CAMP MANAGEMENT PLAN

Sutherland Shire Flying Fox– Temporary and Seasonal Camps

August 2021

Project Number: 20-301

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ACRONYMS AND ABBREVIATIONS

ABLV	Australian bat lyssavirus
BC Act	Biodiversity Conservation Act 2016 (NSW)
BFF	Black Flying-fox (*Pteropus alecto*)
the Code of Practice	Flying-fox Camp Management Code of Practice 2018 (NSW)
DAWE	Commonwealth Department of Agriculture Water and the Environment
DPIE	Department of Planning Industry and Environment (NSW)
EP&A Act	Environmental Planning and Assessment Act 1979 (NSW)
EPA	Environment Protection Authority (NSW)
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999 (Commonwealth)
EPI	Environmental Planning Instrument
GHFF	Grey-headed Flying-fox (*Pteropus poliocephalus*)
the Guideline	Referral guideline for management actions in grey-headed and spectacled flying-fox camps 2015 (Commonwealth)
LGA	local government area
LGNSW	Local Government NSW
LRFF	Little Red Flying-fox (*Pteropus scapulatus*)
MNES	matters of national environmental significance
NPWS	National Parks and Wildlife Service (NSW)
PEPs	protection of the environment policies
the Plan	Camp Management Plan
POEO Act	Protection of the Environment Operations Act 1997 (NSW)
the Policy	Flying-fox Camp Management Policy 2015 (NSW)
SEPPs	State Environmental Planning Policies
SIS	species impact statement
SSC	Sutherland Shire Council
TEC	threatened ecological community

Cover photo: Grey-headed Flying-fox (*Pteropus poliocephalus*) Photographer: Beth Noel.

EXECUTIVE SUMMARY

NGH Pty Ltd has been commissioned by Sutherland Shire Council to produce this Camp Management Plan (CMP) for Temporary and Seasonal Flying-fox Camps, herby referred to as seasonal or 'pop-up' camps. This CMP is intended as a general guide for the management of any camp that may form in the future or has temporarily formed within the Sutherland Shire Local Government Area (LGA), as such the information and advice is not specific to any one location and can be broadly applied to newly formed or temporary/seasonal camps.

In this report we give an overview of current known permanent and 'pop up' camps within the Sutherland Shire LGA, including associated issues and previous management responses. Through desktop analysis, we have identified areas within the LGA with suitable habitat characteristics for flying fox camps, putting them at potential risk of future occupation. We further assessed these areas in terms of the likelihood that camp formation would require a response from Council. We have provided generic camp management options and advice.

Much of the generic information regarding flying fox ecology and behaviour, health concerns and disease information contained in this report has been adapted from the State of NSW and Department of Planning, Industry and Environment's (DPIE) Flying-fox Camp Management Plan Template 2019. With the exception of photographs, the State of NSW and DPIE are pleased to allow this material to be reproduced in whole or in part for educational and non-commercial use, provided the meaning is unchanged and its source, publisher and authorship are acknowledged.

1. OVERVIEW

1.1. Objectives

The objectives of this Camp Management Plan (the Plan) are to provide a general plan to manage potential seasonal, temporary or 'pop-up' flying-fox camps that may already be seasonally present or form in the future on Council owned or managed land across the Sutherland Shire (the Shire). There are already existing Camp Management Plans (CMPs) in place for the two permanent camps within the Shire: the Kareela Camp and Camellia Gardens Camp. In March 2020, a new camp formed in a Crown Land reserve (not in care and control of Council) to the rear of residences in Forum Drive, Heathcote. Rather than create a third Heathcote-specific CMP, this Plan will cover the new Heathcote Camp, and any future 'pop up' camps that may form. In accordance with the NSW Flying-fox Camp Management Policy 2015 and NSW Flying-fox Camp Management Code of Practice 2018, The Plan aims to:

- Outline low-impact (Level 1 and 2) and non-site-specific management actions that can be applied in the event that a new pop-up camp forms.
- Focus on strategies for evidence-based long-term solutions to camp management, such as:
    - community education and amenity programs,
    - land-use planning and development controls,
    - the creation and protection of flying-fox habitat, and
    - streamline flying-fox management and reduce the need for further community engagement in the event of new camp formation.

2. CONTEXT

2.1. Existing camps

As of February 2021, there are two permanent and up to four seasonal/'pop-up' flying fox camps located within the Sutherland Shire Council LGA (Table 2-1).

Table 2-1 *Existing and seasonal flying-fox camps of the Sutherland Shire*

Camp name	Land Owner	Area (ha)	Permanency	Camp Management Plan (Y/N)
Kareela	Crown Land – Council managed	2.2	Permanent	Yes
Camellia Gardens	Council owned and managed	0.6	Permanent	Yes
Heathcote	Crown Land	1.5	New/'pop-up'	No
Captain Cook Drive	Council owned and managed	0.4	Seasonal/unoccupied	No
Desalination Plant	Privately owned	0.6	Seasonal	Yes
Menai	National Parks	Unknown	Observed historically on one occasion/ unoccupied	No

2.2. Definition of Pop Up or Seasonal Camp

Seasonal or pop up camps are defined as:

- Camps that are in a location that has not recorded roosting previously.
- Camps that are known to have roosting activity previously but it is not considered permanent, i.e. the camp vegetation has not been continuously occupied year round, or the camp has only been occupied for less than 3 seasons[1] in a row.

[1] Seasons are defined as the period of time when dependent young are likely to be too large to be carried by their mother, October to March.

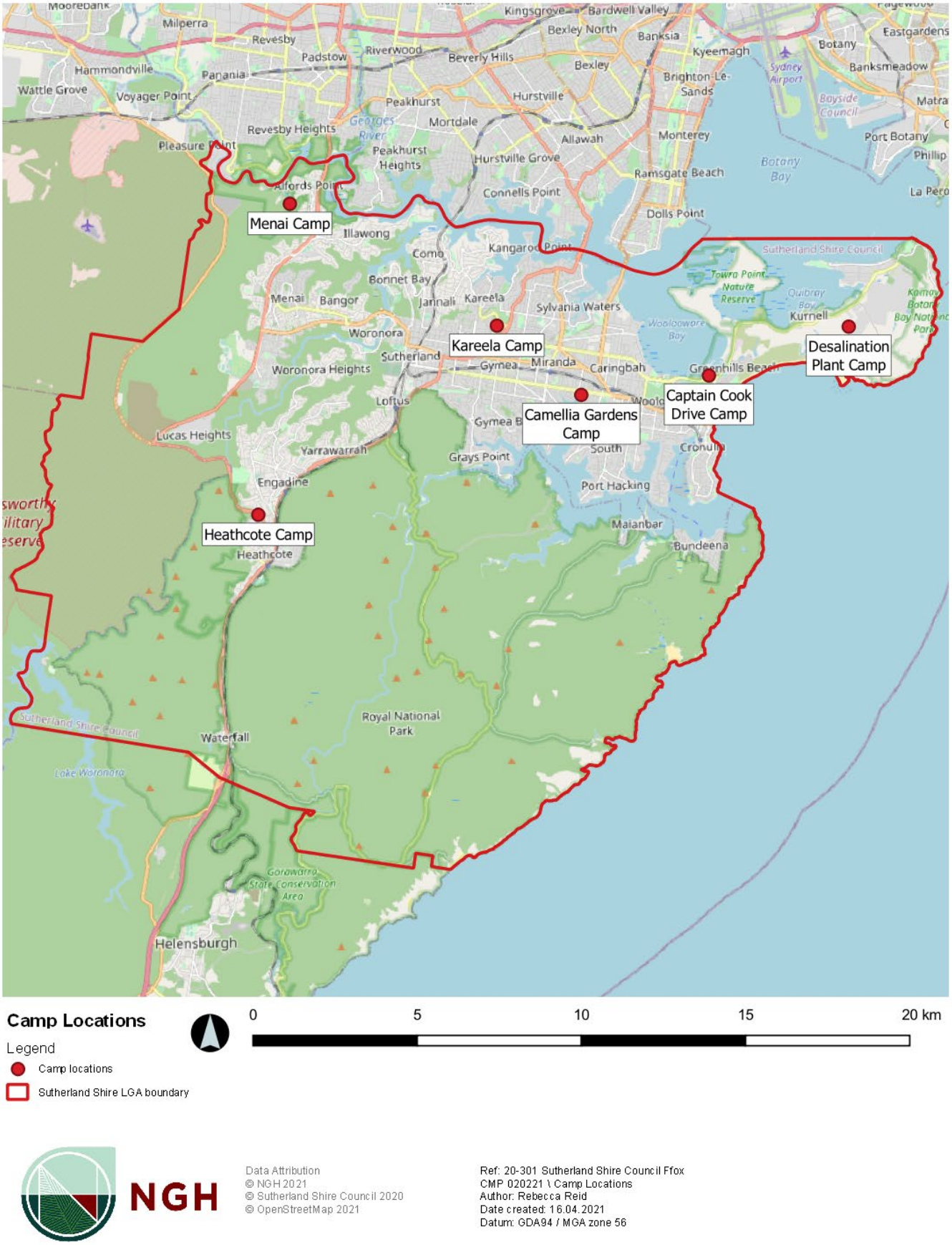


Figure 2-1 Location of flying-fox camps across the Sutherland Shire LGA

Flying-fox CMP's are already in place for the management of the Kareela and Camellia Gardens camps (Eco Logical Australia, 2013; Sutherland Shire Council , 2018). A Grey Headed Flying Fox Management Plan is included in Appendix 1 of the Veolia Water Australia Conservation Area Management Plan (Veolia Water Australia Pty Ltd, 2011), pertaining to the Desalination Plant Camp. No plan exists for the currently unoccupied Captain Cook Drive camp, the unmonitored Menai camp and the currently unoccupied Heathcote camp (as of May 2021). This Plan aims to provide for the management of the recently formed Heathcote camp, Captain Cook Drive camp, Menai camp and any future seasonal or 'pop up' camps in the Sutherland Shire.

Please see the appropriate Camp or Conservation Area Management Plans for more information, provided as follows:

- Camellia Gardens: http://www.sutherlandshire.nsw.gov.au/files/content/website/residents/animals/flying-foxes/camellia-gardens-flying-fox-camp-management-plan-2018-final.pdf
- Kareela:

  http://www.sutherlandshire.nsw.gov.au/files/sharedassets/website/document-library/environmental-management/animal-welfare/kareela-grey-headed-flying-fox-plan-of-management-final.pdf
- Desalination Plant:

  https://www.sydneydesal.com.au/media/1151/conservation-area-management-plan.pdf

2.3. Shire history of flying-fox camp management

Sutherland Shire Council has a 15-year history of managing flying-fox camps. In this time, it has become clear that camps can become controversial and provide genuine amenity impacts. This can result in anxiety within the community that live or work directly adjacent flying-fox camps and those impacted by seasonal feeding. Actions taken in relation to camp management are focused on reducing the impact of camps on the community.

2.3.1. Reported issues related to Shire flying-fox camps

The impacts below have been reported over the last 15 years in relation to flying-fox activity.

Noise

Properties adjacent to flying-fox camps have reported excessive noise, particularly during the mating season (March-May) between sunset and sunrise. Males often stay in the camp hoping to mate, leading to impacts to residents' sleep on a seasonal basis. Noise can also occur at camps during the day, particularly at sunset and sunrise when flying-foxes are departing and arriving at the camp. Noise can also result if disturbance activities are taking place in or adjacent the camp during daylight hours.

Residents with a flying-fox food source adjacent to their property have reported noise at night when flying-foxes are feeding on the food source. Grey-headed Flying-fox are highly social and make frequent social and territorial calls during feeding, particularly when food is in short supply. Cocos Palms are a food source where complaints are very common as the fruit is bunched together and it is a favourite supplementary food during times of food shortage. Other food sources in or adjacent

to urban areas include flowering eucalypts and other nectar/fruit producing trees/shrubs. More commonly, complaints result from food sources within 5km of a camp.

Smell

Properties adjacent to flying-fox camps have reported unpleasant odours. This can occur at any time of year as it is the result of the male flying-foxes marking their territory on roosting trees. The ability for properties surrounding a camp to detect the smell is usually related to weather, wind direction and the number of flying-foxes in the camp. The greater the number of flying-foxes in the camp, the more likely odour complaints will result. Complaints are usually from residential properties but can be from other sensitive facilities such as schools and recreational facilities.

Amenity

Properties adjacent flying-fox camps report amenity impacts. These include faecal drop, visual impacts and odour (detailed above). Impacts such as faecal drop are most extreme at properties underneath the fly out/fly in path from the camp. Flying-foxes returning from a night of feeding are likely to produce faecal drop within 30 minutes of their last meal. This can result in particular dwellings being subject to repeated faecal drop which can lead to property occupants spending time cleaning their paths, walls and roof.

Visual impacts are hard to quantify but complaints generally come from residents and commercial occupants situated adjacent flying-fox camps that can see the flying-fox from their dwelling. Complaints received by Council have been from residents and adjacent schools that would prefer a view of the bushland rather than the flying-foxes. One of the concerns cited regarding visual amenity has been devaluation of property and impacts to business. For example, Sylvanvale teachers reported that parents coming to inspect the school to determine if their child might attend have said the prospective parents have seen the flying-fox camp from their playground and decided not to place their child at the facility. Residents have reported that if they were to sell their home then they would not get market value when compared with adjacent properties that cannot see, hear or smell the flying-fox camp.

Fear of disease

Flying-foxes are feared due to a perception of disease transmission. Complaints regarding disease transmission generally come from those with significant faecal drop, with concerns that they might contract Australian Bat Lyssa Virus (ABLV) or Hendra. ABLV and Hendra cannot be transmitted to humans through flying-fox faeces or urine, however there is a risk of faecal borne diseases and further education could help reduce misinformation leading to anxiety and fear. Human and animal health is discussed further in Section 6.

Damage to vegetation and impacts to biodiversity

Flying-foxes damage roosting trees and shrubs by moving along branches and knocking leaves off, this results in trees having a reduced ability to photosynthesise and die back can result. Complaints relating to damage to vegetation most often occur at the Camellia Gardens, which is a botanic garden. Complaints come from staff at the Gardens and from members of the public. The presence of flying-foxes can impact upon the species and number of other fauna likely to be present in the available habitat. Complaints received by Council include that less birds are present within camp habitat following the arrival of a flying-fox camp or increase in flying-fox numbers.

Health and wellbeing impacts

It is evident from complaints received by Council that anxiety and stress can result from one or more of the previously mentioned impacts. Residents that live adjacent to flying-fox camps that suffer from one or more of the above impacts can become very frustrated by their reduced amenity caused by flying-foxes. The result can be significant impacts to mental health.

Between 2014 and 2021, a total of 168 complaints have been received by Council in relation to flying-fox camps. These are summarised below in Table 2-2.

Table 2-2 Summary of flying-fox complaints received by Sutherland Shire Council between 2014-2021

Year	Feeding	Roosting	Noise	Other	Environ-mental Impact	Faeces	Health	Concern for bat welfare	Cocos Palm
2014	3	5	2	8	4	1	7	4	3
2015	3	3	3	3	0	3	0	1	0
2016	4	2	3	2	0	2	2	2	0
2017	5	1	3	0	0	2	0	0	0
2018	4	2	2	0	0	6	5	0	3
2019	6	1	1	0	2	6	4	0	2
2020	7	3	6	0	0	6	6	0	6
2021	7	0	0	0	1	1	0	0	3
Total	**39**	**17**	**20**	**13**	**7**	**27**	**24**	**7**	**14**

2.3.2. Management response to date

Council have conducted many activities in response to impacts from flying-fox camps, flying-foxes feeding in the urban area and in response to complaints received about flying-foxes. These include:

- Preparation of CMPs (Kareela and Camellia Gardens).
- Creation of buffers between roosting habitat and adjacent properties (Kareela) to reduce the direct amenity impacts such as noise, faecal drop, visual and odour. Once camp vegetation was cleared bush regeneration (non-roosting plant species) was undertaken to screen the camp from residential and school properties.
- Managing disturbance activities such as vegetation maintenance including mowing, whipper snipping, hedging etc. (Kareela and Camellia Gardens).

- Amenity impact reduction grants (Kareela). This involved funding amenity impact actions such as purchase of a gurney to hose down faecal matter, swimming pool cover to protect pools from faecal drop, Cocos palm removal to reduce faecal drop, car and clothesline covers, and air-conditioning to assist with odour control.
- Attempted dispersal of flying-foxes (Kareela and Camellia Gardens). This involved consecutive days of noise, light and smoke used to deter roosting prior to sunrise. This activity was not successful long-term and these camps continue to be occupied.
- Installation of sprinklers and lights to deter roosting, and allow recovery of feature trees on a rotational basis (Camellia Gardens).
- Trial of ultrasonic deterrent devices to discourage roosting outside of core camp (Camellia Gardens).
- Community education and engagement events and signage.
- Subsidies for Cocos Palm removal for properties surrounding the Camellia Gardens camp.
- Installation of fragrant buffers (flowering shrubs) between residents and Camellia Gardens camp.
- Preparation and distribution of procedures to inform the community of what to do if they encounter a flying-fox, particularly an injured or orphaned animal.

All of these actions have been conducted with appropriate approvals and licencing.

3. COMMUNITY ENGAGEMENT

Sutherland Shire Council publicly exhibited a draft version of this Camp Management Plan from 1-29 June 2021 to facilitate community feedback. Members of the community were able to view the draft plan via Sutherland Shire's 'Join the Conversation' community conversation website, or hard copy at 4-20 Eton St Sutherland. Members of the community were then invited to participate in a survey and voice their opinions and concerns regarding flying-fox management.

3.1. Survey results

Thirty four (34) community members completed the online survey, with 27 downloading the document which resulted from a total of 172 page visits. There were nine survey questions in total, two concerning the approach to camp management and key management issues outlined in the draft CMP, and seven questions asking respondents to rank a range of camp management options as high, moderate, or low priority.

3.1.1. Camp management and considerations

Question 1 asked respondents whether they support Council's draft guidelines and approach to managing Temporary and Seasonal Grey-headed Flying-fox camps. Overall, the majority (59%) of respondents supported some or all of the draft CMP, whereas 18% of respondents did not support the approach at all. (Figure 3-1).

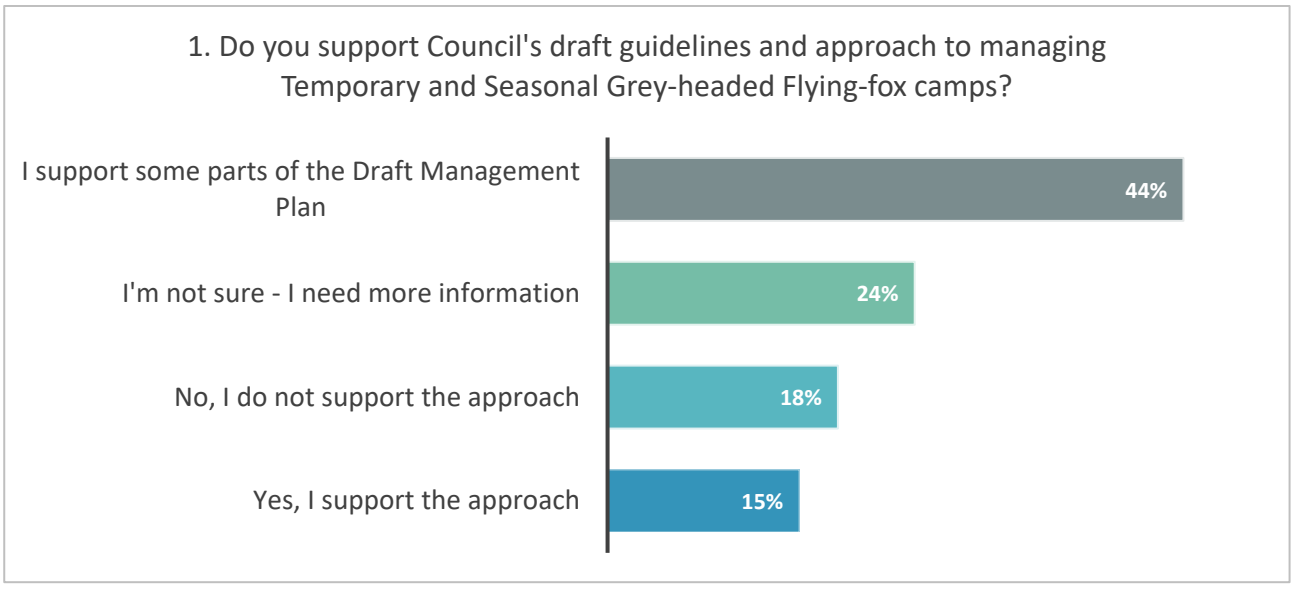


Figure 3-1 Question 1: Do you support Council's draft guidelines and approach to managing Temporary and Seasonal Grey-headed Flying-fox camps?

