Recommendations

1. Undertake a combined fish passage options assessment at:
    - Warrill Creek sheet pile weir (Runnymede) barrier
    - Warrill Creek DNRM v-notch gauging weir barrier

Fish passage options assessment to include identifying the owner/s of both structures, appetite to remove and/or retro-fit fish passage structures at these sites, most suitable fishway design including a cost/benefit analysis and LiDAR analysis to determine extent of sheet pile weir pool. It is recommended that the fish passage options assessment at these two sites occurs at the same time. Any remediation works that occur at the first barrier upstream (sheet pile weir) such as removal and/or construction of rock ramp fishway, may impact the DNRM v-notch gauging weir located only 600 m upstream.

2. Undertake a fish passage options assessment at the Bremer River DNRM v-notch gauging weir barrier.

Fish passage options assessment to include identifying structure owner, appetite to remove and/or retro-fit fish passage structures at this site, and most suitable fishway design including a cost/benefit analysis.

Combined fish passage options assessment at the two Warrill Creek fish barriers should be prioritised over the Bremer River v-notch weir. Results from the current study suggest that these barriers are having a greater impact on Bremer River fish communities. Warrill Creek also appears to contain a greater amount of fish habitat, and may be more important for the conservation of endangered Mary River Cod.

3. Investigate the health of endangered Mary River Cod populations throughout the Bremer River catchment, including signs of recruitment.

Surveys to be undertaken using boat electrofishing methods in order to effectively monitor deep pool snag habitats where Mary River Cod reside. Surveys to encompass all fish communities to investigate any changes in Bremer River catchment fish community health since the inception of Berrys Weir fishway. Project to include local community component to raise awareness of endangered Mary River Cod populations within the Bremer.

4. Raise local community awareness regarding the impact of fish barriers on aquatic ecosystem health, and the benefits of improving aquatic connectivity (This recommendation could be undertaken in-conjunction with recommendation 3. above)

Focus on endangered Mary River Cod and other key recreational fish species such Australian bass, sea mullet, freshwater mullet, Yellow-fin bream and jungle perch. Promote linkages with improving water quality and habitat with increased fish populations. Encourage the local community to become more involved with local waterways to grow and foster ownership within the community.

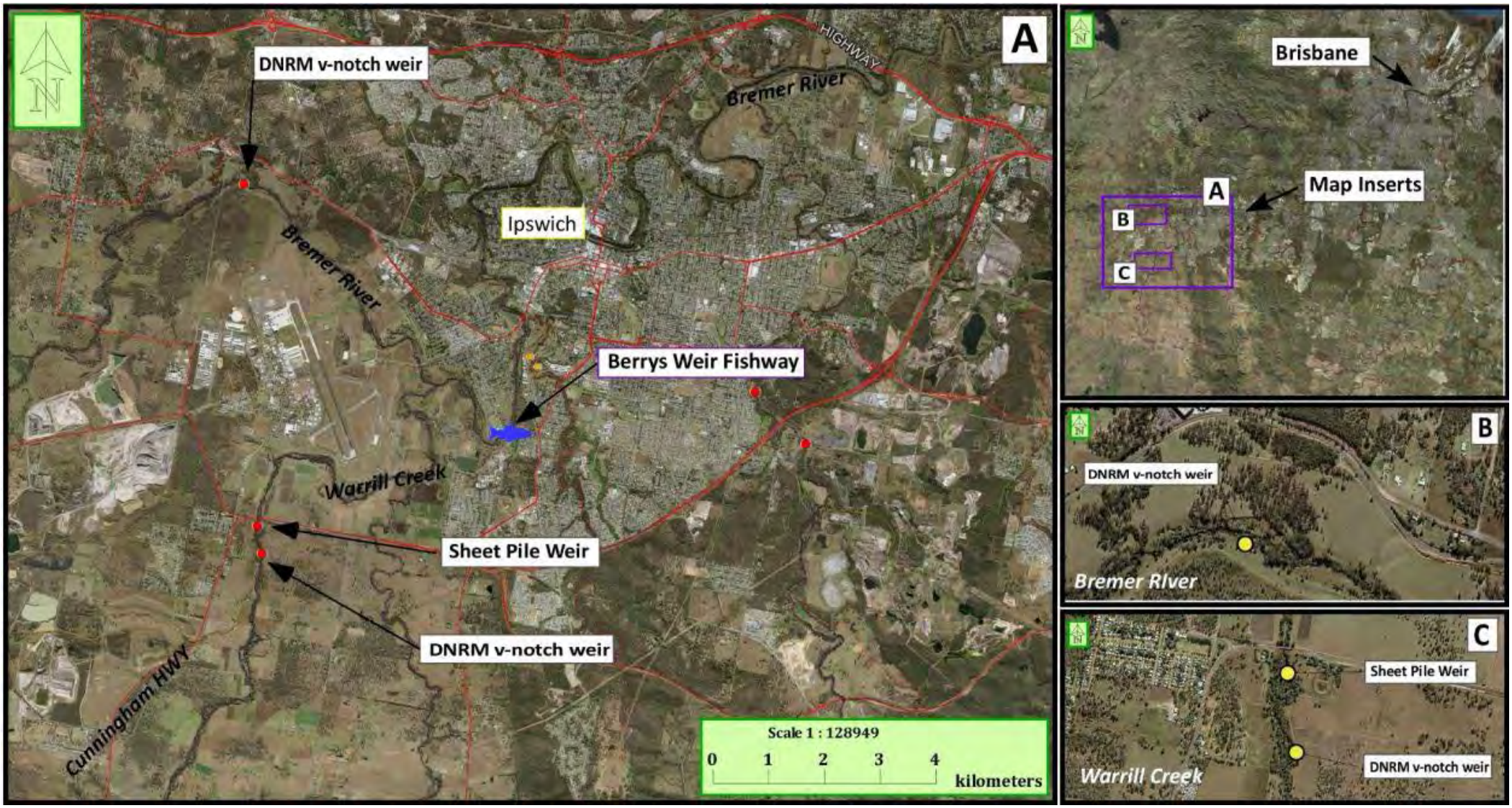
References

Koehn, J.D. & Kennard, M.J. (2013) Habitats, In, Ecology of Australian Freshwater Fishes, Humphries, P. & Walker, K. (eds), pp 81-103, CSIRO Publishing, Victoria, Australia

Moore, M. McCann, J. & Power, T. (2018) Greater Brisbane Fish Barrier Prioritisation. Final Report for the Australian Federal Government. Catchment Solutions, Mackay, Queensland.

Pusey, B. Kennard, M. & Arthington, A. (2004) *Freshwater Fishes of North-Eastern Australia.* CSIRO Publishing. Collingwood. VIC. Australia

Wang R.W., 2008. Aspects of design and monitoring of nature-like fish passes and bottom ramps, Lehrstuhl für Wasserbau und Wasserwirtschaft, Technische Universität München.


A
DNRM v-notch weir
HIGHWAY
Bremer River
Ipswich
Bremer River
Berrys Weir Fishway
Warrill Creek
Sheet Pile Weir
DNRM v-notch weir
Cunningham HWY
Scale 1 : 128949
0 1 2 3 4
kilometers
Brisbane
Map Inserts
A
B
C
B
DNRM v-notch weir
Bremer River
C
Sheet Pile Weir
Warrill Creek
DNRM v-notch weir

Catchment Solutions

FIND YOUR SOLUTION.

catchmentsolutions.com.au

Bremer River Rock-Ramp Fishway Monitoring Report

SDA-0516-030273

February 2018

Jack McCann and Matt Moore

Information contained in this document is provided as general advice only. For application to specific circumstances, professional advice should be sought.

Catchment Solutions has taken all reasonable steps to ensure the information contained in this document is accurate at the time of publication. Readers should ensure that they make appropriate enquiries to determine whether new information is available on the particular subject matter.

For further information contact:
Matt Moore
Senior Fisheries Biologist
Catchment Solutions – Fisheries and Aquatic Ecosystems
Ph: (07) 4968 4214

Enquiries should be addressed to:
General Manager
Catchment Solutions Pty Limited
PO Box 815, Mackay Qld 4740
Tel: +617 4968 4200
Email: info@catchmentsolutions.com.au

Front Cover Image: Top; Berrys Weir fishway, Bottom from left to right, fish successful at ascending fishway: adult and juvenile bullrout, typical trap catch, juvenile sea mullet (top) and freshwater mullet (bottom) & juvenile eel species, freshwater mullet, sea mullet and smelt.

Contents

Background

Construction of Berry's Weir partial width rock-ramp fishway on the Bremer River in Ipswich was completed in October 2016. The fishway was constructed on a 2.4 m weir (Berry's weir) that was constructed in the 1960's to impound water for power generation (Swanbank Power Station). The weir was identified as a priority fish barrier in a recently completed fish barrier prioritisation process; 'Greater Brisbane Urban Fish Barrier Prioritisation' (Moore, 2016) which identified and ranked Berry's Weir as the 7th most important fish barrier requiring remediation in South-East Queensland. Significantly, the weir impacted important life-cycle dependant migrations between downstream estuarine environments and upstream freshwater habitats for a range of economically important fish species, such as Australian bass, sea mullet and long-finned eels. The fishway now allows native fish species the opportunity to access habitat upstream of the weir and complete their life-cycle as necessary. The nature-like rock ramp fishway was designed and constructed by fish passage specialists; Catchment Solutions (CS).

