ecosure

Wallace Park flying-fox roost

Management options report
October 2015

Noosa Council

ecology / vegetation / wildlife / aquatic ecology / GIS

Executive summary

Noosa Council engaged Ecosure to develop a management options report for a flying-fox roost at Wallace Park, Noosaville.

The roost was first officially recorded and counted in 2013, although anecdotal records date back much further. The roost has been used consistently by grey-headed (*Pteropus poliocephalus*) and/or black flying-foxes (*P. alecto*), with seasonal influxes of the little red flying-fox (*P. scapulatus*). The roost generally fluctuates from several hundred to 31,000 individuals, however peaked at almost 468,000 with a large influx of little red flying-foxes in February 2014.

Council has received a number of complaints from residents and businesses in relation to the roost, reporting primarily amenity and financial impacts, and to some extent fear of disease.

In addition to Council and nearby landholders, there are a number of other stakeholders with a keen interest in the park and flying-fox roost. These stakeholders have also been consulted and will be considered in future management.

The roost is considered to be of national importance for the threatened grey-headed flying-fox in accordance with Commonwealth policy. There are also a range of other ecological values of the site, and associated relevant legislation.

To inform and assist the community Council has developed a flying-fox fact sheet, consulted with neighbouring residents and businesses, and created buffers through selective vegetation trimming/removal.

Ecosure assessed a range of management options for this site, including:

- education
- general mitigation measures for private land managers such as managing flying-fox attractants, modifying properties and creating buffers/barriers
- creating buffers between private properties and roosting flying-foxes
- 'nudging' flying-foxes away from high conflict areas using low intensity disturbance
- using planning instruments to avoid future land use conflict
- dispersal.

There are a range of potential risks that are greatly increased with active dispersal (compared with managing a roost in-situ). These include:

- impacts on animal welfare and flying-fox conservation
- increased aircraft strike risk associated with changed flying-fox movement patterns
- splintering the roost into other locations that are equally or more problematic

- shifting the issue to another area
- impact on habitat value
- effects on the flying-fox population, including disease status and associated public health risk
- impacts to nearby residents associated with ongoing dispersal attempts
- excessive initial and/or ongoing resource and financial investment
- negative public perception and backlash
- unsuccessful management requiring multiple attempts, which may exacerbate all of the above.

In addition to risks detailed above, dispersal activities at this location are likely to:

- disrupt residents (including potential health impacts associated with smoke, which is a key dispersal tool)
- stress noise-phobic pets
- increase flying-fox vocalising during the day
- result in trampling damage to the understorey.

The potential cost of dispersal from Wallace Park is compounded by difficulties accessing the site given that it is often waterlogged. Further there a number of ecological and legislative constraints associated with this site as detailed within.

In summary, dispersals are costly, require ongoing commitment and maintenance, are often not entirely successful, and rarely result in desirable outcomes for all stakeholders.

Ecosure preliminarily assessed the risk associated with the roost in its current location, and the site-specific risks associated with dispersing the roost. It was found that all risks (and amenity impacts) associated with the roost can be managed to an acceptably low level through in-situ management. However, despite careful planning and controls, many risks associated with dispersal remain at high and extreme.

Given the above we recommend against dispersal, and suggest management options in the table below to reduce community impacts.

Mitigation type	Recommendation	Responsible
General	Consider all options in Section 4.1.2, and low impact activities outlined in the Qld Low Impact Code of Practice (Section 3.3).	Land owners
Monitoring	Continue to monitor flying-foxes at Wallace Park and surrounds.	Council and the Department of Environment and Heritage Protection
Education	Continue consulting with residents and providing educational material. This roost would be ideal for educational signage (and a potential viewing area), and information could also be distributed from the library.	Council
	Consider educational signage at the bowls club explaining there are no known risks of lyssavirus/Hendra virus from contacting flying-fox excrement, and continue general hygiene practices (including ongoing provision of hand sanitising gel).	Bowls club
Buffers	Create buffers through selective tree trimming/removal and deterrents. It is recommended that buffers of up to 10m from property boundaries be established through selective trimming/removal, with the aim of retaining mature trees. Deterrents listed in Section 4.1.3 could then be used to create an additional 15m buffer from high conflict areas. Proposed buffer areas are shown on Figure 5. A detailed plan should be developed prior to works to manage risks of management detailed in Section 5.2. Additional considerations include: · approvals may be required for management that may impact on values detailed in Section 3.1 · offset planting for all native species removed should be considered as per best practice guidelines · connectivity for other fauna should be retained between contiguous habitat · a fauna and flora survey is required prior to buffer works to avoid impacting key fauna habitat (i.e. hollows) or rare plants, and a fauna spotter catcher should be present during trimming/clearing works.	Council
	Council should liaise with the hospital to determine if a buffer is required on the south-western edge of the maximum roost extent. If it is required, works could potentially be done by the hospital under Council's as-of-right authority.	Noosa Hospital
General	The bowls club, in partnership with Council, may consider assessing the feasibility of a trial to reduce fly-out impacts using deterrents (i.e. wires/netting/flagging etc.) to potentially redirect some fly-over. Grant funding may be available from various sources, including through the State initiative 'Get Playing Spaces and Places – funding to improve facilities'. More information for this grant can be found at http://www.qld.gov.au/recreation/sports/funding/getinthegame/getplaying/. If found to be successful, it may provide a useful management option for other residents that are being severely impacted by faecal drop.	Bowls club and Council
Subsidies/funding assistance	Investigate grant opportunities that may be available to residents and businesses around the roost to assist with general mitigation measures (i.e. seat covers and alternatives to shade cloth awnings for outdoor furniture).	Council and land owners
Aircraft strike management	Ensure the hospital and private airstrip are aware of large influxes of flying-foxes, and any management that may alter flying-fox behaviour/movements, so that pilots can respond to increased strike risk.	Council
	Dawn and dusk flights should be avoided wherever possible, and if required by the hospital, helicopters should be diverted and patient transfer done by ambulance.	Noosa Hospital and private airstrip

Mitigation type	Recommendation	Responsible
Planning instruments to avoid future impacts	Consider adequate buffers and other planning provisions for new developments neighbouring Wallace Park.	Council
Alternative habitat	Encourage re-establishment of the Goat Island roost through limiting disturbance around the island where possible.	Council

Acknowledgements

Ecosure would like to thank Noosa Council for assistance in project planning and background, including providing historical data. We also appreciate historical data provided by the Department of Environment and Heritage Protection, and knowledge shared by members of the Noosa Parks Association, Ringtail Creek Flying-fox Sanctuary and Flying-fox Rescue and Release Noosa Inc. We also gratefully acknowledge initial feedback from a number of residents and businesses.

Acronyms and abbreviations

ABLV	Australian Bat Lyssavirus
BFF	Black flying-fox (*Pteropus alecto*)
CPM Act	Queensland *Coastal Protection and Management Act 1995*
COP	Code of practice
Council	Noosa Council
DoE	Department of the Environment (Commonwealth)
DSDIP	Department of State Development, Infrastructure and Planning
EHP	Department of Environment and Heritage Protection (Queensland)
EP Act	Queensland *Environmental Protection Act 1994*
EPBC Act	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
EVNT	Endangered, Vulnerable or Near Threatened
GHFF	Grey-headed flying-fox (*P. poliocephalus*)
HeV	Hendra virus
LGA	Local government area
LRFF	Little red flying-fox (*P. scapulatus*)
MNES	Matters of National Environmental Significance
MSES	Matters of State Environmental Significance
NC Act	Queensland *Nature Conservation Act 1992*
NICA	Noosa Integrated Catchment Association
NSW	New South Wales
QLD	Queensland
SEQ	South-east Queensland
SFF	Spectacled flying-fox (*P. conspicillatus*)
SPP	Queensland State Planning Policy 2/10 Koala Conservation in South East Queensland
SPRP	South East Queensland Koala Conservation State Planning Regulatory Provisions
VM Act	Queensland *Vegetation Management Act 1999*

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Noosa Council[1] engaged Ecosure to develop a management options report for a flying-fox roost at Wallace Park, Noosaville[2].