Those who responded that they did not support the draft CMP approach respondents cited negative impact to humans (noise, odour, faecal drop, human health, damage to vegetation and risk of camp dispersal to unsuitable locations) as the most significant considerations surrounding temporary and seasonal GHFF camps . This indicates that 18% of respondents support the development and inclusion of additional or alternative management actions not currently in the CMP.

Question 2 asked respondents what they felt are the most significant considerations surrounding Temporary and Seasonal Grey-Headed Flying-Fox camps (Figure 3-2). Respondents were able to select multiple responses.

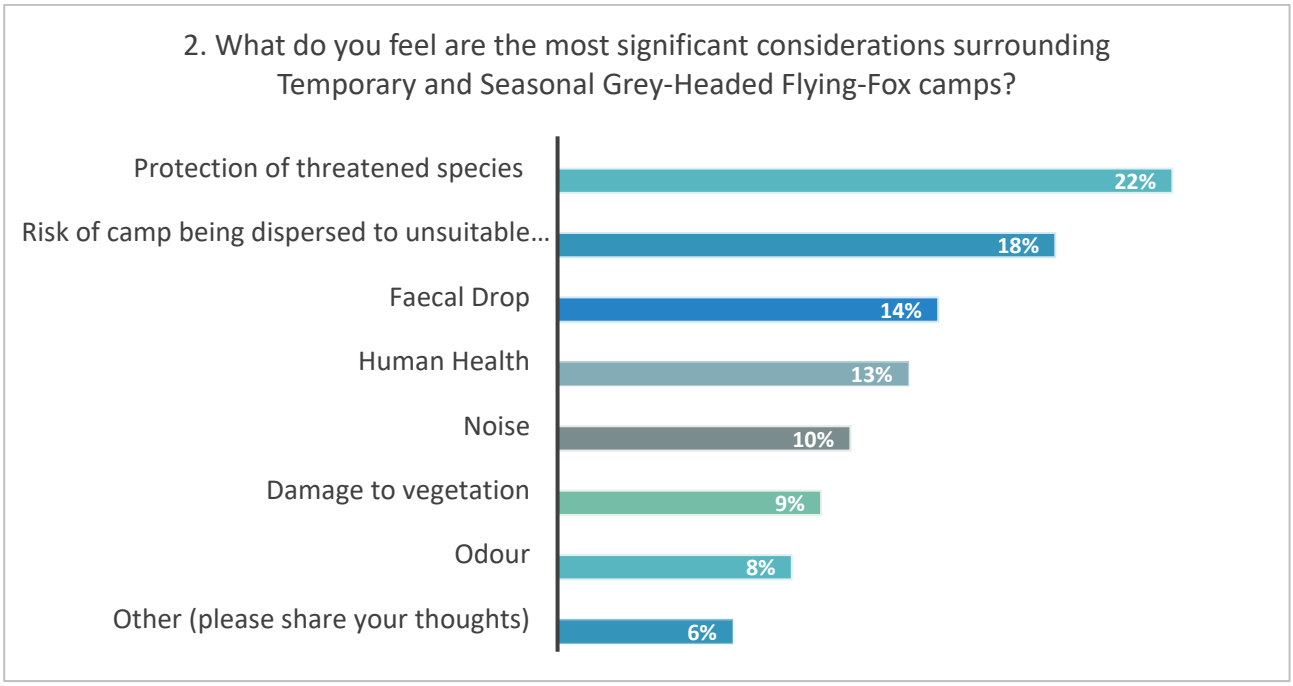
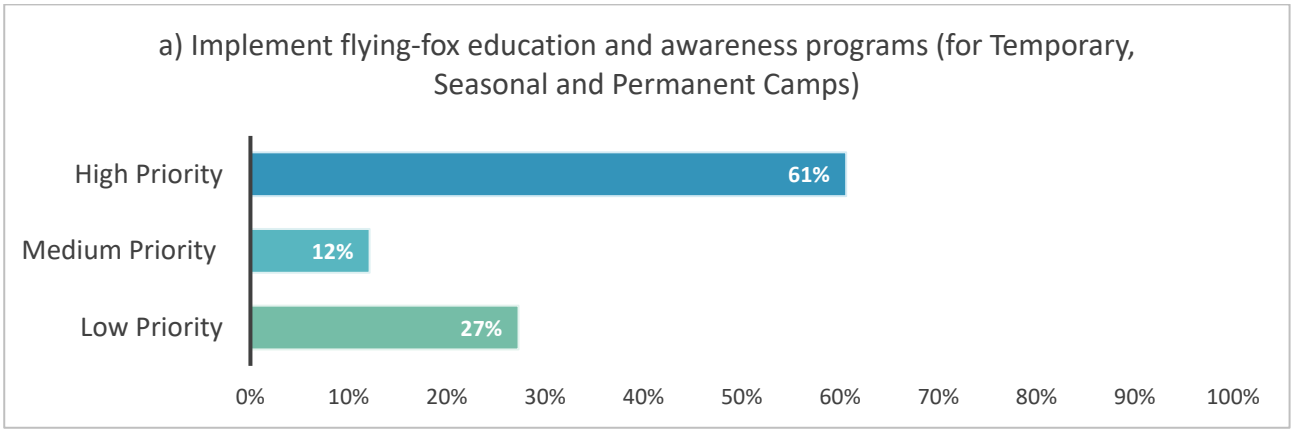


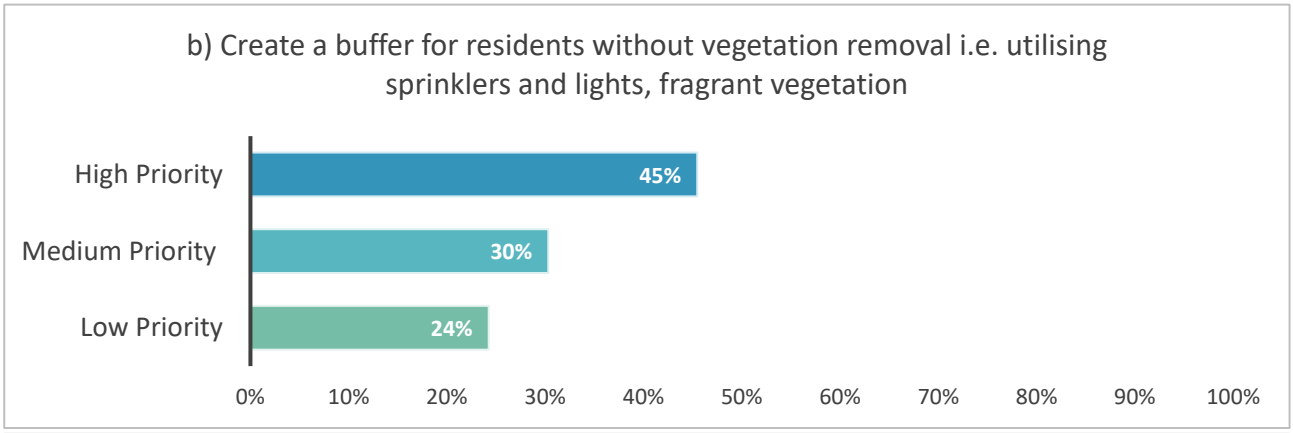
Figure 3-2 Question 2: What do you feel are the most significant considerations surrounding Temporary and Seasonal Grey-Headed Flying-Fox camps?

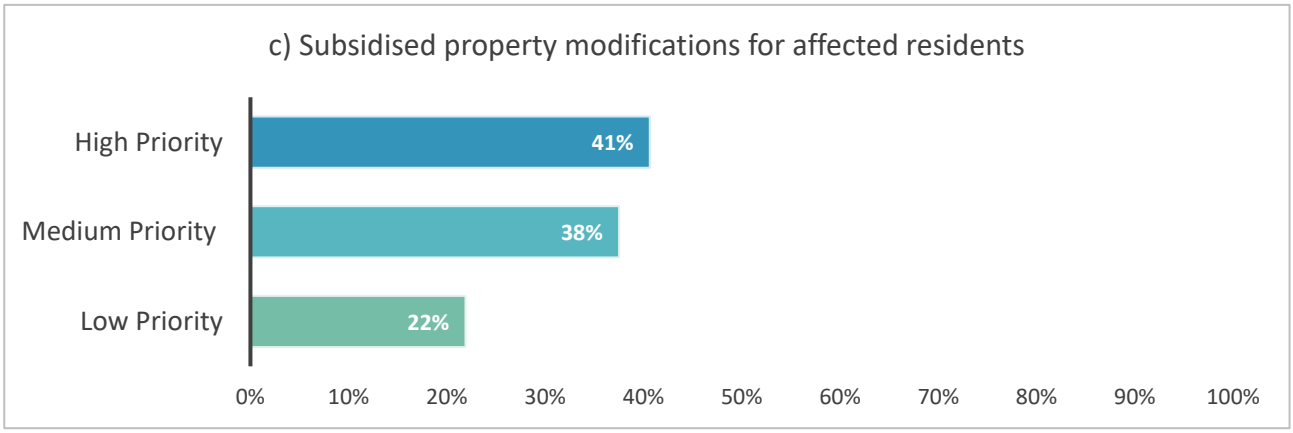
Protection of threatened species received the most nominations, while odour received the least. A small number of respondents also selected 'Other' and left specific comments. Four of the six detailed responses to 'Other' centred around environmental concerns, including species welfare, ecological importance, ignorance of species' as important pollinators. One expressed concern about impacts to childcare centres. One was concerned specifically with damage to property.

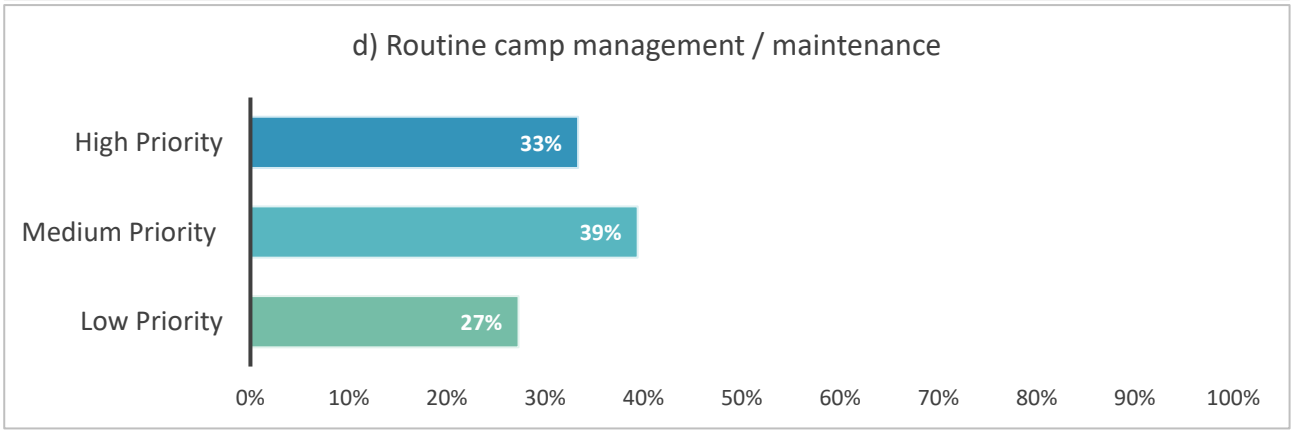
3.1.2. Priorities for potential management actions

Respondents were asked to rank a list of potential flying-fox camp management actions as either high, medium or low priority. Graphs of responses to management actions are provided in Figure 3-3 below. Management actions are listed in descending order, according to whether respondents identify that action to be of a high priority.


a) Implement flying-fox education and awareness programs (for Temporary, Seasonal and Permanent Camps)
High Priority
Medium Priority
Low Priority
61%
12%
27%
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%


b) Create a buffer for residents without vegetation removal i.e. utilising sprinklers and lights, fragrant vegetation
High Priority
Medium Priority
Low Priority
45%
30%
24%
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%


c) Subsidised property modifications for affected residents
High Priority
Medium Priority
Low Priority
41%
38%
22%
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%


d) Routine camp management / maintenance
High Priority
Medium Priority
Low Priority
33%
39%
27%
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%

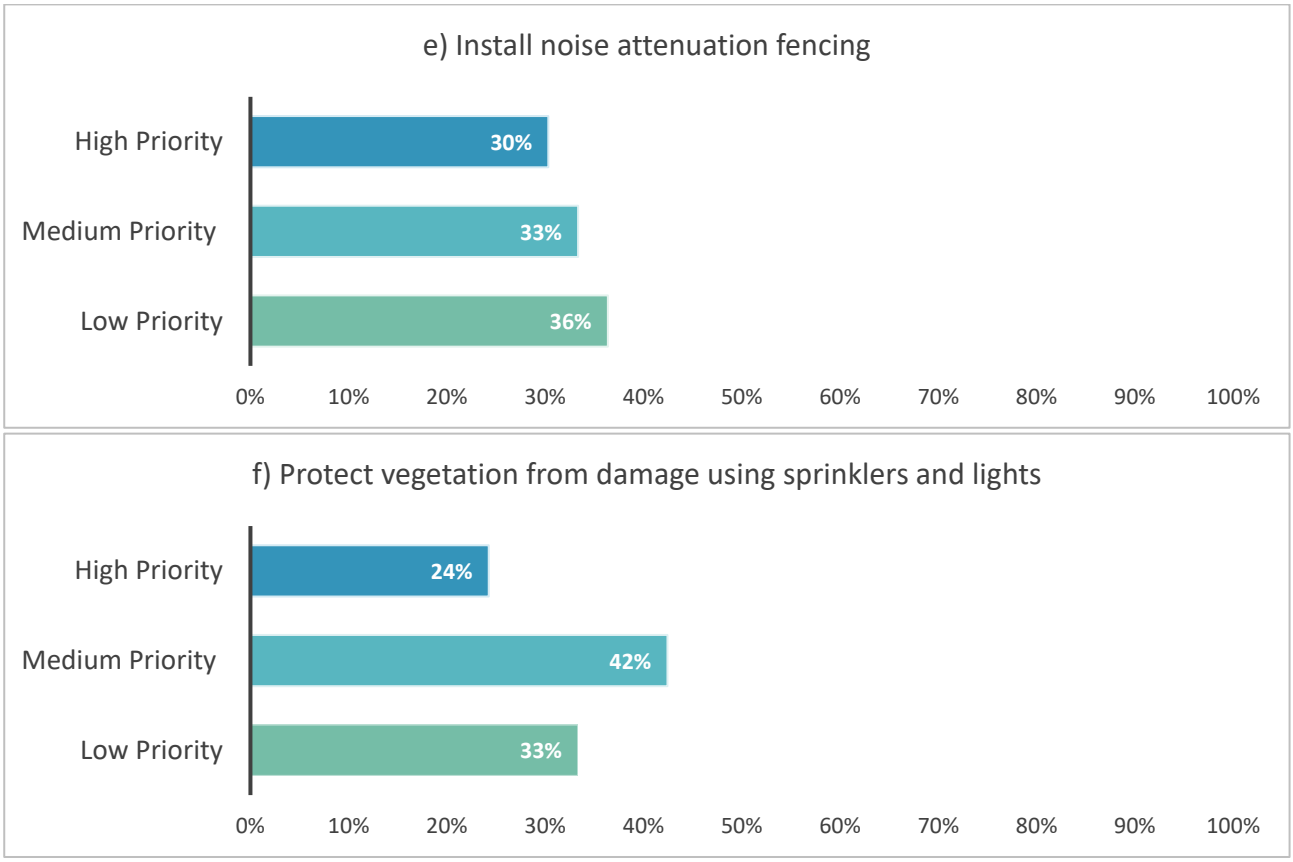


Figure 3-3 Priorities for potential flying-fox camp management actions from survey

The management action considered by the most respondents to be a high priority is the implementation of flying-fox education and awareness programs. The management action considered by the most respondents to be a medium priority is to protect vegetation from damage using sprinklers and lights. The management action considered by the most respondents to be a low priority is the installation of noise attenuation fencing.

3.1.3. Additional feedback and comments

Respondents were also asked to share any other feedback or comments regarding the draft CMP 29 of the 34 respondents left a comment. Individual comments were, for the most part, typically polarised and passionate.

Many commented that they are aware that the GHFF is a threatened species and should be protected, and supported education programs to ensure more people are fully aware of the importance of these species as pollinators. There was also support for human/flying-fox cohabitation solutions, with many respondents appreciative that it is difficult to displace camps and control where new camps will form.

Several respondents left comments strongly in favour of complete removal, using terms like ‘vermin’ and ‘pests’. Some of these respondents made it clear that they are aware of their threatened status, but question the protected status, or do not consider it important.

A few responses were more moderate, expressing appreciation for the species, but also concern for human health and property damage.

3.2. Summary of issues and responses

Table 3-1 below lists the significant considerations from Section 3.1.1 of the survey and provides and index of where those issues are discussed or addressed within this CMP.

Information on the recommended management actions for temporary and seasonal flying-fox camps supported by survey results shown in Section 3.1.2 is provided in Section 9.

Table 3-1 Summary of significant considerations surround flying-fox camps and management, and section(s) of this Camp Management Plan where each issue is addressed

Issue	Section of CMP where issue is discussed/addressed
Protection of threatened species, ecological importance	• **Chapter 4** – Legislation outlining protections afforded to threatened species generally and flying foxes specifically. • **Chapter 5.3** – information regarding threats to flying-foxes. • **Chapter 8** – summary of potential camp management options. • **Chapter 9.1** –potential issues with planned management approach options to seasonal camps. One option relevant to flying-fox protection is animal welfare. • **Chapter 10.1** – Flying-fox welfare issues and how to address them. • **Appendix F** – Flying-fox rescue protocol. • **Appendix G** – Flying-fox heat stress protocol. • **Appendix H** – complete list of all flying-fox management options.
Risk of camp being dispersed to unsuitable locations	• **Chapter 7** – analysis of potential sites within the Sutherland LGA that may be at risk of camp formation in the future, based on landscape characteristics. • **Chapter 8** – summary of potential camp management options. • **Appendix H** – complete list of all flying-fox management options.
Faecal drop	• **Chapter 2.3.1** – Issues previously reported to Sutherland Shire Council, including faecal drop. • **Chapter 2.3.2** – Previous Council responses to reported issues • **Chapter 6** – Human an animal health • **Chapter 8** – summary of potential camp management options. • **Appendix E** – human and animal health information. • **Appendix H** – completed list of all flying-fox management options.
Human Health	• **Chapter 2.3.1** – Issues previously reported to Sutherland Shire Council, including health issues. • **Chapter 2.3.2** – Previous Council responses to reported issues. • **Chapter 6** – Human an animal health. • **Chapter 8** – summary of potential camp management options. • **Chapter 11** – Management of personnel safety, including flying-fox bite and scratch emergency response.

