

Balgowlah Grey-headed Flying-fox Camp Management Plan

March 2016

Manly Council



Revision History

Revision No.	Revision date	Details	Prepared by	Reviewed by	Approved by
00	27/07/2015	Camp management plan	Eco Logical Australia		
01	27/11/2015	Camp management plan review – incorporating comments from Manly Council and OEH, DRAFT	Jess Bracks, Senior Wildlife Biologist Ecosure	Dr Alan House, Principal Ecologist	Dr Alan House, Principal Ecologist
02	1/12/2015	Camp management plan review – incorporating comments from Manly Council, DRAFT R1	Jess Bracks, Senior Wildlife Biologist Ecosure	Dr Alan House, Principal Ecologist	Dr Alan House, Principal Ecologist
03	26/02/2016	Camp management plan – Incorporating public feedback	Jess Bracks, Principal Wildlife Biologist Ecosure	Dr Grant Brearley, Senior Ecologist	Dr Grant Brearley, Senior Ecologist
04	01/03/2016	Camp management plan – Incorporating final Council comments			Jess Bracks, Principal Wildlife Biologist Ecosure
05	21/07/2016	Camp management plan – Incorporating OEH comments	Kristie King, Manly Council		

Distribution List

Copy #	Date	Type	Issued to	Name
1	01/03/2016	Electronic	Manly Council	Kristie King
2	01/03/2016	Electronic	Ecosure	Administration

Citation: Ecosure (2016), Balgowlah Grey-headed Flying-fox Camp Management Plan, Report to Manly Council, Publication Location – Sydney.

Report compiled by Ecosure Pty Ltd

ABN: 63 106 067 976

admin@ecosure.com.au www.ecosure.com.au

PR1368-DE Balgowlah GHFF CMP FINAL.R1

Adelaide

PO Box 145
Pooraka SA 5095
P 1300 112 021
M 0407 295 766

Brisbane

PO Box 675
Fortitude Valley QLD 4006
P 07 3606 1030

Gold Coast

PO Box 404
West Burleigh QLD 4219
P 07 5508 2046
F 07 5508 2544

Rockhampton

PO Box 235
Rockhampton QLD 4700
P 07 4994 1000
F 07 4994 1012

Sydney

PO Box 880
Surry Hills NSW 2010
P 1300 112 021

© Ecosure Proprietary Limited 2016

Commercial in confidence. The information contained in this document produced by Ecosure Pty Ltd is solely for the use of the Client identified on the cover sheet for the purpose for which it has been prepared and Ecosure Pty Ltd undertakes no duty to or accepts any responsibility to any third party who may rely upon this document. All rights reserved. No section or element of this document may be removed from this documents, reproduced, electronically stored or transmitted in any form without the written permission of Ecosure Pty Ltd.



© Ecosure Proprietary Limited 2016

Commercial in confidence. The information contained in this document produced by Ecosure Pty Ltd is solely for the use of the Client identified on the cover sheet for the purpose for which it has been prepared and Ecosure Pty Ltd undertakes no duty to or accepts any responsibility to any third party who may rely upon this document. All rights reserved. No section or element of this document may be removed from this documents, reproduced, electronically stored or transmitted in any form without the written permission of Ecosure Pty Ltd.

Contents

Executive summary.....	iv
Acronyms and abbreviations.....	vi
1 Overview.....	1
1.1 Objectives.....	1
1.2 Purpose and intention.....	2
2 Context.....	3
2.1 Camp area.....	3
2.2 Regional context.....	6
2.3 History of the camp.....	8
2.4 Identification of flying-fox issues and stakeholders.....	10
2.5 Classification of the land.....	11
2.6 Stakeholders.....	11
2.7 Management response to date.....	11
2.8 Legislation.....	13
2.8.1 New South Wales.....	13
2.8.2 Federal approvals.....	13
3 Management considerations.....	14
3.1 Faecal drop.....	14
3.2 Noise.....	14
3.3 Odour.....	14
3.4 Human health risks from pathogens, viruses and diseases.....	15
3.5 Weed infestation and habitat loss.....	15
3.6 Displacement of other native fauna.....	15
4 Ecological considerations.....	16
4.1 Ecological importance.....	16
4.2 Life and reproductive history.....	17
4.3 GHFF under threat.....	18
4.3.1 Heat stress.....	20
5 Identification of camp management actions.....	21
5.1 Level 1 – routine management.....	21

5.2	Supplementary actions	22
5.2.1	Community education	22
5.2.2	General mitigation measures for the community	23
5.2.3	Street trees and parks.....	24
5.3	Level 2 – buffers	24
5.4	Flying-fox welfare standards for Level 1 and 2 actions.....	28
5.5	Flying-fox injury and rescue	29
5.6	Level 3 – camp disturbance or dispersal.....	30
6	Assessment of impacts	31
7	Implementation	33
7.1	Responsibilities.....	33
7.2	Consents	33
7.3	Planning for camp management actions and timing	33
7.4	Costs	33
7.5	Monitoring and adaptive management	34
7.5.1	Plan evaluation and review	34
	References and further information	35
	Appendix 1 Historical camp data	39
	Appendix 2 Flying-foxes and human health.....	41
	Appendix 3 Signage installed at the Balgowlah camp	43
	Appendix 4 Review of past flying-fox dispersals (Roberts & Eby 2013).....	45
	Appendix 5 Dispersal as a management option	46

List of figures

Figure 1 Features of the site	4
Figure 2 Flying-fox camp extent	5
Figure 3 Known GHFF camps in the Sydney Metropolitan area (December 2015).....	7
Figure 5 2002 aerial photograph	9
Figure 4 1943 aerial photograph	9
Figure 6 Weed infested site of proposed constructed bioretention basin	10
Figure 7 Revegetation with native canopy tree species that will provide flying-fox roost habitat.....	12
Figure 8 Exotic vines threatening roost trees	12
Figure 9 Proposed management areas	27

List of tables

Table 1 Key structural flora	6
Table 2 Indicative breeding cycle of the GHFF (and BFF) in NSW and potential impacts....	17
Table 3 Planned Level 1 and 2 actions	25
Table 4 Signs that flying-fox may be at risk, and appropriate mitigation actions.	29

Executive summary

In 2010, a Grey-headed Flying-fox (*Pteropus poliocephalus*) camp established in urban bushland at Burnt Bridge Creek, Balgowlah. Regular monitoring by the Royal Botanic Gardens and Domain Trust determined that numbers of GHFF at the camp have increased in recent years, peaking at about 5,900 individuals in June 2014. The Black Flying-fox (*P. alecto*) and one Little Red Flying-fox (*P. scapulatus*) have also been recorded at the Balgowlah camp.

All flying-fox species are protected under the NSW *National Parks and Wildlife Act 1974*. The Grey-headed Flying-fox is also listed as vulnerable to extinction under the NSW *Threatened Species Conservation Act 1995* and Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*.

Manly Council is responsible for managing the Balgowlah GHFF camp. The NSW and Commonwealth Government legislative and policy requirements require Council, as the land manager, to protect the species and minimise conflicts between flying-foxes and the surrounding community. To date, there have been about 20 complaints from residents in Manly LGA regarding flying-foxes, primarily about noise at night as the flying-foxes are foraging. The NSW Government's Flying-fox Camp Management Policy (February 2015) and Flying-fox Camp Management Template (February 2015) provides a framework for land managers to manage the flying-fox camps effectively. This Balgowlah Camp Management Plan (referred to herein as 'the Plan') has been prepared in accordance with the Policy and Template, with its focus specifically to:

- minimise conflict between the camp and surrounding community
- ensure the long-term viability of the site as roost habitat
- provide the framework for Council to manage activities within the site itself, particularly:
 - weed removal and habitat restoration works to improve the general ecological and amenity values of the site
 - maintenance of the gross pollutant trap located on the southern edge of the site
 - mowing and other routine maintenance activities that may arise
 - removal of limbs/trees which pose a health and safety risk to the public/Council employees (e.g. after a storm event)
 - potential construction of a bioretention basin on the south-western corner of the site, which will provide an additional stormwater pollution control and improve habitat and amenity values of the reserve.

The Plan outlines the following key actions to be taken by Council:

- Continue to restore and protect environmental values of the site by progressively removing Coral Trees and other noxious and environmental weeds, and plant suitable roost trees in appropriate areas away from adjacent residences;

- Obtain a five-year s91 license from NSW Office of Environment and Heritage to cover routine site maintenance activities listed above (Level 1 actions in accordance with the NSW camp management policy and plan template);
- Maintain current buffers (Level 1 action) and progressively create additional buffers to mitigate conflict with nearby residents (Level 2 action);
- Investigate funding opportunities to assist residents with measures to address impacts of the camp;
- Prepare a community education strategy to support implementation of the Plan;
- Support ongoing monitoring of the flying-fox population by Royal Botanic Gardens and Domain Trust, and respond promptly to issues raised by survey data and the community.

Dispersal of the camp is not recommended because of the uncertain outcome (e.g. the camp may relocate to one or more undesirable locations) and high cost. Dispersals are often unsuccessful and the dispersed animals almost never abandon the local area.

The Balgowlah Grey-headed Flying-fox Camp Management Plan (December 2015) was placed on public exhibition from 18th January 2016 to 15th February 2016. A total of nine submissions were received: five respondents supported in-situ management and four respondents (from two properties) requested dispersal. Feedback has been incorporated into the finalised Plan where possible.

Acronyms and abbreviations

Abbreviation	Description
ABLV	Australian Bat Lyssavirus
BFF	Black Flying-fox (<i>Pteropus alecto</i>)
COP	Code of practice
DoE	Commonwealth Department of the Environment
ELA	Eco Logical Australia
EPBC Act	Commonwealth <i>Environment Protection and Biodiversity Conservation Act 1999</i>
GHFF	Grey-headed Flying-fox (<i>P. poliocephalus</i>)
GPT	Gross Pollutant Trap
LEP	Manly Local Environment Plan 2013
LGA	Local Government Area
LRFF	Little Red Flying-fox (<i>P. scapulatus</i>)
NPW Act	NSW <i>National Parks and Wildlife Act 1974</i>
OEH	NSW Office of Environment & Heritage
The Plan	Balgowlah Grey-headed Flying-fox Camp Management Plan (this document)
PoM	Plan of Management
RBGDT	Royal Botanical Gardens and Domain Trust
TSC Act	NSW <i>Threatened Species Conservation Act 1995</i>
WONS	Weeds of National Significance

1 Overview

This Plan has been commissioned by Manly Council to guide management of the Burnt Bridge Creek camp in Balgowlah, which is primarily comprised of the Grey-headed Flying-fox (*Pteropus poliocephalus*; GHFF). The Plan has been prepared in accordance with the NSW Office of Environment & Heritage (OEH) Flying-fox Camp Management Policy (OEH 2015a) and Camp Management Plan Template (OEH 2015b) to facilitate licensing of camp management actions over the next five years. The Plan also provides a framework for Council and others to manage flying-foxes more generally throughout the Manly Local Government Area (LGA).

The Draft Balgowlah Grey-headed Flying-fox Camp Management Plan (December 2015) was placed on public exhibition from 18th January 2016 to 15th February 2016. A total of nine submissions were received: five respondents supported in-situ management and four respondents (from two properties) requested dispersal. Responses included the following key themes:

- *the need to recognise the ecological importance of flying-foxes*
- *the importance of Council educating the community on the role and status of flying-foxes*
- *support for Council's proposed approach to manage the camp in situ.*
- *opposition to dispersal due to cost, associated disruption to residents, welfare concerns and no guarantees of success*
- *concern that residents are not being prioritised over flying-foxes*
- *reports of amenity, financial and potential health impacts*
- *Council should provide assistance/funding for residents to implement mitigation measures such as double-glazing of windows, air conditioners, insulation, etc.*
- *confusion as to how flying-foxes could be threatened.*

Feedback has been considered and concerns addressed where possible in finalising this Plan.

1.1 Objectives

The NSW Government's Flying-fox Camp Management Policy, includes the following objectives for flying-fox camp management:

- address the potential impacts of flying fox camps on human health and amenity
- minimise the impact of camps on local communities
- provide a balance between conservation of flying-foxes and their impacts on human settlements
- clarify roles and responsibilities for OEH, local councils and other land managers such as managers of Crown Lands

- provide options for land managers to obtain upfront five year licensing to improve flexibility in the management of flying-foxes
- enable land managers and other stakeholders to use a range of suitable management responses to sustainably manage flying-foxes
- require land managers to consider the behaviours, habitat and food requirements of flying-foxes when developing and implementing camp management plans
- improve understanding of the relationship between new development and existing flying-fox camps
- implement an adaptive management approach to camp management based on evidence collected as a result of the policy
- enable long term conservation of flying-foxes in appropriate locations by encouraging land managers to establish and protect sufficient food supplies and roosting habitat.

