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FLYING-FOX ROOST MANAGEMENT PLAN

FINAL

June 2022

ROCKHAMPTON REGIONAL COUNCIL

Acknowledgements

We acknowledge the Traditional Owners of this country and pay respect to all Aboriginal and Torres Strait Islander peoples. Traditional Custodians in the Rockhampton Area the First Nations Darumbal peoples. We acknowledge the Elders past, present and emerging and acknowledge the spirits and ancestors of the Clans that lived in this area.

Thanks to the Department of Environment and Science for the supply of historical roost data, and to the Queensland Herbarium/Department of Environment and Science/ CSIRO for sharing information and spatial data on flying-fox foraging resources in the area.

We would also like to acknowledge and thank Council for the provision of data and support during the development of this plan.

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Acronyms and abbreviations

ABLV	Australian bat lyssavirus
ACP Act	*Animal Care and Protection Act 2001* (Queensland)
AEC	Australian Ethics Committee
AIHW	Australian Institute of Health and Wellbeing
ASAP	As soon as possible
ATSB	Australian Transport Safety Bureau
AVA	Australian Veterinary Association
BFF	Black flying-fox (*Pteropus alecto*)
CA Act	*Civil Aviation Act 1998* (Queensland)
CASA	Civil Aviation Safety Authority
CASR	Civil Aviation Safety Regulations
CDC	Centres for Disease Control and Prevention
Council	Rockhampton Regional Council
COVID-19	Sudden Acute Respiratory Syndrome SARS-CoV-2
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DAWE	Department of Agriculture, Water and the Environment (Commonwealth)
DECCW	Department of Environment, Climate Change and Water (New South Wales)
DELWP	Department of Environment, Land, Water and Planning (Victoria)
DES	Department of Environment and Science (Queensland)
DMP	Damage Mitigation Permit
DoE	Department of the Environment (now DAWE)
DPI	Department of Primary Industries (New South Wales) (now DPIE)
DPIE	Department of Planning, Industry and Environment (New South Wales)
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
EVNT	Endangered, vulnerable and near threatened
FF	Flying-fox
FFMP	Flying-fox Management Plan
FFRMP	Flying-fox Roost Management Permit
GHFF	Grey-headed flying-fox (*P. poliocephalus*)

HeV	Hendra virus
HSE	Heat Stress Event
ICAO	International Civil Aviation Organisation
IUCN	International Union for the Conservation of Nature
LGA	Local government area
Low Impact COP	*Code of Practice – Low impact activities affecting flying-fox roosts* (DES 2020c)
LRFF	Little red flying-foxes (*P. scapulatus*)
Management COP	*Code of Practice – Ecologically sustainable management of flying-fox roosts* (DES 2020a)
MERS	Middle East Respiratory Syndrome MERS-CoV
MNES	Matters of national environmental significance
MOS	Manual of Standards
NC Act	*Nature Conservation Act 1992* (Queensland)
n.d.	No date
NSW	New South Wales
OEH	Office of Environment and Heritage (New South Wales)
the Plan	RRC Flying-fox Roost Management Plan
PPE	Personal Protective Equipment
Qld	Queensland
RBG	Rockhampton Botanic Gardens
REs	Regional Ecosystems
PMST	Protected Matters Search Tool
RRC	Rockhampton Regional Council
RSPCA	Royal Society for the Prevention of Cruelty to Animals
SARS	Sudden Acute Respiratory Syndrome SARS-CoV-1
SEQ	South-East Queensland
SL	Special least concern species (conservation status of taxon under the *Nature Conservation Act 1992*)
SOMI	Statement of Management Intent
UFFMA	Urban Flying-fox Management Area
VM Act	*Vegetation Management Act 1999* (Queensland)
WHA	Wildlife Health Australia
NC Animals Regulation	Nature Conservation (Animals) Regulation 2020

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1 Introduction

The Rockhampton Regional Council Flying-fox Management Plan (the Plan) provides Rockhampton Regional Council (Council) with a framework to manage issues that may be associated with three high-conflict flying-fox roosts in the Rockhampton Local Government Area (LGA) and any new emerging sites, whilst ensuring flying-foxes and their ecological services are conserved.

The Plan will focus on three roosts that, at times, experience high conflict with surrounding residents and community members: Rockhampton Botanic Gardens (RBG), Kabra township, and Westwood township. However, it has been developed in a way to assist Council with management and mitigation actions available upon emergence of new roosting sites. The Plan details short- and long-term management actions for the three focal roosts, and provides a framework for assessing and implementing management actions at new, emerging roosts.

The objectives of the Plan are to:

- minimise impacts to the community and avoid future conflicts
- outline management actions that can be utilised at roosts, and which management actions require permits/approvals
- ensure actions are in accordance with relevant legislation
- clearly define roles and responsibilities for management actions
- facilitate an evidence-based, adaptive approach to management
- improve community understanding and appreciation of flying-foxes including their ecological role
- improve community resilience to flying-fox impacts
- minimise amenity impacts associated with roosting flying-foxes
- support long-term conservation of flying-foxes in appropriate locations
- ensure management is sympathetic to flying-fox behaviours and requirements, and that flying-fox welfare is a priority during all activities
- ensure roost management does not contribute to loss of biodiversity or increase threats to threatened species/communities
- effectively communicate with stakeholders during planning and implementation of management activities.

Three species of flying-foxes occur in Queensland: grey-headed flying-fox (*Pteropus poliocephalus*) (GHFF), black flying-fox (*P. alecto*) (BFF), and little red flying-fox (*P. scapulatus*) (LRFF). Roosts in Rockhampton are mainly occupied by BFF, and often at times by the highly transient LRFF. Rockhampton is located at the northern extent of the current known range of the GHFF, with occasional GHFF occupation noted in the LGA. As native animals, all flying-foxes and their roost habitat are protected under the Queensland *Nature*

Conservation Act 1992 (NC Act). The GHFF is classified as threatened, therefore is afforded additional protection under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

1.1 Stakeholders

Stakeholders with an interest in the Rockhampton roost sites and/or flying-foxes include:

- community visitors and businesses in/around Rockhampton Botanic Gardens
- nearby residents/businesses
- Rockhampton South Kindergarten and Westwood State School, with flying-foxes roosting on or adjacent to school grounds
- Rockhampton Regional Council and the Rockhampton Airport
- Department of Environment and Science (DES)
- wildlife carers, researchers, conservationists and community groups such as Batcare Capricornia
- Traditional Custodians - in the Rockhampton area, the First Nations Darumbal peoples are the traditional custodians.

Feedback has been sought from many of these stakeholders through consultation over the past several years, and Council will consult with all key stakeholders prior to Plan implementation.

1.2 Legislation overview

All three flying-fox species located in the Rockhampton LGA and their roost sites are protected in Queensland under the NC Act. The GHFF is also protected as a vulnerable species under the Commonwealth EPBC Act, affording it additional protection.

Under Queensland legislation, local governments have an ‘as-of-right’ authority under the NC Act to manage flying-fox roosts in mapped Urban Flying-fox Management Areas (UFFMAs) in accordance with the Code of Practice – Ecologically sustainable management of flying-fox roosts (Management COP) (DES 2020a). The Management COP outlines how local governments operating under section 61 of the Nature Conservation (Animals) Regulation 2020 (NC Animals Regulation) may:

a) destroy a flying-fox roost;

b) drive away, or attempt to drive away, a flying-fox from a flying-fox roost (‘drive away’ is defined to mean "cause the flying-fox to move away from the roost; or if the flying-fox has moved away from the roost, deter the flying-fox from returning to the roost"); and/or

c) disturb a flying-fox in a flying-fox roost.

The document details key obligations prior to, during, and following undertaking such management actions to ensure that the chance of management actions under this code resulting in harm to flying-foxes is avoided. Refer to Appendix 1 for key obligations when undertaking nudging and/or dispersal attempts.

The Flying-fox Roost Management Guideline (DES 2020b) has also been developed to provide local government with additional information that may assist decision making and management of flying-fox roosts. Councils are required to apply for a flying-fox roost management permit (FFRMP) to manage flying-fox roosts outside an UFFMA, or for management actions not specified in the COP. It must be noted that this 'as-of-right' authority does not oblige Council to manage flying-fox roosts, and does not authorise management under other relevant sections of the NC Act or other legislation (such as the Vegetation Management Act 1999 [VM Act]).

Anyone other than local government is required to apply to the Department of Environment and Science (DES) for a FFRMP for any management directed at roosting flying-foxes, or likely to disturb roosting flying-foxes. Certain low impact activities (e.g. mowing, minor tree trimming) do not require approval if undertaken in accordance with the Code of Practice – Low impact activities affecting flying-fox roosts (DES 2020c).

The Animal Care and Protection Act 2001 also provides for animal welfare, and any management must comply with this legislation.

Key Commonwealth and State legislation specific to flying-fox management is summarised in further detail in Appendix 1.

2 Flying-fox ecology & impacts

2.1 Ecological role

Flying-foxes, along with some birds, make a unique contribution to ecosystem health through their ability to move seeds and pollen over long distances (Southerton et al. 2004). This contributes directly to the reproduction, regeneration, and viability of forest ecosystems (DAWE 2020). It is estimated that a single flying-fox can disperse up to 60,000 seeds in one night (DELWP 2015). Some plants, particularly *Corymbia* spp., have adaptations suggesting they rely more heavily on nocturnal visitors such as bats for pollination than daytime pollinators (Southerton et al. 2004).

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

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

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

2.2 Flying-foxes in urban areas

Flying-foxes appear to be roosting and foraging in urban areas more frequently. In a study of national flying-fox roosts, 55.1% occurred in urban areas and a further 23.5% in agricultural areas (Timmiss 2017). Furthermore, the number of roosts increased with increasing human population densities (up to ~4000 people per km^2) (Timmiss 2017). There are many possible drivers for this urbanising trend, as summarised by Tait et al. (2014):

- loss of native habitat and urban expansion

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

2.3 Roost preferences

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

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

Proximity to water is a key attribute in roost location (Hall and Richards 2000, Roberts 2005) with one study suggesting that 94% of GHFF roosts in NSW were (at that time) located adjacent to or on a waterway or waterbody (Eby and Lunney 2002).

2.4 Flying-fox breeding cycle

Flying-foxes reach reproductive maturity in their second or third year of life. Reproductive cycles detailed below and in Table 1 are indicative and can vary by several weeks between regions, are annually influenced by climatic variables, and births can occur at any time of the year. All three species (GHFF, BFF, LRFF) have been present at various times in Rockhampton, therefore the breeding cycles of all three species are outlined below.

Expert assessment is required to accurately determine the phase in the breeding cycle to inform appropriate management timing.

Black and grey-headed flying-foxes

Mating begins in January with peak conception occurring around March to April/May; this mating season represents the period of peak roost occupancy (Markus 2002). Young (usually a single pup) are born six months later from September to November depending on species (Churchill 2008). The birthing season becomes progressively earlier, albeit by a few weeks, in

more northerly populations (McGuckin and Blackshaw 1991), however out of season breeding is not unusual and births may occur at any time of the year (Ecosure pers. obs. 2015-2021).

Young are highly dependent on their mother for food and thermoregulation. Young are suckled and carried by the mother until approximately four weeks of age (Markus and Blackshaw 2002). At this time, they are left at the roost during the night in a crèche until they begin foraging with their mother in January and February (Churchill 2008) and are usually weaned by six months of age around March. Sexual maturity is reached at two years of age with an average life expectancy of 5-7 years (Divljan et al. 2006; Fox et al. 2008). Individuals have been recorded to live to 18 years of age in the wild (Tidemann and Nelson 2011).

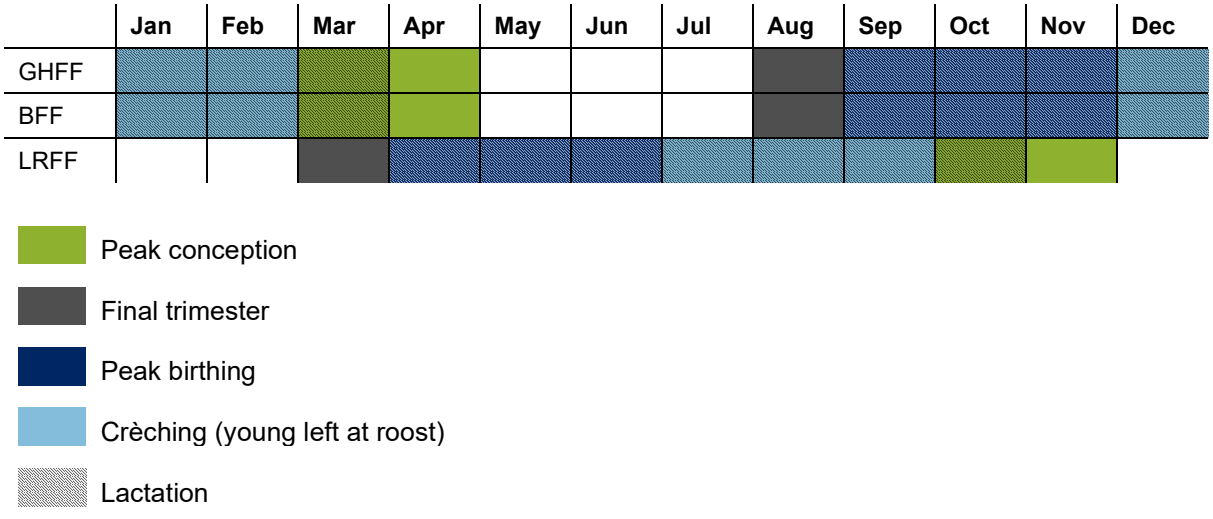
The critical reproductive period for BFF and GHFF is generally from August/September (when females are in late stages of pregnancy) to the end of peak conception around April/May. Dependent pups (Table 1) are usually present from September/October to February.

Little red flying-fox

The LRFF breeding cycle is approximately six months out of phase with BFF and GHFF (Table 1). Conception occurs around October to November, with peak birthing in April-June (McGuckin and Blackshaw 1991, Churchill 2008). Young are carried by their mother for approximately one month then left at the roost while she forages (Churchill 2008). Suckling occurs for several months while young are learning how to forage.

LRFF pups are particularly vulnerable to cold weather and can suffer hypothermia and fall from their crèche trees. If LRFF pups are present, rescuers and carers should be on stand-by during cold weather.

Table 1 Indicative flying-fox reproductive cycle



2.5 Local and regional context

Flying-foxes are highly nomadic, moving across their east coast range between a network of roosts. Roosts may be occupied continuously, annually, irregularly or rarely (Roberts 2005), and numbers can fluctuate significantly on a daily (up to 17% daily colony turnover; Welbergen

et al. 2020) and seasonal basis. A study by Welbergen et al. (2020) tracked individuals of all three species over a 60-month period and found that BFF, GHFF and LRFF roosted in an average of 12, 8 and 24 LGAs per year, respectively. The RBG, Kabra, and Westwood roosts form part of a network of roosts across the species' range (see Appendix 2). There are five known roosts within the Rockhampton LGA, with several others in the adjacent Livingstone, Central Highlands, and Gladstone LGAs (Figure 1).

Typically, the abundance of resources within a 20–50 km radius of a roost site will be a key determinant of the size of a roost (SEQ Catchments 2012). As such, flying-fox roosts are generally temporary and seasonal, tightly tied to the flowering of their preferred food trees. However, understanding the availability of foraging resources is difficult because flowering and fruiting may not occur each year and vary between locations (SEQ Catchments 2012).

A recent Queensland Government funded study by the Queensland Herbarium and CSIRO incorporated data from a range of sources to rank LRFF diet trees in bioregions across Queensland (Eyre et al. 2020). This was done using the method developed by Eby and Law (2008) by assessing the relative importance of LRFF diet tree species, the abundance of nectar produced during peak flowering periods, and the frequency of substantial flowering by a species, to obtain an overall Diet Plant Nectar score. Figure 2 shows the distribution of overall static nectar scores for remnant vegetation within 50 km of RBG, Kabra, and Westwood roosts. While this analysis is based on LRFF diet, there is substantial overlap in dietary preferences between LRFF, BFF and GHFF, and thus this mapping provides insight into all flying-fox occupation within the region.

Between 2019 and 2020, flying-foxes experienced significant population impacts across the east coast of Australia due to extreme weather events. Prolonged drought caused a mass food shortage from Coffs Harbour to Gladstone peaking around October 2019 (DES 2019), in which thousands of flying-foxes perished from starvation (Cox 2019, Huntsdale & Millington 2019). Following this, bushfires across the country resulted in the loss of large areas of native forest that provides natural foraging habitat for flying-fox populations. The total number of flying-foxes lost in these events is impossible to quantify but is likely to have been more than 100,000 individuals (M. Mo pers. comm. 2019).

With these types of events severely impacting natural areas, foraging and roosting resources in and around urban locations become even more important for flying-fox conservation.

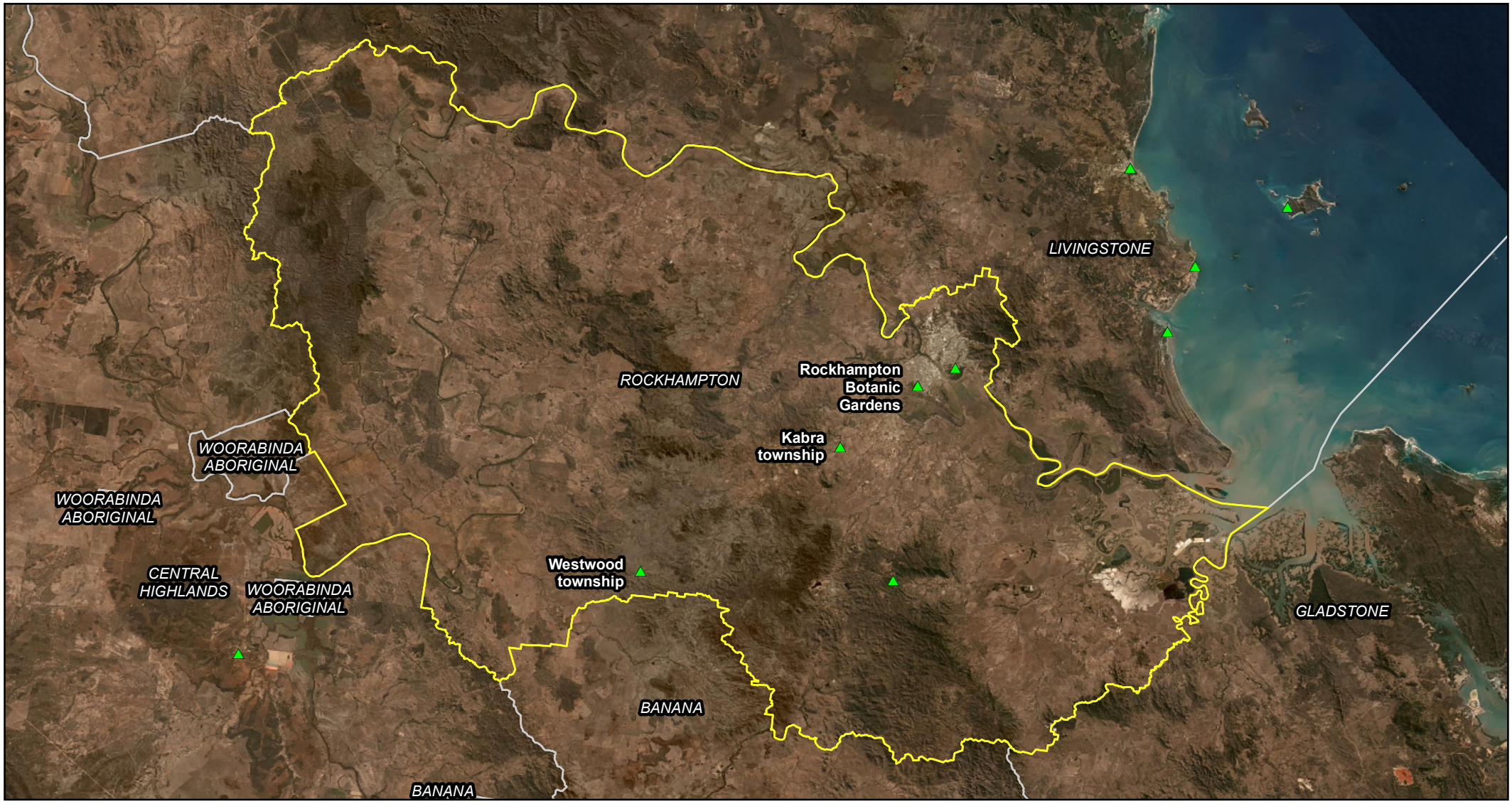


Figure 1: Regional context

Rockhampton Regional Council

RRC Flying Fox Roost Management Plan

Local government areas

Rockhampton Regional LGA

Flying-fox roost (DES data)

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Job number: PR6831
Revision: 0
Author: EK
Date: 3/03/2022

0 5 10 20
Kilometers

GCS GDA 1994
Datum: GDA 1994
Units: Degree

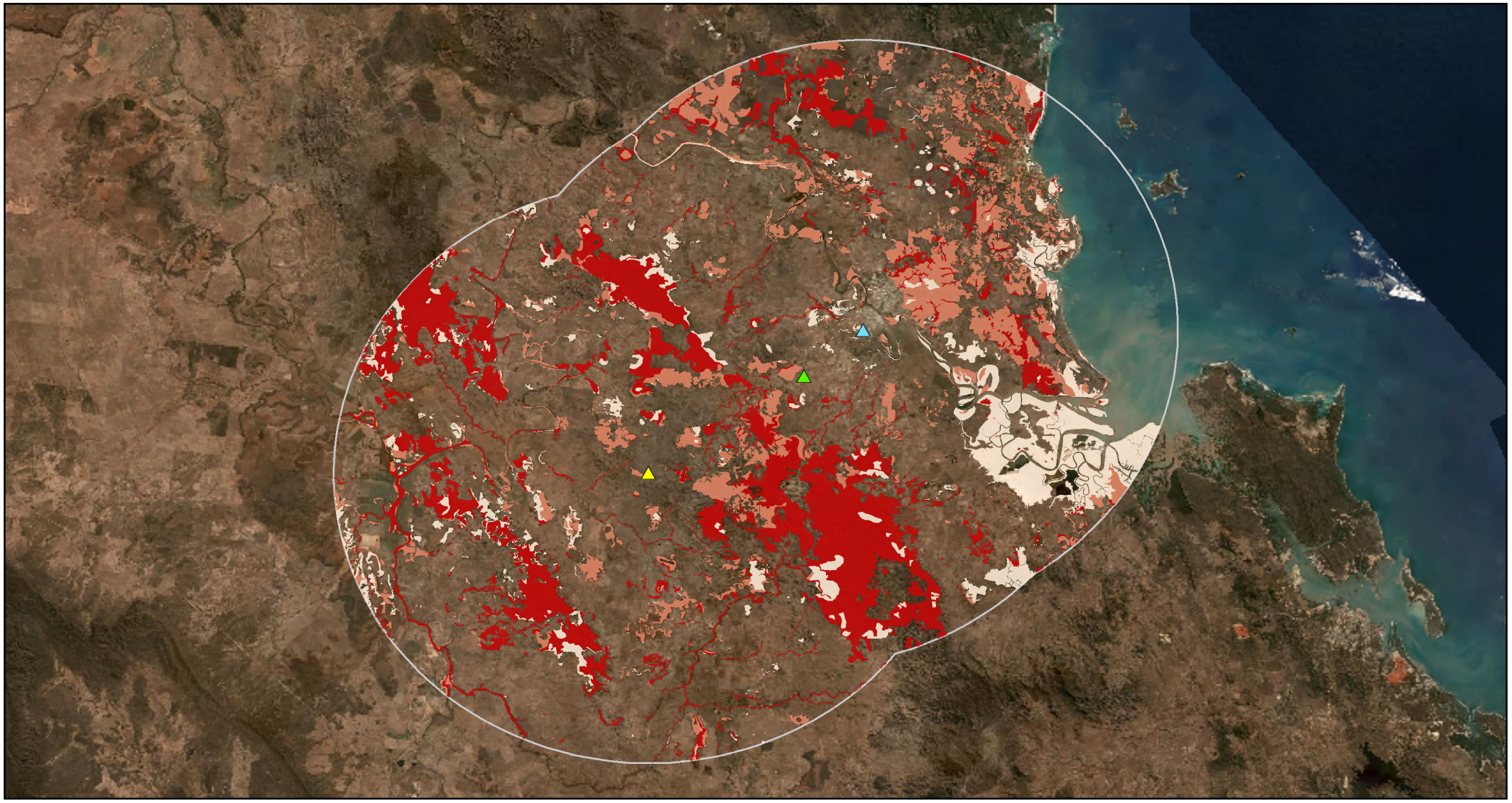

Figure 2: Distribution of the overall static nectar scores for remnant (2015) vegetation within 50 km of RBG, Kabra, and Westwood flying-fox roosts

Data courtesy of Qld Herbarium/DES/CSIRO

Rockhampton Regional Council
RRC Flying Fox Roost Management Plan

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0 5 10 20
Kilometers

GCS GDA 1994
Datum: GDA 1994
Units: Degree

2.6 Potential flying-fox impacts

2.6.1 Noise

A highly sociable and vocal animal, the activity heard from flying-foxes at roosts includes courting, parenting and establishing social hierarchy. Noise is often most disturbing pre-dawn, and during the breeding season (e.g., during mating March/April, and pup rearing in spring/summer).

2.6.2 Odour

Flying-foxes use pheromones to communicate with each other, which is the source of the characteristic musky smell around their roosts and some foraging trees. There are several factors that affect odour detectability and intensity, such as the number of flying-foxes, time of year, weather conditions, wind direction, and site characteristics.

Odour may be more intense at roosts during the breeding and rearing season as female flying-foxes use scent to find their pups after foraging, and males regularly mark their territories (Wagner 2008). Likewise, odour is stronger after rain as males remark branches in their territories.

2.6.3 Human and animal health concerns

Flying-foxes, like all animals, may carry pathogens which can be harmful to humans. These risks can be effectively mitigated through education, protocols, PPE, and basic hygiene measures. The key human and animal health risks associated with flying-foxes are lyssavirus and Hendra virus; the latter being particularly important for flying-fox roosts located in close proximity to horse paddocks. Further information on flying-foxes and human/animal health is provided in Appendix 3.

2.6.4 Faecal drop

Flying-foxes have an extremely fast digestive process with only 12-30 minutes between eating and excreting (SEQ Catchments 2012). Given that flying-foxes regularly forage 20 km from their roost (Markus & Hall 2004) and establish new roosts within 600 m – 6 km when dispersed (Eby and Roberts 2013, Ecosure 2014), attempting to relocate a roost will not reduce this impact. As such, faecal drop impacts are best managed at an individual property level.

Faecal droppings can cause health concerns, reduced amenity, create a slip hazard, requires time and resources to clean, and can damage paint if not promptly removed. Appropriate PPE and hygiene measures are required when cleaning any animal excrement. High-pressure hoses and specific cleaning products are available to assist cleaning. Flying-foxes can be deterred from roosting and foraging around areas of concern. Areas of concern, such as picnic tables and play equipment, could also be covered (e.g. with shade cloth).

2.6.5 Water quality concerns

Contamination of water supplies by any animal excreta (birds, amphibians and mammals such as flying-foxes) poses health risks to humans. This is particularly relevant for Kabra and Westwood township residents who rely on rainwater tanks for drinking water. There is no known risk of contracting bat-related viruses from contact with faecal drop or urine (Qld Health 2020). Household water tanks can be designed to minimise potential contamination, such as using first flush diverters to divert contaminants before they enter water tanks.

Tanks should be appropriately maintained and flushed, and catchment areas regularly cleaned of potential contaminants. Trimming vegetation overhanging the catchment area for the tank (e.g. flying-fox foraging vegetation overhanging 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. Tanks in urban areas are not for domestic drinking water supply and these areas are supplied with reticulated town water.

Pool maintenance practices (e.g. filtration, chlorination, skimming, vacuuming) should remove general contamination associated with wildlife droppings. Public water supplies are regularly monitored for harmful bacteria and are filtered and disinfected before being distributed. Management plans for community supplies should consider whether any large congregation of animals, including flying-foxes, occurs near the supply or catchment area. Should this occur, increased frequency of monitoring should be considered to facilitate early detection and management of contaminants if required.

There have also been concerns about water quality in artificial or natural waterbodies near a flying-fox roost. In stagnant waterbodies there may be an increase in bacteria and nutrients associated with many animals, including flying-foxes and/or native birds. Water quality monitoring should be considered if this is of concern.

2.6.6 Damage to vegetation

Large numbers of roosting flying-foxes can damage vegetation. Most native vegetation is resilient and generally recovers well (e.g. casuarina and eucalypts) and flying-foxes naturally move within a roost site allowing vegetation to recover. However, damage can potentially be significant and permanent, particularly in small patches of vegetation. Intervention may be required (as a last resort) to protect tree health if permanent damage is likely. Overall tree health within the RBG is of particular concern to Council, as is the potential damage to heritage-listed trees within the park. Management actions to deter flying-foxes from roosting in heritage listed trees and maintain the health of all trees within the RBG are considered in Section 5

2.6.7 Flying-foxes and aircraft

The consequence of wildlife strikes with aircraft can be very serious. Worldwide, in civil and military aviation, fatal bird strike incidents have resulted in more than 532 human fatalities and 614 aircraft losses since the beginning of aviation (Shaw et al. 2019). Wildlife strikes cost the

commercial civil aviation industry an estimated US$1.2 billion per annum (Allan 2002) and involve more than just the repair of damaged engines and airframes. Even apparently minor strikes which result in no damage can reduce engine performance, cause concern among aircrew and add to airline operating costs.

The main factors determining the consequences of strikes are the number and size of animal(s) struck, the phase of flight when struck and the part of the aircraft hit. The larger the animal, the greater the damage. Large animals can destroy engines and windshields and cause significant damage to airframe components and leading-edge devices. Strikes involving more than one animal (multiple strikes) can be serious, even with relatively small animals, potentially disabling engines and/or resulting in major accidents.

Historically, over 90% of reported strikes have occurred on or close to airports (ICAO 1999). Consequently, airports are the focus of management programs with the responsibility resting on airport owners and operators. It is, however, important that the whole airport community (including airline operators) and surrounding land managers are aware of wildlife strike as an issue and that all stakeholders become involved in reducing the hazard.

For any strike reduction program to be effective it is imperative that wildlife populations in the vicinity of an aerodrome are identified, monitored, and managed. Under international (International Civil Aviation Organisation Annex 14) and national legislation (Civil Aviation Safety Regulations (CASR) Part 139 Manual of Standards (MOS)) airport operators must identify potential wildlife hazards within 13 km of an aerodrome and engage with landowners to implement regular monitoring and, where required, mitigation strategies to help reduce the risk of strike associated with those hazards.

The RBG roost is less than 1 km from the boundary of the Rockhampton Airport and is of particular concern of airstrikes, and the Kabra roost is approximately 13 km from the Rockhampton Airport. The historic Fitzroy river roost (adjacent to the Rockhampton dump) also occurs within 13 km of the Rockhampton Airport. This roost has been vacant for approximately two years, however if re-established in the future, Council should notify the Rockhampton Airport.

Flying-foxes are large (~1 kg) animals that transit in large numbers at relatively low altitudes. Consequently, in terminal airspace, where aircraft are also operating at low altitudes, they may present a significant risk to air safety particularly prior to first light and post last light, daily. Between 2008 and 2017, flying-foxes and bats[1] were involved in 1,303 strikes in Australia and accounted for 10% of damaging strikes (ATSB 2019). Most notably, between 2016 and 2017 flying-foxes was the most struck flying animal.

[1] Due to inconsistent species reporting, species reported to the Australian Transport Safety Bureau (ATSB) include: flying fox, bat, fruit bat, micro bat, freetail bat, eastern freetail bat, mouse-eared bat, and spectacled flying-fox. ATSB reported that it is likely that many of the strikes involving animals reported as 'bats' actually involved flying-foxes.