Issue	Section of CMP where issue is discussed/addressed
	• **Appendix E** – additional human and animal health information. • **Appendix H** – complete list of all flying-fox management options.
Noise	• **Chapter 2.3.1** – Issues previously reported to Sutherland Shire Council, including noise complaints. • **Chapter 2.3.2** – Previous Council responses to reported issues. • **Chapter 8** – summary of potential camp management options. • **Appendix H** – complete list of all flying-fox management options.
Damage to vegetation	• **Chapter 2.3.1** – Issues previously reported to Sutherland Shire Council, including noise complaints. • **Chapter 2.3.2** – Previous Council responses to reported issues. • **Chapter 8** – summary of potential camp management options. • **Chapter 9.1** –potential issues with planned management approach options to seasonal camps. • **Appendix H** – complete list of all flying-fox management options.
Odour	• **Chapter 2.3.1** – Issues previously reported to Sutherland Shire Council, including noise complaints. • **Chapter 2.3.2** – Previous Council responses to reported issues. • **Chapter 8** – summary of potential camp management options. • **Chapter 9.1** –potential issues with planned management approach options to seasonal camps. • **Appendix H** – complete list of all flying-fox management options.
Damage to property	• **Chapter 2.3.1** – Issues previously reported to Sutherland Shire Council, including noise complaints. • **Chapter 2.3.2** – Previous Council responses to reported issues. • **Chapter 8** – summary of potential camp management options. • **Chapter 9.1** –potential issues with planned management approach options to seasonal camps. • **Appendix H** – complete list of all flying-fox management options.

3.3. Conclusions

Overall, it appears that the majority of respondents appreciate the ecological significance of flying-foxes and are in favour of acting in their best interests, as well as in the best interests of the community. Some respondents appear to potentially be unaware of the issues facing flying-foxes and the justification for their threatened status; education initiatives may be valuable in reaching this section of the community. For those with negative views regarding flying-foxes who are unlikely to be persuaded by education initiatives, proactive cleaning of public spaces and subsidised management/cleaning options for private property appears to be an appropriate solution.

4. LEGISLATION AND POLICY

4.1. State

4.1.1. Flying-fox Camp Management Policy 2015

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

4.1.2. Flying-fox Camp Management Code of Practice 2018

The *Flying-fox Camp Management Code of Practice 2018* applies to public land managers dealing with flying-fox camps on public land. The Code of Practice defines the standards required for effective and humane management of flying-fox camps for these circumstances. Actions needed to manage a flying-fox camp that are consistent with the terms of the Code will not require a licence.

4.1.3. Biodiversity Conservation Act 2016

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

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

The Grey-headed Flying-fox is listed as threatened under the BC Act (see also Section 5.3).

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

a) harm to an animal that is a threatened species, or part of a threatened population
b) the picking of a plant that is a threatened species, or part of a threatened population or ecological community
c) damage to habitat of a threatened species, population or ecological community
d) damage to a declared area of outstanding biodiversity conservation value.

If the Department assesses a biodiversity conservation licence application and determines that a significant impact is unlikely, a biodiversity conservation licence will be granted (the appendix to the Policy lists standard conditions for flying-fox management approvals).
The Department regulates flying-fox camp management through two options provided to land managers:

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

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

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

4.1.4. Prevention of Cruelty to Animals Act 1979

It may be an offence under this Act if there is evidence of unreasonable/unnecessary torment associated with management activities. Adhering to welfare and conservation measures provided in Section 10.3 will ensure compliance with this Act.

4.1.5. Environmental Planning and Assessment Act 1979

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

The EP&A Act is administered by the DPIE.

Development control plans under the Act should consider flying-fox camps so that planning, design and construction of future developments is appropriate to avoid future conflict.

Development under Part 4 of the Act does not require licensing under the BC Act.

Where public authorities such as local councils undertake development under Part 5 of the EP&A Act (known as 'development without consent' or 'activity'), assessment and licensing under the BC Act may not be required; however, a full consideration of the development's potential impacts on threatened species will be required in all cases.

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

4.2. Commonwealth

4.2.1. Environmental Protection and Biodiversity Conservation Act 1999

The Commonwealth's *Environment Protection and Biodiversity Conservation Act 1999* (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 camps or foraging habitat)
- wetlands of international importance (where those wetlands contain flying-fox camps or foraging habitat)
- nationally threatened species and ecological communities.

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

management actions in GHFF and SFF[2] camps (the Guideline) to guide whether referral is required for actions pertaining to the GHFF.

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

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

Provided management at nationally important camps follows the mitigation standards below, DAWE has determined that a significant impact on 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 (Department of the Environment, 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 camp contains females that are in the late stages of pregnancy or have dependent young that cannot fly on their own.
- The action must not occur during or immediately after climatic extremes (heat stress event[3], cyclone event[4]), or during a period of significant food stress[5].
- 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 camp. Sufficient vegetation must be retained to support the maximum number of flying-foxes ever recorded in the camp of interest.

These standards have been incorporated into mitigation measures detailed in Section 10.1. If actions cannot comply with these mitigation measures, referral for activities at nationally important camps is likely to be required.

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[2] spectacled flying-fox (*P. conspicillatus*)
[3] A 'heat stress event' is defined for the purposes of the Australian Government's Referral guideline for management actions in GHFF and SFF camps as a day on which the maximum temperature does (or is predicted to) meet or exceed 38°C.
[4] A 'cyclone event' is defined as a cyclone that is identified by the Australian Bureau of Meteorology (www.bom.gov.au/cyclone/index.shtml).
[5] Food stress events may be apparent if large numbers of low body weight animals are being reported by wildlife carers in the region.

5. FLYING FOX ECOLOGY AND BEHAVIOUR

5.1. Ecological role

Flying-foxes make a substantial contribution to ecosystem health through their ability to move seeds and pollen over long distances (Southerton, Birt, Porter, & Ford, 2004). This directly assists gene movement in native plants, improving the reproduction, regeneration and viability of forest ecosystems (Department of the Environment and Energy, 2019). Some plants, particularly *Corymbia spp*., have adaptations suggesting they rely more heavily on nocturnal visitors such as bats for pollination than daytime pollinators (Southerton, Birt, Porter, & Ford, 2004).

Grey-headed Flying-foxes may travel 100km in a single night with a foraging radius of up to 50km from their camp (McConkey, Prasad, Brodie, & Santamaria, 2012) and have been recorded travelling over 500km in two days between camps (Roberts, Catterall, Eby, & Kanowski, 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 (McConkey, Prasad, Brodie, & Santamaria, 2012; Westcott, Dennis, Bradford, McKeown, & Harrington, 2008) including eucalypt forests, rainforests, woodlands and wetlands (Roberts, Kanowski, & Catterall, 2006). Seeds that are able to germinate away from their parent plant have a greater chance of growing into a mature plant (Department of Environment and Science, 2018). Long-distance dispersal also allows genetic material to be spread between forest patches that would normally be geographically isolated (Parry-Jones & Augee, 1992; Roberts, Kanowski, & Catterall, 2006; Eby, 1991). 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, Wood, Mackey, Woldendorp, & Gibbons, 2006), provide habitat for other animals and plants, stabilise river systems and catchments, add value to production of hardwood timber, honey and fruit (e.g. bananas and mangoes (Fujita, 1991)), and provide recreational and tourism opportunities worth millions of dollars each year (Department of Environment and Science, 2018).

5.2. Flying-foxes in urban areas

Flying-foxes appear to be roosting and foraging in urban areas more frequently. There are many possible drivers for this (Tait, McKeown, & Westcott, 2014).

- loss of native habitat and urban expansion,
- opportunities presented by year-round food availability from native and exotic species found in expanding urban areas,
- disturbance events such as drought, fires, cyclones,
- human disturbance at non-urban roosts or culling at orchards,
- urban effects on local climate,
- refuge from predation, and

- 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.

5.3. Under threat

Flying-foxes roosting and foraging in urban areas more frequently can give the impression that their populations are increasing; however, the Grey-headed Flying-fox is in decline across its range and in 2001 was listed as vulnerable by the NSW Government through the *Threatened Species Conservation Act 1995* (now BC Act).

At the time of listing, the species was considered eligible for listing as vulnerable, as counts of flying-foxes over the previous decade suggested the national population had declined by up to 30%. It was also estimated the population would continue to decrease by at least 20% in the next three generations given the continuation of the current rate of habitat loss, culling and other threats.

The main threat to Grey-headed Flying-foxes in New South Wales is clearing or modification of native vegetation. This removes appropriate roosting and breeding sites and limits the availability of natural food resources, particularly winter–spring feeding habitat in north-eastern NSW. The urbanisation of the coastal plains of south-eastern Queensland and northern NSW has seen the removal of annually reliable winter feeding sites, which is continuing.

There is a wide range of ongoing threats to the survival of the Grey-headed Flying-fox, including:

- habitat loss and degradation
- conflict with humans (including culling at orchards)
- infrastructure-related mortality (e.g. entanglement in barbed wire fencing and fruit netting, power line electrocution, etc.)
- exposure to extreme natural events such as cyclones, drought and heatwaves.

Flying-foxes have limited capacity to respond to these threats and recover from large population losses due to their slow sexual maturation, low reproductive output, long gestation and extended maternal dependence (McIlwee & Martin, 2002).

5.4. Camp characteristics

All flying-foxes are nocturnal, typically roosting during the day in communal camps. These camps may range in number from a few to hundreds of thousands, with individual animals frequently moving between camps within their range. Typically, the abundance of resources within a 20 to 50-kilometre radius of a camp site will be a key determinant of the size of a camp (SEQ Catchments, 2012). Many flying-fox camps are temporary and seasonal, tightly tied to the flowering of their preferred food trees; however, understanding the availability of feeding resources is difficult because flowering and fruiting are not reliable every year, and can vary between localities (SEQ Catchments, 2012) . These are important aspects of camp preference and movement between camps and have implications for long-term management strategies.

Little is known about flying-fox camp preferences; however, research indicates that apart from being in close proximity to food sources, flying-foxes choose to roost in vegetation with at least some of the following general characteristics (SEQ Catchments, 2012; Eco Logical Australia, 2018):

- closed canopy >5 metres high,
- dense vegetation with complex structure (upper, mid- and understorey layers),

- within 500 metres of permanent water source,
- within 50km of the coastline or at an elevation <65 metres above sea level,
- level topography (<5 degree incline), and
- greater than one hectare to accommodate and sustain large numbers of flying-foxes.

Optimal vegetation available for flying-foxes must allow movement between preferred areas of the camp. Specifically, it is recommended that the size of a patch be approximately three times the area occupied by flying-foxes at any one time (SEQ Catchments, 2012).

5.4.1. Other ecological values of roosting habitat

All sites identified as having potential as flying-fox roosting habitat will generally have some other ecological value. Habitat characteristics that make sites suitable for flying-foxes (e.g. dense canopy, proximity to a water source) are also favoured by many other species.

5.5. Flying fox species profiles

5.5.1. Black Flying-fox (*Pteropus alecto*)

The Black flying-fox (BFF) (Figure 5-1) has traditionally occurred throughout coastal areas from Shark Bay in Western Australia, across northern Australia, down through Queensland and into New South Wales (Department of Planning, Industry and Environment, 2019; Churchill, 2008). Since it was first described there has been a substantial southerly shift by the BFF (Webb & Tidemann, 1995).

They forage on the fruit and blossoms of native and introduced plants (Churchill, 2008; Department of Planning, Industry and Environment, 2019), 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 20km of the camp site (Markus & Hall, Foraging behaviour of the black flying-fox (Pteropus alecto) in the urban landscape of Brisbane, Queensland, 2004).

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

Figure 5-1 Black flying-fox indicative species distribution (Department of Planning, Industry and Environment, 2019). 'Black Flying Fox - *Pteropus alecto*' by Andrew Mercer is licenced under CC BY-SA 4.0 (link to source).

5.5.2. Grey-headed Flying-fox (*Pteropus poliocephalus*)

The Grey-headed Flying-fox (GHFF) (Figure 5-2) is found throughout eastern Australia, generally within 200km of the coast, from Finch Hatton in Queensland to Melbourne, Victoria (Department of the Environment and Energy, 2019). This species now ranges into South Australia and individual flying-foxes have been reported on the Bass Islands and mainland Tasmania (Driessen, Brereton, & Pauza, 2011). It requires foraging resources and camp sites within rainforests, open forests, closed and open woodlands (including melaleuca swamps and banksia woodlands). This species is also found throughout urban and agricultural areas where food trees exist and will feed in orchards at times, especially when other food is scarce (Department of Planning, Industry and Environment, 2019).

All the GHFF in Australia are regarded as one population that moves around freely within its entire national range (Webb & Tidemann, 1996; Department of the Environment, 2015). GHFF may travel up to 100km in a single night with a foraging radius of up to 50km from their camp (McConkey, Prasad, Brodie, & Santamaria, 2012). They have been recorded travelling over 500km over 48 hours when moving from one camp to another (Roberts, Catterall, Eby, & Kanowski, 2012). GHFF generally show a high level of fidelity to camp sites, returning year after year to the same site, and have been recorded returning to the same branch of a particular tree (SEQ Catchments, 2012). This may be one of the reasons flying-foxes continue to return to small urban bushland blocks that may be remnants of historically used larger tracts of vegetation.

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

There is evidence the GHFF population declined by up to 30% between 1989 and 2000 (Birt, 2000; Department of Planning, Industry and Environment, 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 (Department of Environment, Climate Change and Water NSW, 2009). For these reasons it is listed as Vulnerable to extinction under NSW and federal legislation (see Section 4).

Figure 5-2 Grey-headed Flying-fox indicative species distribution (Department of Planning, Industry and Environment, 2019). Grey-headed Flying-fox photo © David Noble.

5.5.3. Little Red Flying-fox (*Pteropus scapulatus*)

The little red flying-fox (LRFF) (Figure 5-3) is widely distributed throughout northern and eastern Australia, with populations occurring across northern Australia and down the east coast into Victoria.

The LRFF forages almost exclusively on nectar and pollen, although it will eat fruit at times and occasionally feeds in orchards (Australian Museum, 2010). LRFF often move very long distances in search of sporadic food supplies. The LRFF is the most nomadic species of flying-fox in New South Wales. They are strongly influenced by the availability of food resources, predominantly the flowering of eucalypt species (Churchill, 2008). This means the duration of their stay in any one place is generally very short.

Habitat preferences of this species are quite diverse and range from semi-arid areas to tropical and temperate areas, and can include sclerophyll woodland, melaleuca swamplands, bamboo, mangroves and occasionally orchards (Eby & Roberts, 2016). LRFF frequently roost with other flying-fox species. In some colonies, LRFF individuals can number many hundreds of thousands and they are unique among *Pteropus* species in their habit of clustering in dense bunches on a single branch. As a result, the weight of roosting individuals can break large branches and cause significant structural damage to roost trees, in addition to elevating soil nutrient levels through faecal material (SEQ Catchments, 2012).

Throughout its range, populations within an area or occupying a camp can fluctuate widely. There is a general migration pattern in LRFF, whereby large congregations of over one million individuals can be found in northern camp sites (e.g. Northern Territory, North Queensland) during key breeding periods (Vardon & Tidemann, 1999) (LRFF travel south to visit the coastal areas of south-east Queensland and New South Wales during the summer months. Outside these periods LRFF

undertake regular movements from north to south during winter–spring (July–October) (Milne & Pavey, 2011).

Figure 5-3 Little red flying-fox indicative species distribution (Department of Planning, Industry and Environment, 2019). Little red flying-fox photo © David Noble.

5.6. Reproduction

Black and Grey-headed Flying-foxes

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

Young are highly dependent on their mother for food and thermoregulation. They are suckled and carried by the mother until approximately four weeks of age (Markus & Blackshaw, Behaviour of the black flying-fox Pteropus alecto: 1. An ethogram of behaviour, and preliminary characterisation of mother-infant interactions, 2002). At this time, they are left at the camp during the night in a crèche until they begin foraging with their mother in January and February (Churchill, 2008) and are usually weaned by six months of age around March. Sexual maturity is reached at two years of age with a life expectancy up to 20 years in the wild (Pierson & Rainey, 1992).

As such, the critical reproductive period for GHFF and BFF is generally from August (when females are in their final trimester) to the end of peak conception around April. Dependent pups are usually present from September to March (see Figure 5-4).

Little red flying-fox

The LRFF breeds approximately six months out of phase with the other flying-foxes. Peak conception occurs around October to November, with young born between March and June (McGuckin & AW, 1991; Churchill, 2008) (Figure 5-4). Young are carried by their mother for approximately one month then left at the camp while she forages (Churchill, 2008). Suckling occurs for several months while young are learning how to forage. LRFF generally birth and rear young in temperate areas (rarely in New South Wales).

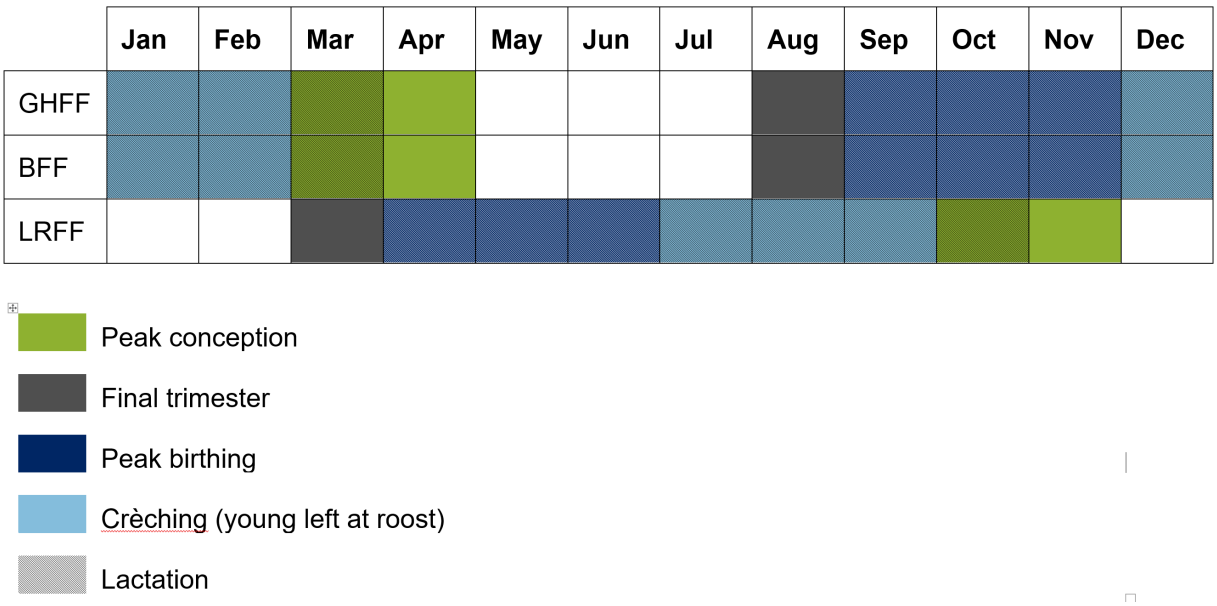

Figure 5-4 Indicative flying-fox reproductive cycle. Note that LRFF rarely birth and rear young in New South Wales. The breeding season of all species is variable between years and location, and expert assessment is required to accurately determine phases in the breeding cycle and inform appropriate management timing. Image © State of New South Wales and Department of Planning, Industry and Environment 2019.