The focus of this Plan is consistent with the policy objectives, being specifically to:

- minimise conflict between the camp and surrounding community
- ensure the long-term viability of the site as roost habitat
- provide the framework for Council to manage activities within the site itself, particularly:
 - weed removal and habitat restoration works to improve the general ecological and amenity values of the site
 - maintenance of the Gross Pollutant Trap (GPT) located on the southern edge of the site
 - mowing and other routine maintenance activities that may arise
 - removal of limbs/trees which pose a health and safety risk to the public/Council employees (e.g. after a storm event)
 - potential construction of a bioretention basin on the south-western corner of the site, which will provide an additional stormwater pollution control and improve habitat and amenity values of the reserve.

1.2 Purpose and intention

There have been approximately 20 complaints from residents in the Manly LGA over the last few years regarding conflicts with flying-foxes. These complaints generally relate to matters such as noise and faecal drop as flying-foxes move around Manly LGA to forage at night. There have been some complaints from residents living near the camp.

There is a need to manage the Balgowlah site so that impacts to surrounding neighbourhoods are minimised. Management of the camp also needs to ensure that the habitat continues to support GHFFs in the long term. This includes careful management of bush regeneration activities and construction / maintenance of infrastructure. This Plan is also needed to help manage the risk of significant numbers of flying-foxes being relocated to the Manly LGA from camps being dispersed elsewhere.

2 Context

This section provides background information on the Balgowlah camp and the issues to be addressed.

2.1 Camp area

The Balgowlah camp is located in urban bushland between Balgowlah Road and the Burnt Bridge Creek Deviation (Figure 1).

In November 2015, the camp comprised about 0.59 ha of occupied/partially occupied roosting habitat for flying-foxes of the approximate 1.8 ha of suitable roost habitat (Figure 2). Given this was close to peak occupancy, it is not expected to expand greatly although slightly higher numbers have been recorded in the past (Appendix 1). As indicated in Figure 1, a 10 m mown grassed buffer separates a block of residential units from bushland at the eastern end of the site. Other residences in close proximity to the camp are on the southern side of Balgowlah Road.

Vegetation within the camp is mapped as Dry Sclerophyll Forest. Field investigation found that a substantial proportion of the site has been subject to bush regeneration or invaded by exotic species. There are no threatened ecological communities mapped as occurring on site, and while a detailed flora assessment was not undertaken, vegetation type was ground-truthed during site assessment and confirmed as non-threatened Dry Sclerophyll Forest (see Table 1). Exotic vines and other weed species are adversely impacting the roosting habitat as well as the broader ecology and amenity.

There is unrestricted public access through the subject site. The site features a sealed cycleway / pedestrian path (Figure 1). Direct vehicle access to the GPT (Figure 1) and proposed bioretention basin (Figure 1) is from the adjacent Balgowlah Road.

Figure 1 Features



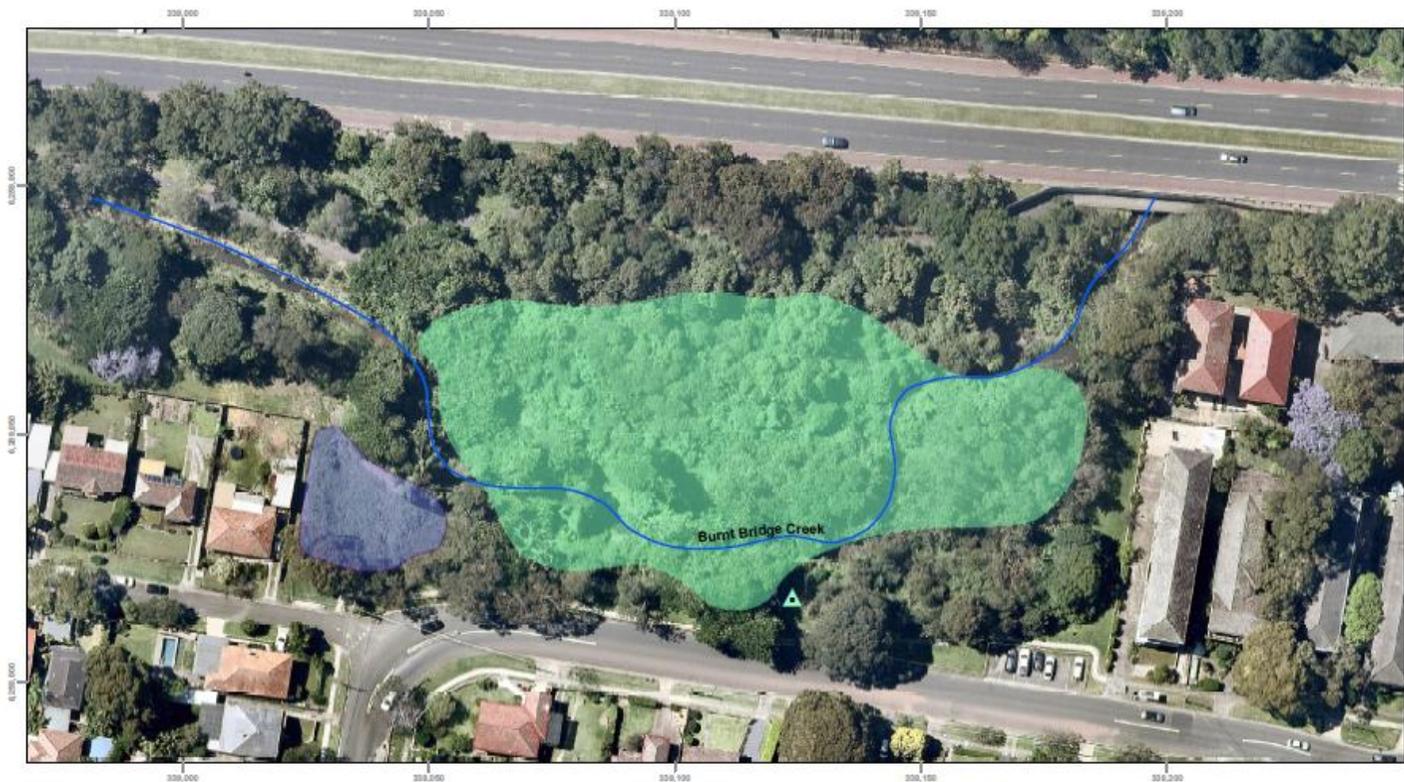


Figure 2: Roost extent
 Manly Council
 Grey-headed flying-fox management plan

■ Roost extent (Nov 2015) ▲ Gross pollutant trap
■ Proposed bioretention basin ~ Waterway



Job number: PR1368
 Revision: 0
 Author: DG
 Date: 27/11/2015

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

Data Sources: © Here Maps, 2015. Ecosure, 2015.
 ECOSURE does not warrant the accuracy or completeness of information displayed in this map and any person using it does so at their own risk. ECOSURE shall bear no responsibility or liability for any errors, faults, defects, or omissions in the information.
 PR1368_MPL_FlyFox_RoostExtent.dwg

Figure 2 Flying-fox camp extent

Table 1 Key structural flora

Species Name	Common Name	Origin
<i>Acacia floribunda</i>	White Sally	Native
<i>Allocasuarina littoralis</i>	Black She-oak	Native
<i>Angophora costata</i>	Smooth Barked Apple	Native
<i>Banksia integrifolia</i>	Coast Banksia, Old Man Banksia	Native
<i>Banksia marginata</i>	Silver Banksia	Native
<i>Bidens pilosa</i>	Cobbler Pegs	Exotic
<i>Casuarina glauca</i>	Swamp She-oak	Native
<i>Dichondra repens</i>	Kidney Weed	Native
<i>Dodonaea triquetra</i>	Common Hop-bush	Native
<i>Erythrina</i> sp.	Coral Tree	Exotic
<i>Glochidion ferdinandi</i>	Cheese Tree	Native
<i>Hedychium gardnerianum</i>	Ginger Weed	Exotic
<i>Ipomoea indica</i>	Common Morning Glory	Exotic*
<i>Lomandra longifolia</i>	Mat rush	Native
<i>Ligustrum sinense</i>	Large – leaf Privet	Exotic*
<i>Nerium oleander</i>	Oleander	Exotic
<i>Persicaria</i> sp.	Knotweed	Native
<i>Solanum</i> sp	Night Shade	Exotic
<i>Tradescantia fluminensis</i>	Wandering Trad	Exotic
Unknown	Tree Ferns	Native

**Ligustrum sinense* and *Ipomoea indica* are listed as Control Class 4 under the *Noxious Weeds Act 1993* for Manly LGA. The growth of the plant must be managed in a manner that continuously inhibits the ability of the plant to spread.

2.2 Regional context

As depicted in Figure 3, the Balgowlah camp is an integral component within the network of camps across eastern Australia and provides a staging platform for GHFFs migrating up and down the coast. Flying-foxes are highly mobile and can travel up to 50 km from the camp during nightly and foraging (OEH 2015a). They have an important role in pollination and seed dispersal for many plants, which is why they are regarded as a 'keystone species'.

The Royal Botanic Gardens camp was dispersed in 2012/13 and numbers of GHFF recorded at other camps in the region have subsequently increased. Radio tracking and monitoring confirmed that prior to dispersal flying-foxes moved between the Royal Botanic Gardens and the Balgowlah camp (along with other camp sites) (John Martin pers. comm. November 2015), and therefore the Balgowlah camp is likely more important to these animals than it was prior to the Royal Botanic Gardens dispersal. Further dispersal of GHFF from other camps has potential implications for the Balgowlah camp.

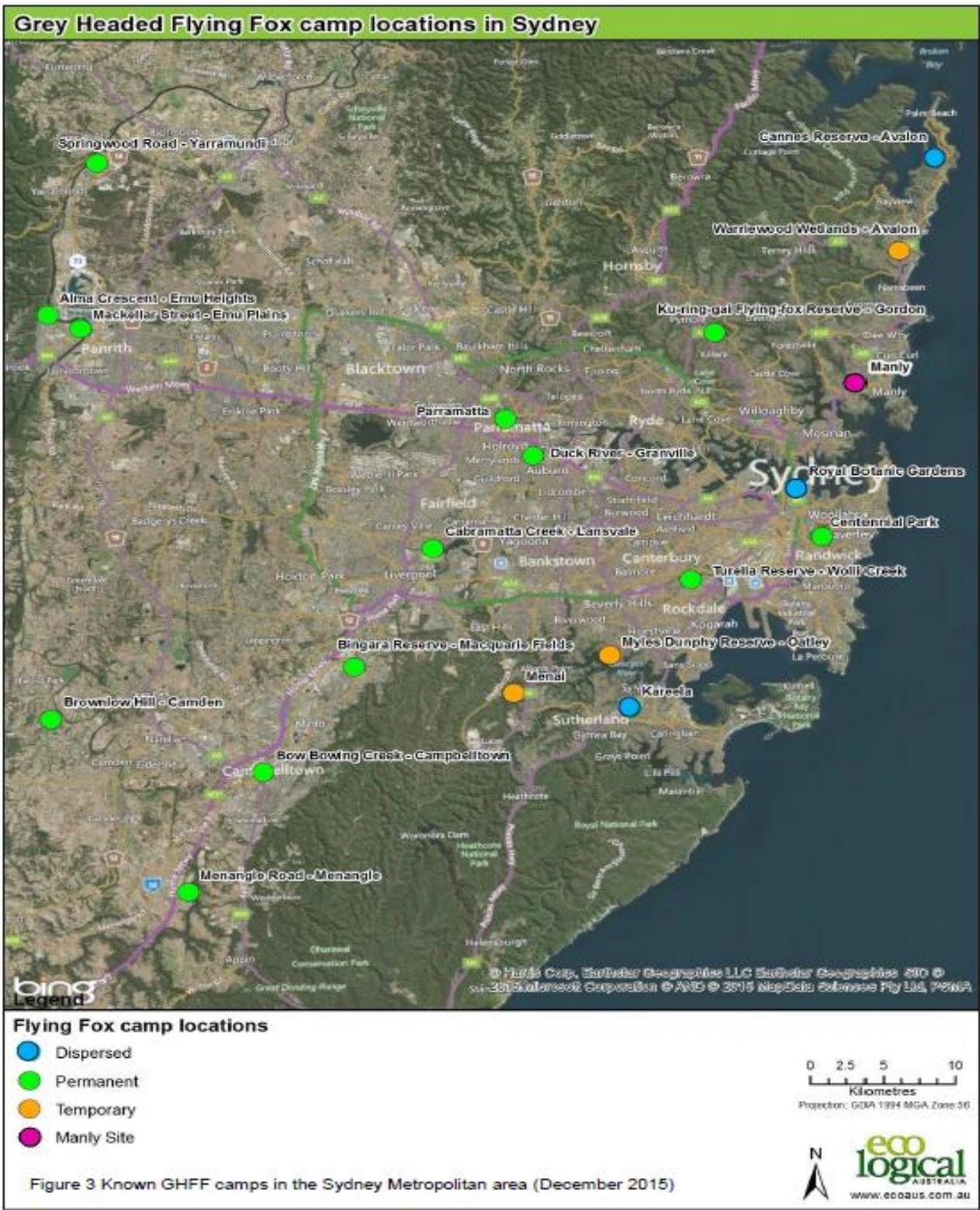


Figure 3 Known GHFF camps in the Sydney Metropolitan area (December 2015)

2.3 History of the camp

Burnt Bridge Creek is a 3 km freshwater creek that drains to Manly Lagoon through an urbanised catchment. A comparison of aerial photographs taken in 1943 (Figure 4), 2002 (Figure 5) and current (Figures 1 and 2) indicate changes to vegetation and urban development in the area.