This roost was first officially recorded and counted in 2013, although anecdotal records date back much further. All three flying-fox species found in South East Queensland have been known to use the roost: grey-headed (*Pteropus poliocephalus*) (GHFF) and/or black flying-foxes (*P. alecto*) (BFF) have occupied the roost during every monitoring event since it was first counted, with seasonal influxes of the little red flying-fox (*P. scapulatus*) (LRFF). The roost generally fluctuates from several hundred to 31,000 individuals. However, an influx of an estimated 465,000 LRFF in February 2014 saw numbers peak at almost 468,000.

Council has received a number of complaints from residents and businesses surrounding the park in relation to the roost, reporting primarily amenity and financial impacts, and to some extent fear of disease.

In addition to Council, there are a number of stakeholders with a keen interest in the site and flying-fox roost. These stakeholders include:

- surrounding residents
- surrounding businesses, including the bowling club, resort and hospital
- Noosa Parks Association (NPA), including the NPA Botany Group and Bird Observers Group
- Noosa Integrated Catchment Association (NICA)
- Wallace Park Bushland Care Association
- Bat Rescue Inc.
- Flying-fox Rescue and Release Noosa Inc.
- Ringtail Creek Flying-fox Sanctuary.

Ecosure assessed the site on 26th August 2015. This assessment focused on identifying the roost extent at the time, traversing the site, and initial consultation with a small number of residents and some of the above stakeholders. An additional visit on 17th September provided further detail on roost size (i.e. number of flying-fox) and species composition.

[1] Herein referred to as 'Council'
[2] Herein referred to as the 'site'

2 Wallace Park roost description

2.1 Site location and description

Wallace Park is located approximately 1.2 km to the west of the township of Noosaville on the Sunshine Coast (see Figure 1).

The site is a mix of Council-managed reserve and free-hold land (including Noosa Leisure Centre and Library), and is surrounded by residential properties, a bowls club and resort to the north, and Noosa Hospital to the south-west.

The current and historical flying-fox roost extents and other ecological values, which are discussed in detail in Sections 2.2 and 3, are also shown on Figure 1.

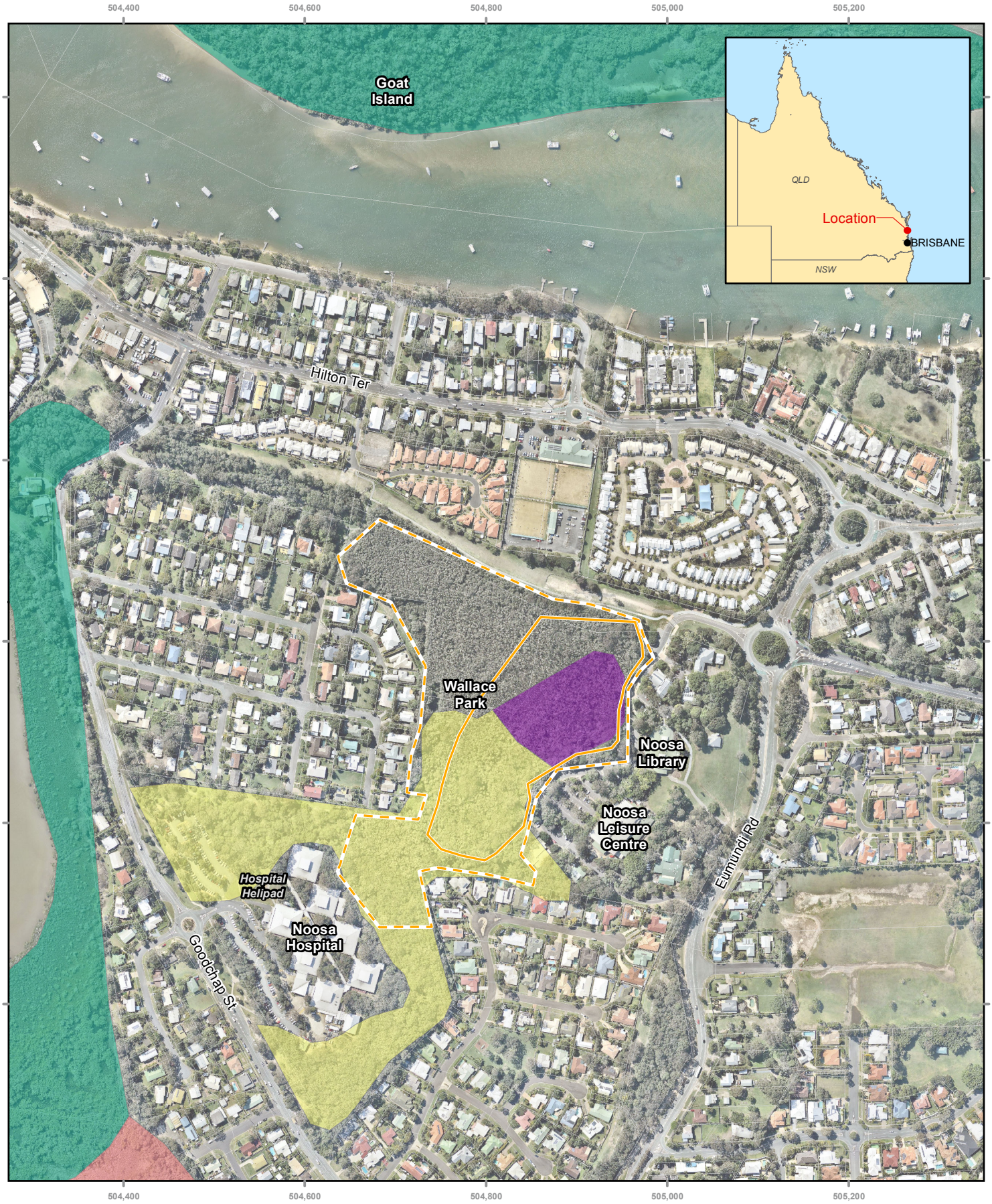

Figure 1: Site location and values

Noosa Council

Flying-fox management options report

Cadastral boundaries

Roost extent as at August 2015

Approximate maximum roost extents combined across counts

(see Section 3.4 for further detail)

Remnant vegetation

- 12.1.2
- 12.1.3/12.1.1
- 12.2.7
- 12.9-10.4

ecosure

Job number: PR1165
Revision: 2
Author: MED
Date: 08/12/2015

0 25 50 100
Metres

GDA 1994 MGA Zone 56
Projection: Transverse Mercator
Datum: GDA 1994
Units: Meter

2.2 Historical flying-fox use

The approximate flying-fox roost extent during the August 2015 site assessment, along with the approximate maximum extent, as determined by previous EHP/Council surveys and by resident accounts are shown on Figure 1.

Figure 2 shows a collation of available data for the site.

