

Application for a



Office of
Environment
& Heritage


Section 91 Licence

under the *Threatened Species Conservation Act 1995* to harm or pick a threatened species, population or ecological community* or damage habitat.

1. Applicant's Name ^: (if additional persons require authorisation by this licence, please attach details of names and addresses)	Luke Durrington	
2. Australian Business Number (ABN):	38 284 779 682	
3. Organisation name and position of applicant ^: (if applicable)	Sydney Trains Environment Specialist	
4. Postal address ^:	PO Box K349, Haymarket NSW 1238	Telephone ^: B.H. 8922 4470 A.H.
5. Location of the action (including grid reference and local government area and delineated on a map).	Wolli Creek Grey Headed Flying Fox Camp (33°55'50.22"S, 151° 8'7.08"E) The majority of the 3.4 hectare site is zoned <i>SP2 Railway</i> in the Rockdale City Council Local Environment Plan 2011, and is managed by Sydney Trains. The land inhabited by GHFF on the north-west side of Wolli Creek is zoned <i>E1 National Parks and Nature Reserves</i> under the City of Canterbury LEP 2012. See appendix 1 figure 1.	

* A threatened species, population or ecological community means a species, population or ecological community identified in Schedule 1, 1A or Schedule 2 of the *Threatened Species Conservation Act 1995*.

^The personal details of all Section 91 licences will be displayed in the register of Section 91 licences required under Section 104 of the *Threatened Species Conservation Act 1995*. See notes.

<p>6. Full description of the action and its purpose (e.g. environmental assessment, development, etc.)</p>	<p>The purpose of the action is to restore Grey-headed Flying-fox (GHFF) habitat adjacent to Wolli Creek. The GHFF Camp at Wolli Creek is listed as a nationally important camp in the Draft EPBC Act Policy Statement Camp Management Guidelines for the Grey-headed and Spectacled flying-fox (DOE 2014). However significant weed infestation is threatening the site's GHFF habitat.</p> <p>A Management Plan (Appendix 1) has been prepared to guide rehabilitation of vegetation at the camp over the next 10 years in order to sustain habitat for the GHFF population. Actions in the Management Plan include undertaking rehabilitation of vegetation through weed control, promotion of regeneration and revegetation works in a manner that is sensitive to the life cycle stages of the GHFF. The development of the Management Plan and vegetation management works are supported by a grant from the Environment Trust and have been developed in consultation with relevant stakeholders.</p> <p>Details of proposed vegetation management activities are included in section 4.41 of the attached management plan. These actions are consistent with Level 1 – Routine Camp Management Actions, as defined by OEH.</p>
<p>7. Details of the area to be affected by the action (<i>in hectares</i>).</p>	<p>The subject site has an area of 3.4 ha which includes about 1.6 ha of core roosting habitat for GHFF, although the area of roosting habitat varies seasonally. The image below shows the extent of the site and GHFF roosting habitat.</p> 
<p>8. Duration and timing of the action (<i>including staging, if any</i>).</p>	<p>Vegetation management works will be undertaken over a period of 10 years in accordance with the attached management plan in order to protect and enhance the quality of GHFF habitat and maintain the camp population. Works will be scheduled to avoid sensitive periods in the GHFF life cycle.</p>
<p>9. Is the action to occur on land declared as critical habitat*? (<i>tick appropriate box</i>)</p>	<p><input type="checkbox"/> Yes <input checked="" type="checkbox"/> No</p>
<p>* Critical habitat means habitat declared as critical habitat under Part 3 of the <i>Threatened Species Conservation Act 1995</i>.</p>	

<p>10. Threatened species, populations or ecological communities to be harmed or picked.</p>	<p><u>Scientific name</u></p> <p><i>Pteropus poliocephalus</i></p>	<p><u>Common name</u> (if known)</p> <p>Grey-headed Flying-fox</p>	<p><u>Conservation status</u> (i.e. critically endangered, endangered or vulnerable)</p> <p>vulnerable</p>	<p><u>Details of no. of individual animals, or proportion and type of plant material</u> (e.g. fertile branchlets for herbarium specimens or whole plants or plant parts)</p> <p>The camp comprises 3,000 to 10,000 GHFF, with peaks of up to approximately 20,000</p>
<p>11. Species impact: (please tick appropriate box) a) For action proposed on land declared as critical habtat; or b) For action proposed on land <u>not</u> declared as critical habitat.</p>	<div style="display: flex; justify-content: space-between;"> <div>an SIS is attached</div> <div> <input type="checkbox"/> Yes <input type="checkbox"/> No </div> </div> <div style="display: flex; justify-content: space-between; margin-top: 10px;"> <div>Items 12 to 25 have been addressed</div> <div> <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No </div> </div>			
<p>N.B: Provision of a species impact statement is a statutory requirement of a licence application if the action is proposed on critical habitat. The provision of information addressing items 12 to 17 is a statutory requirement of a licence application if the action proposed is <u>not</u> on land that is critical habitat. Information addressing any of the questions below must be attached to the application.</p>				
<p>12. Describe the type and condition of habitats in and adjacent to the land to be affected by the action.</p>	<p>The habitat at Wolli Creek comprises a variety of habitat types including; open and closed canopy forest, dense understory and reeds closer to the waterway (Appendix 1 Figure 1).</p> <p>Aerial photos from 1943 show that the section of the site to the south east of Wolli Creek was cleared at that time. Vegetation at the site had partially re-established by 2000 (Appendix 1 Error! Reference source not found.) as a result of replanting in the 1980s and subsequent regrowth. Subsequent years have seen a significant infestation of weeds across the site.</p> <p>Currently exotic vines and other weeds are contributing to vegetation density in some locations which can provide some heat stress relief for GHFF but are also preventing establishment of native species and threatening the long term health of GHFF roost trees.</p>			

13. Provide details of any known records of a threatened species in the same or similar known habitats in the locality (include reference sources).	<p>A search of the Atlas of NSW Wildlife for a 2km radius surrounding the site returned records of 17 threatened species listed below, of these 4 (GHFF, Eastern Bentwing-bat, Powerful Owl, Magenta Lilly Pilly) have been recorded in the Wolli Creek Valley and only the GHFF has been recorded within the area where the action will occur.</p> <table><tr><th>Scientific Name</th><th>Common Name</th><th>NSW status</th></tr><tr><td><i>Melaleuca deanei</i></td><td>Deane's Paperbark</td><td>V,P</td></tr><tr><td><i>Persoonia hirsuta</i></td><td>Hairy Geebung</td><td>E1,P,3</td></tr><tr><td><i>Tetralochea juncea</i></td><td>Black-eyed Susan</td><td>V,P</td></tr><tr><td><i>Litoria aurea</i></td><td>Green and Golden Bell Frog</td><td>E1,P</td></tr><tr><td><i>Pteropus poliocephalus</i></td><td>Grey-headed Flying-fox</td><td>V,P</td></tr><tr><td><i>Acacia pubescens</i></td><td>Downy Wattle</td><td>V,P</td></tr><tr><td><i>Syzygium paniculatum</i></td><td>Magenta Lilly Pilly</td><td>E1,P</td></tr><tr><td><i>Ninox strenua</i></td><td>Powerful Owl</td><td>V,P,3</td></tr><tr><td><i>Miniopterus schreibersii oceanensis</i></td><td>Eastern Bentwing-bat</td><td>V,P</td></tr><tr><td><i>Hirundapus caudacutus</i></td><td>White-throated Needletail</td><td>P</td></tr><tr><td><i>Actitis hypoleucos</i></td><td>Common Sandpiper</td><td>P</td></tr><tr><td><i>Hydroprogne caspia</i></td><td>Caspian Tern</td><td>P</td></tr><tr><td><i>Calidris acuminata</i></td><td>Sharp-tailed Sandpiper</td><td>P</td></tr><tr><td><i>Xenus cinereus</i></td><td>Terek Sandpiper</td><td>V,P</td></tr><tr><td><i>Ardea ibis</i></td><td>Cattle Egret</td><td>P</td></tr><tr><td><i>Hieraaetus morphnoides</i></td><td>Little Eagle</td><td>V,P</td></tr><tr><td><i>Diomedea exulans</i></td><td>Wandering Albatross</td><td>E1,P</td></tr></table>	Scientific Name	Common Name	NSW status	<i>Melaleuca deanei</i>	Deane's Paperbark	V,P	<i>Persoonia hirsuta</i>	Hairy Geebung	E1,P,3	<i>Tetralochea juncea</i>	Black-eyed Susan	V,P	<i>Litoria aurea</i>	Green and Golden Bell Frog	E1,P	<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox	V,P	<i>Acacia pubescens</i>	Downy Wattle	V,P	<i>Syzygium paniculatum</i>	Magenta Lilly Pilly	E1,P	<i>Ninox strenua</i>	Powerful Owl	V,P,3	<i>Miniopterus schreibersii oceanensis</i>	Eastern Bentwing-bat	V,P	<i>Hirundapus caudacutus</i>	White-throated Needletail	P	<i>Actitis hypoleucos</i>	Common Sandpiper	P	<i>Hydroprogne caspia</i>	Caspian Tern	P	<i>Calidris acuminata</i>	Sharp-tailed Sandpiper	P	<i>Xenus cinereus</i>	Terek Sandpiper	V,P	<i>Ardea ibis</i>	Cattle Egret	P	<i>Hieraaetus morphnoides</i>	Little Eagle	V,P	<i>Diomedea exulans</i>	Wandering Albatross	E1,P
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14. Provide details of any known or potential habitat for a threatened species on the land to be affected by the action (include reference sources).	<p>Of the threatened species identified as occurring in the Wolli Creek Valley, known or potential habitat for three species; the Powerful Owl, Eastern Bentwing-bat, and GHFF is present on the land to be affected by the action.</p> <p>Currently approximately 1.6 ha of the 3.4 ha site is utilised by GHFF for roosting. Vegetation in the areas of the site utilised by the GHFF are predominately planted eucalypts and casuarinas, the understory is dominated by weed species including privet, lantana, balloon vine and madeira vine.</p> <p>Habitat for the Eastern Bentwing-bat at the site is limited to foraging habitat as the site lacks caves or other structures used by this species for roosting and breeding.</p> <p>Landscape mapping presented by Bain (<i>et al</i> 2014) indicates that the site is likely to contain Powerful Owl foraging habitat, but is unlikely to contain roosting or breeding habitat, this was supported by observations made by Sydney Trains. Observations at the site did not identify tree hollows required by Powerful Owls to breed. Typical flora species identified in the Recovery Plan for Large Forest owls (DEC NSW 2006) as being associated with roosting habitat were also not identified at the site. The site does however provide potential foraging habitat for the Powerful Owl and supports a population of GHFF, a prey species.</p>																																																						
15. Provide details of the amount of such habitat to be affected by the	<p>The site is 1 of 42 nationally important GHFF camps listed in the Camp management guidelines for the Grey-headed and Spectacled flying-fox (DOE 2014) and is one of 16 permanent GHFF camps in the greater Sydney Metropolitan region. The area used by the GHFF for roosting is</p>																																																						