2.6.8 Protecting flying-foxes and other fauna

2.6.8.1 Extreme weather impacts

Heat

Heatwaves can cause mortality in any fauna, and mass die-offs in a number of species has been reported (e.g. Gordon et al. 1988, Saunders et al. 2011).

Flying-foxes are especially susceptible to extreme heat. Temperatures above 38ºC, consecutive hot days, lactation, age and other weather variables such as high humidity contribute to the likelihood of a Heat Stress Event (HSE) (Bishop 2015, Welbergen et al. 2008). Flying-foxes may die of either heat stroke, or dehydration associated with saliva spreading used for evaporative cooling. Mass mortality commonly occurs when temperatures exceed 42°C (Welbergen et al. 2008, Bishop et al. 2019), however humidity interferes with evaporative cooling, therefore temperatures as low as 40.6ºC have caused HSEs in Queensland (Bishop 2015, Collins 2014).

Thirty-five HSEs have occurred in Australia since 1994 (Lab of Animal Ecology 2020) including the largest on record, 45,500 deaths across 52 SEQ roosts in the summer of 2014 (Welbergen et al. 2014). During this event, consecutive days with temperatures in the high thirties and early forties compounded the effects of heat stress (Table 2).

Table 2 Bureau of Meteorology Daily Maximum Temperature

Dec 2013 29th	Dec 2013 30th	Dec 2013 31st	Jan 2014 1st	Jan 2014 2nd	Jan 2014 3rd	Jan 2014 4th
40.0°C	29.8°C	28.1°C	29.1°C	32.0°C	36.8°C	41.9°C

The Flying-fox Heat Event Response Guidelines SEQ (Bishop & Lyons 2018) provides information for decision makers during HSEs and should be adopted by Council when responding to HSEs in Rockhampton.

A range of intervention methods are used by wildlife rescue and carers to reduce mortality in roosts, including direct spraying of affected animals by hand, or using ground-based or canopy-mounted sprinklers/hoses to simulate a rain shower. These methods were reviewed by Mo and Roache (2020) who found that evaluation of the efficacy of heat stress interventions has been largely anecdotal rather than empirical. Intervention also has the potential to exacerbate HSEs through disturbance, or increasing humidity with spraying. To address this lack of empirical data, the NSW government approved a scientific trial of various methods in combination with flying-fox behaviour and temperature monitoring (currently underway).

Storms

Wildlife rescue must only occur when it is safe for human access. Storm events result in tree loss and damage to vegetation, and resulting fauna habitat loss including roost space for flying-foxes. The loss of tree crowns can open up the canopy, which may result in a hotter drier climate in these areas with little canopy cover. Increased sunlight and drier soils also

favour weed proliferation which can further degrade the habitat. Habitat restoration is critical to ensure sufficient recruitment over time to allow such canopy losses to be replaced as soon as possible.

Storms can also result in injury and mortality in flying-fox roosts, particularly when flightless young are present (during summer, which coincides with storm season).

Drought

Drought and associated lack of natural food sources for flying-foxes can lead to mass mortality and pup abandonment events. Urban roosts with varied and consistent food sources provided by urban parks, street plantings and residential areas become more important during these times. Continued protection of urban roosts, such as the RBG, will be important to limit impacts of more frequent drought under climate change.

Bushfires

Due to the urban nature of the RBG, the risk of a bushfire is quite low. The risk of bushfires within Kabra and Westwood are slightly higher due to the surrounding remnant vegetation. With the increasing impacts of climate change and more severe bushfire seasons in Australia, evident in the 2019-20 bushfire season, flying-foxes are extremely vulnerable to widescale habitat loss (Bat Conservation and Rescue Queensland 2019, Baranowski et al. 2021). With large areas of roosting and foraging habitat burnt during bushfires, flying-foxes are forced to relocate and find alternative suitable roosting and foraging habitat (Baranowski et al. 2021). This can disrupt flying-foxes breeding cycle and the ability to find adequate food for survival (Bat Conservation and Rescue Queensland 2019). Significant loss of habitat in areas affected by bushfire can lead to larger influxes of flying-foxes in urban habitats as they attempt to seek adequate roosting and foraging habitat (Baranowski et al. 2021). This may lead to increasing conflict in communities such as Rockhampton, Kabra and Westwood, therefore preparedness for influxes in particularly severe bushfire seasons is key.

3 Assessment of roosts

3.1 Rockhampton Botanic Gardens

3.1.1 Site description

The RBG is a State Heritage site located on the southern outskirts of Rockhampton, 1 km from Rockhampton Airport, on a reserve of approximately 70 ha, with roughly 30 ha of cultivated space. It is bordered by the Rockhampton Zoo, the Rockhampton Golf Club, residential properties, Murray Lagoon and Yeppen Yeppen Lagoon. The RGB was established in 1869 and became heritage listed in 1999. The RBG hosts a variety of native and exotic plant species in its living collection. There are a number of buildings and points of interest on the grounds of the RGB, including a community services building, Gardens Tearooms, a children's playground and the Rockhampton War Memorial.

The roost generally extends from Murray Lagoon to the vicinity of the clock roundabout on Ann Street, occupying a variety of fig trees (*Ficus spp.*) jacaranda (*Jacaranda mimosifolia*), hoop pine (*Araucaria cunninghamii*), mango (*Mangifera indica*), kauri pine (*Agathis robusta*), African baobab (*Adansonia digitata*) and yellow flame-tree (*Peltophorum pterocarpum*) (Figure 3). Flying-foxes have also been observed feeding on a variety of other trees on site, including Moreton Bay ash (*Corymbia tessellaris*), Queensland blue-gum (*Eucalyptus tereticornis*), coolabah (*Eucalyptus coolabah*, kwai muk (*Artocarpus lingnanensis*), elephant apple (*Dillenia philipensis)*, bumpy satinash (*Syzygium cormiflorum*), Hill's fig (*Ficus hillii*), weeping fig (*Ficus benjamina*) and banyan fig (*Ficus bengalensis*).

3.1.2 Land tenure

The RBG roost is located on Lot 521 SP300242, classified as a Reserve (Figure 3).

3.1.3 Ecological values

The RBG roost does not meet the criteria for a nationally important roost, as no GHFF have been recorded roosting in the RBG. However, GHFF may occur here in the future as they have been recorded at nearby sites, such as Kabra township.

A WildNet search identified five threatened fauna species occurring within 1 km of the RBG roost (DES 2022):

- Caspian tern (*Hydroprogne caspia*) (special least concern [SL])
- Australian painted snipe (*Rostratula australis*) (endangered [E])
- Latham's snipe (*Gallinago hardwickii*) (SL)
- black-tailed godwit (*Limosa limosa*) (SL)
- glossy ibis (Plegadis falcinellus) (SL).

Other threatened species that may, are likely to, or are known to occur within a 1 km buffer area of the RBG roost generated by the Protected Matters Search Tool (PMST) can be found in Appendix 4.

3.1.4 Flying-fox occupancy

BFF are more regularly seen in the RRC LGA than LRFF, but usually are in lower numbers. LRFF are nomadic and move from roost to roost following flowering eucalypts. LRFF periodically join existing BFF roosts, often in large influxes. Flying-foxes were first recorded on the RBG grounds in August 2019 (RRC 2021), with a gradually increasing number of BFF and LRFF over the last two years (Figure 4).

LRFF typically roost in the Rockhampton area during the summer months, however since late May 2021, a birthing roost of LRFF has been established on the RBG grounds (Figure 4).

During the most recent count on the 13th of January 2022, 12,150 BFF and 500 LRFF were recorded at the RBG roost.

Figure 3: Rockhampton Botanic Garden flying-fox roost extent

Rockhampton Regional Council

RRC Flying-fox Roost Management Plan

LRFF extent (13/01/2022)*

BFF extent (13/01/2022)

Cadastral boundary

* LRFF have since vacated this site

ecosure

Job number: PR6831
Revision: 0
Author: EK
Date: 22/02/2022

0 12.5 25 50
Metres

GCS GDA 1994
Datum: GDA 1994
Units: Degree

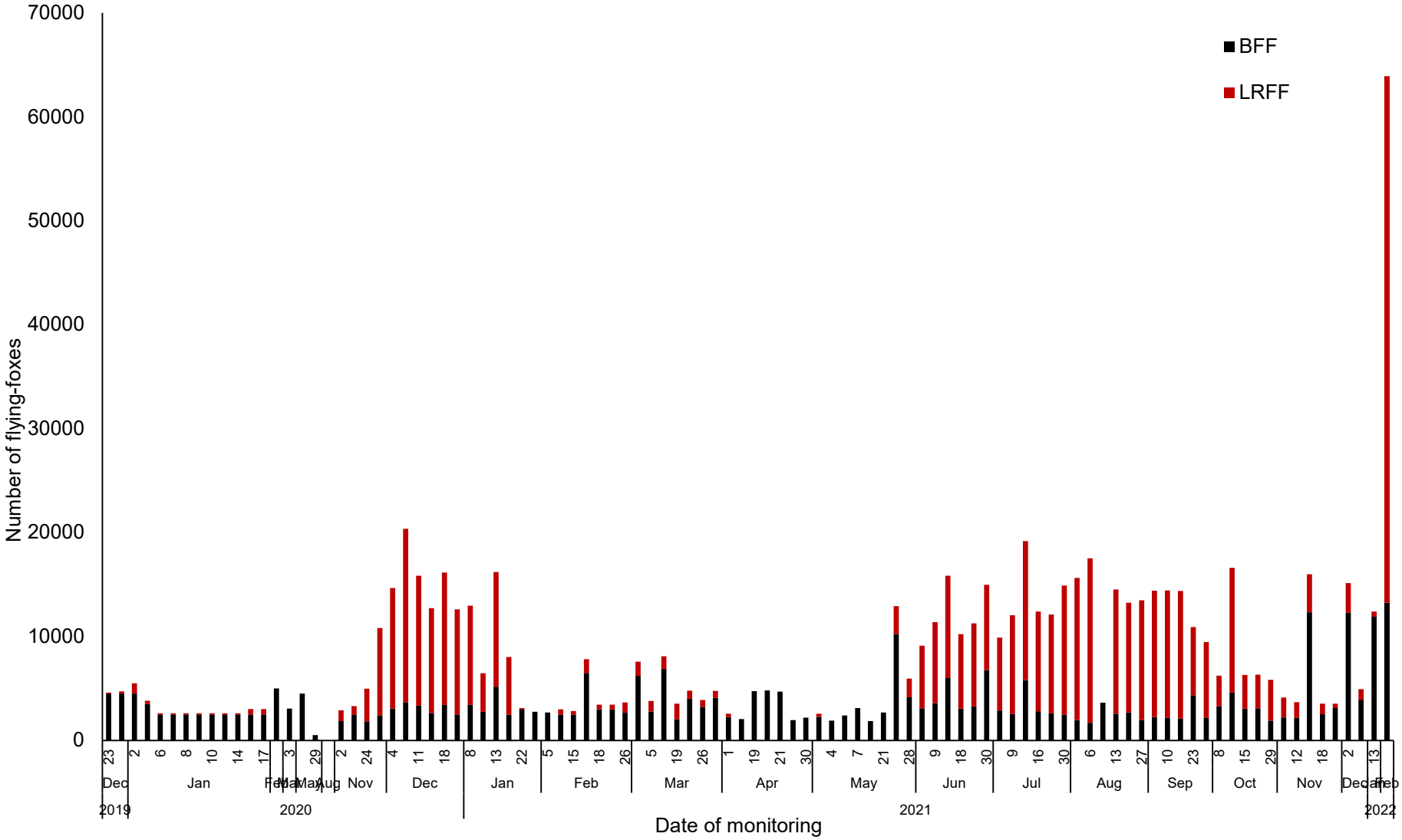


Figure 4 Historical flying-fox roost counts at the Rockhampton Botanic Garden roost (Source: DES, Ecosure)

3.1.4.1 Issues to date

A number of concerns have been raised with the increasing numbers of BFF and LRFF over the last two years. Bamboo plants have been significantly damaged by flying-foxes roosting in the western section of the RBG along Murray Lagoon. Australian white ibis (*Threskiornis moluccus*) roost on bamboo platforms flattened by roosting flying-foxes (Plate 1). Ibis have been recorded roosting in large numbers in this area, though ibis egg and nest removal is often unable to be conducted due to continuous presence of flying-foxes or ibis chicks. Flying-fox presence has also impacted other wildlife management programs in the RBG, such as cattle egrets (*Bubulcus ibis*).

Plate 1 Flying-fox roosting area with vegetation damage and roosting ibis, RBG

Many flying-foxes roost in the fig trees overhanging and surrounding the Gardens Tearooms (Figure 3), resulting in faecal matter on amenity surfaces. This area is a popular location for patrons to eat, so large amounts of faecal matter has raised health concerns. Contractors on behalf of the RBG regularly conduct cleaning in this area, often on a nightly basis, which leads to further safety hazards for staff and visitors due to the wet grounds and potential for the growth of mould.

The RBG has experienced significant damage to vegetation, with tree branches up to 30 cm in diameter breaking due to the high density of flying-foxes roosting. This creates a hazard for staff and visitors and results in a loss of aesthetic value.

There are several sensitive sites (e.g. hospitals, childcare centres, schools, aged care facilities) within 2 km of the RBG roost (Figure 5). The Rockhampton South Kindergarten is located directly to the east of the RBG, where flying-foxes have been recorded roosting in fig trees along the fence line of the kindergarten (in the Arid Garden Beds). More recently, an influx of 50,000 LRFF has pushed BFF to roost closer to the kindergarten which has raised concerns amongst the community. Other sensitive sites are shown in Figure 5.

3.1.4.2 Flying-fox strike risk

Rockhampton Airport is located 1 km away to the north-west of the RBG. Flying-foxes[2] are currently listed as high and moderate risk species in the Rockhampton Airport species risk assessment (Avisure 2022). In the previous five years (2017-2021) flying-foxes have been involved in 35 confirmed on-airport strikes, including five multiple strikes, at Rockhampton Airport (Avisure 2022). Of these, six strikes resulted in adverse effects to planned flight include unserviceable aircraft, aircraft damage, and flight delays and cancellations (Avisure 2022).

Between January 2017 and July 2019, flying-foxes accounted for 14% of confirmed on-airport and airport vicinity strikes at Rockhampton Airport (Avisure 2022). Since the appearance of the RBG flying-fox camp in August 2019, flying-foxes accounted for 36% of confirmed on-airport and airport vicinity strikes (Avisure 2022). This increasing trend in strikes poses an increased damaging strike risk to aircraft operations, particularly before first light and after last light daily when transit activity peaks.

[2] Species include LRFF, unidentified flying-fox, and GHFF.

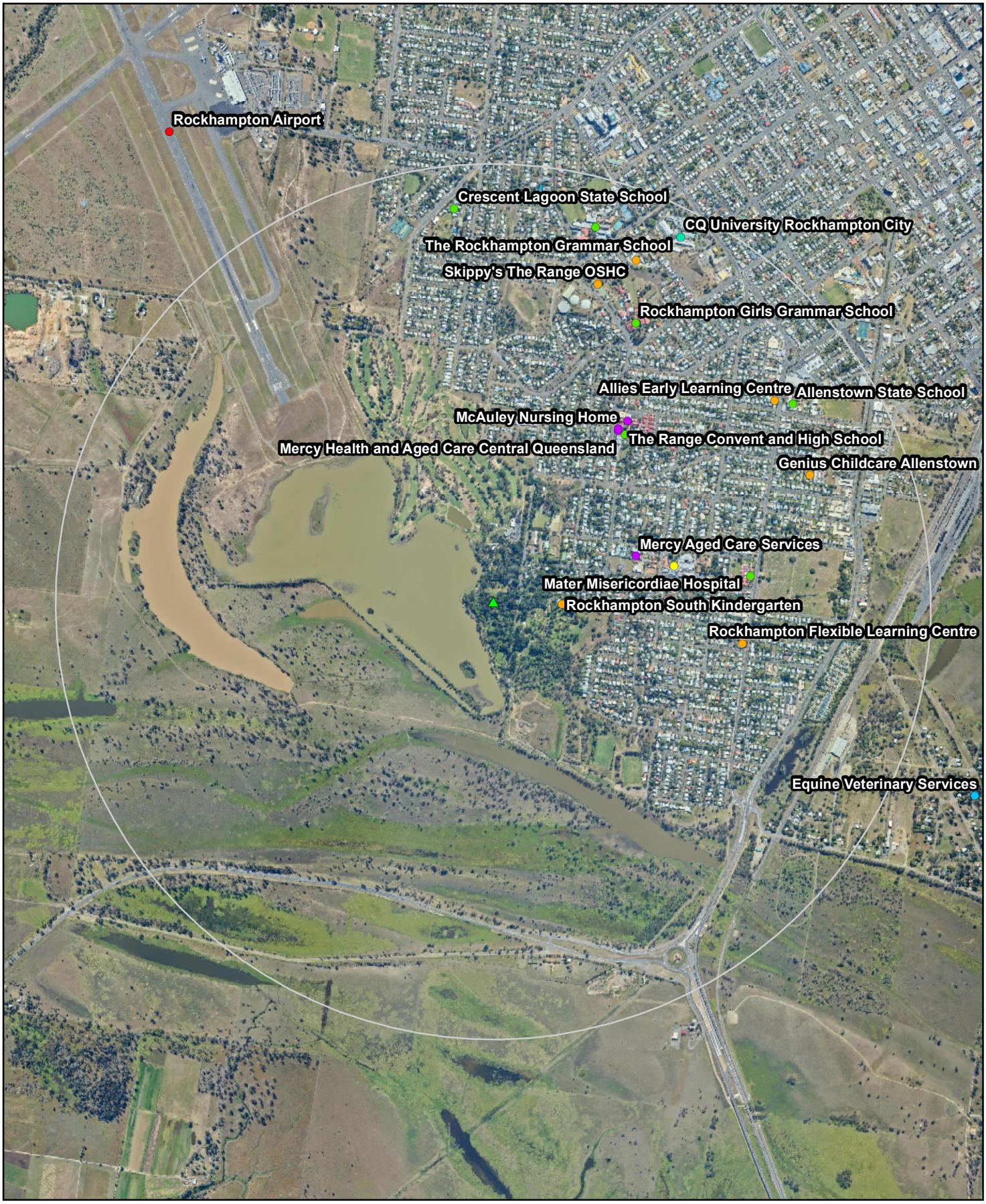


Figure 5: Sensitive sites within 2 km of RBG roost

Rockhampton Regional Council

RRC Flying Fox Roost Management Plan

2 km buffer
Flying-fox roost
Sensitive sites
Aged care facility
Airport
Childcare centre
Equine facility
Hospital
School
University

ecosure

Job number: PR6831
Revision: 0
Author: EK
Date: 22/02/2022

0 100 200 400
Metres

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

3.1.4.3 Management response to date

Since flying-foxes have occupied the RBG, Council have reactively managed the roost, however no long-term management plan has been developed. Various management techniques have been adopted by Council. Ecosure have also conducted regular monitoring at this roost since December 2019.

RRC attempted dispersal of the BFF within the RBG on 19-21 May 2020. The equipment used included lighting towers, handheld spotlights, beacon lights, strobe lights, electric leaf blowers and tree mounted sprinklers to actively disperse the colony. As prescribed in the Code of Practice (DES 2020a), dispersal activity was undertaken during the dawn fly in for a maximum of 3 hours each morning. Following this, an assessment was undertaken to determine the extent of the colony and monitor for any signs of distress including panting, wing fanning, excessive licking, and low roosting individuals. No signs of distress were observed within the roosting colony during these assessments (Ecosure 2020). The number of BFF at the RBG declined during and after the dispersal activities until 5 June 2020 when Ecosure confirmed that no flying-foxes remained at the RBG (Ecosure 2020).

Following the return of BFF in late 2020, RBG gained media attention when local wildlife carers reported hundreds of dead or distressed juvenile BFF within the colony (Stünzner 2020). An ABC article suggested a link between dispersal activities at RBG and the abandonment of BFF pups by their mothers (Stünzner 2020). It is unlikely that the dispersal activities in May 2020 (when no dependent juveniles were present) contributed to the event in December. Maximum daily temperatures at Rockhampton Airport, approximately 2 km from RBG, were recorded at 39 and 38.5 degrees Celsius on 6 and 7 of December respectively. Other (possibly compounding) factors that may have contributed to the mortality event were drought- or fire-associated food shortages in the region.

RRC attempted dispersal in May 2021. In June 2021, sprinklers were installed in the RBG around the Gardens Tearooms and in fig trees leading towards Murray Lagoon to deter flying-foxes roosting in these areas (RRC 2021).

A second, smaller mortality event impacted LRFF in June and July 2021 which was again reported on by the ABC (Stewart et al 2021). This article suggested that a number of juvenile LRFF required rescuing after they “had their homes disturbed”. However, Ecosure understands that no dispersal or other applied management actions (including sprinkler operation) were undertaken on LRFF by RRC while pups were present (M Elgey, pers. comm., 29 June 2021). It is more likely that juvenile LRFF were found dead or distressed due to hypothermia caused by normal winter temperatures and being left alone at night while their mothers foraged.

Contractors have been regularly cleaning the Gardens Tearooms area on the grounds to manage the faecal droppings of flying-foxes roosting in the surrounding fig trees.

In early 2022, Council undertook vegetation modification during a short window prior to the arrival of LRFF to the region. A significant amount of bamboo was removed in an attempt to reduce the potential habitat for LRFF to return to and reduce nesting habitat for Australian white ibis. Since this removal, approximately 50,000 LRFF have returned to the RBG and are

causing little concern (as of 25/02/2022), though their occupation has pushed BFF further towards the Rockhampton South Kindergarten, causing concern amongst the community.

Since August 2019, Rockhampton Airport have liaised with RRC through their twice-yearly Wildlife Hazard Management Committee to share information, identify risks and ensure collaborative management of RBG. RRC also performs regular monitoring of RBG which is shared monthly to Rockhampton Airport, in addition to monthly surveys performed by the airport's wildlife hazard management consultants (Avisure). The frequent information assists Rockhampton Airport in communicating changes in risk to various stakeholders, including the Airport Reporting Officers, pilots, and airlines. As of January 2022, RRC have agreed to share Ecosure's flying-fox monitoring data with Avisure to include in their quarterly and annual wildlife hazard management reports to identify populations changes in the Rockhampton region.

3.2 Kabra township

3.2.1 Site description

Kabra is a small township within the RRC LGA, approximately 15 km southwest of Rockhampton (Figure 1). The Kabra roost is located in the centre of the township and is bordered by Morgan Street and Moonmera Street. The roost is generally located on Council land in between private properties along Middle Creek, however during times of large influxes, flying-foxes have been known to roost on adjacent private properties (Figure 6).

Figure 6: Kabra township maximum flying-fox roost extent

Rockhampton Regional Council

RRC Flying-fox Roost Management Plan

Maximum flying-fox roost extent (10/02/2014)

Cadastral boundary

ecosure

Job number: PR6831
Revision: 0
Author: EK
Date: 22/02/2022

0 5 10 20
Metres

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

PR6831_MP3_RoostExtent_Kabra
A4

3.2.2 Land tenure

Flying-foxes have historically roosted in trees on Council reserve land, and regularly roost within trees on the adjacent private property, Lot 7 K4221 (Figure 6). During times of large influxes, most notably in February 2014, flying-foxes have roosted in trees on other surrounding private properties (Lot 15-20 K4221) (Figure 6). In December 2018, flying-foxes were roosting in a patch of vegetation at the end of Bunerba Street (Figure 6).

3.2.3 Ecological values

GHFF have been recorded in the Kabra roost on three recorded occasions. The number of GHFF has not exceeded 10,000 individuals and does not regularly host more than 2,500 individuals, therefore does not meet the criteria for a nationally important roost.

A WildNet search resulted in no detected threatened species within a 1 km radius of the Kabra roost, however the GHFF is a vulnerable species known to occur in the area.

A list of threatened species that may, are likely to, or are known to occur within 1 km of the Kabra roost generated by the PMST can be found in Appendix 4.

3.2.4 Flying-fox occupancy

All three species of flying-foxes have been recorded in Kabra. BFF are seen more regularly in Kabra than LRFF, but are usually seen in smaller numbers. LRFF are nomadic and move from roost to roost following the flowering eucalypts. They periodically move into existing BFF roosts, often in large influxes. LRFF typically roost in the Rockhampton area during the summer months. In August 2017 and August 2019, GHFF have been recorded roosting in Kabra in small numbers (Figure 7).

Flying-foxes have been recorded on a regular basis in Kabra for a number of years, since at least 2012. One large influx of LRFF was recorded in February 2014, with some smaller influxes generally throughout the summer months. During the large LRFF influx, Council have reactively managed the Kabra roost, however no long-term management plan has been developed. The last occupation of flying-foxes recorded in Kabra was February 2021 (Figure 7). No flying-foxes were observed during a site visit on the 18th of January 2022.

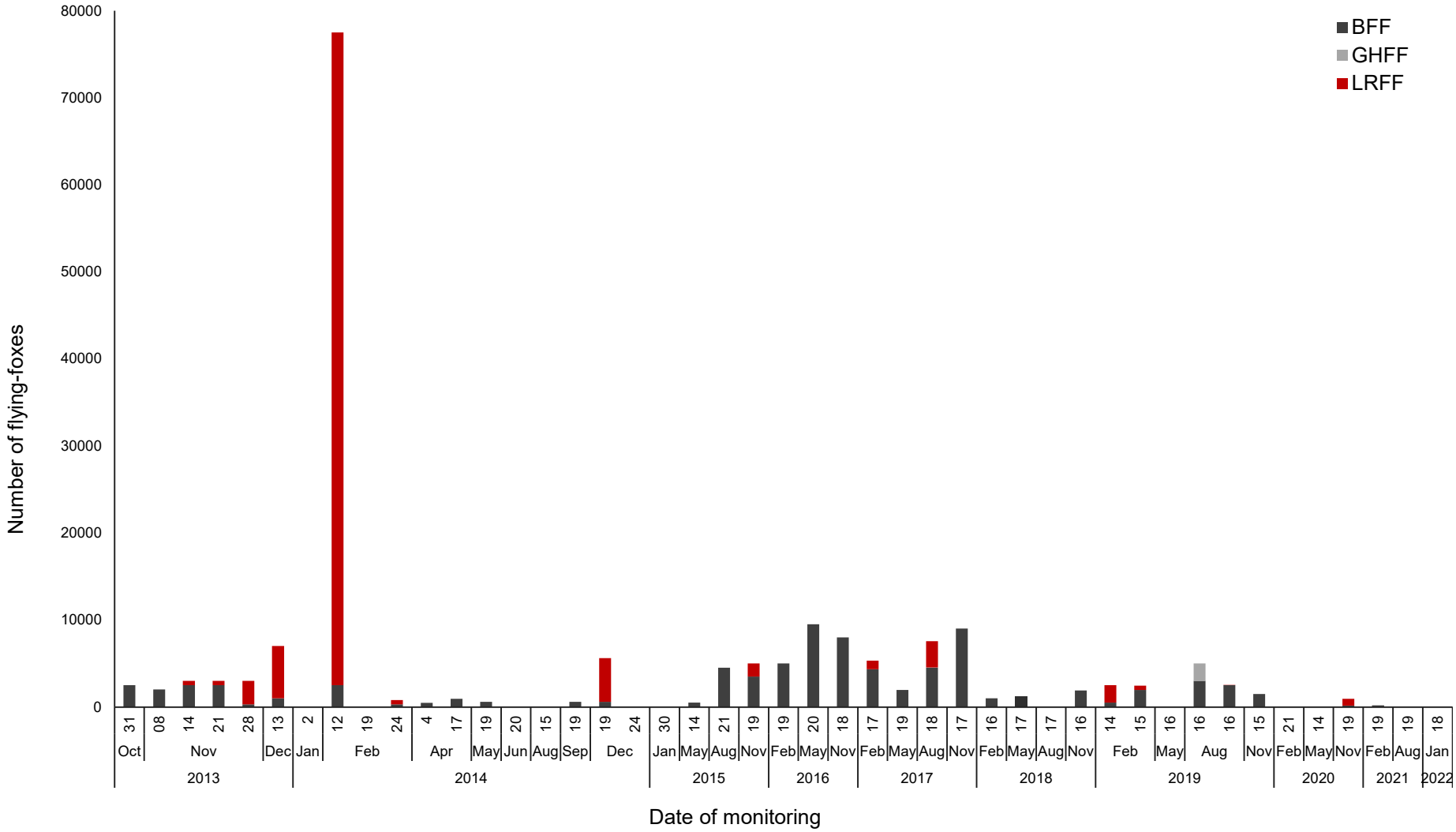


Figure 7 Historic roost count for Kabra Township (Source: DES, Ecosure, RRC 2022)

3.2.4.1 Issues to date

Residents in Kabra rely on rainwater tanks as their main water supply, which has been a concern for many residents due to the fear of contaminated rainwater from flying-fox faecal droppings and urine. Residents have also been impacted by faecal droppings on their property and have experienced significant impact from noise and odour associated with living near a flying-fox roost.

Flying-fox roosting trees have experienced significant vegetation damage, such as slumping/breaking branches and defoliation on both Council land and private property (Plate 2). This is especially evident during times of large influxes.

Plate 2 Flying-fox roosting trees, Kabra

There has been reports that some shooting/attempted shooting of flying-foxes has occurred during high influx periods. This is an illegal act, as flying-foxes are native species protected under the EPBC Act (Appendix 1).

There are no sensitive sites located within 2 km of the Kabra roost, however the Rockhampton Airport is located approximately 12.5 km northeast of the roost. There is also concern for

potential Hendra Virus disease transmission, due to many horses residing on the surrounding private properties.

3.2.4.2 Management response to date

Council have reactively assisted residents with water drops and roof cleaning during the large influx of LRFF in February 2014. During this time, Council have also conducted vegetation removal and thinning of roost trees along Middle Creek on Council land to minimise flying-fox roosting. After this large influx, Council also offered green waste collection for private landholders to dispose of green waste if they chose to conduct vegetation modification on their private properties. Since the vegetation trimming, there has been no recorded large influxes of flying-foxes.

Council have invested resources into residents of Kabra of the important ecological value of flying-foxes and the legality of protecting native species.

3.3 Westwood township

3.3.1 Roost description

Westwood is a small township located within the RRC LGA, approximately 45 km south-west of Rockhampton. Flying-foxes typically roost in trees near the Westwood Hall, adjacent to the Capricorn Highway (Figure 8). During large influxes (notably in February 2018), flying-foxes have been recorded roosting in trees surrounding the Westwood State School, on the corner of Galton Street and Herbert Street, and several other private properties in the area.