The fishway was constructed under State Development Approval (SDA-0516-030273) and was subject to various development conditions. One of the conditions required the implementation of a monitoring program by a '*person or entity that is suitably qualified and experienced in fish passage biology, fish passage design and construction*', to analyse the performance of the fishway. The monitoring program was developed by Catchment Solutions in November 2016, which included the first round of fishway monitoring in December 2016. The monitoring report, including an 'alert and action component', was forwarded to Fisheries QLD in March 2017. This report was accepted as the first round of monitoring. To satisfy the development conditions, the monitoring program requires one more round of fishway monitoring and a monitoring report, again including an 'alert and action component'.

Specifically, the monitoring program must:

- Be developed and implemented by a person or entity that is suitably qualified and experienced in fish passage biology, fish passage design and construction in order to demonstrate the performance of the fishway/s,
- Involve monitoring of fishway performance on low, medium and high flows during the wet season; and during base flows during the dry season to ensure the fishway will work on all expected flow ranges,
- Involve the provision of monitoring reports to notifications@daf.qld.gov.au at 6-month intervals for a total 12 months from the completion of works, and
- Include an alert and action component, which will enable changes to be made to any deficiencies in the fishway promptly and no later than prior to the commencement of the following wet season.

Catchment Solutions successfully completed the required second round of monitoring from December 18th - 22nd 2017, and this report will present the results and findings from this monitoring. Detailed analysis will be made on fishway utilisation, fishway pool and ridge flow velocities as well as water quality observations. Monitoring of other identified barriers within the catchment was also conducted during this period, however these results will be presented in a separate report.

Methods

Fishway Trapping

Round two of the fishway monitoring of the Berry's weir rock-ramp fishway was conducted over five days from the 18th – 22nd December, 2017. Fishway monitoring was undertaken to validate the success of the fishway at passing the entire community of fish species and size classes expected to move within the Bremer River catchment. The fishway trap used for sampling consisted of a single cone entrance configuration, constructed from 8 mm round bar with shade cloth (4.0 mm mesh size) covering the frame. The trap dimensions were 1400 mm x 1000 mm x 1100 mm. Shade cloth wing walls were used to prevent fish from swimming around and underneath the trap, whilst sand bags were used to secure the trap and wing walls in place (Figure 1). Habitat in the form of complex woody branches (*Callistemon sp.*) were added to the inside of the trap to enable small fish to feel safe and assist them in evading any potential larger predators which may enter the trap, such as forked-tail catfish and long-fin eels.

The fishway trap was positioned within the upper most pool of the fishway in order to capture fish that had successfully ascended the rock ramp. Sand bags were used along the nib wall of the fishway to ensure all fish ascending the fishway had to enter the trap, and could not exit the fishway at any other point. Once the trap was correctly set at 9:00am on December 18th, it was left in place until 4:30pm on the 22nd, with multiple trap checks each day and trap set periods ranging between 2.5 - 14 hours.

All individual fish captured in the fishway trap were identified to species level, counted and measured to the nearest millimetre (fork length for forked-tailed species, total length for all other species). When more than 25 individuals of a single species were captured in any single trapping event, a randomised subset of 25 fish were measured and the remainder only counted to contribute to abundance data. All native fish were then released upstream of the fishway, whilst pest fish species were euthanised as per Biosecurity Queensland legislation and ANZCCART procedures and disposed of in an appropriate manner.

Figure 1. Berry's weir rock ramp fishway trap in place, sampling for fish ascending the fishway (left), and the fishway trap full of fish upon retrieval from a trap set period (right)

Flow Velocity

In order to evaluate the flow velocities through the fishway, flow velocity measurements were taken using a Global Water flow meter (GWFP111). Flow velocity data was taken on two occasions across the sampling period, once on Wednesday December 20th at 12:00PM and once again on Friday December 22nd at 5:00PM.

Flow velocity data was obtained for every ridge and every pool of the fishway, by taking a reading of each of the three ridge slots, and three replicates in the following pool. In order to take slot flow velocities, the flow meter was placed into the centre of the ridge slots, and the velocity averaged over a 20 second period. Pool velocity measurements were recorded by positioning the flow meter at six-tenths the depth of the pool and averaging the velocity over a 20 second period (Figure 2). Average velocities for each of the 34 pools and ridges of the fishway were then calculated and used to develop visual outputs for results.

Figure 2. Image displaying locations of flow velocity replicates when taking fishway flow velocity readings, with one replicate in each of the three ridge slots and three replicates in each pool

Water Quality

Water quality parameters were measured in situ using a YSI – Pro Plus multiprobe. Parameters monitored include;

- Temperature (°C)
- pH
- Dissolved oxygen (% saturation and mg/L), and
- Electrical conductivity (µs/cm).

The water quality sampling method involved placing the probe into the water at a depth of 0.1m and waiting for a short period of time for the readings to stabilise. After stabilisation, values were recorded for each of the water quality parameters. When conducting water quality measurements, three replicates were taken; the first being upstream of the fishway, the second in the middle pool of the fishway (pool 17) and the third immediately downstream of the last ridge of the fishway (**Figure 3**). Water quality parameters were measured three times out of the five- day monitoring period.

Figure 3. Fishway showing points of water quality readings which were upstream and downstream of the fishway, and also in the middle pool of the fishway

Results

Fishway Trapping

A total of 16, 401 individual fish were captured ascending the fishway in 98.58 hrs at an overall catch rate of 4075.5 fish per day. This was made up of 16 species in total, comprised of 15 native species and one introduced species. Native fish individuals represented 99.99% of the catch, with only a single introduced fish (tilapia, *O. mossambicus*) recorded ascending the fishway. Significantly, diadromous species represented 96.12% of the total individuals captured (Table 1).

Empire gudgeon (*H. compressa*) were the most abundant species (n=8131) making up 49.6% of the total catch, followed by striped gudgeon (*G. australis*) (n=5166), sea mullet (*M. cephalus*) (n=1273) and freshwater mullet (*T. petardi*) (n=1073) which made up 31.5%, 7.8% and 6.5% of the catch respectively. The smallest fish recorded successfully ascending the fishway was a 19 mm flathead gudgeon (*P. grandiceps*), followed by a 21 mm empire gudgeon, a 21 mm striped gudgeon and a 22 mm Australian smelt (*R. semoni*). The largest fish species recorded was a 1200 mm long-fined eel (*A. reinhardtii*), followed by a 385 mm tilapia, a 234 mm sea mullet and a 204 mm bony bream (*N. erebi*). The median size of all fish captured successfully migrating through the fishway equated to 34 mm (Figure 4).

Note, four juvenile eels were captured ascending the fishway (*Anguilla sp.*) and could not be identified to species level. These individuals could potentially be either of the long-finned eel (*A. reinhardtii*) or the southern shortfin eel (*A. australis*) which are both known from within the Brisbane catchment. As juveniles, both species share many morphological traits, making field identifications difficult.

Table 1. Species captured ascending the Berry's weir fishway, separated into migratory classifications, and displaying the minimum, maximum and median sizes (mm) as well as the total captured and catch per unit effort (fish/day)

Migration Classification	Common Name	Species Name	Size		Total Individuals		CPUE (fish/day)
			Min (mm)	Median (mm)	Max (mm)		
Diadromous	Bullrout	*Notesthes robusta*	28	35	165	112	27.8
	Eel sp.	*Anguilla sp.*	50	57.5	65	4	1.0
	Empire gudgeon	*Hypseleotris compressa*	21	30	64	8131	2020.5
	Freshwater mullet	*Trachystoma petardi*	51	62	79	1073	266.6
	Long-finned eel	*Anguilla reinhardtii*	400	750	1200	6	1.5
	Sea mullet	*Mugil cephalus*	34	51	234	1273	316.3
	Striped gudgeon	*Gobiomorphus australis*	21	30	83	5166	1283.7
Potamodromous	Australian smelt	*Retropinna semoni*	22	33	54	487	121.0
	Barred Grunter	*Amniataba percoides*	110	110	110	1	0.2
	Bony bream	*Nematalosa erebi*	39	104	204	85	21.1
	Crimson-spotted rainbowfish	*Melanotaenia duboulayi*	36	38.5	41	2	0.5
	Firetail gudgeon	*Hypseleotris galii*	28	32.5	42	51	12.7
	Flathead gudgeon	*Philypnodon grandiceps*	19	22	25	2	0.5
	Spangled perch	*Leiopotherapon unicolor*	165	180	195	2	0.5
	Unspecked hardyhead	*Craterocephalus fulvus*	35	38	56	5	1.2
Pest Fish	Tilapia	*Oreochromis mossambicus*	385	385	385	1	0.2
Overall Min., Median, Max., Total Individuals and CPUE			**19**	**34**	**1200**	**16401**	**4075.5**
Total Species			**16**				