<p>action proposed in relation to the known distribution of the species and its habitat in the locality.</p>	<p>approximately 1.6 hectares within an area of 14 hectares of similar habitat.</p> <p>Proposed actions are unlikely to affect the suitability of habitat for the Powerful Owl or Eastern Bentwing-bat within the site.</p>
<p>16. Provide an assessment of the likely nature and intensity of the effect of the action on the lifecycle and habitat of the species.</p>	<p>Positive Effects</p> <p>The proposed actions are intended to improve and maintain the quality of the GHFF roosting habitat. Should the works not be carried out, a loss of habitat is likely to occur due to limited regrowth of new roosting trees.</p> <p>Negative Effects</p> <p>Works within the camp have the potential to disturb roosting bats. This is of particular concern during particularly spring and summer months while the rearing of young is occurring.</p> <p>Vegetation management work including the removal of weeds from the site has the potential to affect the site microclimate. Large scale weed removal has the potential to make the colony more susceptible to heat stress.</p> <p>The proposed actions are to be carried out in accordance with the Management Plan, as a result the intensity of the negative effects are considered to be minimised.</p>
<p>17. Provide details of possible measures to avoid or ameliorate the effect of the action.</p>	<p>Measures to avoid or ameliorate potential negative effects of the action have been incorporated into the Management Plan. This includes carrying out vegetation management in a targeted and staged manner, where targeted weed species will be treated in specified zones over several years.</p> <p>Works will be timed to occur in autumn and winter to avoid the sensitive periods in the Grey headed flying fox life cycle.</p> <p>Works within the camp will be carried out in a manner that limits disturbance of GHFF.</p>
<p><i>N.B: The Director-General must determine whether the action proposed is likely to significantly affect threatened species, populations or ecological communities, or their habitats. To enable this assessment the Applicant is required to address items 18 to 24. Any additional information referred to in addressing these items must be attached to the application.</i></p>	
<p>18. In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of</p>	<p>Carrying out the proposed action as per the management plan is unlikely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.</p> <p>The Management Plan for the site has been developed to improve the sustainability of the GHFF roosting habitat at the site and to avoid the effects of weed infestation having an adverse effect on the quality of the roosting habitat and therefore life cycle of the species.</p>

extinction.	
19. In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.	No endangered population will be significantly impacted by the proposed actions.
20. In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed: (i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or (ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.	No endangered ecological community or critically endangered ecological community will be significantly impacted by the proposed actions.

<p>21. In relation to the habitat of a threatened species, population or ecological community:</p> <p>(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and</p> <p>(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat, and</p> <p>(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.</p>	<p>i) The purpose of the proposed actions is to maintain and increase the available GHFF roosting habitat at the site. Modification to habitat will include removing those weeds that impact GHFF roosting habitat in a staged manner. No decrease in roosting habitat is expected as a result of the proposed actions.</p> <p>ii) No fragmentation of this vegetation will occur as a result of the proposed action</p> <p>iii) The site is recognised as a nationally important GHFF camp. Proposed actions are to maintain and improve the sites' GHFF roosting habitat.</p>
<p>22. Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).</p>	<p>There are no areas of declared critical habitat that will be impacted by the proposed actions.</p>
<p>23. Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.</p>	<p>The action proposed is consistent with the objectives of the Draft National Recovery Plan for the Grey-headed Flying-fox (DEC 2009). Objective 4 of the Draft National Recovery Plan is to protect and enhance roosting habitat critical to the survival of Grey-headed Flying-foxes.</p> <p>The actions proposed are consistent with this objective in that they are intended to protect and enhance the habitat of a nationally important roosting site.</p>
<p>24. Whether the action</p>	<p>The action proposed does not constitute and is not part of a key threatening</p>

proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

process. Works conducted in accordance with the management plan are not likely to result in the operation of, or increase the impact of, a key threatening process.

Important information for the applicant

Processing times and fees

The *Threatened Species Conservation Act 1995* provides that the Director-General must make a decision on the licence application within 120 days where a species impact statement (SIS) has been received. No timeframes have been set for those applications which do not require a SIS. The Director-General will assess your application as soon as possible. You can assist this process by providing clear and concise information in your application.

Applicants may be charged a processing fee. The Director-General is required to advise prospective applicants of the maximum fee payable before the licence application is lodged. Therefore, prospective applicants should contact the Office of Environment and Heritage (OEH) prior to submitting a licence application.

A \$30 licence application fee must accompany a licence application.

Protected fauna and protected native plants*

Licensing provisions for protected fauna and protected native plants are contained within the *National Parks and Wildlife Act 1974*. However, a Section 91 Licence may be extended to include protected fauna and protected native plants when these will be affected by the action.

If you are applying for a licence to cover both threatened and protected species please provide the information requested in Item 10 *as well as* a list of protected species and details of the number of individuals animals or proportion and type of plant material which are likely to be harmed or picked.

Request for additional information

The Director-General may, after receiving the application, request additional information necessary for the determination of the licence application.

Species impact statement

Where the application is not accompanied by a SIS, the Director-General may decide, following an initial assessment of your application, that the action proposed is likely to have a significant effect on threatened species, populations or ecological communities, or their habitats. In such cases, the *Threatened Species Conservation Act 1995* requires that the applicant submit a SIS. Following

* Protected fauna means fauna of a species not named in Schedule 11 of the *National Parks and Wildlife Act 1974*.

Protected native plant means a native plant of a species named in Schedule 13 of the *National Parks and Wildlife Service 1974*.

the *Threatened Species Conservation Act 1995* requires that the applicant submit a SIS. Following initial review of the application, the Director-General will advise the applicant of the need to prepare a SIS.

Director-General's requirements for a SIS

Prior to the preparation of a SIS, a request for Director-General's requirements must be forwarded to the relevant OEH Office. The SIS must be prepared in accordance with section 109 and 110 of the TSC Act and must comply with any requirements notified by the Director-General of OEH.

Disclosure of Personal Information in the Public Register of s91 Licences

The Public Register provides a list of licence applications and licences granted. A person about whom personal information is contained in a public register may request that the information is removed or not placed on the register as publicly available.

Copies of all applications and licences issued under section 91 and certificates issued under section 95 of the Act are available on the OEH website at

www.environment.nsw.gov.au/threatenedspecies/S91TscRegisterByDate.htm

or in hardcopy form from The Librarian, OEH, 59 Goulburn St, Sydney.

Certificates

If the Director-General decides, following an assessment of your application, that the proposed action is not likely to significantly affect threatened species, populations or ecological communities, or their habitats, a Section 91 Licence is not required and the Director-General must, as soon as practicable after making the determination, issue the applicant with a certificate to that effect.

N.B: An action that is not required to be licensed under the Threatened Species Conservation Act 1995, may require licensing under the National Parks and Wildlife Act 1974, if it is likely to affect protected fauna or protected native plants.

I confirm that the information contained in this application is correct. I hereby apply for a licence under the provisions of Section 91 of the *Threatened Species Conservation Act 1995*.

