contractor
Porter Park, Golden Beach Background – Roost established at the site in March 2020 and is regarded as a high conflict site due to the roost's close proximity to an aged care facility. The average population of flying-foxes has increased from ~1,400 flying-foxes in 2020 to ~2,500 in 2021. The average monthly population of LRFF increased by 10-fold between 2020 and 2021; a monthly average of ~8 individuals in 2020 to ~800 individuals in 2021. The average number of BFF also increased across the two years. As of October 2022, flying-foxes have moved to the other side of the reserve, creating further distance from aged care facility. If additional action is required, refer to Table 2 for recommended category actions and/or Fig 6 to reassess roost category.			
Include site in monthly monitoring	Relatively new roost and inclusion in monthly monitoring schedule may assist council to respond to potential issues before they arise.	Ongoing	Council officers
Trail of canopy mounted sprinklers	To discourage roosting to increase the distance between residents and flying-fox roost.	Complete	Project manager
Install interpretive/information signage at roost site.	To increase communication and information for residents.	As required	Project officer

Establish buffer through selective tree removal adjacent to impacted properties	To increase the distance between residents and flying-fox roosts, resulting in reduced impacts of noise and odour.	Completed	Project manager / Environmental officers
Undertake trial of odour neutralising technology	Trial to be undertaken by Ecosure designed to work specifically on flying-fox scent.	Complete	
Prepare a site-specific options paper	Discuss mitigation actions to reduce impacts to the nearby community and provide information to the public through publication of options paper on the council website	Complete	Project manager / Contractor
Undertake weed management to discourage flying-fox roosting.	To discourage roosting in sections of the reserve most likely to result in human/flying-fox conflict.	Ongoing	Council officers
Category 4 Roosts			
Livistonia Cres, Currimundi			
Background – The roost first reported in 2021. If additional action is required, refer to Table 2 for recommended category actions and/or Fig 6 to reassess roost category.			
Include site in monthly monitoring	New roost recorded in 2021. Inclusion in monthly monitoring schedule may assist council to respond to potential issues before they arise.	Ongoing	Council officers
Meridan Downs Park, Little Mountain			
Background – The roost first reported in April 2022. If additional action is required, refer to Table 2 for recommended category actions and/or Fig 6 to reassess roost category.			
Include site in monthly monitoring	New roost recorded in 2022. Inclusion in monthly monitoring schedule may assist council to respond to potential issues before they arise.	Ongoing	Council officers
Mellum Creek Esplanade, Landsborough			
Background – The roost established in 2020 and there is a single record of 1,640 GHFF at this roost in November 2020. There have been no flying-foxes recorded at the roost after that time. If additional action is required, refer to Table 2 for recommended category actions and/or Fig 6 to reassess roost category.			
Include site in monthly monitoring	New roost recorded in 2020. Inclusion in monthly monitoring schedule may assist council to respond to potential issues before they arise.	Ongoing	Council officers
Mooloolah Gardens Reveg Area, Mooloolah Valley			
Background – The roost was anecdotally identified in 2020 but the only formal records are of GHFF in November and December 2021, with 1,793 and 1,682 flying-foxes respectively. If additional action is required, refer to Table 2 for recommended category actions and/or Fig 6 to reassess roost category.			
Include site in monthly monitoring	New roost recorded in 2020. Inclusion in monthly monitoring schedule may assist council to respond to potential issues before they arise.	Ongoing	Council officers
Undertake weed management to enhance habitat value	Increased on-ground weed management will enhance the habitat value at this low conflict site.	Ongoing	Council officers

Parkside Dve, Beerwah Background – The roost was first formally identified in 2021, with 12,683 flying foxes in Feb 2021, which decreased to 1,502 in April 2021. The most common species in 2021 was the LRFF, which made up approximately 88% of the roost. The GHFF and BFF were present in similar numbers of approximately 800 individuals on average. If action is required, refer to Table 2 for recommended category actions and/or Fig 6 to reassess roost category.			
Include site in monthly monitoring	Inclusion in monthly monitoring schedule for this relatively new roost may assist council to respond to potential issues before they arise.	Ongoing	Council officers
Category 5 Roosts – currently no roosts in this category			
Category 6 Roosts			
Bells Creek, Bell's Creek Background – This roost is located on State owned land in protected tenure. Direct enquiries to DES. Although a State managed site, the roost is located near some populated areas, including the developing Aura. It should continue to be monitored quarterly for population growth and the State advised if growth occurs. Environmental education and engagement with the Aura community may reduce the likelihood of conflict between community and flying-foxes.			
Coochin Creek, Coochin Creek Background – Roost located on State owned land in protected tenure. Disseminate environmental educational material on request. Direct enquiries to DES.			
Palmer Resort, Coolum Beach Background – Roost located on private property known to be occupied from 2010 – 2011. Advise property owner to liaise directly with DES in relation to roost management.			
Herron Rd, Conondale Background – Roost located on private property. Advise property owner to liaise directly with DES in relation to roost management.			
Investigate the use of planning instruments including: A development buffer around existing roost	Provision of a buffer around existing flying-fox roost may prevent future land use conflict if development occurs adjacent to the site. As of 2022, the roost appears to be abandoned.	As advised	Project manager
Eumundi-Kenilworth Rd, Eerwah Vale Background – Roost located on private property. Advise property owner to liaise directly with DES in relation to roost management.			
Investigate the use of planning instruments including: A development buffer around existing roost.	Provision of a buffer around existing flying-fox roost may prevent future land use conflict if development occurs adjacent to the site. As of 2022, the roost appears to be abandoned.	As advised	Project manager

Jubilee Drive, Palmwoods Background – This roost was established in 2013 and receives quarterly monitoring to provide greater context for the roost at Kolora Park, as it is likely that the two roosts are connected due to their close proximity. The average yearly population was very low in 2013 (200 individuals) and reached 7,500 in 2014 and 6,000 in 2015. Between 2013 and 2015, no LRFF were recorded at the roost. However, large numbers of LRFF were recorded at the roost in 2019. The roost is located on State owned land in protected tenure, and management enquiries are directed to DES.			
Undertake quarterly monitoring of roost.	Site receives quarterly monitoring. No flying-foxes have been present since occupation by a large number of LRFF in 2019.	Ongoing	Environmental officers
Eudlo Ck CP, Eudlo Background – Roost is located on State owned land in protected tenure. No flying-foxes have been recorded on site since 2007. Direct enquiries to DES in relation to roost management.			
Obi Obi Creek, Kidaman Creek Background – Roost located on private property and first recorded in Jan 2014, possibly in response to a seasonal heat event. Provision of a buffer around existing flying-fox roosts may help to prevent future land use conflict that would likely occur if development occurred adjacent to the site. Advise property owner to liaise directly with DES in relation to roost management.			
Goat Island, Maroochy River Background – Roost located on State owned land in protected tenure. The roost is seasonally occupied during the winter months. Direct enquiries to DES in relation to roost management.			
Barcrest Dve, Yandina Background – Roost established on private land in 2020. Advise property owner to liaise directly with DES in relation to roost management.			
Frizzos, Glenview Background – Roost established in 2014 on private land adjacent a council reserve. Advise property owner to liaise directly with DES in relation to roost management.			
Kawana Island, Seriata Way, Mountain Creek Background - This may be a single colony using this small island, the Kawana Island Environment Reserve, Parrearra and occasionally the Mooloolah River NP. Liaise with DES re this colony due to possible shared roost tenures over part of mobile colony.			
Kawana Island Environment Reserve, Parrearra Background – As above, this may be a single colony using this reserve, Kawana Island (Seriata Way) and occasionally the Mooloolah River NP. Liaise with DES re this colony due to possible shared roost tenures over part of mobile colony.			
Maroochydhore High School, Maroochydhore Background – Roost located on State owned land, with flying-foxes known to be present in Summer each year. Direct enquiries to DES in relation to roost management.			
Parkland Cres, Witta Background - Roost on private land with colony likely moving between properties in the area. Advise property owners to liaise directly with DES in relation to roost management.			