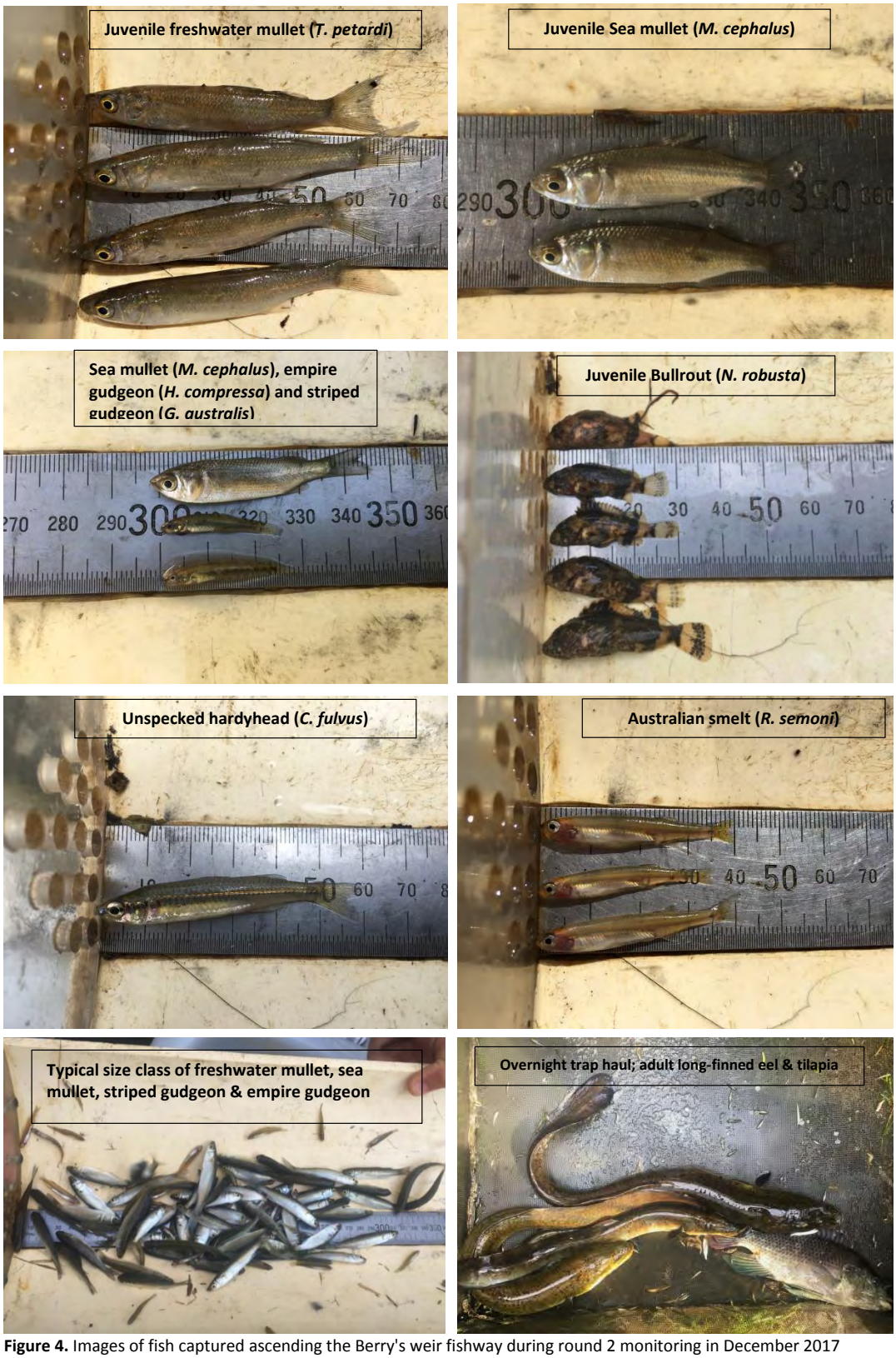


Figure 4. Images of fish captured ascending the Berry's weir fishway during round 2 monitoring in December 2017

Flow Velocity

River flow conditions during the fishway monitoring period, indicated as the period between the red lines in Figure 5, varied little over the five-day monitoring period. River height data gauged at intervals of one minute upstream of Berry's weir for the monitoring period showed an average height of 7.62 m, ranging between 7.47 and 7.66 m (**Figure 5**). Fishway velocity measurements were recorded on two occasions during the monitoring period. Firstly, on the 20th December at 12:00pm and secondly on the 22nd December at 5:00pm.

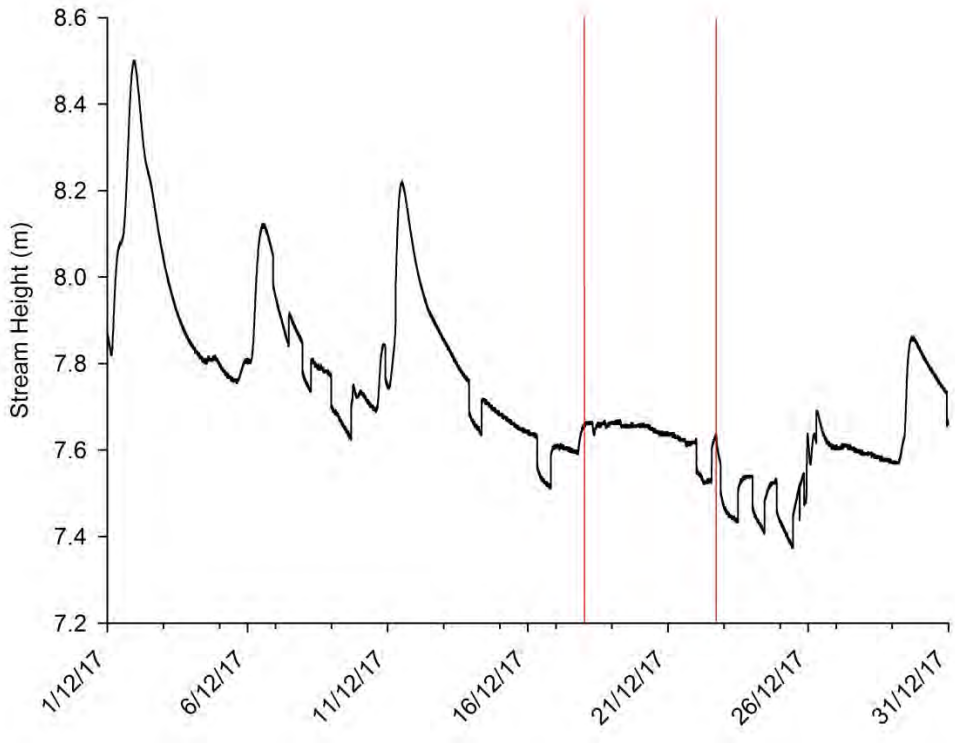


Figure 5. Hydrograph of stream height gauged at Berry's weir for the entire month of December 2017, with the sample period outlined by two red lines (Source: Stanwell, Swanbank Power Station, December 2017)

A high degree of variability in velocity measurements was recorded within each pool and ridge (Figure 6). A conservative approach has been taken to determine the minimum velocity fish had to negotiate through each ridge in order to reach the next upstream pool. This approach entailed identifying the slot within each ridge with the lowest velocity reading, and using this as the 'minimum velocity' fish had to negotiate to ascend to the next pool. For example, velocity readings through the three slots of ridge 14 on December 20th from left to right consisted of 1.2 m/sec, 1.5 m/sec and 1.3 m/sec, therefore 1.2 m/sec was determined to be the minimum velocity fish had to swim through to reach the next pool. Fish may have ascended through the 1.5 m/sec slot; however, this is unknown.

0n the 20th December (elevated base flow, river height = 7.64 m) the minimum slot velocity fish had to negotiate while ascending the fishway was 1.7 m/sec through the right-hand slot of ridge 5. The minimum pool velocity fish had to negotiate (or rest in) was 0.2 m/sec recorded in both pool 7 and pool 16.

0n the 22nd December (elevated base flow, river height = 7.63 m) the minimum slot velocity fish had to negotiate while ascending the fishway was 1.3 m/sec through ridges 3, 6, 15, 24, 28 and 30. The

minimum pool velocity fish had to swim through (or rest in) was 0.2 m/sec recorded in pool 15 (Figure 6). Insufficient data was able to be recorded at pool 1 and ridge 1 when samples were being taken, and thus the plot commences at pool 2.