Applicant's name

(Please print)

Luke Durrington


Applicant's Position &

Organisation (if relevant)

(Please print)

Environment Specialist

Applicant's signature



Date

4th August 2015

For more information or to lodge this form, contact the nearest branch of OEH's Conservation and Regulation Division:

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F: 02 9995 6900
PO Box 668
Parramatta
NSW 2124

North East Branch

P: 02 6640 2500
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Office of Environment and Heritage (NSW)

PO Box A290, Sydney South NSW 1232

Phone: 131 555 (Environment Line) Fax: 9995 5999

Email: info@environment.nsw.gov.au

Appendix 1

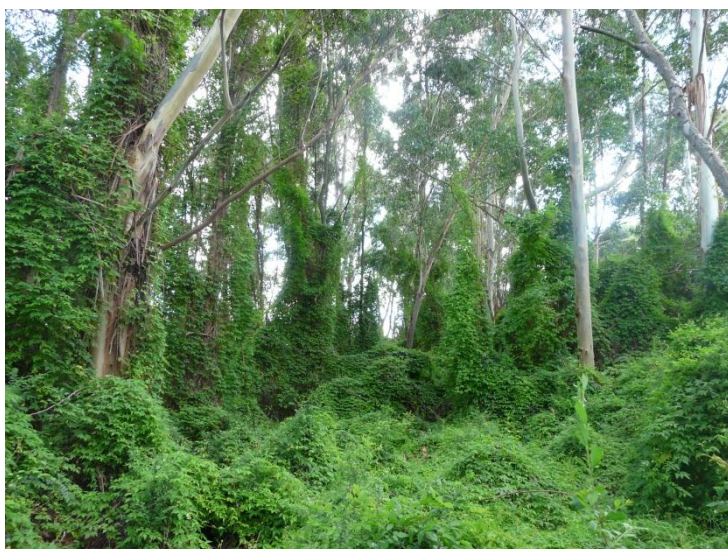


Wolli Creek Grey-headed Flying-fox Camp

Management Plan

Prepared for
Rockdale City Council

26 June 2015



DOCUMENT TRACKING

Item	Detail
Project Name	Wolli Creek Grey-headed Flying-fox Management Plan
Project Number	14SUT-222
Project Manager	Beth Medway 8536 8612 PO Box 12 Sutherland NSW 1499
Prepared by	Beth Medway, Andrew Whitford, Dr Rodney Armistead, Toni Frecker
Reviewed by	Dr Rodney Armistead
Approved by	Beth Medway
Status	Final
Version Number	3
Last saved on	26 June 2015
Cover photos	Photos of the subject site taken by Toni Frecker and Dr Rod Armistead in January 2015

This report should be cited as 'Eco Logical Australia 2015. *Wolli Creek Grey-headed Flying-fox Management Plan*. Prepared for Rockdale City Council.'

ACKNOWLEDGEMENTS

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Disclaimer

This document may only be used for the purpose for which it was commissioned and in accordance with the contract between Eco Logical Australia Pty Ltd and Rockdale City Council. The scope of services was defined in consultation with Rockdale City Council, by time and budgetary constraints imposed by the client, and the availability of reports and other data on the subject area. Changes to available information, legislation and schedules are made on an ongoing basis and readers should obtain up to date information.

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Template 08/05/2014

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Abbreviations

Abbreviation	Description
ABLV	Australian Bat Lyssavirus
DoE	Commonwealth Department of the Environment
ELA	Eco Logical Australia
EPBC	Commonwealth <i>Environment Protection and Biodiversity Conservation Act 1999</i>
GHFF	Grey-headed Flying-fox
OEH	NSW Office of Environment and Heritage
SC	Stakeholder Committee
TSC	NSW <i>Threatened Species Conservation Act 1995</i>
WCPS	Wolli Creek Preservation Society
WONS	Weeds of National Significance

Executive summary

In 2007, a Grey-headed Flying-fox (GHFF) camp established in bushland at Wolli Creek owned by Sydney Trains, Rockdale City Council and Canterbury City Council. The site is significantly weed infested, which is threatening GHFF habitat. This management plan has been prepared to guide rehabilitation of vegetation at the camp to sustain habitat for the GHFF population.

Numbers of GHFF flying out from the camp have been regularly monitored by the Royal Botanic Gardens and, independent to this, by community volunteers from the Wolli Creek Preservation Society. In recent years, numbers of GHFF at the camp have typically been between 3,000 to 10,000 individuals, depending on seasonal conditions. Despite the camp's size, many people in neighbouring areas are unaware of its existence because of its inaccessible location. There have been no conflicts recorded between GHFF at the camp and nearby residents.

The GHFF is listed as vulnerable to extinction under NSW and Commonwealth legislation. The *Draft National GHFF Recovery Plan* (DECCW 2009) identified that the Wolli Creek camp is 'roosting habitat critical to survival of the species' and the 2014 *Draft EPBC Act Policy Statement – Camp Management Guidelines for the Grey-headed and Spectacled flying-fox* identifies the Wolli Creek camp as Nationally Important. The Flying-fox Camp Management Policy (NSW OEH 2015) aims to protect the species as well as reduce conflicts between camps and communities.

This Plan has been prepared consistent with legislation and policies to assist agencies and the community manage the 3.4 ha Wolli Creek camp over the next ten years. The primary management objective for the Wolli Creek camp is to protect the GHFF population and ensure its habitat is sustainable. Prioritised actions are identified, including staged bush regeneration measures that take into account sensitive periods in the GHFF life cycle and the distribution of habitat within the subject site.

This plan provides agencies and the community with a strong foundation to obtain funds and resources for implementation. It is expected that the Wolli Creek GHFF camp will become an increasingly important site for protection of GHFF as other camps throughout the Sydney metropolitan area are dispersed due to conflicts with adjacent communities.

1 Introduction

1.1 Overview

This plan has been commissioned to guide the rehabilitation and management of the Wolli Creek Grey-headed Flying-fox (GHFF) camp over the next ten years. It has been developed in consultation with community representatives from the Wolli Creek Preservation Society, and relevant land owners and managers (Sydney Trains, Rockdale City Council, Canterbury City Council and the NSW Office of Environment and Heritage).

As shown in **Figure 1**, the subject site has an area of 3.4 ha which includes about 1.6 ha of core roosting habitat for GHFF, although the area of roosting habitat varies seasonally. The camp is positioned in degraded bushland, and access to the site is restricted due to the adjacent waterway, escarpment and railway corridor. Many people living or working in the vicinity of the Wolli Creek camp are unaware that the GHFF camp exists, and there have been no records of complaints or conflicts from nearby residents or businesses about the camp.

1.2 Need for the plan

The GHFF camp at Wolli Creek is positioned in highly degraded bushland that needs to be rehabilitated to sustain the camp in the long term and meet broader environmental objectives. Rehabilitation of vegetation through weed control, natural regeneration and revegetation needs to be done in a manner that is sensitive to the life cycle stages of the GHFF. This plan sets out these requirements.

The GHFF is protected under the *National Parks and Wildlife Act 1974*, and listed as vulnerable to extinction under the *NSW Threatened Species Conservation Act 1995* and *Commonwealth Environment Protection and Biodiversity Conservation Act 1999*. The Wolli Creek camp contains 'roosting habitat critical to survival of the species', as defined in the draft National GHFF Recovery Plan (DECCW 2009). This is because the camp has been permanently occupied since 2010, comprises 3,000 to 10,000 GHFF with peaks of up to approximately 20,000 GHFF, and supports breeding and lactating females. The Wolli Creek camp has been identified as Nationally Important under the 2014 *Draft EPBC Act Policy Statement – Camp Management Guidelines for the Grey-headed and Spectacled flying-fox*.

As depicted in **Figure 2**, the Wolli Creek camp is an integral component within the network of camps across eastern Australia and provides a staging platform for migrating GHFFs. Flying-foxes are highly mobile and can travel large distances during their nightly and seasonal foraging forays. They have an important role in pollination and seed dispersal for many plants.

There is a need to manage the Wolli Creek site so that the habitat continues to support GHFFs in the long term. Management of the camp also needs to ensure that risks and impacts to surrounding neighbourhoods are minimal. These include noise, odour, faecal drop and disease. Sydney Airport is approximately 5 km from the camp, so there is also a need to consider the risk of bats colliding with aircraft.

The plan will be implemented over ten years and is to be comprehensively reviewed every five years.

1.3 Objectives

The primary objective of the Wolli Creek Management Plan is to guide strategic conservation activities to restore and maintain functional habitat for the GHFF at Wolli Creek. Secondary objectives include broader ecological improvements at the camp, raising community and Council awareness and knowledge on the importance of maintaining suitable urban habitat for the GHFF through education and engagement activities, and minimising the risk of potential conflict with neighbouring communities and land uses.

The actions proposed in this plan are consistent with current best practice, including the Management and Restoration of Flying-fox Camps Guidelines and Recommendations (SEQ Catchments 2012).



Figure 1: Subject site and GHFF core roosting habitat in January 2015 (these areas will be subject to seasonal fluctuations)