13. Managing significant Grey-headed flying-fox habitat and populations

- a) The *Referral guideline for management actions in grey-headed and spectacled flying-fox camps* defines nationally-important flying-fox camps by the following: Camps that have contained $\geq 10,000$ individuals in more than one year in the last 10 years, or,
- b) Have been occupied by more than 2,500 individuals permanently or seasonally every year for the last 10 years.

In the Sunshine Coast LGA, the Peachester roost is currently identified as a nationally important camp under the new draft policy. Other significant roosts such as Kolora Park, Palmwoods and Pecan Park, Maleny may also fulfil the above criteria.

14. Mitigating risks of multiple management actions

Council has a number of high conflict roost sites in urban areas and may be requested to conduct multiple management actions across the region at the same time and/or over consecutive years.

Under the *Referral guideline for management actions in grey-headed and spectacled flying-fox camps*—if a proponent is proposing dispersal of multiple camps or repeated in situ management actions at one or more camps they should consider their action more strategically as a single, larger action and undertake appropriate strategic planning.

Multiple management actions increase risks to flying-foxes through cumulative impacts of the following non-lethal dispersal outcomes (See **Appendix 1**).

- Fragmentation of colony
- Overcrowding at alternative roost sites, and as a result, increased stress/dehydration.
- Flying-fox injury, disorientation, fatigue, exhaustion and cumulative malnutrition and sleep debt.
- Disruption to breeding cycle at management site and alternative roost sites.
- Spontaneous abortion/dropping or abandonment of young
- Increased pressure on food resources nearby to alternative roost sites

This Plan addresses potential cumulative impacts to flying-foxes through:

- a) Adaptive management to deliver decision making based on:
 - Comprehensive monthly monitoring of key roosts within the region
 - Use of triggers for timing of management (for example, identification of breeding cycles based on roost observations), and
 - Use of triggers for changing roost categorisation (and subsequently, recommended management actions).
- b) Council will not conduct a concurrent dispersal (within 5km) where GHFF numbers exceed 2500 (Eby 2009) at either one of the dispersal sites. 2500 has been identified as a significant number of breeding animals and concurrent dispersal in close proximity may cause cumulative impacts to the vulnerable GHFF.
- c) Council has comprehensively mapped the region for suitable roosting habitat, and classified the habitat into three levels of potential conflict.
 - Zone A (habitat within 100m of a building structure)
 - Zone B (habitat between 100 and 300m of a building structure)
 - Zone C (habitat outside of 300m from a building structure)

There is 14,161ha of low conflict suitable roosting habitat within the Sunshine Coast region, and a further 20,373ha of low conflict suitable habitat within the neighbouring region to the north (Noosa Shire Council).

The mapping indicates the availability of suitable low conflict habitat within 20km of all existing roost sites.

15. Research Monitoring and Education

Research and monitoring is recognised by experts and the public as an important requirement to improve our understanding of flying-foxes and flying-fox roost management. Education that includes the community will also assist with the regions capacity to manage flying-fox issues.

Council will support a three year research program working with leading scientists and associated tertiary institutions to develop a greater understanding of flying fox behaviour and movements. This will incorporate the use of GPS tracking devices in a collaborative study authorised for use under Australian Animal Ethics standards. The research program will be guided by Terms of Reference from a literature review developed by Council on the topic of flying-fox ecology and its relevance to management in urban areas.

Monthly monitoring has occurred at most known Sunshine Coast roosts since 2003 with weekly monitoring occasionally occurring at high-conflict roosts since September 2014. Monitoring will continue to be undertaken as a means of providing population information and assessing the outcome of management activities while also allowing for early detection of a colony to a new or unsuitable roost location.

Education programs will be responsive to community expectations. This includes covering a range of issues such as how to avoid the health risks associated with ABLV and Hendra Virus; learning more about the seasonal movements of flying foxes and understanding the importance of flying-foxes to the survival of our native forests. The program will deliver presentations to local schools and the general public, a school holiday program and educational video.

Flying-fox roosts and feeding areas occur across all land tenures on the Sunshine Coast and the decisions of flying fox management can impact the whole community as well as the local ecology. Therefore a partnership approach is fundamental to the delivery of the research, monitoring and education program. Council is currently a member of the Australasian Bat Society and has been engaged in partnerships with several key stakeholders, including the late Dr Les Hall; Queensland Health and LGAQ. Other stakeholders include SEQ catchments, ecotourism business and DES.

16. Acknowledgements

Sunshine Coast Council acknowledges the authors of GeoLINK's *Draft Lorn Flying-fox Management Strategy* for the use of the management options discussion format within this report.

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Appendix 1: Flying-fox Management Methods

In the event that flying-fox management is required, the following methods will form the basis of on-ground works.

It is important to note that an intervention action associated with any known flying-fox roost or roost sites will only occur when:

1. The Australian and State Government have approved the action, and
2. A report (Options Paper) outlining the costs, feasibility and risks is presented to Council for its consideration, approval and funding allocation.

All other management options to mitigate the impact on residents will be explored prior to any permit or referral applications. For example, such options may include the installation of noise attenuation fencing and canopy mounted sprinklers. Canopy mounted sprinklers are subject to approval from DES as they are not an approved method listed in the Code of Practice. Application for a Flying-fox Roost Management Permit is required before installation and use.

Flying-fox Management

Several types of management can be considered in the options paper. These can be classified into two distinct categories, management insitu or non-lethal dispersal.

Management In-situ

Buffer establishment

- Environmental weed control
- Understorey removal
- Tree trimming
- Tree removal
- Deterrents in buffer zones (eg. water sprinklers)

Non-lethal dispersal

Uncontrolled non-lethal dispersal

- Noise, smoke and intensive lighting for three hours per day commencing at fly-in
- Controlled dispersal through vegetation management
- Weed management
- Understorey Removal
- Tree trimming
- Tree removal

Note: Vegetation works undertaken in all options are to be in accordance with the Australian Standards 4373-2007 Pruning for amenity trees.

The employment of any of the above options will be dependent on the nature of the site. Consequently, any or all of the above options may be utilised at any given site.

Early Intervention Dispersal

Where flying-foxes are observed at a subsequent location following non-lethal dispersal works, early intervention dispersal may be used.

Early intervention dispersal techniques may be used where one of the following criteria is met:

1. Flying-foxes attempt to settle within a private urban or peri-urban residence where the conflict potential is equal or higher than the original site, or
2. Flying-foxes attempt to settle at any other location that is recognised as likely to generate a high level of land use conflict (e.g. hospital, childcare centre, school, aged care facility).