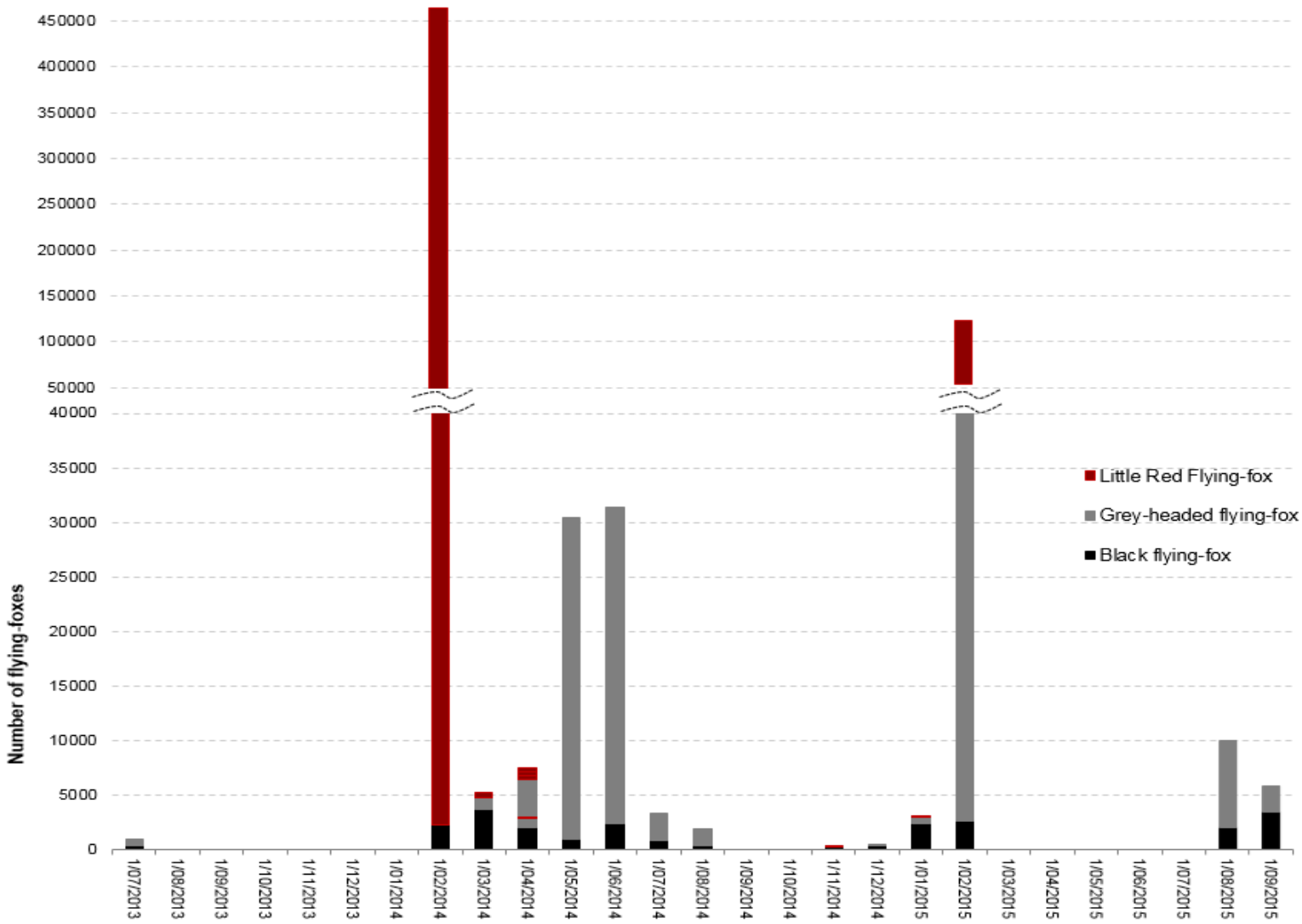

Figure 2 Historical flying-fox data. Data sources: Noosa Council, EHP and Ecosure. Note the break in the graph showing an influx of LRFF February 2014 and 2015.

Figure 3 shows a comparison of data from Wallace Park and two nearby roosts that flying-foxes reportedly move between. These data are combined GHFF and BFF records, and where more than one count was conducted in a single month, data was averaged for ease of comparison. LRFF counts that have been excluded from the graph are highly sporadic, and no correlation was evident. It should be noted that LRFF have never been recorded on Goat Island. While there are several considerable gaps in the data, it is evident that flying-foxes use Weyba Road less commonly, and were absent from Goat Island during 2014 monitoring. This suggests that Wallace Park is now the preferred roost site in the area.

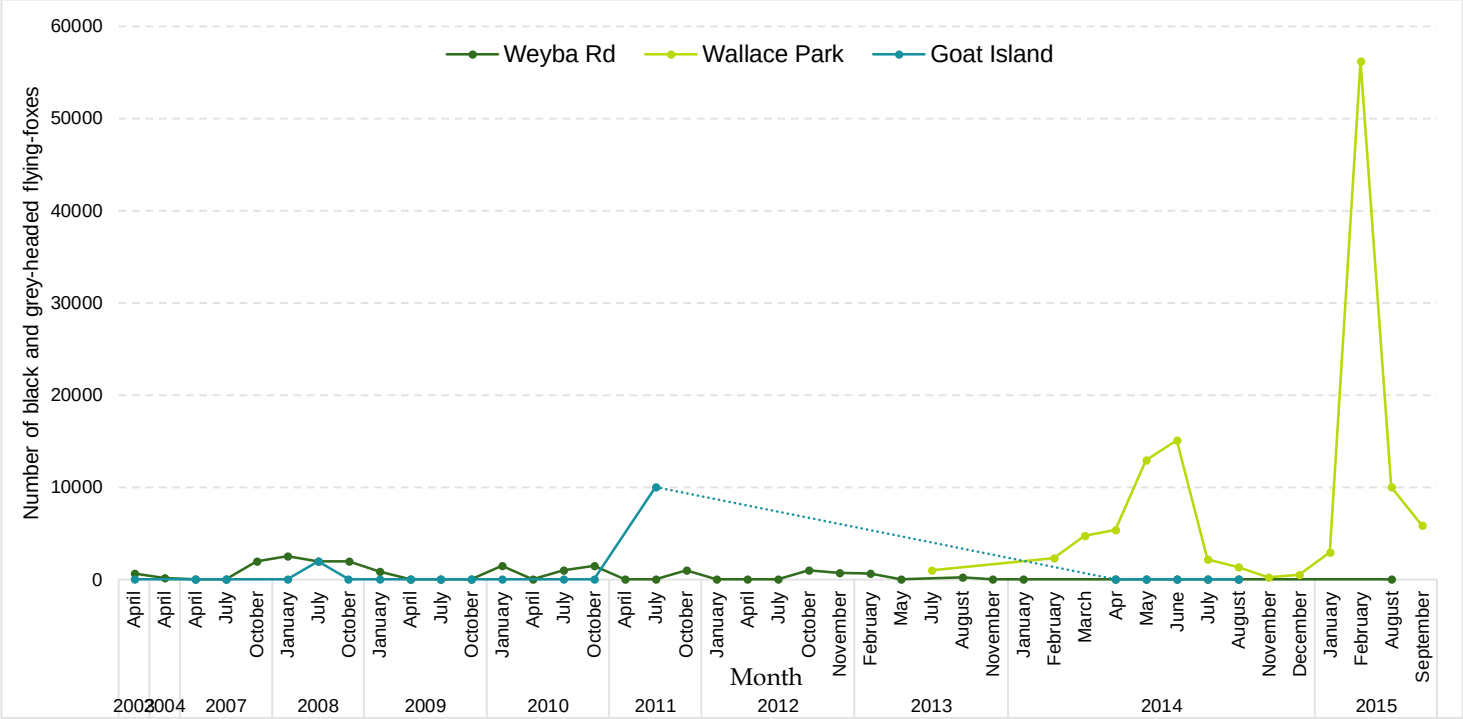

Figure 3 Comparison of nearby roosts that are anecdotally correlated. The dotted line represents a large gap in available data for Goat Island. Data sources: Noosa Council, EHP and Ecosure.