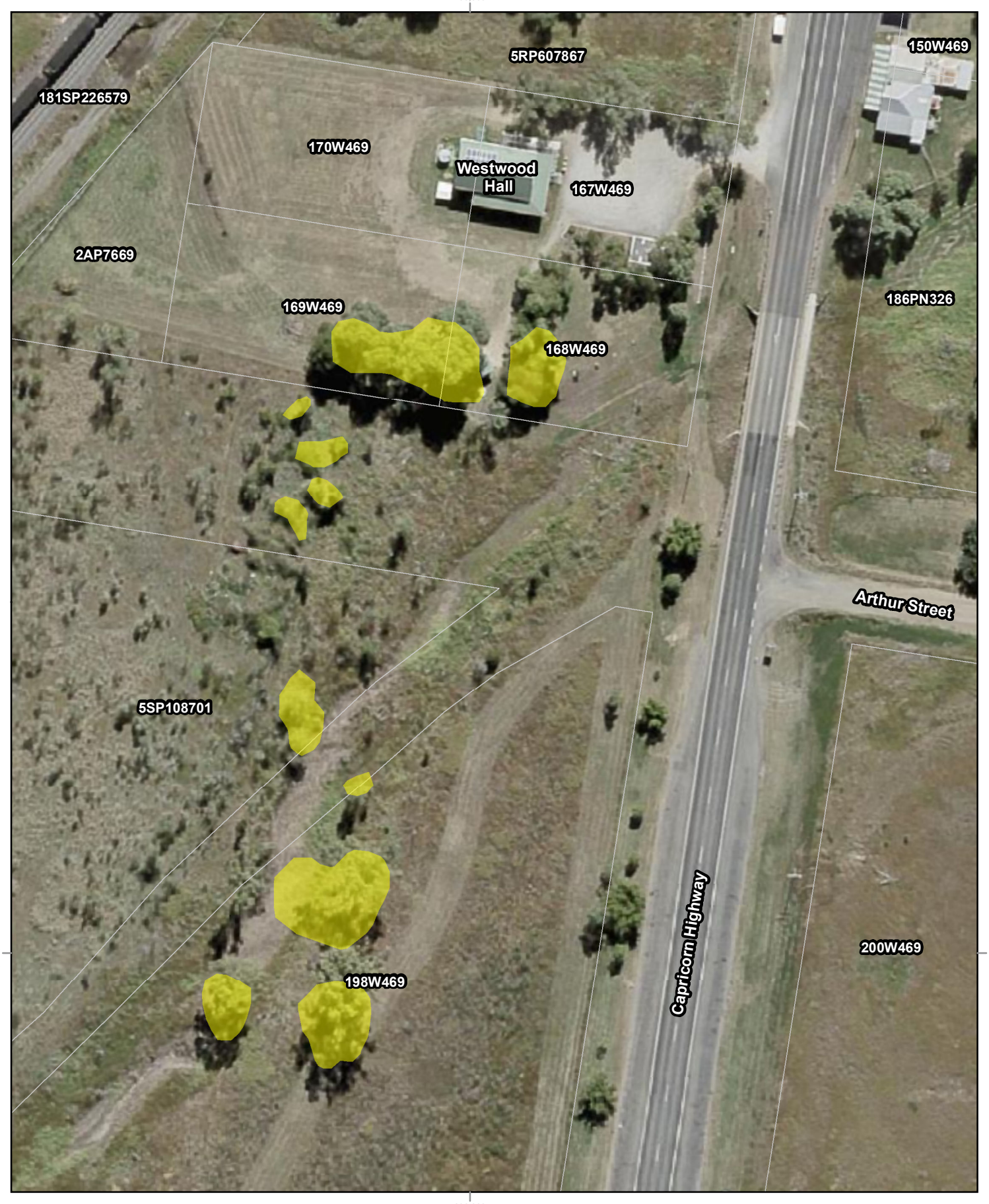


Figure 8: Westwood township flying-fox roost extent

Rockhampton Regional Council

RRC Flying-fox Roost Management Plan

BFF extent (18/01/2022)

Cadastral boundary

ecosure

Job number: PR6831
Revision: 0
Author: EK
Date: 22/02/2022

0 5 10 20
Metres

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

PR6831_MP3_RoostExtent_Westwood
A4

3.3.2 Land tenure

The primary roost trees are located on Council reserve land, Lot 167-170 W469 (Figure 8). Flying-foxes also regularly roost in trees on the adjacent private property (Lot 5 RP607867) directly north of the Council reserve land. During a large influx of LRFF in February 2018, flying-foxes were roosting in trees on the Westwood State School property, Lot 501 SP179894.

3.3.3 Ecological values

The Westwood roost does not meet the criteria for a nationally important roost as no GHFF have been recorded roosting in Westwood. However, GHFF may occur here in the future due to being recorded at nearby sites, such as the Kabra roost.

A WildNet search resulted in no detected threatened species within 1 km of the Westwood roost. A list of threatened species that may, are likely to or known to occur within a 1 km buffer area of the Westwood roost generated by the PMST can be found in Appendix 4.

3.3.4 Flying-fox occupancy

Both BFF and LRFF have been recorded at the Westwood roost. BFF are seen more regularly in Westwood than LRFF, but are usually seen in smaller numbers (Figure 9). LRFF are nomadic and move from roost to roost following flowering eucalypts. They periodically move into existing BFF roosts, often in large influxes. LRFF typically roost in the Rockhampton area during the summer months.

BFF have been recorded on a regular basis in Westwood since at least 2012, typically with less than 1000 individuals at any one time (Figure 9). One large influx of LRFF was recorded in February 2018, with an estimation of 48,900 individuals (Figure 9). During this large influx, Council have reactively managed the Westwood roost, however no long-term management plan has been developed. Since this large influx, only small numbers of BFF and LRFF have been recorded roosting here (Figure 9).

2,070 BFF were recorded during a site visit on the 18th of January 2022. Some were observed carrying dependent juveniles, while many young were starting to hang independently.

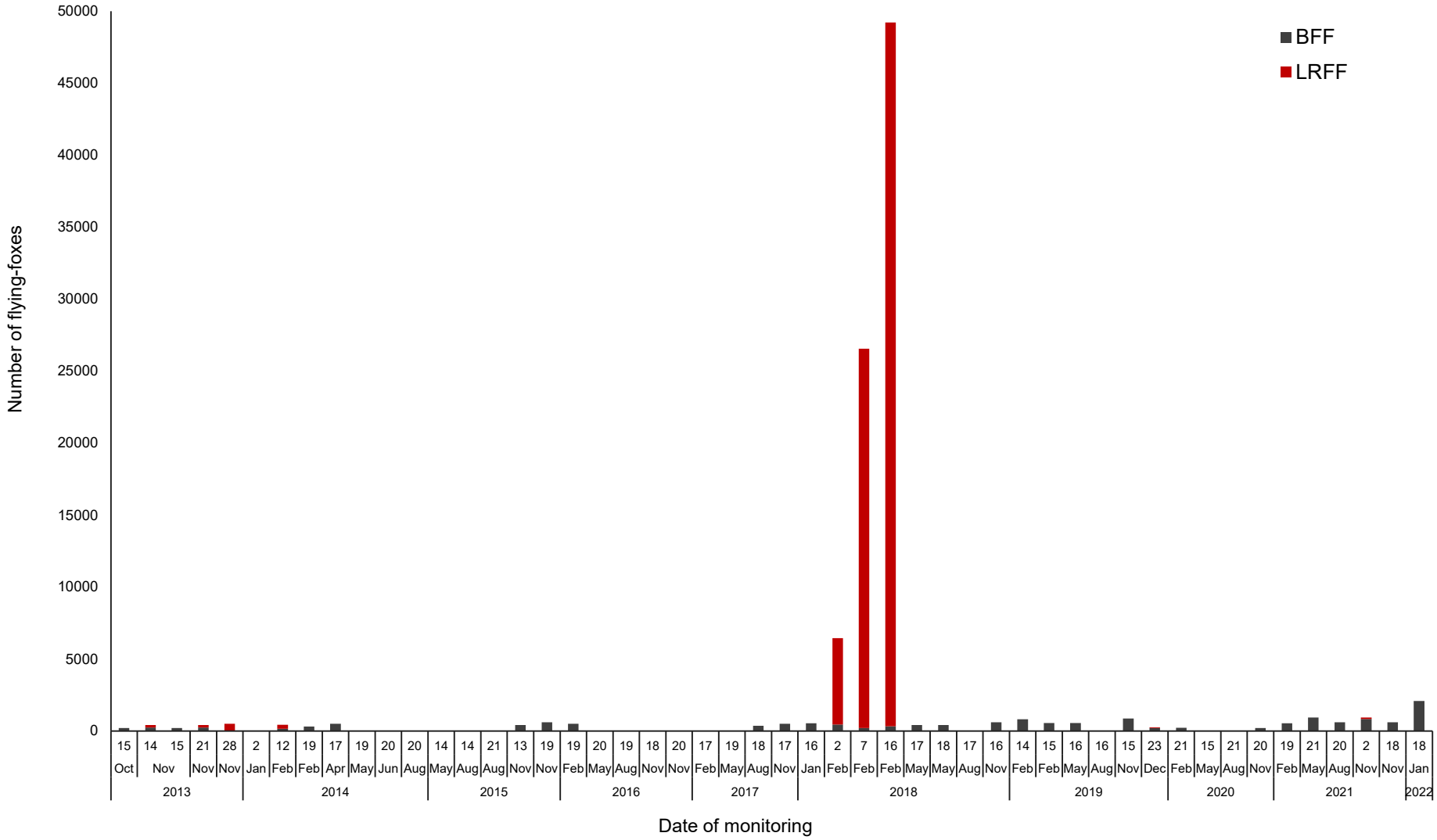


Figure 9 Historic roost count for Westwood Township (Source: DES, Ecosure)

3.3.4.1 Issues to date

Health and safety concerns have been raised due to the close proximity of the public toilet facilities on the Westwood town hall grounds and the potential for contamination of the rainwater supply (Plate 3). Community events such as markets and Anzac Day parades are held at the Westwood Hall, where the proximity to flying-foxes is of concern for the health and safety of attendees. In addition to contamination of the water supply of the town hall toilet blocks, contamination of the rainwater supply for nearby residents is also of concern.

Plate 3 Flying-fox roosting tree above public toilet block, Westwood.

Residents have raised concerns for the health and safety of children, particularly during large influxes of flying-foxes. In February 2018, a large number of LRFF roosted in trees at the front of the school. As a result, the school pick-up location was diverted to the back of the school, causing disruptions to the wider community. Some parents also refused to allow their children to go to school to prevent close contact with the flying-foxes. Another safety concern is vegetation damage caused by the high density of roosting flying-foxes at times (Plate 4). During the large influx of LRFF, branches of roosting trees broke close to powerlines (Plate 5). This caused concerns for people living nearby as it provided a falling hazard and potential for electrocution or power outages in the township. There is a report of a resident getting scratched by a flying-fox, though the resident did not seek medical treatment.

Plate 4 Flying-fox roosting trees with vegetation damage, Westwood

Plate 5 Vegetation damage near powerlines, Westwood.

Westwood State School is a sensitive site located within 1 km of the Westwood flying-fox roost (Figure 10). There is also concern for potential Hendra virus disease transmission, due to many horses residing on the surrounding private properties.

3.3.4.2 Management response to date

Council provided residents with fresh water drops during the large LRFF influx to mitigate potential issues with contaminated rainwater. Council provided assistance in supplying green waste removal services for residents conducting vegetation modification on private properties. Council also provided vegetation modification assistance to the property directly adjacent to the north of the town hall.

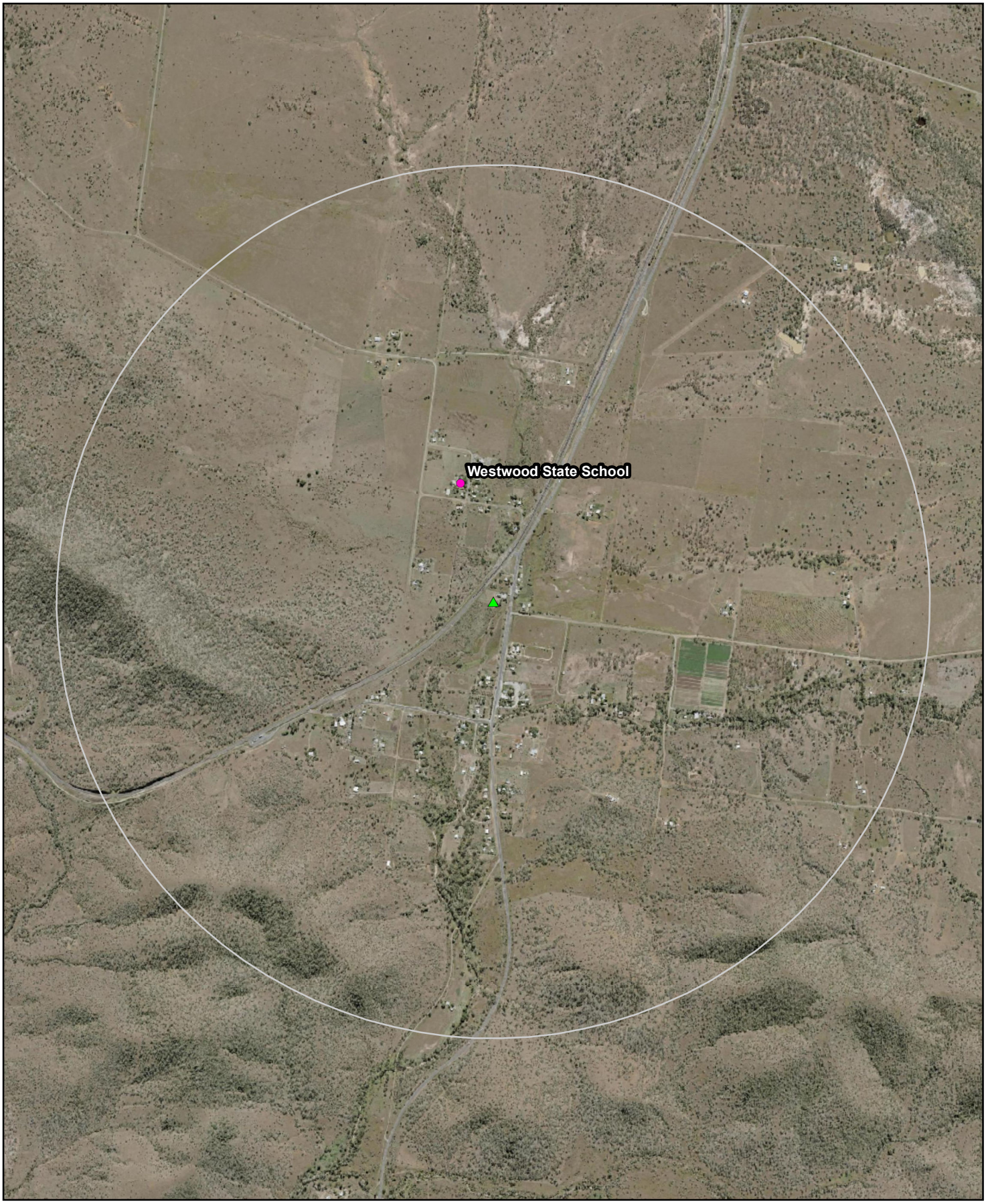


Figure 10: Sensitive sites within 2 km of Westwood township roost

Rockhampton Regional Council

RRC Flying Fox Roost Management Plan

2 km buffer

Flying-fox roost

Sensitive sites

School

ecosure

Job number: PR6831
Revision: 0
Author: EK
Date: 17/02/2022

0 100 200 400
Metres

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

4 Community engagement

Early and effective community engagement and education has benefits for both communities and land managers. These benefits include increasing community understanding and awareness of flying-foxes, their critical ecological role, and factors that need to be considered in developing a management approach. Engaging with the community is equally important to ensure land managers understand impacts associated with a roost to effectively manage community concerns. Council sought to consult with all stakeholders with an interest in the flying-fox roosts during the development of the Plan. The results of the engagement are detailed below.

4.1 Online survey results

The community online survey was advertised via social media and Council marketing and was open for three weeks (24 January - 14 February 2022). Survey results are summarised in Appendix 5. The survey was completed by 237 people. Forty-seven percent of survey respondents identified as residents or business owners impacted by a roost, 39% identified as residents or business owners not impacted by a roost, with the remainder identifying as members of club or occasional visitors to the Rockhampton region.

Approximately 99% of respondents identified Rockhampton as being the general location of experienced impacts. Respondents' proximity to the roost from their home was only answered by 43% of respondents, amongst these responses, 4% lived within 100 m or less of a roost, and the majority (55%) living between 300 m and 1 km of a roost. Most respondents experienced impacts in recreational areas/RBG and their home, with a small number of respondents experiencing impacts at work, and the Rockhampton South Kindergarten (Figure 11).

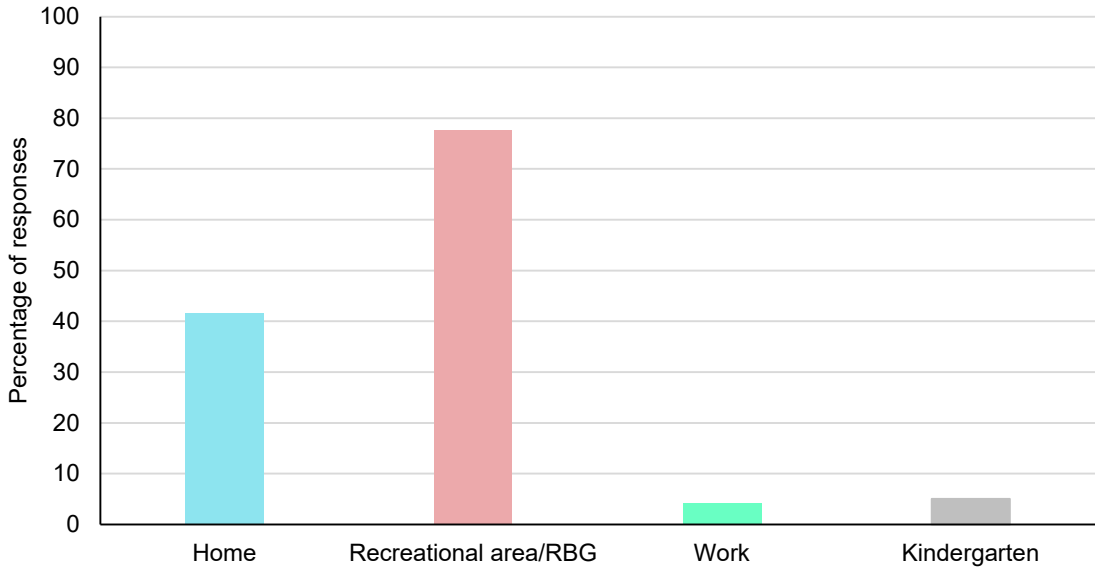


Figure 11 Responses to the question: "Where are you being impacted (home, work, recreational area)?"

Given that the times respondents experienced impacts was an open-ended question, distinguishing exactly when respondents experienced impacts was somewhat subjective, and percentages are only a rough approximation. Majority of the responses listed 'all day', daylight hours or anytime when visiting the gardens (~42%). This was followed by impacts during dusk/evening/night (~34%), then followed by impacts in the morning/dawn (~22%). The smallest percentage of respondents listed 'all times' or '24/7' (~9%). Note that the distinction between 'all day' and 'all times' were assumed, as many responses listed 'all day' were given alongside context of 'when visiting the gardens', however 'all times', were not given context of visiting the gardens, so may or may not be an indication of impacts experienced 24 hours a day.

The community was asked to respond a range of statements about flying-foxes. The majority of respondents were aware that flying-foxes are a native species (85.4%) protected under legislation (87.2%). In response to the statement that flying-foxes 'are increasing in numbers', 54.3% of respondents answered true. In response to the statement that flying-foxes 'are decreasing in numbers', only 26.2% of respondents answered true, with the remainder answering false (50.2%), don't know (21%) and don't care (2.6%). The majority of respondents acknowledged that flying-foxes perform important ecological roles (70%) and that flying-foxes are migratory, moving between Rockhampton and other parts of Australia (66%). When prompted statements regarding disease transmission, 67.7% of respondents believed that flying-foxes 'carry disease that is easily transmitted to humans and animals' and only 45% of respondents believed that flying-foxes 'carry disease that can be easily prevented in humans and animals'.

Respondents were asked to address how strongly they agreed with certain statements. The majority of respondents agreed to some extent (56.9%) that flying-foxes were important to the environment. When prompted with the statement that 'flying-foxes are a pest and should be managed', 65% of respondents agreed to some extent and 31.5% disagreed to some extent. Most respondents acknowledged that living next to bushland presents some challenges in relation to wildlife (72.2%), and also agreed to some extent that Council should balance conservation and resident amenity (77%).

The community was asked to assess their experience or interaction with flying-foxes in Rockhampton and their responses were predominantly negative. Sixty percent responded as negative, 26.7% responded as positive and 14.4% responded as neutral.

Note multiple responses could be selected for some questions which accounts for >100% total. Of the 237 survey respondents, only 26.6% responded to the question regarding what they like about flying-foxes. Respondents who felt positively about flying-foxes especially appreciated their role in the ecosystem as pollinators (93.7%), being able to live with native wildlife (92%) and enjoy watching them roost /flying out (88.8%). Other comments that were added regarding the positive experience with flying-foxes included the tourism opportunities they provide in Rockhampton.

When asked what issues relating to flying-foxes are of concern (Figure 12), three issues stood out by a large margin, with mess from droppings (73.5%), smell (66.5%) and fear of disease (59.9%) mentioned in a majority of the responses. Noise and damage to vegetation were

followed shortly after mentioned in 48.5% and 45% of responses, respectively. Other concerns listed included flying-fox habitat protection (29.5%), flying-fox welfare (28.6%), misinformation about flying-foxes (24.2%), flying-fox conservation (24.2%), fruit loss at orchards (22.9%), foraging in my yard (22.5%) and visual amenity (19.4%). Other comments given by respondents also outlined the threat of strike risk and damage to aircrafts at the nearby Rockhampton Airport.

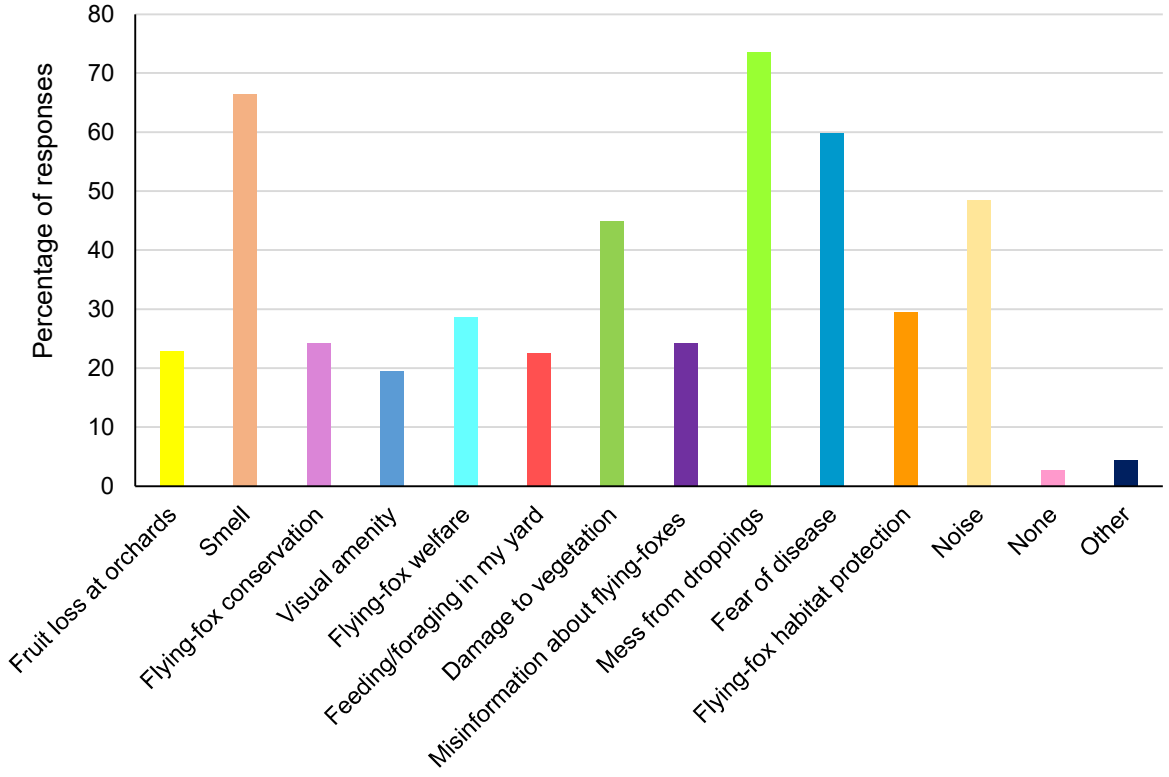


Figure 12 Responses to the question: “Which of the following topics relating to flying-foxes are of concern to you?”

When respondents submitted an answer as to how they had personally been impacted one of the flying-fox roosts, the impacts experienced were similar to the issues they were concerned about. Of 133 answers given, the top three impacts answered in open ended questions were a loss of amenity/loss of recreational space (~53%) particular in regards to the Rockhampton Botanic gardens, followed by impacts of smell (~49%) and excrement/mess (~43%). Other highly cited impacts include noise, disease risk, property damage and flying-foxes eating fruit from their gardens. A range of other impacts were listed such as a loss of work, vegetation damage, bat flies, biodiversity loss around flying-fox roosts, being scratched by flying-foxes, water contamination (rain water tanks and pools), power outages (Kabra), lack of education around flying-foxes, the increase in ibis numbers in the RBG and disruption to their pets.

Respondents expressed similar concerns for flying-fox welfare, removal of habitat and concerns over a lack of awareness or appreciation for the species. The following is a sample of comments illustrating the range of perspectives on flying-foxes in Rockhampton:

- *Poop dropping on roofs, cars etc, horrible stench from their roosting areas, noise and also stripping/killing the vegetation.*

- *Danger to planes landing; affects on local community run kindergarten; the 'bat fly/ticks' that fall off them onto anyone walking/seated under their roosts; the management of Ibis and Egrets no longer taking place.*
- *I love the flying foxes and will often go to the gardens to see them. Please take care of them!*
- *The flying foxes at the botanic gardens cafe makes the outdoor space unattractive and unusable.*
- *Can no longer meet at Gardens for coffee. Easy to fall as some paths are slippery with faeces. Smell is intolerable. Walkways blocked under collapsed bamboo due to bats. People are being pushed out of this vital space. People are at risk of disease through food contamination. Other wildlife eg parrots are reducing in nos. Cannot eat under banyans as faeces of bats and ibis are continually falling.*
- *I fully understand that living near a roost can be a very noisy, smelly, and messy experience. But with climate change severely affecting flying fox populations, they need safe, natural habitats where they can flourish.*
- *The flying foxes need to be seen as an asset, not a 'pest' animal. They are a protected species for a reason, rather turn the roost into a tourist attraction. It is right next to the zoo - you literally could not ask them to be in a more convenient location as far as education goes. People could visit the Zoo AND see a free flying native animal (do talks etc.).*

The majority of respondents considered it important that Council protect vegetation and other environmental values in parklands and bush areas (88.9%). This issue was ranked as highly important (rated 10) for 52.2% of respondents.

The most supported management option for respondents was protecting and enhancing flying-fox habitat in low conflict areas (55.6%) (Figure 13). Buffer between people and flying-foxes using non flowering plants and buffers using deterrents were also supported by majority of the respondents (52% and 53.4% respectively). Land use planning and education/research were supported by 43% of respondents, with the remaining management options having support from less than 20% of respondents.

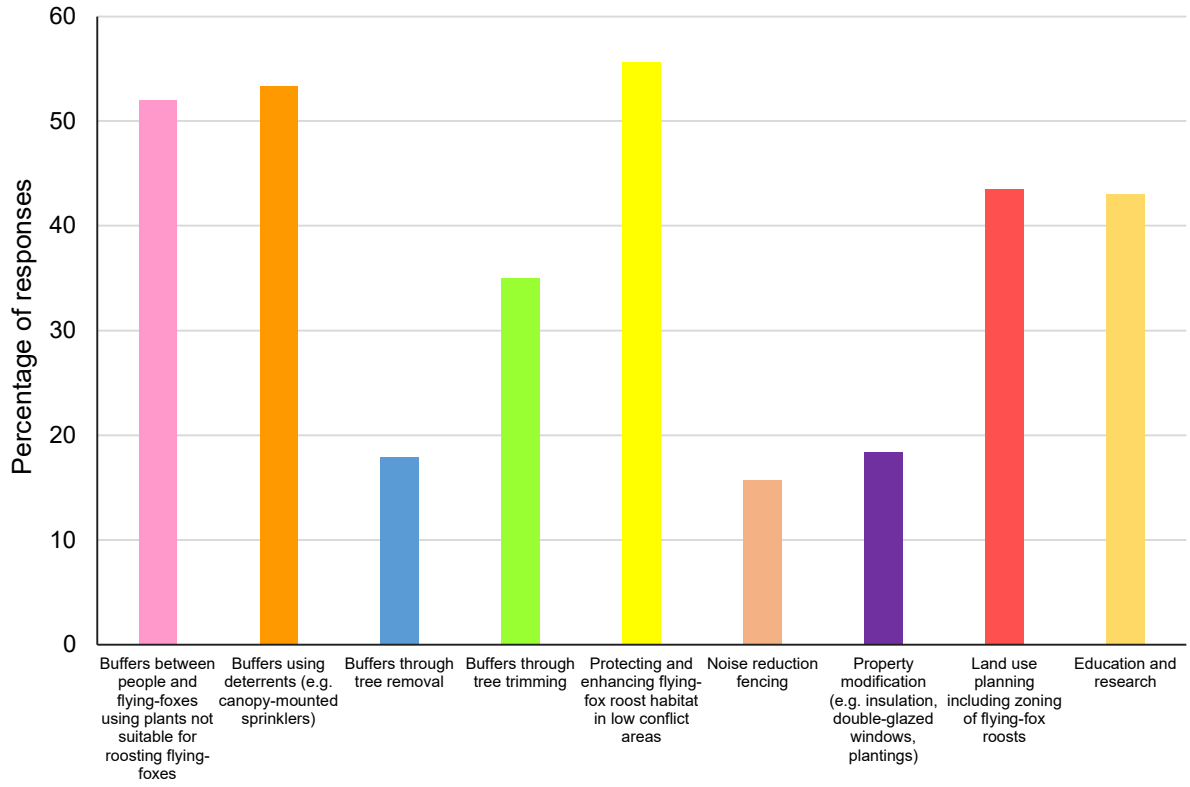


Figure 13 Responses to the question: "Which of the following management options do you supports?"

Only 77.6% of respondents answered which education options they supported. Out of the respondents who answered, the most supported education options were educational signage (54.9%), website with links and up-to-date information (52.7%) and fact sheets with up-to-date information regarding flying-foxes or the roost (50.5%). Additional education options listed still had relatively high support (30-45%). Seventeen percent of responses to this question were classified as 'other', which primarily consisted of responses not approving any education options, as it does not remove flying-foxes from the area. Though, some responses given outlined reiterating the importance of flying-foxes for future generations and their importance in the ecosystem and pollination.

When respondents were asked what management options were not appealing, roughly 45% did not support vegetation removal/trimming, stating that Rockhampton needs more vegetation, not less. Sixty-four percent of respondents were interested to know more information about plants to avoid attracting or attract flying-foxes to their yard. Of these respondents, 76% would like to know about plants to avoid attracting flying-foxes to their backyard, while 31% would like to know about plants to attract flying-foxes to their yard.

5 Management options analysis

Figure 3 outlines a site-specific assessment of flying-fox impact management options commonly used across Australia, and their suitability for the RBG, Kabra, and Westwood roosts, as well as emerging roosts. Descriptions and examples of management options are provided in Appendix 6.

Table 3 Management options analysis (see Appendix 6 for option descriptions).