Early intervention dispersal works include noise, smoke and intense lighting for three hours per day commencing at fly in.

Potential Environmental Impacts

While it is not always possible to accurately predict impacts with any degree of certainty, the following potential direct and non-direct environmental impacts have been identified as potential outcomes associated with each management category.

Management In-situ

- Loss of flying-fox and other fauna habitat
- Increased edge effects
- Reduction in ecological viability
- Reduction in bushland amenity level for adjoining properties.
- Change to the vegetation structure of the site
- Reduction of bushland amenity for adjoining properties
- Change to visual amenity for surrounding community
- Overcrowding at alternative roost sites, and as a result, increased stress/dehydration.
- Increased pressure on food resources nearby to alternative roost sites
- Potential for temporary water quality issues.

Non-lethal dispersal

- Loss of flying-fox and other fauna habitat
- Loss or reduction in ecological viability
- Loss or change to visual amenity for surrounding community
- Increased pressure on food resources nearby to alternative roost sites
- Potential for temporary water quality issues.
- Overcrowding at alternative roost sites, and as a result, increased stress/dehydration.
- Reduction/loss of bushland amenity for adjoining properties
- Flying-fox injury, disorientation, fatigue, exhaustion and cumulative malnutrition and sleep debt.
- Fragmentation of colony
- Disruption to breeding cycle at management site and alternative roost sites.
- Damage to hearing
- Spontaneous abortion/dropping or abandonment of young
- Increased pressure on food resources nearby to alternative roost sites

Mitigation strategies to avoid these potential impacts are detailed in **Appendix 3**.

Activity Participants

The detailed components of any on-ground actions are likely to vary, depending on the landscape setting and other site-specific factors. However, as a general rule the following personnel will be likely to participate in any dispersal activities.

Personnel

Project Manager / Incident Controller

Fauna Spotter/Catcher

Council Officers

Contractor

Council Education Officer/Media Officer
DES Officers

Duties

- Supervision of all works undertaken under the permit.
- Monitoring fauna present within roost
- Liaison with project manager to alert of animal welfare issues.
- Liaison with DES officers
- Pruning of vegetation
- Dispersal works
- Monitoring
- Dispersal works
- Vegetation management works
- Monitoring
- Liaison with observers and media
- Compliance supervision of permit conditions

A suitably qualified fauna spotter/catcher should be able to demonstrate experience of or methodology for:

- Classifying flying-fox species
- Assessing flying-fox population numbers in particular roosts
- Identifying flying-fox breeding cycles including evidence of breeding and rearing activity in particular roosts
- Recognising signs of distress in, or harm to, flying-foxes.

In some circumstances there may be additional members of the community present who may not be actively involved in the on-ground actions, but have some interest in the process and/or outcomes.

Observer	Reason for attending
Councillors	• Key stakeholder
Landholders (including Traditional Owners)	• Key stakeholder
Residents	• Key stakeholder
	• Works to be undertaken directly adjacent to a residential address.
	• Likely to be disturbed by works
Emergency Services / Queensland Police	• Crowd control
Wildlife Carers	• Key stakeholder
	• To assist in welfare component
	• To protest the action
Media	• To report on action taken and impacts
Other interested community members	• Interested party
	• Incidental attendance
	• To protest the action
Researchers / University Students	• To record/study the action
Community Groups	• Interested party
	• To protest the action

Clear roles, responsibilities and limits of authority for each participant will be established prior to commencement of works, and communicated during daily project meetings.

Appendix 2: Flying fox Property Management Plan Conditions Queensland Government – DES

Regulatory Statements

1. A Return of Operations form must be sent to DES within 10 business days after each three month period after each notified flying-fox roost management activity for the duration of the FFPMP. A copy must be kept for your records. If the Return of Operations on the approved form is not submitted a penalty may apply. The approved form should be downloaded via the following link:
<https://environment.des.qld.gov.au/licences-permits/plants-animals/return-of-operations>
This Flying-fox Property Management Plan is approved under the Queensland Government's *Nature Conservation (Animals) Regulation 2020* and does not constitute approval under the Australian Government *Environment Protection and Biodiversity Conservation Act 1999*.
2. The licensee must meet all requirements outlined in the Code of Practice – Ecologically sustainable management of flying-fox roosts.

Operational Permit Conditions

The permit holder is to notify DES in writing at least 48 hours in advance of flying-fox roost management commencing, via an e-mail to wildlife.management@des.qld.gov.au

1. DES may direct management activities not to commence or to be suspended at any time. Direction from a DES officer is to be followed at all times
2. DES officers can enter and remain at the activity site at any time during which management activities are being undertaken.
3. An authorised wildlife carer or veterinarian (inoculated against Australian Bat Lyssavirus) must be on call at all times that dispersal activities are undertaken
4. If the flying-foxes disperse to a location that is considered to be unsuitable by either DES or local government, the permit holder is to, upon notification by DES:
 - a. take all reasonable actions to disperse the flying-foxes from the unsuitable location; and
 - b. where entry to land not owned by the permit holder is required to carry out the necessary management activity, seek permission from the relevant landholders to enter the land.

Appendix 3: Animal Welfare and Conservation

Cessation Triggers

Where the following triggers occur, all works on site will cease until further notification by a DES officer:

- Death or injury to a flying-fox or other fauna
- Notification from a DES officer, Contractor, Council Officer, Wildlife Carer or Fauna Spotter/Catcher that unacceptable stress levels are occurring (including fatigue) Where visibly pregnant flying-foxes are observed
- Where dependent young flying-foxes are observed

Works resume only after approval from a DES officer.

Impact Mitigation Strategies

The following mitigation strategies will minimise risks to flying-foxes:

- Non-lethal dispersal action will only occur outside of critical breeding timeframes, where there are no dependant young flying-foxes or visibly pregnant flying-foxes within the roost. This assessment will be based on roost observations by a suitably qualified fauna spotter/catcher.
- Vegetation management works are to be undertaken only during the night after fly-out, or alternatively, during the daytime, outside of 50m from the nearest roosting flying-fox.
- A suitably qualified fauna spotter/catcher holding a current Queensland Government Rehabilitation Permit with demonstrated experience in flying-fox management is to be engaged to provide advice and recommendations during proposed works.
- Where a flying-fox appears injured, an experienced, vaccinated flying-fox handler only is to approach, handle and collect the animal. The animal is to be transported to a veterinary facility immediately.
- Works will be timed to avoid periods when flying-fox health is likely to be compromised (i.e. food bottlenecks).
- Rest days will be scheduled every six days during non-lethal dispersal programs.
- Clear responsibilities and limits of authorities will be established and communicated in project inductions and daily meetings.
- A thorough monitoring program associated with any management activity to allow adaptive management in response to outcomes (including welfare/conservation outcomes) (See **Appendix 2**).
- Mitigating risks of multiple management actions
 - Under the *Referral guideline for management actions in grey-headed and spectacled flying-fox camps* – if a proponent is proposing dispersal or multiple camps or repeated in situ management actions at one or more caps they should consider their action more strategically as a single, larger action and undertake appropriate strategic planning.
 - Council will not conduct a concurrent dispersal (within 5km) where GHFF numbers exceed 2500 (Eby 2009) at either one of the dispersal sites. 2500 has been identified as a significant number of breeding animals and concurrent dispersal in close proximity may cause cumulative impacts to the vulnerable GHFF.