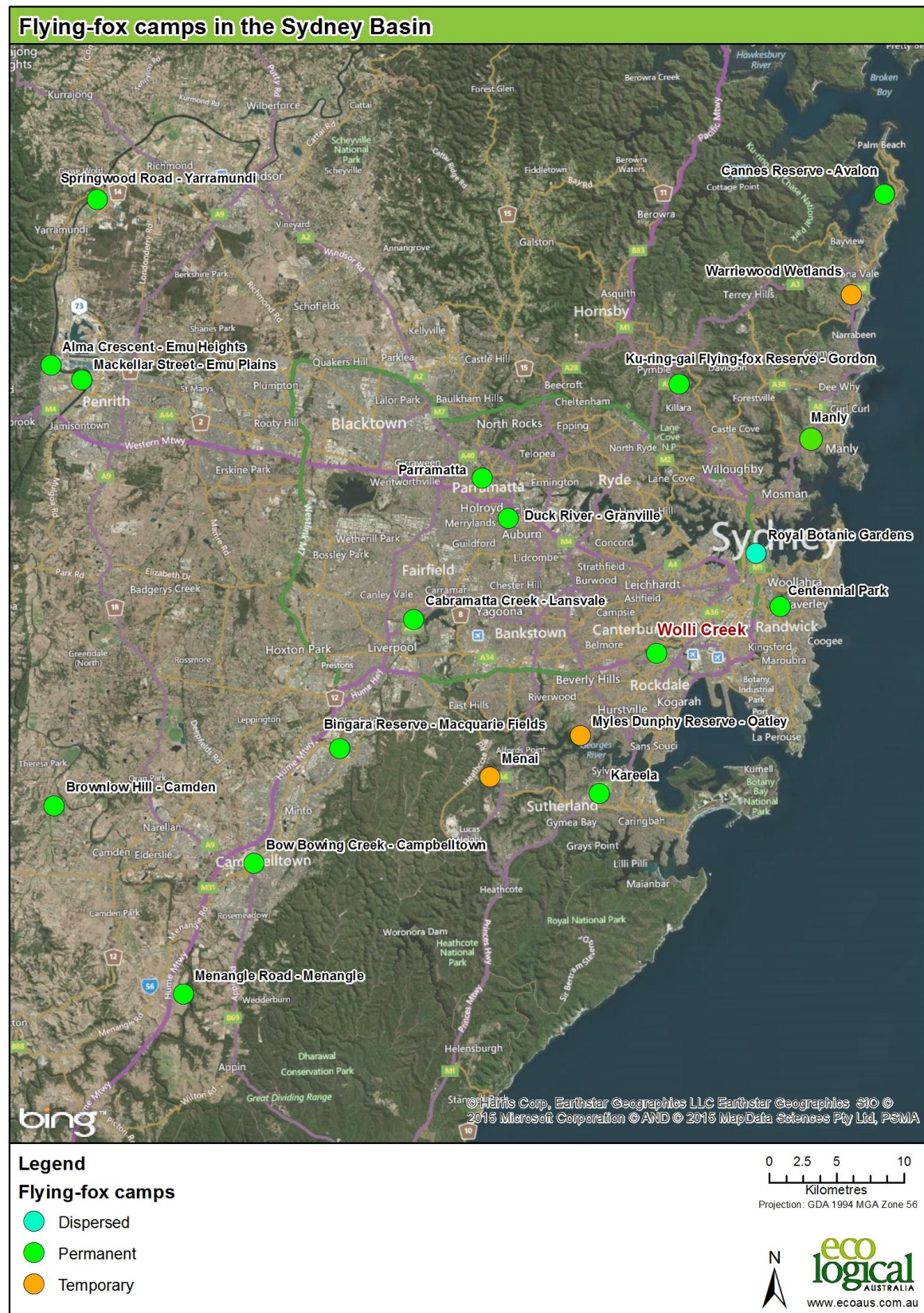


Figure 2: GHFF camps in the Sydney metropolitan area (January 2015)

2 Context

This chapter provides background information on GHFF, the Wolli Creek camp and the issues to be addressed.

2.1 Grey-headed Flying-foxes

The GHFF (*Pteropus poliocephalus*) is Australia's largest bat and only endemic pteropidid. 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, areas for social interactions such as reproduction (mating, conception and births), to raise young, and for protection against predation and climatic extremes.

2.1.1 Ecological importance

Flying-foxes are highly mobile and travel large distances during their nightly and seasonal foraging forays (Roberts et al. 2008). There is considerable variation in the migratory patterns of individual GHFFs in terms of distances travelled, time spent within and between different roosts and longitudinal regions (Geolink 2011, Roberts et al. 2012). The migratory patterns of GHFF are closely associated with reliance on food resources that have irregular seasonal and temporal patterns of production, mating opportunities and exchange of social information (Tidemann and Nelson 2004, Eby and Law 2008, DECCW 2009).

This ability to move over vast distances enables them to spread genetic and reproductive material (pollen in their fur and seeds in faeces) between forest patches that would normally be geographically isolated (Parry-Jones and Auger 1992, Eby 1991, Roberts 2006, Roberts et al. 2008). Therefore, flying-foxes are a 'keystone' species because they have beneficial outcomes to the health, longevity and molecular diversity among and between vegetation communities, especially those that are fragmented and/or isolated.

2.1.2 Life and reproductive history

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 in October or November.

When the young are born they are highly dependent on their mother for food, care and thermo-regulation (Roberts 2006). The young remain dependant 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 1 on the following page sets out the stages in the GHFF life cycle and highlights periods of susceptibility to impacts of disturbance.

Table 1: GHFF life cycle 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 camp. 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 where they are at risk of starvation and 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, mating and conception	There might be some short term disruption to normal camp dynamics. These are unlikely to cause a significant impact.
	April		
	May	Gestation / pregnancy extends across a 6 month period (includes March – August). Heavily pregnant females will be present in camp in August and into September	There might be some short term disruption to normal camp dynamics. These are unlikely to cause a significant impact.
Winter	June	Some individuals become nomadic and 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.	
	July		Stressed adult females could abort young
	August		
Spring	September	Birth and lactation Births and dependant 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 where they become vulnerable to starvation and predation.
	October		
	November	Final stages of lactation and care for young Dependant young remain at camp while parents leave to forage. Parents return.	The juveniles are easily stressed and can fall to the ground where they become vulnerable to starvation and predation.
Summer	December	Final stages of care before young become independent Dependant young remain at camp while parents leave to forage. Parents return.	Dependant juvenile GHFFs continue to roost in the camp. The juveniles are easily stressed and can fall to the ground where they become vulnerable to starvation and predation.

2.1.3 GHFF status and key threatening processes

Flying-foxes (*Pteropus* spp.) were once common and widespread across much of eastern Australia. Since European settlement, many flying-fox species have suffered considerable range and population declines (Westcott et al. 2011) due to destruction of foraging and roosting habitats through forestry, agriculture and urbanisation, intra-species competition and persecution (Tidemann et al. 1999, DECCW 2009, Westcott et al. 2011). 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 NSW OEH and Commonwealth Department of Environment (DoE) state that GHFF face ongoing threats by:

- destruction of roosting and foraging habitat
- electrocution on powerlines, and entanglement on netting and barbed wire
- heat stress
- conflict with humans including unregulated shooting and / or culling
- predation by species such as *Haliaeetus leucogaster* (White-bellied Sea-eagle), *Haliastur indus* (Brahminy Kite), *Ninox strenua* (Powerful Owl), snakes, Dingos, *Canis domesticus* (domestic dogs) and feral cats (Hall and Richards 2000)
- competition and hybridisation with Black Flying-foxes.

2.1.4 Legislation and policies

In recognition of its significant decline and need for conservation, the GHFF is listed as vulnerable to extinction under the both the NSW *Threatened Species Conservation Act 1995* (TSC Act) and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

The Commonwealth Government has listed the Wolli Creek camp as Nationally Important and the 2014 *Draft EPBC Act Policy Statement – Camp Management Guidelines for the Grey-headed and Spectacled flying-fox* aims to ensure that there are no significant impacts on the species associated with actions to manage their camps. The policy describes which actions are likely to have a significant impact and when approval will be required from the Commonwealth DoE.

Federal approvals are not likely to be needed for work as described in this plan. However, it is recommended that Council/Sydney Trains contact the Commonwealth DoE prior to implementation to confirm that this is the case.

In 2015, the NSW OEH released the *Flying-fox Camp Management Policy*, which includes the following objectives for flying-fox camp management:

- address the potential impacts of flying fox camps on human health
- 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 the NSW 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
- 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 the policy is to reduce and manage conflict between camps and surrounding communities. Given the lack of conflict between the Wolli Creek camp and surrounding residences, some of the objectives from the 2015 policy are less relevant to this Plan.

Bush regeneration and rehabilitation activities that may impact GHFF, especially a Nationally Important camp such as Wolli Creek, will be subject to restrictions and licence conditions. There are two licences that will be needed from the NSW OEH to conduct bush regeneration in the GHFF camp.

Section 132c

Under section 132c of the *National Parks and Wildlife Service Act 1974*, the NSW OEH requires a bush regeneration licence to be issued for 2-5 years for landholder managed sites. The bush regeneration licence covers activities for conservation purposes in Threatened Ecological Communities, the habitat of threatened species or critical habitat.

Sydney Trains has a Section 132c Scientific Licence which expires on 31 October 2015. The licence covers 'bush regeneration of Sydney Trains threatened species, population and endangered ecological communities' and allows 'bush regeneration activities within endangered ecological communities and habitat of threatened species'. Bush regeneration activities are covered under this licence in accordance with the site plans submitted to the NSW OEH Wildlife Licensing and Management Unit, which indicate proposed works and methods for the site. The licence requires that an annual report and data be submitted.

Section 91

A Section 91 Licence under the *Threatened Species Conservation Act 1995* is needed from the NSW OEH to harm or pick a threatened species, population or ecological community, or damage habitat. The licence application requires details of measures that will be taken to avoid or ameliorate the effect of the actions. Examples of measures relevant to bush regeneration works within or near a GHFF camp include restrictions on the time of the work, and GHFF population and behaviour monitoring.

2.2 Zoning and land ownership

The majority of the site is zoned *SP2 Railway* under Rockdale Local Environment Plan (LEP) 2011 and is owned by Sydney Trains. The pocket of land inhabited by GHFF on the north-west side of Wolli Creek lies within Canterbury LGA and is zoned *E1 National Parks and Nature Reserves* under Canterbury LEP 2012.

2.3 Site history

According to Benson and Howell (1990), vegetation along Wolli Creek at the time of European settlement would have included estuarine wetlands (saltmarsh and mangroves). In colonial times, Wolli Creek was known as Cabbage Tree Creek and the Wolli Creek valley was known as the home of the

'Cabbage Tree Hat Mob' because of the settlers who wore hats woven from the leaves of Cabbage Tree Palms (*Livistona australis*)¹. Other species likely to have grown at the subject site include *Eucalyptus robusta*, *Casuarina glauca*, *Melaleuca linariifolia* and *Acmena smithii* (Benson and Howell 1990).

Parts of the Wolli Creek valley, including the subject site (**Figure 3**), were cleared from the mid-1800s to mid-1900s to create orchards, market gardens and other farming enterprises. Vegetation at the subject site had partially re-established by 2000 (**Figure 4**) as a result of replanting in the 1980s and regrowth. Subsequent years have seen significant infestation of the site with weeds.