2.3 Community impacts

Noise, smell and faecal drop were the primary causes of concern reported to Ecosure during initial consultation.

Residents reported a lack of sleep and associated impacts on their well-being, as well as a loss of amenity (especially in outdoor areas). Residents are most impacted during periods of large influxes, and seasonally when flying-foxes are reported to shift to the eastern side of the park (assumedly in response to prevailing weather conditions).

Feacal drop from fly-in and fly-out and the associated financial burdens of cleaning and replacing outdoor furnishings, were also a concern for both residents and the nearby bowling club.

There was also one concerned resident unwilling to use an installed rainwater tank with fear

of disease, and others concerned about faecal drop into swimming pools.

The bowls club is significantly impacted by faecal mess from transiting animals, estimating that one hour per day is required to clean outdoor areas, as well as staining and/or permanent damage to shade sails that require replacement. Faecal mess on the bowling greens also raises concern for patrons, with fear of hygiene/disease risk associated with potential transfer to bowling balls.

There is also potential for the roost to impact on the nearby Noosa Hospital, particularly during periods of large influxes. Vegetation surrounding the hospital is less favoured by roosting flying-foxes; however, during large influxes they have been known to spill over into this area. Most importantly for the hospital is the potential strike risk to emergency helicopters. See Sections 4.1.6 and 5.

2.4 Previous management activities

Council has developed a flying-fox fact sheet (linked in References and Further Reading) and has had ongoing discussions with neighbouring residents and businesses.

Council has also selectively removed and trimmed trees at the western edge of the site to make less attractive habitat to roosting flying-foxes immediately adjacent to residents. Although this has been helpful, further vegetation management is likely to be required.

3 Legislative framework

3.1 Ecological values

A summary of legislated ecological values of the site are found in Table 1; however, additional permits/approvals may be required for management that may impact on these values.

Legislation specific to general flying-fox management is discussed in further detail in the remainder of Section 3.

Table 1 Ecological values summary

Source	Value
Commonwealth	
EPBC Protected Matters Report (0.2km search)	25 species listed as threatened and 13 migratory species under the EPBC Act may occur within 0.2 km of the project area. One threatened ecological community listed as critically endangered under the EPBC Act may occur within 0.2 km of the project area.
Other EPBC matters	The roost has contained >10,000 GHFF in two months in 2014, so meets the first criteria for a nationally important roost. Therefore any management activity will need to be in accordance with the *Referral guideline for management actions in GHFF and SFF camps*, and some activities may require referral to the Department of the Environment.
State	
Essential habitat	The park contains mapped Essential habitat.
Koala mapping	The site contains medium and low value bushland habitat under the Queensland State Planning Policy 2/10 Koala Conservation in South East Queensland (SPP). The site is outside the South-east Queensland Koala Conservation State Planning Regulatory Provisions (SPRP) assessable development area.
Regional Ecosystem mapping	Vegetation being used by the roost is a mix of 12.9-10.4 (*Eucalyptus racemosa subsp. racemose* woodland on sedimentary rocks) and 12.2.7 (*Melaleuca quinquenervia*) which are listed as Least Concern under the *Vegetation Management Act 1999.*
Regrowth	There is no regrowth vegetation mapped within the study site.
South East Queensland (SEQ) Biodiversity Planning Assessment (BPA)	The park contains areas of mapped state habitat for EVNT taxa and is mapped as having regional biodiversity significance. The park is located within both state and regional corridors.
Wildlife Online database (1 km search)	133 species listed under the NC Act have been recorded within 1 km of the study site. This includes two species listed as vulnerable, one near threatened and 17 special least concern species listed under the NC Act.
NC Act high priority vegetation	The site is mapped as Category B remnant vegetation under the protected plants flora survey trigger area (i.e. this is considered to be a high risk area). This means that before any vegetation can be removed, the area will require a flora survey and may need a clearing permit.
Referable wetland	Not mapped as a referable under the *Environmental Protection Act 1994 (EP Act).*
Coastal area	Not mapped as a coastal management area under the *Coastal Protection and Management Act 1995 (CPM Act)* but a section of the park is mapped as a coastal hazard area- medium storm tide inundation area.
Other Matters of State Environmental Significance (MSES)	The site is mapped as wildlife habitat and as having regulated vegetation.
Local	
Planning Scheme	The site is mapped as Environmental Protection under the Council Biodiversity overlay, as is RE 12.2.7, and is located within the 100y flood inundation zone. The park contains records of six glossy-black cockatoo sightings.

3.2 Local

Local government agencies are required to prepare planning schemes consistent with Queensland Planning Provisions under the *Sustainable Planning Act 2009*.

Planning schemes enable an LGA to manage growth and change in their local government area through land use and administrative definitions, zones, overlays, infrastructure planning provisions, assessment codes and other administrative matters. A planning scheme identifies the kind of development requiring approval, as well as areas that constrain the use of land due to its environmental value.

In relation to bushland reserve management, Council is exempt under the Noosa Plan for works such as vegetation maintenance. There are no provisions in the Noosa Plan for flying fox separation buffers between developments and flying fox colonies. Private landholders are able to trim native vegetation on their land, but may be restricted when it comes to removing vegetation. Landholders can contact Council to enquire about vegetation protection on their property.

3.3 Queensland

As native species, all flying-foxes and their habitat are protected under the *Nature Conservation Act 1992* (NC Act). The NC Act is administered by the Department of Environment and Heritage Protection (EHP).

Local government has an 'as-of-right' authority in defined urban areas to do the following, provided that activities are in accordance with the Code of Practice for the Ecologically Sustainable Management of Flying-fox Roosts (2013a):

- destroy a flying-fox roost
- drive away, or attempt to drive away, a flying-fox from a flying-fox roost, and
- disturb a flying-fox in a flying-fox roost.

Another Code of Practice (COP) (for Low Impact Activities Affecting Flying-fox Roosts' (EHP 2013b)) describes how a land owner/manager may undertake low impact activities at a flying-fox roost. Relevant low impact activities include mulching, mowing or weeding under or near roost trees, and/or minor trimming of roost trees. These activities must not be directed at destroying a flying-fox roost, driving away, or attempting to drive away, a flying-fox from a flying-fox roost, or disturbing a flying-fox in a flying-fox roost.

The low impact COP outlines the following restrictions for activities undertaken by private landowners:

- No roost tree may be trimmed when there are flying-foxes in that part of the tree being trimmed, or when flying-foxes are near to the tree and likely to be harmed as a result of the trimming.
- Any trimming of roost trees must be limited to 10% of the total canopy occupied by the roost (not 10% of the whole tree's canopy).

- Low impact activities must immediately cease, and EHP be immediately notified, if a flying-fox appears to have been killed or injured.
- Where low impact activities are required to be undertaken during the day time, works must immediately cease and EHP be immediately notified if 30% or more of the adult flying-foxes leave the roost for five minutes or more.

It is important to note that neither COP provides exemptions to other legislation and provisions that are likely to be relevant to flying-fox management activities, such as the Queensland *Vegetation Management Act 1999*, *Fisheries Act 1994*, the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and various state and local planning provisions. They also do not provide exemptions for all vegetation under the NC Act.

3.4 Commonwealth

The GHFF is listed as a vulnerable species under the EPBC Act, meaning it is considered to be a matter of national environmental significance (MNES).

A referral to the Australian Department of the Environment (DoE) may be required under the EPBC Act for any action that has the potential to significantly impact on a MNES.