Management options	Advantages & disadvantages	Suitability for RBG, Kabra and Westwood Township sites	Suitability for emerging roost	Permits required	Appraisal
Education and awareness programs	**Advantages:** Low cost, promotes conservation of flying-foxes, contributes to attitude change which may reduce general need for roost intervention and reduce anxiety, increasing awareness and providing options for landholders to reduce impacts can be an effective long-term solution, can be undertaken quickly, will not impact on ecological or amenity value of the site. **Disadvantages:** Education and advice itself will not mitigate all issues, and in isolation would not be acceptable to the community.	Collecting and providing information should always be the first response to community concerns in an attempt to alleviate issues without the need to actively manage flying-foxes or their habitat. Council has engaged with affected residents to provide information on human health, legislation, and the importance of flying-foxes. Continued education and ensuring all residents have access to the latest health information is required. Increased education targeting students, parents, and teachers at Westwood State School and Rockhampton South Kindergarten should also be implemented to address potential future influxes of flying-foxes in the RBG and Westwood roosts.	Proactive engagement with surrounding landholders and sensitive site occupants/attendees (e.g. schools, hospitals) is vital to address impacts and concerns before they arise.	No	Continue and increase at all three sites, particularly at Westwood State School and Rockhampton South Kindergarten
Subsidy program - property modification / item	**Advantages:** Property-level impact mitigation (e.g. double-glazing, indoor odour-neutralising pots, noise attenuating insulation, car covers, boundary barriers such as dense plantings with fragrant flowers) is one of the most effective ways to reduce amenity impacts. It provides more certain outcomes compared with attempting to manage flying-foxes or their habitat. It is relatively low cost, can be included in building design and materials, will not	Property modification is not likely to be well-received by the community as a management option (see Section 4.1). However, it may be more supported if costs were able to be assisted by a Council-funded subsidy program. It also may have had poor support in the community survey as the majority of respondents resided near the RBG, so this result does not necessarily represent the wants/needs of Kabra and Westwood residents, where flying-foxes roost close to residential properties.	Suitable for emerging roosts in high conflict areas, particularly if residents are experiencing impacts related to noise and smell, or other issues that	No	Investigate subsidy options and communicate options with affected residents

Management options	Advantages & disadvantages	Suitability for RBG, Kabra and Westwood Township sites	Suitability for emerging roost	Permits required	Appraisal
	impact on the roost and may add value to the property. **Disadvantages:** May be cost-prohibitive for private landholders, unlikely to fully mitigate community concerns.	**RBG:** Few residents affected and low support from community for this management option. May be supported by Rockhampton South Kindergarten if flying-foxes continue to roost in close proximity. **Kabra/Westwood townships:** Property modification is ideal as costs can be more easily budgeted than for roost management, which is hard to predict. Council should investigate potential for a Council-funded subsidy program, and opportunities to apply for grants to supplement such a program. Residents in these areas rely on rainwater tanks for drinking water supply, so subsidies could be used to assist in providing water contamination solutions. See Appendix 6 for further information regarding subsidy programs.	could be alleviated through an item/property-based subsidy program		
Subsidy program - services	**Advantages:** Service subsidies (e.g. assistance with cleaning faecal drop) may encourage tolerance of living near a roost; promotes conservation of flying-foxes; can be undertaken quickly; will not impact on the site; would reduce the need for property modification. **Disadvantages:** Costly over a large scale which must be considered if proposed development intends to increase dwelling density around roost.	**Kabra/Westwood townships:** This management technique has been successfully adopted at Westwood and Kabra townships (see Sections 3.2.4.2 and 3.3.4.2). While it can be costly over a large scale, it is suitable for these sites that are smaller with fewer impacted residents than larger townships. **RBG:** Council currently assists cleaning in/around the RBG Gardens Tearooms. This has proven costly over the long-term, and other management techniques should be adopted to prevent flying-foxes from roosting in close proximity to the Gardens Tearooms. Ongoing cleaning may still be required on a reactive basis. Mess from droppings was identified as a main concern for many community members. Service subsidies to clean faeces off amenities would therefore be highly regarded.	Suitable for emerging roosts in high conflict areas, particularly if residents are experiencing impacts related to mess from faecal matter (e.g. on cars, solar panels, in water tanks), or other issues that could be alleviated through a service-based subsidy program.	Council to investigate potential for a Council-funded subsidy program which may include service subsidies, and opportunities to apply for grants to supplement such a program. See Appendix 6 for further information regarding subsidy programs.	Continue at all sites when required (e.g. during flying-fox occupancy and/or influxes)

Management options	Advantages & disadvantages	Suitability for RBG, Kabra and Westwood Township sites	Suitability for emerging roost	Permits required	Appraisal
Routine roost management	**Advantages:** Can improve amenity at the site as well as impacts to biodiversity such as weeds on the site and in downstream areas. **Disadvantages:** Will not generally mitigate amenity impacts for nearby landholders. Weed removal and bushfire management has the potential to reduce roost availability and reduce numbers of roosting flying-foxes. Removing weeds also changes the microclimate which can increase roost temperature and therefore susceptibility to HSEs.	**Kabra/Westwood townships:** Residents (notably those at Kabra and Westwood) are able to maintain properties in accordance with the Low Impact COP. Where Council considers appropriate, vegetation in high conflict areas at each site (e.g. around Westwood State School) may be thinned, removed or lopped so it is less attractive for roosting in future. Council removed vegetation in Kabra following the large LRFF influx in 2014; this vegetation should be managed/improved to restore ecological values to the site, without attracting flying-foxes back. **RBG:** Roost management is likely not required at RBG as vegetation is already regularly maintained, being a heritage listed site. The heritage listing may impact Council's ability to manage roost vegetation.	Avoid undertaking roost management activities that are likely to discourage flying-fox roosting at low conflict sites (e.g. weed removal). Encourage roosting at low conflict sites through habitat improvement activities. For an emerging roost in a high conflict area, roost vegetation should be managed to discourage roosting (e.g. vegetation thinning, weed removal).	No permit required for weed management or habitat improvement.	Continue in suitable areas and at appropriate times (ideally in the non-breeding season or adapted during the breeding season to be less disruptive)
Alternative habitat creation	**Advantages:** If successful in attracting flying-foxes away from high conflict areas, dedicated habitat in low conflict areas will mitigate all impacts and helps flying-fox conservation. Rehabilitation of degraded habitat that is likely to be suitable for flying-fox use could be a more practical and faster approach than habitat creation.	**RBG:** The Fitzroy River roost, located in proximity to the RBG, is an ideal alternative roost for flying-foxes in the RBG and is a lower conflict site. Council should avoid disturbance to this habitat to encourage flying-foxes roosting here (e.g. liaising with Council contractors and educating the public). Council should aim to identify suitable roost habitat in low conflict locations and restore and/or	If emerging roost is in high conflict location, Council should aim to identify suitable roost habitat in low conflict locations and	No	Avoid disturbance at Fitzroy River roost. Identify alternative, low-conflict sites for habitat restoration/enhancement

Management options	Advantages & disadvantages	Suitability for RBG, Kabra and Westwood Township sites	Suitability for emerging roost	Permits required	Appraisal
	Disadvantages: Generally costly, long-term approach so cannot be undertaken quickly, previous attempts to attract flying-foxes to a new site have not been known to succeed.	enhance habitat to encourage flying-fox roosting. Habitat enhancement should aim to maintain good canopy health through weed and vine removal, and maintain good canopy succession (i.e. lower, mid and upper storey) to prevent complete forest deterioration during large flying-fox influxes and provide refuge habitat during HSEs. This is likely to be well received by the community, as the most supported management option from the community survey was protecting and enhancing flying-fox habitat in low conflict areas. **Kabra/Westwood townships:** Given that flying-fox occupancy is relatively low and transient at Kabra and Westwood townships, this costly option is not justified currently. However, Council could investigate potential alternative sites for habitat enhancement as a long-term management solution.	restore and/or enhance habitat to encourage flying-fox roosting there. At low conflict sites, habitat should be improved to encourage roosting (as row above).		
Provision of artificial roosting habitat	**Advantages:** Artificial roosting habitat (e.g. suspended ropes) could be considered to supplement the canopy if weed removal or roost management affects available roosting space. **Disadvantages:** No guarantee that flying-foxes would use artificial habitat but collaborating with a researcher on varying design options would increase the likelihood of success.	To date artificial habitat structures have not been effective. Further trials could be considered with the aim of reducing pressure on roosting vegetation where this is a main concern.	Potentially suitable to enhance a low-conflict emerging roost where the pressure on roosting vegetation where this is a main concern.	No	Investigate for sites where vegetation damage is a main concern
Protocols to manage incidents	**Advantages:** Protocols for managing incidents (e.g. HSEs, unauthorised disturbances) can reduce the risk of negative human/pet-flying-fox interactions. Low cost, promotes conservation of flying-foxes, can be undertaken quickly. In some cases, infrastructure problems such as power black-outs from flying-foxes being electrocuted on powerlines may be	Council should respond to HSEs as per the Flying-fox Heat Event Response Guideline for south-east Queensland (Bishop et al. 2019) or consider developing a region-specific HSE document. Council should continue to engage with wildlife carers and nearby residents, particularly during potential mass mortality events such as HSEs and post-storm recovery.	Protocols for managing incidents should be established at both low and high conflict emerging roosts.	No	Continue to manage incidents in close communication with local carers

Management options	Advantages & disadvantages	Suitability for RBG, Kabra and Westwood Township sites	Suitability for emerging roost	Permits required	Appraisal
	avoided by proactive management (e.g. adding spacers on powerlines). **Disadvantages:** Will not mitigate amenity impacts.				
Research	**Advantages:** Support research that improves understanding and more effectively mitigates impacts. For example, outdoor odour-neutralising technology could be used to mitigate odour impacts to residents. Develop understanding of native flowering event in area. **Disadvantages:** Generally, cannot be undertaken quickly, management trials may require cost input.	Smell was identified as the second highest concern associated with flying-foxes amongst the community. As the survey was predominantly completed by those impacted at the RBG, an odour-neutralising trial could be conducted at this site – focusing on high trafficked areas such as the Garden Tearooms. New research should be reviewed at least annually and incorporated into management where appropriate.	Odour-neutralising trial could be considered at high conflict sites where odour is regarded as the major impact. Research should be ongoing for both low and high conflict sites.	Research permit and Animal Ethics Committee (AEC) approval required for outdoor odour-neutralising trial	Investigate outdoor odour-neutralising trial
Appropriate land-use planning	**Advantages:** Planning for future land use where possible, will reduce potential for future conflict between community and flying-fox roosts. **Disadvantages:** Will not generally mitigate current impacts.	Incorporate planning controls where possible.	Incorporate planning controls where possible.	No	Investigate
Property acquisition	**Advantages:** Allows affected landholders to move away from a roost, mitigating all impacts. Supports flying-fox conservation. **Disadvantages:** Costly; property owners may not want to sell.	This option is considered cost-prohibitive and unlikely to be accepted by affected residents.	This option is considered cost-prohibitive and unlikely to be accepted by affected residents.	No	Not suitable
Buffers through vegetation	**Advantages:** Can provide a buffer between the community and flying-fox roosts which can reduce concerns in some instances.	**RBG:** Buffers should be created between flying-fox habitat and the Rockhampton South Kindergarten at RBG to prevent flying-foxes	Suitable at high conflict sites where residents	Possibly under VM Act* Relevant	Consider at RBG if other methods (below) are

Management options	Advantages & disadvantages	Suitability for RBG, Kabra and Westwood Township sites	Suitability for emerging roost	Permits required	Appraisal
removal	**Disadvantages:** Removing vegetation can reduce buffering benefits of the vegetation to noise, odour and visual impacts, with potential to create additional conflict. Vegetation removed may exacerbate the impacts of HSEs.	roosting along the boundary fence or on the kindergarten grounds. The community survey revealed very low acceptance of vegetation removal (trimming was more accepted) as a management option, so other buffering methods should be explored first (below). Buffers should also be created around the Gardens Tearooms, though visual and olfactory deterrents would be more suitable here (below). **Kabra township:** Buffers should be created between vegetation lining the creek (bordered by Morgan and Moonmera Street) and residential properties in this block. During influxes, flying-foxes roost on or adjacent to private properties west of this block. Given these vegetation patches are relatively small and located very close to residential dwellings, creating buffers through vegetation removal may be difficult. However, residents are able to maintain properties in accordance with the Low Impact COP. **Westwood township:** The current roosting location in Westwood township is not problematic, though buffers may be required in future for vegetation adjacent to Westwood State School. Vegetation could be managed around the Westwood Hall and/or toilet block if flying-foxes are causing damage to amenity or health concerns. Where there is a high infestation of weeds or a dense mid/understorey (particularly below a low canopy), weed and understorey management may sufficiently alter buffer habitat, making it unfavourable for roosting flying-foxes. If weeds and/or understorey are not present, trees may require trimming to create a buffer.	are in close proximity to flying-fox roosting habitat. Vegetation removal should be avoided/limited at low conflict sites to avoid inadvertent dispersal of flying-foxes.	approvals/permits may also be required at RBG is it is a heritage listed site. Weed removal can occur as a general maintenance program and is permitted under the DES Low Impact COP. If undertaking vegetation works outside of the Low Impact COP, DES notification will be required.	unsuccessful. Consider at Kabra roost currently and Westwood in future.
Buffers without vegetation removal –	**Advantages:** Canopy-mounted water sprinklers to create buffers have been effective at many roost sites in Queensland with no welfare impacts observed during	**Kabra township:** Given that residents in Kabra rely on rainwater tanks for their water supply, CMS are unlikely to be feasible as a buffering method. Other methods, such as PROVolitans,	Suitable at high conflict sites where residents are in proximity	Notification to DES and possible approval	Trial D-ter and PROVolitans lighting in fig trees

Management options	Advantages & disadvantages	Suitability for RBG, Kabra and Westwood Township sites	Suitability for emerging roost	Permits required	Appraisal
visual deterrents, taste deterrent, noise emitters, canopy mounted sprinklers (CMS)	monitoring. Visual deterrents – such as plastic bags, fluoro vests (GeoLINK 2012), and balloons (Ecosure pers. comm. 2016) in roost trees have shown to have localised effects, with flying-foxes deterred from roosting within 1–10 m of the deterrents. Lights tend to have limited effectiveness in deterring roosting. For example, a high-intensity strobe light was trialled in the Sydney Botanic Gardens to deter roosting; flying-foxes demonstrated only a slight reaction and lights did not deter flying-foxes from roosting (van der Ree & North 2009). However, a recent study identified a light that flying-foxes perceive as abnormal (Olkkola 2019), which PROVolitans trialled above the canopy of a roost tree, reporting an 80% decrease in the number of flying-foxes roosting in the tree. PROVolitans lights may offer a non-harmful method of flying-fox deterrence for future trials. D-ter is a smell and taste deterrent commonly used as a bird repellent but has also been trialled as a deterrent for flying-foxes (van der Ree and North 2009). The overall success of D-ter was deemed limited as it was only effective short-term and in individual trees (van der Ree and North 2009). **Disadvantages:** Can be logistically difficult (installation and water sourcing) and may be cost-prohibitive. Misting may increase humidity and exacerbate HSEs, and overuse may impact other environmental values of the site. Water restriction consideration required. The type and placement of visual deterrents	could be trialled to create a buffer between residential dwellings directly adjacent to flying-fox habitat along the creek. This is not deemed essential currently as flying-foxes are only transiently occupying this roost. **Westwood township:** Similarly, there is little need for buffers currently as flying-foxes are not regularly roosting adjacent to residential properties or Westwood State School. PROVolitans and/or D-Ter trials could be considered if deemed appropriate in the future. **RBG:** Visual, olfactory and audio methods could be trialled to deter flying-foxes from roosting in specific trees (e.g. heritage listed trees or those at risk of permanent damage), to preserve tree health. While D-ter has a very localised effect, it could be used to deter flying-foxes from specific, individual trees, such as figs directly adjacent to the Gardens Tearooms. PROVolitans lights should also be trialled to deter flying-foxes from high conflict areas, such as surrounding the Gardens Tearooms and the kindergarten (if flying-foxes establish roosting site there). Given the structure and size of these figs, CMS may be logistically difficult to install and have limited effectiveness.	to flying-fox roosting habitat. Buffering method (e.g. CMS) should be determined on a site-specific basis.	under the VM Act* (if removing vegetation to install sprinklers).	surrounding Gardens Tearooms and Rockhampton South Kindergarten at RBG. Also trial deterrence methods in other heritage listed trees or trees likely to be permanently damaged by roosting flying-foxes (if unsuccessful, vegetation removal and/or nudging may need to be considered at RBG). Investigate for future use at Kabra and Westwood townships.

Management options	Advantages & disadvantages	Suitability for RBG, Kabra and Westwood Township sites	Suitability for emerging roost	Permits required	Appraisal
	would need to be varied regularly to avoid habituation. May appear an eye-sore and lead to increase in rubbish in the natural environment.				
Noise attenuation fencing	**Advantages:** Standard noise attenuation fencing is intended to alleviate amenity issues for residents. Advice from an acoustic consultant may provide site-specific alternatives. **Disadvantages:** Noise attenuation fencing is costly and can be considered unsightly if not cleaned of faecal drop.	**Kabra/Westwood township:** Noise was identified as an issue to the two residents (one from Kabra and one from Westwood) that responded to the community survey. To avoid the high costs associated with permanent acoustic fencing, and where flying-fox presence is transient, temporary fencing could be erected in property backyards. Residents/businesses could have the ability to fold down the acoustic fence when there are no flying-foxes present and erect it when flying-foxes return to the site. **RBG:** Given the limited number or residents impacted currently, noise-attenuation fencing is not justified at this stage. It was also the least supported management option in the community survey. Council should liaise with Rockhampton South Kindergarten; if noise is a primary concern, noise attenuation fencing should be considered.	Potentially suitable at high conflict sites where noise is identified as the main concern for residents. Not suitable for low conflict sites due to cost.	No	Consider and liaise with residents at Kabra and Westwood townships and Rockhampton South Kindergarten
Nudging using low intensity disturbance	**Advantages:** Can encourage flying-foxes to shift away from high conflict areas next to residential areas. **Disadvantages:** May lead to inadvertent dispersal if not done at the correct time, frequency or duration. Resource intensive with flying-foxes quickly returning to their favoured roost trees.	**Kabra township:** Given the narrow width of much of the site, it is unlikely that nudging will be effective and will shift flying-foxes closer to other residents or cause the roost to splinter into private residential yards (as has done before during large influxes). Since Council undertook vegetation management following the LRFF influx in 2014, there have been no large influxes of flying-foxes. Given this, the above management techniques should sufficiently reduce impacts at this site, without the need for nudging or dispersal. **Westwood township:** The current roosting location is low conflict and does not require nudging. Nudging attempts at this site may shift flying-foxes closer to Westwood State School or nearby residential backyards. If a large number of	Early intervention nudging may be suitable for new roosts in high conflict areas to prevent the roost from establishing in high conflict locations (e.g. directly adjacent to residents or sensitive sites).	Nudging may be done at certain times under the Management COP and Council's as-of-right but should be during the day to avoid inadvertent dispersal/splintering of the roost which would require a FFRMP. If	Only suitable where other management techniques have been effectively implemented and proven unsuccessful in alleviating impacts.

Management options	Advantages & disadvantages	Suitability for RBG, Kabra and Westwood Township sites	Suitability for emerging roost	Permits required	Appraisal
		flying-foxes establish a long-term roosting site in trees adjacent to the school, and other management techniques (e.g. buffers) are ineffective, nudging may be considered in future. **RBG:** While nudging flying-foxes away from the Gardens Tearooms may alleviate current issues, it may also shift flying-foxes closer to nearby sensitive receptors, such as the Rockhampton South Kindergarten, or nearby residential properties. Previous attempts to nudge flying-foxes from this location have had both positive and negative feedback from the community, but have ultimately been unsuccessful in shifting flying-foxes from high-conflict locations long-term. If other management techniques (e.g. buffers through vegetation removal, PROVolitans, D-Ter, lighting etc.) to shift flying-foxes away from high conflict areas (e.g. Garden Tearooms) are unsuccessful, and negative impacts increase, nudging only in very high conflict areas (Gardens Tearooms, the kindergarten, or significant heritage trees) may be considered in future.		attached young are present, nudging activities should be as passive as possible. Nudging is not appropriate if creching young are present.	
Passive dispersal through vegetation removal	**Advantages:** If successful can mitigate all flying-fox impacts at that site. **Disadvantages:** Likely less stressful on flying-foxes if done in a staged way than active dispersal, but risks as per active dispersal with additional impacts of losing native vegetation.	**RBG:** Vegetation removal is unlikely to be a viable option due to the RBG being heritage listed. It is also unlikely to be supported by the community, as vegetation removal was the second least selected management option in the community survey. Given the size of the site and number of potential roosting trees, flying-foxes are unlikely to vacate the RBG completely even if some trees are removed (i.e. nudging effect rather than dispersal). **Westwood:** Any means of dispersal is not deemed necessary currently, given the relatively low number of transient flying-foxes occupying the roost, and their low-conflict roosting location. As above, if a large number of flying-foxes establish a long-term roosting site in trees adjacent to Westwood State School, and other management	Early intervention dispersal through tree removal may be suitable for new roosts in high conflict areas to prevent the roost from establishing in high conflict locations (e.g. directly adjacent to residents or sensitive sites).	Removal of vegetation would require approval.	Only suitable where other management techniques have been effectively implemented and proven unsuccessful in alleviating impacts.

Management options	Advantages & disadvantages	Suitability for RBG, Kabra and Westwood Township sites	Suitability for emerging roost	Permits required	Appraisal
		techniques (e.g. buffers and nudging) are ineffective, passive dispersal may be considered in future. **Kabra:** Any means of dispersal is not deemed necessary currently, given the relatively low number of transient flying-foxes occupying the roost. Removal of vegetation from Council-managed land is likely to push flying-foxes onto private land (as previously during influxes), and private residents may not be receptive to removing trees from yards.	Suitability for vegetation removal will need to be determine on a site-specific bases.		
Active dispersal through disturbance	**Advantages:** If successful can mitigate all flying-fox impacts at that site. **Disadvantages:** Multiple studies show that dispersal is rarely successful, especially without significant vegetation removal (not suitable for this site) or high levels of ongoing effort and significant expenditure (e.g. several years of daily works and over $1M for Sydney Botanic Gardens). Flying-foxes will almost always continue to roost in the area (generally within 600 m, Roberts and Eby 2013), and often splinter into several locations which may result in more widespread impacts. Appendix 7 provides a summary of research conducted on flying-fox dispersals in Australia.	Active dispersal is very costly with highly unpredictable outcomes and can often worsen human-wildlife conflict. As such, it is not curremtly recommended for RBG, Kabra, or Westwood roosts. While previous dispersal and nudging attempts at the RBG have had temporary success, none have provided a long-term solution for the conflict at the site. If conflict increases and/or alternative management strategies are deemed ineffective following effective implementation, dispersal may be considered at high conflict sites (e.g. if LRFF begin roosting on Westwood State School grounds again). However, with the above management strategies implemented, the potential need for dispersal is considered very low.	Early intervention dispersal may be suitable for new roosts in high conflict areas to prevent the roost from establishing at the site. Once a roost has established, the suitability of dispersal significantly decreases.	Dispersal in accordance with the Management COP is permitted under Council's as-of-right authority with notification to DES.	Only suitable where other management techniques have been effectively implemented and proven unsuccessful in alleviating impacts

6 Management approach

Table 4 outlines management actions for the RBG, Kabra township, and Westwood township, based on site-specific analysis of available flying-fox impact management options. An overview of the approach in the short-term is to reduce current impacts on residents through:

- creating buffers between residential dwellings/businesses and flying-fox habitat, mainly at Kabra township and RBG, through weed management, vegetation trimming (not removal), and potentially CMS, as well as trialling D-ter and PROVolitans lighting around the Gardens Tearooms
- continuing to assist residents in Kabra and Westwood township with cleaning services (e.g. cleaning faeces off cars and rooves) during flying-fox influxes, and cleaning faeces off amenities in the RBG (particularly around Gardens Tearooms) on a reactive basis (less frequently than currently if buffering solutions are successful)
- offering impacted residents novel approaches to reducing noise and odour impacts e.g. temporary fencing, indoor odour-neutralising gel pots, consider trialling an outdoor odour neutralising product (initially trialled by Eurobodalla Shire Council at a flying-fox roost on the Sunshine Coast – see Appendix 6 for further detail)
- increasing education within the community, particularly at Westwood State School and Rockhampton South Kindergarten, through interpretive signage and school-based information sessions, as well as providing up-to-date information on flyers and Council's website (most popular educational tools identified during the community survey).

Education will form an important part of the ongoing management (short and long-term) of flying-foxes at the RBG. The community survey revealed some misinformation amongst the community, with only ~57% of people agreeing to some extent that flying-foxes are important to the environment. Fear of disease was also identified as one of the top three issues concerning community members. Educational material should aim to cover key messages in a way that educates and informs, rather than cause alarm, e.g. emphasising that there is no risk associated with living or playing near a flying-fox roost (Queensland Government 2021) – 'no touch, no risk'. Council should aim to provide residents at Kabra and Westwood township of methods to prevent contamination of water tanks (see Section 2.6.5). Council should also proactively engage with students, teachers, and parents of Westwood State School and Rockhampton South Kindergarten to provide key information and avoid concern associated with sudden, large influxes near schools/kindergartens. If flying-foxes begin to encroach onto school/kindergarten property, vegetation trimming and/or sprinklers should be considered to provide a buffer between the roost and school/kindergarten property. Staff at both facilities should also undertake sweeps of the school grounds each morning prior to student arrivals to check for flying-foxes on the ground, to prevent health risks to students. This will be particularly important during large influxes of flying-foxes (e.g. LRFF influx in summer months).

In addition to education, long-term management approaches to alleviate impacts to the community include:

- implementing long-term service and property subsidies programs for primary and secondary-affected residents (based on proximity to roost), particularly during large flying-fox influxes
- avoiding disturbance to flying-fox habitat at nearby Fitzroy River roost to encourage RBG flying-foxes to roost there
- identify suitable roost habitat in low conflict locations in proximity to the three roosts, and across the region more broadly, and restore and/or enhance habitat to encourage flying-fox roosting
- undertake monthly monitoring at Kabra, Westwood and RBG flying-fox roosts, increasing to weekly four weeks prior to and following any active management (e.g. nudging, dispersal), and daily three days prior to, during, and following active management.

Active management, including nudging and/or dispersal activities, should only be considered for very high conflict sites where other management techniques have been effectively implemented and proven unsuccessful in alleviating impacts. Where necessary, nudging attempts should be as passive as possible (e.g. lighting as opposed to noise), particularly when attached young may be present, to avoid welfare impacts. No form of nudging is appropriate in areas where creching young are present as it will likely result in harm and breach legislation. Further it will not be effective when flightless young are present.

If active management techniques are planned, Council will develop a Project Health and Safety Plan to protect the safety of personnel, flying-fox welfare, and to manage any other associated risks.

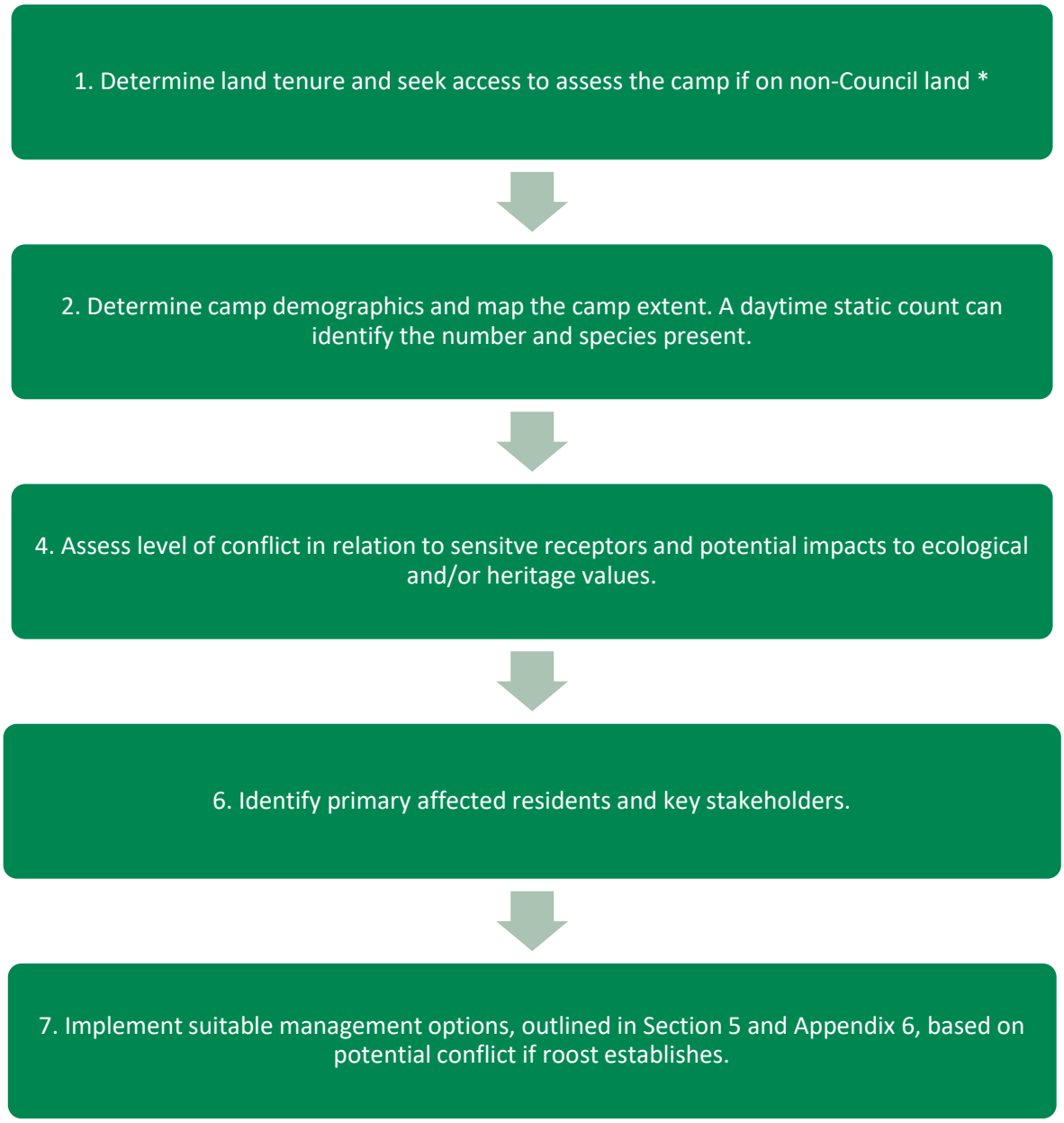
Table 4 Management actions to be implemented at RBG, Kabra, and Westwood roosts. Note costs are indicative only for external assistance (i.e. estimates not provided for Council time).