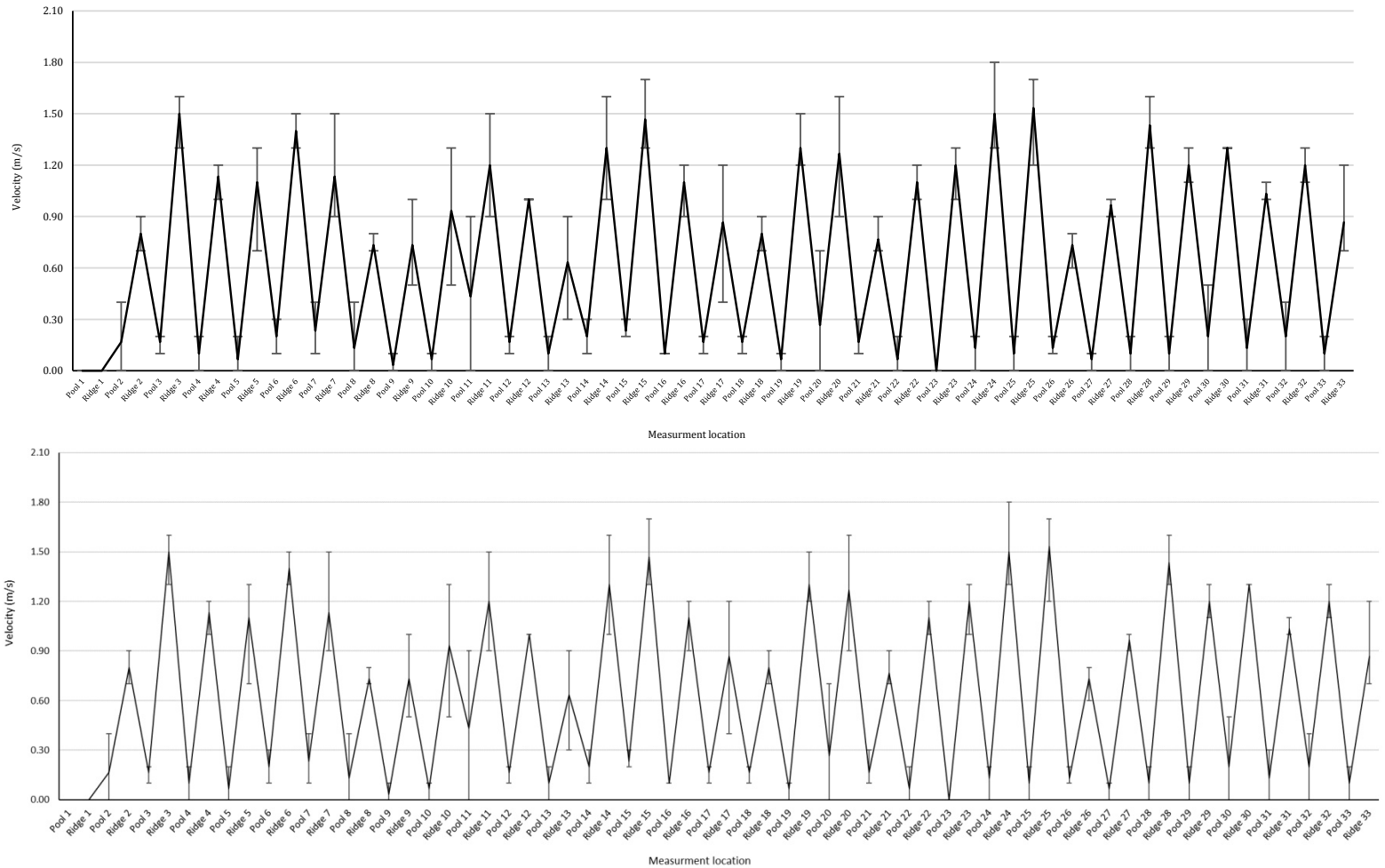


Figure 6. Fishway flow velocities during the monitoring period with flow velocities recorded at 12:00PM on the 20/12/17 (top) and 5:00PM on the 22/12/17 (bottom). Note pool 1 is the first pool at the base of the fishway whilst ridge 33 is the final ridge at the exit of the fishway on the upstream side

Water Quality

Water quality readings varied little between days in which observations were made throughout the monitoring period (Table 2). Observed measurements recorded were typical of the seasonal conditions of the region and characteristic of the habitat type. Temperature ranges across the sample period varied little, between 26°C and 27.1°C, with variation between replicates on sample days of .1°C. The pH range varied between 7.37 and 8.22, with a general trend observed of decreasing pH from upstream to downstream of the fishway. Dissolved oxygen concentrations ranged between 38.3% and 71% saturation and 3.18 and 5.62 mg/L, with an observed trend towards increasing dissolved oxygen concentrations moving from upstream to downstream of the fishway. Electrical conductivity readings also showed very little variation, ranging between 543 and 609 µs/cm, and variation in measurements on days surveyed of only 3 µs/cm.

Table 2. Water quality readings measured on three occasions over the monitoring period upstream and downstream of the fishway, as well as in the middle pool of the fishway

Date & Time	Temp (°C)			pH			DO (% sat.)			DO (mg/L)			EC (µs/cm)		
	U/S	Mid	D/S	U/S	Mid	D/S	U/S	Mid	D/S	U/S	Mid	D/S	U/S	Mid	D/S
18/12/17 9:00	26.3	26.2	26.2	8.22	7.75	7.64	48.2	61.3	64.8	3.86	4.96	5.16	546	543	543
19/12/17 7:15	26.1	26.1	26	7.87	7.61	7.54	42.1	59.4	63	3.41	4.78	5.1	550	548	549
22/12/17 7:45	27	27.1	27.1	7.55	7.37	7.38	38.3	62.2	71	3.18	4.96	5.62	609	609	609

Discussion

Fishway Trapping

The results of the fishway monitoring demonstrate that the rock-ramp fishway is successfully passing different fish species, size classes and life-stages of fish in the Bremer River. Significantly, the fishway was successful at passing juvenile diadromous and small bodied fish species which possess the weakest swimming abilities. Flathead gudgeon (*P. grandiceps*) as small as 19 mm were able to ascend the fishway, whilst long-finned eels (*A. reinhardtii*) as long as 1200mm were also able to ascend the fishway. In total, 16,401 fish moved through the fishway over the monitoring period, at a rate of 4075.5 fish/day. This was dominated by juvenile diadromous fish, with juvenile empire gudgeon (*H. compressa*), juvenile striped gudgeon (*G. australis*), juvenile sea mullet (*M. cephalus*) and juvenile freshwater mullet (*T. petardi*) contributing to 95.4% (n=15,643) of the total overall catch. This highlights the importance of the Berry's weir fishway in facilitating connectivity to important upstream nursery habitats for juvenile diadromous fish, which are required to move upstream to complete their life-cycle (Pusey, Kennard and Arthington 2004).

Significant numbers of economically important commercial, recreational and indigenous fishery species such as sea mullet, freshwater mullet and eel species were able to successfully ascend the fishway. Of these economically important fish, juvenile sea mullet were the most abundant with 1273 individuals recorded during sampling at a catch rate of 316.3 individuals per trapping day, followed by freshwater mullet (1073) and eel species (10) at catch rates of 266.6 and 2.5 individuals per day respectively. Sea mullet form one of the most important commercial fishery resources in south-east Queensland, where all of the fish is harvested and utilised for varying purposes. When extrapolated across an entire recruitment season, the numbers of juvenile sea mullet observed utilising the fishway and accessing upstream nursery habitats would in time have significant contribution to the sea mullet fishery output in south-east Queensland.

As the entire period of fishway monitoring was conducted during slightly elevated base flows, the results obtained give valuable insight into the species and number of individuals migrating upstream under normal flow conditions at the time of year sampled. Figure 7 below displays the hydrograph of stream height (m) at Berry's weir for the period monitored, with median fish length (mm) for each trap set period represented by a small circle and error bars representing the 10th and 90th percentile. Of the 14 individual trap set periods, 11 have very similar results with relatively consistent average median and 10th percentile fish sizes ascending the fishway. The first, fourth and seventh trap sets however have noticeably higher 90th percentile fish sizes. These trap sets do not correspond to any noticeable peaks or troughs in the hydrograph, so it is likely that these are simply indicative of larger fish moving upstream at random times as opposed to responses to changes in flow conditions.

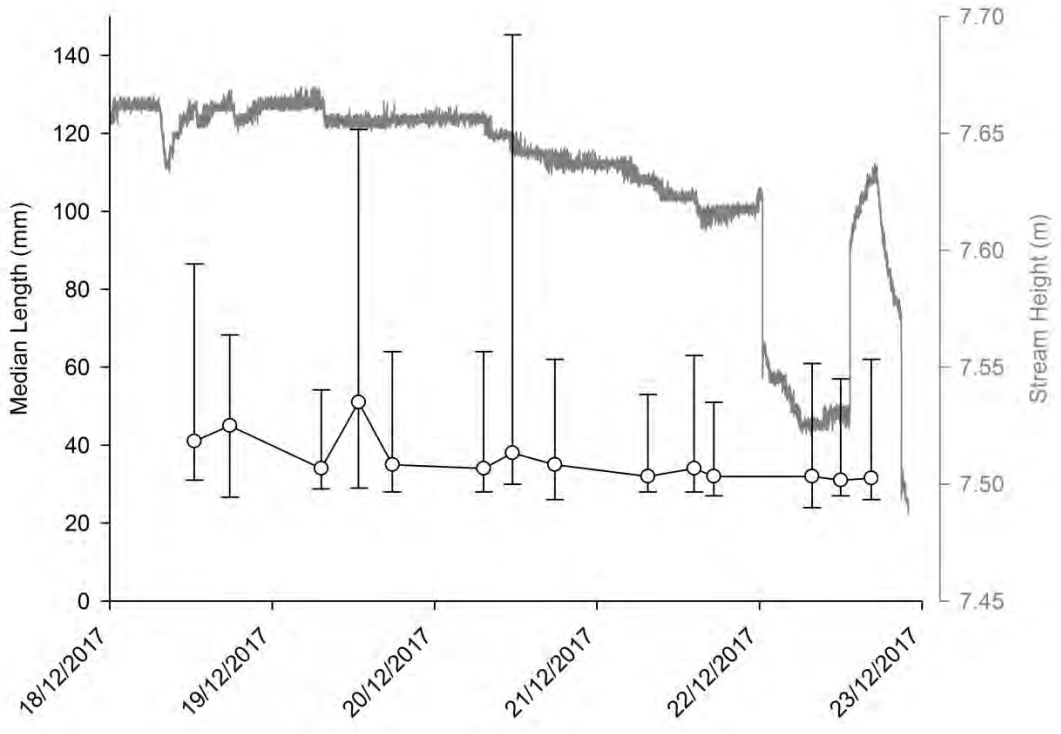


Figure 7. Hydrograph of stream height (m) at Berry's weir for period monitored, with median fish length (mm) for each trap set period represented by a small circle, and error bars representing the 10th and 90th percentile

Comparison to Monitoring Round 1, December 2016

As round 2 monitoring was carried out at an identical time to the first round of monitoring in December 2016, meaningful comparisons can be drawn as to the trends in fishway utilisation over the two monitoring rounds. Table 3 displays a breakdown of unique species which were captured during round 1 monitoring and not captured in round 2 monitoring, and also new species captured in round 2 monitoring which were not observed in round 1 monitoring. Note that Australian bass (*M. novemaculeata*) and Mary River cod (*M. mariensis*) captured during round 1 monitoring have been omitted from this breakdown as they were artificially stocked fish at the time of monitoring.