The *Referral guideline for management actions in GHFF and SFF[3] camps* (DoE 2015) defines a nationally important GHFF camp as those that have either:

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

As detailed in Table 1, the Wallace Park roost meets the first criteria and is considered a nationally important camp. As such, provided that management follows the below mitigation standards as outlined in the referral guideline, referral to the DoE will not be required for activities recommended in Section 6.

Mitigation standards

- The action must not occur if the camp contains females that are in the late stages of pregnancy or have dependent young that cannot fly on their own.
- The action must not occur during or immediately after climatic extremes (heat stress event[4], cyclone event[5]), or during a period of significant food stress[6].
- Disturbance must be carried out using non-lethal means, such as acoustic, visual and/or physical[5] disturbance or use of smoke.

[3] Spectacled flying-fox (*P. conspicillatus*)

[4] A 'heat stress event' is defined for the purposes of this document as a day on which the maximum temperature does (or is predicted to) meet or exceed 38°C.

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

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

- Disturbance activities must be limited to a maximum of 2.5 hours in any 12 hour period, preferably at or before sunrise or at sunset.
- Trees are not felled, lopped or have large branches removed when flying-foxes are in or near to a tree and likely to be harmed.
- The action must be supervised by a person with knowledge and experience relevant to the management of flying-foxes and their habitat, who can identify dependent young and is aware of climatic extremes and food stress events. This person must make an assessment of the relevant conditions and advise the proponent whether the activity can go ahead consistent with these standards.
- The action must not involve the clearing of all vegetation supporting a nationally-important flying-fox camp. Sufficient vegetation must be retained to support the maximum number of flying-foxes ever recorded in the camp of interest.

As noted in Figures 1 and 2, the maximum roost extent shown is the combined total area ever occupied across monitoring events, rather than during any single count. The maximum extent on any one survey was approximately half the maximum area shown, and therefore buffer works will not risk insufficient vegetation being available for the maximum number of flying-foxes ever recorded. Further, if the extent of the maximum number of GHFF/BFF (31,450 total, June 2014) was combined with the extent of the maximum LRFF/BFF count (467,074 total February 2014) (should these separate peaks coincide in the future), there would be sufficient habitat available without the proposed buffer area. Maps showing these extents are available with appropriate data permissions if required.

4 Available management options

Options for management involve either mitigation or dispersal, or both. Mitigation aims to reduce amenity impacts to residents while flying-foxes remain at the roost, whereas dispersal aims to non-lethally disperse the population from the site to more suitable location(s).

4.1 Mitigation

4.1.1 Education

Engaging and educating people is key to ensuring the community understands the ecological importance of flying-foxes, the actual health risks, and options available to reduce impacts associated with roosting and foraging flying-foxes. Collecting and providing information should always be the first response to community concerns, and should be a key component of any approach.

Residents should be made aware that faecal drop and noise at night are mainly associated with foraging flying-foxes. There are a number of things that landholders can do to reduce these impacts (see Section 4.1.2).

Residents should also be provided with disease risk information, some of which is included below.

Australian Bat Lyssavirus

Australian Bat Lyssavirus (ABLV) is a rabies-like virus found in the four common species of flying-fox. Advice from Queensland Health is that the risk of becoming infected with ABLV is very low (Queensland Health 2015).

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

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

The disease in humans can easily be prevented by avoiding direct contact with bats. Pre and post-exposure vaccinations are also available that will prevent the disease.

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

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

If bat saliva gets into a mucous membrane or open wound, flush thoroughly with water and seek immediate medical advice.

Hendra Virus

Flying-foxes are the natural host for Hendra Virus (HeV), which can be transmitted from flying-foxes to horses. Infected horses sometimes amplify the virus and can then transmit it to other horses, humans and on two occasions dogs. There is no evidence that the virus can be passed directly from flying-foxes to humans (or dogs) (Queensland Health 2015). Although the virus is periodically present in flying-fox populations across Australia, the likelihood of horses becoming infected is low and consequently human infection is extremely rare. Horses are thought to contract the disease after ingesting forage or water contaminated with flying-fox urine, saliva or birthing fluids. Humans contract the disease after close contact with an infected horse. HeV infection in humans is a serious and often fatal disease and there is currently no effective post-exposure treatment or vaccine available for people. The mortality rate of unvaccinated infected horses is approximately 75% (Department of Agriculture and Fisheries ({DAFF} 2013a). Vaccination of horses can protect horses and subsequently humans from infection (DAFF 2013a).

Water supply contamination

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

Pool contamination

The World Health Organisation guidelines for safe recreational water environments (i.e. recreational swimming pools) considers contamination of pool water from animal faeces a low risk to the public (WHO 2006). The only pathogenic bacteria potentially linked directly to animal faeces found in swimming pools is *Leptospira spp*. (cause of Leptospirosis). Flying-fox are known to carry this bacteria and shed it in their urine (Cox et al, 2005). According to the guidelines outbreak of Leptospirosis from swimming pools is extremely rare and can be prevented by maintaining adequate disinfectant concentrations (e.g. chlorine). Escherichia coli contamination of pools could potentially lead to infections in people but known outbreaks of disease caused by E. coli in swimming pools (as opposed to still natural pools) have been linked to people shedding the bacteria in the pool rather than through contamination from animal faeces (WHO 2006). Further, chemical treatment and filtration of pool water should prevent infections. There is no evidence to suggest that there is any risk from Lyssavirus or Hendra virus from flying-foxes defecating or urinating in pools. Lyssavirus is transmitted

through infected saliva or bodily fluids (not urine or faeces) and it does not survive outside of an infected animal for more than a few hours (NSW Health, nd). Hendra virus also has a short life outside of the host and infection is only known through infected horses (Queensland Government, 2014).

WHO (2006) Guidelines for safe recreational water environments Volume 2: swimming pools and similar environments. World Health Organisation. URL: http://www.who.int/water_sanitation_health/bathing/srwe2full.pdf.

4.1.2 General mitigation measures

Residents and neighbouring land managers should consider the following measures to minimise impacts from roosting and foraging flying-foxes:

- manage foraging trees (i.e. plants that produce fruit/nectar-exuding flowers) within properties through pruning/covering (with bags or wildlife friendly netting)/early removal of fruit/tree replacement to reduce attracting flying-foxes to your property
- cover vehicles, structures and clothes lines where faecal contamination is an issue, or remove washing from the line before dawn/dusk
- move or cover eating areas (i.e. BBQs and tables) within close proximity to a roost or foraging tree to avoid contamination by flying-foxes
- install double-glazed windows, insulation and use air-conditioners when needed to reduce noise disturbance and smell associated with a nearby roost
- vaccinate horses against HeV, follow husbandry and property management guidelines in the Hendra virus information pack for horse owners (DAFF 2013b)
- include suitable buffers and other provisions (i.e. covered car parks) in planning of new developments
- avoid disturbing flying-foxes during the day which will increase roost noise
- turn off lighting at night (i.e. floodlights around the bowling club) which may assist flying-fox navigation and increase fly-over impacts
- consider removable covers for swimming pools and ensure working filter and regular chlorine treatment (see Section 4.1.1)
- create visual/sound/smell barriers with fencing or hedges. To avoid attracting flying-foxes, species selected for hedging should not produce edible fruit or nectar-exuding flowers, should grow in dense formation between two and five metres (Roberts 2006) (or be maintained at less than 5 m). Potentially suitable native species include *Hovea acutifolia, Westringia fruticosa, Pultenaea villosa, Dodonaea viscosa* and *Jacksonia scoparia*.

While there has been no trial to our knowledge, Council may consider a feasibility study on wires/netting/flagging/other deterrents with the aim of somewhat directing or reducing fly-over.