Management type	Management action	Indicative costs (ex GST)	Timeframe
Education	Increase education within the community to ensure access to up-to-date health information is available, and residents are aware of impact mitigation options available at a property level (e.g. methods to prevent water tank contamination, odour-neutralising gel pots, noise attenuation fencing, vegetation management on private land) and legislative responsibilities. Educational tools should include flyers, regularly updating Council's website, and installing interpretive signage at RBG. Direct, one-on-one engagement may be required for primary-affect residents.	Council time.	ASAP
	Facilitate community information sessions, targeting primary-affected residents and students, teachers, and parents at Westwood State School and Rockhampton South Kindergarten. Information sessions should be offered prior to the predicted influx of LRFF in summer months and continue during large influxes.		ASAP
Active removal of flying-fox carcasses	Teachers at Westwood State School and Rockhampton South Kindergarten should undertake sweeps of the grounds to identify and remove flying-foxes in a safe manner, thus reducing health risks to students. Sweeps should be done every morning while flying-foxes are roosting adjacent to grounds and during large influxes of flying-foxes. Otherwise, sweeps may be undertaken once weekly during other times.	Westwood State School and Rockhampton South Kindergarten staff time.	ASAP and ongoing during large influxes
Buffer	Trial D-ter and PROVolitans lighting in fig trees surrounding Gardens Tearooms and vegetation bordering Rockhampton South Kindergarten at RBG to deter flying-foxes from these high-conflict areas and create a 20 m buffer where possible. If unsuccessful, CMS and/or vegetation removal may need to be considered.	≈ $10,000	ASAP
	Create a 20 m buffer (where possible) between residential properties and flying-fox habitat at Kabra township roost through weed removal and vegetation trimming and/or removal. Buffers should be created between vegetation lining the creek (bordered by Morgan and Moonmera Street) and residential properties in this block. During influxes, flying-foxes roost on or adjacent to private properties west of this block. As such, residents should be directed to the Low Impact COP for information on how they can maintain vegetation on their properties. Vegetation adjacent to Westwood State School should also be trimmed to create a 20 m buffer between the school boundary and flying-fox habitat, with the anticipation that flying-foxes may once again occupy this area.	≈ $30,000 (including labour, environmental assessments, offset)	By November 2022 (prior to next anticipated LRFF arrival)
Subsidy program	Investigate a subsidy program for residents to modify properties and assist with the cost of services. Subsidies could be provided for items (e.g. vehicle covers, carports, clothesline covers, clothes dryers, pool/spa covers, shade cloths, rainwater first-flush diverters, high-pressure water cleaners, air conditioners, fragrance dispensers or deodorisers, double-glazing of windows, door seals, screen planting, tree netting, and lighting) or services (e.g. clothes washing, cleaning outside areas and property,	Variable as budget allows.	ASAP

Management type	Management action	Indicative costs (ex GST)	Timeframe
	solar panel cleaning, car washing, removing exotic trees, or contributing to water/electricity bills). Alternatively, a nominal amount of money could be offered to residents based on their proximity to the flying-fox roost, on the basis they can prove the relevance of expenditure to mitigating flying-fox impacts. Further information regarding subsidy programs (e.g. subsidy options, means of delivery, and potential outcomes) is provided in Appendix 6. Council should aim to engage one-on-one with affected residents to establish how their concerns could be addressed through a subsidy program.		
Habitat improvement	Avoid disturbance to Fitzroy River roost habitat to encourage flying-foxes to roost at this low conflict site.	Council time (e.g. liaising with Council contractors and educating the public)	ASAP and ongoing
	Identify suitable roost habitat in low conflict locations and restore and/or enhance habitat to encourage flying-fox roosting. Habitat enhancement should aim to maintain good canopy health through weed and vine removal, and maintain good canopy succession (i.e. lower, mid and upper storey) to prevent complete forest deterioration during large flying-fox influxes and provide refuge habitat during HSEs.	Costs will depend on extent of restoration efforts.	By the end of 2022
Active management (nudging and/or dispersal)	Active management will only be considered for very high conflict sites where other management techniques have been effectively implemented and proven unsuccessful in alleviating impacts.	Costs will depend on the size of the roost, location, resources and personnel required to undertake initial works, and ongoing costs to maintain nudging/dispersal outcomes	Only when required
Regular monitoring	Undertake regular, monthly monitoring of the Kabra (static count), Westwood (static count) and RBG (fly-out count) flying-fox roosts to detect any changes in population numbers or distribution in the area. Where possible, monthly monitoring should also include other known roosts in the area, such as the Lakes Creek roost, to inform knowledge regarding flying-fox movement and resources in the region. Monitoring at the three key roosts should increase to weekly in the four weeks leading up to and following any active roost management. Moreover, monitoring should increase to daily in the three days prior to, during, and following active management.	Half-day for suitably qualified contractor to monitor the three key roosts (one person required for static counts at Kabra and Westwood roosts, three people required for fly-out count at RBG) = $985.00 (excl. GST)	ASAP and ongoing

6.1 Management framework for emerging roosts

Emerging roosts will be assessed and managed in accordance management options detailed in Section 5 and Appendix 6. The following flow chart outlines a general procedure to assess and manage emerging flying-fox camps in Rockhampton LGA.



* Early management intervention at an emerging roost may be possible without state approval, before it meets the criteria for a flying-fox roost (see DES 2021). In this case, it is important to note that the NC Act still applies, meaning any actions to kill, injure or harm flying-foxes are prohibited, and native vegetation is protected. Planning required to properly coordinate management actions to avoid community and flying-fox impacts should always be prioritised over the speed of management actions implemented.

7 Plan administration

7.1 Evaluation and review

A review of the Plan, including community consultation and expert input, should be scheduled annually. The Plan shall remain in force until a revised version is adopted by Council.

The following may trigger an earlier Plan update:

- changes to relevant policy/legislation
- new management techniques becoming available
- outcomes of research that may influence the Plan
- incidents associated with the roosts.

Progress and priority of management actions in the Plan will be evaluated annually by Council.

7.2 Reporting

Council will complete the DES evaluation form for actions under its as-of-right authority, returned within six weeks of the date of as-of-right actions being completed, and will comply with any reporting obligations under other permits or approvals obtained to implement the Plan.

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Appendix 1 Legislation

State

***Nature Conservation Act 1992* (NC Act)**

As native species, all flying-foxes and their roosting habitat are protected in Queensland under the NC Act. State approval is required to:

d) destroy a flying-fox roost;

e) drive away, or attempt to drive away, a flying-fox from a flying-fox roost ('drive away' is defined to mean "cause the flying-fox to move away from the roost; or if the flying-fox has moved away from the roost, deter the flying-fox from returning to the roost"); and/or

f) disturb a flying-fox in a flying-fox roost.

The Code of Practice – Ecologically sustainable management of flying-fox roosts (Management COP) (DES 2020a) outlines how local governments operating under section 61 of the Nature Conservation (Animals) Regulation 2020 (NC Animals Regulation) may undertake the above management actions. Key obligations for such management actions include:

- DES must be notified at least two business days prior to commencing any management actions by completion of the flying-fox roost management notification form, unless an authorised person from DES provides written advice that these actions can commence earlier.
- No roost tree may be destroyed if there are flying-foxes in the tree or within 20 m of the tree.
- Management actions must cease completely if a flying-fox is killed, injured or found on the ground during works, and DES must be notified immediately.
- Any nudging attempts (i.e. to move flying-foxes within a roost site) should be undertaken with methods that minimise all possible disturbance to flying-foxes.
- Any dispersal attempts must be properly coordinated by the *person in charge*, may only occur with a *person knowledgeable about flying-fox behaviours* and may only occur in the early evening or early morning. See the Management COP for additional conditions.
- Council must send DES a flying-fox roost management evaluation form within six weeks of the date of notification, detailing the outcomes of management actions.

Refer to the Management COP for further detail regarding Council's obligations prior to, during, and following undertaking nudging and/or dispersal activities.

Note that the definition under Queensland law means that once a flying-fox roost is

established, it remains as such even when it is unoccupied. The *Interim policy for determining when a flying-fox congregation is regarded as a flying-fox roost under section 88C of the NC Act* (DES 2021) has recently been released and is currently in consultation. It is our understanding that the Plan aligns with this roost policy, however amendments can be made to the Plan in consultation with DES if required.

A 'flying-fox roost' is defined under the NC Act as 'a tree or other place where flying-foxes congregate from time to time for breeding or rearing their young'.

Council 'as-of-right' management

Under the NC Act, local governments have an 'as-of-right' authority under the NC Act to manage flying-fox roosts in mapped Urban Flying-fox Management Areas (UFFMAs), without the requirement for a permit, in accordance with the Management COP (DES 2020a).

Councils must however still notify DES of the planned management. Notification is by means of a completed flying-fox management notification form from the DES website submitted at least two business days prior to commencing any management actions, unless an authorised person from DES provides written advice that these actions can commence earlier. Local governments may also choose to, with the relevant landholder's permission, exercise their as-of-right authority on private land. Notification is valid for all notified management actions within a four week timeframe.

The *Flying-fox Roost Management Guideline* (DES 2020b) has also been developed to provide local government with additional information that may assist decision making and management of flying-fox roosts. Councils are required to apply for a flying-fox roost management permit (FFRMP) to manage flying-fox roosts outside an UFFMA, or for management actions not specified in the Management COP. It must be noted that this 'as-of-right' authority does not oblige Council to manage flying-fox roosts, and does not authorise management under other relevant sections of the NC Act or other legislation (such as the *Vegetation Management Act 1999* [VM Act], see also Section 2.3). Anyone other than local government is required to apply to DES for a FFRMP for any management directed at roosting flying-foxes, or likely to disturb roosting flying-foxes. Certain low impact activities (e.g. mowing, minor tree trimming) do not require approval if undertaken in accordance with the *Code of Practice – Low impact activities affecting flying-fox roosts* (Low Impact Code) (DES 2020c).

Low impact roost management

All landholders – private or public – can undertake low impact activities such as mulching, mowing and weeding near flying-fox roosts, as well as allowing trimming of up to 10% of the total canopy of the roost without a FFRMP if it is done in accordance with the Low Impact Code (DES 2020c). This authorisation is provided these activities not being undertaken with the intention of destroying the roost, or disturbing or driving away the flying-foxes.

Flying-fox roost management permits

Councils wishing to manage flying-fox roosts located outside an UFFMA or to conduct flying-fox management activities that are not Code-compliant, must apply to DES for a FFRMP.

Under the NC Animals Regulation, a FFRMP may only be approved for management of a flying-fox roost where its resident flying-foxes are causing or may cause damage to property; or represent a threat or potential threat to human health or wellbeing. The Management COP may generally also apply where such a requirement is stated on the FFRMP. Such a permit is valid for a period of one year, or up to three with a DES-approved flying-fox management plan (e.g. this Plan).

Anyone other than local government is required to apply for an FFRMP to conduct flying-fox roost management activities.

Flying-fox management statements and planning

Council has a Statement of Management Intent (SoMI) to articulate the approach that Council will take to the management of flying-fox roosts in the Rockhampton Region (RRC 2014). Council's intent is to manage flying-fox roosts on Council-owned or controlled land, and to have no involvement in the management of roosts solely on State or private land.

Local councils may also opt to develop a FFMP for the whole of their local government area (LGA). If the FFMP is approved by DES, the local council can be granted three years' approval to manage flying-foxes outside their UFFMAs under an FFRMP.

The *Flying-fox roost management guideline* was developed to provide local councils and other entities wishing to manage flying-fox roosts with additional information that may assist their decision-making, including developing SOMIs and FFMPs (DES 2020b).

Vegetation under the *NC Act 1992*

All plants native to Australia are protected under the NC Act. Prior to any clearing of protected plants, a person must refer to the flora survey trigger map to determine if the clearing is within a high risk area.

- in a high risk area, a flora survey must be undertaken and a clearing permit may be required for clearing endangered, vulnerable and near threatened (EVNT) plants and their supporting habitat.
- if a flora survey identifies that EVNT plants are not present or can be avoided by 100 m, the clearing activity may be exempt from a permit. An exempt clearing notification form is required.
- in an area other than a high risk area, a clearing permit is only required where a person is, or becomes, aware that EVNT plants are present.
- clearing of least concern plants will be exempt from requiring a clearing permit within a low risk area.

Vegetation under the *Fisheries Act 1994*

All marine plants, including mangroves, seagrass, saltcouch, algae, samphire vegetation and adjacent plants (e.g. melaleuca and casuarina), are protected under Queensland law through provisions of the *Fisheries Act 1994*. Approval must be gained from Fisheries Queensland to

destroy, damage, or disturb any marine plant. Under the Fisheries Act, a 'marine plant' includes:

a) a plant (a 'tidal plant') that usually grows on, or adjacent to, tidal land, whether it is living or dead, standing or fallen;
    - The *Fisheries Act* does not define 'adjacent' as it relates to marine plants. In the absence of a definition, the Fish Habitat Management Operational Policy describes the application of 'adjacent' in terms of when a marine plant development permit application would be required for disturbance of plants in or adjacent to the tidal zone.

b) the material of a tidal plant, or other plant material on tidal land;

c) a plant, or material of a plant, prescribed under a regulation or management plan to be a marine plant.

Vegetation Management Act 1999

The clearing of native vegetation in Queensland is regulated by the VM Act, the *Sustainable Planning Act 2009* and associated policies and codes.

The type of clearing activity allowed, and how it is regulated, depends on:

- the type of vegetation (as indicated on the regulated vegetation management map and supporting maps)
- the tenure of the land (e.g. freehold or Indigenous land)
- the location, extent and purpose of the proposed clearing
- the applicant proposing to do the clearing (e.g. state government body, landholder).

Depending on these factors, clearing activities will either:

- be exempt from any approval or notification process
- require notification and adherence to a self-assessable code
- require notification and adherence to an area management plan
- require a development approval.

VM Act exemptions allow native vegetation to be cleared for a range of routine property management activities without the need for a development approval or notification. A number of VM Act exemptions may apply to clearing vegetation that is flying-fox roosting or foraging habitat. However, specific advice should be obtained from Department of Natural Resources and Mines for each proposed vegetation clearing activity.

No explicit VM Act exemptions for clearing flying-fox roosting or foraging vegetation were in place as of September 2017.

Animal Care and Protection Act 2001

The *Animal Care and Protection Act 2001* (the ACP Act) provides for animal welfare. The ACP

Act is administered by Biosecurity Queensland within the Department of Agriculture and Fisheries. The ACP Act applies to all living vertebrate animals, including wildlife. To comply with the ACP Act flying-fox management actions must not cause mental or physical suffering, pain or distress.

Civil Aviation Act 1998 (CA Act)

The CA Act establishes Australia's Civil Aviation Safety Authority (CASA) functions in relation to civil aviation, with particular emphasis on safety. Civil Aviation Safety Regulations 1998 Part 139 contains specific requirements for wildlife hazard management.

Council and/or DES should ensure Rockhampton Airport is aware of large influxes to the area so that strike risk can be managed, and Council must ensure this legislation is adhered to when considering events with aircraft.

Commonwealth

Environment Protection and Biodiversity Conservation Act 1999

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

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

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

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

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

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

Provided that management at nationally important roosts follows the mitigation standards below, DAWE has determined that a significant impact to the population is unlikely, and referral is not likely to be required. Referral will be required if a significant impact to any other MNES is considered likely as a result of management actions outlined in the Plan. Self-assessable criteria are available in the Significant Impact Guidelines 1.1 (DoE 2013) to assist

in determining whether a significant impact is likely; otherwise, consultation with DAWE will be required.

Mitigation standards:

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

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

Appendix 2 Species profiles

Black flying-fox (*Pteropus alecto*)

Black flying-fox indicative species distribution, adapted from OEH 2015

The BFF has traditionally occurred throughout coastal areas from Shark Bay in Western Australia, across Northern Australia, down through Queensland and into NSW (Churchill 2008). Since it was first described there has been a substantial southerly shift by the BFF (Webb and Tidemann 1995). This shift has consequently led to an increase in indirect competition with the threatened GHFF, which appears to be favouring the BFF (DoE 2016).

They forage on the fruit and blossoms of native and introduced plants (Churchill 2008), including orchard species at times. BFF are largely nomadic animals with movement and local distribution influenced by climatic variability and the flowering and fruiting patterns of their preferred food plants. Feeding commonly occurs within 20 km of the roost site (Markus and Hall 2004).

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

Little red flying-fox (*Pteropus scapulatus*)

Little red flying-fox indicative species distribution, adapted from OEH 2015

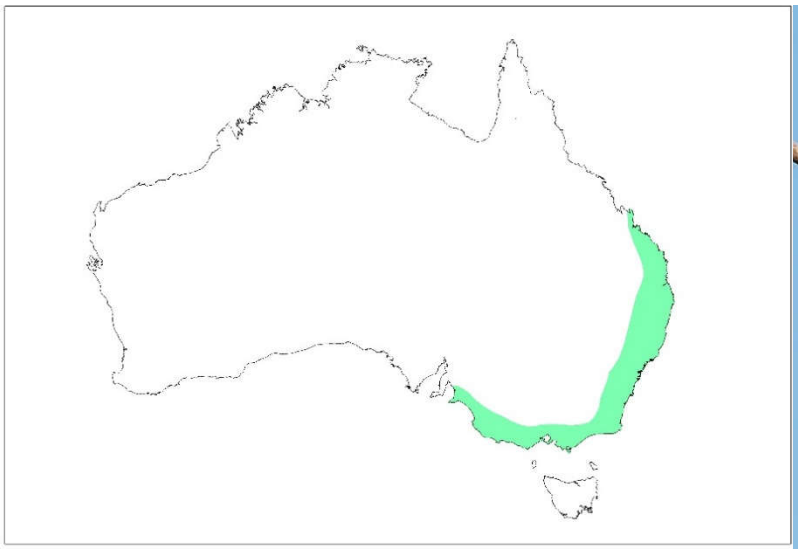
The LRFF is widely distributed throughout northern and eastern Australia, with populations occurring across northern Australia and down the east coast into Victoria.

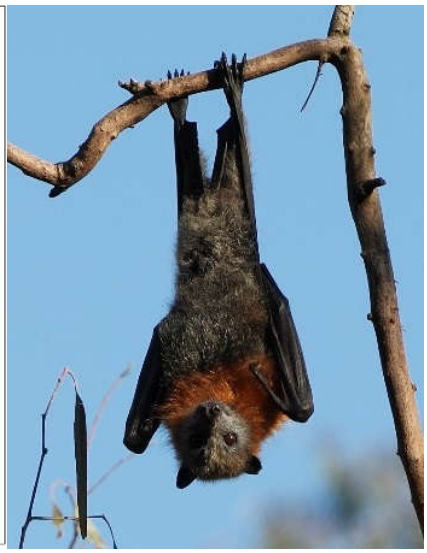
The LRFF forages almost exclusively on nectar and pollen, although will eat fruit at times and occasionally raids orchards (Australian Museum 2010). LRFF often move sub-continental distances in search of sporadic food supplies. The LRFF has the most nomadic distribution, strongly influenced by availability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

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

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

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





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

The GHFF is found throughout eastern Australia, generally within 200 kilometres of the coast, from Finch Hatton in Queensland to the north to Melbourne, Victoria (DPIE 2019). This species now ranges into South Australia and individual flying-foxes have been reported on the Bass Islands and mainland Tasmania (Driessen et al. 2011). It requires foraging resources and roost sites within rainforests, open forests, closed and open woodlands (including melaleuca swamps and banksia woodlands). This species is also found throughout urban and agricultural areas where food trees exist and will feed in orchards at times, especially when other food is scarce (DPIE 2019).

All the GHFF in Australia are regarded as one population that moves around freely within its entire national range (Webb and Tidemann 1996, DAWE 2021). GHFF may travel up to 100 kilometres in a single night with a foraging radius of up to 50 kilometres from their roost (McConkey et al. 2012). They have been recorded travelling over 500 kilometres over 48 hours when moving from one roost to another (Roberts et al. 2012). GHFF generally show a high level of fidelity to roost sites, returning year after year to the same site, and have been recorded returning to the same branch of a particular tree (SEQ Catchments 2012). This may be one of the reasons flying-foxes continue to return to small urban bushland blocks that may be remnants of historically used larger tracts of vegetation.

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

There is evidence the GHFF population declined by up to 30% between 1989 and 2000 (Birt

2000, Richards 2000 cited in DPIE 2019). There is a wide range of ongoing threats to the survival of the GHFF, including habitat loss and degradation, culling in orchards, conflict with humans, infrastructure-related mortality (e.g. entanglement in barbed wire fencing and fruit netting, and power line electrocution) and competition and hybridisation with the BFF (DECCW 2009). For these reasons it is listed as vulnerable to extinction under NSW and federal legislation.

Appendix 3 Human and animal health

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

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

These diseases are also easily prevented through vaccination, personal protective equipment, safe flying-fox handling (by trained and vaccinated personnel only) and appropriate horse husbandry. Therefore, despite the fact that human infection with these agents can be fatal, the probability of infection is extremely low, and the overall public health risk is also judged to be low (Qld Health 2016).

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

Disease and flying-fox management

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

The effects of stress are linked to increased susceptibility and expression of disease in both humans (AIHW 2012) and animals (Henry & Stephens-Larson 1985; Aich et. al. 2009), including reduced immunity to disease.

Therefore, it can be assumed that management actions which may cause stress (e.g. dispersal), particularly over a prolonged period or at times where other stressors are increased (e.g. food shortages, habitat fragmentation, etc.), are likely to increase the susceptibility and prevalence of disease within the flying-fox population, and consequently the risk of transfer to humans.

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

- forcing flying-foxes into closer proximity to one another, increasing the probability of disease transfer between individuals and within the population.

- resulting in abortions and/or dropped young if inappropriate management methods are used during critical periods of the breeding cycle. This will increase the likelihood of direct interaction between flying-foxes and the public, and potential for disease exposure.
- adoption of inhumane methods with potential to cause injury which would increase the likelihood of the community coming into contact with injured/dying or deceased flying-foxes.

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

Australian bat lyssavirus

ABLV is a rabies-like virus that may be found in all flying-fox species on mainland Australia. It has also been found in an insectivorous microbat and it is assumed it may be carried by any bat species. The probability of human infection with ABLV is very low with less than 1% of the flying-fox population being affected (Qld Heath 2020) and transmission requiring direct contact with an infected animal that is secreting the virus. In Australia three people have died from ABLV infection since the virus was identified in 1996 (Qld Health 2020).

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

Transmission of the virus from bats to humans is through a bite or scratch but may have potential to be transferred if bat saliva directly contacts the eyes, nose, mouth or broken skin. ABLV is unlikely to survive in the environment for more than a few hours, especially in dry environments that are exposed to sunlight (Qld Health 2020).

Transmission of closely related viruses suggests that contact or exposure to bat faeces, urine or blood does not pose a risk of exposure to ABLV, nor does living, playing or walking near bat roosting areas (Qld Health 2020, Qld Health 2016).

The incubation period in humans is assumed similar to rabies and variable between two weeks and several years. Similarly, the disease in humans presents essentially the same clinical picture as classical rabies. Once clinical signs have developed the infection is invariably fatal. However, infection can easily be prevented by avoiding direct contact with bats (i.e. handling). Pre-exposure vaccination provides reliable protection from the disease for people who are likely to have direct contact with bats, and it is generally a mandatory workplace health and safety requirement that all persons working with bats receive pre-vaccination and have their level of protection regularly assessed. Like classical rabies, ABLV infection in humans also appears to be effectively treated using post-exposure vaccination and so any person who suspects they have been exposed should seek immediate medical treatment. Post-exposure vaccination is usually ineffective once clinical manifestations of the disease have commenced.

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

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

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

Hendra virus

Flying-foxes are the natural host for 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 (Qld Health 2017). There is no evidence that the virus can be passed directly from flying-foxes to humans or to dogs (AVA 2015). Clinical studies have shown cats, pigs, ferrets and guinea pigs can carry the infection (DPI 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 primarily with flying-fox urine (CDC 2014).

Humans may contract the disease after close contact with an infected horse. HeV infection in humans presents as a serious and often fatal respiratory and/or neurological disease and there is currently no effective post-exposure treatment or vaccine available for people. The mortality rate in horses is greater than 70% (DPI 2014). Since 1994, 81 horses have died, and four of the seven people infected with HeV have lost their lives (DPI 2014, Qld Health 2017).

Previous studies have shown that HeV spillover events have been associated with foraging flying-foxes rather than roost locations. Therefore, risk is considered similar at any location within the range of flying-fox species and all horse owners should be vigilant. Vaccination of horses can protect horses and subsequently humans from infection (Qld Health 2017), as can appropriate horse husbandry (e.g. covering food and water troughs, fencing flying-fox foraging trees in paddocks, etc.).

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

Coronaviruses

There is no evidence of SARS or SARS-like, MERS or MERS-like, 2019-nCOV or 2019-nCoV-like viruses in Australian wildlife (including bats). Novel CoV-2019 (COVID-19) is not closely related to any known Australian bat coronaviruses and there is no suggestion that 2019-nCoV (COVID-19) is present in Australian wildlife, although further surveillance and studies are

recommended. There is no evidence that livestock or pets such as dogs or cats can be infected with 2019-nCoV (COVID-19) and no evidence to suggest that any animals (livestock, pets or wildlife) in Australia might be a source of infection of 2019-nCoV (COVID-19). Regardless, appropriate personal hygiene (e.g., washing hands) is always recommended before and after contact with animals (Wildlife Health Australia 2020).

Ectoparasites

Bat flies are highly specialised ectoparasites that feed on the blood of bats. There are two families of bat flies; Nycteribiidae and Streblidae, though only species belonging to Nycteribiidae have been observed on flying-foxes in Australia (WHA Bat Focus Group members pers. comm. 2020). They are generally considered to be highly host-specific and are usually only found on or near bats. This is predominantly due to them being obligate parasites, meaning they need regular blood meals to remain viable (WHA Bat Focus Group members pers. comm. 2020). There is limited available literature on the relationship between bat flies and flying-foxes in Australia. However, ectoparasite loads appear to be higher in little-red flying-fox roosts, perhaps due to their very close roosting style/structure (Ecosure pers. obs.).

To date, there has been limited research on the effect of bat fly bites on humans, though the risk of transmitting diseases to humans is considered low (WHA Bat Focus Group members pers. comm. 2020). Firstly, bat flies tend to remain very close to flying-fox roosts, and rarely remain after flying-foxes have left. As such, the only opportunity for contact between bat flies and humans would be if someone were to walk directly underneath a roost. The chance of this contact occurring will increase if the roost contains LRFF, is large, or if the flying-foxes are highly mobile (Ecosure pers. obs.), but is generally considered low. While bat flies generally do not cause issues for humans and they do not burrow into the skin the way a tick does, some people can react to bites (Dick and Patterson 2006).

There is no evidence to show that bat flies can transmit diseases that Australian flying-foxes may carry. A study by Vidgen et al. (2016) investigated the ability of bat flies in the *Cyclopodia* genus to carry Hendra virus. The study found no evidence of any bat fly carrying the virus, even those found feeding on virus positive black flying-foxes (Vidgen et al. 2016). There is some evidence to suggest that bat flies may be vectors for *Bartonella spp*. overseas (Kamani et al. 2014, Dietrich et al. 2016, Moskaluk et al. 2018). There appears to be no reports of zoonotic pathogens in Australian bat flies, indicating either a lack of presence or very low prevalence.

Overall, the risk of disease transmission from bat fly to human is considered very low as it relies on three infrequent factors; a bat fly carrying a zoonotic pathogen, contact between a bat fly and human, and the bat fly burrowing sufficiently into the skin to transfer the pathogen (WHA Bat Focus Group members pers. comm. 2020).

Measures to avoid bat fly bites are:

- Avoid walking directly under dense groups of roosting flying-foxes.

- If possible, postpone manual cleaning of fallen vegetation and debris under a roost for 1-2 weeks after it has emptied at which time flies without a bat host should have died. If this is not possible, consider machine clean-up options.
- Follow protective measures used to avoid tick bites, such as applying insect repellent, long pants and sleeves, and double-sided tape around wrists and ankles to trap biting insects.
- If bitten and a reaction occurs, seek medical advice.

General health considerations

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

Bat urine and faeces should be treated like any other animal excrement. Viruses are not transferred to humans from bat urine or faeces. As with any accumulation of animal faeces (bird, bat, domestic animals), fungi or bacteria may be present and care should be taken when cleaning faeces. This includes wetting dried faeces before cleaning or mowing, wearing appropriate PPE and maintaining appropriate hygiene. If disturbing dried bird or bat droppings, particulate respirators should be worn to prevent inhalation of dust and aerosols. See 'Work with bird and bat droppings' for detail.

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

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

Appendix 4 Protected Matters Search Tool results

Australian Government

Department of Agriculture, Water and the Environment

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

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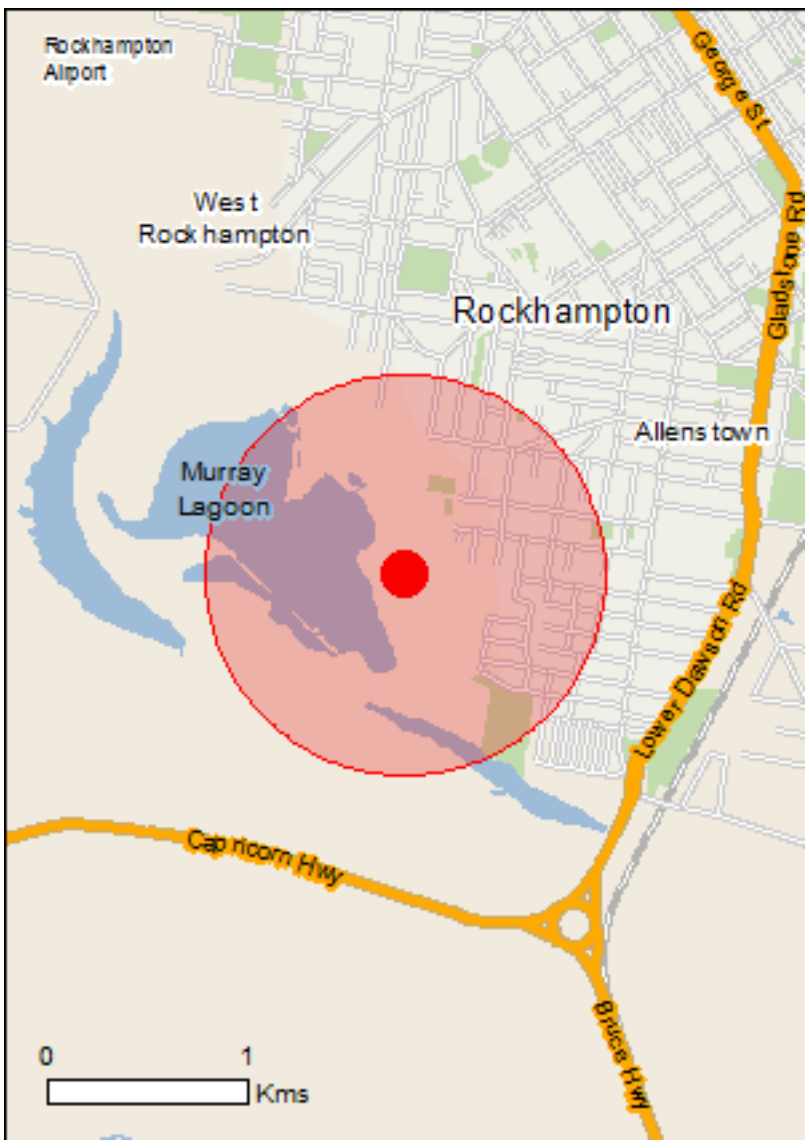

This map may contain data which are ©Commonwealth of Australia (Geoscience Australia), ©PSMA 2015

Coordinates

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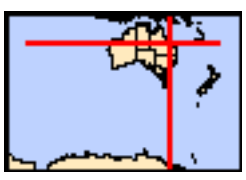

Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	2
Listed Threatened Species:	29
Listed Migratory Species:	16

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	21
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	None
Regional Forest Agreements:	None
Invasive Species:	30
Nationally Important Wetlands:	1
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Listed Threatened Ecological Communities		[Resource Information]
For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.		
Name	Status	Type of Presence
Poplar Box Grassy Woodland on Alluvial Plains	Endangered	Community may occur within area
Weeping Myall Woodlands	Endangered	Community may occur within area

Listed Threatened Species		[Resource Information]
Name	Status	Type of Presence
Birds		
Botaurus poiciloptilus Australasian Bittern [1001]	Endangered	Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Epthianura crocea macgregori Capricorn Yellow Chat, Yellow Chat (Dawson) [67090]	Critically Endangered	Species or species habitat may occur within area
Erythrotriorchis radiatus Red Goshawk [942]	Vulnerable	Species or species habitat likely to occur within area
Falco hypoleucos Grey Falcon [929]	Vulnerable	Species or species habitat likely to occur within area
Geophaps scripta scripta Squatter Pigeon (southern) [64440]	Vulnerable	Species or species habitat known to occur within area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area
Neochmia ruficauda ruficauda Star Finch (eastern), Star Finch (southern) [26027]	Endangered	Species or species habitat likely to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Poephila cincta cincta Southern Black-throated Finch [64447]	Endangered	Species or species habitat may occur within area