6. HUMAN AND ANIMAL HEALTH

Flying-foxes, like all animals, carry pathogens that may pose human health risks. Many of these are viruses that cause only minor infections with no clinical signs in flying-foxes themselves, but may cause significant disease in other animals that are exposed. In Australia the most well-defined of these include Australian bat lyssavirus (ABLV), Hendra virus and Menangle virus. Specific information on these viruses is provided in Appendix E.

Outside of an occupational cohort, including wildlife carers and vets, human exposure to these viruses is extremely rare and similarly, transmission rates and incidence of human infection are very low. In addition, Hendra virus infection in humans apparently requires transfer from an infected intermediate equine host and direct transmission from bats to humans has not been reported. As such, 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 judged to be low (Queensland Health, 2016).

6.1. Disease and flying-fox management

A recent study at several camps before, during and after disturbance (Edson, Jordan, Kung, Mayer, & Smith) showed no statistical association between Hendra virus prevalence and flying-fox disturbance; however, the consequences of chronic or ongoing disturbance and harassment and its effect on Hendra virus 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 (Australian Institute of Health and Welfare, 2012) and animals (Henry & Stephens-Larson, 1985; Aich, Potter, & Griebel, 2009), including reduced immunity to disease. Therefore, it can be assumed that management actions that 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 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 the potential to cause injury which would increase the likelihood of the community coming into contact with injured/dying 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.

7. POTENTIAL CAMP LOCATIONS AND RISK ASSESSMENT

7.1. Overview

A desktop mapping spatial analysis study was conducted to identify candidate sites within the Sutherland Shire LGA at risk of forming flying-fox camps, and assign a sensitivity/responsibility rating to each.

The following characteristics were assessed through desktop mapping analysis to identify candidate sites:

- dense vegetation with a closed canopy
- situated in vegetation adjacent or above first order streams
- level or minimal change in topography (<5 degree slope)
- greater than 0.5 ha vegetation patch to accommodate and sustain large numbers of flying-foxes.

The characteristics above are based on factors detailed in section 5.4, combined with observations of Sutherland Shire LGA flying-fox camps that have formed to date.

Candidate sites were then assessed against zoning data, and proximity of each site to land under the care and control of Sutherland Shire Council, to assign a sensitivity/responsibility rating to each.

7.2. Data sources

Several data sources were used to inform the spatial analysis. The layer name, data source and URL, and function in the analysis is outlined in Table 7-1.

Table 7-1 List of spatial data layers used in risk assessment

Layer name	Source/URL(active April 2021)	Use
Clip & Ship Layers for Sutherland Shire: • **Local Government Area** • **NPWS Reserve** • **Point of interest**	SIX Maps (NSW online mapping tool) https://maps.six.nsw.gov.au/clipnship.html	Defining the subject area, identifying the large areas under the control of NPWS and Defence, pinpointing sensitive receptors
Sutherland Shire Vegetation Communities Map, 2011. VIS_ID 4198	Data.gov.au (Australian open government data) https://data.gov.au/dataset/ds-nsw-df1167b6-4ebf-489d-8e5c-e4edfd4eadaa/details?q=	Mapping areas of continuous vegetation of the right type that could support a flying-fox camp (including exotic/planted vegetation)

Layer name	Source/URL(active April 2021)	Use
The Native Vegetation of the Sydney Metropolitan Area - Version 3.1 (OEH, 2016) VIS_ID 4489	SEED (NSW government portal for **S**haring and **E**nabling **E**nvironmental **D**ata) https://datasets.seed.nsw.gov.au/dataset/the-native-vegetation-of-the-sydney-metropolitan-area-oeh-2016-vis-id-4489	Mapping areas of continuous vegetation of the right type that could support a flying-fox camp
Digital Elevation Model (DEM) of Australia derived from LiDAR 5 Metre Grid	Data.gov.au (Australian open government data) https://data.gov.au/dataset/ds-ga-22be4b55-2465-4320-e053-10a3070a5236/details?q=	Mapping areas with a slope of 5 degrees or less.
NSW Strahler	Water in NSW (Department of Planning, Industry and Environment) https://www.industry.nsw.gov.au/water/licensing-trade/hydroline-spatial-data	Identifying first order streams that form part of the habitat requirements of a flying-fox camp.
Environmental Planning Instrument - Land Zoning: • **EPI Land Zoning** • **EPI Future Residential Growth Areas**	NSW Planning Portal (part of the Department of Planning, Industry and Environment) https://www.planningportal.nsw.gov.au/opendata/dataset/environment-planning-instrument-local-environmental-plan-land-zoning	Identifying zoning categories and areas earmarked for potential future growth in proximity to candidate sites
Data provided by Sutherland Shire Council GIS Services: • **PRP PropertyRegister poly** • **Drainage Pipes**	Provided by Sutherland Shire Council	Identifying areas of land Sutherland Shire Council either owns or is responsible for Identifying drainage lines that may form part of the habitat requirements of a flying-fox camp

7.3. Methodology

7.3.1. Identification of candidate sites at risk of camp formation

Vegetation

To establish the likely vegetation suitable for use as a flying-fox camp, two complementary vegetation spatial data layers were used. As flying-fox camps can form in both native and non-native vegetation, using both the Sutherland Shire Vegetation Communities layers and the Native Vegetation of the Sydney Metro gave greater certainty that all suitable vegetation types were included in the mapping. Vegetation types that are highly unlikely or unable to support flying-fox camps were removed from each of the following layers. The remaining vegetation types were used to identify areas likely to have closed vegetation canopy and suitable vegetation structure:

- **Sutherland Shire Vegetation Communities Map, 2011. VIS_ID 4198**; any feature within the 'Veg_Commun' field containing 'Posidonia', 'Coastal Dune Heath', 'Sydney Sandstone Heath', 'Taren Point Shorebird Community', 'Coastal Saltmarsh', and 'Riparian Scrub' was removed from the data set.
- **The Native Vegetation of the Sydney Metropolitan Area - Version 3.1 (OEH, 2016) VIS_ID 4489**; any feature within the 'StateClass' field containing 'Sydney Coastal Heaths', 'Seagrass Meadows', 'Coastal Headland Heaths', 'Wallum Sand Heaths', 'Saltmarshes', and any feature within the 'DomSpp' containing 'Water', was removed from the data set.

Topography

To identify areas with suitable topography, the Digital Elevation Model (DEM) of Australia derived from LiDAR 5 Metre Grid spatial data layer was used to locate areas within the Sutherland Shire LGA with a slope of 5 degrees or less.

Hydrology

To identify areas with suitable hydrology, 1st order streams from the NSW Strahler spatial dataset were combined with any features from the Sutherland Shire Council 'Drainage_Pipes' layer that were classed as 'Open Channel' in the NODE_TYPE field. A 50 m buffer was added either side of the candidate hydro lines.

Habitat data synthesis

Areas featuring suitable vegetation, topography and hydrology were combined to identify the candidate sites at risk of flying-fox camp formation.

Sites within NPWS- or Defence-owned land were removed from the dataset, with the exception of those on the edges of these areas, as they may still be subject to impacts.

Any sites < 0.5 ha were removed, as smaller sites are unlikely to support camp formation. The smaller 0.5 ha area was chosen rather than 1 ha as the area cut-off so as to limit the chance of missing potential sites.

7.3.2. Assessment of candidate sites

The area within 100 m of each candidate sites was assessed against zoning spatial data, and areas of land that Sutherland Shire council either owns or is responsible for, to assign a sensitivity/responsibility rating to each site.

Zoning

Zoning types were divided into 3 categories of sensitivity according to likelihood of being at risk of community impacts; high, medium or low. The zoning categories and their assigned sensitivity category are outlined below in Table 7-2.

Table 7-2 Sutherland LGA land use categories and associated risk weighting

Land sensitivity	Land use	
High	High Density Residential Medium Density Residential Low Density Residential Environmental Living	
Medium	Public Recreation Private Recreation Recreational Waterways Business Development Commercial Core Neighbourhood Centre Infrastructure	General Industrial Light Industrial Heavy Industrial Enterprise Corridor Deferred Matter Special Activities
Low	NPWS & Reserves Environmental Conservation Environmental Management Natural Waterways Unzoned	

Council responsibility

Candidate sites meeting the criteria as having the likelihood of being suitable for a flying-fox camp to form were further assessed to determine whether any land up to 100m from each site is the responsibility of Sutherland Shire Council (Council), either through ownership or assigned responsibility.

Risk Matrix

The following risk matrix was used to determine the likelihood that community would be impacted and that Council will need to take action if a flying-fox camp were to form in any of the identified candidate sites. Numeric weightings were assigned to zoning categories and Council-owned land to yield an overall sensitivity-responsibility score for each site.

Land that Council either owns or is responsible for was assigned a weighting of 3; any other tenure was assigned a weighting of 0. High, medium and low sensitivity zoning categories were assigned

weightings of 3, 2, and 1 respectively. The Risk Matrix in Table 7-3 below illustrates the 6 categories of risk/responsibility possible for candidate sites, indicative of the likelihood of the site requiring action from Council. The higher the rating number, the greater the land use sensitivity and the greater the likelihood that Council will be required to respond if a camp forms.

Table 7-3 Risk Matrix for Candidate Sites

		Ownership	
		Council (3)	**Other (0)**
Zoning sensitivity	**High (3)**	6	3
	Medium (2)	5	2
	Low (1)	4	1

7.4. Results

7.4.1. Overview

A total of 88 candidate sites with the potential to be suitable habitat that could result in a flying-fox camp forming were identified (Table 7-4, Figure 7-1). Finer scale maps of these locations are provided in Appendix A. Of these, four schools were identified as being within 100 m of the candidate sites (marked on Figure 7-1):

- Woolooware High School
- Cronulla High School
- Aspect South East Sydney School Kirrawee
- Bates Drive School.

These schools fall within candidate sites that have already been assigned the highest risk score of 6. No other sensitive receptors were identified as falling within 100m of the candidate sites (e.g. hospitals, aged care facilities).

A number of candidate sites with a low risk score (1-2) are adjacent to areas marked as EPI Future Residential Growth Areas. While currently not an issue for Council with no current resident to respond to, this may be something to consider in future rezoning or LEP development.

A number of candidate sites fall within NWPS or Defence owned land; while these areas are not the responsibility of Council, they are within close proximity or encroach upon areas of high sensitivity zoning (i.e. residential areas). These areas may similarly require management consideration despite being outside of Council's jurisdiction.

Table 7-4 Summary of candidate sites and risk/responsibility score

Risk/Responsibility Score	Number of sites
6	23
5	17

Risk/Responsibility Score	Number of sites
4	13
3	3
2	29
1	3
Total	**88**

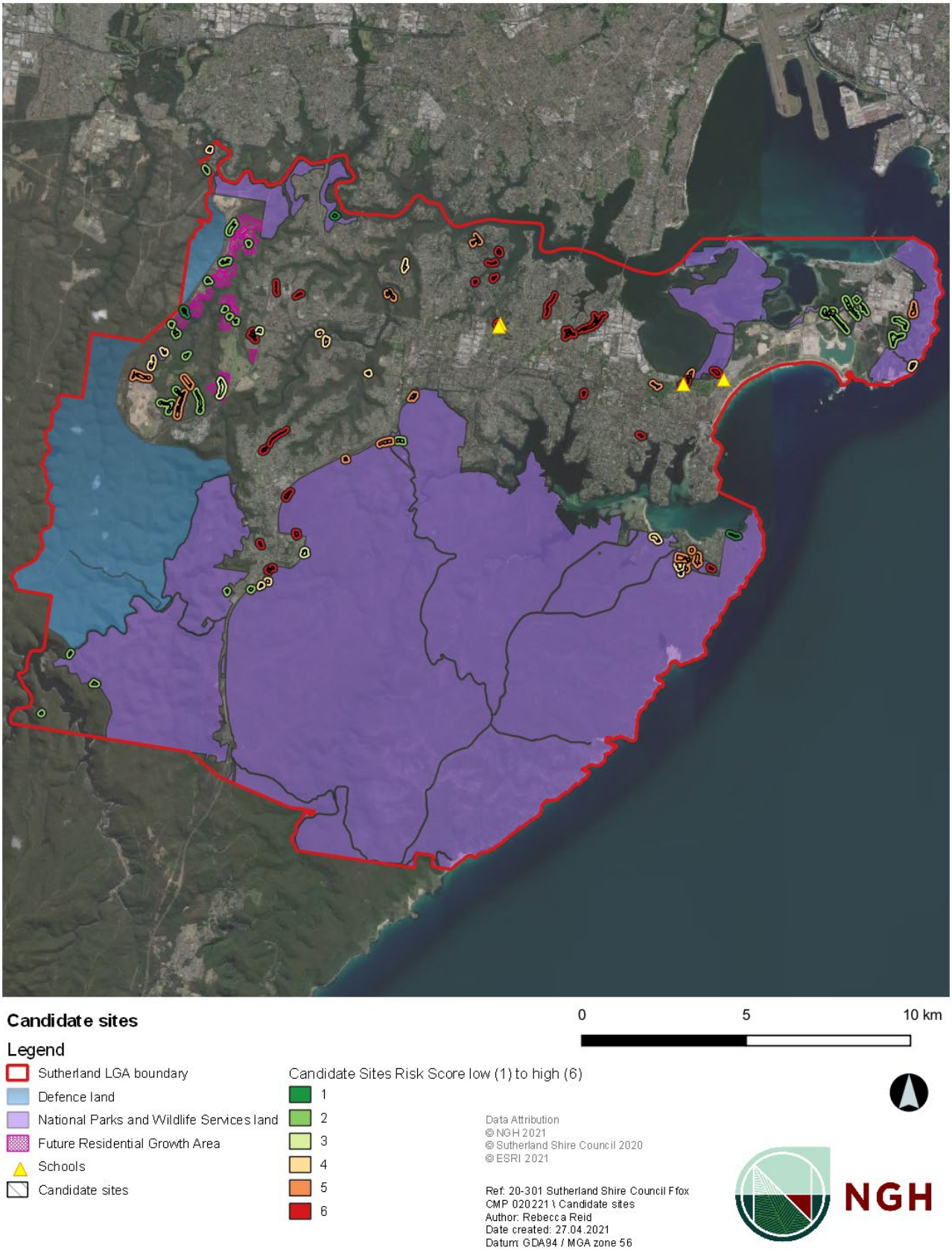

Figure 7-1 Candidate site locations and assigned risk score

7.4.2. Candidate sites under council jurisdiction

Of the 88 candidate sites, 41 fall on land Council either owns or is responsible for (Figure 7-2). Note that this is land directly within the footprint of the candidate sites and therefore directly the responsibility of Council, not within a 100 m buffer of the sites. These sites have risk scores ranging from 4-6 due to the need for Council to respond if a camp formed and impacts were occurring.

7.5. Caveat

All existing camps/'pop up' camps previously mapped by Council were identified as falling within or in close proximity to candidate sites identified by this analysis, with the exception of the Heathcote and Menai camps. Regarding the Heathcote camp, it is likely that by lessening some of the constraints used in this analysis, e.g. increasing the slope to 10 degrees, that this camp would have met the habitat constraints and fallen within a candidate site. Very little is known about the Menai camp, including precise location, area and nature of occupation; best estimates of its location put it within the NPWS boundary, and therefore did not fall within any of our mapped candidate sites as National Park area was excluded unless it was directly adjacent residential or other sensitive land use.

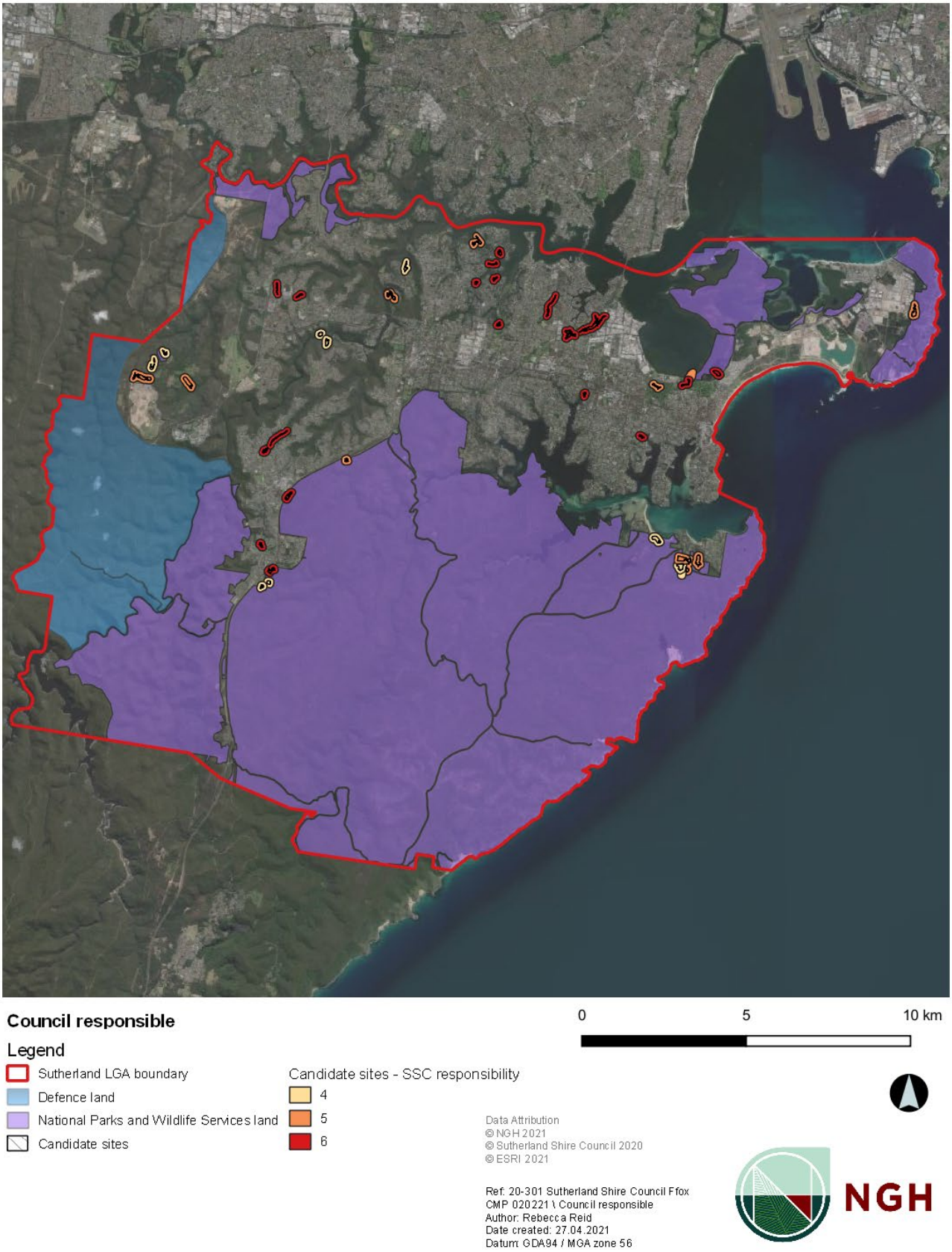

Figure 7-2 Council responsible candidate sites

8. SUMMARY OF POTENTIAL CAMP MANAGEMENT OPTIONS

The following shows a summary of all the options that could be used to manage flying-fox camps showing their relative cost, advantages and disadvantages. A detailed list of these actions is provided in Table 8-1. In addition, further information on which of these actions have been proposed to be implemented by Sutherland Shire Council for 'pop up' camps is presented in section 9. Further information on each of the potential camp management options is provided in Appendix H.

8.1. Summary of potential camp management options

Table 8-1 Summary of all potential camp management options including advantages and disadvantages

Management Option	Relevant impacts	Cost	Advantages	Disadvantages
Level 1 actions				
Education and awareness programs	Fear of disease Noise Smell Faecal drop	$	Low cost, promotes conservation of flying-foxes, contributes to attitude change which may reduce general need for camp 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.	Education and advice itself will not mitigate all issues and may be seen as not doing enough.
Property modification	Noise Smell Faecal drop Health/wellbeing Property devaluation	$–$$	Property modification is one of the most effective ways to reduce amenity impacts of a camp without dispersal (and associated	May be cost-prohibitive for private landholders, unlikely to fully mitigate amenity issues in outdoor areas.