Appendix 4: Human Health Impact Mitigation Strategies

The following mitigation strategies will be undertaken during any proposed works to minimise risks to human health:

- Personnel are required to observe workplace health and safety requirements
- Personnel are required to wear personal protective equipment as recommended within workplace health and safety requirements
- Personnel are to attend site induction and briefing prior to commencement of work
- Strictly no non-vaccinated personnel are to come in contact with flying-foxes during works
- Injured or dead flying-foxes are only to be collected by personnel who are currently vaccinated against Australian Bat Lyssavirus (ABLV)
- Where contact (bite or scratch) between a flying-fox and human is reported, the person is to advise the project manager and attend a general practitioner as soon as possible for treatment. First aid treatment should include washing the wound for fifteen minutes with soapy water (not scrubbing) and apply an iodine based solution.

Appendix 5: Monitoring

Council currently monitors key flying-fox roosts in the region on a monthly basis, all of which regularly support GHFF. Monitoring involves diurnal counts by experienced personnel following scientifically rigorous methods developed by the CSIRO (Westcott *et al* 2011). This provides a standardised roost population estimate each month, including species composition, which is directly comparable over time. Reproductive status and body condition is also recorded where possible. In addition, SCC flying-fox roost data collected by DES is monitored.

The data allows Council to identify population changes at an individual roost and regional level, which is used to inform management decisions. For example, management will be avoided when dependent young are recorded during monitoring, or if body condition appears to be poor. Importantly it will also allow Council to evaluate outcomes and potential impacts of varying management activities to ensure that regional population impacts can be minimised.

Additional monitoring will be associated with any specific management action as detailed below.

On-site monitoring during management works

Following on-ground works, monitoring of flying-foxes will be undertaken at the site by the following personnel:

- DES officers
- Fauna Spotter/Catcher
- Council officers
- Flying-fox carer

Off-site monitoring during management works

Monitoring of potential alternative roost sites will be undertaken by the following personnel:

- Pre-selected residents at key roost and other locations likely to attract disturbed flying-foxes
- Council officers
- Wildlife care community groups, and
- General public.

Offsite monitoring will be undertaken at all known, current and historic flying-fox roosts or reserves that have been identified as suitable flying-fox habitat.

Monitoring Indicators

DES officers, Fauna Spotter/Catchers, Wildlife Carers and Council officers in attendance at the site will be observing behaviour of flying-foxes throughout any action. Specifically, flying-foxes will be monitored for:

- a) Fatigue (low flying animals, laboured flight)
- b) Pregnant females (action is not to take place where pregnant female flying-foxes are identified)
- c) Aborted fetuses
- d) Exposure to extreme weather (refer below, Heat stress)
- e) Body condition (poor body condition may indicate nutritional stress and lead to higher levels of fatigue)
- f) Dependent young (action is not to take place where dependent young are identified)
- g) Vocalisations (short low frequency calling)

Heat Stress

In January 2014, the Palmwoods roost suffered extreme temperatures resulting in the death of approximately 3000 Black flying-foxes.

Where daytime average temperatures are predicted to be over 35°C, works are not to be undertaken within 50m of roosting flying-foxes (including dispersal works).

A study by Welbergen *et al.* (2008) recommended close monitoring of colonies where temperatures exceeding 42.0°C, as it may result in die-off due to heat. As a conservative measure, we have adopted 35°C and a 50m buffer from flying-foxes in extreme weather conditions.

During extreme heat conditions, flying-foxes will be monitored by DES officers, Council Officers, Fauna Spotter/Catchers and Wildlife Carers for the following heat stress related behaviours:

- a) Wing-fanning
- b) Shade-seeking
- c) Panting
- d) Saliva-spreading

In extreme heat conditions, these stress indicators may also be monitored at other roosts prior to and during management activities to ensure alternative sites can accept displaced individuals.

Appendix 6: Communication Plan

Prior to any action the following will occur:

- A communication plan is to be developed in consultation with Council's media and PR team to:
 - Manage key messages
 - Inform the wider community
 - Inform the primary and secondary impacted residents
 - Plan media opportunities
- For land not under Council's management control or ownership, landowner consent will be obtained (including Traditional Owners)
- Early consultation with residents or businesses likely to be affected by any actions will be undertaken
- Information will be disseminated to all adjacent residents and other stakeholders, and
- Information will be disseminated to the broader community for the purpose of timely notification of relocation on dispersed bats into other inappropriate locations.

Appendix 7: Management options discussion

1. No on-ground management

This approach means that nature would be left to take its course and no reactive or proactive responses would occur from Council in relation to flying-fox roosts in the LGA.

Criteria	Suitability Assessment
Legislative Implications	Flying-foxes are currently protected under state and federal legislation. If this approach is adopted there will be no considerations under the following legislation: • <i>Nature Conservation Act 1992</i> and associated Nature Conservation (Animals) Regulation 2020; • <i>Environment Protection & Biodiversity Conservation Act 1999</i>, and • <i>Animal Care & Protection Act 2001</i>.
Animal Welfare	If no action is taken animal welfare will not be a formal issue. However, community frustration in some areas may result in unauthorised dispersal, which will almost certainly create animal welfare issues.
Community Concerns	For most colonies in the Sunshine Coast LGA, this approach will not raise any negative community concerns. However, for those residents impacted by the noise and odour associated with living in close proximity to a roost, this management option is not likely to be satisfactory.
Likelihood of Success	The likelihood of successfully solving issues associated with existing problematic colonies is minimal. The conflict issue will not be resolved and unauthorised dispersal and disturbance from the community is likely to create harm to the colony.
Strengths	No cost to Council.
Weaknesses	• Issues around problematic colonies will not be addressed; • Negative community response to council inaction; and • Inaction may prompt illegal dispersal or culling activity.
Cost	No direct cost but indirect costs from increased resource commitments addressing escalated customer requests.
Consistency with Plan Objectives	Inconsistent with Plan's objective: • To address and manage the concerns of residents experiencing lifestyle impacts associated with living in close proximity to large or problematic flying-fox roosts.

2. Disperse flying-foxes through habitat modification

Criteria	Suitability Assessment
Legislative Implications	If this approach is adopted there will be considerations under the following legislation: • <i>Nature Conservation Act 1992</i> and associated Nature conservation (Animals) Regulation 2020; • <i>Environment Protection & Biodiversity Conservation Act 1999</i> (if the roost includes the GHFF); • <i>Vegetation Management Act 1999</i>; and potentially the • <i>Animal Care & Protection Act 2001</i>. • <i>Aboriginal Cultural Heritage Act 2003</i>