Name	Status	Type of Presence
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat known to occur within area
Turnix melanogaster Black-breasted Button-quail [923]	Vulnerable	Species or species habitat may occur within area
Mammals		
Chalinolobus dwyeri Large-eared Pied Bat, Large Pied Bat [183]	Vulnerable	Species or species habitat may occur within area
Dasyurus hallucatus Northern Quoll, Digul [Gogo-Yimidir], Wijingadda [Dambimangari], Wiminji [Martu] [331]	Endangered	Species or species habitat likely to occur within area
Macroderma gigas Ghost Bat [174]	Vulnerable	Species or species habitat likely to occur within area
Nyctophilus corbeni Corben's Long-eared Bat, South-eastern Long-eared Bat [83395]	Vulnerable	Species or species habitat may occur within area
Phascolarctos cinereus (combined populations of Qld, NSW and the ACT) Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory) [85104]	Vulnerable	Species or species habitat likely to occur within area
Pteropus poliocephalus Grey-headed Flying-fox [186]	Vulnerable	Foraging, feeding or related behaviour may occur within area
Plants		
Cupaniopsis shirleyana Wedge-leaf Tuckeroo [3205]	Vulnerable	Species or species habitat may occur within area
Cycas ophiolitica [55797]	Endangered	Species or species habitat may occur within area
Dichanthium setosum bluegrass [14159]	Vulnerable	Species or species habitat likely to occur within area
Eucalyptus raveretiana Black Ironbox [16344]	Vulnerable	Species or species habitat likely to occur within area
Marsdenia brevifolia [64585]	Vulnerable	Species or species habitat may occur within area
Samadera bidwillii Quassia [29708]	Vulnerable	Species or species habitat may occur within area
Reptiles		
Delma torquata Adorned Delma, Collared Delma [1656]	Vulnerable	Species or species habitat may occur within area
Denisonia maculata Ornamental Snake [1193]	Vulnerable	Species or species habitat likely to occur within area
Egernia rugosa Yakka Skink [1420]	Vulnerable	Species or species habitat may occur within area
Furina dunmalli Dunmall's Snake [59254]	Vulnerable	Species or species

Name	Status	Type of Presence
		habitat may occur within area
Rheodytes leukops		
Fitzroy River Turtle, Fitzroy Tortoise, Fitzroy Turtle, White-eyed River Diver [1761]	Vulnerable	Species or species habitat may occur within area

Listed Migratory Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus		
Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Migratory Marine Species		
Crocodylus porosus		
Salt-water Crocodile, Estuarine Crocodile [1774]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
Cuculus optatus		
Oriental Cuckoo, Horsfield's Cuckoo [86651]		Species or species habitat may occur within area
Hirundapus caudacutus		
White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area
Monarcha melanopsis		
Black-faced Monarch [609]		Species or species habitat may occur within area
Monarcha trivirgatus		
Spectacled Monarch [610]		Species or species habitat known to occur within area
Myiagra cyanoleuca		
Satin Flycatcher [612]		Species or species habitat likely to occur within area
Rhipidura rufifrons		
Rufous Fantail [592]		Species or species habitat known to occur within area
Migratory Wetlands Species		
Actitis hypoleucos		
Common Sandpiper [59309]		Species or species habitat may occur within area
Calidris acuminata		
Sharp-tailed Sandpiper [874]		Species or species habitat known to occur within area
Calidris ferruginea		
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris melanotos		
Pectoral Sandpiper [858]		Species or species habitat may occur within area
Gallinago hardwickii		
Latham's Snipe, Japanese Snipe [863]		Species or species habitat known to occur within area
Numenius madagascariensis		
Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pandion haliaetus		
Osprey [952]		Species or species

Name	Threatened	Type of Presence
		habitat known to occur within area
Tringa nebularia		
Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area

Other Matters Protected by the EPBC Act

Listed Marine Species		[Resource Information]
* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.		
Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos		
Common Sandpiper [59309]		Species or species habitat may occur within area
Anseranas semipalmata		
Magpie Goose [978]		Species or species habitat may occur within area
Apus pacificus		
Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea ibis		
Cattle Egret [59542]		Species or species habitat may occur within area
Calidris acuminata		
Sharp-tailed Sandpiper [874]		Species or species habitat known to occur within area
Calidris ferruginea		
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris melanotos		
Pectoral Sandpiper [858]		Species or species habitat may occur within area
Chrysococcyx osculans		
Black-eared Cuckoo [705]		Species or species habitat likely to occur within area
Gallinago hardwickii		
Latham's Snipe, Japanese Snipe [863]		Species or species habitat known to occur within area
Haliaeetus leucogaster		
White-bellied Sea-Eagle [943]		Species or species habitat known to occur within area

Name	Threatened	Type of Presence
Hirundapus caudacutus		
White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area
Merops ornatus		
Rainbow Bee-eater [670]		Species or species habitat may occur within area
Monarcha melanopsis		
Black-faced Monarch [609]		Species or species habitat may occur within area
Monarcha trivirgatus		
Spectacled Monarch [610]		Species or species habitat known to occur within area
Myiagra cyanoleuca		
Satin Flycatcher [612]		Species or species habitat likely to occur within area
Numenius madagascariensis		
Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pandion haliaetus		
Osprey [952]		Species or species habitat known to occur within area
Rhipidura rufifrons		
Rufous Fantail [592]		Species or species habitat known to occur within area
Rostratula benghalensis (sensu lato)		
Painted Snipe [889]	Endangered*	Species or species habitat known to occur within area
Tringa nebularia		
Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area
Reptiles		
Crocodylus porosus		
Salt-water Crocodile, Estuarine Crocodile [1774]		Species or species habitat likely to occur within area

Extra Information

Invasive Species	[Resource Information]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

Name	Status	Type of Presence
Birds		
Acridotheres tristis		
Common Myna, Indian Myna [387]		Species or species habitat likely to occur

Name	Status	Type of Presence within area
Anas platyrhynchos Mallard [974]		Species or species habitat likely to occur within area
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Lonchura punctulata Nutmeg Mannikin [399]		Species or species habitat likely to occur within area
Passer domesticus House Sparrow [405]		Species or species habitat likely to occur within area
Streptopelia chinensis Spotted Turtle-Dove [780]		Species or species habitat likely to occur within area
Sturnus vulgaris Common Starling [389]		Species or species habitat likely to occur within area
Frogs		
Rhinella marina Cane Toad [83218]		Species or species habitat known to occur within area
Mammals		
Bos taurus Domestic Cattle [16]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Lepus capensis Brown Hare [127]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
Sus scrofa Pig [6]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Acacia nilotica subsp. indica Prickly Acacia [6196]		Species or species habitat may occur within area

Name	Status	Type of Presence
Cryptostegia grandiflora Rubber Vine, Rubbervine, India Rubber Vine, India Rubbervine, Palay Rubbervine, Purple Allamanda [18913]		Species or species habitat likely to occur within area
Eichhornia crassipes Water Hyacinth, Water Orchid, Nile Lily [13466]		Species or species habitat likely to occur within area
Hymenachne amplexicaulis Hymenachne, Olive Hymenachne, Water Stargrass, West Indian Grass, West Indian Marsh Grass [31754]		Species or species habitat likely to occur within area
Jatropha gossypifolia Cotton-leaved Physic-Nut, Bellyache Bush, Cotton-leaf Physic Nut, Cotton-leaf Jatropha, Black Physic Nut [7507]		Species or species habitat likely to occur within area
Lantana camara Lantana, Common Lantana, Kamara Lantana, Large-leaf Lantana, Pink Flowered Lantana, Red Flowered Lantana, Red-Flowered Sage, White Sage, Wild Sage [10892]		Species or species habitat likely to occur within area
Opuntia spp. Prickly Pears [82753]		Species or species habitat likely to occur within area
Parkinsonia aculeata Parkinsonia, Jerusalem Thorn, Jelly Bean Tree, Horse Bean [12301]		Species or species habitat likely to occur within area
Parthenium hysterophorus Parthenium Weed, Bitter Weed, Carrot Grass, False Ragweed [19566]		Species or species habitat likely to occur within area
Salvinia molesta Salvinia, Giant Salvinia, Aquarium Watermoss, Kariba Weed [13665]		Species or species habitat likely to occur within area
Vachellia nilotica Prickly Acacia, Blackthorn, Prickly Mimosa, Black Piquant, Babul [84351]		Species or species habitat likely to occur within area
Reptiles		
Hemidactylus frenatus Asian House Gecko [1708]		Species or species habitat likely to occur within area
Ramphotyphlops braminus Flowerpot Blind Snake, Brahminy Blind Snake, Cacing Besi [1258]		Species or species habitat may occur within area

Nationally Important Wetlands [Resource Information]

Name	State
Fitzroy River Floodplain	QLD

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

-23.4 150.4903

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

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Australian Government

Department of Agriculture, Water and the Environment

EPBC Act Protected Matters Report

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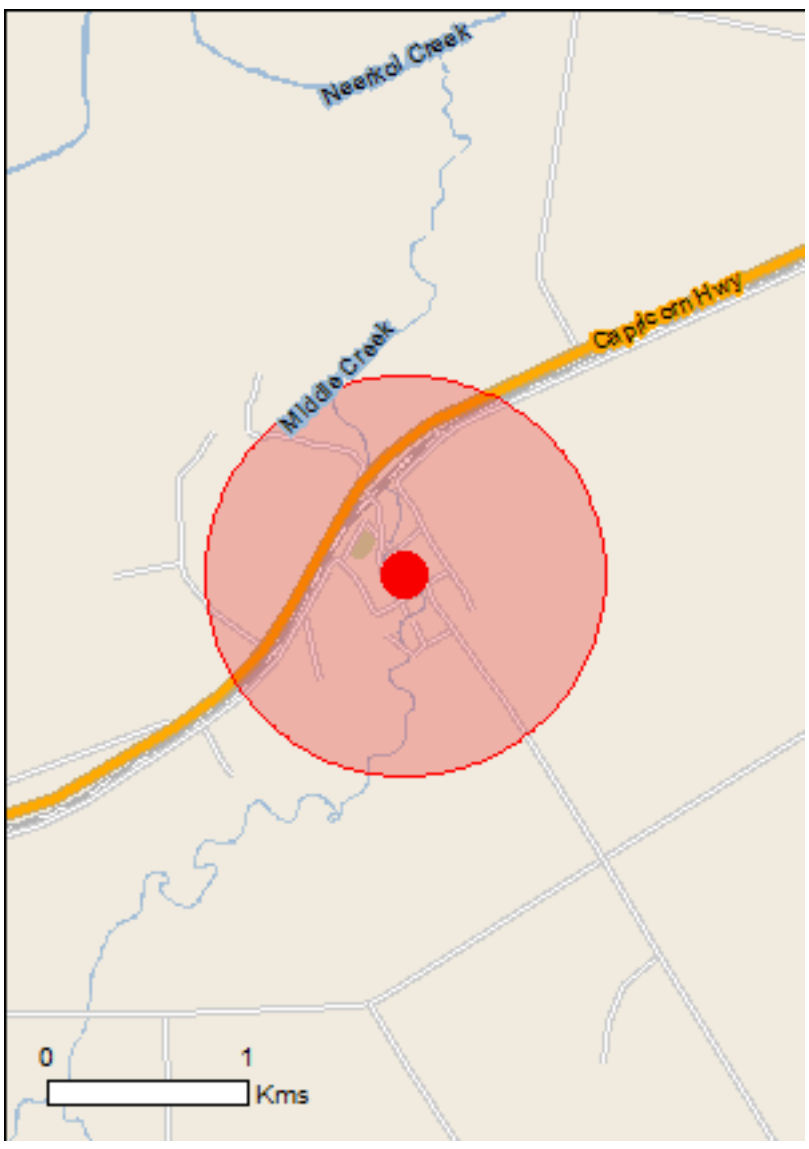

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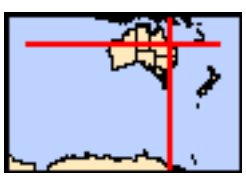

Summary

Matters of National Environmental Significance

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World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	3
Listed Threatened Species:	28
Listed Migratory Species:	15

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	20
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	None
Regional Forest Agreements:	None
Invasive Species:	28
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Listed Threatened Ecological Communities [Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Name	Status	Type of Presence
Coolibah - Black Box Woodlands of the Darling Riverine Plains and the Brigalow Belt South Bioregions	Endangered	Community may occur within area
Poplar Box Grassy Woodland on Alluvial Plains	Endangered	Community likely to occur within area
Weeping Myall Woodlands	Endangered	Community may occur within area

Listed Threatened Species [Resource Information]

Name	Status	Type of Presence
Birds		
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Erythrotriorchis radiatus Red Goshawk [942]	Vulnerable	Species or species habitat likely to occur within area
Falco hypoleucos Grey Falcon [929]	Vulnerable	Species or species habitat likely to occur within area
Geophaps scripta scripta Squatter Pigeon (southern) [64440]	Vulnerable	Species or species habitat known to occur within area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat may occur within area
Neochmia ruficauda ruficauda Star Finch (eastern), Star Finch (southern) [26027]	Endangered	Species or species habitat likely to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Poephila cincta cincta Southern Black-throated Finch [64447]	Endangered	Species or species habitat may occur within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat likely to occur within area
Turnix melanogaster Black-breasted Button-quail [923]	Vulnerable	Species or species

Name	Status	Type of Presence
		habitat may occur within area
Mammals		
Chalinolobus dwyeri Large-eared Pied Bat, Large Pied Bat [183]	Vulnerable	Species or species habitat may occur within area
Dasyurus hallucatus Northern Quoll, Digul [Gogo-Yimidir], Wijingadda [Dambimangari], Wiminji [Martu] [331]	Endangered	Species or species habitat likely to occur within area
Macroderma gigas Ghost Bat [174]	Vulnerable	Species or species habitat likely to occur within area
Nyctophilus corbeni Corben's Long-eared Bat, South-eastern Long-eared Bat [83395]	Vulnerable	Species or species habitat may occur within area
Petauroides volans Greater Glider [254]	Vulnerable	Species or species habitat may occur within area
Phascolarctos cinereus (combined populations of Qld, NSW and the ACT) Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory) [85104]	Vulnerable	Species or species habitat likely to occur within area
Pteropus poliocephalus Grey-headed Flying-fox [186]	Vulnerable	Foraging, feeding or related behaviour may occur within area
Plants		
Cossinia australiana Cossinia [3066]	Endangered	Species or species habitat may occur within area
Cycas megacarpa [55794]	Endangered	Species or species habitat may occur within area
Dichanthium setosum bluegrass [14159]	Vulnerable	Species or species habitat likely to occur within area
Eucalyptus raveretiana Black Ironbox [16344]	Vulnerable	Species or species habitat likely to occur within area
Marsdenia brevifolia [64585]	Vulnerable	Species or species habitat may occur within area
Samadera bidwillii Quassia [29708]	Vulnerable	Species or species habitat likely to occur within area
Reptiles		
Delma torquata Adorned Delma, Collared Delma [1656]	Vulnerable	Species or species habitat may occur within area
Denisonia maculata Ornamental Snake [1193]	Vulnerable	Species or species habitat likely to occur within area
Egernia rugosa Yakka Skink [1420]	Vulnerable	Species or species habitat may occur within area
Furina dunmalli Dunmall's Snake [59254]	Vulnerable	Species or species habitat may occur within area

Name	Status	Type of Presence
[Rheodytes leukops](#) Fitzroy River Turtle, Fitzroy Tortoise, Fitzroy Turtle, White-eyed River Diver [1761]	Vulnerable	Species or species habitat may occur within area

Listed Migratory Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
[Apus pacificus](#) Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Migratory Marine Species		
[Crocodylus porosus](#) Salt-water Crocodile, Estuarine Crocodile [1774]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
[Cuculus optatus](#) Oriental Cuckoo, Horsfield's Cuckoo [86651]		Species or species habitat may occur within area
[Hirundapus caudacutus](#) White-throated Needletail [682]	Vulnerable	Species or species habitat may occur within area
[Monarcha melanopsis](#) Black-faced Monarch [609]		Species or species habitat may occur within area
[Monarcha trivirgatus](#) Spectacled Monarch [610]		Species or species habitat may occur within area
[Myiagra cyanoleuca](#) Satin Flycatcher [612]		Species or species habitat likely to occur within area
[Rhipidura rufifrons](#) Rufous Fantail [592]		Species or species habitat likely to occur within area
Migratory Wetlands Species		
[Actitis hypoleucos](#) Common Sandpiper [59309]		Species or species habitat may occur within area
[Calidris acuminata](#) Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
[Calidris ferruginea](#) Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
[Calidris melanotos](#) Pectoral Sandpiper [858]		Species or species habitat may occur within area
[Gallinago hardwickii](#) Latham's Snipe, Japanese Snipe [863]		Species or species habitat likely to occur within area
[Numenius madagascariensis](#) Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
[Pandion haliaetus](#) Osprey [952]		Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Listed Marine Species		[Resource Information]
* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.		
Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Anseranas semipalmata Magpie Goose [978]		Species or species habitat may occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Chrysococcyx osculans Black-eared Cuckoo [705]		Species or species habitat likely to occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Species or species habitat likely to occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat may occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Monarcha melanopsis Black-faced Monarch [609]		Species or species habitat may occur within area
Monarcha trivirgatus Spectacled Monarch [610]		Species or species habitat may occur within area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat likely to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within

Name	Threatened	Type of Presence
		area
Pandion haliaetus		
Osprey [952]		Species or species habitat may occur within area
Rhipidura rufifrons		
Rufous Fantail [592]		Species or species habitat likely to occur within area
Rostratula benghalensis (sensu lato)		
Painted Snipe [889]	Endangered*	Species or species habitat likely to occur within area
Reptiles		
Crocodylus porosus		
Salt-water Crocodile, Estuarine Crocodile [1774]		Species or species habitat likely to occur within area

Extra Information

Invasive Species [Resource Information]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

Name	Status	Type of Presence
Birds		
Acridotheres tristis		
Common Myna, Indian Myna [387]		Species or species habitat likely to occur within area
Anas platyrhynchos		
Mallard [974]		Species or species habitat likely to occur within area
Columba livia		
Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Lonchura punctulata		
Nutmeg Mannikin [399]		Species or species habitat likely to occur within area
Passer domesticus		
House Sparrow [405]		Species or species habitat likely to occur within area
Streptopelia chinensis		
Spotted Turtle-Dove [780]		Species or species habitat likely to occur within area
Sturnus vulgaris		
Common Starling [389]		Species or species habitat likely to occur within area
Frogs		

Name	Status	Type of Presence
Rhinella marina Cane Toad [83218]		Species or species habitat known to occur within area
Mammals		
Bos taurus Domestic Cattle [16]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Lepus capensis Brown Hare [127]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
Sus scrofa Pig [6]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Anredera cordifolia Madeira Vine, Jalap, Lamb's-tail, Mignonette Vine, Anredera, Gulf Madeiravine, Heartleaf Madeiravine, Potato Vine [2643]		Species or species habitat likely to occur within area
Cryptostegia grandiflora Rubber Vine, Rubbervine, India Rubber Vine, India Rubbervine, Palay Rubbervine, Purple Allamanda [18913]		Species or species habitat likely to occur within area
Hymenachne amplexicaulis Hymenachne, Olive Hymenachne, Water Stargrass, West Indian Grass, West Indian Marsh Grass [31754]		Species or species habitat likely to occur within area
Jatropha gossypifolia Cotton-leaved Physic-Nut, Bellyache Bush, Cotton-leaf Physic Nut, Cotton-leaf Jatropha, Black Physic Nut [7507]		Species or species habitat likely to occur within area
Lantana camara Lantana, Common Lantana, Kamara Lantana, Large-leaf Lantana, Pink Flowered Lantana, Red Flowered Lantana, Red-Flowered Sage, White Sage, Wild Sage [10892]		Species or species habitat likely to occur within area
Opuntia spp. Prickly Pears [82753]		Species or species habitat likely to occur within area
Parkinsonia aculeata Parkinsonia, Jerusalem Thorn, Jelly Bean Tree, Horse Bean [12301]		Species or species habitat likely to occur within area
Parthenium hysterophorus Parthenium Weed, Bitter Weed, Carrot Grass, False		Species or species

Name	Status	Type of Presence
Ragweed [19566]		habitat likely to occur within area
Salvinia molesta Salvinia, Giant Salvinia, Aquarium Watermoss, Kariba Weed [13665]		Species or species habitat likely to occur within area
Vachellia nilotica Prickly Acacia, Blackthorn, Prickly Mimosa, Black Piquant, Babul [84351]		Species or species habitat likely to occur within area
Reptiles		
Hemidactylus frenatus Asian House Gecko [1708]		Species or species habitat likely to occur within area

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

-23.4712 150.3971

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

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EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

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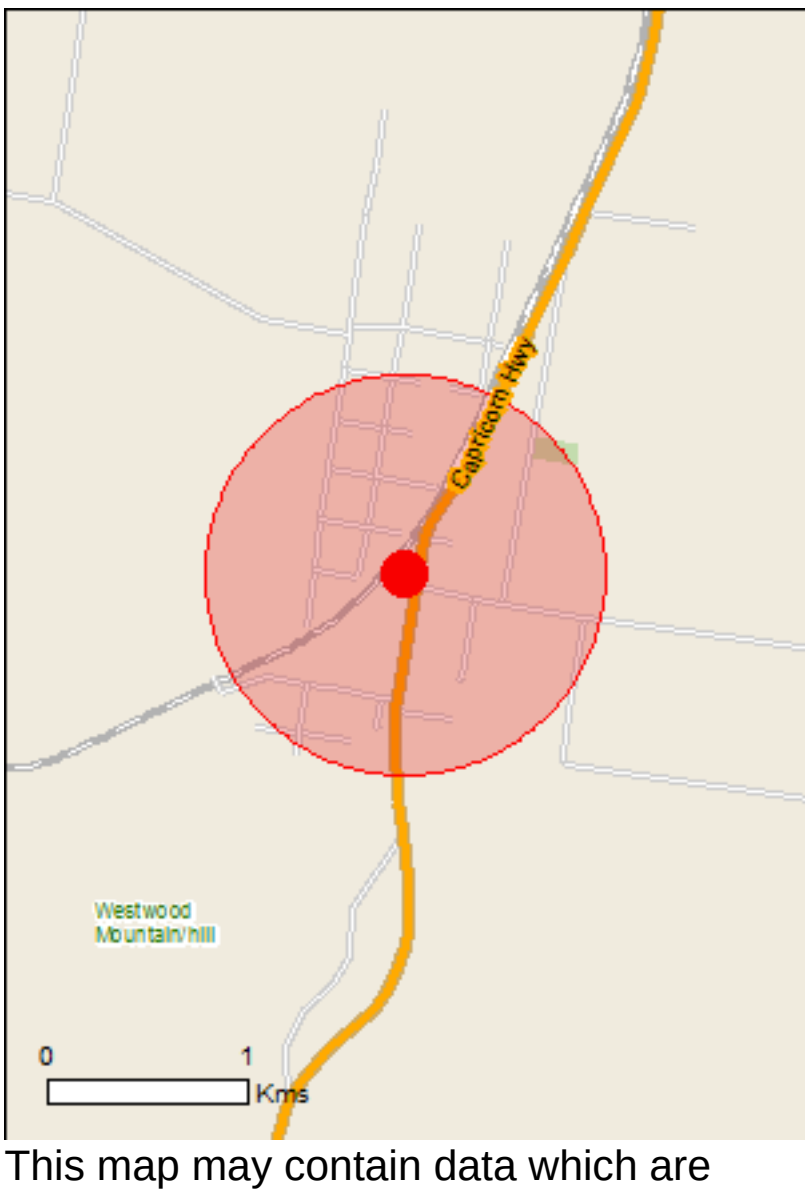
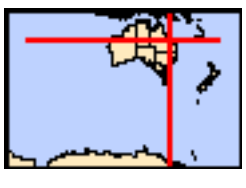


Coordinates

Buffer: 1.0Km



Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	3
Listed Threatened Species:	29
Listed Migratory Species:	15

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	20
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	None
Regional Forest Agreements:	None
Invasive Species:	23
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Listed Threatened Ecological Communities [Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Name	Status	Type of Presence
Coolibah - Black Box Woodlands of the Darling Riverine Plains and the Brigalow Belt South Bioregions	Endangered	Community may occur within area
Poplar Box Grassy Woodland on Alluvial Plains	Endangered	Community may occur within area
Weeping Myall Woodlands	Endangered	Community may occur within area

Listed Threatened Species [Resource Information]

Name	Status	Type of Presence
Birds		
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Erythrotriorchis radiatus Red Goshawk [942]	Vulnerable	Species or species habitat likely to occur within area
Falco hypoleucos Grey Falcon [929]	Vulnerable	Species or species habitat may occur within area
Geophaps scripta scripta Squatter Pigeon (southern) [64440]	Vulnerable	Species or species habitat likely to occur within area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat may occur within area
Neochmia ruficauda ruficauda Star Finch (eastern), Star Finch (southern) [26027]	Endangered	Species or species habitat likely to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Poephila cincta cincta Southern Black-throated Finch [64447]	Endangered	Species or species habitat may occur within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat likely to occur within area
Turnix melanogaster Black-breasted Button-quail [923]	Vulnerable	Species or species

Name	Status	Type of Presence
		habitat may occur within area
Mammals		
[Chalinolobus dwyeri](#) Large-eared Pied Bat, Large Pied Bat [183]	Vulnerable	Species or species habitat may occur within area
[Dasyurus hallucatus](#) Northern Quoll, Digul [Gogo-Yimidir], Wijingadda [Dambimangari], Wiminji [Martu] [331]	Endangered	Species or species habitat likely to occur within area
[Macroderma gigas](#) Ghost Bat [174]	Vulnerable	Species or species habitat likely to occur within area
[Nyctophilus corbeni](#) Corben's Long-eared Bat, South-eastern Long-eared Bat [83395]	Vulnerable	Species or species habitat may occur within area
[Petauroides volans](#) Greater Glider [254]	Vulnerable	Species or species habitat may occur within area
[Phascolarctos cinereus (combined populations of Qld, NSW and the ACT)](#) Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory) [85104]	Vulnerable	Species or species habitat likely to occur within area
[Pteropus poliocephalus](#) Grey-headed Flying-fox [186]	Vulnerable	Foraging, feeding or related behaviour may occur within area
Plants		
[Cadellia pentastylis](#) Ooline [9828]	Vulnerable	Species or species habitat may occur within area
[Cossinia australiana](#) Cossinia [3066]	Endangered	Species or species habitat likely to occur within area
[Cycas megacarpa](#) [55794]	Endangered	Species or species habitat likely to occur within area
[Dichanthium setosum](#) bluegrass [14159]	Vulnerable	Species or species habitat likely to occur within area
[Eucalyptus raveretiana](#) Black Ironbox [16344]	Vulnerable	Species or species habitat likely to occur within area
[Marsdenia brevifolia](#) [64585]	Vulnerable	Species or species habitat may occur within area
[Samadera bidwillii](#) Quassia [29708]	Vulnerable	Species or species habitat may occur within area
Reptiles		
[Delma torquata](#) Adorned Delma, Collared Delma [1656]	Vulnerable	Species or species habitat may occur within area
[Denisonia maculata](#) Ornamental Snake [1193]	Vulnerable	Species or species habitat may occur within area
[Egernia rugosa](#) Yakka Skink [1420]	Vulnerable	Species or species habitat may occur within area

Name	Status	Type of Presence
Furina dunmalli		
Dunmall's Snake [59254]	Vulnerable	Species or species habitat may occur within area
Rheodytes leukops		
Fitzroy River Turtle, Fitzroy Tortoise, Fitzroy Turtle, White-eyed River Diver [1761]	Vulnerable	Species or species habitat may occur within area

Listed Migratory Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus		
Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Migratory Marine Species		
Crocodylus porosus		
Salt-water Crocodile, Estuarine Crocodile [1774]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
Cuculus optatus		
Oriental Cuckoo, Horsfield's Cuckoo [86651]		Species or species habitat may occur within area
Hirundapus caudacutus		
White-throated Needletail [682]	Vulnerable	Species or species habitat may occur within area
Monarcha melanopsis		
Black-faced Monarch [609]		Species or species habitat may occur within area
Motacilla flava		
Yellow Wagtail [644]		Species or species habitat may occur within area
Myiagra cyanoleuca		
Satin Flycatcher [612]		Species or species habitat likely to occur within area
Rhipidura rufifrons		
Rufous Fantail [592]		Species or species habitat may occur within area
Migratory Wetlands Species		
Actitis hypoleucos		
Common Sandpiper [59309]		Species or species habitat may occur within area
Calidris acuminata		
Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris ferruginea		
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos		
Pectoral Sandpiper [858]		Species or species habitat may occur within area
Gallinago hardwickii		
Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area
Numenius madagascariensis		
Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area

Name	Threatened	Type of Presence
Pandion haliaetus		
Osprey [952]		Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Listed Marine Species		[Resource Information]
* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.		
Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos		
Common Sandpiper [59309]		Species or species habitat may occur within area
Anseranas semipalmata		
Magpie Goose [978]		Species or species habitat may occur within area
Apus pacificus		
Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea ibis		
Cattle Egret [59542]		Species or species habitat may occur within area
Calidris acuminata		
Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris ferruginea		
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos		
Pectoral Sandpiper [858]		Species or species habitat may occur within area
Chrysococcyx osculans		
Black-eared Cuckoo [705]		Species or species habitat likely to occur within area
Gallinago hardwickii		
Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area
Haliaeetus leucogaster		
White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area

Name	Threatened	Type of Presence
Hirundapus caudacutus		
White-throated Needletail [682]	Vulnerable	Species or species habitat may occur within area
Merops ornatus		
Rainbow Bee-eater [670]		Species or species habitat may occur within area
Monarcha melanopsis		
Black-faced Monarch [609]		Species or species habitat may occur within area
Motacilla flava		
Yellow Wagtail [644]		Species or species habitat may occur within area
Myiagra cyanoleuca		
Satin Flycatcher [612]		Species or species habitat likely to occur within area
Numenius madagascariensis		
Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pandion haliaetus		
Osprey [952]		Species or species habitat may occur within area
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Rufous Fantail [592]		Species or species habitat may occur within area
Rostratula benghalensis (sensu lato)		
Painted Snipe [889]	Endangered*	Species or species habitat likely to occur within area
Reptiles		
Crocodylus porosus		
Salt-water Crocodile, Estuarine Crocodile [1774]		Species or species habitat likely to occur within area

Extra Information

Invasive Species	[Resource Information]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

Name	Status	Type of Presence
Birds		
Columba livia		
Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Lonchura punctulata		
Nutmeg Mannikin [399]		Species or species habitat likely to occur

Name	Status	Type of Presence within area
Passer domesticus House Sparrow [405]		Species or species habitat likely to occur within area
Streptopelia chinensis Spotted Turtle-Dove [780]		Species or species habitat likely to occur within area
Sturnus vulgaris Common Starling [389]		Species or species habitat likely to occur within area
Frogs		
Rhinella marina Cane Toad [83218]		Species or species habitat known to occur within area
Mammals		
Bos taurus Domestic Cattle [16]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Lepus capensis Brown Hare [127]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Sus scrofa Pig [6]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Cryptostegia grandiflora Rubber Vine, Rubbervine, India Rubber Vine, India Rubbervine, Palay Rubbervine, Purple Allamanda [18913]		Species or species habitat likely to occur within area
Jatropha gossypifolia Cotton-leaved Physic-Nut, Bellyache Bush, Cotton-leaf Physic Nut, Cotton-leaf Jatropha, Black Physic Nut [7507]		Species or species habitat likely to occur within area
Lantana camara Lantana, Common Lantana, Kamara Lantana, Large-leaf Lantana, Pink Flowered Lantana, Red Flowered Lantana, Red-Flowered Sage, White Sage, Wild Sage [10892]		Species or species habitat likely to occur within area
Parkinsonia aculeata Parkinsonia, Jerusalem Thorn, Jelly Bean Tree, Horse Bean [12301]		Species or species habitat likely to occur within area
Parthenium hysterophorus Parthenium Weed, Bitter Weed, Carrot Grass, False Ragweed [19566]		Species or species habitat likely to occur within area

Name	Status	Type of Presence
Prosopis spp. Mesquite, Algaroba [68407]		Species or species habitat likely to occur within area
Salix spp. except S.babylonica, S.x calodendron & S.x reichardtii Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow [68497]		Species or species habitat likely to occur within area
Salvinia molesta Salvinia, Giant Salvinia, Aquarium Watermoss, Kariba Weed [13665]		Species or species habitat likely to occur within area
Vachellia nilotica Prickly Acacia, Blackthorn, Prickly Mimosa, Black Piquant, Babul [84351]		Species or species habitat likely to occur within area

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

-23.6219 150.1559

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

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Appendix 5 Community survey results

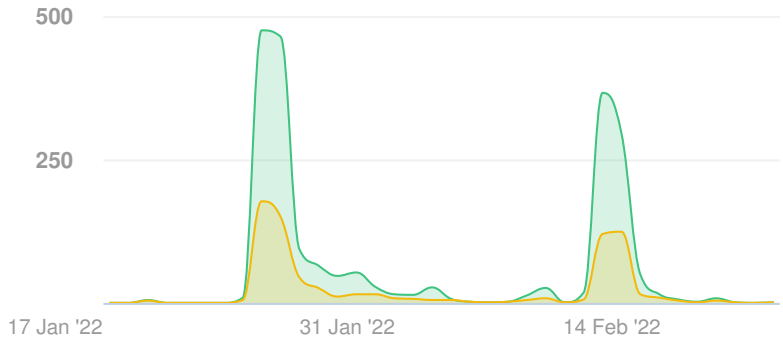
Project Report

15 April 2019 - 21 February 2022

Engage Rockhampton Region

Flying-fox Roost Management Plan

Visitors Summary



Highlights

TOTAL VISITS	MAX VISITORS PER DAY	NEW REGISTRATIONS
824	177	150

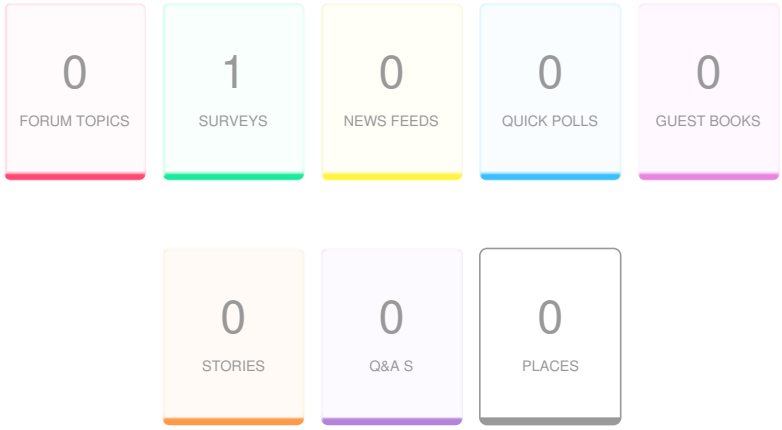
ENGAGED VISITORS	INFORMED VISITORS	AWARE VISITORS
237	570	748

Aware Participants	748
Aware Actions Performed	Participants
Visited a Project or Tool Page	748

Informed Participants	570
Informed Actions Performed	Participants
Viewed a video	0
Viewed a photo	0
Downloaded a document	0
Visited the Key Dates page	0
Visited an FAQ list Page	0
Visited Instagram Page	0
Visited Multiple Project Pages	322
Contributed to a tool (engaged)	237

Engaged Participants	237		
Engaged Actions Performed	Registered	Unverified	Anonymous
Contributed on Forums	0	0	0
Participated in Surveys	237	0	0
Contributed to Newsfeeds	0	0	0
Participated in Quick Polls	0	0	0
Posted on Guestbooks	0	0	0
Contributed to Stories	0	0	0
Asked Questions	0	0	0
Placed Pins on Places	0	0	0
Contributed to Ideas	0	0	0

ENGAGEMENT TOOLS SUMMARY



Tool Type	Engagement Tool Name	Tool Status	Visitors	Contributors		
				Registered	Unverified	Anonymous
Survey Tool	Flying-fox Roost Management Plan - Community Survey	Archived	652	237	0	0

ENGAGEMENT TOOL: SURVEY TOOL

Flying-fox Roost Management Plan - Community Survey

Visitors 652	Contributors 237	CONTRIBUTIONS 237

Please select an answer for each of the following statements.Flying-foxes....