Management Option	Relevant impacts	Cost	Advantages	Disadvantages
	Lost rental return		risks),relatively low cost, promotes conservation of flying-foxes, can be undertaken quickly, will not impact on the site, may add value to the property.	
Fully-fund/subsidise property modification	Noise Smell Faecal drop Health/wellbeing Property devaluation Lost rental return	$–$$	Potential advantages as per property modification, but also overcomes the issue of cost for private landholders.	Costs to the land manager will vary depending on the criteria set for the subsidy including proximity to site, term of subsidy, level of subsidy. Potential for community conflict when developing the criteria, and may lead to expectations for similar subsidies for other issues.
Service subsidies including rate rebates	Noise Smell Faecal drop Health/wellbeing Property devaluation Lost rental return	$–$$	May encourage tolerance of living near a camp, promotes conservation of flying-foxes, can be undertaken quickly, will not impact on the site, would reduce the need for property modification.	May be costly across multiple properties and would incur ongoing costs, may set unrealistic community expectations for other community issues, effort required to determine who would receive subsidies.
Routine camp management	Health/wellbeing	$	Will allow property maintenance, likely to improve habitat, could improve public perception of the site, will ensure safety risks of a public site can be managed. Weed removal has the potential to reduce roost availability and reduce	Will not generally mitigate amenity impacts for nearby landholders.

Management Option	Relevant impacts	Cost	Advantages	Disadvantages
			numbers of roosting flying-foxes. To avoid this, weed removal should be staged and alternative roost habitat planted, otherwise activities may constitute a Level 3 action.	
Alternative habitat creation	All	$$–$$$	If successful in attracting flying-foxes away from high conflict areas, dedicated habitat in low conflict areas will mitigate all impacts, promotes 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.	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.
Provision of artificial roosting habitat	All	$–$$	If successful in attracting flying-foxes away from high conflict areas, artificial roosting habitat in low conflict areas will assist in mitigating all impacts, generally low cost, can be undertaken quickly, promotes flying-fox conservation.	Would need to be combined with other measures (e.g. buffers/alternative habitat creation) to mitigate impacts; previous attempts have had limited success.
Protocols to manage incidents	Health/wellbeing	$	Low cost, will reduce actual risk of negative human/pet–flying-fox interactions, promotes conservation of flying-foxes, can be	Will not generally mitigate amenity impacts.

Management Option	Relevant impacts	Cost	Advantages	Disadvantages
			undertaken quickly, will not impact the site.	
Research	All	$	Supporting research to improve understanding may contribute to more effectively mitigating all impacts, promotes flying-fox conservation.	Generally cannot be undertaken quickly, management trials may require further cost input.
Appropriate land use planning	All	$	Likely to reduce future conflict, promotes flying-fox conservation. Identification of degraded sites that may be suitable for long-term rehabilitation for flying-foxes could facilitate offset strategies should clearing be required under Level 2 actions.	Will not generally mitigate current impacts, land use restrictions may impact the landholder.
Property acquisition	All for specific property owners Nil for broader community	$$$	Will reduce future conflict with the owners of the acquired property.	Owners may not want to move, only improves amenity for those who fit criteria for acquisition, very expensive.
Do nothing	Nil	Nil	No resource expenditure.	Will not mitigate impacts and unlikely to be considered acceptable by the community.
Level 2 actions				
Buffers through vegetation removal	Noise Smell Health/wellbeing Property devaluation Lost rental return	$–$$	Will reduce impacts, promotes flying-fox conservation, can be undertaken quickly, limited maintenance costs.	Will impact the site, will not generally eliminate impacts, vegetation removal may not be favoured by the community.

Management Option	Relevant impacts	Cost	Advantages	Disadvantages
Buffers without vegetation removal	Noise Smell Health/wellbeing Damage to vegetation Property devaluation Lost rental return	$$	Successful creation of a buffer will reduce impacts, promotes flying-fox conservation, can be undertaken quickly, options without vegetation removal may be preferred by the community.	May impact the site, buffers will not generally eliminate impacts, maintenance costs may be significant, often logistically difficult, limited trials so likely effectiveness unknown.
Noise attenuation fencing	Noise Smell Health/wellbeing Property devaluation Lost rental return	$$	Will eliminate/significantly reduce noise impacts, will reduce other impacts, limited maintenance costs.	Costly, likely to impact visual amenity of the site, will not eliminate all impacts, may impact other wildlife at the site.
Level 3 actions				
Nudging	All	$$–$$$	If nudging is successful, this may mitigate all impacts.	Costly, flying-foxes will continue attempting to recolonise the area unless combined with habitat modification/deterrents.
Passive dispersal through vegetation management	All at that site but not generally appropriate for amenity impacts only (see Section 8)	$$–$$$	If successful can mitigate all impacts at that site, compared with active dispersal: less stress on flying-foxes, less ongoing cost, less restrictive in timing with ability for evening vegetation removal.	Costly, will impact site, risk of removing habitat before outcome known, potential to splinter the camp creating problems at other locations (although less than active dispersal), potential welfare impacts, disturbance to community, negative public perception, unknown conservation impacts, unpredictability makes budgeting and risk assessment difficult, may increase disease risk (see

Management Option	Relevant impacts	Cost	Advantages	Disadvantages
				Section 7.1), potential to impact on aircraft safety.
Passive dispersal through water management	All at that site but not generally appropriate for amenity impacts only (see Section 8)	$$–$$$	Potential advantages as per passive dispersal through vegetation removal; however,' likelihood of success unknown.	Potential disadvantages as per passive dispersal through vegetation removal; however, likelihood of success unknown.
Active dispersal	All at that site but not generally appropriate for amenity impacts only (see Section 8)	$$$	If successful can mitigate all impacts at that site, often stated as the preferred method for impacted community members.	May be very costly, often unsuccessful, ongoing dispersal generally required unless combined with habitat modification, potential to splinter the camp creating problems in other locations, potential for significant animal welfare impacts, disturbance to community, negative public perception, unknown conservation impacts, unpredictability makes budgeting and risk assessment difficult, may increase disease risk (see Section 7.1), potential to impact on aircraft safety.
Early dispersal before a camp is established at a new location	All at that site	$$–$$$	Potential advantages as per other dispersal methods, but more likely to be successful than dispersal of a historic camp.	Potential disadvantages as per other dispersal methods, but possibly less costly and slightly lower risk than dispersing a historic camp. Potential to increase pressure on flying-foxes that may have relocated from another dispersed camp, which may exacerbate

Management Option	Relevant impacts	Cost	Advantages	Disadvantages
				impacts on these individuals.

9. PLANNED MANAGEMENT APPROACH – SEASONAL AND 'POP UP' CAMPS

The following is a universal approach across the Sutherland Shire Council LGA to management of seasonal and 'pop up' camps. These are defined as

- Camps that are in a location that has not recorded roosting previously.
- Camps that are known to have roosting activity previously but it is not considered permanent, i.e. the camp vegetation has not been continuously occupied year round, or the camp has only been occupied for less than 3 seasons[6] in a row.

The following are the proposed 'pop up' camp priority management actions which are listed in order of priority below, these have been informed by community engagement (Section 3):

- Level 1: Education and awareness programs. To ensure adjacent occupants and the general community are fully informed about GHFF roosting and feeding behaviours, and actual human health risks.
- Level 1: Routine camp management–weed removal, tree pruning, vegetation maintenance.
- Level 1: Property modification. Encouragement of residents to implement appropriate property modification to reduce their impacts e.g. double glazing, car ports, visual screening.
- Level 2: Buffers through other deterrents e.g. sprinklers and lights
- Level 1: Dense fragrant planting at boundaries –if residents deemed that odour and visual amenity are a significant issue, this could be implemented (where appropriate). Note that this may not be appropriate on the periphery of native bushland reserves, particularly fragrant species are non-native.
- Level 1: Appropriate land-use planning. To prevent the location of future residential development adjacent high risk locations (informed by Risk Assessment). See Figure 7-1 showing future sites at risk of a camp forming.
- Level 1: Alternative habitat creation –creation of additional roosting habitat within nearby reserves not located near sensitive receptors.
- Level 1: Cocos palm removal grant program –offer grants to residents within 250m of the camp the opportunity to apply for up to $500/property for Cocos palm removal as a once off.
- Level 2: Buffers through vegetation removal for camps that reform on a semi-regular or seasonal basis (not required for temporary camps).

Should flying-fox numbers within the 'pop up' camp increase or impacts to adjacent occupants and users of the environment increase, a review of actions will be undertaken and if necessary a more active management approach will be considered. However, at the time of this report Level 3 actions are not being considered for any 'pop up' camps.

[6] Seasons are defined as the time when dependent young are likely to be too large to be carried by their mother, October to March

9.1. Seasonal/ ‘pop up’ camp issues and management actions

The issues associated with seasonal and ‘pop up’ camps and their associated management actions are outlined in Table 9-1.

Table 9-1 List of management actions proposed for seasonal and 'pop up' camps and the issues they address.

Issue	Management aim	Success measures	Level 1 actions	Level 2 actions	Level 3 actions
Odour	Mitigate odour impacts for adjacent occupants	Respond to odour complaints within 7 working days of report. Reasonable amenity achieved for the majority of time.	Education and awareness programs (e.g. ensuring community understand not associated with uncleanliness).Property modification (including providing subsidies if possible).Appropriate land-use planning. Dense planting at boundaries (including use of fragrant flowers to mask odour) where appropriate. Revegetate to create alternative habitat. Support research to determine odour masking techniques. Fragrance dispensers for affected residential properties.	Buffers.	Level 3 actions will not be considered to mitigate this issue.
Disease	Promote awareness of actual disease risk.	Respond to health and wellbeing complaints within two working days of report.	Education and awareness programs (e.g. ensuring community understand actual low risk of disease	Trim roost vegetation overhanging properties where hygiene protocols may not be sufficient (e.g. child care centres).	Level 3 actions will not be considered to mitigate this issue.

Issue	Management aim	Success measures	Level 1 actions	Level 2 actions	Level 3 actions
		All concerned community and staff members are provided access to factual information on disease. Community and staff educated and have their concerns addressed.	transfer and simple mitigation measures). Site risk assessment and implementation of protocols to prevent incidents.		
Health / wellbeing impacts	Mitigate health and wellbeing impacts.	Respond to health and wellbeing complaints within two working days of report. All concerned community and staff members are provided access to factual information on disease. Community and staff educated and have their concerns addressed. Establish a line of communication for affected staff and residents.	Education and awareness programs. Property modification (including subsidies) to reduce wellbeing impacts. Routine management actions to improve the amenity of the site. Revegetate land to create alternative habitat further away from sensitive receptors such as residential properties. Fragrant vegetation buffer.	Buffers. Noise attenuation fencing. Visual screen.	N/A

Issue	Management aim	Success measures	Level 1 actions	Level 2 actions	Level 3 actions
			Online flying-fox reporting tool. Targeted mail out to immediately-affected neighbours. Open line of communication with Council flying-fox management representatives. Revegetate and manage land to create alternative habitat further from sensitive receptors. Cocos palm removal grant.		
Damage to vegetation	Mitigate impacts to native vegetation.	Long-term viability of native vegetation not at risk, or plant species at risk can be replanted as they are common.	I Revegetate and manage land to create alternative habitat further from sensitive receptors such as residential properties and schools. Note that this approach has previously been undertaken at the Camellia Gardens site and	Deterrents such as sprinklers and lighting to be used to protect selected roosting trees to give them a rest, particularly deciduous trees in bud or those at risk of dying in the short term. Note that this approach may not be appropriate or	N/A

Issue	Management aim	Success measures	Level 1 actions	Level 2 actions	Level 3 actions
			may not be appropriate for all sites. Bush regeneration and supplementary planting in affected reserves.	feasible in a bushland setting.	
Property devaluation/ reduced rental return	Reduce economic loss associated with potential property devaluation.	Property value impacts reduced where practicable.	Property modification (including subsidies). Appropriate land-use planning. Dense planting to create screens at residential boundaries. Revegetate and manage land to create alternative habitat further from sensitive receptors such as residential properties.	Buffers. Noise attenuation fencing. Visual/odour/noise screens.	N/A
Animal welfare	Reduce the impact of human activity on flying-fox camps.	No flying-fox deaths or injuries resulting from activities adjacent flying-fox camps.	Appropriate welfare procedures in place to prevent impacts to flying-foxes (see section 10).	N/A	N/A

10. MANAGEMENT OF FLYING-FOX WELFARE IMPACTS

Management of animal welfare is critical to the sustainable management of a flying-fox camp as they are a threatened species and any measurable impacts could affect the species population and will prevent Council undertaking further actions. Management actions will cease and will not recommence or progress to subsequent levels without consulting DPIE in accordance with the guidelines outlined in Table 10-1.

A person with experience in flying-fox behaviour (as per Appendix A) will monitor for welfare triggers and direct works where required in the above table. Non-critical works will be conducted in periods where the camp is either empty or numbers are lowest, timed to avoid late stage pregnancy and the presence of dependent young (usually Jun-Jul for GHFF). A maximum of two unsuccessful attempts to recommence work are allowed before ceasing for the day. A Dispersal Plan must be developed to detail how actions will be managed. DPIE and DAWE conditions must be adhered to for all Level 2 and Level 3 actions.

10.1. Types of flying fox welfare issues

The types of actions that may affect flying-fox welfare and the triggers for those actions to cease are outlined below in Table 10-1.

Table 10-1 Management of flying-fox welfare impacts

Camp Management Category	Types of action	Triggers for Actions to cease	Monitoring required to confirm triggers	Response
Level 1	Tree trimming, lawn mowing, mulching, other loud machinery operation.	More than 30% of the camp takes flight and/or more than 10 animals are circling for more than 3 minutes.	Onsite workers are to be informed of what to look for. Includes bush regenerators, lawn mowers, arborists, onsite staff etc. Loud machinery is to be started away from the camp to allow animals to adjust.	Cease works if trigger behaviours are observed. Contact works supervisor and/or Environmental Science Unit. Modification of works can be attempted but if the same trigger occurs then works must cease.

Camp Management Category	Types of action	Triggers for Actions to cease	Monitoring required to confirm triggers	Response
		If individuals observed are: panting, saliva spreading or located within 2m of the ground	Onsite workers are to be informed of what to look for. Includes bush regenerators, lawn mowers, arborists, onsite staff etc. Loud machinery is to be started away from the camp to allow animals to adjust	Cease works if trigger behaviours are observed. Contact works supervisor and/or Environmental Science Unit. Modification of works can be attempted but if the same trigger occurs then works must cease.
		During and following heat stress events (temperatures above 40°C) where animals were visibly affected or animals required rescue are likely to need at least a week to recover.	If site workers are unsure about conditions a DPIE approved ecologist is to review the camp and weather conditions.	Cease works if conditions deemed that they may impact upon the animals in the camp.
		During the period when females are carrying young (October to December) non urgent and/or excessively loud work should not be undertaken	No non-essential works are to be undertaken during October to December.	Do not commence non-essential works if dependent young are present.
Level 2	Buffer creation i.e. roosting habitat removal or sprinkler/deterrent	During vegetation removal actions or installation of sprinklers/deterrents no works to	DPIE approved ecologist to check camp prior to vegetation removal works commencing to confirm camp is empty and/or that no	Do not commence works if flying-foxes are present within 20m of work zone.

Camp Management Category	Types of action	Triggers for Actions to cease	Monitoring required to confirm triggers	Response
	installation to prevent flying-foxes roosting close to sensitive receptors	occur if flying-foxes are present in the work area.	flying-foxes are present within 20m of the work area.	
	Sprinkler/deterrent operation	More than 30% of the camp takes flight and/or more than 10 animals are circling for more than 3 minutes	Operators of the sprinkler system are to be informed of what to look for.	Cease works if trigger behaviours are observed. Contact works supervisor and/or Environmental Science Unit. Modification of works can be attempted but if the same trigger occurs then works must cease.
		If dependent young are present in the sprinkler affected trees	Operators of the sprinkler system are to be informed of what to look for. If site workers are unsure about conditions a DPIE approved ecologist is to review the camp.	Cease works if dependent young are observed in sprinkler affected trees. If young relocate to other trees actions can continue. Contact works supervisor and/or Environmental Science Unit. Modification of works can be attempted but if the same trigger occurs then works must cease.
		Works to cease if unacceptable impacts at other camps are occurring or have occurred.	Maintain contact with 20km radius camp managers.	Cease works and reassess actions if any 20km radius camp managers complain formally in writing that their

Camp Management Category	Types of action	Triggers for Actions to cease	Monitoring required to confirm triggers	Response
				camp has been adversely affected by sprinkler operation.
Level 3	Camp dispersal or disturbance with the potential to cause dispersal	Presence of dependent young	DPIE approved ecologist to listen for mum/young calling, observe first thing in the morning and during daylight for young feeding on mum, watch animals in flight to see if any are carrying young and check at least 10 trees containing females at least once every 24 hours during day light for the presence of young.	Cease works if dependent young are observed. No further works to be undertaken unless dependent young are no longer detected.
		Presence of heavily pregnant females	DPIE approved ecologist to observe at least 10 roost trees containing females, observe them in flight. Check at least once every 24 hours during day light for signs of late pregnancy.	Cease works if heavily pregnant females are observed. No further works to be undertaken unless heavily pregnant females are no longer detected.
		Undernourished individuals are observed	DPIE approved ecologist to watch animals in flight early morning and roosting during daylight hours at	Cease works if undernourished individuals are observed. No further works to be undertaken unless

Camp Management Category	Types of action	Triggers for Actions to cease	Monitoring required to confirm triggers	Response
			least once every 24 hours to observe signs of malnutrition.	undernourished individuals are no longer detected.
		Noise complaints have been received	Cease works if greater than two properties submit written complaints to Council. If noise complaints are received verbally during activities onsite, modify activities and if complaints continue cease works and seek advice.	Cease works if more than two of the residents complains in writing and modify the methodology. Consult with complainants to see if impacts have reduced to a suitable level, if they have then modified works can recommence if not then works cease.
		New camps have formed as a result of actions or other camps are unsustainably impacted	Monitor all habitat locations within 600m of the camp daily, within 10km of the camp weekly and within 20km of the camp monthly. The definition of a new camp forming is if it appears that roosting has occurred in a location for more than 3 days in numbers greater than 50. Remain in contact with 20km radius camp managers.	Cease works if a new camp has been confirmed to have formed following habitat monitoring during dispersal work. Reassess if it is in an unsuitable location or there is further risk of forming other camps in unsuitable locations.
		Works to cease if unacceptable impacts at other camps is	Check 20km radius camps weekly during initial dispersal and monthly	Cease works and reassess if populations at 20km radius camps

Camp Management Category	Types of action	Triggers for Actions to cease	Monitoring required to confirm triggers	Response
		occurring or has occurred during or following works	during maintenance dispersal. Monitor camps for population numbers or any unexplained ill health e.g. spontaneous abortion and reproductive abnormalities.	have increased to unacceptable levels. Cease works and seek advice if reproductive abnormalities are observed or suspected and dispersal could be a contributing or causal factor.
		Dispersal methods are not successful	If by day 14 of initial dispersal numbers have not reduced by at least 40-50% (on initial numbers) then dispersal is deemed unsuccessful.	Cease works if monitoring shows dispersal to be unsuccessful. Re-evaluate work methods with DPIE.
		Initial dispersal actions conducted outside of Jun-Aug	No initial dispersal outside of Jun-Aug.	No initial dispersal works to be initiated outside of Jun-Aug.
		Maintenance dispersal actions conducted during Jan-Feb/creching time	No maintenance dispersal within Jan-Feb or when dependent young are left alone at night in the camp (creching).	No dispersal activities during creching.
		Unacceptable levels of stress	Panting, saliva spreading, animals within 2m of the ground as observed by the DPIE approved ecologist.	Dispersal must cease if these behaviours are observed. Re-evaluate work methods with DPIE.