Criteria	Suitability Assessment
Animal Welfare	• Implications for animal welfare if undertaken at an inappropriate stage in their breeding cycle; • Likely to cause stress for colony if undertaken while the roost is occupied; • Increased risk of predation if flying-foxes are forced to seek alternative roosts during daylight hours; and • May force flying-foxes into sub-standard habitat that will impact on their health and wellbeing. • Fauna survey results will investigate potential impacts on other fauna species.
Community Concerns	The drastic nature of habitat modification required to effectively disperse a colony may carry both positive and negative community implications. For impacted residents this management action is likely to be perceived positively if it results in a successful dispersal. However, the local community may also be concerned about the loss of amenity and habitat for other fauna that will result from this management action.
Likelihood of Success	Based on case studies from around Australia, this type of action is likely to result in the movement of flying-foxes to an equally unsuitable or unexpected site. Identified suitable habitat mapping in the Sunshine Coast area illustrate a wide range of alternative sites that are likely to result in land use conflict.
Strengths	Short and long term relief for residents if dispersal and habitat modification is effective.
Weaknesses	• Depending on the extent of habitat modification, the actions may not be reversible; • Possibility of the colony dispersing to another unsuitable site; • Impact on other species through loss of habitat; • Unsustainable solution due to ongoing actions required if flying-foxes disperse to other unsuitable locations; • Complete removal of mature trees would probably be required due to the Australian Standards for Pruning that may prohibit the drastic pruning required to deter flying-foxes; and • Will disrupt ecological processes such as pollen dispersal at a local level.
Cost	Very expensive to undertake removal of mature trees, around \$20,000 for 20 trees (GeoLink 2012).
Consistency with Plan Objectives	Consistent with the objective to: • Address and manage the concerns of residents experiencing lifestyle impacts associated with living in close proximity to large or problematic flying-fox roosts. But inconsistent with other objectives.

The modification of habitat as a means of dispersal would probably require significant vegetation removal to be effective. For example, Bundall on the Gold Coast required vegetation removal of up to 90% to achieve complete relocation of the flying-fox roost.

To minimise the immediate impact on flying-foxes it would be expected that vegetation would be removed or pruned in conjunction with another dispersal technique to discourage recolonisation. Under such circumstance vegetation work would take place immediately following dispersal before the colony make any attempt at re-establishing at the same site. Alternatively, habitat modification can be carried out as soon as the flying-foxes naturally leave a roost in search of other food sources.

For roosts that are still occupied, habitat modification can be undertaken incrementally over a number of nights while flying-foxes are out foraging. This would need to be undertaken at a time of the year where young were not present in the roost.

3. Disperse flying-foxes by active disturbance (Non-lethal dispersal)

Criteria	Suitability assessment
Legislative implications	Within a UFFMA, dispersals must be undertaken in accordance with the <i>Code of practice – Ecologically sustainable management of flying-fox roosts</i> and notification given to DES 48 hours prior to commencement of dispersals. Outside a UFFMA, a flying-fox roost management permit (FFRMP) or an approved RFFMP is required from DES. Currently, referral to DCCEEW is necessary for dispersals at roosts containing GHFF.
Animal welfare	• Most methods create high level of stress and fatigue; • High infant mortality through dropping of young or separation from mother; • Likelihood of stress-induced spontaneous abortion by pregnant females; • Increased risk of predation from diurnal birds of prey; and • May force flying-foxes to roost in sub-standard habitat.
Community Concerns	If this management action resulted in the successful dispersal of a problematic colony, the temporary inconvenience associated with active disturbance will probably not be a major concern for residents. If the dispersal is not successful, the community may be less tolerant of the significant noise and light disruption associated with repeated active disturbance attempts.
Likelihood of success	See discussion below. Likelihood of success is variable depending on method chosen but generally low. In NSW, 23 dispersal attempts have been attempted at the Maclean colony in the Clarence River Valley (Roberts, 2011). Not only do flying-foxes still occupy the roost but they have also expanded into surrounding residential areas. Around Australia 80% of dispersal attempts resulted in the problem simply being moved into another conflict area.
Strengths	Short term improvement if dispersal successful.
Weaknesses	• Most dispersal programs are protracted exercises with unpredictable results; • Usually high mortality associated with dispersal; • High level of stress associated with forced dispersal thought to possibly increase flying-fox susceptibility to Hendra virus; and • Inability to control where dispersed flying-foxes move to.
Cost	Cost estimate for one off dispersals over 3-4 weeks using sound and smoke is \$150 000.
Consistency with Plan objectives	Consistent with this plan's objective: • To address and manage the concerns of residents experiencing lifestyle impacts associated with living in close proximity to large flying-fox roosts.

Dispersal of flying-foxes through active disturbance has been attempted at many locations in Australia using a variety of methods including physical disturbance, odour, noise, taste, visual and a combination of all of the above. Levels of success have been variable in terms of cost, dispersal outcomes and animal welfare considerations. Examination of some known and estimated costs for various methods illustrates the difficulties associated with this option (GeoLink, 2012).

All non-lethal dispersal activities must be undertaken in accordance with the mitigation measures listed **Appendices 1 – 4** of this plan.

Noise Disturbance

The generation of temporally and spatially random noise as a dispersal tool has been shown to be effective. However, it can be expensive due to the high labour intensity of the activity and the follow up monitoring of dispersal success and ensuring recolonisation does not occur. Exact costs are difficult to predict as they are dependent on the size of the colony and the dispersal effort required to move the roost on. For example, the dispersal of the colony occupying the Melbourne Royal Botanical Gardens involved 40-50 people for a flying-fox colony of 20,000-30,000 animals. A CD recorded for dispersal purposes used by the Sydney and Melbourne Botanical Gardens may reduce the cost of noise generation, although the effectiveness of the CD would probably be enhanced through the addition of other human generated noise around the site.

In addition to the cost of actually generating the noise disturbance, the costs of post-dispersal monitoring are substantial and difficult to predict. Such costs would include an initial dispersal plan, an ongoing dispersal maintenance plan and possible additional action if the flying-foxes return or settle in a site that is equally unsuitable.

Visual Disturbance

The use of visual disturbance techniques alone have traditionally not been very successful, with little more than localised (small areas within a roost) avoidance occurring for short periods of time. Some techniques have included reflective objects hung in trees, strobe-lighting, hanging of plastic bags and high intensity sweeping floodlights. All showed low and usually localised effectiveness and flying-foxes were fairly quick to habituate to the disturbance.

Odour Disturbance

The use of scent deterrents has met with variable success in some areas. Flying-foxes have been known to avoid the odour of paradichlorobenzene (found in toilet deodoriser blocks) and the odour of D-Ter (a deterrent manufactured by Heiniger). However, in both instances the effect is usually localised and expensive in terms of the quantity of product required and the resources required to apply it at high densities across large areas.

The application of python excrement on the roosting branches of dominant males has been known to be highly effective but this method shares the shortcomings of the previous two odour deterrents and has the additional problem of sourcing large quantities of python excrement.

Physical Disturbance

The introduction of physical deterrents such as netting, trip wires and rope has also been found to be ineffective. For example, heavy fishing line introduced at the Melbourne Botanical Gardens roost as a trip/nuisance hazard proved unsuccessful and was eventually used by the flying-foxes as extra roost space.

The netting of an entire roost was costed by the Sydney Botanical Gardens at around \$500,000 but was never trialled due to the high cost and logistical issues. In addition to the high initial

cost there would be significant ongoing monitoring costs to minimise flying-fox and bird mortality.

The use of canopy mounted water sprinklers has been rated by the authors of the Lorn Flying-fox Management Strategy as likely to be highly successful (GeoLINK 2012). Sprinklers mounted and set on automated random cycles may initially be labour intensive but low cost compared to some other options, with an estimate of around \$25,000 plus water usage. That cost would vary according to the size and location of the site as sprinklers would need to be installed in almost every tree.