Targeted weed control was conducted in part of the site (area referred to as G1 in **Figure 10**) when the bats were absent from the camp in 2011. This involved a mosaic approach targeting vines and was the first time that weed management works were conducted at the site.

According to the WCPS, GHFF established the camp at Wolli Creek in mid-2007. There are no records of a camp at an earlier date, although they may have roosted in the valley when conditions were suitable. The camp has been continuously occupied since winter 2013, which coincides approximately with when a colony of GHFF was dispersed from the Royal Botanic Gardens in 2012/13.

2.4 Current status

2.4.1 GHFF

Numbers of GHFF at the Wolli Creek camp fluctuate with seasonal conditions. Bat fly-out counts are conducted regularly by WCPS volunteers (see data in **Figure 5**) and by ecologists as part of the conditions of the Royal Botanic Gardens GHFF camp dispersal. Fly-out counts conducted by ELA in the summer of 2014/15 were consistent with the numbers recorded by WCPS volunteers over the same period. Recent counts indicate that the camp comprises 3,000 to 10,000 GHFF, with peaks of up to approximately 20,000 GHFF.

The GHFF fly out of the camp in most directions, although generally not to the east (pers. com. D. Little WCPS 2015). The direction is determined by the location of food sources. For example, in late 2014 the GHFF flew primarily west and south to seek flowering *Angophora costata* (Sydney Red Gum/Smooth-barked Apple) along the valley, as well as throughout the southern suburbs.

¹ From the Wolli Creek Preservation Society website http://www.wollicreek.org.au/wolli_valley/location Accessed February 2015.



Figure 3: 1943 aerial photograph showing most vegetation has been cleared



Figure 4: 2000 aerial photograph showing re-establishment of vegetation

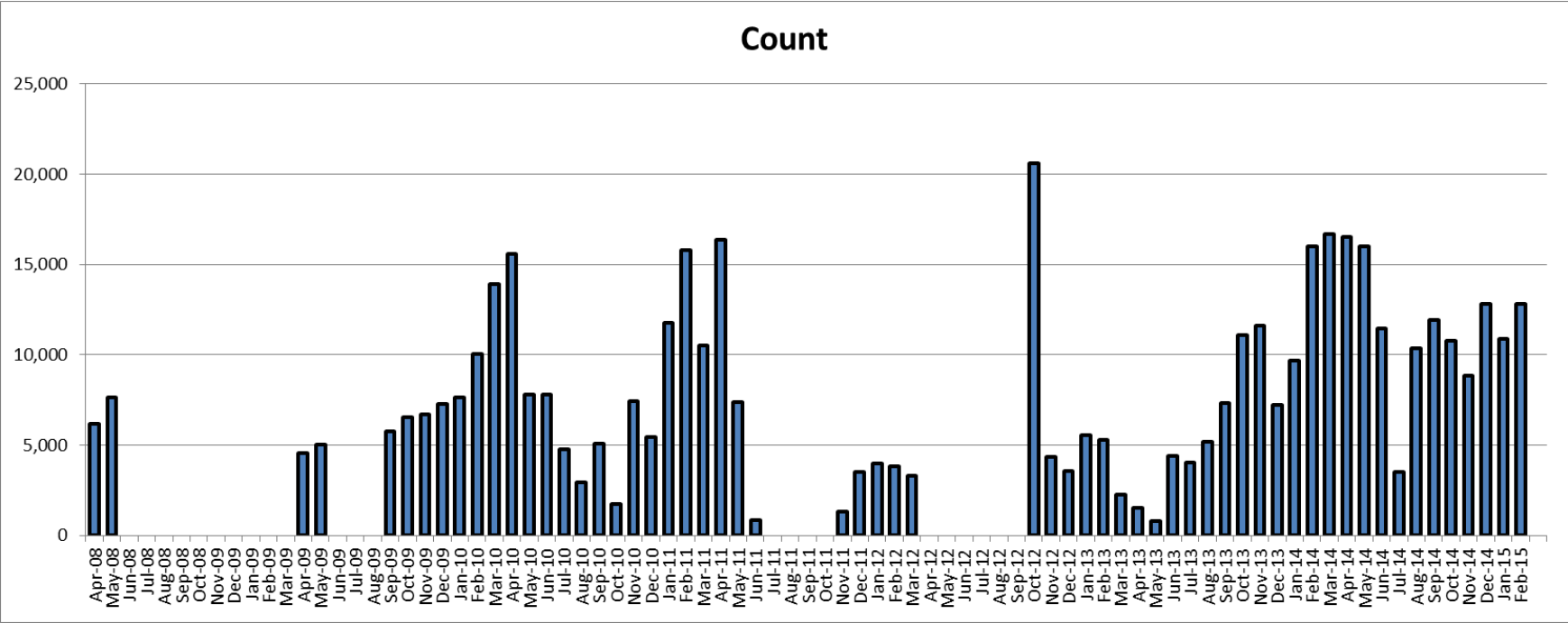


Figure 5: GHFF count data collected by WCPS from 2008 to 2015

2.4.2 Vegetation and GHFF habitat requirements

GHFF are not restricted to particular vegetation communities or plant species. They prefer to roost in tall (>5 m) sclerophyll forests and woodland, or rainforest. However, they are also found in heath, swamps, gardens and crops. The canopy does not need to be dense and dead trees are frequently used as long as there are healthy trees nearby to sustain the camp. Mid and understorey vegetation is desirable to maintain a cool, humid and sheltered environment to mitigate stress during drought and extreme temperatures, and protect against ground-dwelling predators and disturbance. Most camps are in close proximity to a waterway such as a creek or drainage channel.

The habitat at Wolli Creek comprises a variety of habitat types including open and closed canopy forest, dense understorey and reeds closer to the waterway (**Figure 6**). Exotic vines and other weeds are contributing to vegetation density in some locations but are also preventing establishment of native species and threatening the health of roost trees. The GHFF prefer to roost in the trees that aren't infested with vines.



Figure 6: Examples of habitat at Wolli Creek; GHFF roosting in trees

There have been previous attempts to map the vegetation at Wolli Creek based on desktop assessment of aerial photography, soils and position in the landscape (e.g. SMCMA 2010 and ELA 2014). However, field validation by ELA in 2015 found that vegetation communities at the site cannot be conclusively defined due to the high prevalence of weeds and planted species. A list of flora species recorded in 2015 is provided in **Appendix A**.

It is likely that the vegetation in the area, prior to clearing, cropping and revegetation (as illustrated in **Figure 3** and **Figure 4**), would have been consistent with Estuarine Reedland (found in environments inundated by saline or brackish water) and Coastal Alluvial Bangalay Forest (found on low-lying alluvial deposits). Floristics associated with these communities are tabulated below (from NSW OEH 2013) and should be used as reference for future vegetation management at the camp. Some of these species are already present, as identified in **Appendix A**.

Table 2: Vegetation communities to be rehabilitated

Structure	Coastal Alluvial Bangalay Forest	Estuarine Reedland
Trees	<i>Eucalyptus botryoides</i> , <i>Angophora costata</i>	
Small trees	<i>Allocasuarina torulosa</i> , <i>Livistona australis</i> , <i>Glochidion ferdinandi</i> , <i>Casuarina glauca</i>	<i>Casuarina glauca</i>
Shrubs	<i>Dodonaea triquetra</i> , <i>Acacia longifolia</i> , <i>Breynia oblongifolia</i>	
Ground covers	<i>Pteridium esculentum</i> , <i>Entolasia marginata</i> , <i>Imperata cylindrica</i> var. <i>major</i> , <i>Calochlaena dubia</i> , <i>Hydrocotyle peduncularis</i> , <i>Gahnia clarkei</i> , <i>Oplismenus imbecillis</i> , <i>Pratia purpurascens</i> , <i>Pseuderanthemum variabile</i> , <i>Pomax umbellata</i>	<i>Juncus kraussii</i> , <i>Samolus repens</i> , <i>Baumea juncea</i> , <i>Lobelia anceps</i> , <i>Phragmites australis</i> , <i>Alternanthera denticulata</i> , <i>Apium prostratum</i> , <i>Cyperus polystachyos</i>
Vines & climbers	<i>Eustrephus latifolius</i> , <i>Smilax glycyphylla</i> , <i>Kennedia rubicunda</i> , <i>Cissus hypoglauca</i> , <i>Glycine clandestina</i> , <i>Stephania japonica</i>	

2.4.3 Access

Access to the camp is currently restricted by the creek and railway corridor, which helps to minimise the risk of conflict between GHFF and people. However, there is unrestricted public access, though difficult, between the rail corridor and the camp. A fence is needed here for public safety reasons and the design needs to take into consideration the close proximity of the GHFF camp.

3 Management issues

As discussed in **Section 2.1.3**, GHFF are subject to a number of key threatening processes. This chapter outlines threats relevant to GHFF at Wolli Creek and factors that can potentially lead to conflict between people and GHFF.

3.1 Camp management

3.1.1 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 (see photo below of dead roost habitat surrounded by other vegetation). The loss of canopy, combined with increased levels of sunlight reaching the lower vegetation strata and increased nutrient loadings can lead to a proliferation of weeds unless native species are encouraged to regenerate.



Figure 7: Defoliated roost trees in centre of the Wolli Creek camp

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 regenerate. Wolli Creek has an area of 3.4 ha which provides scope for the core roosting area to shift. However, weedy vines growing into the canopy and proliferation of other weeds can result in the loss of existing and potential GHFF habitat, even though the weeds may also offer some relief to GHFF from heat stress (**Figure 8**). Removal of vines and other weeds is necessary for the long-term sustainability of the habitat but needs to be conducted in a manner that minimises risks to GHFF.