Opportunities for funding assistance could be investigated for these type of management activities through environment and other local/state grants.

4.1.3 Buffers

A buffer of 300 m from a flying-fox roost is considered ideal, however smell and noise impacts are reduced with a buffer of 50 m (SEQ Catchments 2012).

Buffers can be created through vegetation removal, installation of permanent/semi-permanent deterrents, 'nudging' flying-foxes from conflict areas using low intensity disturbance, or by using a combination of these methods.

Buffers through habitat modification

Removing vegetation in high conflict areas can alter the habitat so it is no longer suitable for roosting animals. The amount of vegetation removal needed varies between sites and particular roosts; it may be as little as removing a weedy understorey to alter the microclimate, selectively trimming roost trees, or in some instances can require the removal of more than 90% of the canopy.

Any vegetation removal should be done using a staged approach, with the aim of removing as little native vegetation as possible. This is of particular importance at this site given its high ecological value. Thorough site assessment will inform whether vegetation management is suitable (i.e. can impacts to other wildlife and/or the community be avoided).

Loss of under and midstorey vegetation may increase flying-fox mortality during heat stress events (which are common in summer). Aside from obvious welfare and conservation impacts associated with increased mortality, flying-fox mortality will also impact surrounding residents (i.e. smell) which should be considered when planning habitat modification.

Buffers with deterrents

Permanent/semi-permanent deterrents may be installed to deter flying-foxes from a designated buffer area. Many deterrents have been trialled in the past with limited success, however several options are worthy of further investigation:

- Canopy-mounted water sprinklers – this method has been highly effective in deterring flying-foxes from certain roost trees during dispersal (Ecosure personal experience), and is the most likely to be successful. This option would be logistically difficult (installation and water sourcing) and may be cost prohibitive, however is considered worthy of a trial.
- Python excrement – bagged snake excrement hung in trees has previously had localised effects. Logistical issues associated with sourcing and regularly applying large amounts of snake excrement would need to be overcome. The smell of large amounts may also impact nearby residents. There is also the potential for flying-foxes to habituate to this deterrent.
- Visual deterrents – visual deterrents, such as plastic bags, fluoro vests and balloons (Ecosure personal experience) in roost trees have been shown to have localised

effects (i.e. with flying-foxes avoiding roosting within 1-10 m). The type and placement of visual deterrents would need to be varied regularly to avoid habituation.

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

4.1.4 Nudging

Noise and other low intensity disturbance restricted to certain areas of the roost can be used to 'nudge' flying-foxes away from high conflict areas. This technique aims to make high conflict areas (i.e. buffers) less attractive for roosting flying-foxes, while allowing them to remain in other areas of the roost.

Nudging should not generally be conducted early in the morning as this will most likely lead to inadvertent dispersal of flying-foxes from the entire roost. It should rather be conducted during the daytime to encourage flying-foxes to move a small distance (i.e. 10 m) rather than leaving the roost. Daytime disturbance such as this is not permitted in the COP, and would require approval from EHP. Disturbance during the day should also be limited in frequency (i.e. twice per day or less, with regular rest days of no disturbance) to avoid welfare impacts. As with dispersal, it is also critical to avoid periods when dependent young are present (as identified by a suitably experienced person).

4.1.5 Using planning instruments to avoid future land use conflict

To avoid future land use conflict, planning instruments may be able to be used to ensure adequate distances are maintained between the roost and future residential developments.

The inclusion of a flying-fox overlay and supporting code in Noosa Plan may help alleviate future land use conflict. Future development could then be designed where possible to provide a buffer around existing roosts.

4.1.6 Aircraft strike management

The Queensland State Planning Policy 1/02 (Department of State Development, Infrastructure and Planning {DSDIP} 2014) defines the distance where flying-foxes may create a safety hazard for strategic airports as 13 km. This aligns with the National Airports Safeguarding Framework Guideline C – Produced by the Federal Department of Infrastructure and Transport.

Council should liaise closely with managers of any airport or airstrip within this proximity, particularly private airstrip to the south-east, regarding flying-fox activity and management that may affect flying-fox movement patterns in the short or long-term.

Council has consulted hospital managers on this strike risk for emergency helicopters, and it is regarded as low and manageable given there are very few flights at dawn/dusk (fly-in/fly-

out), and if required the helicopter can divert and an ambulance used for patient transfer. Pilots should be aware of large influxes, or if flying-foxes are roosting in close proximity to the flight path, as disturbance causing flying-foxes to take flight will pose a risk at any time of the day.

4.2 Dispersal

There are a range of potential risks that are greatly increased with active dispersal (compared with in-situ management as above). These include:

- impact on animal welfare and flying-fox conservation
- increased aircraft strike risk associated with changed flying-fox movement patterns
- splintering the roost into other locations that are equally or more problematic
- shifting the issue to another area
- impact on habitat value
- effects on the flying-fox population, including disease status and associated public health risk
- impacts to nearby residents associated with ongoing dispersal attempts
- excessive initial and/or ongoing resource and financial investment
- negative public perception and backlash
- unsuccessful management requiring multiple attempts, which may exacerbate all of the above.

Successful dispersals generally require either:

1. substantial vegetation removal/modification that is likely to incur significant long-term ecological impacts on the roost area, and/or
2. sustained disturbance at the site and intensive monitoring, with subsequent additional and ideally simultaneous dispersal of splinter roosts that may form at undesirable locations.

Both of the above dispersal approaches are costly, require ongoing commitment and maintenance, are often not entirely successful, and rarely result in desirable outcomes for all stakeholders. For example, Roberts and Eby (2013) summarised 17 known flying-fox dispersals between 1990 and 2013, and made the following conclusions:

1. In all cases, dispersed animals did not abandon the local area[7].
2. In 16 of the 17 cases, dispersals did not reduce the number of flying-foxes in a local area.
3. Dispersed animals did not move far (in approx. 63% of cases the animals only moved <600m from the original site, contingent on the distribution of available vegetation). In 85% of cases, new camps were established nearby.

[7] Local area is defined as the area within a 20 km radius of the original site = typical feeding area of a flying-fox.

4. In all cases, it was not possible to predict where replacement camps would form.
5. Conflict was often not resolved. In 71% of cases conflict was still being reported either at the original site or within the local area years after the initial dispersal actions.
6. Repeat dispersal actions were generally required (all cases except extensive vegetation removal).
7. The financial costs of all dispersal attempts were high ranging from tens of thousands of dollars for vegetation removal to hundreds of thousands for active dispersals (e.g. using noise, smoke etc).

Flying-fox roosts are in a constant state of flux, with individual animals at the roost changing on a regular basis as they move around the landscape. For example, the Wallace Park historical counts peak at 467,412, however it may actually be used by a million or more animals at different times. This is one of the most significant challenges of a dispersal, in that it takes an extensive amount of time to 'educate' all animals that have used the roost over time. Flying-foxes will also attempt to recolonise a roost even after they have been dispersed. The ongoing effort required means that dispersals are inevitably expensive (generally hundreds of thousands of dollars), and the uncertainty makes budgeting and outcomes impossible to accurately predict.

The potential cost of dispersal from Wallace Park is compounded by difficulties accessing the site given that it is often waterlogged. Further there a number of ecological and legislative constraints associated with this site as detailed in Section 3.

4.2.1 Passive dispersal with vegetation removal

Removing vegetation can be used to passively disperse a roost, by gradually making the habitat unattractive so that flying-foxes abandon the site. This method is less stressful to flying-foxes, and greatly reduces the risk of splinter colonies forming in other locations (as flying-foxes are more likely to move to other known sites within their roost network when not being forced to move immediately, as in active dispersal). However it usually involves removing an extensive amount of canopy vegetation, and is therefore not appropriate for sites with high ecological and amenity value such as Wallace Park roost.