Camp Management Category	Types of action	Triggers for Actions to cease	Monitoring required to confirm triggers	Response
		Fatigue	Low flying, laboured flight, settling despite dispersal efforts.	Dispersal must cease if these behaviours are observed. Re-evaluate work methods with DPIE.
		Injury/death	A flying-fox appears to have been injured/killed on site (including aborted foetuses). Any flying-fox death reported within 1km of the dispersal site that could be related to dispersal.	Dispersal must cease if any injury or death occurs on site or within 1km of the site. Re-evaluate work methods with DPIE.

11. MANAGEMENT OF PERSONNEL SAFETY

The following list is proposed to ensure Council personnel are safe when working around flying-fox camps:

- People working in or around the camp for the majority of their working day should wash their clothes daily. Appropriate hygiene practices should be adopted such as washing hands with soap and water before eating, smoking or applying sun cream or skin products.
- Personal protective equipment should be made available to all staff and worn on an as-needed basis.
- A person vaccinated and trained to handle flying-foxes should be onsite at all times during Level 2 and 3 actions. Level 2 actions such as sprinkler installation should have vaccinated and trained staff onsite. However sprinkler operation, once established, is considered to have similar impacts on the flying-foxes as Level 1 actions. The likelihood of staff coming into contact with flying-foxes is significantly reduced during sprinkler operation and a vaccinated person need not be onsite.
- A wash station will be available on site during works along with an anti-viral antiseptic containing iodine provolone (e.g. Betadine) should someone be bitten or scratched. See below in case of a bite or scratch.

11.1. Bite and Scratch Emergency Response

Post exposure management is recommended for any person with a bite or scratch from an Australian bat, or mucous membrane or broken skin contact with the saliva or neural tissues of an Australian bat. Every effort should be made to immediately neutralise or inactivate any potential virus while it is still in the exposure wound and before it enters into the nervous system (Merritt, et al., 2018).

If bitten or scratched by a bat:

1. Immediately clean the wound with soap and water for at least 5 minutes
2. Apply an antiseptic such as aqueous iodine solution or alcohol (ethanol) after washing
3. Attend the nearest hospital emergency department, regardless of the site or severity of the bite.
4. Direct nurse/treating physician to contact the NSW Public Health Unit on 9382 8333 (menu 3) to discuss and arrange appropriate treatment, including delivery of vaccine/immunoglobulin depending on your vaccination status:
   - **Unvaccinated:**

     If you have not received at least 3 doses of rabies vaccine or are uncertain, you will require a course of 4 doses (days 0, 3, 7 and 14) of rabies vaccine, PLUS a dose of rabies immunoglobulin that is in part to be injected into the wound.

   - ***Vaccinated:***

     If you have received a prior course of at least 3 doses of rabies vaccine, you can attend a local GP/medical centre for assessment and should only require 2 more doses (day 0 and day 3) of rabies vaccine only

12. EVALUATION AND REVIEW OF CMP

Council has always taken an adaptive approach to flying-fox management by evolving its actions in response to flying-fox behaviour, community feedback and changing management strategies. However, to formalise the process, the following details how and what triggers will result in an update of the CMP.

The CMP will have a minor informal review annually, which will include evaluation of management actions against success criteria shown in section 9.1. The following will trigger an assessment of the currency of the CMP:

- Pressure to deviate from priority actions listed in section 9.
- Significant changes to relevant policy/legislation.
- Major outcomes of research that may influence the CMP.
- Incidents associated with the camp.
- Significant changes to the number of flying-foxes within the camp.
- Significant increase in community complaints.

If the CMP requires a major review (for example, all actions previously proposed have been conducted or have been deemed not viable and/or a major change in the health risk at the site), a major review will be conducted in consultation with DPIE. If the CMP is to remain current, a full review including stakeholder consultation and expert input will be undertaken after five years and will be re-submitted to DPIE.

13. CMP ADMINISTRATION

13.1. Monitoring of the camp

Monitoring of seasonal/'pop-up' camps would likely be performed on a weekly basis.

13.2. Reporting

Reporting on seasonal/'pop-up' camp activity to DPIE would likely be on a fortnightly basis. Additional reporting would depend on the management actions being undertaken, if any.

13.3. Management structure and responsibilities

13.3.1. Roles and responsibilities

Figure Roles and responsibilities

Role	Name	Required experience/approvals	Responsibilities/authority	Communication lines
Program Coordinator	[insert]	Project management Human resource management Community engagement Reporting	Inform and consult with stakeholders and interested parties Community engagement Evaluate program Submit reports to DPIE/DAWE Ensure all landowners have provided consent prior to works	Reports to: [insert] Direct reports: Project Manager
Project Manager	[insert]	Project management Team leadership and coordination Data management	Coordinate field teams and ensure all personnel are appropriately experienced and trained for their roles Induct all personnel to the program Collect and collate data Liaise with DPIE and DAWE Liaise with wildlife carers/veterinarians (for orphaned/injured wildlife only)	Reports to: Program Coordinator Direct reports: Supervisor, Contractor

Role	Name	Required experience/approvals	Responsibilities/authority	Communication lines
Supervisor	[insert]	Knowledgeable in flying-fox biology, behaviour and camp management (see Appendix 1 for detail) ABLV-vaccinated and trained in flying-fox rescue Team training, leadership and supervision	Pre- and post-management monitoring Surrounding camp monitoring Coordinate daily site briefings Coordinate daily activities Monitor flying-fox behaviour Rescue flying-foxes if required (and no carer/vet on-site) Determine daily works end point Participate in management activities	Reports to: Project Manager Direct reports: Team members, Observers/support
Team member	[insert]	Recommended ABLV-vaccinated (employer to assess risk) Ideally, all team knowledgeable in flying-fox biology, behaviour and camp management; however, not required	Attend daily site briefings Participate in relevant management activities	Reports to: Supervisor Direct reports: Nil
Contractor [insert type e.g. arborist]	[insert]	Relevant licences and experience in field	Conduct specified activities (e.g. tree trimming)	Reports to: Project Manager Direct reports: Nil

Role	Name	Required experience/approvals	Responsibilities/authority	Communication lines
			–Adhere to all directions given by Supervisor	
Observer/support	[insert]	Approval to access site	Provide care of injured/orphaned wildlife (under licence) if required	Reports to: Supervisor Direct reports: Nil
Flying-fox expert	[insert]	See Appendix 1	On-site population assessment, monitor flying-fox behaviour and ensure compliance with the CMP	Reports to: Supervisor Direct reports: Nil

13.4. Adaptive management

Identify mechanisms for amending the CMP based on lessons from implementation, feedback from the community and any other feedback mechanisms

13.5. Funding commitment

The implementation of any management action has to be considered within the context of Council's current and longer term financial position and balanced against the needs of the community. Proceeding with any works will have financial implications that will need to be considered on a case by case basis by Council as individual circumstances arise, and an appropriate budget assigned. Council will also pursue any available opportunities for external grant funding to supplement the costs of these actions.

Where possible, the delivery of these actions will be undertaken utilising existing staff resources, complemented by specialist consultants and contractors.

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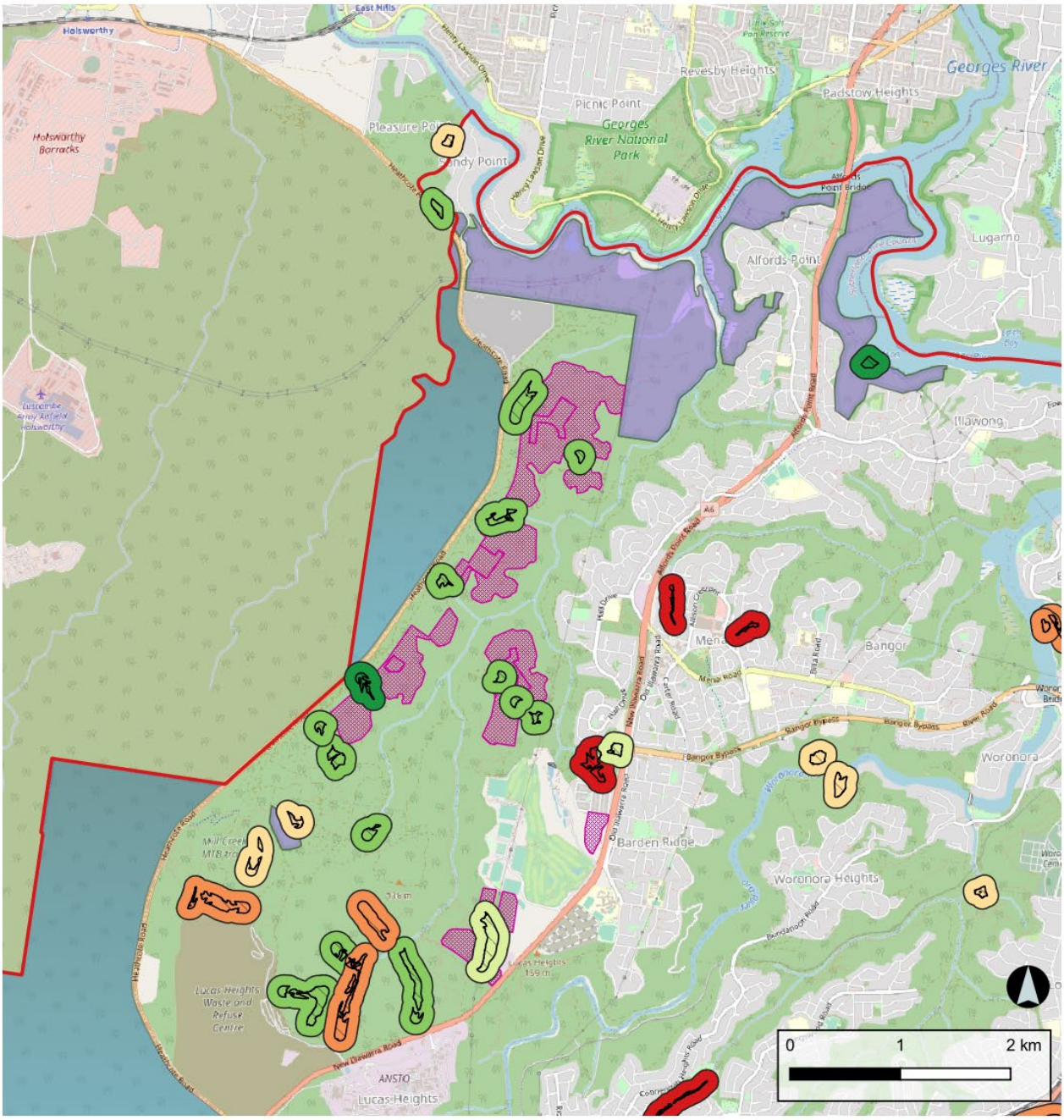
Appendix A POTENTIAL CAMP LOCATIONS IN DETAIL



Candidate sites - atlas
Map 1

Legend

- Sutherland LGA boundary
- Defence land
- National Parks and Wildlife Services land
- Future Residential Growth Area
- Schools
- Candidate sites

Candidate Sites Risk Score low (1) to high (6)

- 1
- 2
- 3
- 4
- 5
- 6

NGH

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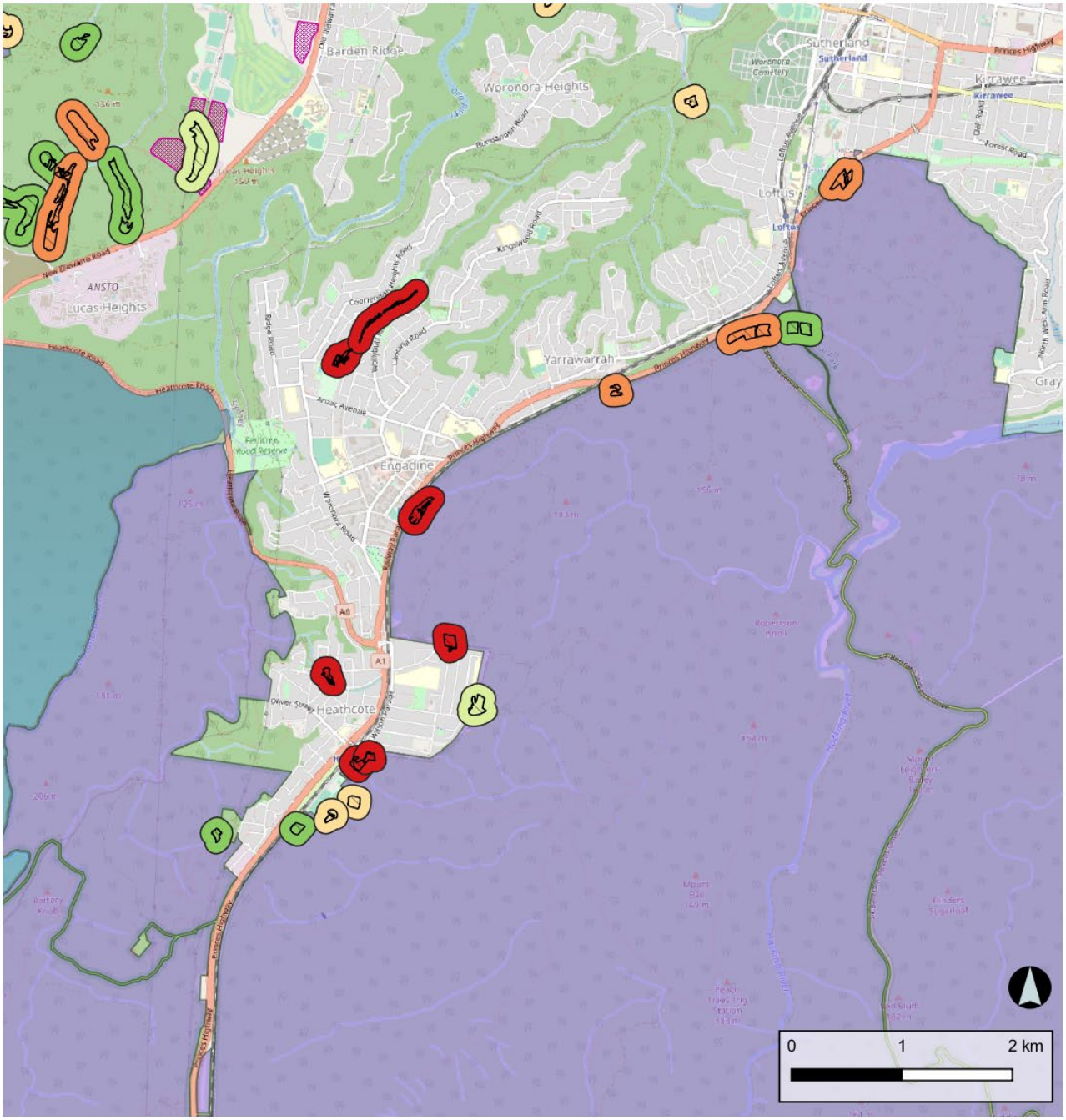


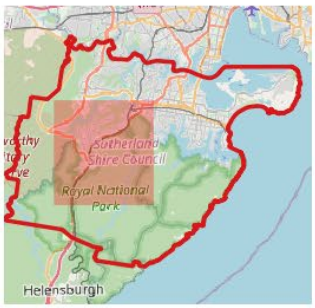
Candidate sites - atlas
Map 2

Legend

- Sutherland LGA boundary
- Defence land
- National Parks and Wildlife Services land
- Future Residential Growth Area
- Schools
- Candidate sites

Candidate Sites Risk Score low (1) to high (6)

- 1
- 2
- 3
- 4
- 5
- 6



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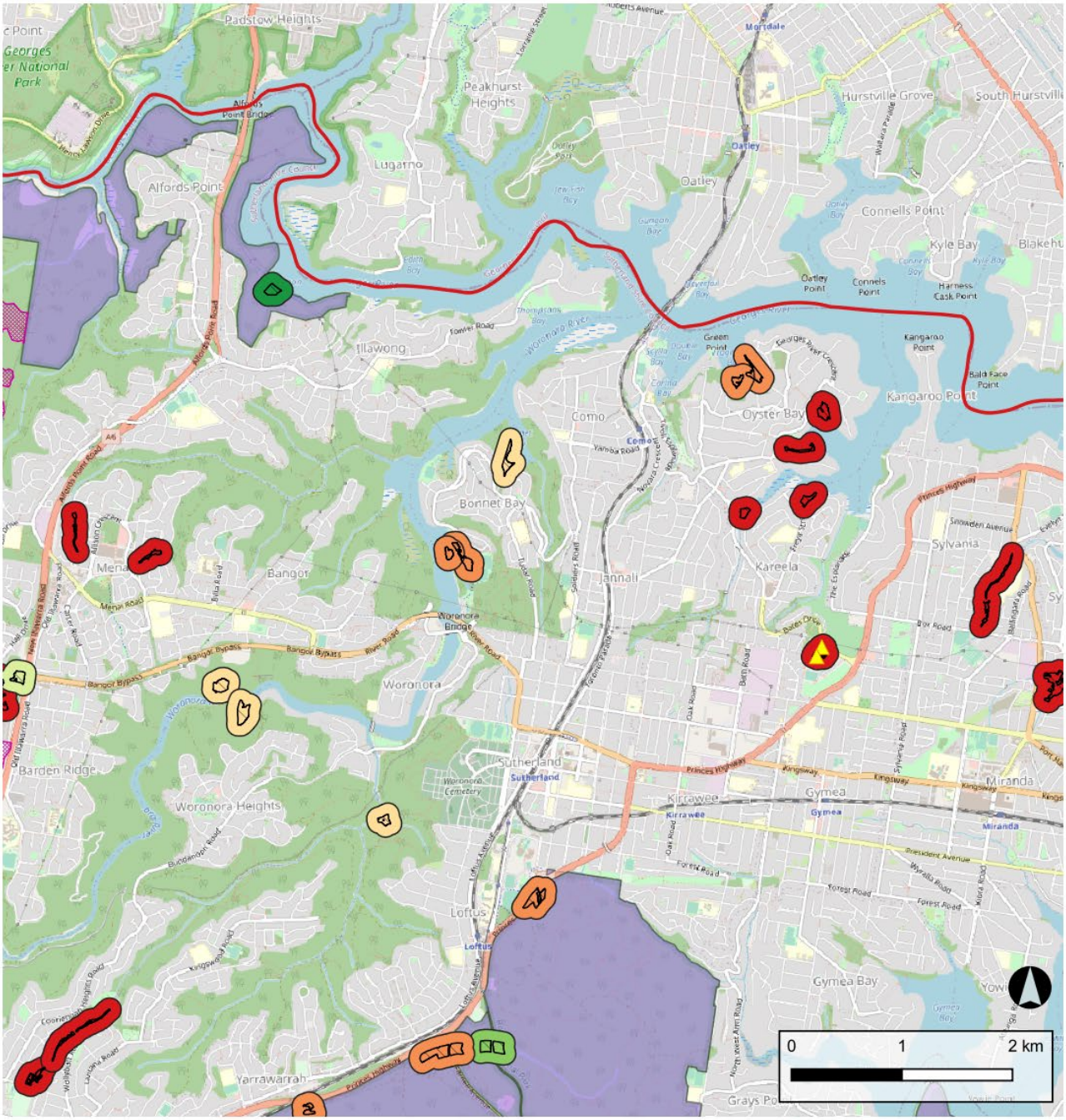