Sydney Trains has no plans to widen the rail corridor on the south-eastern boundary of the camp site. However, certain types of rail maintenance may impact on the camp and preferably should be scheduled to minimise adverse impacts to GHFF. Maintenance by Sydney Trains includes keeping the edge of the railway line clear of vegetation (**Figure 9**).



Figure 8: Vines and ground cover weeds degrading habitat



Figure 9: Railway corridor

3.1.2 Heat stress

Stanvic et al 2013 report that a heat stress event, which occurs when temperatures within the colony reach 40°C or more, can harm or kill GHFF. Heat stress or hyperthermia occurs when the body absorbs or produces more heat than it can dissipate. This process can be fatal as the internal body temperatures climb rapidly leading to severe dehydration and vital organ failure. Heat stress events can cause deaths of thousands of flying-foxes in a single camp.

Contributing factors that might increase the likelihood of heat stress and death of GHFF include:

- absence of adequate understorey vegetation – dense understorey vegetation provides a refuge to escape intense heat
- high temperatures occurring during the GHFF birthing season or when juveniles are present in the camp
- high numbers of GHFF in camp - more bats will lead to competition for cool roost locations
- stress from other factors (noise, low food resources, disease or a combination of these things) will mean the GHFF have lower resilience to additional stress.

There has been one heat incident at Wolli Creek in recent years when there were several days of temperatures >40°C. Anecdotal evidence suggests that the Wolli Creek camp was not as severely affected as some other camps in Sydney at that time, perhaps because of the permanent water supply and variety of habitat (including dense understorey) available at Wolli Creek.

3.2 Off-site GHFF management issues

3.2.1 Electrocuting or entanglement

Electrocution and entanglement are significant threats to GHFF. GHFF can be injured or killed when they become entangled in fruit tree netting. Similarly, flying-foxes can be electrocuted by power lines.

3.2.2 Bat strike

Bat or bird strike occurs when a bat or bird collides with an aircraft. ATSB (2012) states, 'while it is uncommon that a birdstrike² causes any harm to aircraft crew and passengers, many result in damage to aircraft, and some have resulted in serious consequential events, such as forced landings and high speed rejected takeoffs'.

ATSB (2014) states that historically, birdstrikes have not been a significant safety risk to civilian air travel in Australia. ATSB data dating back to 1969 show no civilian aviation fatalities attributed to birdstrikes. Additionally, the vast majority (98.7%) of birdstrikes across Australia over the period 2004-13 were assessed as being low risk occurrences. Bat/flying-fox strikes have only resulted in minor damage, compared to some other types of birdstrike which have resulted in substantial or destructive damage in the 2004-13 period (ATSB 2014).

Flying foxes and bats continue to be the most commonly struck species in Australia for the 2004 to 2013 period, with the majority of strikes occurring at locations on the east coast of Australia. The number of strikes involving bat/flying foxes has increased in recent years across Australia, with an average 113 strikes per year for 2012 and 2013 compared with 90 per year on average across the 10-

² ATSB includes bats in 'birdstrike' data

years (ATSB 2014). However, the rate of birdstrike at Sydney airport was lower in 2013 than in 2004 (ATSB 2014), and the recent rates (2012-13) are less relative to the ten year average.

The risk of a flying-fox colliding with an aircraft is greatest at around dusk when flying-foxes leave their roost.

3.2.3 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 (which is highly acidic) 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 unless droppings are cleaned soon after they occur (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 any pathogen that is currently known to cause significant disease among humans (Geolink 2011).

3.2.4 Noise

Dogs, birds of prey, planes, machinery and people can disturb roosting GHFF (Roberts 2006). If sufficiently disturbed, GHFF have been known to relocate to a different camp site. However, roosting GHFF can also become resilient to background noise e.g. GHFF at the Royal Botanic Gardens required very loud 'industrial' noise to disperse the camp over a long period. The Wolli Creek GHFF appear to be accustomed to background train and aircraft noise, although they become unsettled when people walk in close proximity to 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). However, noises from socialising GHFF at the Wolli Creek camp would be unlikely to affect people because of the distance between the camp and nearest residences. There have been no known noise complaints regarding this camp.

3.2.5 Odour

Flying-foxes use odour 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. The characteristic pungent 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). Odour does not come from 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.

There have been no known complaints of odour regarding this camp from local residents.

3.3 Human health risks from pathogens, viruses and diseases

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

The risk to human health from GHFF at the Wolli Creek camp is extremely low. However, it is important that people visiting the site (e.g. to do 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.

Further information is provided in **Appendix B**.

3.4 Future planning issues

This management plan is focused on current land uses and activities in the vicinity of the Wolli Creek camp. Any future proposed redevelopment within the area would be subject to environmental impact assessment and approval processes. However, it is worth noting that proposed construction of the F6 above ground and expansion of the M5 (east) would result in loss of foraging habitat for GHFF, which may affect the sustainability of the camp. Potential impacts would require detailed investigation if development is proposed in these areas in future.

4 Management actions and implementation

This chapter identifies actions to be implemented to assist with protection of the GHFF and its habitat at Wolli Creek. The proposed actions are designed to benefit GHFF and improve community awareness so that the risk of conflicts with residents is minimal. The actions are consistent with Level 1 – Routine Camp Management Actions, as defined by the NSW OEH.

Where possible, the actions are presented so that they are specific but not prescriptive, to allow flexibility with implementation as circumstances change. Performance targets are included where relevant.

4.1 Responsibilities

Sydney Trains, Rockdale City Council and City of Canterbury Council are responsible for implementation of this plan. They will be supported by the NSW OEH and WCPS. Ideally, a Camp Management Coordinator should be identified as the first point of contact and coordination for matters relevant to the camp. However, in interim, a Stakeholder Committee will undertake this role.

Grant funding applications should be made jointly where possible to increase the chance of success.

Access requirements for the site need to be provided by Sydney Trains and arranged at least two weeks in advance. Rail Protection Officers may need to be involved.

4.2 Priorities

Priorities for implementation of actions are as follows:

- high priority (initiate in the first two years)
 - vegetation management
 - GHFF population monitoring
 - fencing
 - community engagement
 - management of injured or dead flying-foxes
 - heat stress management
- medium priority (initiate in two to five years)
 - signage
 - street trees and parks
- low priority
 - management plan to be reviewed after five years.

Actions and performance targets are described in the following sections.

4.2.1 Vegetation management

A program of bush restoration is needed to ensure the subject site continues to provide suitable habitat for GHFF in the long term.

Areas within the site are weed infested, as mapped broadly in **Figure 10**. Some weeds, over time, if not treated, will result in loss of GHFF habitat. However, the treatment of weeds and associated restoration of native plants needs to be managed so that areas of protective understorey continue to be available as a refuge for GHFF during heatwaves. Given the primary objective of this plan is to ensure that

functional habitat for the GHFF is maintained (refer to **Section 1.3**), and the site's condition, land use history and location on a (very weed infested) floodplain, there will need to be tolerance of some sub-canopy weed species even in the medium to long term, especially where they contribute to functional, structural habitat and heatwave refuge.

4.2.2 Principles

Licences need to be obtained prior to on-ground work commencing

Based on previous experience of managing vegetation at other camps, it is expected that the NSW OEH (and possibly Commonwealth DoE) will impose restrictions on bush regeneration activities at the GHFF camp as part of licence approvals (see **Section 2.1.4**). The restrictions will aim to reduce potential impacts on the GHFF life cycle (refer to **Table 1**).

Work should be conducted by trained and qualified bush regenerators

The bush regeneration team needs to include a person with demonstrated relevant experience in wildlife handling and ecology to monitor bat stress levels during works. Alternatively, the team needs to have a representative from WIRES (NSW Wildlife Information, Rescue and Education Service) or Sydney Metropolitan Wildlife Services present during on-ground works. The designated person would have authority to issue stop work orders if needed i.e. if the bats appear to be stressed and at risk. Signs of stress include:

- the majority of GHFF showing agitated behaviour and taking flight
- dependent young (less than half the size of normal) that can't fly are moving around in the roost or falling to ground.

Members of the bush regeneration team to be suitably qualified in bushland management (minimum Certificate II or III in Conservation and Land Management) and experienced. It is preferable that they are vaccinated against Lyssavirus. Non vaccinated workers are not to have any contact with GHFF.

All on-ground works need to be performed in accordance with best practice bush regeneration techniques and a Safe Work Method Statement that includes information about risks and working in a GHFF camp.

Weed removal and associated regeneration/revegetation should be staged

As indicated in **Table 3**, highest priority is given to treating vines that are threatening the GHFF canopy habitat. The vines will be treated over a three year period, in a staged mosaic pattern, initially targeting tree canopies most threatened by vine growth. Young, developing canopy trees are equally a priority for vine treatment. Vines will be allowed to die in situ. This approach is intended to cause minimal disruption to the camp and the dead vines will provide ongoing refuge from heat in the mid and lower storey.

As previously discussed, work will need to be scheduled to avoid sensitive periods in the GHFF life cycle. **Table 1** shows that the best time to conduct primary weed control is Autumn and Winter. Maintenance bush regeneration should be done as needed. However, no work is allowed during September and October when the risks to GHFF are greatest. Further information about the timing of works is tabulated below in **Tables 3-5**.

Best practice weed control techniques should be applied

All weed control in the core habitat area will be by hand. Mechanical methods of weed control (e.g. brushcutter, chainsaw) are **not** permitted in the core habitat area because of the risk that the GHFF will become stressed. Mechanical methods may be used in areas outside of the core habitat only during

the months March to August, subject to stress levels of GHFF in the wider vicinity. All weed control will be by hand unless the camp is unoccupied at the time.