GHFF were first recorded at the site during radio tracking by Dr Peggy Eby in 2010 (pers com John Martin, RBGDT March 2015). However, flying-foxes may have roosted at the site previously when conditions were suitable. Black Flying-fox (*P. alecto*; BFF) are also commonly recorded, with only one record of a single Little Red Flying-fox (*P. scapulatus*; LRFF). Monthly count data is provided in Appendix 1.

In 1996, Council prepared a Plan of Management (PoM) for Community Lands along Burnt Bridge Creek. The PoM appears to pre-date establishment of the GHFF camp because the camp is not mentioned in the Plan. However, the PoM states that native habitats should be conserved and/or recreated where possible.

Over the past ten years Manly Council has applied funds from Council's Environment Levy to the Burnt Bridge Creek catchment to:

- revegetate
- control weeds
- educate residents to influence behaviour on environmental issues (e.g. to stop garden waste being dumped in bushland)
- sweep streets to remove pollutants
- install interpretive signage
- upgrade the walking/cycle path.

The Burnt Bridge Creek Integrated Restoration Project was initiated by Manly and Warringah Councils with funding from the NSW Environmental Trust. While ongoing aspects of this project are continued by Manly Council, the initial joint initiative is complete and included:

- stormwater harvesting and quality treatment – this includes a GPT which was constructed in 2009 (location of the GPT is indicated in Figure 2)
- establishment of a bioretention basin - proposed location for the constructed wetland / rain garden is identified in Figure 2
- removal of aquatic and riparian weeds and bush regeneration
- creek bank restoration
- catchment-wide community education.



Figure 4 1943 aerial photograph

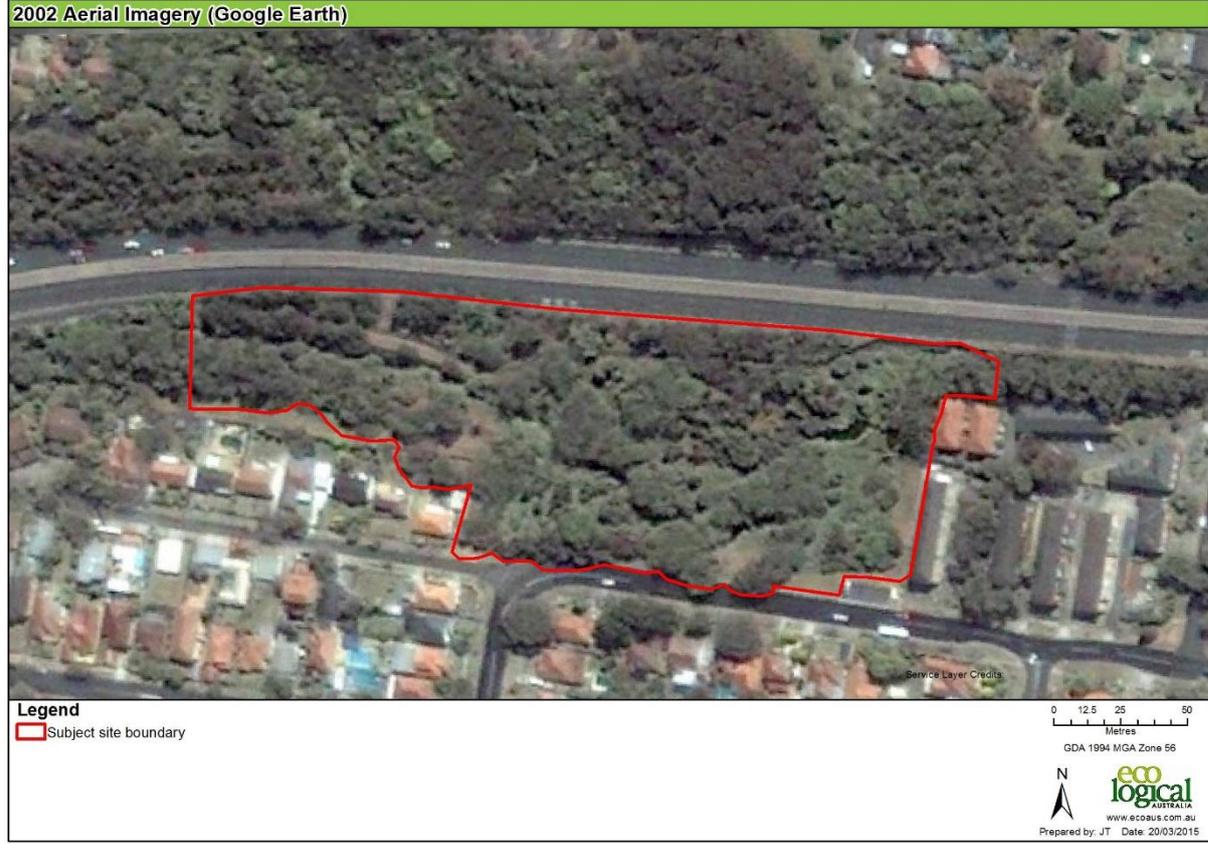


Figure 5 2002 aerial photograph



Figure 6 Weed infested site of proposed constructed bioretention basin

2.4 Identification of flying-fox issues and stakeholders

Over the last few years Council has received a number of complaints (<10 of the ~20 total complaints) from residents and landowners of properties adjacent to the camp. Concerns relate to amenity issues such as noise, odour, faecal drop, human health and wellbeing impacts (particularly associated with sleep deprivation), and perceived financial impacts (e.g. high rental turnover, property devaluation).

The wider Manly community has strong representation from residents keen to conserve wildlife in the area and manage the camp sustainably in situ. Some of these views were expressed at the July 2015 meeting of Council's Community Environment Committee when a summary of this Plan was presented. The community has been actively engaged in the rehabilitation of the Burnt Bridge Creek catchment for several years.

Council staff have raised concerns about the Coral Trees within the camp, even though they provide roost habitat. Coral Trees shade out native species and create conditions that are not suitable for regeneration of native species. Coral Trees are also prone to dropping limbs and falling, which has implications for site management and safety. Many of the Coral Trees within the site are mature and their structural integrity is compromised. Dropped limbs and fallen trees will reshoot and become a further environmental weed problem.

Council staff also have concerns about the restrictive conditions of the s132C licence issued by OEH. The current licence prohibits Council from undertaking bush regeneration within 20 m of roosting flying-foxes. This has resulted in progressive degradation of the site, which means the camp would not be sustained in the long term. Weed proliferation at the camp also

contributes to the spread of weeds throughout the catchment and lessens the amenity of the area. It is proposed that a s91 licence or s95 certificate replace the current s132C licence (see Section 2.7).

2.5 Classification of the land

The site is Crown land managed by Manly Council and zoned RE1 Public Recreation under the Manly Local Environment Plan (LEP) 2013.

2.6 Stakeholders

In addition to Manly Council, there are a number of stakeholders directly or indirectly affected by the camp, or who otherwise have interest in the camp:

- surrounding residents and landholders, including within Warringah Council on the northern side of the camp
- pedestrians and cyclists using footpaths and bicycle paths around the camp
- OEH
- wildlife carers and conservationists
- neighbouring Councils, in particular Warringah Council with the camp being located on the boundary of the Manly Council-Warringah Council LGAs.

Additional stakeholders will be identified through community engagement including public exhibition of the Plan.

2.7 Management response to date

Manly Council has restored habitat across much of the site. This has included planting suitable roost tree species, and extensive weed removal to allow natural regeneration and protect roost trees from being smothered or otherwise out-competed.

Restoration activities to date have provided an estimated 25% additional roosting habitat, and protected the viability of the remainder against weeds. Many of these rehabilitated areas, including plantings 5-10 years old, are currently being used by flying-foxes, with other areas anticipated to reach sufficient height over the next 2 – 5 years (Figure 7).

Restrictions conditioned in the existing s132C licence have meant that weed removal and maintenance under the camp has not been possible, and this is urgently needed to protect the ecological values of the site (Figure 8).



Figure 7 Revegetation with native canopy tree species that will provide flying-fox roost habitat



Figure 8 Exotic vines threatening roost trees

Council has responded to community concerns by:

- removing Coral Trees on the western and eastern boundaries to provide a buffer for adjacent residents (and improve the ecological condition of the site)
- maintaining a mowed buffer between residents at the eastern boundary.
- installing informative signage at several locations around the camp. This signage aims to inform the community on the importance of flying-foxes to foster appreciation and tolerance. It also details the protected and threatened status of the GHFF (and penalties for disturbing the camp under State and Federal law), and what a person should do if they find an injured or distressed flying-fox.

Council also supports regular monitoring conducted by flying-fox experts from the RBGDT and elsewhere. This monitoring data will continue to be used to inform exact timing of management activities as detailed in Sections 5 and 7. Furthermore, Council works with Sydney Wildlife volunteers to care for injured animals, and will continue to do so as required.

Education and community consultation has been effective at reducing conflict when flying-fox numbers are low, with very few complaints received during these times. However in recent

years, which temporally coincides with the Royal Botanic Gardens dispersal, higher numbers of flying-foxes have occupied the site (with the site permanently inhabited since November 2012). Complaints from residents have consequently increased.

2.8 Legislation

The GHFF is protected under the *National Parks and Wildlife Act 1974* (NPW Act), and listed as vulnerable to extinction under the NSW *Threatened Species Conservation Act 1995* (TSC Act) and Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Further management requirements are set out in the EPBC Act Policy Statement – Referral Guideline for Management Actions in Grey-headed and Spectacled Flying-fox Camps (DoE 2015) and Flying-fox Camp Management Policy (OEH 2015).

2.8.1 New South Wales

Council will need to apply to OEH for a Section 91 Licence under the TSC Act to harm or pick a threatened species, population or ecological community, or damage habitat. The licence may be issued for five years to cover routine camp maintenance activities such as mowing, bush regeneration, and infrastructure maintenance. It is anticipated that construction of the bioretention basin with respect to avoiding impacts to the camp will be permitted under this licence in accordance with the restrictions outlined in this Plan. This Plan should be submitted to OEH for approval with a completed s91 licence application form.

It is proposed that the s91 licence (or s95 certificate if impacts are assessed as unlikely to significantly affect the GHFF) will replace the current s132C licence.

2.8.2 Federal approvals

Federal approvals by the Department of the Environment (DoE) are not required for work as described in this Plan because the camp does not meet the threshold size for consideration and approvals¹. While referral under the EPBC Act is not required currently, there have been over 2,500 GHFF occupying the site seasonally since 2013, and therefore this camp may be considered nationally-important in the future, particularly in the context of an increasing number of camp dispersals. As such, welfare measures detailed in Section 5 are aligned with mitigation standards outlined in the EPBC Act Policy Statement.

¹ A camp is considered nationally-important if it has contained $\geq 10,000$ GHFF in more than 1 year, or 2,500 GHFF permanently/seasonally every year for 10 years (DoE 2015).

3 Management considerations

3.1 Faecal drop

Flying-foxes have a very efficient digestive system which allows food to pass through very quickly (12-30 minutes) and consequently they will primarily defecate at their feed sites or as they travel back to their roost sites (Westcott et al. 2011). However, flying-foxes are also known to defecate immediately as they leave their roosts to fly to their nightly foraging habitats. If deposited in flight, faecal matter and urine can splatter and create mess, damage property as well as cause other inconveniences such as not being able to dry washing on warm nights (Hall and Richards 2000). Flying-fox droppings can permanently mark painted objects such as cars, houses and pathways (Hall and Richards 2000, ELA 2012).

All animal faeces and urine can contain bacteria, viruses and other microorganisms that can cause illness among humans (Geolink 2012). However, NSW Health (2009) and the Department of Sustainability and Environment (DSE 2009) advise that touching and/or coming in contact with flying-fox faecal matter or urine will not transmit Australian Bat Lyssavirus (ABLV), Hendra virus or any other pathogen that is currently known to cause significant disease among humans (Geolink 2011).