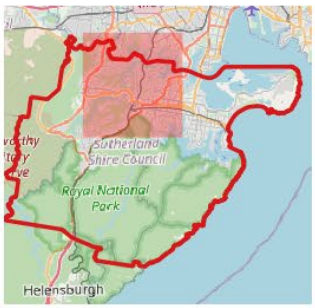
Candidate sites - atlas
Map 3

Legend

- Sutherland LGA boundary
- Defence land
- National Parks and Wildlife Services land
- Future Residential Growth Area
- Schools
- Candidate sites

Candidate Sites Risk Score low (1) to high (6)

- 1
- 2
- 3
- 4
- 5
- 6



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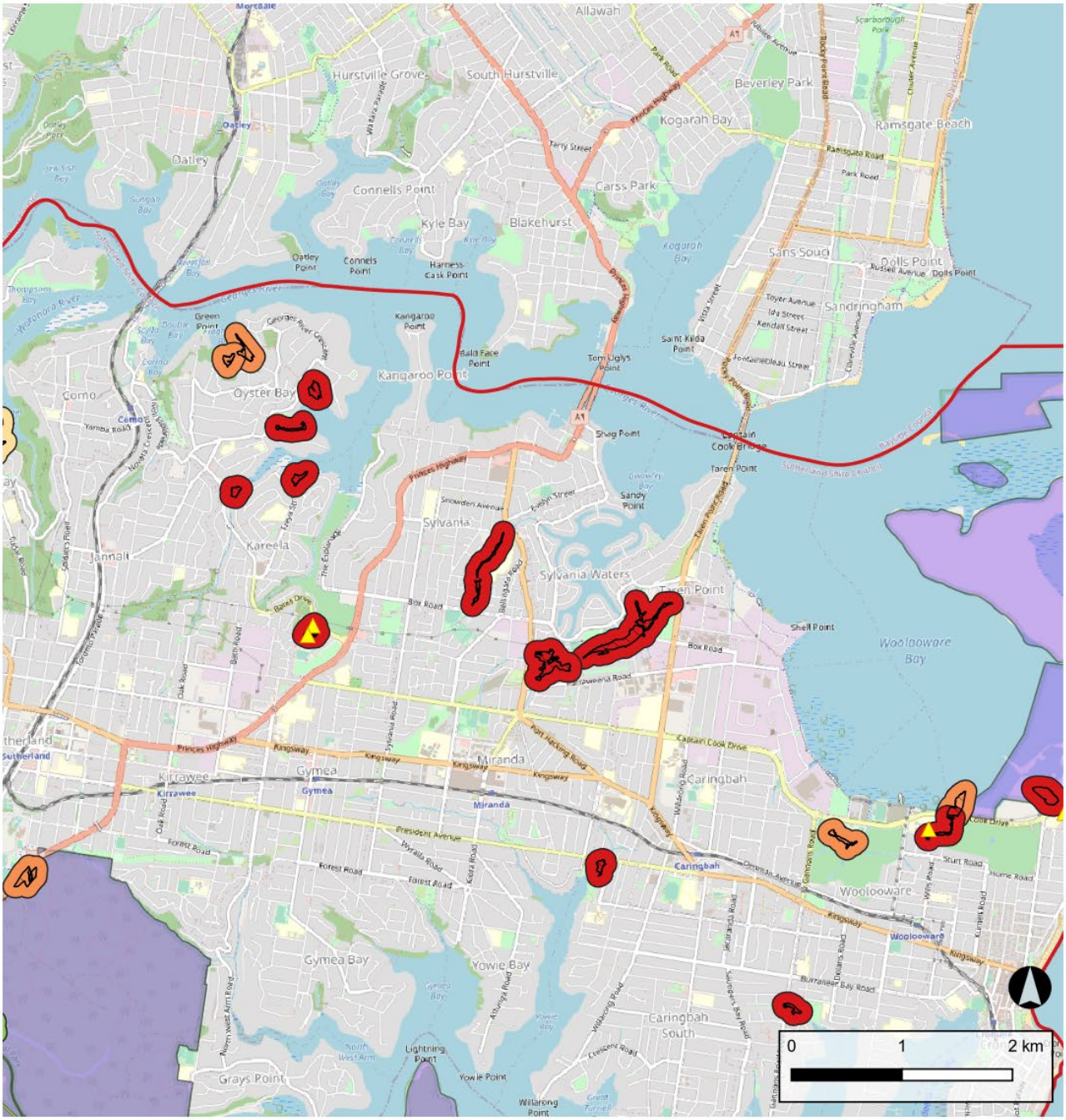


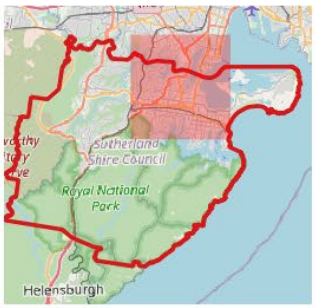
Candidate sites - atlas
Map 4

Legend

- Sutherland LGA boundary
- Defence land
- National Parks and Wildlife Services land
- Future Residential Growth Area
- Schools
- Candidate sites

Candidate Sites Risk Score low (1) to high (6)

- 1
- 2
- 3
- 4
- 5
- 6



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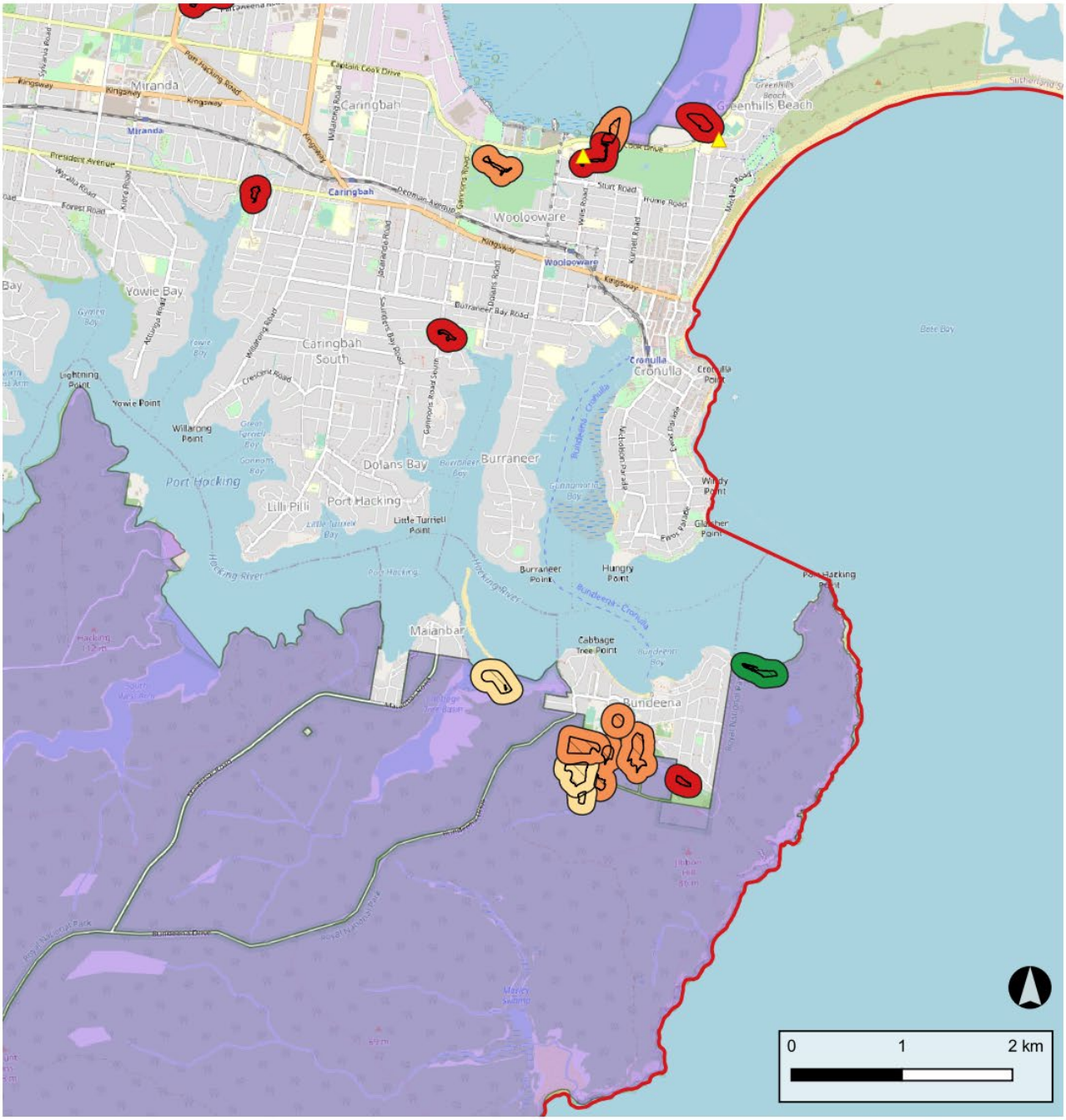


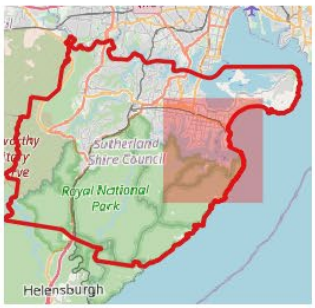
Candidate sites - atlas
Map 5

Legend

- Sutherland LGA boundary
- Defence land
- National Parks and Wildlife Services land
- Future Residential Growth Area
- Schools
- Candidate sites

Candidate Sites Risk Score low (1) to high (6)

- 1
- 2
- 3
- 4
- 5
- 6



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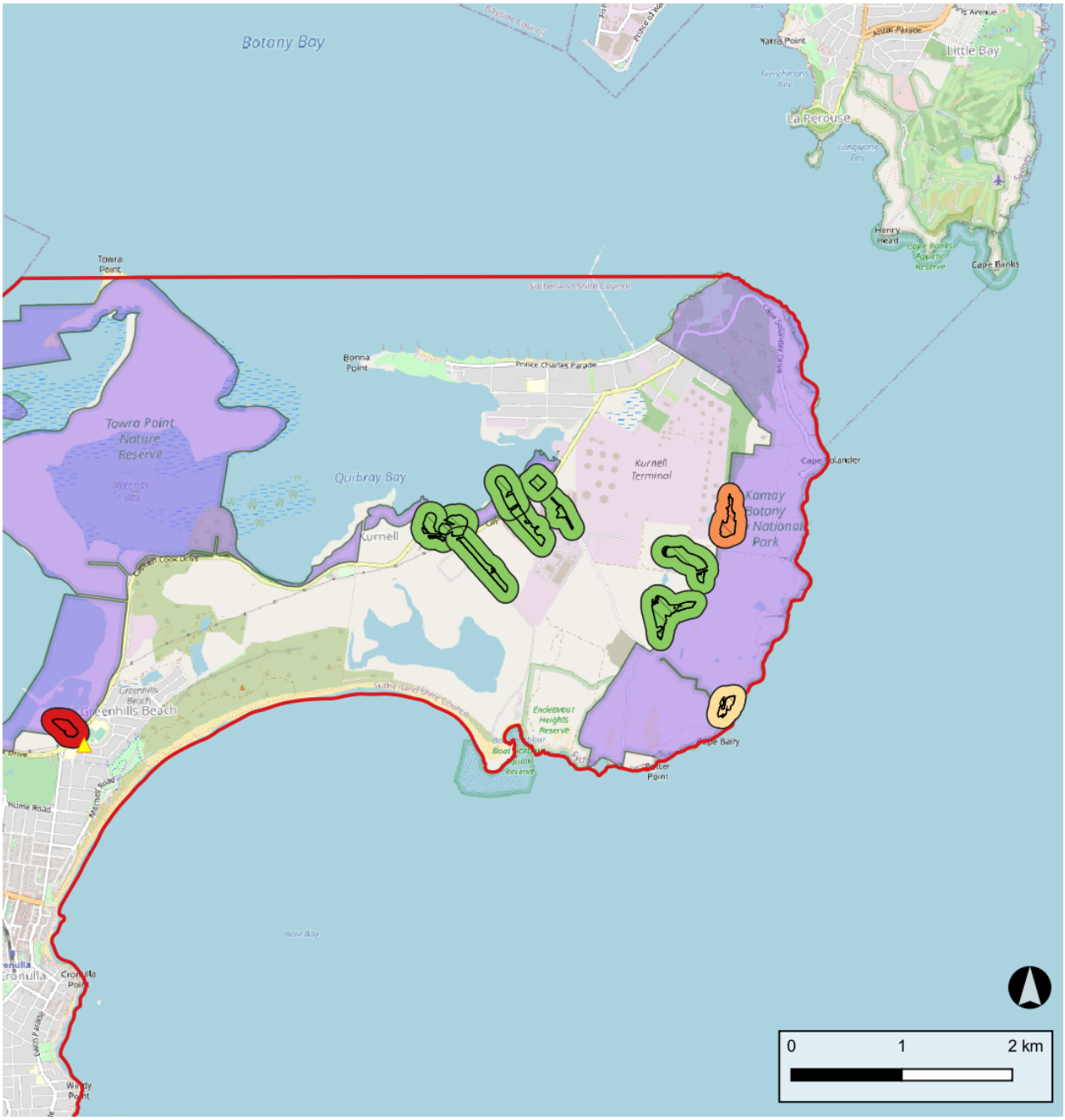


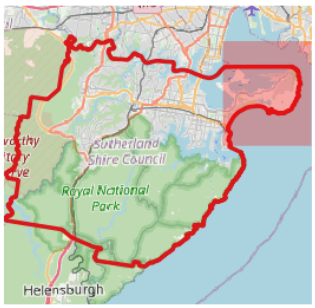
Candidate sites - atlas
Map 6

Legend

- Sutherland LGA boundary
- Defence land
- National Parks and Wildlife Services land
- Future Residential Growth Area
- Schools
- Candidate sites

Candidate Sites Risk Score low (1) to high (6)

- 1
- 2
- 3
- 4
- 5
- 6



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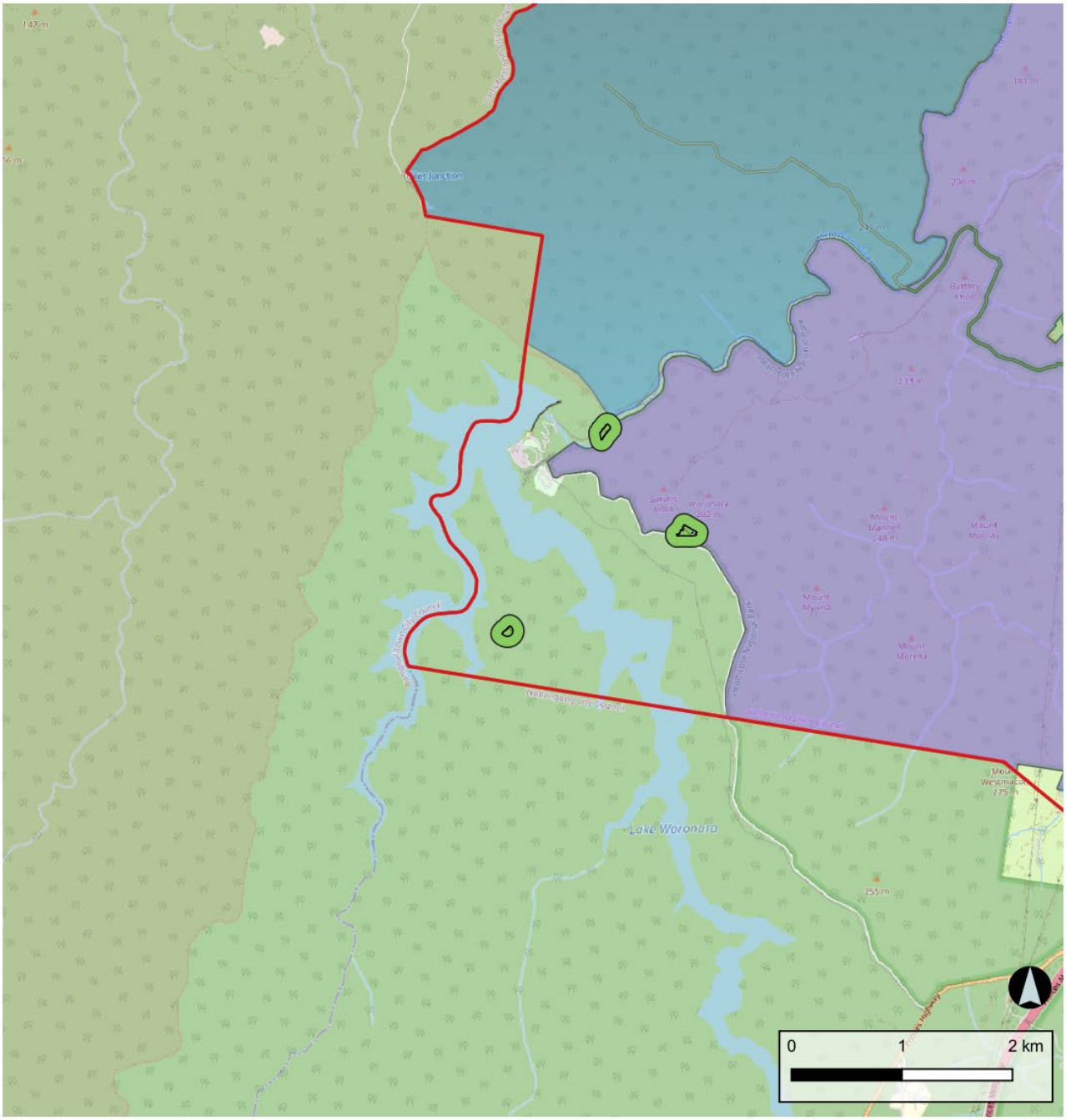


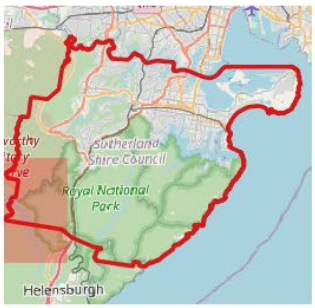
Candidate sites - atlas
Map 7

Legend

- Sutherland LGA boundary
- Defence land
- National Parks and Wildlife Services land
- Future Residential Growth Area
- Schools
- Candidate sites

Candidate Sites Risk Score
low (1) to high (6)

- 1
- 2
- 3
- 4
- 5
- 6



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Author: Rebecca Reid
Date created: 21.05.2021
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Appendix B EXPERT ASSESSMENT REQUIREMENTS

The Plan identifies where expert input is required. The following are the minimum required skills and experience which must be demonstrated by each expert.

B.1 Flying-fox expert

Essential

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

Desirable

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

B.2 Ecologist

Essential

- At least five years demonstrated experience in ecological surveys, including identifying fauna and flora to species level, fauna habitat and ecological communities.
- The ability to identify flora and fauna, including ground-truthing of vegetation mapping.
- Formal training in ecology or similar, specifically flora and fauna identification.

Desirable

- Tertiary qualification in ecology or similar.
- Local knowledge and experience.
- Accredited Biodiversity Assessment Method assessor under the *Biodiversity Conservation Act 2016.*
- Practising member of the Ecological Consultants Association of NSW.

Depending on the site, for example, when vegetation management is proposed for an endangered ecological community or an area with a high likelihood of containing other threatened flora and fauna species, a specialist in that field (e.g. specialist botanist) may be required.

Appendix C SUMMARY OF OTHER KEY LEGISLATION

C.1 Local government legislation

Local government is required to prepare planning schemes (including environmental planning instruments and development control plans) consistent with provisions under the *Environmental Planning and Assessment Act 1979* (EP&A Act; see Section 4.1.4 of the template).