The use of smoke as a dispersal technique was trialled by the Melbourne Botanical Gardens but appeared to only agitate the flying-foxes. This technique is difficult to control as it can be hugely influenced by wind direction and speed. Labour and material costs are likely to be low but so also is the measure of success.

Regardless which of the above techniques were used it would be necessary to develop a dispersal plan and dispersal monitoring plan when applying for a damage mitigation permit.

4. Reduce flying-fox numbers/culling

As state and national legislation currently stands, culling is not an option for urban flying-fox colonies.

The Queensland State Government discussion paper 'A new approach to managing flying-fox roosts' (2013) states that 'Shooting of flying-foxes is not allowed as it is an ineffective and inhumane way to manage roosts'.

5. Early intervention option

Criteria	Suitability Assessment
Legislative Implications	No legislative implications for council in relation to monitoring but early intervention will require Compliance under the: • <i>Nature Conservation Act 1992</i> • <i>Animal Care & Protection Act 2001</i>; and • <i>Environment Protection and Biodiversity Conservation Act 1999</i>. As per the discussion around active disturbance as a management tool, early intervention must comply with Appendices 1 – 4 of this plan.
Animal Welfare	May be animal welfare issues, depending on method of early intervention. However, these can be minimised by early detection and swift intervention before a roost becomes established.
Community Concerns	This is likely to be a popular management option for residents who may be otherwise impacted by living in close proximity to a large roost.
Likelihood of Success	Unknown likelihood of success. Unable to find documented cases from elsewhere. However, early intervention is supported by Dr Les Hall (pers com) as a management option.
Strengths	• Prevents the establishment of a roost before a conflict situation arises; • Minimises harm to flying-foxes in comparison to the harmful impact of dispersing an established roost.
Weaknesses	• Would require consistent monitoring of all potentially suitable but undesirable sites;

Criteria	Suitability Assessment
	Time lag between detection of early colonisers and approvals to take dispersal action may be problematic.
Cost	Operational costs associated with monitoring previously occupied colonies and natural areas potentially capable of supporting colonies. Dispersal costs at the early intervention stage would be minimal compared to the costs associated with dispersing an established roost.
Consistency with Plan Objectives	Consistent with the following objectives of this Plan: To address and manage the concerns of residents experiencing lifestyle impacts associated with living in close proximity to large flying-fox roosts.

The capacity to intervene at the earliest sign of recolonisation or the establishment of a new roost in an unsuitable location is an essential tool for council. It will allow a cost effective means to avoid future conflict situations and allow resolution of some existing conflict situations if action can be taken quickly when an existing colony temporarily moves out.

Netting of trees within adjacent residents' properties may be investigated as an early intervention technique. However, this would not be suitable on council reserves due to the large area involved. Early intervention could also include 'nudging' the camp away from conflict area—this currently requires permit approval for GHFF.

6. Incentives/compensation for severely impacted residents

Criteria	Suitability Assessment
Legislative Implications	No legislative considerations as no direct action on colonies would be taken.
Animal Welfare	No animal welfare implications.
Community Concerns	The offering of incentives may be viewed with appreciation that something is being done. However, this may not be enough to compensate for some lifestyle impacts.
Likelihood of Success	Modification of buildings through air-conditioning, shelters etc have been proven to improve indoor amenity but this is unlikely to be a viable sustainable option in terms of resourcing. It will also fail to address outdoor amenity issues.
Strengths	- Fitting of air-conditioning would improve indoor air quality; - Provision of shade structures or outdoor roofs could alleviate faecal contamination of outdoor living space; - No harm to flying-fox colony; and - Building modifications such as air-conditioning, insulation, double-glazed windows offer immediate relief.
Weaknesses	- Would not solve outdoor noise & odour issues; - Who pays? - May create precedent for rate reductions or other incentives for other annoying urban wildlife impacts, e.g ibis; and - Residents may feel "trapped" inside air-conditioned buildings.
Cost	Depending on the number of residences affected, the cost could be quite substantial. In addition to significant upfront infrastructure costs, there would be ongoing expense for residents relating to electricity use for air-conditioning.
Consistency with Plan Objectives	Consistent with the following objectives of this Plan:

Criteria	Suitability Assessment
	- To address and manage the concerns of residents experiencing lifestyle impacts associated with living in close proximity to large flying-fox roosts; and - To develop achievable flying-fox conservation strategies to protect the three species found in the Sunshine Coast local government area.

Incentives or compensation could take the form of modifying residential buildings and backyards or monetary compensation such as a rates reduction.

In the Clarence River Valley, the installation of air-conditioning in residences proved to effectively reduce odour and noise. The provision of roofs and shade structures over back yards can also be used to minimise the impact of faecal droppings in outdoor living areas (Roberts 2006).

7. Provision of artificial roosts

Criteria	Suitability assessment
Legislative Implications	Legislation that may need to be considered include: <i>Nature Conservation Act 1992</i> <i>Environment Protection & Biodiversity Conservation Act 1999</i> (if the roost includes the GHFF); <i>Vegetation Management Act 1999</i>; and <i>Animal Care & Protection Act 2001</i>.
Animal Welfare	Short term animal welfare issues associated with initial roost construction but long term benefit through provision of habitat.
Community Concerns	Artificial roosts are usually provided in existing roosts to increase roosting opportunities in the core area to compensate for loss of roosting sites through habitat modification undertaken to provide a residential buffer. The community are likely to support this management option if it results in establishing or increasing a buffer between the affected residents and the flying-fox roost.
Likelihood of Success	Has been shown to be successful when undertaken in conjunction with habitat modification on roost periphery to provide a buffer between roost and residents.
Strengths	- Provides a buffer between the roost and impacted residents, which will improve amenity; - Doesn't reduce habitat opportunity for flying-foxes; and - Designs already developed by Coffs Harbour City Council.
Weaknesses	- Difficult to achieve in small and narrow roost areas, such as Cassia Wildlife Corridor; and - Current designs only support small numbers of flying foxes. - Artificial roosting structures have, to date, proven unsuccessful (GeoLINK, 2012)
Cost	Difficult to estimate costs.
Consistency with Plan Objectives	Consistent with the following objectives of this Plan: - To address and manage the concerns of residents experiencing lifestyle impacts associated with living in close proximity to large flying-fox roosts; and - To develop achievable flying-fox conservation strategies to protect the three species found in the Sunshine Coast LGA.

The provision of artificial roosts is usually used in conjunction with habitat modification or vegetation removal on roost periphery for the purpose of providing a buffer. It provides an opportunity to increase the distance between flying-foxes and residents without reducing roosting opportunities.