Monitor regenerating species and revegetate if needed

Regenerating species should be consistent with species from the Estuarine Reedland and Coastal Alluvial Bangalay Forest communities that support establishment or retention of GHFF habitat (**Table 2**). The highly degraded nature of the site means that suitable species may not regenerate naturally. Revegetation may be needed to ensure that the structure and composition of these target communities is recreated to support the GHFF camp in the long term. The need for revegetation can be determined by the bush regeneration team monitoring and reporting what species are regenerating and what established trees are declining.

4.2.3 Monitoring and performance criteria

The bush regeneration team will be required to complete a daily record of work performed and any impact on the GHFF. The CMC should be notified immediately of 'stop work' actions required due to GHFF stress levels.

The effectiveness of the bush regeneration program will be determined by annual review undertaken by a qualified bush regenerator and a GHFF expert. Further evaluation will be performed by an ecologist who has expertise in rehabilitation of GHFF camps. Feedback from the review process should be used to inform and improve the management practices on site.

Performance criteria include:

- 50% annual reduction in target area weed cover compared to the previous year (canopy vines in Years 1-3; then woody weeds of concern in Years 4-6)
- maintenance of a mosaic of refuges in the mid and lower storey by retention of dead weeds in situ, selective live weeds and restoration of (or revegetation with) native species
- suppression of new outbreaks of weeds in previously treated areas
- no adverse impacts to GHFF.

4.2.4 Cost for high priority bush regeneration

A cost estimate for high priority bush regeneration actions is provided below to support funding applications. Bush regeneration during Years 1 to 3 is expected to cost approximately \$30-60,000 p.a.. These costs have been estimated based on the number of person days allocated to high priority tasks based on average cost of \$45-60/hr for a trained bush regenerator contractor plus disbursements at cost and project management. It is recommended that potential costs be reviewed to reflect conditions at the time of application.

Table 3: High priority bush regeneration actions, Years 1-3

Habitat	Action	Resources and Timing
Core	<p>Remove exotic vines that are threatening existing young and developing canopy trees. Highest densities of these vines are currently in zones D, G2 and J (refer to Figure 10 for vegetation management zones).</p> <p>Maintain previously treated zones such as G1.</p>	<p>No works during Sept-Oct</p> <p>Primary works: approximately 60 person days per year in Autumn/Winter</p> <p>Secondary/maintenance in accordance with best practice bush regeneration techniques: approximately 30 person days per year during growing season</p>
Potential/ Other	<p>Remove exotic vines that are threatening canopy trees. Highest densities of these vines are currently in zones D, G2 and J.</p> <p>Maintain previously treated zones such as G1.</p>	<p>No works during Sept-Oct</p> <p>Primary works: approximately 20 person days per year in Autumn/Winter</p> <p>Secondary/maintenance: approximately 10 person days during growing season</p>

Table 4: Medium priority bush regeneration actions, Years 4-6

Habitat	Action	Resources and Timing
Core	<p>Target woody weeds of concern. Highest densities of these are currently in zones B2, C, E, F, H, I.</p> <p>Maintain previously treated zones.</p>	<p>No works during Sept-Oct</p> <p>Primary works: approximately 30 person days per year in Autumn/Winter</p> <p>Secondary/maintenance: approximately 25 person days per year during growing season</p>
Potential/ Other	<p>Target woody weeds of concern. Highest densities of these are currently in zones B2, C, E, F, H, I.</p> <p>Maintain previously treated zones.</p>	<p>No works during Sept-Oct</p> <p>Primary works: approximately 20 person days per year in Autumn/Winter</p> <p>Secondary/maintenance: approximately 15 person days per year during growing season</p>

Table 5: Low priority bush regeneration actions, Years 7+

Action	Resources and Timing
<p>Maintain previously treated zones.</p> <p>Revegetation with local provenance native species from the desired vegetation communities (if required)</p>	<p>No works during Sept-Oct</p> <p>Secondary/maintenance in accordance with best practice bush regeneration techniques: approximately 40 person days per year during growing season</p>

Vegetation Zones

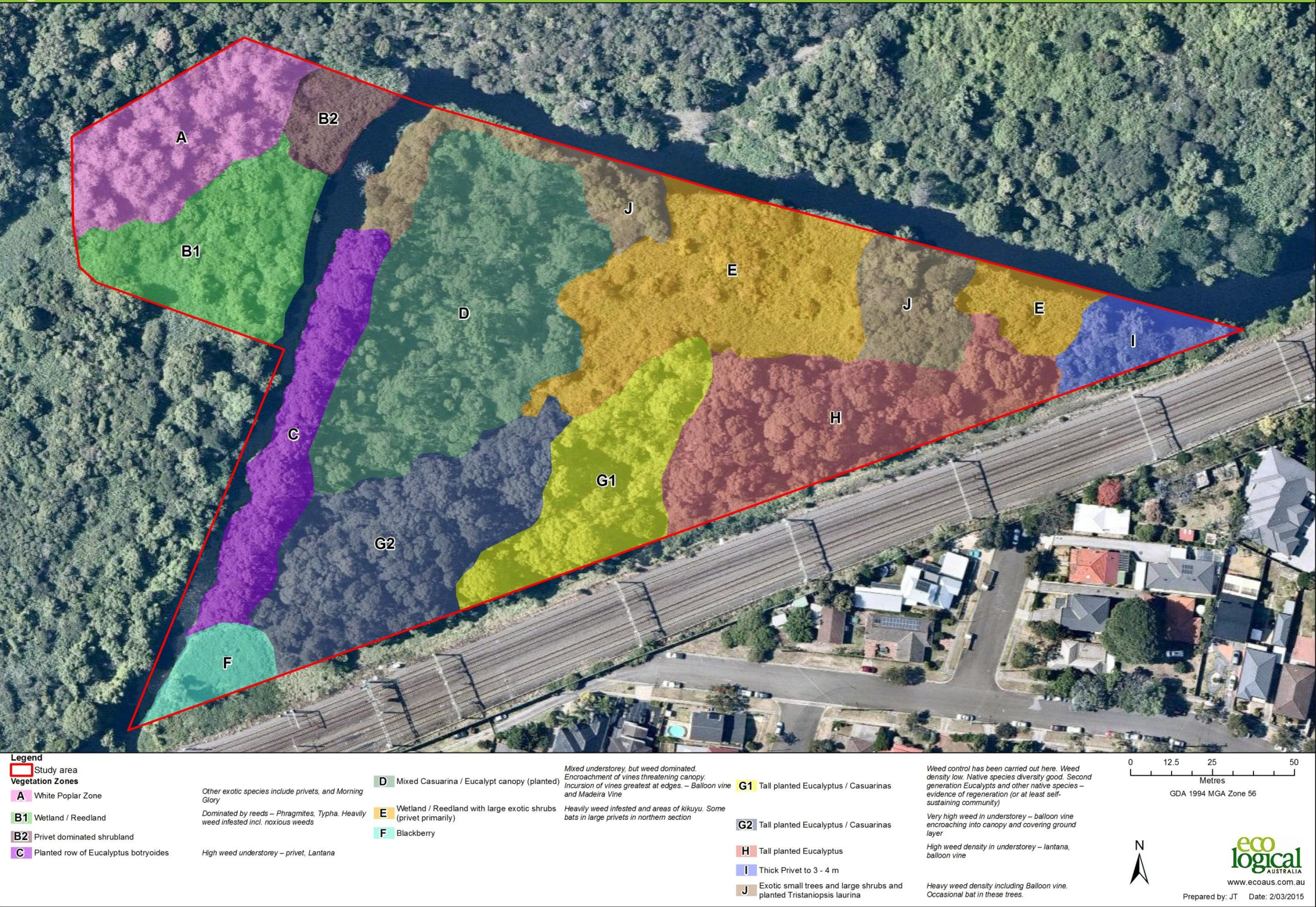


Figure 10: Vegetation management zones

4.3 Population monitoring

A number of other GHFF camps are being dispersed in the Sydney metropolitan area and this will place greater pressure on remaining camps.

Action:

- Continue GHFF fly-out counts by WCPS and Botanic Gardens.
- Request the NSW OEH to establish a forum with Councils, other agencies and relevant community groups (including wildlife rescue groups) to share count data and other information relevant to GHFF camp management.
- Record fly-out directions to determine trends.
- Review the suitability of the CSIRO method of population monitoring.
- Undertake GHFF population monitoring consistent with the CSIRO method being applied in the national flying-fox monitoring program

Performance target:

- Data is made available to contribute to local and regional GHFF population monitoring.

4.4 Fencing and signage

Action:

- Sydney Trains to install security fencing and signage in the cleared buffer along the edge of the railway corridor to separate the site and prevent public access.

Performance target:

- Fence and signs installed.

4.5 Community education and concerns

Volunteers with the Wolli Creek Preservation Society (WCPS) are highly active in protecting and monitoring the GHFF site. They have conducted monthly bat counts since 2008, have hosted community talks and events, and promote environmental issues in the media. Local councils and Sydney Trains work with WCPS but do not have a separate community program.

Actions:

- Continue to support WCPS through collaborative grant funding and activities.
- Update Councils' websites and environmental education material/programs to include positive messages about:
 - the ecological importance of flying-foxes as pollinators and seed dispersers
 - commonly asked questions on native wildlife (this may also help to manage some complaints), such as: what are the health risks from GHFF, 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 to do if you find an injured or dead GHFF
 - ways to reduce conflict between residents and GHFF
 - develop a complaints protocol so that staff know to refer complaints about GHFF for the environmental officer

- the use of bat friendly fruit tree netting
- Council to investigate the effectiveness of installing protective covers (e.g. shade sails) to reduce faecal drop on sensitive areas. Costs and installation would be the responsibility of the landowner.