3.2 Noise

Dogs, birds of prey, planes, machinery and people can disturb roosting flying-foxes (Roberts 2006). If sufficiently disturbed they have been known to relocate to a different camp site. However, roosting flying-foxes can also become resilient to background noise e.g. GHFF at the Royal Botanic Gardens required very loud 'industrial' noise to disperse the camp. The Balgowlah flying-foxes appear to be accustomed to background traffic noise, and have stayed at the site despite regular maintenance of the Council's gross pollutant trap (GPT) directly near core roosting habitat.

The noise created from flying-fox camps, especially during peak periods of activity, such as fly-outs and as foraging individuals return to the camp in the early morning can adversely affect human sleep patterns, create annoyance, cause stress and impact on the wellbeing of local residents (Roberts 2006, ELA 2012, Geolink 2013).

3.3 Odour

Flying-foxes use scent for identification, including attractants during the reproductive period to enable mothers to find their young when they return to the camp following their nightly foraging activities (Ipswich City Council, nd). The characteristic odour emitted from flying-fox camps is a scent produced by a male scapular gland applied to tree branches to mark territories and attract females (Roberts 2006, Geolink 2011). There is minimal odour associated with a build-up of faecal matter and urine underneath the roosting flying-foxes. The odour emitted from camps is noticeably stronger and generally regarded as being more unpleasant during:

- periods of prolonged rainfall, which causes the males to have to remark their territories
- periods of hot and humid weather conditions
- periods when the camp is densely populated by flying-foxes.

3.4 Human health risks from pathogens, viruses and diseases

Australian flying-foxes have potential to carry a number of viruses that can pose human health risks and if contracted can be fatal without the appropriate treatment (NSW Health 2012). This includes the ABLV, Hendra virus and Menangle virus (Field 2005, NSW Health 2012).

A fact sheet produced by NSW Health (2012) suggests that the occurrence and risk of transmission of these agents are very rare and the public health risk is negligible. Often these pathogens are only transmitted to humans via a third party (e.g. pigs and horses) or through directly handling or contact between an infected flying-fox and a human (DAFF 2007). Further information is provided in Appendix 2.

The risk to human health from flying-foxes at the Balgowlah camp is extremely low. However, it is important that people visiting the site (e.g. to undertake bush regeneration) and the broader public are aware of the risks and what they should do if they encounter a dead or injured flying-fox (refer to Section 5.1.4). Signage has been installed at the site to assist with this (see Appendix 3).

3.5 Weed infestation and habitat loss

Flying-foxes will often defoliate and break branches while landing and flying within their roosts. Tree deaths are common in densely populated camps or during prolonged periods of camp occupation. The loss of canopy, combined with increased levels of sunlight reaching the lower vegetation strata and increased nutrient loadings leads to a proliferation of weeds.

A camp will be sustainable if there is sufficient habitat for the GHFF to shift into new roost trees and allow old roosts to recover or revegetate. The Balgowlah camp has bushland adjacent to the core roosting habitat, which provides scope for the roosting area to shift. However, weedy vines growing into the canopy can result in loss of existing and potential GHFF habitat. The density of weed infestation and the apparent lack of site resilience also prevents the natural regeneration of suitable canopy trees.

3.6 Displacement of other native fauna

Damage and weed invasion associated with GHFF camps can displace other native species. However, it is more likely that numbers and diversity of native species are reduced at the Balgowlah camp because of past habitat clearing, and predation and competition from domestic and feral animals (e.g. cats and foxes). If fauna has been displaced from the immediate camp area, this should be considered in the context of the broad-scale ecological services that flying-foxes provide (see Section 4.1).

4 Ecological considerations

The Balgowlah camp is permanently inhabited by GHFF and is a maternity camp. It is therefore important to the sustainability of the species.

4.1 Ecological importance

Flying-foxes, along with some birds, make a unique contribution to ecosystem health through their ability to move seeds and pollen over long-distances (Southerton et al. 2004). This contributes directly to the reproduction, regeneration and viability of forest ecosystems (DoE 2016). If numbers of GHFF are reduced to small or localised groups, rainforest seed dispersal and hardwood pollination processes will be severely impacted (Richards 2000 cited in DoE 2016).

It is estimated that a single flying-fox can disperse up to 60,000 seeds in one night (ELW&P 2015). Some plants, particularly *Corymbia* spp., have adaptations suggesting they rely more heavily on nocturnal visitors such as bats for pollination than daytime pollinators (Southerton et al. 2004).

GHFF may travel 100 km in a single night with a foraging radius of up to 50 km from their camp (McConkey et al. 2012), and have been recorded travelling over 5,400 km in 2 days between camps (Roberts et al. 2012). In comparison insects (such as bees), which are also important pollinators, move much shorter foraging distances; often less than one kilometre (Zurbuchen et al. 2010).

Long-distance seed dispersal and pollination makes flying-foxes critical to the long-term persistence of many plant communities (Westcott et al. 2008; McConkey et al. 2012), including eucalypt forests, rainforests, woodlands and wetlands (Roberts et al. 2006). Seeds that are able to germinate away from their parent plant have a greater chance of growing into a mature plant (EHP 2012). It also allows genetic material to be spread between forest patches that would normally be geographically isolated (Parry-Jones and Augee 1992; Eby 1991; Roberts 2006). This genetic diversity allows species to adapt to environmental change and respond to disease pathogens, and 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, provide habitat for other fauna and flora, 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 (EHP 2012; ELW&P 2015).

4.2 Life and reproductive history

The GHFF is Australia’s largest bat and only endemic flying-fox (i.e. belonging to the Pteropid family). They are distributed across eastern Australia, primarily in the wetter coastal regions. The communal camps are generally located within 20 km of a regular food source and are commonly found in gullies, close to water, in vegetation with a dense canopy. The camps provide a suitable location for roosting, resting, social interaction such as reproduction (mating, conception and births), to raise young, and for protection against predation and climatic extremes.

GHFFs are a relatively long-lived species and have been recorded living up to 20 years in the wild and 30 years in captivity (Pierson and Rainey 1992, Roberts 2006). They are highly seasonal and synchronised breeders with relatively low reproductive rates (Pierson and Rainey 1992, Roberts 2006, DECCW 2009). Mating behaviour among GHFF commences in January with conception occurring in April and May, which is followed by a six month gestation period and the birth of a single pup September - November (indicative timing in NSW).

When the young are born they are highly dependent on their mother for food, care and thermo-regulation (Roberts 2006). The young remain dependent on the mother until they are six months old and are carried during her night foraging activities for the first three weeks of their lives (Roberts 2006). The young remain flightless and confined to the camp for the first three to four months. They are weaned at six months of age. GHFF do not become sexually mature until they are two to three years old and tend not to raise young until they are three to four years old, after which they generally raise one young per year (Roberts 2006).

Table 2 shows key stages in the GHFF (and BFF) life cycle and highlights periods of susceptibility to impacts of disturbance.

Table 2 Indicative breeding cycle of the GHFF (and BFF) in NSW and potential impacts

Season	Month	GHFF activities and camp dynamics	Potential Impacts
Summer	January	Lead up to post-natal juvenile dispersal. Juvenile GHFFs are becoming independent, but some juveniles have restricted flight capabilities. Some individuals may leave maternal camps and migrate elsewhere, whilst others will remain in maternal camps. Numbers of GHFFs in Sydney camps are likely to be at their highest.	Juvenile GHFF are still prone to stress and falling to the ground which may result in death directly, or through starvation/predation.
	February	Lead phase to the reproductive period. Males begin forming territories before the mating period begins	Disruption to normal reproductive / camp activities
Autumn	March	Creation, maintenance of male territories.	There might be some short term disruption to normal camp dynamics. These are unlikely to cause a significant impact.
	April	Mating and conception.	
	May	Mating and conception. Gestation / pregnancy extends across a 6 month period. Heavily pregnant females will be present in camp in August and September. Some individuals become nomadic and	There might be some short term disruption to normal camp dynamics. These are unlikely to cause a significant impact.

Season	Month	GHFF activities and camp dynamics	Potential Impacts
Winter	June	move between camps. The level of movement depends on the location and level of productivity of localised winter food resources. Because of this reason, the Sydney GHFF camp numbers are usually at their lowest.	Stressed adult females could abort young
	July		
	August		
Spring	September	Birth and lactation Births and dependent young are carried by mothers during foraging movements for at least three weeks.	Stressed adult females could abort or abandon young. When not attached to mother, stressed young are at risk of falling to ground which may result in death directly, or through starvation/predation.
	October		
	November		
Summer	December	Final stages of care before young become independent Dependent young remain at the camp while parents leave to forage.	Dependent juvenile GHFFs continue to roost in the camp. The juveniles are easily stressed and can fall to the ground which may result in death directly, or through starvation/predation.

4.3 GHFF under threat

Flying-foxes appear to be more frequently roosting and foraging in urban areas. There are many possible drivers for this, as summarised by Tait et al. (2014):

- loss of native habitat and urban expansion (Markus and Hall 2004; Hall and Richards 2000)
- opportunities presented by year-round food availability from native and exotic species found in urban areas (Hall and Richards 2000 Eby 1991; Eby et al. 1999; Parry-Jones and Augee 2001)
- disturbance events such as droughts (Tidemann CR; Nelson JE 2004), fires (Jenkins et al. 2007) and cyclones (Shilton et al. 2008; Craig et al. 1994, Esselstyn et al. 2006)
- human disturbance or culling at non-urban roosts or orchards (Hall and Richards 2000)
- urban effects on local climate (Parris and Hazell 2005)
- refuge from predation (Parry-Jones and Augee 2001)
- 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 (Tait et al. 2014).

The GHFF is an endemic species found only in Australia (DoE 2016), and is considered to have a single population that moves around within its entire national range (Webb and Tidemann 1996, DoE 2015). The annual north-south migration results in up to 75% of the total population occurring within NSW in summer (Eby 2000).

These factors may contribute to a perception within the broader community that flying-fox populations are increasing, when the GHFF (and other species) are actually in decline across their range.

Ratcliffe (1931) believed that the GHFF had declined by 50% following European settlement, largely as a result of clearing native vegetation (Tidemann et al. 1999). Between 1989 and 2000 alone there is evidence the GHFF population declined by up to 30% (Birt 2000; Richards 2000; cited in OEH 2011a).

There is a wide range of ongoing threats to the survival of the GHFF, 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, powerline electrocution, etc.)
- predation by native and introduced animals
- competition and hybridisation with the BFF (DECCW 2009).

Flying-foxes are also vulnerable to extreme natural events such as cyclones, drought and heat waves. For example, in January 2014, more than 45,500 flying-foxes perished in South-east Queensland as a result of heat stress (Welbergen 2014), with many more dying elsewhere during the year.

Flying-foxes have limited capacity to respond to these threats and recover from large population losses. They naturally live to a maximum of 15-20 years (McIlwee and Martin 2002), with average life expectancy much lower (7.1 ± 3.9 years; Tidemann and Nelson 2011 cited in DoE 2016). Females are rarely able to produce viable young before their third year of life, and are then capable of rearing just one pup per year. Pregnancy lasts six months with lactation a further 3-4 months (Martin et al. 1996 cited in McIlwee and Martin 2002).

Slow sexual maturation, small litter size, long gestation and extended maternal dependence makes up a breeding strategy only successful for long-lived animals with naturally low mortality rates. This reflects the pre-European environment in which flying-foxes evolved where individuals experienced low levels of natural mortality and long survival times in the wild, probably upwards of 15 years (McIlwee and Martin 2002).

Due to threats discussed above, mortality rates are now high (Vardon and Tidemann 2000). Through population modelling, McIlwee and Martin (2002) conclude that high levels of mortality, either natural or unnatural, will lead to species decline. They calculated that two of the four species of flying-fox on mainland Australia (including the GHFF) are in “imminent danger of extinction if current threats persist”.

For these reasons the GHFF is listed as vulnerable to extinction under NSW state and Federal legislation (see Section 2.8), and requires additional protection.

In 2013, a national flying-fox monitoring program commenced to gather data on population trends according to a method devised by the CSIRO. Results of this monitoring program will contribute to understanding of the abundance and distribution of flying-foxes across Australia.

The survival of flying-foxes depends on our ability to live with them. Council aims to find a balance between managing flying-foxes in urban areas and protecting their future.