8. Attract flying-foxes to alternative habitat

Criteria	Suitability assessment
Legislative Implications	No statutory considerations for habitat enhancement at alternative sites. However, implications exist under the following legislation if the action is accompanied by dispersal attempts from the existing roosts: • <i>Nature Conservation Act 1992</i> and associated Nature conservation (Animals) Regulation 2020; • <i>Environment Protection & Biodiversity Conservation Act 1999</i> (if the roost includes the GHFF); • <i>Vegetation Management Act 1999</i>; and potentially the • <i>Animal Care & Protection Act 2001</i>.
Animal Welfare	Possible long-term benefits through provision of suitable habitat but significant animal welfare issues likely to arise during associated dispersal efforts.
Community Concerns	This management option is likely to be well received by the community if it results in the successful dispersal of a problematic colony. However, the action will be less enthusiastically received by residents of a newly impacted area if the flying-foxes don't move to a planned location.
Likelihood of Success	Large areas of suitable habitat already exist in the local government area and flying-foxes have not chosen to utilise it. In other areas (e.g Coffs Harbour) minor habitat modifications made within existing roosts have successfully attracted animals to certain areas of the roost. However, efforts to encourage a roost to relocate from one area to another have been notoriously unsuccessful. For example, in the only partial success story to date, Melbourne spent around \$3m trying to move a colony from the Botanical Gardens to Geelong. In the end two thirds of the roost relocated to Yarra Bend and only a small portion of the colony relocated to Geelong (Roberts et al 2011).
Strengths	• Reduces the likelihood of resident/flying-fox conflict; and • Non-invasive management technique that enhances animal welfare.
Weaknesses	• High likelihood that flying-foxes would not move to the identified alternative habitat; • Would rely on planning instruments to ensure the long-term suitability of the site was retained; and • Not likely to solve conflict issues in the short-term, e.g. some attempts to attract roosts to a new location have run over as long as 10 years.
Cost	Probably minimal cost provided the chosen site was already in public ownership.
Consistency with Plan Objectives	This management option meets the following plan objectives: • To develop flying-fox management strategies to protect the three species found in the Sunshine Coast LGA;

Criteria	Suitability assessment
	- To develop flying-fox management strategies consistent with legislative obligations; and - To identify and prevent future residential/flying-fox land use conflict issues where possible.

9. Participate in research to improve knowledge of flying-fox ecology

Criteria	Suitability assessment
Legislative implications	Compliance with the Australian Code of Practice for the Care and Use of Animals for Scientific Purposes is compulsory under Section 91 of the <i>Animal Care & Protection Act 2001</i> .
Animal welfare	Long term animal welfare issues likely to improve with increased knowledge of flying-fox ecology.
Community Concerns	There is not likely to be any community opposition to this management option. Research that increases our understanding of flying-foxes, their ecological role and how we can satisfactorily share the urban environment will be ultimately beneficial for the community.
Likelihood of Success	Research undertaken by council would enhance local knowledge of some aspects of flying-fox ecology and may assist with management of our colonies. Council's participation in research carried out by other organisations will also enhance our knowledge of flying-fox ecology and other flying-fox issues.
Strengths	May provide long term solution to flying-fox/resident conflict issues.
Weaknesses	- Will not provide any short term solution to concerns surrounding existing problematic roosts; and - Knowledge expansion at a national level is required, so it is beyond the capacity of a single local government organisation.
Cost	Difficult to quantify as costs would be dependent on the nature of the research. External funding opportunities could be sought for research opportunities.
Consistency with Plan Objectives	- To develop achievable flying-fox conservation strategies to protect the three species found in the Sunshine Coast LGA; - To increase community understanding and appreciation of the essential ecological role of flying-foxes and the need for conservation efforts; and - To develop information management strategies to ensure community access to accurate and up to date information relating to perceived health risks.

Considering the high level of public interest in flying-foxes, due to both their role as essential pollinators and their negative image in the eyes of some members of the community, there is surprisingly significant gaps in our knowledge of flying-fox ecology. While it is not necessarily Council's role to initiate or fund flying-fox research, it is in its interest to participate in or assist broader research if requested to do so.

10. Use planning to avoid future land use conflict

Criteria	Suitability assessment
Legislative Implications	The <i>Sustainable Planning Act</i> 2009 offers the potential to require a buffer for certain activities, e.g. some agriculture and quarry activities.
Animal Welfare	Animal welfare benefits would occur through the minimisation of disturbance at relevant sites.
Community Concerns	To the wider community this management option is likely to be seen as appropriate and beneficial in the long term. However, planning restrictions may not be so well received by landowners who may be directly impacted by such restrictions.
Likelihood of Success	Buffers of around 300m have been shown to alleviate residential/flying fox land use conflict. Even smaller buffers have been effective in Coffs Harbour and Gordon in NSW.
Strengths	• The planting or retention of species unsuitable for roosting in the buffer zone can provide habitat for other fauna; • Provision or retention of buffers around roosts proven to alleviate amenity concerns of residents; and • May prevent future conflict issues.
Weaknesses	• Does not address the problems associated with current problematic colonies; and • May be unnecessary as there is no certainty around flying-fox movements and roost selection.
Cost	Costs would vary depending on whether the buffer is a developer contribution or Council acquisition.
Consistency with Plan Objectives	Consistent with this Plan's objectives: • To develop flying-fox management strategies consistent with legislative obligations; • To identify and prevent future residential/flying-fox land use conflict issues where possible; and • To develop achievable flying-fox conservation strategies to protect the three species found in the Sunshine Coast local government area.

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

The inclusion of a property note advising of adjacent flying-fox roost may help to alleviate future land use conflict. Future development could then be designed where possible to provide a buffer around existing roosts.

11. Provide buffers around existing or historic roost sites

Criteria	Suitability Assessment
Legislative Implications	If this approach is adopted there will be considerations under the following legislation: • <i>Nature Conservation Act 1992</i> and associated Nature Conservation (Animals) Regulation 2020;

Criteria	Suitability Assessment
	• <i>Environment Protection & Biodiversity Conservation Act 1999</i> (if the roost includes the GHFF); <i>Vegetation Management Act 1999</i>; and potentially the <i>Animal Care & Protection Act 2001</i>. • <i>Aboriginal Cultural Heritage Act 2003</i>
Animal Welfare	Fauna survey results will investigate potential impacts on other fauna species.
Community Concerns	This management option is likely to be well received by residents that are directly impacted by living in close proximity to a large roost. Establishment of a sufficient buffer has been shown to alleviate impacts such as noise and odour for previously affected residents.
Likelihood of Success	With appropriate buffer plantings high likelihood of preventing future resident/flying-fox conflict issues.
Strengths	• The planting or retention of species unsuitable for roosting in the buffer zone can provide habitat for other fauna; • Provision or retention of buffers around roosts proven to alleviate amenity concerns of residents; • Increases the distance between residents and flying-fox roosts; and • Could protect and enhance habitat for other fauna.
Weaknesses	• Land may not be available for use as a buffer; and • May be cost prohibitive if available land for buffer sits in private tenure. • May cause unacceptable loss of amenity at some sites • Not suitable at narrow/linear roost sites
Cost	Costs may be significant unless buffer land for planting is already available or development conditions can be imposed via covenant or similar agreement.
Consistency with Plan Objectives	Consistent with this Plan's objectives: • To develop achievable flying-fox conservation strategies to protect the three species found in the Sunshine Coast LGA; and • To identify and prevent future residential/flying-fox land use conflict issues where possible.

In NSW, the provision of buffers at a number of urban flying-fox roosts has been effective in alleviating some of the concerns of nearby residents. Roberts (2006) recommends that such buffers be included in the boundary definition of a flying-fox roost.