Optional question (237 response(s), 0 skipped)

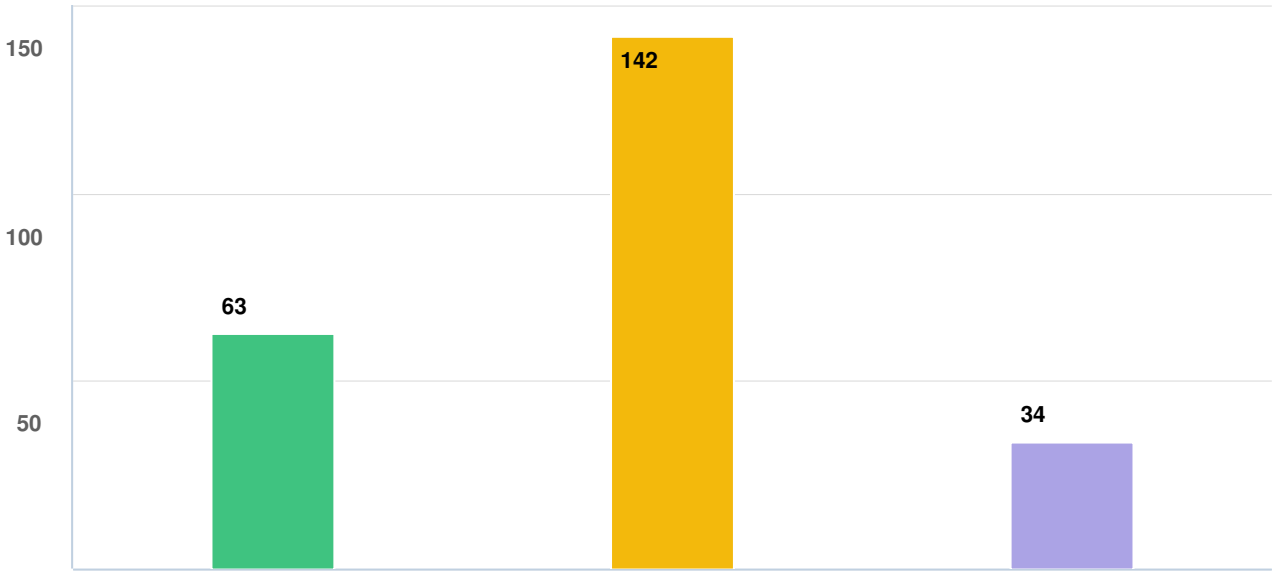
Question type: Likert Question

Please indicate how strongly you agree or disagree with the following statements:

Optional question (237 response(s), 0 skipped)

Question type: Likert Question

How would you rate your experience or interactions with flying-foxes?



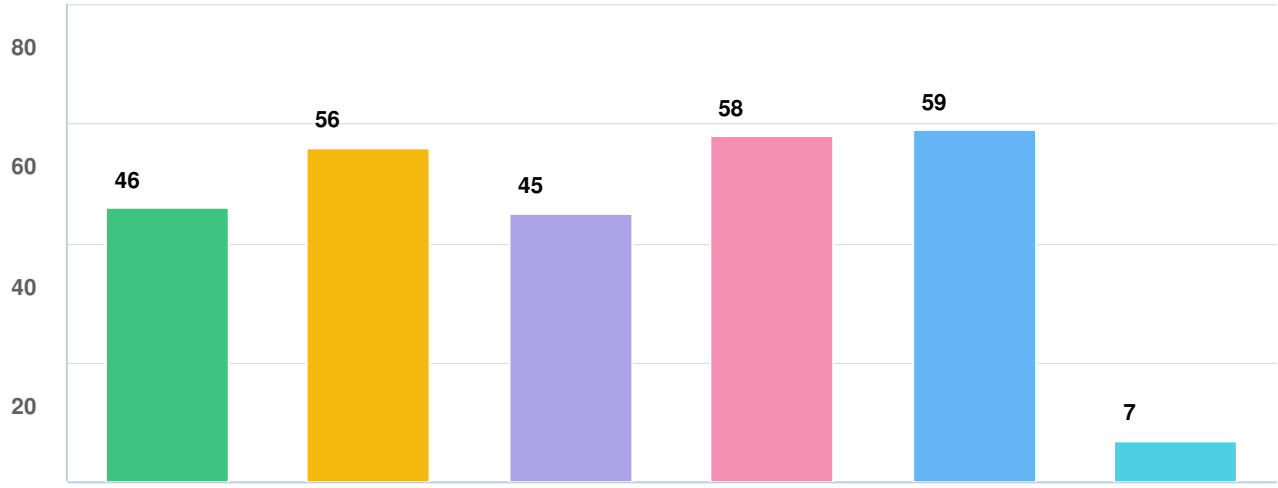
Question options

Neutral Negative Positive

Optional question (236 response(s), 1 skipped)

Question type: Checkbox Question

If your experiences with flying-foxes are positive, what do you like about them?



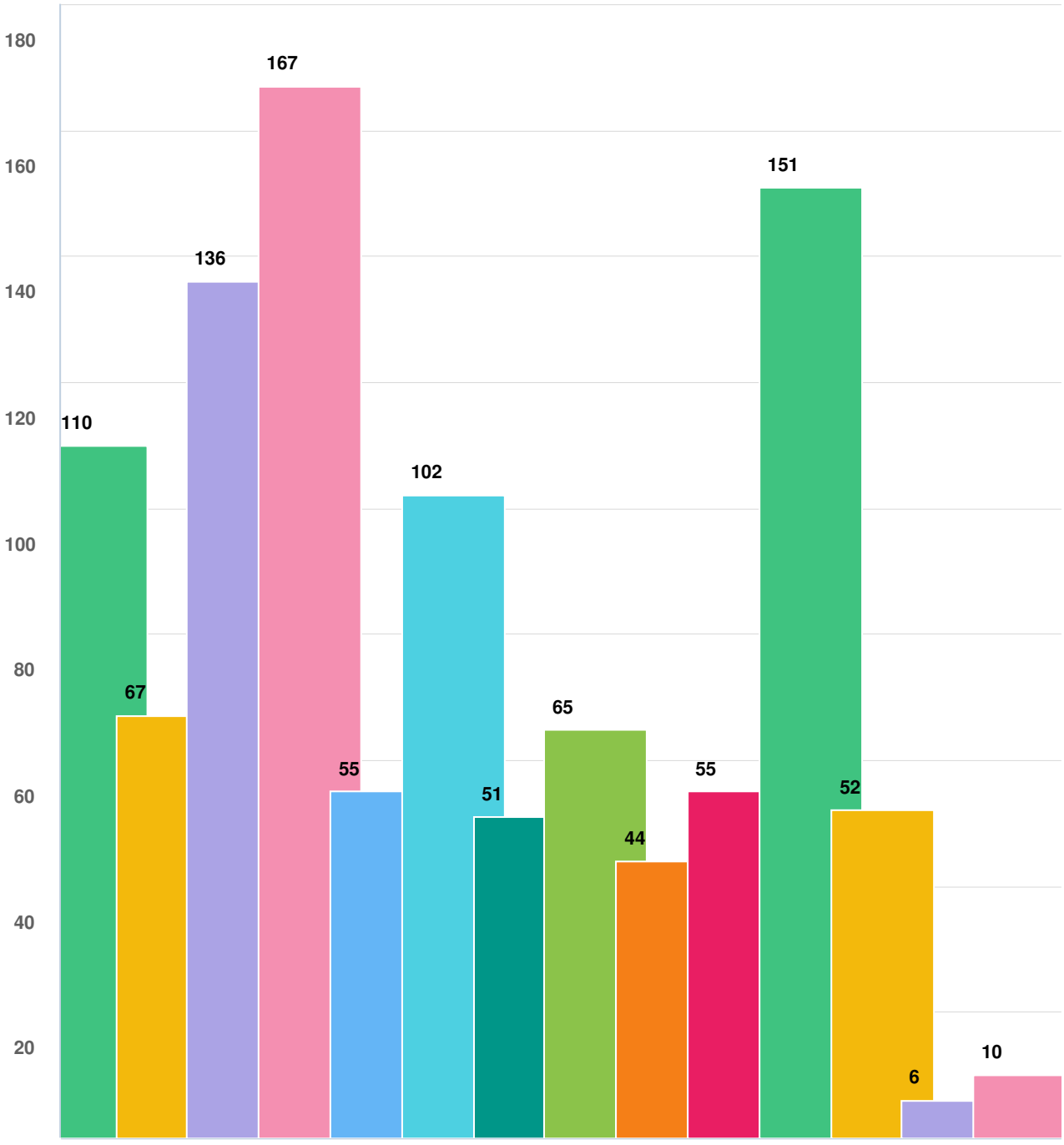
Question options

- Other
- Flying-foxes are great pollinators and seed dispersers and an important part of our ecosystem
- I appreciate being able to live with native wildlife
- I enjoy when they visit my backyard
- I enjoy watching them at the roost / flying out
- They are intelligent and social

Optional question (63 response(s), 174 skipped)

Question type: Checkbox Question

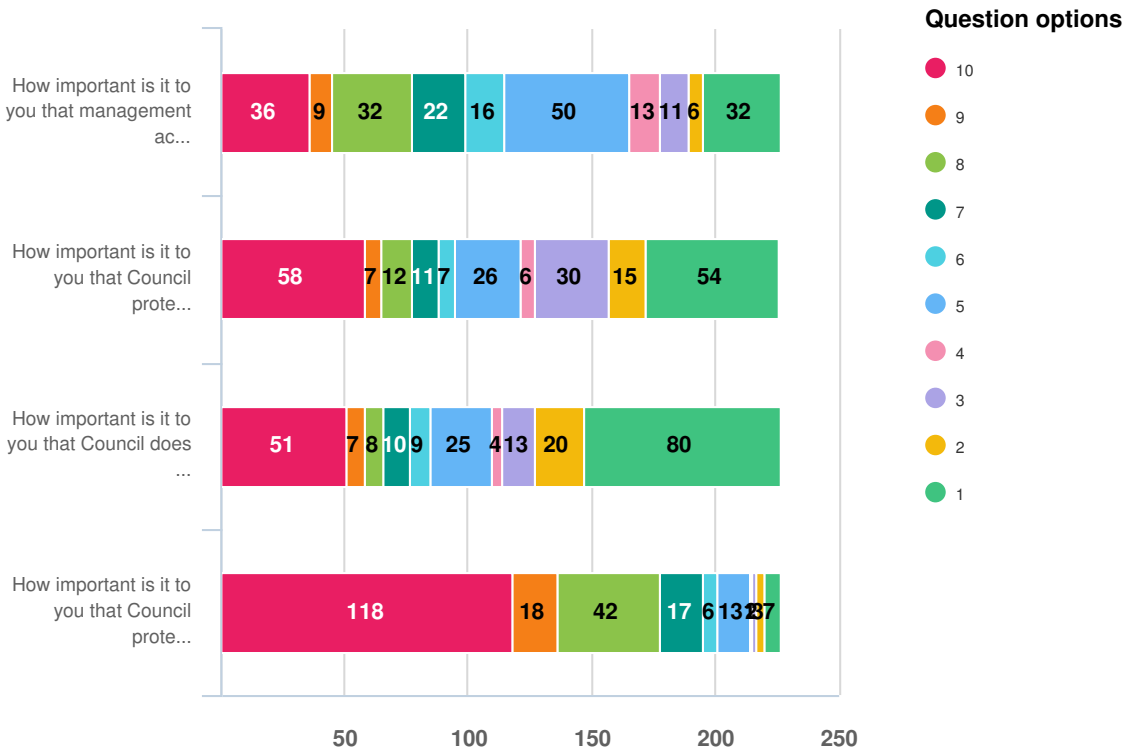
Which of the following topics relating to flying-foxes are of concern to you?



Optional question (227 response(s), 10 skipped)

Question type: Checkbox Question

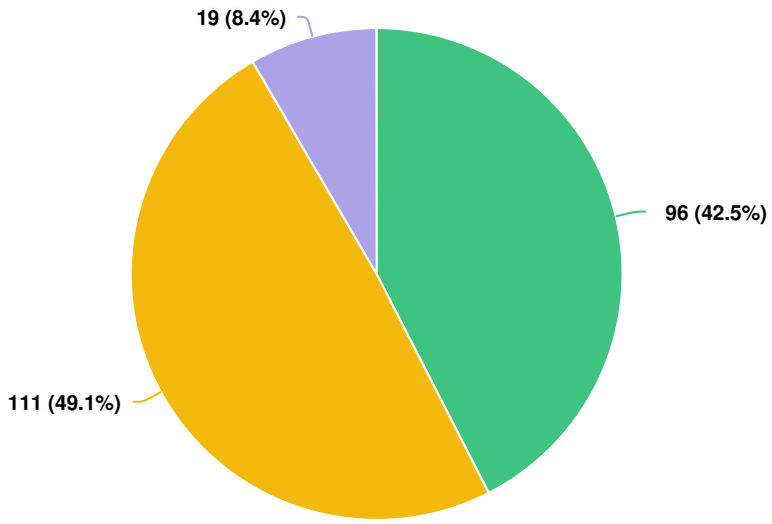
Please rank the following in order of importance (1-least important) (5- Neutral) (10-most important)



Optional question (227 response(s), 10 skipped)

Question type: Likert Question

Do you live near a flying-fox roost?



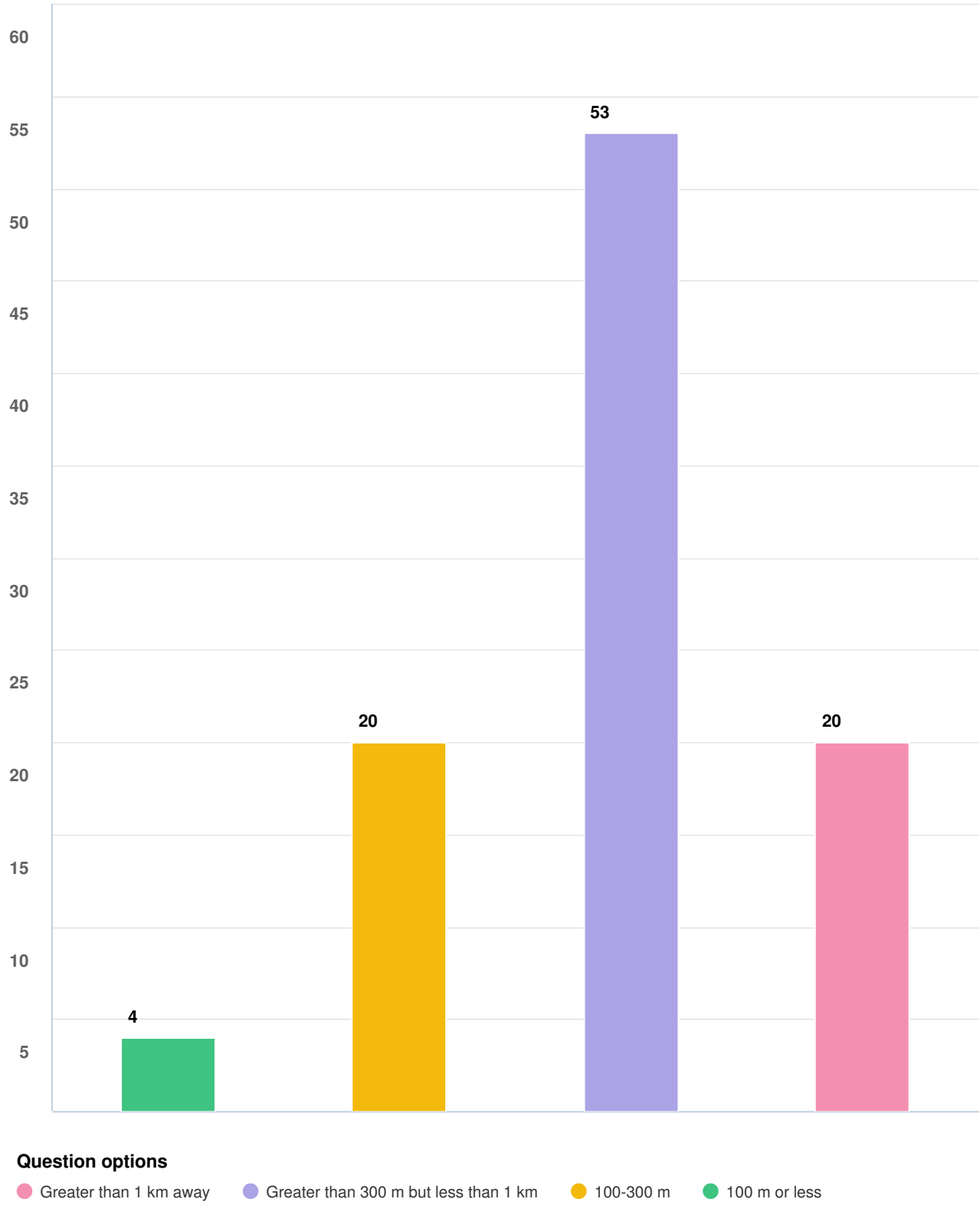
Question options

Don't know No Yes

Optional question (226 response(s), 11 skipped)

Question type: Radio Button Question

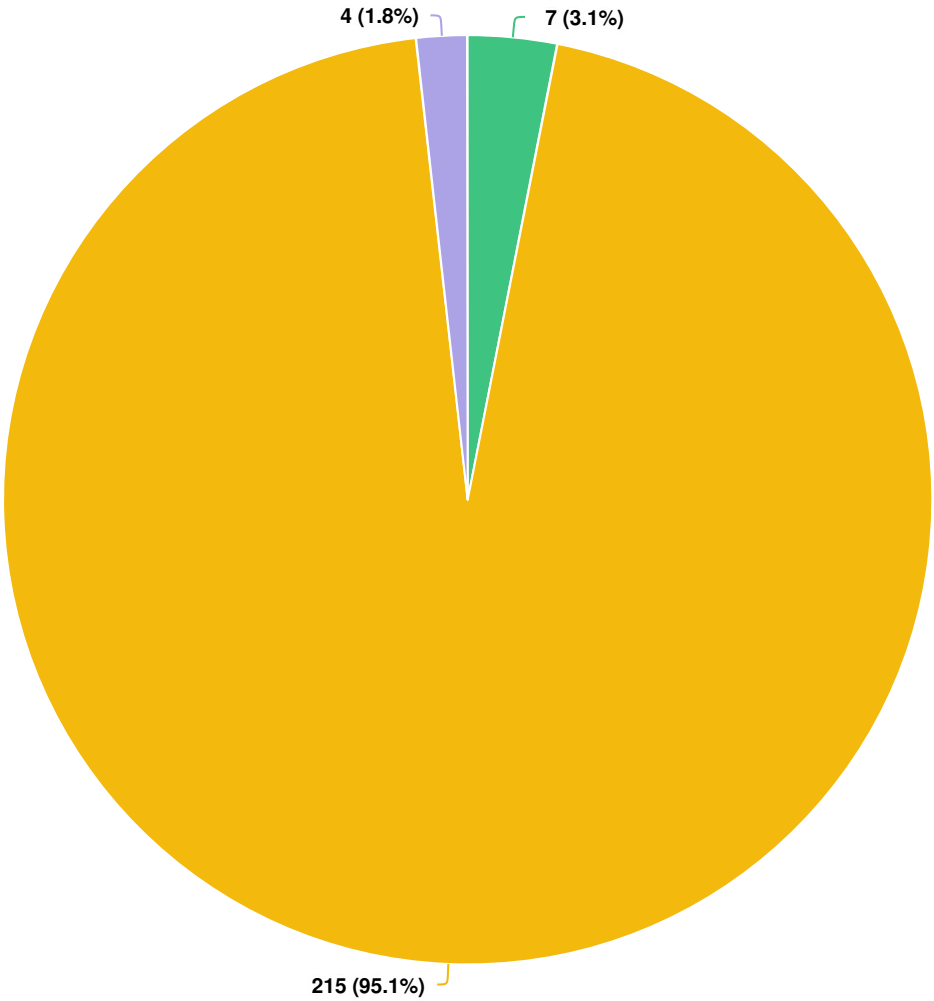
Approximately how far away is the roost from your home?



Optional question (96 response(s), 141 skipped)

Question type: Checkbox Question

Do you own a business near a flying-fox roost?



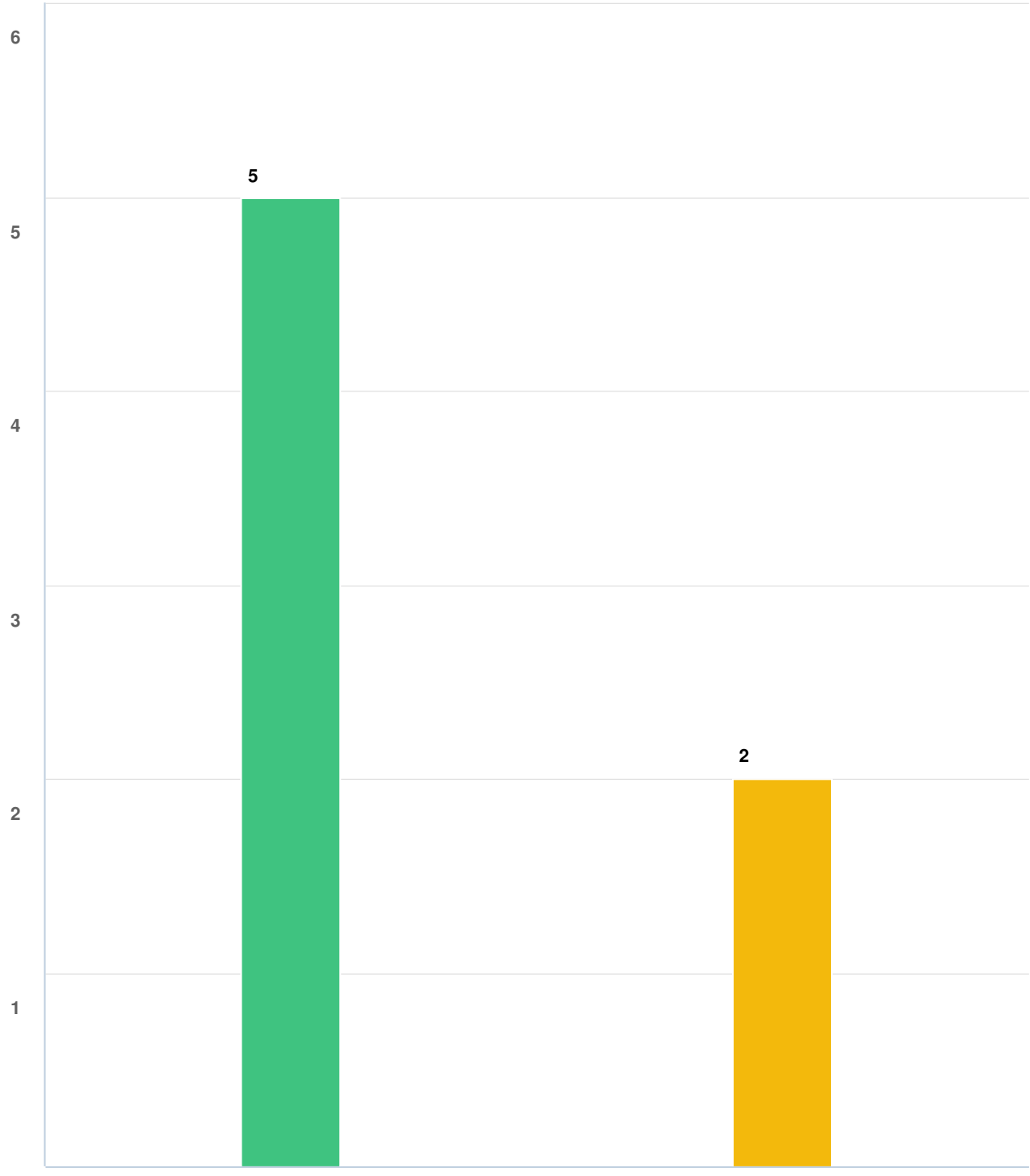
Question options

Don't know No Yes

Optional question (226 response(s), 11 skipped)

Question type: Radio Button Question

Approximately how far away is the roost from your business?



Question options

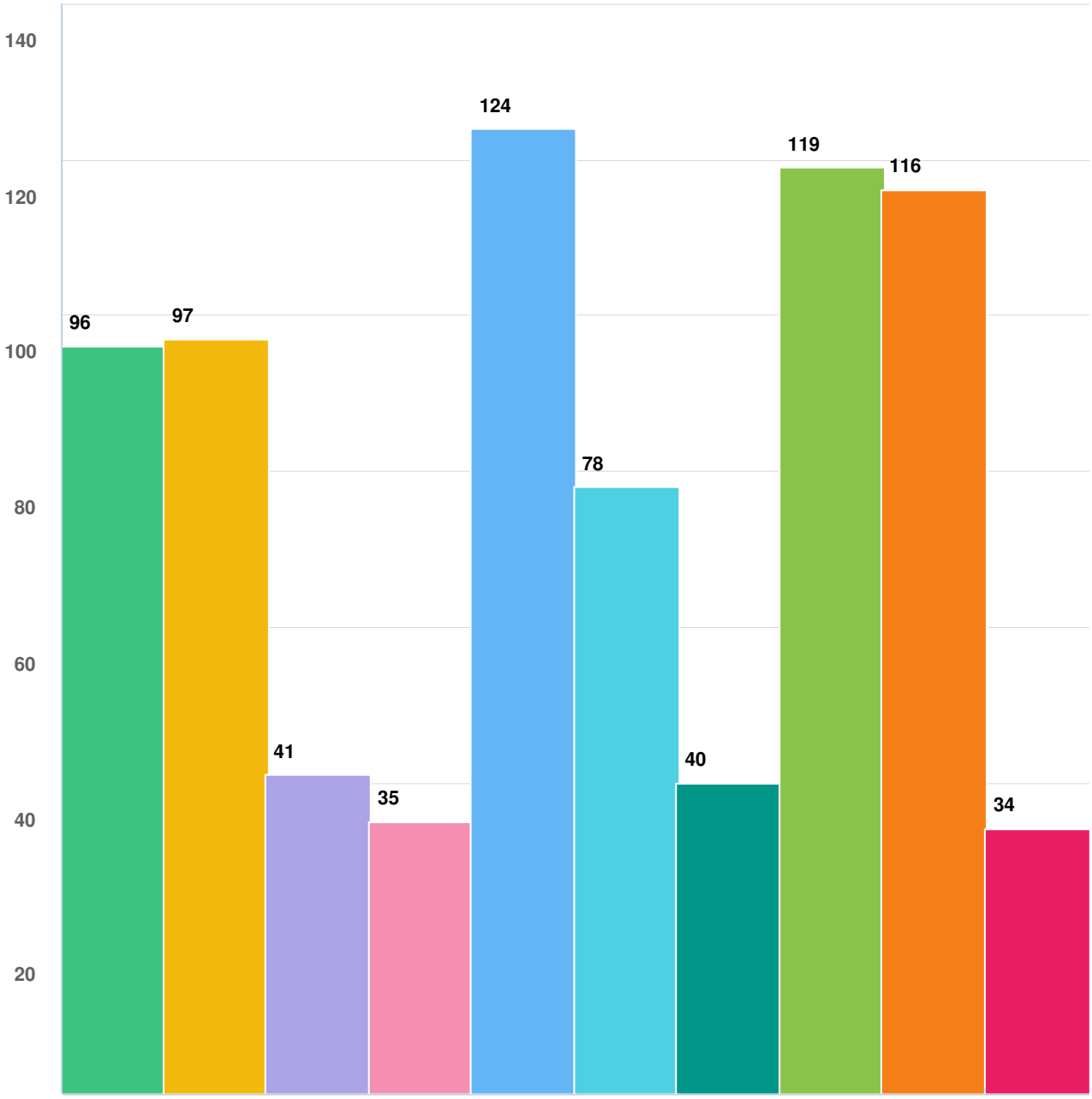
Greater than 300 m but less than 1 km

100 m or less

Optional question (7 response(s), 230 skipped)

Question type: Checkbox Question

Which of the following management options do you support?