4.3.1 Heat stress

Heatwaves over 40°C can harm or kill GHFF. Consecutive days with temperatures in the high thirties also compound the effects of heat stress. Contributing factors that might increase / decrease the impacts of heat stress include:

- access to or absence of adequate understorey vegetation – understorey vegetation assists in regulating the microclimate and provides a refuge to escape intense heat
- timing and age of GHFFs in the camp – during the birthing season or presence of juveniles in camp (juveniles are most susceptible to heat stress events)
- the numbers of GHFF in camp (more bats will lead to competition for cool roost locations and potentially more deaths)
- condition of GHFFs in camp – if they are already under stress from other factors (noise, low food resources, disease or a combination of these things), they will be more prone to heat stress events.

5 Identification of camp management actions

Actions that are intended to be undertaken over a five-year period are identified in this section. Actions beyond five years are also outlined, however these will be further detailed at the five year plan review and re-submission and do not require assessment by OEH until that time. These actions are consistent with the NSW Flying-fox Camp Management Policy (OEH 2015). The three levels of actions outlined in the Policy are:

- Routine camp management actions (Level 1 actions): Routine camp management actions include weed removal, trimming/removing trees that pose a health and safety risk; trimming understorey; planting vegetation or other minor habitat augmentation; mowing; mulching or removing leaf litter/other material from the ground.
- Creation of buffers (Level 2 actions): This involves the creation of buffers (physical or visual) barriers aimed at providing space between the edge of the camp and nearby residents or nudging flying-fox populations away from urban settlements.
- Camp disturbance or dispersal (Level 3 actions): This action involves dispersing flying-foxes from the camp through acoustic and visual disturbances. Despite being the only management action that would completely remove the localised conflict, it has many challenges and has proven to have unpredicted and often undesired outcomes (refer to Appendix 4 for a review of past dispersals). Dispersal is also expensive and may result in the establishment of a camp in a more sensitive location.

5.1 Level 1 – routine management

Planned routine (Level 1) camp management activities within the Balgowlah Camp include:

- weed control (including Coral Trees and vines) and revegetation
- trimming trees overhanging pathways
- trimming/removing trees within the site that pose a risk to the public or Council employees
- maintaining mown areas around the edges of the camp (including around the GPT)
- removing rubbish from the site
- cleaning the GPT.

Noise associated with these activities is generally minor and/or of short duration. For example, a truck is required to vacuum clean the GPT every 1-2 months, which takes approximately two hours (refer to Table 3 for proposed frequency of GPT cleaning).

As part of the program of weed control and bush regeneration, Council proposes to progressively remove vines and Coral Trees from the site. Coral Tree and vine removal will be implemented using a staged approach to ensure sufficient roost habitat is retained at all

times, and conditions remain conducive to roosting flying-foxes. The intention of Coral Tree removal as part of Level 1 management, is to remove weeds, allow restoration to continue and ensure the long-term viability of the site. Coral Trees being used by roosting flying-foxes at the edge of the camp will not be removed unless there is sufficient alternative roost habitat adjacent. Coral Trees in the core area (Figure 9) will be retained for 5-10 years while other areas of the site continue to regenerate. At the time of Ecosure's site assessment (November 2015), there were a sufficient number of suitable roost trees within the core area and other areas of the site so that removal of Coral Trees at the outskirts of the camp will not reduce roosting potential. A gradual, staged approach over five years will also ensure that edge-habitat is not modified so rapidly that flying-foxes will be deterred from large portions of the site. See Figure 9 and Table 3 for indicative stages and timing, and Section 5.4 for mitigation measures.

Council is also proposing to construct a bioretention basin in an area that comprises weed ground cover (Figure 9). The basin will improve water quality and the flow regime in Burnt Bridge Creek. Construction will involve:

- earthworks using trucks, excavators and rollers
- rock delivery and placement to create the embankments
- revegetation of the edges, drains and other areas disturbed during the work.

The basin site is located on the edge of the camp habitat (Figure 2). Noise associated with construction would almost certainly disturb the camp, and as such, works will be undertaken when flying-foxes are naturally absent (either if the camp empties for a period of time, or at night while flying-foxes are away foraging; see Table 3 and Section 5.4).

This bioretention basin will improve water quality of the creek and overall reserve health and will therefore benefit roosting flying-foxes.

5.2 Supplementary actions

The following additional actions will commence with Level 1 management, and continue with Level 2 or 3 actions if required to progress past Level 1.

5.2.1 Community education

Council has resolved [OM 118/15] to prepare a Community Engagement Strategy to support implementation of the Plan. This Strategy will be developed to align with the 'Working with communities living with flying-foxes' fact sheet (unpublished draft, OEH 2015).

Council's community education strategy is anticipated to include the following:

- Regularly updated website and environmental education material to include positive messages about:
 - the ecological importance of flying-foxes as pollinators and seed dispersers
 - what to do if you find an injured or dead flying-fox

- what the community can do to reduce amenity impacts associated with living near a camp (see Section 5.1.2)
 - commonly asked questions on native wildlife (this may also help to manage some complaints), such as: what are the health risks from flying-fox (see Appendix 2), can I get sick from odour or faecal drop, how long will noise last from bats feeding in trees, how can I clean faecal droppings, what is the noise, what is the smell?
 - develop a complaints protocol so that staff know to refer complaints about flying-foxes to the appropriate officer
- Informing the community of their legislative responsibilities regarding activities near a roost (e.g. disturbance may result in fines).

5.2.2 General mitigation measures for the community

Potential measures that residents and neighbouring land managers may implement to minimise impacts from roosting and foraging flying-foxes include:

- managing foraging trees (e.g. plants that produce fruit or nectar-exuding flowers) within properties through pruning, covering (with bags or wildlife friendly netting), early removal of fruit or tree replacement to reduce attracting flying-foxes to your property
- covering vehicles, structures and clothes lines where faecal contamination is an issue, or remove washing from the line before dawn and dusk
- moving or covering eating areas (e.g. BBQs and tables) within close proximity to a roost or foraging tree to avoid contamination by flying-foxes
- installing double-glazed windows, insulation and use air-conditioners when needed to reduce noise disturbance and smell associated with a nearby roost
- including suitable buffers and other provisions (e.g. covered car parks) in planning of new developments
- avoiding activities that disturb flying-foxes during the day which will increase roost noise
- turning off lighting at night (e.g. floodlights) which may assist flying-fox navigation and increase fly-over impacts
- considering removable covers for swimming pools and ensure working filter and regular chlorine treatment
- creating visual, sound and smell barriers with fencing or hedges. To avoid attracting flying-foxes, species selected for hedging should not produce edible fruit or nectar-exuding flowers, should grow in dense formation between two and five metres (Roberts 2006) (or be maintained at less than 5 m). Potentially suitable native species include *Hovea acutifolia*, *Westringia fruticosa*, *Pultenaea villosa*, *Dodonaea viscosa* and *Jacksonia scoparia*. Species that produce fragrant flowers may also assist in reducing odour associated with the camp.

Council will investigate opportunities for external funding support to assist affected residents with the implementation of mitigation measures such as those listed above.

5.2.3 Street trees and parks

To increase foraging habitat in suitable locations throughout the LGA, Council should increase the number of GHFF food trees in suitable locations on Council land. Pollen and nectar from flowering Eucalyptus, as well as fleshy fruits, are a primary source of food for GHFF. Suitable locations for planting these trees could include parks and reserves, chosen in consultation with Council's environmental staff.

5.3 Level 2 – buffers

Removing exotic vines and Coral Trees will allow the remaining areas of the reserves to be planted and restored, and will ensure the long-term viability of native roost trees by preventing them from being smothered or otherwise out-competed.

Upon staged completion of Level 1 actions along each boundary, Council will assess the requirement to increase buffers between the camp and adjacent residents. For example, if Council deems that amenity impacts to residents are not sufficiently mitigated through Level 1 actions in that area, native vegetation within a 10 m buffer area (from dwellings or boundaries) may be selectively trimmed or removed to discourage roosting flying-foxes from this area (see Figure 9).

As management will be implemented using a staged approach per area, Level 2 actions may begin in an area where Level 1 actions are complete, prior to Level 1 actions be completed across the entire site.

Council has already planted and regenerated a greater area of roosting habitat than proposed to be removed through weed removal and buffer works (if required) over the next five years. Further, where Coral Trees are removed, planting will be at a ratio of at least 2:1 for each roost tree removed, including suitable roost trees such as *Allocasuarina littoralis*, *Eucalyptus robusta* and *Angophora costata*.

Summary of planned bushland restoration activities including indicative timing and proposed methods are shown in Table 3. Note that timing and methods may vary slightly (informed by ongoing monitoring detailed in Section 7.6), however monitoring and welfare standards detailed in Section 5.4 will be complied with during all works.

Table 3 Planned Level 1 and 2 actions. Management areas are shown in Figure 9.

Activity	Methods	Planned schedule	Seasonal timing and 'no-work' periods N.B. Stop work triggers detailed in Section 5.4 apply to all activities.
Bushland maintenance and restoration across the site (e.g. ground cover weed removal, revegetation, picking up rubbish etc.) (Level 1).	Hand tools only. Weed removal will be staged to avoid microclimate impacts.	Ongoing and regularly undertaken over next 5 years.	Works not scheduled within the roost while pups are being carried (Sep – Nov). Where activities are required during this period, works will be done in the evening at/after fly-out, or with a suitably qualified person ² monitoring flying-fox behaviour to stop work if required.
Maintenance of mown areas surrounding the roost (Level 1).	Ride-on mower.	Ongoing and undertaken approximately monthly over next 5 years.	Council will monitor disturbance levels during mowing while pups are being carried (Sep – Nov) to ensure compliance with this plan, and if required, additional mitigation measures will be implemented (e.g. mowing during this period done at/after fly-out; hand mown in close proximity to the camp, etc).
Stage 1-4 Coral Tree removal at edges of camp (Level 1).	Non-roost trees – chainsaws and/or hand tools. Roost trees – stem-inject so roost trees remain available, but dense canopy does not inhibit plantings underneath. Trees will remain in-situ where possible, otherwise removed as below.	Staged over next 5 years.	Non-roost trees – removal with chainsaws during the day if flying-foxes will tolerate noise; and have sufficient buffer so they are not at risk from falling branches (monitoring required; see Section 5.4), otherwise at/after fly-out or using hand tools only. Mature trees will only be removed during the non-birthing/rearing season. Roost trees – stem-injection only, may be done at any time, but timed so that defoliation does not occur while pups are creching (Sep-Feb).
Removing dead trees (Level 1).	Chainsaws and/or hand tools with hand removal. Cranes if required.	As required.	Chainsaw only at edges of camp if flying-foxes will tolerate noise and have sufficient buffer so they are not at risk from falling branches (monitoring required; see Sections 5.4), otherwise at/after fly-out or using hand tools only. Daytime works will only be done during the non-birthing/rearing season. If cranes are required, these will only be operated at/after fly-out or when the camp is otherwise naturally empty.

² A person experienced in flying-fox behaviour, able to identify each stage of the reproductive cycle, ABLV-vaccinated and trained to rescue flying-foxes if required.

Activity	Methods	Planned schedule	Seasonal timing and 'no-work' periods N.B. Stop work triggers detailed in Section 5.4 apply to all activities.
Trimming canopy vegetation overhanging paths (Level 1) /buffer area (if required) (Level 2).	Chainsaws and/or hand tools.	As required.	Chainsaws during the day if flying-foxes will tolerate noise and have sufficient buffer so they are not at risk from falling branches (monitoring required; see Sections 5.4), otherwise at/after fly-out or using hand tools only. A suitably qualified person will be on site to monitor flying-fox behaviour if works are required during the breeding season (Sep – Mar) to stop works if required.
Chipping debris from above vegetation works (Level 1).	Chipper.	As required.	Chipping will only be done at a suitable distance from the camp so that flying-foxes are not stressed, or at/after fly-out.
Cleaning GPT (Level 1).	Truck with mechanical arm (every 1-2 months) and truck and vacuum to remove debris twice per year (truck can remain approximately 10m from the GPT).	1-2 times per month plus an additional full clean twice per year (or once every two months when below average rainfall).	During the day while flying-foxes are not carrying pups; at/after fly-out if required while pups are being carried/creching (e.g. Sep – Feb). If required during the day Sep – Feb, a suitably qualified person will be on site monitoring flying-fox behaviour to stop work if required.
Stage 5 Coral Tree removal	Non-roost trees – chainsaws and/or hand tools. Roost trees – stem-inject so roost trees remain available, but dense canopy does not inhibit plantings underneath. Trees will remain in-situ where possible, otherwise removed as below.	5 – 10 years (outside the life of the current Plan – OEH assessment not required).	Non-roost trees – removal with chainsaws during the day if flying-foxes will tolerate noise and have sufficient buffer so they are not at risk from falling branches (monitoring required; see Section 5.4), otherwise at/after fly-out or using hand tools only. Mature trees will only be removed during the non-birthing/rearing season. Roost trees – stem-injection only, may be done at any time, but timed so that defoliation does not occur while pups are creching (Sep-Feb).
Core area Coral Tree removal (Level 1).	Roost trees – stem-inject so roost trees remain available, but dense canopy does not inhibit plantings underneath.	5 – 10 years + (outside the life of the current Plan – OEH assessment not required).	It is anticipated that every 2 nd Coral Tree will be stem injected within the core in approximately 5 years, followed by revegetation underneath (including fast-growing roost trees such as casuarina) and allowed to achieve suitable roosting height over 5 years, at which time the remaining Coral Trees will be stem injected. Approach to be detailed at the 5 year plan review.