Table 3. Breakdown of species unique to each round of monitoring, including median fish size (mm) total number of individuals and catch per unit effort (fish/day)

	2016 Monitoring			2017 Monitoring		
Migration Classification	**Common name**	**Species name**	**Total Individuals**	**Common name**	**Species name**	**Total Individuals**
Diadromous				Freshwater mullet	*Trachystoma petardi*	1073
				Eel sp.	*Anguilla sp.*	4
Marine Vagrant	Yellowfin bream	*Acanthopagrus australis*	1			
Potamodromous	Agassizi's glassfish	*Ambassis agassizii*	2	Barred grunter	*Amniataba percoides*	1
	Eel-tailed catfish	*Tandanus tandanus*	1	Spangled perch	*Leiopotherapon unicolor*	2
	Fork-tailed catfish	*Arius graeffei*	6	Unspecked hardyhead	*Caterocephalus fulvus*	5
	Hypseleotris specie	*Hypseleotris sp.*	1263			
	Pacific blue-eye	*Pseudomugil signifer*	1			
	Platy	*Xiphophorous maculatus*	1			
	Speckled goby	*Redigobius bikolanus*	12			
		Median fish size	**34mm**		**Median fish size**	**34mm**
		Total Number of Individuals	**3,514**		**Total Number of Individuals**	**16,401**
		CPUE (Fish/day)	**690.4**		**CPUE (Fish/day)**	**4,075.5**

In total, there was eight species detected in round 1 monitoring of December 2016 which were not detected in round 2 monitoring in December 2017. Of these species, seven were captured in abundances of ≤ 12 individuals, with only a single individual captured of the eel-tailed catfish (*T. tandanus*), Pacific blue-eye (*P. signifer*), Platy (*X. maculatus*) and yellowfin bream (*A. australis*). Two individual Agassizi's glassfish (*A. agassizii*), six fork-tailed catfish (*A. graeffei*) and 12 speckled goby's (*R. bikolanus*) were also caught uniquely to 2016 monitoring. The only species caught unique to 2016 monitoring in significant abundances was the Hypseleotris specie (comprised of firetail gudgeons, *H. galii*, and the western carp gudgeon, *H. klunzingeri*) in which 1,263 individuals were captured at a rate of 248.1 fish per trapping day.

Throughout monitoring round 2, five new species were captured, again with four of these species caught in very low abundances of ≤ five individuals. A single barred grunter (*A. percoides*), two spangled perch (*L. unicolor*), four eel sp. (*Anguilla sp.*) and five Unspecked hardyhead (*C. fulvus*) were captured across the trapping period. The only species caught in significant numbers in round 2 which was not present in round 1 was the freshwater mullet (*T. petardi*) in which 1073 were captured at a rate of 266.6 fish per trapping day.

Interestingly, almost all of the unique species detected in each monitoring round were potamodromous, meaning that they can complete their entire life-cycle in freshwater, and besides natural dispersal, have no obligate necessity to move throughout systems (Koehn and Crook 2013). This could explain the low numbers of these unique species detected in each of the two monitoring rounds, and also help explain why they may have been detected in one round and not another. The detection of an individual yellowfin bream in round 1 could also be explained by similar dispersal. Yellowfin bream are known to be a marine vagrant species which can tolerate low salinities, and at times will move freely into freshwater habitats to feed (Allen, Midgley and Allen 2002).

Freshwater mullet and eel sp. were the only unique diadromous fish species detected amongst the two monitoring rounds. Furthermore, along with unspecked hardyhead, this is the first-time freshwater mullet have been detected in the upper Bremer River catchment, with neither of these species detected throughout Healthy Waterways (EHMP) fish community surveys over the past 14 years on over 90 occasions. This emphasises the necessity of fishways, in allowing diadromous fishes free passage between upstream and downstream habitats. Previous to fishway installation, recruiting juvenile freshwater mullet would have been unable to access significant expanses of upstream nursery habitat (Allen, Midgley and Allen 2002).

The numbers of fish caught in round 2 monitoring (n=16,401) were substantially higher than that of round 1 monitoring (n=3,514), with over four times as many fish captured. Catch rates for each trapping period went from 690.4 fish per day in December 2016, to 4075.5 fish per day in December 2017 (see Appendix 1 for detailed breakdown of round 1 catch results). This substantial increase in fishway utilisation could potentially be due to the elevated base flow conditions experienced during the time of round 2 sampling in December 2017. The river height data hydrograph (Figure 5) shows a sustained period of consistent flow during the monitoring period of December 2017 averaging 7.62m, and was the most stable point of the hydrograph for the entire month. There were three flow peaks which appear on the hydrograph earlier in the month when flows reached 8.4, 8.1 and 8.2 m which potentially cued diadromous fishes to migrate upstream, and then the steady period of flow during the sample period provided suitable conditions for upstream fish movements.

Alert & Action

All of the results obtained during the second round of fishway monitoring in December 2017 suggest the fishway is functioning as designed. In total, 16 fish species were detected utilising the fishway, at a rate of 4075.5 fish ascending the fishway per day over the sampling period. Over the elevated base flow conditions monitored, flow velocities of each pool and ridge of the fishway sit well within suitable ranges for upstream movement of juvenile and small-bodied native fish. There are no current deficiencies in fishway performance.

References

Allen, G.R., Midgley, S.H. and Allen, M. (2002) *Field guide to the freshwater fishes of Australia*, Western Australia Museum, Perth.

Koehn, J.D. and Crook, D.A. (2013) '*Movements and migration*', Ch. 5, pp. 105- 129 in Humphries, P and Walker, K.F. (Eds) (2013) '*Ecology of Australian Freshwater Fishes*', CSIRO Publishing.

Pusey, B., Kennard, M. and Arthington, A. (2004) *Freshwater fishes of north-eastern Australia*, CSIRO Publishing, Victoria.

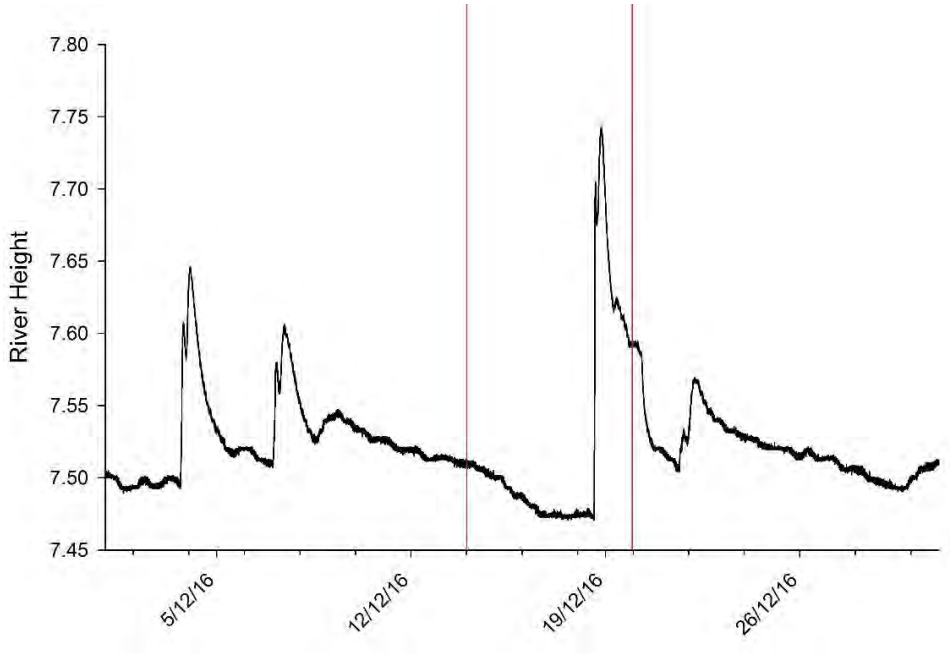
Appendix 1- Round 1 Monitoring Fishway Trapping Results

Overall fish catch data during round 1 monitoring in December 2016, separated into migratory classifications and displaying the minimum, maximum and median sizes (mm) as well as the total number of individuals captured and catch per unit effort (fish/day).

Migration Classification	Common Name	Species Name	Size			Total Individuals	CPUE (fish/day)
			Min (mm)	Median (mm)	Max (mm)		
Diadromous	Empire gudgeon	*Hypseleotris compressa*	19	35	52	581	114.1
	Striped gudgeon	*Gobiomorphus australis*	21	35	52	407	80
	Sea mullet	*Mugil cephalus*	38	65	72	198	38.9
	Australian bass#	*Macquaria novemaculeata*	30	35	48	41	8.1
	Bullrout	*Notesthes robusta*	35	54	58	8	1.6
	Long-finned eel	*Anguilla reinhardtii*	70	255	550	14	2.8
Marine Vagrant	Yellowfin bream*	*Acanthopagrus australis*	254	254	254	1	0.2
Potamodromous	Crimson-spotted rainbowfish	*Melanotaenia duboulayi*	18	31	74	903	177.4
	Hypseleotris species	*Hypseleotris sp.*	15	23	41	1263	248.1
	Bony bream	*Nematalosa erebi*	110	118	254	6	1.2
	Speckled goby	*Redigobius bikolanus*	25	29	33	12	2.4
	Firetail gudgeon	*Hypseleotris galii*	31	31	33	5	1
	Flathead gudgeon	*Philypnodon grandiceps*	20	31	51	52	10.2
	Australian smelt	*Retropinna semoni*	24	32	40	10	2
	Fork-tailed catfish	*Arius graeffei*	230	298	350	6	1.2
	Pacific blue-eye*	*Pseudomugil signifer*	32	32	32	1	0.2
	Eel-tailed catfish*	*Tandanus tandanus*	34	34	34	1	0.2
	Agassiz's glassfish	*Ambassis agassizii*	40	47	53	2	0.4
	Mary River cod*#	*Maccullochella mariensis*	62	62	62	1	0.2
Pest Fish (Potamodromous)	Tilapia*	*Oreochromis mossambicus*	72	72	72	1	0.2
	Platy*	*Xiphophorus maculatus*	25	25	25	1	0.2
Overall min, median, max, total individuals/CPUE (fish/hour)			**15**	**34**	**550**	**3514**	**690.4**
Total Species			**21**				

Appendix 2- Round 1 Monitoring Hydrograph

River height readings from Berry's Weir (fishway site), during round 1 monitoring in December 2016. The area between the red lines represents the period of fishway monitoring. (Source: Stanwell, Swanbank Power Station, December 2016).