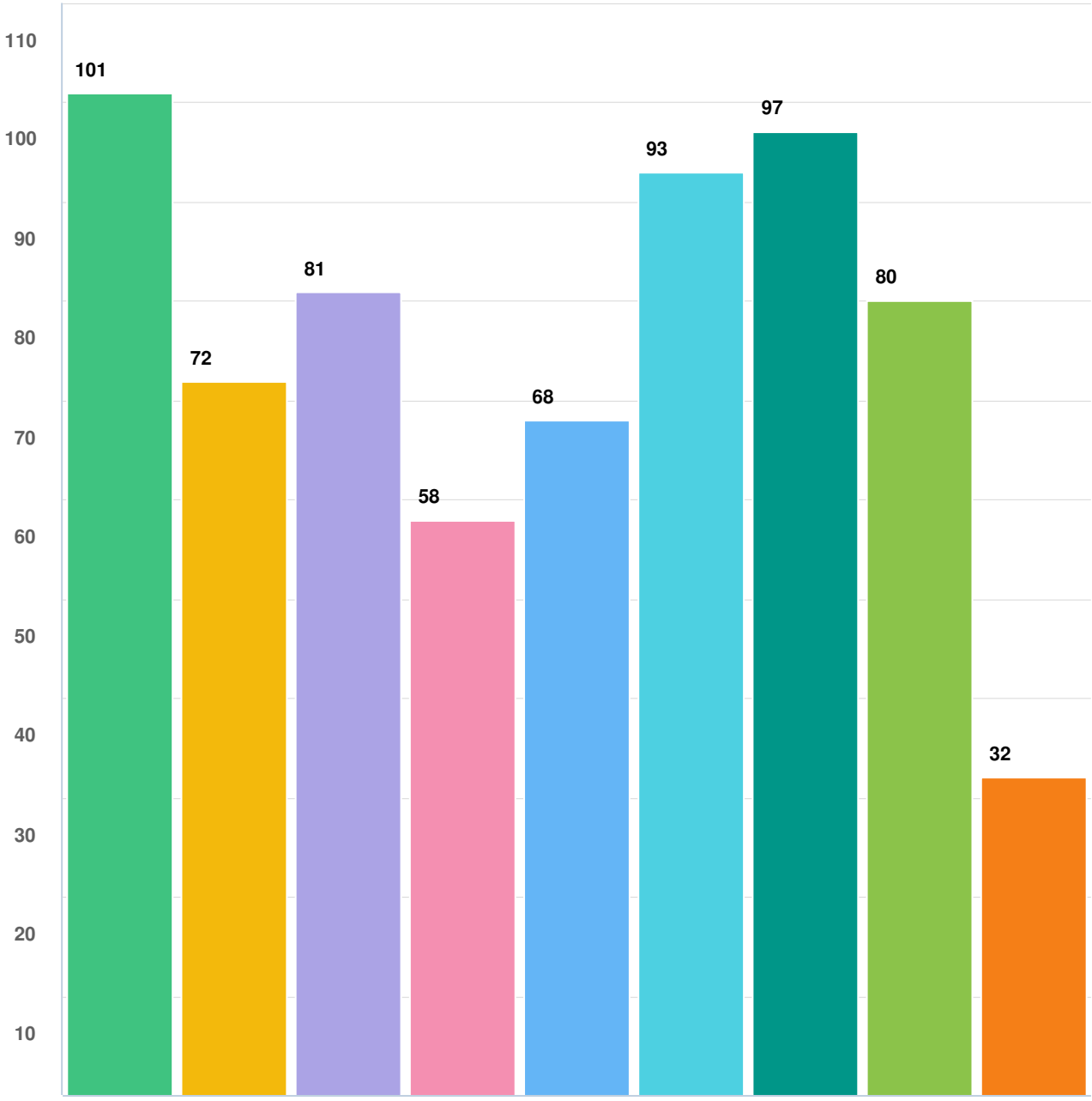
Question options

- Other
- Buffers between people and flying-foxes using plants not suitable for roosting flying-foxes
- Buffers using deterrents (e.g. canopy-mounted sprinklers)
- Buffers through tree removal
- Buffers through tree trimming
- Protecting and enhancing flying-fox roost habitat in low conflict areas
- Noise reduction fencing
- Property modification (e.g. insulation, double-glazed windows, plantings)
- Land use planning including zoning of flying-fox roosts
- Education and research

Optional question (223 response(s), 14 skipped)

Question type: Checkbox Question

Which of the following education options appeal to you? Choose one or more, or suggest your own.



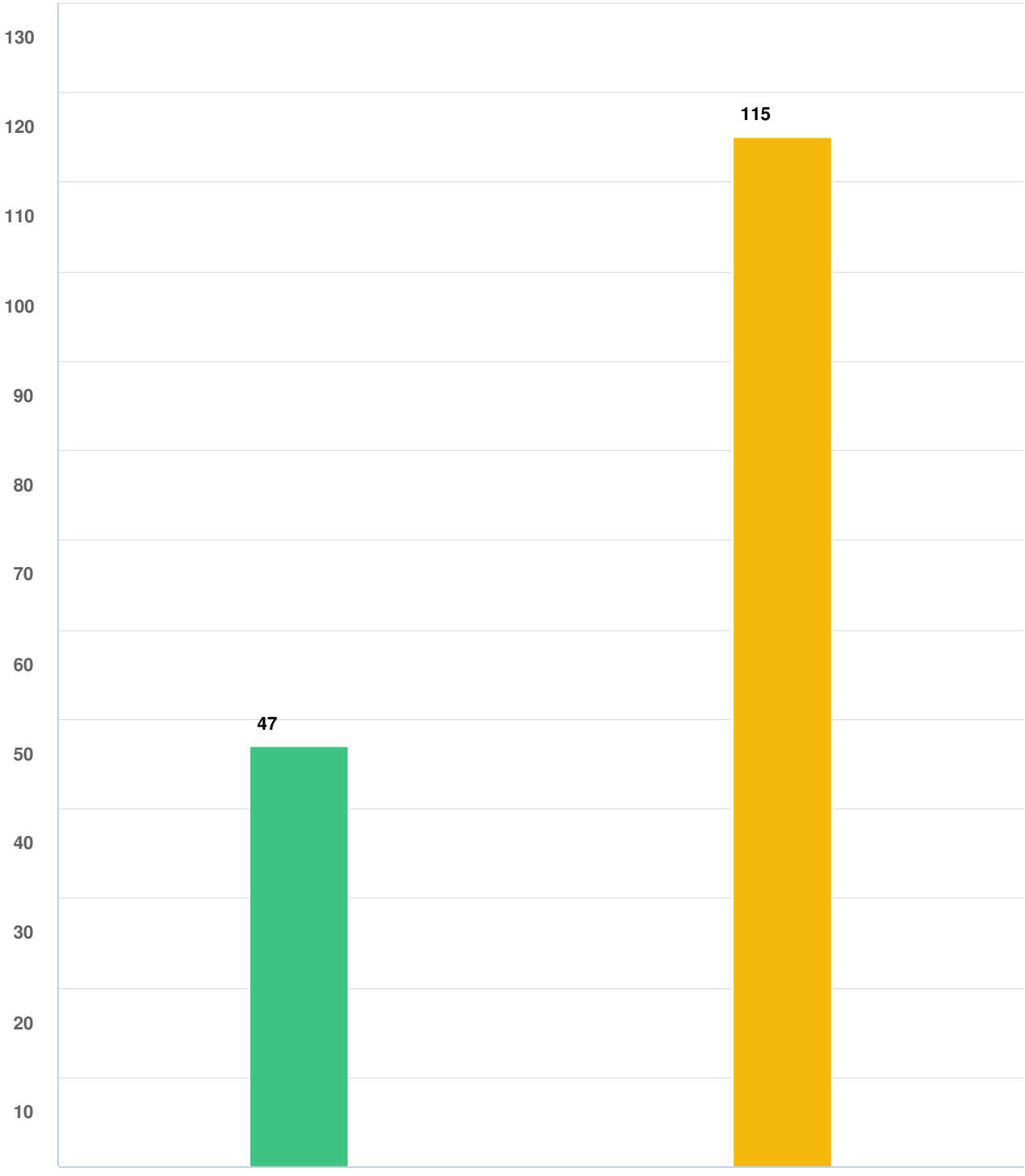
Question options

- Other
- School engagement programs
- Website with links to up-to-date information
- Fact sheets with up-to-date information regarding flying-foxes or the roost
- Promote the flying-fox roost as a natural asset to future residents
- Opportunities to meet a flying-fox
- Talks by Traditional Owners/wildlife carers/rangers
- Annual flying-fox night with flying-fox specialists, community and local government
- Educational signage

Optional question (184 response(s), 53 skipped)

Question type: Checkbox Question

Would you like more information about garden plants that:



Question options

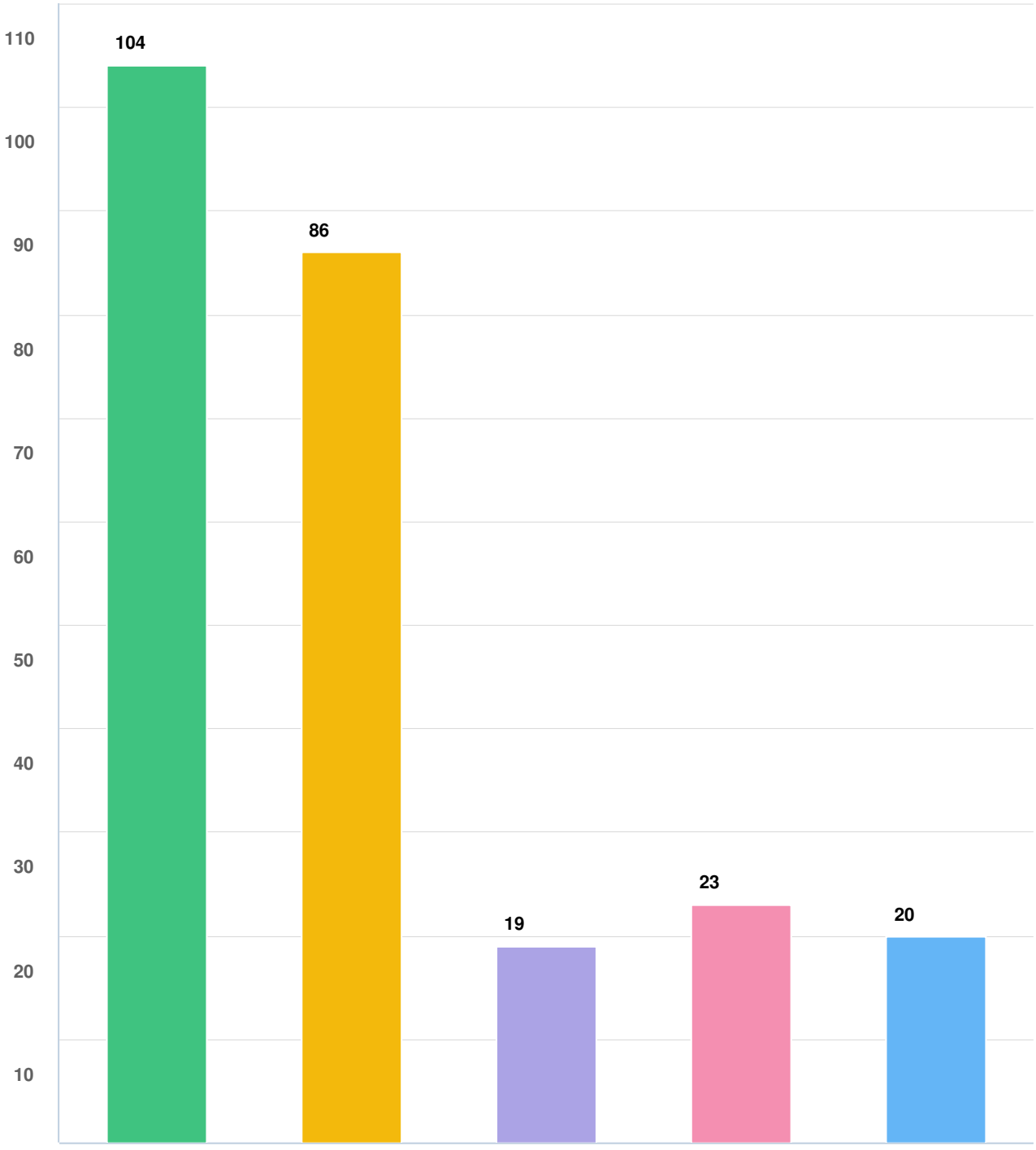
Avoid attracting flying-foxes to your backyard.

Attract flying-foxes to your backyard

Optional question (152 response(s), 85 skipped)

Question type: Checkbox Question

Which of the following best describes you?



Question options

Other
Member of a club or group?
Occasional visitor to the Rockhampton region
Resident or Business owner not impacted by a roost
Resident or Business owner impacted by a roost

Optional question (223 response(s), 14 skipped)

Question type: Checkbox Question

Appendix 6 Management options

Below is an overview of management options commonly used across Queensland and Australia which were considered in the development of the Plan.

Low impact options

Education and awareness programs

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

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

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

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

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

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

An education program may include components shown below.

Property modification

The managers of land on which a flying-fox roost is located would promote or encourage the adoption of certain actions on properties adjacent to or near the roost to minimise impacts from roosting and foraging flying-foxes:

- 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 metres). Vegetation that produces fragrant flowers can assist in masking roost odour where this is of concern.
- Manage foraging trees (i.e. plants that produce fruit/nectar-exuding flowers) within properties through pruning/covering with bags or wildlife friendly netting, early removal of fruit, or tree replacement.
- Cover vehicles, structures and clothes lines where faecal contamination is an issue, or remove washing from the line before dawn/dusk.
- Move or cover eating areas (e.g. BBQs and tables) within close proximity to a 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.
- Include suitable buffers and other provisions (e.g. covered car parks) in planning of new developments.
- Turn off lighting at night which may assist flying-fox navigation and increase fly-over impacts.
- Consider removable covers for swimming pools and ensure working filter and regular chlorine treatment.
- Appropriately manage rainwater tanks, including installing first-flush systems.
- Avoid disturbing flying-foxes during the day as this will increase roost noise.

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

Odour neutralising trial

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

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

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

Subsidy programs

Subsidy programs provide Council with an opportunity to support impacted residents living near flying-fox roosts. There are a number of factors to consider when establishing a subsidy program, including who to offer subsidies to (e.g. who is eligible and how is this determined), what subsidies to offer (e.g. service-based or property-based), how subsidies should be offered (e.g. reimbursements for purchases or upfront funding), and how the program will be evaluated to determine effectiveness for reducing flying-fox impacts to residents. A recent report published by the NSW Department of Planning, Industry & Environment (Mo & Roache 2019) summarised the implementation and efficacy of subsidy programs across six councils in NSW: Eurobodalla, Ku-ring-gai, Cessnock, Tamworth, and Sutherland councils. This report provides insight into the aforementioned factors for Council's consideration, if a subsidy program is to be adopted.

Government initiatives that provide financial assistance commonly assess residents' eligibility based on a number of variables, including property distance from a roost, and deliver subsidies as partial or full reimbursements for purchases. It is important to consider that the popularity of certain subsidies likely varies across different communities, so affected residents should be consulted in the process of establishing an effective subsidy program. The NSW subsidy study (Mo & Roache 2019) found managers who design programs that best meet community needs have an increased probability of alleviating human-wildlife conflicts. Critical thresholds of flying-fox numbers at a roost and distance to a roost may also be used to determine when subsidies would apply. However, distance measures must be used with care as the extent to which a resident feels impacted is not a simple function of how close they live, as shown in a large-scale survey of 8,000 residents where there was no correlation between distance and level of bother within 300 m of a flying-fox roost (Lentini et al. 2020).

While subsidies have the potential to alleviate flying-fox impacts within a community, they can be negatively received if residents believe there are broader issues associated with flying-foxes that are not being addressed (Mo & Roache 2019). As such, it is important (as with any community-based program) to assess the needs of residents and have open, ongoing communication throughout the program to ensure the subsidies are effectively reducing impacts, and if not, how the program can be adapted to address these needs.

A brief description and examples of property and service-based subsidies is provided below.

<u>Property modification/item subsidies</u>

Fully funding or providing subsidies to property owners for property modifications may be considered to manage the impacts of the flying-foxes. Providing subsidies to install infrastructure may improve the value of the property, which may also offset concerns regarding perceived or actual property value or rental return losses. Focusing funds towards manipulating the existing built environment also reduces the need for modification and removal of vegetation. Examples of property modification subsidies include vehicle covers, carports, clothesline covers, clothes dryers, pool/spa covers, shade cloths, rainwater first-flush diverters, high-pressure water cleaners, air conditioners, fragrance dispensers or deodorisers, double-glazing of windows, door seals, screen planting, tree netting, and lighting (to

discourage flying-foxes). Of these, vehicle and clothesline covers and high-pressure water cleaners were the most common subsidies taken by residents (Mo & Roache 2019).

When offered, double-glazing windows was popular amongst residents and was able to achieve a 65% reduction in flying-fox noise (Mo & Roache 2019). Furthermore, in a study by Pearson and Cheng (2018), it was found using infrastructure such as double-glazing windows significantly reduced the external noise level measured inside a house adjacent to a roost. This finding was supported by post-subsidy surveys undertaken by Port Macquarie Hastings Council that showed that double-glazed windows were rated as being more effective in mitigating impacts than any other subsidised option (e.g. high pressure cleaners, clothesline covers, shade cloths etc.) (Reynolds 2021).

Sunshine Coast Council undertook several rounds of a private property grant trial in 2021-2022. The trial was used to facilitate property improvement or impact reduction infrastructure on eligible private properties. Feedback from this round confirmed that residents that have lived nearby a roost long-term are more likely to participate in the trial and experience more positive outcomes. It is acknowledged that residents that have only experienced short-term impacts may not be ready yet for this intervention. Council is currently implementing Round 2 of the grant trial where a one-off grant would be provided to eligible residents, which would be supported by ongoing roost management, education, research and monitoring.

Service subsidies

This management option involves providing property owners with a subsidy to help manage impacts on the property and lifestyle of residents. The types of services that could be subsidised include clothes washing, cleaning outside areas and property, solar panel cleaning, car washing, removing exotic trees, or contributing to water/electricity bills. The NSW subsidy study showed that while many property modification subsidies proved popular amongst residents (e.g. high-pressure cleaners, air conditioners), many raised concerns over the increase in water/electricity bills. Increases in bills can be difficult to quantify and justify, and has not yet been effectively offered by a council in a subsidy program.

Routine roost maintenance and operational activities

All persons are authorised to undertake low impact activities at roosts in accordance with the Code of practice—Low impact activities affecting flying-fox roosts. Low impact activities include weeding, mulching, mowing or minor tree trimming.

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

Revegetation and land management to create alternative habitat

This management option involves revegetating and managing land to create alternative flying-fox roosting habitat through improving and extending existing low-conflict roosts or developing

new roosting habitat in areas away from human settlement.

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

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

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

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

Provision of artificial roosting habitat

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

Protocols to manage incidents

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

Participation in research

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

Appropriate land-use planning

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

Property acquisition

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

Do nothing

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

Buffers

Buffers can be created through vegetation removal, revegetation of non-flying-fox attractant vegetation and/or the installation of permanent/semi-permanent deterrents.

Creating buffers may involve planting low-growing, spiky, non-flowering plants between residents or other conflict areas and the flying-fox roost. Such plantings can create a physical and/or visual buffer between the roost and residences or make areas of the roost inaccessible to humans.

Previous studies have recommended that vegetation buffers consisting of habitat not used by flying-foxes, should be 300 m or as wide as the site allows to mitigate amenity impacts for a community (SEQ Catchments 2012). Buffers need to take into consideration the variability of use of a roost site by flying-foxes within and across years, including large, seasonal influxes of flying-foxes. The usefulness of a buffer declines if the flying-fox roost is within 50 m of human habitation.

Buffers through vegetation removal

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

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

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

Suitable experts should be consulted to assist selective vegetation trimming/removal to minimise vegetation loss and associated impacts. The importance of under- and mid-storey vegetation in the buffer area for flying-foxes during heat stress events also requires consideration.

Buffers without vegetation removal

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

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

- Visual deterrents – Visual deterrents such as plastic bags, fluoro vests (GeoLINK 2012) and balloons (Ecosure, pers. comm.) in roost trees have shown to have localised effects, with flying-foxes deterred from roosting within 1–10 metres of the deterrents. The type and placement of visual deterrents would need to be varied regularly to avoid habituation. Potential for litter pollution should be considered and managed when selecting the type and placement of visual deterrents. In the absence of effective maintenance, this option could potentially lead to an increase in rubbish in the natural environment.
- Noise emitters on timers – Noise needs to be random, varied and unexpected to avoid flying-foxes habituating. As such these emitters would need to be portable, on varying timers and a diverse array of noises would be required. It is likely to require some level of additional disturbance to maintain its effectiveness, and ways to avoid disturbing flying-foxes from desirable areas would need to be identified. This is also likely to be disruptive to nearby residents.
- Smell deterrents – For example, bagged python excrement hung in trees has previously had a short-term localised effect (GeoLINK 2012). The smell of certain deterrents may also impact nearby residents, and there is potential for flying-foxes to habituate.
- Canopy-mounted water sprinklers – This method has been effective in deterring flying-foxes during dispersals (Ecosure personal experience), and current trials in Queensland are showing promise for keeping flying-foxes out of designated buffer zones. This option can be logistically difficult (installation and water sourcing) and may be cost-prohibitive. Design and use of sprinklers need to be considerate of animal welfare and features of the site. For example, misting may increase humidity and exacerbate heat stress events, and overuse may impact other environmental values of the site. Further information regarding canopy-mounted sprinklers is detailed below.
- Screening plants – A ‘screen’ can be created by planting a row of trees along the edge of a roost, with the aim of reducing visual impacts associated with flying-foxes. This technique can be particularly useful in cases where residents can suffer extreme reactions triggered by the mere sight of flying-foxes.

Canopy-mounted sprinklers

Installing canopy-mounted sprinklers (CMS) can be used to deter flying-foxes from a buffer. CMS can be installed either:

- without any roost tree trimming/removal or
- accompanied by selective roost tree trimming/removal.

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

As CMS are operated by residents, clear guidelines on sprinkler use will need to be established with residents. To date CMS have been successful at other locations at discouraging flying-foxes from roosting in the buffer zone and enabling residents to have more control over flying-foxes near their properties.

Canopy-mounted sprinklers can be installed and effectively operated without the need for any vegetation removal, as long as the vegetation is not so thick as to restrict the extent of water spray. If vegetation thinning is required to allow sprinklers to operate effectively in some areas, approval will be required under the VM Act as exemptions do not exist for this purpose (see Appendix 1).

Water pressure must be firm so it is sufficient to deter flying-foxes, however, must not risk injuring flying-foxes (or other fauna) or knocking an animal from the tree. Water misting should be minimised as this is unlikely to deter flying-foxes and could exacerbate heat stress event effects. Flying-fox heat stroke generally occurs when the temperature reaches 42°C, however, can occur at lower temperatures in more humid conditions (Bishop 2015). Given that humidity is likely to increase with water in the environment, sprinklers may need to be turned off in

higher temperatures (e.g. >30°C) to avoid exacerbating heat stress (N.B. A NSW government-funded trial through Western Sydney University is currently underway to determine if sprinklers increase humidity and potential heat stress impacts; results should be considered for sprinkler usage).

Sprinklers should release a jet of air prior to water, as an additional deterrent and to cue animals to move prior to water being released. The intention of the sprinklers is to make the buffer unattractive, and effectively 'train' individuals to stay out of the buffer area.

If installed, sprinklers should be programmed to operate on a random schedule and in a staggered manner (i.e. not all sprinklers operating at the same time, to avoid excessive disturbance). Each activation should be for approximately 30-45 seconds per sprinkler. Each sprinkler should be activated up to five times between 0630 and 1600 avoiding critical fly-in or fly-out periods. To avoid flying-foxes habituating to the stimuli, sprinklers should only be operated by residents when flying-foxes are within range. Sprinkler settings would also need to account for seasonal changes (e.g. not in the heat of the day during summer when they may be an attractant, and/or could increase humidity and exacerbate heat events). Individual sprinklers may also need to be temporarily turned off depending on location of creching young, or if it appears likely that animals will be displaced to undesirable locations.

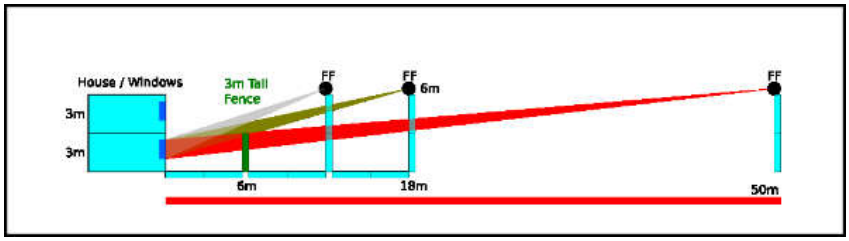
Infrastructure should ideally be designed to accommodate additional sprinklers should they be required in the future. Sprinklers should be designed and attached in a way that allows for future maintenance, replacement, and sprinkler head adjustments, with consideration given to vandalism if located in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

Noise attenuation fencing

Noise attenuation fencing aims to reduce noise and potentially odour where the roost is close to residents.

Example of noise attenuation fencing (source: http://www.slimwall.com.au/gallery)

This may also assist with odour reduction, and perspex fencing could be investigated to assist fence amenity. Although expensive to install, this option could negate the need for habitat modification, maintaining the ecological values of the site, and may be more cost-effective than ongoing management. If flying-fox roosts are located directly adjacent (or very close) to residential properties, fencing may need to be relatively tall, as indicated below.



Indicative scaled distances to achieve shielding for bats approximately 6 m elevated, to a typical window height (Air Noise Environment 2019). Image is indicative only with further investigation required.

To avoid the high costs associated with permanent acoustic fencing, and where flying-fox presence is transient, temporary fencing can be erected in property backyards (below). Residents/businesses can have the ability to fold down the acoustic fence when there are no flying-foxes present and erect it when flying-foxes return to the site (highly likely during melaleuca flowering periods).

Sound Block Acoustic Barrier (source: https://fortressfencing.com.au/sound-block-acoustic-barrier-noise-barrier)

Disturbance or dispersal

Nudging

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

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

Dispersal

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

- actively disturbing the roost pre-dawn as flying-foxes attempt to return from nightly foraging

- passively, by removal of all roosting habitat.

Dispersal via disturbance has been shown to reduce concerns and improve amenity in the short term, however, roosts are usually recolonised, and the conflict remains (Roberts & Eby 2013, Currey et al. 2018). Data from these and more recent studies show that in 95% of cases, dispersal did not reduce the number of flying-foxes from the local area (Roberts et al. 2021).

A review of dispersal attempts between 1990 and 2013 found that flying-foxes only moved within 600 m of the original site in 63% of cases (Roberts & Eby 2013). Similarly, another review of 69 dispersal attempts undertaken between 1992 and 2020 found that in 88% of dispersals, new camps established within 1 kilometre and resulted in new conflict sites (Roberts et al. 2021). In addition, a review of 25 dispersal attempts in Queensland between November 2013 and November 2014 found that when flying-foxes were dispersed, they did not move further than 6 km away for the original roost site (Ecosure 2014). Ultimately, these results indicate that, when dispersed, flying-foxes generally relocate within 600 m – 1 km of the original roost site, and do not travel further than 6 km away.

Driving flying-foxes away from an established roost is challenging and resource intensive. There is a range of risks associated with roost dispersal. These include:

- shifting or splintering the roost into other locations that are equally or more problematic
- impacts on animal welfare and flying-fox conservation
- impacts on the flying-fox population including disease status and associated public health risk
- impacts to the community associated with ongoing dispersal attempts
- increased aircraft strike risk associated with changed flying-fox movement patterns
- high initial and/or ongoing resource requirement and financial investment
- negative public perception from some community members and conservationists opposed to dispersal.

Despite these risks, there are some situations where roost dispersal may be considered. ‘Passive’ or ‘active’ is described further below.

Passive dispersal

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

Generally, a significant proportion of vegetation needs to be removed in order to achieve dispersal of flying-foxes from a roost or to prevent roost re-establishment. For example, flying-

foxes abandoned a roost in Bundall, Queensland once 70% of the canopy/mid-storey and 90% of the understorey had been removed (Ecosure 2011). Ongoing maintenance of the site is required to prevent vegetation structure returning to levels favourable for colonisation by flying-foxes. Importantly, at nationally important roosts, sufficient vegetation must be retained to accommodate the maximum number of flying-foxes recorded at the site.

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

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

Active dispersal through disturbance

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

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

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

Early dispersal before a roost is established at a new location

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

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

establishing a roost.

Maintenance dispersal

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

Unlawful activities

Culling

Culling is addressed here as it is often raised by community members as a preferred management method; however, culling is contrary to conservation legislation will not be permitted as a method to manage flying-fox roosts.

Appendix 7 Dispersal summary results

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

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

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

An overview of findings[4] is summarised below.

- There were attempts to disperse 25 separate roosts in Queensland (compared with nine roosts between 1990 and June 2013 analysed in Roberts and Eby (2013)). Compared with the historical average (less than 0.4 roosts/year) the number of roosts dispersed in the year since the framework was introduced has increased by 6250%.
- Dispersal methods included fog[5], birdfrite, lights, noise, physical deterrents, smoke, extensive vegetation modification, water (including cannons), paintball guns and helicopters.

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

- The most common dispersal methods were extensive vegetation modification alone and extensive vegetation modification combined with other methods.
- In nine of the 24 roosts dispersed, dispersal actions did not reduce the number of flying-foxes in the LGA.
- In all cases, it was not possible to predict where new roosts would form.
- When flying-foxes were dispersed, they did not move further than six kilometres away.
- As at November 2014 repeat actions had already been required in 18 cases.
- Conflict for the council and community was resolved in 60% of cases, but with many councils stating they feel this resolution is only temporary.
- The financial costs of all dispersal attempts were considerable, regardless of methods used, ranging from $7500 to more than $400,000 (with costs ongoing).

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

- Of the 48 roost dispersals attempted, only 23% were deemed a success at reducing conflict with communities, and this generally only occurred after extensive destruction of roost habitat.
- No project with a budget less than A$250,000 was deemed successful.
- Repeat actions were required in 58% of cases, some for months and years following the initial activities.
- In 88% of cases, replacement roosts were established within one kilometre of the original roost, transferring conflict to neighbouring communities.

Revision History

Revision No.	Revision date	Details	Prepared by	Reviewed by	Approved by
00	3/03/2022	RRC Flying-fox Roost Management Plan DRAFT	Tegan Dinsdale, Graduate Wildlife Ecologist Ellie Kirke, Wildlife Biologist	Mitch Horan, Ecologist	Jess Bracks, Principal Wildlife Biologist
01	19/05/2022	RRC Flying-fox Roost Management Plan DRAFT R1	Ellie Kirke, Wildlife Biologist	Jess Bracks, Principal Wildlife Biologist	
02	28/06/2022	RRC Flying-fox Roost Management Plan Final	Ellie Kirke, Wildlife Biologist	Jess Bracks, Principal Wildlife Biologist	

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1	28/06/2022	Electronic	Rockhampton Regional Council	Karen Moody
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