Figure 9: Management areas

Manly Council
Grey-headed flying-fox management plan

- | | |
|-----------------------------|---|
| Roost extent | Coral tree management
0 - 5 years (current plan) |
| Waterway | 5 - 10 years (to be considered at plan review) |
| Buffer up to 10 m | 5 - 10+ years (to be considered at plan review) |
| Proposed bioretention basin | |



Job number: PR1368
Revision: 0
Author: DB
Date: 26/11/2015

0 5 10 20
Meters

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

Data Source: © Near Maps, 2015. Ecosure, 2015.
ECOSURE does not warrant the accuracy or completeness of information displayed in this map and any person using it does so at their own risk. ECOSURE shall bear no responsibility or liability for any errors, faults, defects, or omissions in the information.

5.4 Flying-fox welfare standards for Level 1 and 2 actions

To minimise risk to roosting flying-foxes the following measures apply to all Level 1 and 2 management activities:

- timing restrictions as outlined in Table 3
- monitoring during activities as per Table 3, with triggers for when management activities are to cease or be adapted (Table 4)
- trees are not to be trimmed or felled when flying-foxes are in or near a tree and likely to be harmed
- all activities carried out in a sequential manner where possible, beginning at the furthest distance and moving towards the roost, in order to allow some level of habituation to noise and activity
- minimise use of loud machinery and sudden impacts/sudden loud noises (use of hand tools rather than noisy machinery where possible (where chainsaws are required, start the chainsaw away from the roost and let it run for a short time to allow flying-foxes to adjust)
- work to be performed in the minimum duration possible
- work performed by the minimum number of personnel possible
- all personnel working in and around the camp to be as quiet as possible (e.g. communication via SMS only when under the roost)
- application of staged, best practice bush regeneration techniques and clear work vs no-work areas identified prior to works commencing
- 1-2 days per week where works are not scheduled to allow flying-foxes to rest
- exclusion zones of at least 20m (or further if flying-foxes appear stressed) from roosting flying-foxes if temperatures reach or are predicted to reach 35°C or above, or when stress is likely to already be increased (e.g. other severe weather events, food shortages)
- inclusion of the Balgowlah Flying-fox Camp Management Plan in Council and contractor inductions
- contact details for Council environmental staff and a wildlife carer (refer to Management of injured or dead flying-foxes below) included in safe work method statements.

All Council and contractor personnel are responsible for complying with these mitigation measures. Any sign of impacts and action taken will be recorded and reported to Council. Council will review these reports and assess, in consultation with experts as required, whether additional mitigation measures are required to prevent impacts.

Table 4 Signs that flying-fox may be at risk, and appropriate mitigation actions.

Potential impact	Signs	Action
Initial signs of stress	<ul style="list-style-type: none"> · flying-foxes are generally agitated and likely to take flight 	<p>Works to cease in the area until flying-foxes settle.</p> <p>If flying-foxes again become agitated; intensity of works to reduce or cease in the immediate area.</p>
Unacceptable levels of stress	<ul style="list-style-type: none"> · panting · saliva spreading · located on or within 2 m of the ground · unusual vocalisations · >50% of the roost take flight · flying-foxes in flight for more than 2 minutes · flying-foxes leave the roost during daylight hours 	<p>Works to cease in the immediate area for the day. A suitably qualified person is required to determine whether work may continue in alternative areas of the site.</p>
Dependent young at risk	<ul style="list-style-type: none"> · adults moving away from dependent young · adults carrying young being disturbed · flightless young becoming agitated and at risk of falling 	<p>Works to cease in the area, and potential need for rescue determined. If dependent young are dropped/abandoned, they will be rescued if required (see Section 5.4) and OEH contacted to discuss the best way forward.</p>
Injury/death	<ul style="list-style-type: none"> · a flying-fox appears to have been injured/killed on site (including aborted foetuses) 	<p>Works to cease immediately and where any death or injury has occurred OEH notified</p> <p>AND</p> <p>works to be rescheduled</p> <p>OR</p> <p>works to be adapted sufficiently so that significant impacts (e.g. death/injury) are highly unlikely to occur, as confirmed by a suitably qualified person.</p>

5.5 Flying-fox injury and rescue

Council will arrange rescue of injured or orphaned flying-foxes in the event rescue is required and will liaise with the NSW Wildlife Information, Rescue and Education Service (WIRES) (1300 094 737), or the Sydney Metropolitan Wildlife Services (9413 4300) as required. Under no circumstance should personnel that are not trained in rescue, handling and vaccinated against ABLV attempt to assist a flying-fox.

In accordance with the NSW Code of Practice (COP) for Injured, Sick and Orphaned Flying-foxes (OEH 2012) and the COP for Injured, Sick and Orphaned Protected Fauna (OEH 2011b) the general rescue process is as follows:

- i. assess to confirm rescue is required
- ii. establish an exclusion zone for any person not essential to the rescue
- iii. contact relevant carer to advise of likely admission

- iv. plan the rescue to ensure risk to rescuer can be appropriately managed (e.g. appropriate tools and PPE available), and further stress/injury to the animal can be minimised
- v. assess the animal for obvious signs of injury to determine whether veterinary care is required
- vi. transport the animal (in appropriate transport container) to a veterinarian (if injured) or suitable wildlife carer.

Should dependent young need to be rescued and hand-reared, or injured animals treated, Council will cover costs associated with their care.

5.6 Level 3 – camp disturbance or dispersal

Level 3 actions are not proposed for OEH assessment. Dispersal as a management option has been discussed in Appendix 5, however is not currently under consideration.

It is anticipated that current impacts will be sufficiently mitigated through Level 1, progressing only to Level 2 actions if required. If risk or impacts change so that they cannot be managed with Level 1 and 2 actions and dispersal is being considered, OEH will be consulted and the Plan amended for OEH assessment.

6 Assessment of impacts

The assessment of impacts is based on the camp being managed in situ (Level 1 actions, and Level 2 actions if required). Further assessment would be needed if a dispersal action is considered.

Type and condition of habitat

Areas of habitat restored by Council to date have provided an estimated 25% additional roosting habitat, and protected the viability of the remaining habitat against weeds. Many of these rehabilitated areas, including plantings 5-10 years old, are currently being used by flying-foxes, with other areas anticipated to reach sufficient height over the next 2 – 5 years.

Areas where restoration (or maintenance of restored areas) has been restricted due to the requirement of maintaining a 20m exclusion zone from roosting flying-foxes (under the existing s132C licence), are heavily infested by weeds. These weeds threaten the viability of the habitat. OEH approving works in accordance with Section 5, will be of benefit to roosting flying-foxes.

Known GHFF records in the surrounds

The Balgowlah roost is the only roost within Manly Council local government area (LGA). There are a number of roosts in surrounding LGAs (as shown in Figure 3), and likely suitable alternative roosting habitat has been mapped in Appendix 5. This has identified potential habitat in other less suitable locations and supports the recommendation against dispersal. Assessment of impacts of a dispersal have not been discussed as Level 3 actions are not being considered in this Plan (see Section 5).

GHFF habitat likely to be affected

Flying-foxes are roosting in some Coral Trees proposed for removal (see Figures 2 and 9 for locations and Table 3 for methods). Management Stages 1- 4 (Level 1 actions during the life of this Plan; see Figure 9 and Table 3) comprise a total of 0.14 ha of the total 1.8 ha of suitable habitat. Stage 5 (outside the life of this Plan; see Figure 9 and Table 3) is a further 0.03 ha, and the core area proposed for removal in 5 – 10 years is 0.23 ha. Should Level 2 be required, these buffers are a total of approximately 0.08 ha (vegetated area). As such, should both Level 1 and Level 2 be required, over the five year life of the Plan this is removal of 0.22 ha of the 1.8 ha total, with potential for a further 0.26 ha in 5+ years (to be assessed at Plan review). The gradual and staged approach over 5 years (and retention of Coral Trees within the core roost area for 5-10+ years), combined with the improved habitat viability along with revegetation and regeneration of suitable roost habitat, will ensure that sufficient (and in the long-term, additional) roost habitat is retained at all times.

Nature and intensity of the effect on life cycle and habitat

As detailed above, works are proposed to be gradual and passive with minimal disturbance to roosting flying-foxes. Welfare standards and stop-work triggers detailed in Section 5.4 will be

complied with at all times to ensure the life cycle of flying-foxes breeding at the site is not impacted.

As demonstrated throughout the Plan, proposed Level 1 and 2 actions aim to protect and restore the site and will therefore benefit rather than impact the local population. These actions are therefore consistent with objectives of the draft National Recovery Plan for the GHFF (DoE 2009).

7 Implementation

7.1 Responsibilities

Manly Council is responsible for implementation of the Plan once it has been endorsed by OEH, and will seek expert advice from OEH as required during implementation.

All Council and contractor personnel are responsible for complying with mitigation measures detailed in Section 5. This responsibility, and all aspects of this Plan, will be clearly explained by Council at inductions to the site.

All members of the bush regeneration team need to be qualified (minimum Certificate II or III in Conservation and Land Management) and experienced. It is preferable that they are vaccinated for the ABLV prior to working in the camp. Contractors will need to carry out their own risk assessment to determine requirements for pre-exposure vaccinations against ABLV for personnel.

All on-ground works need to be performed in accordance with a Safe Work Method Statement that includes risks and mitigation measures for working in a flying-fox camp.

If there is a sudden influx of flying-foxes to the camp, other councils and agencies should be consulted to determine if it is related to a dispersal. If this is the case, assistance will be sought from the Council dispersing to manage any issues that arise.

7.2 Consents

The camp is on Crown land managed by Council. Routine maintenance activities, including restoration, do not require consent. Council needs to serve a copy of the development application to the Land and Property Management Authority (on behalf of the NSW Minister for Lands) for the proposed development of the bioretention basin.

7.3 Planning for camp management actions and timing

Please refer to Section 5.

7.4 Costs

Manly Council will cover costs associated with implementation of this Plan.

Funds for bush regeneration at the camp, including removal of the Coral Trees, have been sourced from a NSW Government grant. Where possible, future grant funding applications should be made jointly with Warringah Council, which is responsible for land on the northern side of the creek, and community organisations where possible to increase the chance of success.

7.5 Monitoring and adaptive management

A number of other GHFF camps are being dispersed in the Sydney metropolitan area which may place greater pressure on remaining camps such as Balgowlah. It is the responsibility of the Council or Agency dispersing a camp to manage any issues arising from the dispersal. To assist with this it is recommended that Manly Council continue to support GHFF population monitoring being undertaken at Balgowlah by the RBGDT.

Actions include:

- Continue fly-out counts by RBGDT. Council should support RBGDT, or engage another suitably experienced person, to expand current monthly monitoring to include fly-out direction, species composition, camp extent and breeding status. This data can be used to inform management, particularly ideal timing of works (guided by timeframes in Table 2).
- Support the National Flying-fox Monitoring Program where possible, and regularly review data obtained through this program on a quarterly basis.
- Work with Council's Community Environment Committee to encourage members of the community to participate in fly-out counts (similar to activities undertaken by the Wollli Creek Preservation Society in relation to the Wollli Creek camp).
- Respond quickly to notify relevant Councils/agencies if there is a sudden increase in the flying-fox population at Balgowlah.
- Continue to participate (including attending meetings) in the *NSW land managers' network for flying-fox roosts* established by OEHS
- Monitor during works as per Section 5.

7.5.1 Plan evaluation and review

Implementation will be continually reviewed and will be measured by the Plan's ability to:

- protect the welfare of flying-foxes during management activities
- ensure the long-term viability of the site as roost habitat
- minimise conflict between the camp and surrounding community
- facilitate routine management activities described in Section 5
- adapt to new issues as they arise.

The Plan will also be reviewed and updated after five years, or before if there has been a substantial change in the number of flying-foxes in the camp or issues associated with the camp.

References and further information

ATSB 2012, *Australian Aviation Wildlife Strike Statistics: Bird and Animal Strikes 2002 to 2011*, Australian Transport Safety Bureau.

AVA 2015, *Hendra virus*, Australian Veterinary Association. Viewed 12 January 2016, <http://www.ava.com.au/hendra-virus>.