Conservation and Environment Committee	
Mtg Date: 16.07.18	OAR: YES
Authorisation: Bryce Hines	

TS:TS
H:\Departmental\Commitee Reports\1806TS Flying-fox weed control subsidy and local management plans CR

25 June 2018

M E M O R A N D U M

TO: SPORT RECREATION AND NATURAL RESOURCES MANAGER

FROM: PLANNING OFFICER (BIODIVERSITY)

RE: FLYING-FOX WEED CONTROL SUBSIDY AND LOCAL MANAGEMENT PLANS

INTRODUCTION:

This is a report by the Planning Officer (Biodiversity) dated 25 June 2018 concerning the creation of a weed control subsidy for flying-fox colonies and timelines and engagement strategies for development of local roost management plans.

BACKGROUND:

At Council's Ordinary Meeting held on 29 May 2018 it was resolved*:*

A. That Council contact all residents adjacent to the Deebing Creek Flying-Fox Colony and seek an update on their property management activities with regard to flying foxes.

B. That Council offer a subsidy program under the Environmental Weed Program to support impacted residents adjacent to all flying fox colonies.

C. That a regular meeting with impacted divisional councillors occur to discuss flying fox management plans.

A copy of this report is shown in Attachment A.

The matter of flying-foxes was further discussed at the June Conservation and Environment Committee and at the Council Ordinary Meeting held on 26 June 2018 it was resolved:

A. That the Planning Officer (Biodiversity) make the recommended edits to the Flying-fox Roost Management Plan to be reflective of the broader suite of in-situ management techniques that have been used through South East Queensland.

B. That the Chief Operating Officer (Works Parks and Recreation), in consultation with the Chairperson of the Conservation and Environment Committee and relevant Divisional Councillors develop a suite of Local Roost Management Plans for flying-fox roosts located on Council owned and/or managed land across the City over the next six (6) months for presentation at a future Conservation and Environment Committee.

A copy of this report is shown in Attachment B.

This report provides an update on the subsidy program under the Environmental Weed Program and a proposed schedule for the development of local area management plans for consideration.

ENVIRONMENTAL WEED SUBSIDY FOR FLYING-FOX COLONIES:

Context

Council has previously used removal of environmental weeds as a flying-fox management action, primarily through the removal of woody weeds at the Yamanto flying-fox colony where they represented high quality roosting habitat. The viability of this depends on a number of factors, including the ease of control, potential adverse impacts of weed control and how much of the colony is actually composed of environmental weeds.

Legislation

The state definition of a flying-fox roost refers to trees or other places where flying-foxes congregate from time to time for breeding or rearing of young. Importantly this definition does not make any distinction between native or non-native vegetation, meaning that in the context of flying-fox management they are treated the same. This is contrary to other state legislation where clearing non-native vegetation is usually an exempt activity. This definition accounts for the majority of local roosts which make use of a variety of non-native vegetation.

What is actually considered a roost and therefore subject to state compliance activity under the above definition is usually recognised though mapping conducted at a local level. The Planning Officer (Biodiversity) monitors roosts across Ipswich every quarter on behalf of the State and produces roost maps as part of this activity. It is also important to note that an area can still be considered a roost despite not being occupied for several years e.g. Pan Pacific Peace Gardens has been empty since 2014 but could still be recolonised at any time while there is suitable habitat and nearby foraging resources.

Meaning for landholders

Given non-native vegetation, including environmental weeds, can still be considered flying-fox roosting habitat they are still subject to relevant legislation. For a private landholder this means that to remove weeds from a recognised flying-fox roost, a Damage Mitigation Permit from the Department of Environment and Science would be required. Council could conduct the works under its existing as-of-right authority to manage flying-fox roosts without a permit. All works, either by Council or private landholders, would then need to be conducted under the Code of Practice - Ecologically sustainable management of flying-fox roosts (Attachment C).

This would not be the case where environmental weeds are saplings or juvenile trees. Where this is the case, they can be managed under the Code of Practice - Low impact activities affecting flying-fox roosts (Attachment D). Under this Code of Practice activities such as mulching, weeding and mowing are authorised for all landholders without a permit. This arrangement was used by Council during management actions at the Yamanto colony where Council used its as-of-right authority to remove roosting vegetation in the first instance and landholders were responsible for maintaining the weedy regrowth under the Low impact activities Code of Practice.

Recommended approach

Given the complexity of legislation with regard to removing environmental weeds from flying-fox colonies it is suggested that any works be coordinated by Council under its as-of-right authority. This would have the following advantages:

- Initial works could be coordinated under Councils as-of-right, greatly reducing the administrative work required by landholders
- Given it is unlikely that all landholders would want to complete an application for a Damage Mitigation Permit, having works coordinated by Council could lead to holistic action across a roost that spans multiple properties.
- Council can maintain some oversight, ensuring that management actions within flying-fox colonies are ecologically sensible, especially with regard to maintaining habitat for heat wave refuge.

Integration with local management plans

Under Council's Flying-fox Roost Management Plan, some of the roosts within Ipswich would be considered low risk or preferred roost locations. As such it is not recommended that any modification to roosting habitat, native or weed, be undertaken at these locations.

This emphasizes that weed management and associated subsidies cannot be used as a management tool uniformly across the city. Instead it is recommended that weed management activities, and any future subsidies be implemented only in locations where it is considered a suitable management action. Locations where this is a suitable management action should be reflected in and driven by local management plans rather than having a weed subsidy available to all residents that live near a flying-fox colony.

CREATION OF LOCAL MANAGEMENT PLANS FOR ROOSTS ON COUNCIL OWNED OR MANAGED LAND:

Content

Each local management plan will include the following:

- Background on species and population numbers
- History of known complaints and the nature of complaints
- Roost status under the ICC Flying-fox Roost Management Plan (i.e. medium risk, low risk, preferred roost location)
- History of management actions at the site
- Mapping of the roost including what is considered the extent of the roost under the state definition
- Mapping and list of properties to be considered affected by the roost (this is mainly for the purpose of defining suitable management actions)
- Recommended and prioritised management actions (including whether a weed subsidy program would be considered appropriate)

Order and timing of creation

1. Lorikeet Street Reserve Bundamba – Division 4 – July 2018
2. Queens Park Nature Centre – Division 7 – October 2018
3. Pilny Reserve/Sandy Creek Camira – Division 1 – December 2018
4. Poplar Street Reserve Walloon – Division 10 – December 2018
5. Woodend Nature Centre – Division 7 – December 2018
6. Pan Pacific Peace Gardens – Division 2 – December 2018

Consultation Process

The relevant divisional Councillors will be consulted on each local management plan within their division over two stages:

Stage 1: Presentation and feedback on a draft map and draft management actions
Stage 2: Feedback and finalisation of local management plan

These consultation sessions will be conducted in person to ensure that certainty and clear expectations are established and conducted and will include impacted divisional Councillors.

CONCLUSION:

An environmental weed subsidy program may be considered a suitable management action in certain locations across the city. However, there are practical and ecological risks associated with implementing a program uniformly across the city.

In addition, there are legislative constraints with regard to the status of environment weeds as suitable flying-fox habitat that would greatly reduce the ability of landholders to effectively implement the program. These risks can be mitigated through the creation of local roost management plans that will set the direction and identify where a weed subsidy program should be implemented.

Over the next six (6) months local management plans will be developed in order to guide the direction of the environmental weed subsidy and other suitable management actions. These plans are sequenced to ensure adequate consultation is undertaken to inform the management actions.

ATTACHMENTS:

Name of Attachment	Attachment
Conservation and Environment Committee Report No. 2018(05) of 21 May 2018	Attachment A
Conservation and Environment Committee Report No. 2018(06) of 18 June 2018	Attachment B
Code of Practice - Ecologically sustainable management of flying-fox roosts	Attachment C
Code of Practice - Low impact activities affecting flying-fox roosts	Attachment D

RECOMMENDATION:

A. That Council develop local management plans following the schedule and consultation process as outlined in the report by the Planning Officer (Biodiversity) dated 25 June 2018.

B. That an environmental weed subsidy be included as a management action at appropriate locations and included within and subject to the relevant local management plan.

C. That where required, any future use of an environmental weed subsidy through implementation of a local management action is coordinated by Council using its as-of-right authority under the *Nature Conservation Act 1992*.

D. That the local management plans be developed in consultation with the Chairperson of the Conservation and Environment Committee and relevant divisional Councillors.

Tim Shields
PLANNING OFFICER (BIODIVERSITY)

I concur with the recommendation/s contained in this report.