Local Environment Elans are environmental planning instruments that are legal documents and that relate to an LGA. Other Environmental Planning Instruments, such as State Environmental Planning Policies (SEPPs), may relate to the whole or part of the state. A Development Control Plan provides detailed planning and design guidelines to support the planning controls in a Local Environment Plan, but they are not legal documents.

Planning schemes enable a local government authority to manage growth and change in their LGA through land use and administrative definitions, zones, overlays, infrastructure planning provisions, assessment codes and other administrative provisions. A planning scheme identifies the kind of development requiring approval, as well as zoning all areas within the LGA based on the environmental values and development requirements of that land. Planning schemes could potentially include a flying-fox habitat overlay and may designate some habitat as flying-fox conservation areas.

C.2 State legislation

Rural Fires Act 1997

The objects of this Act are to prevent, mitigate and suppress bushfires, coordinate bush firefighting, while protecting persons from injury or death and property from damage from fire. A permit is generally required from the Rural Fire Service for any fires in the open that are lit during the local Bush Fire Danger Period as determined each year. This may be relevant for fires used to disperse flying-foxes, or for any burning associated with vegetation management.

Protection of the Environment Operations Act 1997

The main object of the *Protection of the Environment Operations Act 1997* (POEO Act) is to set out explicit protection of the environment polices (PEPs) and adopt more innovative approaches to reducing pollution.

The use of smoke as a dispersal mechanism may constitute ‘chemical production’ under Schedule 1, clause 8 of the POEO Act, so this type of dispersal activity may require a license under Chapter 3 of the Act.

The POEO Act also regulates noise including ‘offensive noise’. The Protection of the Environment Operations (Noise Control) Regulation 2017 (Part 4) provides information on the types of noise that can be ‘offensive’ and for which the Environment Protection Authority (EPA) can issue fines. This may include noise generated as a part of dispersal activities. It is best to discuss the types of noise makers and the sound levels and times these will be generated, along with identified noise receptors, with council prior to any dispersal. Detailed advice and guidance on noise regulation can be found in the EPA’s Noise Guide for Local Government (Environmental Protection Authority, 2013).

Crown Land Management Act 2016

The principles of Crown land management include the observance of environmental protection principles and the conservation of its natural resources, including water, soil, flora, fauna and scenic quality. Any works on land that is held or reserved under the Crown Land Management Act 2016 (including vegetation management and dispersal activities) are an offence under the Act without prior authorisation obtained through Department of Planning, Industry and Environment (Lands).

Local Government Act 1993

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

C.3 State Environmental Planning Policies

SEPPs are environmental planning instruments that address specific planning issues within New South Wales. These SEPPs often remove power from local councils in order to control specific types of development or development in specific areas. SEPPs often transfer decision-making from councils to the Planning Minister. While there may be others, some of the SEPPs likely to apply at some flying-fox camps are outlined below.

SEPP (Coastal Management) 2018

The aim of this policy is to promote an integrated and coordinated approach to land use planning in the coastal zone in a manner consistent with the objects of the Coastal Management Act 2016.

Development consent must be obtained before any clearing of native vegetation, earthworks, construction of levees, draining or environmental protection works can occur on a mapped coastal wetland or littoral rainforest.

Camps are unlikely to fall within the bounds of a mapped coastal wetland, but additional restrictions for vegetation management in these areas may be required if they do. It is unlikely that clearing for flying-fox management in mapped littoral rainforest would be considered significant enough to trigger this policy, but this should be confirmed if the site is within a mapped littoral rainforest.

SEPP 19 – Bushland in Urban Areas

The aim of this policy is to protect and preserve bushland within urban areas defined in Schedule 1 of the SEPP. Broadly, this covers most LGAs within the Greater Sydney Region. It does not cover:

- land reserved or dedicated under the National Parks and Wildlife Act 1974
- state forests, flora reserves or timber reserves under the Forestry Act 1916
- land to which SEPP (Western Sydney Parklands) 2009 applies.

Bushland within the designated LGAs may not be disturbed without the consent of the council unless the disturbance is for: bushfire hazard reduction, facilitating recreational use of the bushland in accordance with a plan of management referred to in clause 8 of the policy, or essential infrastructure such as electricity, sewerage, gas or main roads. If the land owned by the proponent is zoned as SEPP 19 bushland, council approval would be required under this SEPP.

Council should be contacted to discuss any potential disturbance associated with camp management.

Appendix D DESKTOP ECOLOGICAL ASSESSMENT

Following refinement of the risk assessment (Section 7.4), Council may consider conducting ecological assessments for high risk sites on a case by case basis.

Appendix E ADDITIONAL HUMAN AND ANIMAL HEALTH INFORMATION

Flying-fox camps in public places, such as parks, school grounds and residential areas can sometimes raise concerns for community members about possible health risks. Human infections with viruses borne by flying-foxes are very rare. There is no risk of being infected with these viruses as long as people do not come into physical contact with flying-foxes.

E.1 Australian bat lyssavirus

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 (Department of Primary Industries, 2017) 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 (NSW Health, 2015).

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, Field, Smith, & Storie, 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 (NSW Health, 2015).

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 (NSW Health, 2015).

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 classic 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-exposure vaccination and have their level of protection regularly assessed. Like classic 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.

E.2 Hendra virus

Flying-foxes are the natural host for Hendra virus, 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 (Department of Primary Industries, 2018). There is no evidence that the virus can be passed directly from flying-foxes to humans or to dogs (Halim, Polkinghorne, Bell, van den Berg, & Sheppeard, 2015). Clinical studies have shown cats, pigs, ferrets and guinea pigs can carry the infection (Department of Primary Industries, 2018).

Although the virus is periodically present in flying-fox populations across Australia, the likelihood of horses becoming infected is low and consequently, human infection is extremely rare. Horses are thought to contract the disease after ingesting forage or water contaminated with urine from an infected flying-fox (Centers for Disease Control and Prevention, 2014).

Humans may contract the disease after close contact with an infected horse. Hendra virus 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% (Department of Primary Industries, 2018). Since 1994, more than 100 horses have died (Degeling, et al., 2018) and four of the seven infections in humans were fatal (Goldspink, et al., 2015).

Previous studies have shown that infections of horses have been associated with foraging flying-foxes rather than camp locations. Therefore, risks are 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 (Department of Primary Industries, 2018), 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 Hendra virus 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 Hendra virus via aerosol of heavily contaminated substrate should consider additional personal protective equipment (PPE), e.g. respiratory filters, and potentially dampening down dry dusty substrate.

E.3 Menangle virus

Menangle virus (also known as bat paramyxovirus no. 2) was first isolated from stillborn piglets from a NSW piggery in 1997. Little is known about the epidemiology of this virus, except that it has been recorded in flying-foxes, pigs and humans (Field, 2002; Kirkland, 2017). The virus caused reproductive failure in pigs and severe febrile (flu-like) illness in two piggery workers employed at the same Menangle piggery where the virus (Field, 2002). The virus is thought to have been transmitted to the pigs from flying-foxes via an oral–faecal matter route (Kirkland, 2017). Flying-foxes had been recorded flying over the pig yards prior to the occurrence of disease symptoms. The two infected piggery workers made a full recovery, and this has been the only case of Menangle virus recorded in Australia.

E.4 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. Direct contact with faecal material should be avoided and general hygiene measures taken to reduce the low risk of gastrointestinal and other diseases.

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 F FLYING-FOX RESCUE PROTOCOL

Insert this document as per Code of Practice for Injured, Sick and Orphaned Protected Fauna:

https://www.environment.nsw.gov.au/resources/wildlifelicences/110004FaunaRehab.pdf

If a suitably trained and experienced person cannot be sourced in an emergency, then a wildlife rescue organisation should be contacted. No person that is untrained and/or unvaccinated should attempt to handle a flying-fox.

Appendix G HEAT STRESS PROTOCOL

Heat stress affects flying-foxes when temperatures reach 42°C or more. Over the past two decades, a number of documented heat stress events have resulted in significant flying-fox mortality (Department of Planning Industry and the Environment, 2015). Heat stress or hyperthermia occurs when the body produces more heat than it can dissipate. Post-mortems suggest that flying-foxes mainly die from resulting heat shock i.e. the body can no longer function effectively (Department of Planning Industry and the Environment, 2015). When ambient temperatures rise above 35°C flying-foxes tend to alter their behaviour to reduce exposure to heat. A range of behaviours may be exhibited, depending on multiple variables in their environment. The impacts of heat stress events are likely to vary site by site, and can depend on conditions in the preceding days. Ambient temperature alone may thus not be a sound indicator of a heat stress event, and flying-fox behaviour may provide more reliable information. As flying-foxes experience heat stress, they are likely to exhibit a series of behaviours indicating progressive impact of that stress, including:

- clustering or clumping;
- panting, licking wrists and wing membranes; and
- descending to lower levels of vegetation or to the ground.

If these behaviours coincide with 35°C plus temperatures then heat stress should be assumed. If the pop up camp has a lack of mid-storey vegetation that would normally provide some protection from heat stress; thus the moisture levels can be increased artificially at this type of site. When the maximum temperature at Sydney Airport Bureau of Meteorology weather station is predicted to be 40ºC or above, Council Environmental Science staff are to implement Council's Heat Stress Emergency Response Plan if one is available (as per the one for Camellia Garden camp).

A Heat Stress Protocol would be developed for a pop up camp if the above behaviours were observed on any day where temperatures were 35°C plus. Any Heat Stress Emergency Response Plan would be made available by Council to relevant staff and wildlife rescue organisations. If concerns are raised by the community in relation to whether a pop up camp requires a Heat Stress Emergency Response Plan then an DPIE approved GHFF expert should be consulted.

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Appendix H COMPLETE LIST OF ALL FLYING-FOX CAMP MANAGEMENT ACTIONS

The following details all possible flying-fox camp management actions, these are generic and not specific to any camp. Some are not legal but this list provides all options available for community information. Actions selected by Sutherland Shire Council for management of pop up camps are detailed in section 9.

Level 1 actions: routine camp management

H1.1 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 managing risk and alleviating concern about health and safety issues associated with flying-foxes, options available to reduce impacts from roosting and foraging flying-foxes, an up-to-date program of works being undertaken at the camp, and information about flying-fox numbers and flying-fox behaviour at the camp.

Residents should also be made aware that faecal drop and noise at night is mainly associated with plants that provide food, independent of camp 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. Approval from the local council may be required for the removal of some trees.

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. See also Section 3 and incorporate an education and awareness program into any community engagement plan.

An education program may include components shown in Figure 14-1.

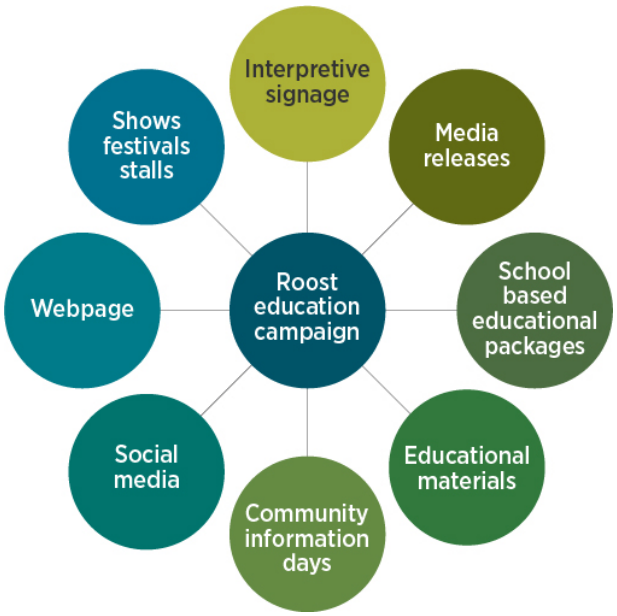

Figure 14-1 Possible components of an education program

By adopting these strategies, 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 a better understanding of flying-fox ecology and applying that understanding to careful urban planning and development.

H.2 Property modification without subsidies

The managers of land on which a flying-fox camp is located would promote or encourage the adoption of certain actions on properties adjacent or near to the camp to minimise impacts from roosting and foraging flying-foxes (note that approval may be required for some activities, refer to Section 4 for further information):

- 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 five metres). Vegetation that produces fragrant flowers can assist in masking camp odour where this is of concern.
- Manage foraging trees (i.e. plants that produce fruit/nectar-exuding flowers) within properties through pruning/covering with bags or wildlife friendly netting, early removal of fruit, or tree replacement.
- Cover vehicles, structures and clothes lines where faecal contamination is an issue, or remove washing from the line before dawn/dusk.
- Move or cover eating areas (e.g. barbecues and tables) that are close to a camp or foraging trees to avoid droppings by flying-foxes.
- Install double-glazed windows, insulation and use air-conditioners when needed to reduce noise disturbance and smell associated with a nearby camp.
- Follow horse husbandry and property management guidelines provided at the Hendra virus webpage (Department of Planning, Industry and Environment, 2019).
- Include suitable buffers and other provisions (e.g. covered car parks) in planning of new developments.
- Consider removable covers for swimming pools and ensure working filters and regular chlorine treatment.
- Appropriately manage rainwater tanks, including installing first-flush systems.
- Avoid disturbing flying-foxes during the day as this will increase camp noise.

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

H.3 Property modification subsidies

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.

The level and type of subsidy would need to be agreed to by the entity responsible for managing the flying-fox camp.

H.4 Service subsidies

This management option involves providing property owners with a subsidy to help manage impacts on their property and the lifestyle of residents. The types of services that could be subsidised include clothes washing, cleaning outside areas and property, car washing or power bills. Rate reductions could also be considered.

Critical thresholds of flying-fox numbers at a camp and distance to a camp may be used to determine when subsidies would apply.

H.5 Routine camp maintenance and operational activities

Examples of routine camp management actions are provided in the Policy. These include:

- removal of tree limbs or whole trees that pose a genuine health and safety risk, as determined by a qualified arborist
- weed removal, including removal of terrestrial and aquatic weeds under the Commonwealth *Biosecurity Act 2015*, or species listed as undesirable by a council
- trimming of understorey vegetation or the planting of vegetation
- minor habitat augmentation for the benefit of the roosting animals
- mowing of grass and similar grounds-keeping actions that will not create a major disturbance to roosting flying-foxes
- application of mulch or removal of leaf litter or other material on the ground.

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

H.6 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 camps 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 camp sites would be dedicated as a flying-fox reserve. However, if a staged and long-term approach is used to make unsuitable current camps less attractive, while concurrently improving appropriate sites, it is a viable option (particularly for the transient and less selective LRFF). Supporting further research into flying-fox camp preferences may improve the potential to create new flying-fox habitat.

When improving a site for a designated flying-fox camp, preferred habitat characteristics detailed in Section 6.4 should be considered.

Foraging trees planted amongst and surrounding roost trees (excluding in/near horse paddocks) may help to attract flying-foxes to the 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 camp location. Supply of an artificial water source should be considered if unavailable naturally; however, this may be cost-prohibitive.

Potential habitat mapping using camp preferences (see Section 7.4) and suitable land tenure can assist in initial alternative site selection. A feasibility study would then be required prior to site designation to assess the likelihood of success and determine the warranted level of resource allocated to habitat improvement.

H.7 Provision of artificial roosting habitat

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

H.8 Protocols to manage incidents

This management option involves implementing protocols for managing incidents or situations specific to particular camps. Such protocols may include 'bat watch' patrols at sites that host vulnerable people, management of pets at sites popular for walking dogs, or preparation for heat stress incidents (when the camp is subjected to extremely high temperatures leading to flying-foxes changing their behaviour and/or dying).

H.9 Participation in research

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

H.10 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 camps. While this management option will not assist in the resolution of existing land use conflict, it may prevent issues for future residents.

H.11 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.

H.12 Do nothing

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

H.13 Level 2 actions: in situ management

H.14 Buffers

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

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

Buffers greater than 300 metres are likely to be required to fully mitigate amenity impacts (SEQ Catchments, 2012). The usefulness of a buffer to mitigate odour and noise impacts generally declines if the camp is within 50 metres of human habitation (SEQ Catchments, 2012); however, any buffer will assist and should be as wide as the site allows.

Buffers through vegetation removal

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

Any vegetation removal must 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 (further to desktop searches, see Appendix D) will inform whether vegetation management is suitable (e.g. can impacts to other wildlife and/or the community be avoided?).

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

Suitable experts (Appendix A) 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 also requires consideration. Under- and mid-storey vegetation should be retained in the buffer area of camps that are known or likely to be affected by heat stress events.

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 2016, 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.
- 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 – Bagged python excrement has been hung in trees at some sites; however, its effectiveness as a deterrent remains unproven. The smell of certain deterrents may also impact nearby residents, while flying-foxes may become used to it.
- Canopy-mounted water sprinklers – This method has been effective in deterring flying-foxes during dispersals (Ecosure personal experience), and current trials in Queensland and New South Wales 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 needs 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 and/or lead to flying-foxes becoming habituated.

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

The use of visual deterrents, in the absence of effective maintenance, could potentially lead to an increase in rubbish in the natural environment.

H.15 Noise attenuation fencing

Noise attenuation fencing could be installed in areas where the camp is particularly close to residents. This may also assist with odour reduction, and opaque 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.

H.16 Level 3 actions: disturbance or dispersal

Nudging

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

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

Dispersal

Dispersal aims to encourage a camp to move to another location, through either disturbance or habitat modification.

There is a range of potential risks, costs and legal implications that are greatly increased with dispersal (compared with in situ management as above). See for more details. These include:

- impact on animal welfare and flying-fox conservation
- splintering the camp into other locations that are equally or more problematic
- shifting the issue to another area
- impact on habitat value
- effects on the flying-fox population, including potential increase in disease susceptibility and associated public health risk
- impacts to nearby residents associated with ongoing dispersal attempts
- excessive initial and/or ongoing effort and financial investment required
- negative public perception and backlash
- unsuccessful management requiring multiple attempts, which may exacerbate all of the above.

Despite these risks, there are some situations where camp dispersal may be considered. Dispersal can broadly be categorised as 'passive' or 'active' as detailed below.

Passive dispersal

Removing vegetation in a staged manner can be used to passively disperse a camp. This gradually makes the habitat unattractive to flying-foxes so they will disperse of their own accord over time with relatively little stress compared to active dispersal. This greatly reduces the risk of splinter colonies forming in other locations. Flying-foxes are more likely to move to other known sites within their camp network when not being forced to move immediately, as in active dispersal.

Generally, a significant proportion of vegetation needs to be removed in order to achieve dispersal of flying-foxes from a camp or to prevent camp re-establishment. For example, flying-foxes abandoned a camp in Bundall, Queensland once 70% of the canopy/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 camps (defined in Section 4.2.1) sufficient vegetation must be retained to accommodate the maximum number of flying-foxes recorded at the site.

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

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

Active dispersal through disturbance

Dispersal is more effective in the short term 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). The exact location of these and positioning of personnel will need to be determined on a daily basis in response to flying-fox movement and behaviour, as well as prevailing weather conditions (e.g. wind direction for smoke drums).

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

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

It should be noted that active dispersal generally requires ongoing dispersal attempts to prevent flying-foxes re-establishing the camp. The cost of ongoing dispersal attempts is likely to be prohibitive for most land managers.

Early dispersal before a camp is established at a new location

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

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

Maintenance dispersal

Maintenance dispersal refers to active disturbance following a successful dispersal to prevent the camp from re-establishing. It differs from initial dispersal by aiming to discourage occasional over-flying individuals from returning, rather than attempting to actively disperse animals that have been recently roosting at the site. As such, maintenance dispersal may have fewer timing restrictions than initial dispersal, provided that appropriate mitigation measures are in place (see Section 10).

H.17 Unlawful activities

Culling

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