AWHN 2010, Menangle virus fact sheet, Australian Wildlife Health Network: [https://www.wildlifehealthaustralia.com.au/Portals/0/Documents/FactSheets/Menangle%20Virus%205%20Jul%202010%20\(1.0\).pdf](https://www.wildlifehealthaustralia.com.au/Portals/0/Documents/FactSheets/Menangle%20Virus%205%20Jul%202010%20(1.0).pdf).

Australasian Bat Society www.ausbats.org.au

Australian Research Centre for Urban Ecology, Royal Botanic Gardens Melbourne 2009, *Public Environment Report: Proposed Relocation of a Camp of Grey-headed Flying-foxes (Pteropus poliocephalus) from the Royal Botanic Gardens Sydney*. A report prepared for Botanic Gardens Trust.

Benson, D and Howell, J 1990, *Taken for Granted – The Bushland of Sydney and its Suburbs*, The Royal Botanic Gardens, Sydney.

DECCW 2009, *Draft National Recovery Plan for the Grey-headed Flying-fox Pteropus poliocephalus*. Prepared by Dr Peggy Eby, Department of Environment, Climate Change and Water NSW.

Den Exter, K, Roberts, B, Underwood, A and Martin, L 2011, *A discussion paper on flying foxes and the implications for bush regeneration at their camp sites*. Big Scrub Landcare: <https://bigscrubrainforest.org.au/?p=129>.

DOE 2015, *Referral guideline for management actions in GHFF and SFF camps*, Australian Government, Canberra.

DoE 2016, *Pteropus poliocephalus in Species Profile and Threats Database*, Department of the Environment, Australian Government, Canberra: http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=186.

DPI 2013, *Australian bat lyssavirus*, June 2013 Primefact 1291 2nd edition, Department of Primary Industries, NSW: http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0011/461873/Australian-Bat-lyssavirus.pdf.

DPI 2014, *Hendra Virus*, June 2014 Primefact 970 9th edition, Department of Primary Industries, NSW, viewed 12 January 2016, http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0019/310492/hendra_virus_primefact_970.pdf.

DPI 2016, *Bats and Human Health*, NSW Department of Primary Industries

<http://www.dpi.nsw.gov.au/biosecurity/animal/humans/bat-health-risks>

Eby P 1991, 'Seasonal movements of Grey-headed Flying-foxes, *Pteropus poliocephalus* (Chiroptera: Pteropodidae) from two maternity roosts in northern New South Wales', *Wildlife Research*, vol. 18, pp. 547–59.

Eby, P 2006, *Site Management Plan for the Grey-headed Flying-fox camp at the Sydney Desalination Plant Site*. A report to Sydney Water Corporation.

Eby, P, and Lunney, D 2002, *Managing the Grey-headed Flying-fox as a threatened species in NSW*, Royal Society of New South Wales.

Eby, P, Richards, G, Collins, L and Parry-Jones, K 1999, 'The distribution, abundance and vulnerability to population reduction of a nomadic nectarivore, the Grey-headed Flying-fox *Pteropus poliocephalus* in New South Wales, during a period of resource concentration', *Australian Zoologist*, vol. 31(1), pp. 240-253.

Eco Logical Australia 2012, *Cannes Reserve, Avalon – Grey-headed Flying Fox Camp Management and Species Impact Statement*. A report prepared for Pittwater Council.

Eco Logical Australia 2012, *Grey-Headed Flying-fox Assessment of Significance for a proposed development at Factory Rd, Granville*. A report to Urbania Design Pty Ltd.

Ecosure 2014, *Cannes Reserve flying-fox management strategy*, Report to Pittwater Council, Burleigh Heads.

EHP 2012, *Importance of flying-foxes*, Department of Environment and Heritage Protection, State of Queensland:

<https://www.ehp.qld.gov.au/wildlife/livingwith/flyingfoxes/importance.html>

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

Fujita, MS, 1991, 'Flying-fox (Chiroptera: Pteropodidae) pollination, seed dispersal, and economic importance: a tabular summary of current knowledge', *Resource Publication No. 2*. Bat Conservation International.

Geolink 2010, *Maclean Flying-fox Management Strategy*. Prepared for Clarence Valley Council, Department, Climate Change and Water on behalf of the Maclean Flying-fox Working Group.

Ipswich City Council nd, *Living with Flying-foxes fact sheet*, Ipswich City Council, Ipswich.

Lunney, D, Richards, G and Dickman, C. 2008, *Pteropus poliocephalus*. The IUCN Red List of Threatened Species <http://dx.doi.org/10.2305/IUCN.UK.2008.RLTS.T18751A8554062.en>.

McDonald, SSV and Collins L, 2013, *Managing heat stress in flying-foxes colonies*.

McIlwee, AP, and Martin, L 2002, 'On the intrinsic capacity for increase of Australian flying-

foxes (*Pteropus spp.*, *Megachiroptera*), *Australian Zoologist* vol. 32 (1).

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

Muir B and Madden L 1992, *Wolli Creek Valley Heritage Assessment Report – Bibliography of Historical References relating to the Wolli Creek Valley*, Prepared for the Wolli Creek Preservation Society.

NSW Health 2013, *Rabies and Australian Bat Lyssavirus Infection*, NSW: <http://www.health.nsw.gov.au/Infectious/factsheets/Pages/Rabies-Australian-Bat-Lyssavirus-Infection.aspx>.

OEH 2011a, Grey-headed flying-fox – vulnerable species listing, Office of Environment and Heritage, Sydney, <http://www.environment.nsw.gov.au/determinations/GreyheadedFlyingFoxVulSpListing.htm>.

OEH 2011b, *NSW Code of Practice for Injured, Sick and Orphaned Protected Fauna*, Office of Environment and Heritage, Sydney.

OEH 2012, *NSW Code of Practice for Injured, Sick and Orphaned Flying-foxes*, Office of Environment and Heritage, Sydney.

OEH 2015a, *Flying-fox Camp Management Policy*, Office of Environment & Heritage, NSW.

OEH 2015b, *Flying-fox Camp Management Plan Template*, Office of Environment & Heritage, NSW.

OEH 2015c, *GHFF threatened species profile*, Office of Environment & Heritage, NSW.

Parry-Jones, K and Augee, M 2001, 'Factors affecting the occupation of a colony site in Sydney, New South Wales by the Grey-headed Flying-fox *Pteropus poliocephalus* (Pteropodidae)'. *Austral Ecology* 26: 47–55.

Parsons, JG, Blair D, Luly, J and Robson, SK 2008, 'Bat Strikes in the Australian Aviation Industry', *Journal of Wildlife Management* 73(4): 526-529; 2009.

Roberts, B and Eby, P 2013, *Review of past flying-fox dispersal actions between 1990-2013. SEQ Catchments 2012*, Management and Restoration of Flying-fox Camps – Guidelines and Recommendations.

Roberts, BJ 2006, *Management of Urban Flying-fox Camps. Issues of relevance to camps in the Lower Clarence Valley*, NSW. A report prepared for Valley Water Inc and The Department of Environment and Conservation.

Roberts, BJ, Eby, P, Catterall. CP, Kanowski, J, and Bennett, G 2011, 'The outcomes and costs of relocating flying-fox camps: insights from the case of Maclean, Australia.' In, *The Biology and Conservation of Australasian Bats*. (Ed. Bradley Law, Peggy Eby, Daniel

Lunney and Lindy Lumsden). Royal Zoological Society of NSW, Mosman, NSW, Australia.

Roberts, BJ, Catterall, CP, Eby, P and Kanowski, J, 2012, Long-Distance and Frequent Movements of the Flying-Fox *Pteropus poliocephalus*: Implications for Management. *PLoS ONE* 7(8): e42532.

SEQ Catchments 2010, *Management and Restoration of Flying-fox Camps Guidelines and Recommendations*, SEQ Catchments.

Southerton SG, Birt P, Porter J, & Ford HA. 2004, 'Review of gene movement by bats and birds and its potential significance for eucalypt plantation forestry', *Australian Forestry*, 67(1), pp. 45-54.

Tait J, Perotto-Baldivieso HL, McKeown A, Westcott DA 2014, 'Are Flying-Foxes Coming to Town? Urbanisation of the Spectacled Flying-Fox (*Pteropus conspicillatus*) in Australia', *PLoS ONE* 9(10).

Tidemann, C, Eby, P, Parry-Jones, K, Vardon, M 1999, *The Action Plan for Australian Bats: Grey-headed Flying-fox*, Environment Australia. <http://www.environment.gov.au/node/14622>

Welbergen, JA 2014, *Canaries in the coalmine: flying-foxes and extreme heat events in a warming climate*, Presentation at the Griffith Climate Change Seminar, July 2014: <https://www.griffith.edu.au/research/research-excellence/griffith-climate-change-response-program/program/?a=628188>

Welbergen, JA, Klose, SM, Markus, N & Eby, P 2008, 'Climate change and the effects of temperature extremes on Australian flying-foxes', *Proceedings of the Royal Society of London B: Biological Sciences*, vol. 275, no. 1633, pp.419-425: <http://rspb.royalsocietypublishing.org/content/275/1633/419.short>

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

Wiles, GJ, & Fujita, MS 1992, 'Food plants and economic importance of flying foxes on Pacific islands, Pacific Island flying foxes: proceedings of an international conservation conference', *Biological Report*. vol. 90.

Zurbuchen, A, Landert, L, Klaiber, J, Muller, A, Hein, S & Dorn, S 2010, 'Maximum foraging ranges in solitary bees: only few individuals have the capability to cover long-foraging distances', *Biological Conservation*, vo. 142, no. 3, pp. 669-676.

Appendix 1 Historical camp data

The table below shows the results of counts undertaken at the Balgowlah camp. Only one Little Red Flying-fox has been recorded at the site (unknown date).

Date	GHFF	BFF	Source/notes
5/08/2010	214		RBGDT
19/08/2010	230		RBGDT
16/09/2010	260		RBGDT
14/10/2010	0		RBGDT
25/11/2010	50		RBGDT
23/12/2010	150		RBGDT
19/01/2011	180		RBGDT
17/02/2011	400		RBGDT
17/03/2011	450		RBGDT
13/04/2011	1050		RBGDT
12/05/2011	1100		RBGDT
16/06/2011	1150		RBGDT
21/07/2011	250		RBGDT
18/08/2011	0		RBGDT
21/09/2011	n/a		RBGDT
19/10/2011	n/a		RBGDT
16/11/2011	n/a		RBGDT
21/12/2011	250		RBGDT
18/01/2012	0		RBGDT
15/02/2012	0		RBGDT
21/03/2012	0		RBGDT
18/04/2012	n/a		RBGDT
17/05/2012	n/a		RBGDT
14/06/2012	120		RBGDT
5/07/2012	10		RBGDT
19/07/2012	0		RBGDT
16/08/2012	0		RBGDT
13/09/2012	0		RBGDT
11/10/2012	0		RBGDT
15/11/2012	1050		RBGDT
20/12/2012	850		RBGDT
23/01/2013	700		RBGDT
14/02/2013	500		RBGDT
14/03/2013	500		RBGDT

Date	GHFF	BFF	Source/notes
10/04/2013	1050		RBGDT
15/05/2013	2500		RBGDT
12/06/2013	430		RBGDT
24/07/2013	3000		RBGDT
14/08/2013	3000		RBGDT
11/09/2013	3000		RBGDT
16/10/2013	3200		RBGDT
13/11/2013	3250	20	RBGDT
12/12/2013	2350	20	RBGDT
15/01/2014	2300	15	RBGDT
20/02/2014	2300	10	RBGDT
20/03/2014	2550	20	RBGDT
17/04/2014	440	10	RBGDT
15/05/2014	5700	50	RBGDT
12/06/2014	5900	40	RBGDT
10/07/2014	5200	25	RBGDT
14/08/2014	3400	70	RBGDT
25/09/2014	3100	55	RBGDT
16/10/2014	3100	40	RBGDT
20/11/2014	3500	110	RBGDT
18/12/2014	3600	70	RBGDT
22/01/2015	3400	50	RBGDT
19/02/2015	5100	50	RBGDT
16/09/2015	-6000	0	RBGDT
20/10/2015	-4000	0	RBGDT
23/11/2015	-5500	0	Ecosure (estimate only); Most adult females with pups 3-4 weeks old.
16/12/2015	2600		RBGDT
20/01/2016	2100		RBGDT
24/03/2016	3400	200	RBGDT
19/04/2016	7400		RBGDT
28/06/2016	6000		RBGDT

Appendix 2 Flying-foxes and human health

NSW Health provides current advice on risks to human health associated with flying-foxes. Information provided by state health authorities is summarised below.

Australian Bat Lyssavirus

Australian Bat Lyssavirus (ABLV) is a rabies-like virus found in the four common species of flying-fox. Advice from Queensland Health is that the risk of becoming infected with ABLV is very low with less than 1% of the flying-fox population being affected (DPI 2013).