Performance targets:

- Up-to-date information available to the community via Councils' websites and brochures.
- Prompt and consistent response to queries and complaints.

4.6 Management of injured or dead flying-foxes

If a sick, dead or injured GHFF is found it should be reported to Council's environmental staff, NSW Wildlife Information, Rescue and Education Service (WIRES), or the Sydney Metropolitan Wildlife Services. The public and other staff should not handle sick, dead or injured GHFF.

Within Sydney Trains land, any sick, dead or injured GHFF should also be reported to Sydney Trains.

The need to handle injured or dead GHFF is likely to increase during heatwaves, so suitable staff and volunteers should be identified in advance to minimise risk and ensure a timely response.

Actions:

- Stakeholder Committee, Sydney Trains and NSW OEH environmental managers to identify staff and volunteers who have been trained in GHFF handling and vaccinated in Lyssavirus, and the Stakeholder Committee, Sydney Trains and NSW OEH environmental managers should have their contact details.
- Prepare brief information for site inductions (e.g. to be included in safe work method statements) to educate Council staff/contractors, Sydney Trains staff/contractors and WCPS volunteers about safety protocols regarding GHFF when accessing the Wolli Creek camp.
- Bush regeneration contractors and volunteers working at the subject site should preferably be vaccinated against Lyssavirus.
- Include advice on Councils' and WCPS website about what to do if you find a GHFF.

Performance target:

- Induction signed off by Stakeholder Committee.

4.7 Heat stress management

A heat stress protocol for the GHFF camp should be developed in consultation with the Stakeholder Committee, Sydney Trains and NSW OEH in line with relevant policies..

Performance targets:

- Development of protocol consistent with current NSW OEH policy.

Street trees and parks

Actions:

- Councils to increase the number of GHFF food trees (especially *Eucalyptus* species) in suitable locations on Council land to increase foraging habitat for GHFF. Pollen and nectar from flowering Eucalyptus is a primary source of food for GHFF. Suitable locations for planting these trees could include roadsides that do not have electricity wires, pavement or underground services; and in parks and reserves, chosen in consultation with Councils' environmental staff.

Performance targets:

- Increase foraging habitat in suitable locations, represented by the number of food trees planted.

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Appendix A Species recorded in January 2015

Family	Scientific Name	Common Name
Acanthaceae	<i>Thunbergia alata</i> *	Black-eyed Susan
Amaranthaceae	<i>Alternanthera philoxeroides</i> *	Alligator Weed
Apiaceae	<i>Centella asiatica</i>	Swamp Pennywort
	<i>Foeniculum vulgare</i> *	Fennel
Arecaceae	<i>Livistona australis</i>	Cabbage Tree Palm
Asteraceae	<i>Ageratina adenophorum</i> *	Crofton Weed
	<i>Cirsium vulgare</i> *	Spear Thistle
	<i>Taraxacum officinale</i> *	Dandelion
Caesalpiniaceae	<i>Senna coronilloides</i> *	Senna
Casuarinaceae	<i>Casuarina glauca</i>	Swamp Oak
Commelinaceae	<i>Commelina cyanea</i>	Scurvy Weed
	<i>Tradescantia fluminensis</i> *	Wandering Jew
Dennstaedtiaceae	<i>Pteridium esculentum</i>	Bracken Fern
Dicksoniaceae	<i>Calochlaena dubia</i>	False Bracken
Fabaceae	<i>Erythrina X sykesii</i> *	Coral Tree
Fagaceae	<i>Quercus robur</i> *	English Oak
Lauraceae	<i>Cinnamomum camphora</i> *	Camphor Laurel
Lomandraceae	<i>Lomandra longifolia</i>	Spiky-headed Mat-rush
Malvaceae	<i>Modiola caroliniana</i> *	Red-flowered Mallow
	<i>Pavonia hastata</i>	Pavonia
	<i>Sida rhombifolia</i> *	Paddy's Lucerne
Moraceae	<i>Ficus rubiginosa</i>	Port Jackson Fig
Myrtaceae	<i>Acmena smithii</i>	Lillypilly
	<i>Angophora costata</i>	Smooth-barked Apple
	<i>Corymbia maculata</i>	Spotted Gum
	<i>Eucalyptus botryoides</i>	Bangalay
	<i>Eucalyptus saligna x botryoides</i>	
	<i>Leptospermum laevigatum</i>	Coast Tea-tree
	<i>Melaleuca linariifolia</i>	Flax-leaved Paperbark
	<i>Melaleuca styphelioides</i>	Prickly-leaved Tea Tree

Family	Scientific Name	Common Name
	<i>Tristaniopsis laurina</i>	Water Gum
Oleaceae	<i>Ligustrum lucidum</i> *	Large-leaved Privet
Oleaceae	<i>Ligustrum sinense</i> *	Small-leaved Privet
Onagraceae	<i>Ludwigia peruviana</i> *	Peruvian Ludwigia
Phormiaceae	<i>Dianella caerulea</i> var. <i>caerulea</i>	Flax Lily
Pittosporaceae	<i>Pittosporum undulatum</i>	Sweet Pittosporum
Poaceae	<i>Andropogon virginicus</i> *	Whiskey Grass
	<i>Eragrostis curvula</i> *	African Lovegrass
	<i>Pennisetum clandestinum</i> *	Kikuyu
	<i>Phragmites australis</i>	Common Reed
Proteaceae	<i>Banksia integrifolia</i> subsp. <i>integrifolia</i>	Coast Banksia
	<i>Grevillea robusta</i>	Silky Oak
Rosaceae	<i>Rubus fruticosus</i> agg.	Blackberry
Rutaceae	<i>Correa reflexa</i>	Common Correa
Salicaceae	<i>Salix babylonica</i> *	Weeping Willow
Solanaceae	<i>Cestrum parqui</i> *	Chilean Cestrum
	<i>Solanum mauritianum</i> *	Wild Tobacco
Typhaceae	<i>Typha orientalis</i>	Cumbungi
	<i>Verbena bonariensis</i> *	Purpletop
Violaceae	<i>Viola</i> sp.	Violet
VINES		
Apocynaceae	<i>Parsonsia straminea</i>	Common Silkpod
Asclepiadaceae	<i>Araujia hortorum</i> *	Mothvine
Basellaceae	<i>Anredera cordifolia</i> *	Madiera Vine
Caprifoliaceae	<i>Lonicera japonica</i> *	Japanese Honeysuckle
Convolvulaceae	<i>Ipomoea indica</i> *	Morning Glory
Pittosporaceae	<i>Billardiera scandens</i> var. <i>scandens</i>	Apple Dumplings
Sapindaceae	<i>Cardiospermum grandiflorum</i> *	Balloon Vine, Love in a Puff
EPIPHYTES		
Loranthaceae	<i>Amyema</i> sp.	Mistletoe

Appendix B Human health risk

Australian Bat Lyssavirus

The ABLV is closely related to the rabies virus and in Australia infects four species of flying-fox (including GHFF) and a number of microchiropteran bat species. There have been three recorded cases of ABLV since the virus was identified in Australia, all of which have resulted in the death of the infected person. The mode of transmission of ABLV is through virus-laden saliva from infected animals introduced via a scratch or a bite, contamination of mucous skin or broken skin (NSW Health 2013).

According to AHA (2009), flying-foxes affected with ABLV show a range of clinical symptoms that may be difficult for members of the general public to determine. These symptoms include overt aggression, paresis and paralysis, seizures and tremors, weakness, respiratory difficulties and change of voice. These symptoms are not exclusive to ABLV infection and may be caused by other factors.

Affected animals can be found on the ground or low in a tree, and are unwilling or unable to fly. ABLV also occurs in dead or dying flying-foxes, or those that appear to be suffering from another disease such as lead poisoning or angiostrongylosis (AAH 2009). Therefore, it should always be assumed that all Australian bat species have the potential to carry and consequently transmit ABLV (Australian Government Department of Health 2013).

The virus may incubate for 3-8 weeks following contraction, after which it affects the central nervous system and can be fatal if left untreated. Early symptoms of ABLV in humans are flu-like and include headache, fever, aversion to fresh air and water, weakness and fatigue. The disease can progress rapidly and malaise, delirium, convulsions, coma and death occur within a week or two (NSW Health 2013).

People at most risk of becoming infected by ABLV are those whose occupation includes volunteering or recreation activities resulting in exposure to potential diseased flying-foxes (Australian Government Department of Health 2013). However, there is a vaccine that can be administered prior to and after being bitten or scratched that can prevent disease, illness and death among humans. According to NSW Health and AHA (2009), contact or exposure to bat faeces, urine or blood will not pose a risk of exposure to ABLV.

Hendra virus

The Hendra virus, which is also known as the equine morbillivirus or bat paramyxovirus no.1 was first discovered in Australia following an outbreak of illness among horses at a large racing stable near Brisbane, Queensland (NSW Health 2012). To date, the virus has resulted in seven known human infections, of which there have been four deaths (NSW Health 2012). The transmission of the virus appears to have occurred through horses consuming food that is contaminated by the faeces from infected flying-foxes.

Human symptoms include fever, cough, sore throat, headache and tiredness which can develop between 5-21 days following contact with infectious horses. Further symptoms associated with meningitis or encephalitis (inflammation of the brain) can also develop, resulting in headache, high fever, drowsiness and sometimes convulsions and coma (NSW Health 2012).

There is no evidence of Hendra being transmitted from bat to humans, or from human to human (NSW Health 2012). In addition, it also appears that the Hendra virus is not readily transmitted between infected and un-infected horses (NSW Health 2012).

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 (Australian Wildlife Health Network (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.



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