4.2.2 Active dispersal without vegetation removal

A range of tools can be used to actively disperse flying-foxes, including noise (i.e. stock whips, whistles, recorded noise), visual deterrents (i.e. lights, laser pointers) and olfactory (i.e. smoke).

Dispersal personnel position themselves under the roost prior to flying-foxes returning to the roost from nightly foraging, which varies seasonally but may be as early as 0300. In accordance with the EPBC guideline (see Section 3.4), dispersal should continue for no more than 2.5 hours each morning. It is anticipated that at least six personnel would be required at Wallace Park, with additional stand-by staff that may need to disperse from other inappropriate splinter locations.

Initial dispersal generally spans several weeks, with maintenance dispersal required as flying-foxes attempt to re-establish the roost. Some level of maintenance dispersal is usually required for at least several years, and often indefinitely without habitat modification.

In addition to risks detailed above, dispersal activities at this location are likely to:

- disrupt residents (including potential health impacts associated with smoke, which is a key dispersal tool)
- stress noise-phobic pets
- increase flying-fox vocalising during the day
- result in trampling damage to the understorey.

As detailed above, additional risk management and welfare impact mitigation strategies are required for active dispersal, and if this is the desired strategy a detailed site-specific dispersal plan will be required.

Where this last-resort option is required, Ecosure advocates a gentle approach aimed at irritating (rather than stressing) flying-foxes so fewer return to the roost each day. An aggressive approach to dispersal (i.e. using excessively loud noise, not allowing flying-foxes to settle in any area of the known roost) forces flying-foxes to find an alternative roost on the morning of dispersal, which is much more likely to stress the animals, and cause them to splinter to other undesirable locations.

4.2.3 Dispersal costs and likelihood of success

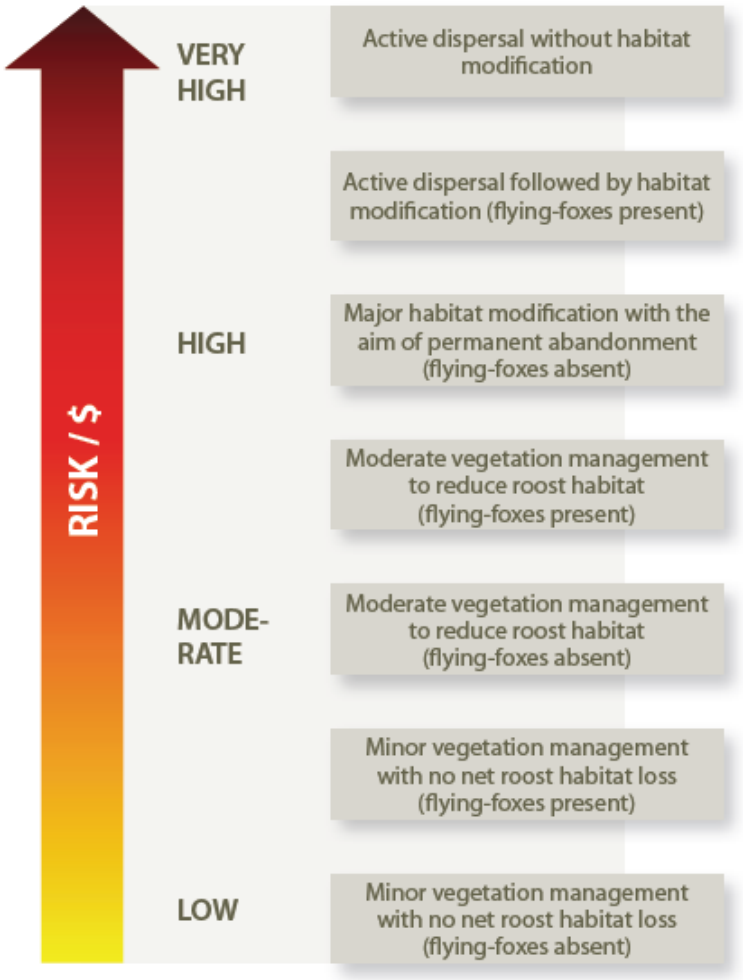

Figure 4 Roost management options – indicative cost and risk (Ecosure 2013).

Management costs are highly variable, and are impossible to predict for management options where the outcomes are unpredictable (i.e. dispersal). Risks also vary with the management approach, with the highest level of risk associated with dispersal (see our indicative diagram below). Dispersal often requires upward of a $100,000 investment, with the most costly dispersal known to be in excess of $3M and ongoing (i.e. Melbourne Botanic Gardens).

5 Preliminary risk assessment

5.1 Risk associated with the roost in its current location

Table 2 Risks associated with the roost unmanaged, and residual risk with controls implemented.

Sensitive site	Distance (based on maximum extent) and direction	Risk	Risk score (refer to Appendix 1)	Mitigation measures	Residual risk score
Residential properties	Immediately adjacent W and S; 30 m N	Disease transfer	14*	See Sections 4.1.1, 4.1.2 and 6	1
		General hygiene issues	4	See Sections 4.1.1, 4.1.2, 4.13 and 6	2
		Financial loss (including time cleaning)	17	See Sections 4.1.1, 4.1.2, 4.13 and 6	13
		Noise/smell/well-being impacts	17	See Sections 4.1.1, 4.1.2, 4.13 and 6	12
Business – bowling club and resort	35-40 m N	Disease transfer	14*	See Sections 4.1.1, 4.1.2 and 6	5
		General hygiene issues	4	See Sections 4.1.1, 4.1.2, 4.13 and 6	5
		Financial loss (including time cleaning)	17	See Sections 4.1.1, 4.1.2, 4.13 and 6	13
		Financial loss from reduced patronage	10	See Sections 4.1.1, 4.1.2, 4.13 and 6	9
Hospital – general	10 m SW (but >100 m from regular roost area)	Disease transfer (hospital enclosed)	10*	See Sections 4.1.1, 4.1.2 and 6	1
		Amenity/well-being for patients	14	See Sections 4.1.1, 4.1.2, 4.13 and 6	5
Hospital – helicopter		Flying-fox strike	22	See Section 4.1.6 and 6.	15
Private airstrip	2.4 km SW	Flying-fox strike	22	See Section 4.1.6 and 6.	15

Classification	**Action required**
20-25 = EXTREME	Unacceptable risk. Do not proceed. Controls required to reduce risk.
16-19 = HIGH	Unacceptable risk. Do not proceed. Controls required to reduce risk.
7-15 = MODERATE	Acceptable with adequate controls in place.
1-6 = LOW	Low risk.

*__N.B.__ This risk level assumes direct contact with a flying-fox resulting in a bite or scratch. There is no known disease risk from living near a roost.