Kaye Cavanagh
SPORTS RECREATION AND NATURAL RESOURCES MANAGER

I concur with the recommendation/s contained in this report.

Bryce Hines
CHIEF OPERATING OFFICER (WORKS, PARKS AND RECREATION)

Conservation and Environment Committee	
Mtg Date: 21.05.2018	OAR: YES
Authorisation: Bryce Hines	

TS: TS
H:\Departmental\Commitee Reports\1804TS Management Options for Yamanto Flying-fox colony CR.docx

30 April 2018

M E M O R A N D U M

TO: ACTING SPORT RECREATION AND NATURAL RESOURCES MANAGER

FROM: PLANNING OFFICER (BIODIVERSITY)

RE: MANAGEMENT OPTIONS FOR YAMANTO FLYING-FOX COLONY – DIVISION 7

INTRODUCTION:

This is a report by the Planning Officer (Biodiversity) dated 30 April 2018 concerning future management actions for the Yamanto flying-fox colony.

BACKGROUND:

The Yamanto flying-fox colony extends across Deebing Creek, covering Box Street and Beechwood Drive and is located on private property and Unallocated State Land (being the Deebing Creek corridor). This roost has been raised as a concern by a number of residents previously, and more recently through an email to Mayor dated 18 March 2018.

Under Council's Flying-fox Roost Management Plan the Yamanto roost is classified as medium risk; which specifies - where a medium conflict roosts exists on private property Council may consider a partnership with the Queensland Government and landholders to undertake in-situ management actions on private land. Dispersal actions would only be considered under high risk scenarios.

In 2016, Council undertook works to create a distance buffer between residents and roosting flying-foxes. This was done by altering vegetation on the western and southern sides of Deebing Creek through removal of large woody weeds and selected trimming of native vegetation.

PURPOSE:

This report outlines a process for Council to be able to make an informed decision regarding the on-going management of the Yamanto Flying Fox Roost.

The report lists a suite of management options including the potential advantages, disadvantages and cost to Council for each.

All management options will need to be in accordance with Council's adopted Flying-fox Roost Management Plan (FFRMP), Flying-fox Roost Management Policy, the *Nature Conservation Act 1992 (Qld)* and its associated regulations and codes of practice, and the *Environmental Protection and Biodiversity Conservation Act 1999 (Cwth)*.

Council is required to make a decision to either stand by the previous arrangement to do no further work at the Yamanto roost site, or to invest in further works selected from the options outlined below.

MANAGEMENT OPTIONS:

Option 1: Vegetation modification

Description:
Much of the vegetation removed in 2016 to create a physical buffer between roosting flying-foxes has regrown and may recreate the previous flying-fox habitat on the western and southern sides of Deebing Creek. The licence agreements signed by the participating residents in 2016 stated that on-going management of vegetation following completion of the initial works was the responsibility of the landholder. However, Council understands that this has not occurred.

Management option 1 is to undertake another round of vegetation modification to consolidate the buffer created in 2016 through removal of regrowth and woody weeds.

Advantages:
- This action was successful previously at this location;
- Removal of regrowth is relatively easy given the previous clearing of woody weeds;
- Some residents who participated in the initial works may be receptive to follow up actions.

Disadvantages:
- Vegetation modification works are dependent on when and where flying-foxes are located in a colony;
- On-going management of the site was not undertaken following the initial works, as specified in the licence agreement with residents;
- There are many areas within the creek corridor where vegetation management cannot occur under state legislation (ie: Riverine Protection Permits);
- Further action may not appease all residents, particularly where they feel impacts have been compounding over time and cite issues such as mental health impacts

Costs:
Works conducted in 2016 cost $60,000 for vegetation modification and weed removal on 14 properties and one bank of Deebing Creek.

Given the work has previously been done, it is expected that further vegetation management in these areas would cost $40,000-$50,000, depending on the presence and abundance of flying-foxes within the colony, as prices will increase where night works are required.

Option 2: Active dispersal

Description:
Active dispersal involves the continual use of accepted techniques in an attempt to permanently disperse flying-foxes from a colony. The actions that can be undertaken are regulated through the relevant State and Commonwealth legislation and associated guidelines, guiding the timing and type of actions. In addition, the success of the dispersal is highly variable as flying-foxes are extremely mobile and often travel short distances to form a new roost, or make use of another existing roost.

Active dispersal of the Yamanto colony would require Council staff or contractors, in agreement with landholders, to enter private property to conduct dispersal actions. To ensure a successful outcome native vegetation on private property and along Deebing Creek would need to be removed.

Advantages:
- If successful, permanently disperse flying-foxes from the current colony.

Disadvantages:
- High chance of failure;
- High risk and uncertainty of where flying-foxes will settle once dispersed;
- High risk of creating a new roost in close proximity to the current site or joining another existing or previous site such as Lorikeet Street Reserve or Queens Park Nature Centre;
- Effort is high cost and resource intensive in the immediate to short term;
- Dispersal actions will need to be recurring until all animals have left the roost site;
- Loss of native vegetation on private property and along Deebing Creek increasing a risk of bank erosion and regrowth of weed species;
- Noise disturbance to residents whilst undertaking the dispersal actions which may extend over a number of days to weeks. Actions are required to be undertaken before dawn or after dusk;
- Legislative constraints on the time of year when dispersal actions can be undertaken.

Costs:
Cost can be highly variable depending on a number of factors including:
- Size of colony and area requiring dispersal actions;
- Number of personnel required;
- Number of days required to undertake works;
- Whether dispersal actions are successful;
- Where dispersed flying-foxes land;
- Whether vegetation modification is required;
- The time a colony of flying-foxes has occupied a site for;

- Presence and abundance of local food sources.

When considering all of the factors above, upfront dispersals cost could be anywhere between $50,000 and $500,000. Given the large numbers of flying-foxes and area covered by the Yamanto colony, costs are likely to be in the hundreds of thousands. Given that the colony occupies the riparian area of the highly erosive Deebing Creek, complete vegetation removal may not be an option, so flying-foxes would continually be drawn back to the site. As such an ongoing yearly cost of $50,000 to $100,000 would be required.

Case studies:
The Melbourne Botanic Gardens is the best example of the amount of effort required to conduct a flying-fox dispersal where complete vegetation removal is not appropriate. Dispersal efforts were successful at a cost of over $3,000,000 with works ongoing to this day to ensure flying-foxes do not return to the gardens.

Other dispersals, such as in Charters Towers, have cost over $400,000 and are still considered unsuccessful.

Option 3: Extend distance buffer

Description:
Further works conducted within Deebing Creek to extend the buffer between residents on Beechwood Drive and Box Street. Further habitat is available for roosting on the Briggs Road side of Deebing Creek where conflict with landowners is substantially lower.

Works would potentially require additional remediation of Deebing Creek to minimise potential erosion.

Previous correspondence with the Department of Natural Resources and Mines indicates that additional works within the creek corridor (deemed to be Unallocated State Land) would require additional permits before vegetation clearing and potentially written approval from the Minister.

Advantages:
- Increase the effectiveness of previous buffering actions as a method for reducing the impacts;
- Push flying-foxes further from residences where current conflict occurs;
- Avoid the need to remove flying-foxes from the roost while reducing impacts on residents livelihoods;
- Existing Licence Agreements between Council and the majority of landholders in this area.

Disadvantages:
- Significant risk involved with further clearing of vegetation on Deebing Creek and increased erosion risk;

- Increased administration and potential delays to obtain permits required from the Department Natural Resources Mines and Energy with Ministerial approval;
- Pushing flying-foxes further towards Briggs Road and further from the creek corridor (through substantial removal of roosting vegetation) could potentially make the entire roost unsuitable and flying-foxes may begin roosting in different parts of Deebing Creek or more to another nearby site;
- Further works in Deebing Creek will remove a substantial portion of the heat stress refuge habitat within the Yamanto flying-fox colony, increasing risk of mortality at this location;
- Previous works at Yamanto flying-fox colony have shown that on-going maintenance of the site has not been undertaken by landholders;
- Council is unable to maintain the site as it is on private property and Unallocated State Land.

Costs:
- It is expected that costs would increase from the previous works, due to remediation works to reduce erosion risk on Deebing Creek post vegetation clearance;
- Potential expectation for Council to fund on-going maintenance works to ensure vegetation does not become suitable for roosting again.

Option 4: Artificial buffering (e.g. canopy mounted sprinklers)

Description:
Where complete removal of vegetation is not possible or desirable by residents, artificial buffers can be used. Currently, approved artificial buffers are mostly limited to the use of canopy mounted sprinklers. The arc of the sprinklers creates a zone that flying-foxes find non-desirable and are not likely to roost in. Sprinklers can be mounted along a boundary of a property or along the current edge of a colony to push or nudge roosting flying-foxes in the desired direction. This technique was recently trialled in the Queens Park Nature Centre with anecdotal success.

Council can consider giving ownership of the sprinklers to residents, allowing the residents to decide when to turn them on and off. Council may also consider subsidizing water costs to residents.

Advantages:
- Non offensive buffering effect;
- Can retain trees and aesthetic value and other vegetation whilst still making trees undesirable for roosting;
- Can be very selective and target specific trees for buffering;
- Can give residents ownership and sense of power with managing the issues;
- The technique has been used successfully by other local authorities at trail sites.

Disadvantages:
- Requires additional permits under the Nature Conservation Act beyond Council's current as-of-right provisions;

- Will require a commitment from all landholders to ensure there is no "gap" in the artificial buffer;
- Will not completely remove the impacts of smell and mess from a colony;
- Costs and works are ongoing indefinitely;
- Can be logistic difficulties in installation.