12. Community education

Criteria	Suitability Assessment
Legislative Implications	No legislative implications.
Animal Welfare	Some positive animal welfare implications if community education improves understanding and tolerance of flying-foxes.
Likelihood of Success	Community education has proven to be highly effective in alleviating concerns of residents living near flying-fox roosts, (Roberts, 2012). The likelihood of improving community

Criteria	Suitability Assessment
	understanding of flying-fox issues is high. However, the extent to which that understanding will help alleviate conflict issues is unknown. Extensive education for decision-makers, the media and the broader community is required to overcome the current community perception of flying-foxes. While Council can contribute to that process, it is not feasible for Council to have sole carriage of the education role.
Strengths	• Non-invasive management technique to enhance long term acceptance of flying-foxes; • Opportunity to engage sections of the community affected by flying-foxes; and • Community will gain a better appreciation of the importance of flying-fox to Australia's forest ecosystems; • Community will gain a better appreciation for flying fox management difficulties.
Weaknesses	• Fails to address current conflict issues in the short term; • Education may assist in alleviating health fears and enhancing ecological knowledge but it might not appease residents experiencing severe amenity impacts;
Cost	Can be incorporated to some extent into current environmental education roles and resources within Council. External funding opportunities could be sought to provide more extensive educational resources.
Consistency with Plan Objectives	Consistent with the objectives of this plan: • To increase community understanding and appreciation of the essential ecological role of flying-foxes and the need for conservation efforts; and • To develop information management strategies to ensure community access to accurate and up to date information relating to perceived health risks.

13. Vacate role as trustee

Criteria	Suitability Assessment
Legislative Implications	Under Section 50 of the <i>Land Act</i> , Council can vacate its role as trustee by forwarding signed notice of resignation to the Minister. Section 50 imposes no registration requirement analogous to that contained in Section 51 concerning a removal of trustee.
Animal Welfare	No direct animal welfare implications associated with this action.
Community Concerns	The loss of Council managed open space may be viewed as an unacceptable outcome by the community.
Likelihood of Success	May provide short term relief of responsibility at some locations but will not provide a sustainable solution to the issue.
Strengths	Would shift Council's responsibility for flying-fox management on trustee land to the State government.
Weaknesses	• May present Council in poor light if community perceives it has abandoned its responsibilities; and • Not all problematic colonies are located on trustee land (e.g Cassia is freehold) so Council will still need to develop flying-fox management strategies.
Cost	Nil cost associated with this action. Cost benefit if it results in absolution of Council responsibility.

Criteria	Suitability Assessment
Consistency with Plan Objectives	Not consistent with Plan's objectives.

14. Enhance habitat at existing low conflict roosts

Criteria	Suitability Assessment
Legislative Implications	No legislative implications.
Animal Welfare	Positive impact on animal welfare through habitat improvement.
Community Concerns	Likely to receive community support if it results in flying-foxes remaining in low conflict areas.
Likelihood of Success	Flying-foxes are mobile by nature and there is no guarantee that a colony will stay at any given location. Flying-fox colonies have been known to occupy areas of replanted or regrown forests in places such as northern NSW (C Catterall pers comm.).
Strengths	• If successful, colony will remain in a low conflict area; • Will benefit a range of other native species in addition to flying-foxes; and • Proactive management likely to be well received by the community.
Weaknesses	• No guarantee of success; • Only relevant for the two low conflict sites.
Cost	Minimal cost associated with higher service level.
Consistency with Plan Objectives	Consistent with the following Plan objectives: • To develop flying-fox strategies consistent with legislative obligations; • To identify and prevent future residential/flying-fox land user conflict where possible; and • To develop achievable flying-fox conservation strategies to protect the three species found in the Sunshine Coast local government area.

Appendix 8: Case studies

Duaringa - 2012

Cost \$150,000

Damage mitigation permit granted to disperse 200,000-300,000 Little red flying-foxes. The colony had been present in the center of town spread over a small number of private urban backyards and a small council park for a period of seven months.

Drastic habitat modifications occurred over 5 nights with 60% of vegetation modified on the first night. Returning flying-foxes flew around confused for around 2 hours then crammed into remaining 40% of the original vegetation and into some nearby residential trees.

On Day 2 tree lopping resumed immediately after fly-out (approx. 7pm) and continued through to 3am. Smoke, gas guns and lights were also introduced from Day 2. Flying foxes finally moved 600m east of roost to an abandoned Council depot site.

The smoke machine produced an odour similar to burning timber, which is a natural deterrent for flying-foxes. Gas guns were also thought to be a crucial component. Both were used during the day to disturb roosting.

Gold Coast - 2011

Cost \$250,000 - \$300,000, which included:

- Consultant fees before and after (Ecosure);
- Vegetation removal 80-90%; and
- Monthly monitoring post dispersal.

This project involved the dispersal of approximately 1,000 GHFF and BFFs from Gold Market Park Reserve, which adjoined the Gold Coast Equine Precinct. The property size was 4 ha but only a portion of the vegetation on the property was cleared. Flying-foxes began to abandon the site when 70% of understory and 30% of canopy were removed.

Gold Coast Council has spent \$500,000 in last 12 months on flying-fox issues and have recently authorised application for a DMP to disperse another colony on private and crown land.

Mackay Regional Council - 2009

Cost approx. \$45,000

Council undertook the dispersal of approximately 6,000 BFFs, primarily on one residential property at 20 Mill Street, North Eton (5,000 FFs on one 3,800m block). Numbers had fluctuated on the site between 0-10,000 for a period of 7 years.

Dispersal was originally undertaken over four days and nights and involved tree lopping, smoke machines, spraying with tea tree/eucalypt extracts, noise from fogging machines and Birdfrite and intense lighting from strategically placed flood lights. Works were undertaken for a period of 10 days, with tree trimming on the first 2 nights followed up with the disturbance techniques outlined above.

In April 2010 a new DMP was approved to disperse 1,000 flying-foxes that had settled at an alternate suitable roost site 2km from the original dispersal site in Mill Street.

In May 2010, 600 flying-foxes returned to crown land in Mill Street after the satisfactory alternative roost site mentioned above reached 3,000 before being abandoned. During 26 - 28 May intense lighting and fogging commenced, but resulted in little dispersal success.

In June 2010 approval was given to trim mango trees on crown land after fly out. After flying-foxes left of their own accord the mango trees were trimmed to prevent establishment if they returned.

To date, flying-foxes have not returned but there is no guarantee of long term success. In this instance Mackay Council officers believe habitat modifications to be the key to success.

Melbourne Botanical Gardens - 2003

Cost approx. \$2.5 - \$3m

Dispersal of approximately 28,000 GHFF was finally achieved after repeated attempts to disperse flying-foxes to protect iconic vegetation at the Gardens.

A site was prepared at Horseshoe Bend with a plan to relocate the colony from the Royal Botanic Gardens through a combination of two outcomes: scaring them from the Gardens using sound, and attracting to Horseshoe Bend through habitat enhancement. A total of \$110,000 spent on habitat restoration at Horseshoe Bend.

After repeated attempts, dispersal was eventually successful but the colony settled at Yarra Bend, not Horseshoe Bend. The City of Melbourne has allocated \$1.7m (over 5 years) for the implementation of the Yarra Bend Management Plan aimed at consolidating the site to keep the colony in place.

Maclean Rainforest Reserve - 1999

Cost \$750,000+

Approximately 10,000-20,000 GHFF, BFF and LRFFs were dispersed through noise from a variety of sources for short periods of time first before dawn and dusk. Ongoing dispersal efforts were undertaken another 20 times in the following 6 years. Prior to the dispersal, the roost had been occupied since at least 1890.



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