5.2 Risk of management

Management option	Risk	Risk score (refer to Appendix 1)	Mitigation measures	Residual risk score
Education	Nil	N/A	N/A	N/A
General mitigation measures	Cost which may not mitigate impacts.	17	See Sections 4 and 6 for most suitable mitigation measures, and potential for grants etc.	9
In-situ management	Moderate cost which may be insufficient to mitigate community impacts.	17	Detailed plan developed prior to works commencing.	8
	Impact to animal welfare.	17	Ensure management is not done near roosting flying-foxes during the pupping season, and flying-foxes are monitored for signs of stress during significant works (i.e. tree removal). Develop a detailed works plan prior to commencing.	3
	Inadvertent dispersal	8	Ensure management is not done near roosting flying-foxes during the pupping season, and flying-foxes are monitored for signs of stress during significant works (i.e. tree removal). Develop a detailed works plan prior to commencing.	3
Dispersal	Impact to animal welfare and flying-fox conservation.	21	Appropriate planning for a dispersal can reduce risks (detailed dispersal strategy required), however despite careful planning risks remain at moderate-high.	18
	Increased aircraft strike risk associated with changed flying-fox movement patterns.	24		19
	Splintering the roost into other locations that are equally or more problematic.	21		21
	Shifting the issue to another area.	21		21
	Increasing disease status and associated public health risk.	22		18
	Impacts to nearby residents associated with ongoing dispersal attempts.	16		16
	Excessive initial and/or ongoing resource and financial investment.	23		23
	Negative public perception and backlash.	17		17
	Impact on habitat value (with significant vegetation management).	23		23

Classification	Action required
20-25 = EXTREME	Unacceptable risk. Do not proceed. Controls required to reduce risk.
16-19 = HIGH	Unacceptable risk. Do not proceed. Controls required to reduce risk.
7-15 = MODERATE	Acceptable with adequate controls in place.
1-6 = LOW	Low risk.

6 Recommendations

As shown in Section 5, risks associated with the roost can be managed to an acceptably low level through in-situ management. Amenity impacts can be similarly managed with the provision of buffers and other mitigation measures.

Dispersal is not recommended for these reasons, and the associated risks detailed in Section 4.2.

Recommendations to reduce impacts associated with the roost in its current location are provided in Table 3.

Table 3 Recommended management options

Mitigation type	Recommendation	Responsible
General	Consider all options in Section 4.1.2, and low impact activities outlined in the COP (see Section 3.3).	Land owners
Monitoring	Continue to monitor flying-foxes at Wallace Park and surrounds.	Council and EHP
Education	Continue consulting with residents and providing educational material. This roost would be ideal for educational signage (and a potential viewing area), and information could also be distributed from the library.	Council
	Consider educational signage at the bowls club explaining there are no known risks of lyssavirus/Hendra virus from contacting flying-fox excrement, and continue general hygiene practices (including ongoing provision of hand sanitising gel).	Bowls club
Buffers	Create buffers through selective tree trimming/removal and deterrents. It is recommended that buffers of up to 10m from property boundaries be established through selective trimming/removal, with the aim of retaining mature trees. Deterrents listed in Section 4.1.3 could then be used to create an additional 15m buffer from high conflict areas. Proposed buffer areas are shown on Figure 5. A detailed plan should be developed prior to works to manage risks of management detailed in Section 5.2. Additional considerations include: · approvals may be required for management that may impact on values detailed in Section 3.1 · offset planting for all native species removed should be considered as per best practice guidelines · connectivity for other fauna should be retained between contiguous habitat · a fauna and flora survey is required prior to buffer works to avoid impacting key fauna habitat (i.e. hollows) or rare plants, and a fauna spotter catcher should be present during trimming/clearing works.	Council

Mitigation type	Recommendation	Responsible
	Council should liaise with the hospital to determine if a buffer is required on the south-western edge of the maximum roost extent. If it is required, works could potentially be done by the hospital under Council's as-of-right authority.	Noosa Hospital
General	The bowls club, in partnership with Council, may consider assessing the feasibility of a trial to reduce fly-out impacts using deterrents (i.e. wires/netting/flagging etc.) to potentially redirect some fly-over. Grant funding may be available from various sources, including through the State initiative 'Get Playing Spaces and Places – funding to improve facilities'. More information for this grant can be found at http://www.qld.gov.au/recreation/sports/funding/getinthegame/getplaying/. If found to be successful, it may provide a useful management option for other residents that are being severely impacted by faecal drop.	Bowls club and Council
Subsidies/funding assistance	Investigate grant opportunities that may be available to residents and businesses around the roost to assist with general mitigation measures (i.e. seat covers and alternatives to shade cloth awnings for outdoor furniture).	Council and land owners
Aircraft strike management	Ensure the hospital and private airstrip are aware of large influxes of flying-foxes, and any management that may alter flying-fox behaviour/movements, so that pilots can respond to increased strike risk.	Council
	Dawn and dusk flights should be avoided wherever possible, and if required by the hospital, helicopters should be diverted and patient transfer done by ambulance.	Noosa Hospital and private airstrip
Planning instruments to avoid future impacts	Consider adequate buffers and other planning provisions for new developments neighbouring Wallace Park.	Council
Alternative habitat	Encourage re-establishment of the Goat Island roost through limiting disturbance around the island where possible.	Council

Figure 5: Recommended management areas

Noosa Council

Flying-fox management options report

Hospital property

Cadastral boundaries

Roost extent as at August 2015

Approximate maximum roost extents combined across counts

(see Section 3.4 for further detail)

ecosure

Job number: PR1165
Revision: 2
Author: MED
Date: 08/12/2015

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Metres

GDA 1994 MGA Zone 56
Projection: Transverse Mercator
Datum: GDA 1994
Units: Meter

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Appendix 1 Ecosure flying-fox risk matrix

Potential Consequences					Probability				
Risk Score	People – Health and Safety	Project/ Business	Environment	Reputation	A – almost certain to happen	B – likely to happen at some point	C – may happen, but not common	D – unlikely to happen	E – extremely unlikely to happen
1 Catastrophic impact	Multiple fatalities/ permanent serious injury to more than 1 person	Could cause catastrophic loss or damage (>$500K)	Disastrous impact; major long term remediation required; prosecution	Lasting damage to reputation; national and international media criticism	25	24	22	19	15
2 Severe negative impact	Single fatality Severe permanent disability	Could cause major loss or damage ($100K - $500K)	Serious impact, medium term effects; requires significant remediation; likely prosecution	Significant damage to reputation; criticism in national media	23	21	18	14	10
3 Major negative impact	Major injury to one person (> 5 days LTI) Severe health impacts on more than one person	Could cause moderate loss or damage ($10K-$100K)	Moderate reversible impact; no chance of prosecution	Significant public criticism; possibility of state media involvement	20	17	13	9	6
4 Negative impact	Significant injury (< 5 days LTI) Health impacts on more than one person	Could cause minor loss or damage ($1K-$10K)	Minor, reversible impact; minor remediation required	Slight negative impact on more than one individual in local community	16	12	8	5	3
5 Minor negative impact	Minor injury Slight health impact	Possible minima loss or damage (<$1K)	Negligible, reversible impact; no remediation required	Slight negative impact on an individual in local community	11	7	4	2	1

Classification	Action required
20-25 = EXTREME	Unacceptable risk. Do not proceed. Controls required to reduce risk.
16-19 = HIGH	Unacceptable risk. Do not proceed. Controls required to reduce risk.
7-15 = MODERATE	Acceptable with adequate controls in place.
1-6 = LOW	Low risk.

Revision History

Revision No.	Revision date	Details	Prepared by	Reviewed by	Approved by
00	18/09/2015	Wallace Park flying-fox roost – management options report DRAFT	Jessica Bracks, Senior Wildlife Biologist	Grant Brearley, Senior Wildlife Ecologist	
01	28/09/2015	Wallace Park flying-fox roost – management options report FINAL DRAFT	Jess Bracks, Senior Wildlife Biologist (Incorporating client comments)	Jessica Bracks, Senior Wildlife Biologist	
02	14/10/2015	Wallace Park flying-fox roost – management options report	Jess Bracks, Senior Wildlife Biologist (Incorporating client comments)	Jessica Bracks, Senior Wildlife Biologist	

Distribution List

Copy #	Date	Type	Issued to	Name
1	14/10/2015	Electronic	Noosa Council	Peter Milne
2	14/10/2015	Electronic	Ecosure	Administration

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