Transmission of the virus from bats to humans is thought to be by a bite or scratch, but may have potential to be transferred if bat saliva directly contacts the eyes, nose or mouth. ABLV is unlikely to survive in the environment for more than a few hours, especially in dry environments that are exposed to sunlight (NSW Health 2013).

Transmission of closely related viruses suggests that contact or exposure to bat faeces, urine or blood do not pose a risk of exposure to ABLV, nor do living, playing or walking near bat roosting areas (NSW Health 2013).

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

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

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

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

Hendra Virus

Flying-foxes are the natural host for Hendra Virus (HeV), which can be transmitted from flying-foxes to horses. Infected horses sometimes amplify the virus and can then transmit it to other horses, humans and on two occasions, dogs. There is no evidence that the virus can be passed directly from flying-foxes to humans (or dogs) (AVA 2015). Although the virus is periodically present in flying-fox populations across Australia, the likelihood of horses becoming infected is low and consequently human infection is extremely rare. Horses are thought to contract the disease after ingesting forage or water contaminated with flying-fox urine, saliva or birthing fluids. Humans contract the disease after close contact with an infected horse. HeV infection in humans is a serious and often fatal disease and there is currently no effective post-exposure treatment or vaccine available for people. The mortality rate of unvaccinated infected horses is greater than 70% (DPI 2014). Vaccination of horses can protect horses and subsequently humans from infection (DPI 2014), as can suitable horse husbandry (e.g. covering food and water troughs, fencing foraging trees in paddocks, etc.).

Menangle virus

The 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 (AWHN 2010). The virus caused reproductive failure in pigs and severe febrile illness in two piggery workers employed at the same Menangle piggery where the virus was recorded (AWHN 2010). The virus is thought to have been transmitted to the pigs from flying-foxes via an oral-faecal matter route (AWHN 2010). 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 recorded in Australia.

Appendix 3 Signage installed at the Balgowlah camp

BALGOWLAH GREY-HEADED FLYING-FOX CAMP

A VULNERABLE & PROTECTED NATIVE ANIMAL

The Grey-headed Flying-fox (*Pteropus poliocephalus*) is a native Australian animal at risk of extinction due to widespread loss of its roosting and foraging habitat.

Due to this status, the Grey-headed Flying-fox is protected under State and Federal environmental legislation, including the *NSW Threatened Species Conservation Act 1995* and the *Environment Protection and Biodiversity Conservation Act 1999*.

It is an offence under both NSW and Federal law to disturb or harm Grey-headed Flying-foxes or their habitat without approval, and can attract penalties of up to \$8,500 per offence.

ABOUT THE GREY-HEADED FLYING-FOX

The Grey-headed Flying-fox is Australia's largest bat species. They are a type of 'fruit-bat', feeding predominantly on the pollen, nectar and fruit of native plants. During the day they occupy roosts called colonies or 'camps'. Around dusk, Grey-headed Flying-foxes leave the roost to forage, moving in response to the blossoming of their favourite plants.

By dispersing the pollen and seeds of native plants such as eucalypts, banksias and melaleucas, the Grey-headed Flying-fox plays a vital role in ensuring the long-term health and biodiversity of Australia's bushland and wetlands.

LIVING WITH THE GREY-HEADED FLYING-FOX

Grey-headed Flying-foxes rely heavily on sound to communicate, using a complex language with over 20 different calls.

They also communicate via a unique scent which is released by male flying-foxes during the breeding season. This scent is not created by droppings or urine, but by specialised glands on the male's shoulder.

Manly Council is working with State agencies and the local community to manage this vulnerable native animal into the future. For further information about the Balgowlah Grey-headed Flying-fox Camp, please contact Council on 02 9976 1500 or at records@manly.nsw.gov.au



PLEASE DO NOT HANDLE FLYING-FOXES

NSW Health states that there is no risk to the community from Grey-headed Flying-foxes providing that no handling or direct contact occurs.

NSW Health also states there is no risk of virus infection from droppings or if people live, play or walk near their colonies.

Please assist in protecting flying-foxes and the community by avoiding disturbance to the camp.

To report injured or distressed flying-foxes please contact WIRES on 1300 094 737.



SURF CITY
MANLY AUSTRALIA®

SURF CITY
AUSTRALIA®

www.manly.nsw.gov.au

Appendix 4 Review of past flying-fox dispersals (Roberts & Eby 2013)

The following information was presented in a paper by Billie Roberts and Peggy Eby (June 2013) titled *Review of past flying-fox dispersal actions between 1990 and 2013*. Further details are available in the paper.

To understand the utility of dispersals as a management tool to resolve conflict between humans and flying-foxes, the outcomes of 17 recent camp dispersal attempts were systematically reviewed. The review identified a set of common outcomes of camp dispersals that should guide their use in Australia. A further observation was that the outcomes of dispersals are often not known for several years.

1. In all cases, dispersed animals did not abandon the local area¹.
2. In 16 of the 17 cases, dispersals did not reduce the number of flying-foxes in a local area¹.
3. Dispersed animals did not move far (in approx. 63% of cases the animals only moved <600 m from the original site, contingent on the distribution of available vegetation). In 85% of cases, new camps were established nearby.
4. In all cases, it was not possible to predict where replacement camps would form.
5. Conflict was often not resolved. In 71% of cases conflict was still being reported either at the original site or within the local area years after the initial dispersal actions.
6. Repeat dispersal actions were generally required (all cases except extensive vegetation removal).
7. The financial costs of all dispersal attempts were high ranging from tens of thousands of dollars for vegetation removal to hundreds of thousands for active dispersals (e.g. using noise, smoke etc).

¹ Local area is defined as the area within a 20 km radius of the original site = typical feeding area of a flying-fox.

There were a few exceptions to these patterns, but they only occurred when there were abundant financial and human resources (e.g. RBG Melbourne and RBG Sydney) and/or specific landscape characteristics (e.g., isolation from neighbours (Batchelor, NT) or habitat link to 'acceptable' location (RBG Melbourne)).

Appendix 5 Dispersal as a management option

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

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

Successful dispersals generally require either:

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

Given these risks and costs (further detailed in Appendix 3), dispersal should only be considered as a last resort. As indicated in Appendix 4, dispersals are often unsuccessful. They are expensive and are likely to shift conflicts elsewhere. Dispersal is not recommended for the Balgowlah camp. However, Council may reconsider this option if there is a significant influx of GHFF permanently roosting at the Balgowlah camp (e.g. as a result of dispersal from other camps), and conflicts between the camp and neighbouring residents increase substantially.

The figure below illustrates likely roosting habitat for GHFF in the region. It is acknowledged that this type of assessment is generally associated with flying-fox camp dispersal management plans (e.g. ARCUE 2009; Ecosure 2014). This information has been provided to Manly Council due to the impending dispersal of other Sydney GHFF camps and because of the uncertainty associated with where the displaced bats will relocate to. It also highlights the risk of the camp relocating to undesirable sites if it were dispersed. Note that only likely

potential habitat can be identified using known camp characteristics. A large amount of potential habitat will not be captured by this modelling as flying-fox roost preferences are still largely unknown. Similarly, much of this habitat will not actually be considered suitable by flying-foxes for such unknown reasons.

To undertake this assessment, criteria presented in ARCUE (2009) were applied to predict the probable locations in which flying-foxes might be expected to establish a camp. The areas are suitable roost habitat according to the following criteria is based on previous knowledge of the species:

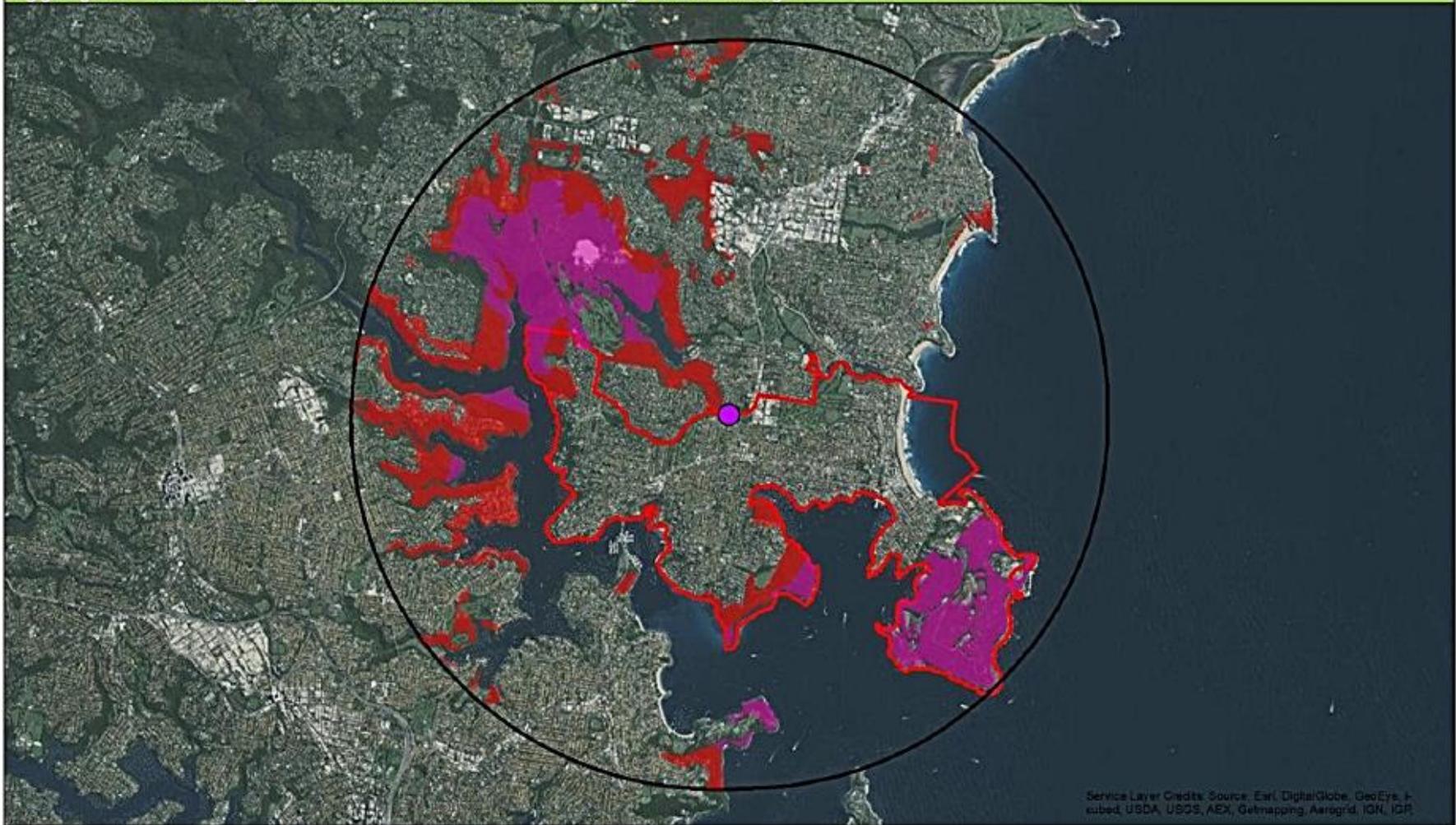
- patch size to allow for seasonal influxes of flying-foxes and greater than 1 ha
- vegetation type containing vegetation in excess of 3 m in height with dense foliage
- proximity to aquatic habitat (creeks, swamps)
- historically been used by flying-foxes.

Ideal locations for the establishment of a new camp are those that satisfy the following criteria:

- unlikely to negatively impact upon any other threatened flora or fauna species or ecological communities
- there is a minimum 300 m buffer separating the camp from residential dwellings or industry
- the neighbouring landowners or managers are accepting of occupancy within their land or neighbouring areas
- there is sufficient habitat to provide suitable roosting habitat for between 5000 and 12000 individuals
- there is an area large enough and contains enough vegetation that will survive the destructive nature of permanent flying-fox occupation.

Ideally the site will be of sufficient size and contain enough vegetation to allow the camp to occupy no more than one third of the available roost habitat at any given time (DECC 2007), this will allow the camp to shift and occupy other areas in response to the usual canopy degradation associated with flying-fox camps. Areas mapped as suitable habitat that do not fit this criterion are considered 'inappropriate'.

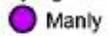
Appropriate Roosting Habitat within 10km of the Manly GHFF Camp



Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aergrid, IGN, IGP

Legend

Flying Fox Camp



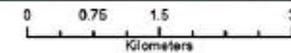
5km radius from site



Roosting habitat

Not Appropriate habitat

Appropriate habitat



GDA 1994 MGA Zone 56



eco
logical
AUSTRALIA

www.ecoaus.com.au

Prepared by: JT Date: 18/03/2015