Costs:
Refer to Sunshine Coast case study below.

Case studies:
Sunshine Coast Regional Council has installed an extensive series of canopy mounted sprinklers at one of their most contentious flying-foxes colonies. The council used a line of sprinklers on either side of the colony where houses ran adjacent and pushed the colony towards the middle of the site. Sunshine Coast gave control of the sprinklers to the residents and subsidised water costs. The Council had to hire professional tree climbers to install the sprinklers.

During the first year of the project Sunshine Coast Regional Council spent approx. $60,000, including equipment purchase, installation costs and water costs.

Option 5: Subsidy program (double glazing and other services)

Description:
A subsidy program would provide an option for residents living directly next to an active flying-fox roost to receive a subsidy towards a pre-determined set of products or services. The subsidy would only be available to residents who immediately adjoin an active roost site and can demonstrate a significant financial or health impact. The subsidy would cover products or services that can reduce in-situ impacts of roosting flying-foxes on residents such as noise and smell. These may include:

- Air fresheners;
- Car covers;
- Clotheslines covers;
- High pressure water cleaners;
- Professional solar panel cleaning;
- Double glazing windows.

Advantages:
- Solutions can be tailored to the needs of an individual based on their main grievances;
- Relatively inexpensive;
- Can increase resident satisfaction with Council actions, creating a working relationship.

Disadvantages:
- Different methods may have varying level of effectiveness;
- The set of products or services may not appease residents of the flying-fox colony;
- Determining an appropriate subsidy to be made available to residents;
- Residents may still be restricted for use of their outdoor areas.

Costs:
Costs vary greatly depending on the following:

- Number of residents to take up the subsidy;
- The willingness and uptake of residents;
- Amount of subsidy provided to each applicant.

Case studies:
Noosa Council subsidy program

Noosa Council trialled a subsidy program for one of its flying-fox colonies that was offered to 55 affected residences within 75m of the colonies extent.

After a three month trial, residents were surveyed to gauge their satisfaction with the services provided. The most important finding was that the program had successfully reduced the majority of residents concerns with regard to living near a flying-fox colony:

Previous impact of FF on their lifestyle = 7.6/10

Current impact of FF on their lifestyle = 3.2/10

CONCLUSION:

A suite of management options are available to Council, each of which has distinct advantages and disadvantages. No one option is likely to be 100% effective at reducing the direct and indirect impacts of roosting flying-foxes on the livelihood of Yamanto residents.

If Council decides to undertake further works, that Option 1 - Vegetation Modification be considered in the first instance, with a proposal for Option 5 - Subsidy Program to be presented with additional cost details at a future Conservation and Environment Committee.

If Council decides to not undertake further works, that advice be provided to the affected residents in Beechwood Drive and Box Street.

RECOMMENDATION

Amended at Conservation and Environment Committee No. 2018(05) of 21 May 2018.

~~A. That Council implements Option 1 to undertake one more run of maintenance of the area along Deebing Creek that was subject to the previous vegetation modification works.~~

B. That Council offer a subsidy program under the Environmental Weed Program to support impacted residents adjacent to all flying fox colonies.

C. That a regular meeting with impacted divisional councillors occur to discuss flying fox management plans.

Formatted: Indent: Left: 0", Hanging: 0.59"

Formatted: Indent: Left: 0", Hanging: 0.59", Numbered + Level: 1 + Numbering Style: A, B, C, … + Start at: 1 + Alignment: Left + Aligned at: 0.25" +

~~B. That Council investigates the feasibility of a subsidy program to support impacted~~

Tim Shields
PLANNING OFFICER (BIODIVERSITY)

I concur with the recommendation/s contained in this report.

Kaye Cavanagh
ACTING SPORT RECREATION AND NATURAL RESOURCES MANAGER

I concur with the recommendation/s contained in this report.

Bryce Hines
CHIEF OPERATING OFFICER (WORKS, PARKS AND RECREATION)

Conservation and Environment Committee	
Mtg Date: 18.06.18	OAR: YES
Authorisation: Bryce Hines	

TS: TS
H:\Departmental\Commitee Reports\1806TS Review of ICC Flying-fox Roost Management Plan CR.docx

5 June 2018

M E M O R A N D U M

TO: ACTING SPORT RECREATION AND NATURAL RESOURCES MANAGER

FROM: PLANNING OFFICER (BIODIVERSITY)

RE: REVIEW OF THE IPSWICH CITY COUNCIL FLYING-FOX ROOST MANAGEMENT PLAN AND DEVELOPMENT OF LOCAL ROOST MANAGEMENT PLANS

INTRODUCTION:

This is a report by the Planning Officer (Biodiversity) dated 5 June 2018 concerning a review of Council's Flying-fox Roost Management Plan and the development of local roost management plans.

BACKGROUND:

A report detailing management options for Yamanto flying-fox was presented to Conservation and Environment Committee No. 2018(05) of 21 May 2018 and Council Ordinary Meeting 29 May 2018 (Attachment A).

Based on discussions at the Conservation and Environment Committee it was determined that Council officers:

A. Provide a copy of, the Flying-fox Roost Management Plan to a future meeting (Attachment B)
B. Undertake a preliminary review of the Flying-fox Roost Management Plan
C. Consider the development of local roost management plans.

PURPOSE:

The purpose of the review of the Flying-fox Roost Management Plan is to:

1. Ensure the plan remains consistent with State legislation
2. Reconfirm Council's position on managing roosts on private land
3. Ensure Council's suite of management options remains up to date with best practice and consistent with other local governments across south-east Queensland

4. Develop further clarity around the consistent and appropriate application of the plan across geographical areas, divisions and different roosts

KEY CONSIDERATIONS IN REVIEW OF THE FLYING-F0X ROOST MANAGEMENT PLAN:

1: Consistency with state legislation

Council adopted the Flying-fox Roost Management Plan in 2015. This followed amendments to the *Nature Conservation Act 1992* in late 2013 that gave local governments' as-of-right authority to manage flying-fox roosts where they fell within an Urban Flying-fox Management Area. The legislation and accompanying codes of practice have remained unchanged since 2013, and the Flying-fox Roost Management Plan remains consistent and up-to-date with relevant State and Commonwealth legislation.

2: Management of flying-foxes on private land

The Flying-fox Roost Management Plan operates on the principles of risk management with two main risk matrices, being:

1. Risk regarding the choice of management actions and associated consequences
2. Risk regarding the geographical context of a roost

With regards to managing roosts on private land, available options under the management plan are guided by the risk profile of the relevant roost. The current position remains relevant and consistent with Council's approach to roost management.

3: Current best practice

Flying-fox management in south-east Queensland has increased significantly in its sophistication since the amendments to the *Nature Conservation Act 1992* in late 2013.

One of the primary changes has been the reduction in the number of active dispersals been undertaken. Based on the evidence and outcomes concerning active dispersals it is well recognised across local and state government that dispersals are associated with high risk, high cost and low success rate. Council's current Management Plan acknowledges this approach through its Management Action Assessment Process, which only recommends dispersal as last resort action for high risk areas.

While dispersal is now used less frequently across SEQ, the number of in-situ management techniques has increased and is highly variable. At the time of writing the Flying-fox Roost Management Plan, in-situ management techniques were primarily limited to vegetation management. It is recommend that the development of local roost management plan be reflective of the greater suite of in-situ management actions, and that a slight amendment be made to the Flying-fox Roost Management Plan. Such techniques include, but are not limited to, canopy mounter sprinklers, artificial buffering and subsidy programs.

4: Consistent application

Given the primary decision making tools within the Management Plan are risk based, the need or request for management actions can be assessed on a case by case basis. This allows for consistent application of the assessment framework across all flying-fox roosts. This also means that not all flying-fox roosts across the city receive the same management actions, as this assessment framework recognised the incredible complexity of flying-fox colonies.

Another important component of the Management Plan specifies that where a flying-fox roost is recognised as low risk or a preferred roost location, management actions are generally not required. For example, Poplar Street Reserve exists mostly within a rural road reserve and is only occupied for several short periods of time per year. It is also a substantial distance away from any places of residence and is thus considered a preferred roost location under the plan.

While the Management Plan explicitly describes the type of geographic risk and its selection criteria, this is not tied back to specific local roosts. As such, a suite of local roost management plans are proposed to be developed for each known roost within the local government area. These local plans will identify the risk level for the roost, illustrate constraints and local considerations, and list suitable management actions going forward.

This type of local plan has previously been developed for some roosts following elevated levels of community complaints. A plan for the Bundamba roost has been provided as an example in Attachment C.

CONCLUSION:

Upon review of the Ipswich Flying-fox Roost Management Plan, it is evident that it provides Council with a robust framework for assessing the need for management actions on a case by case basis. The plan remains consistent with State and Commonwealth legislation whilst providing Council with the tools for consistent application across the local government area.

In response to updated flying-fox roost management since the time of writing, the Plan should be updated to reflect this. In addition the creation of local management plans will help highlight how the management plan as a whole, is used and reflected at a local level.

ATTACHMENTS:

Name of Attachment	Attachment
Conservation and Environment Committee No. 2018(05) of 21 May 2018 and Council Ordinary Meeting 29 May 2018	Attachment A
Ipswich Flying-fox Roost Management Plan	Attachment B

Example local plan – Lorikeet Street Reserve	Attachment C

RECOMMENDATIONS:

A. That the Planning Officer (Biodiversity) make the recommended edits to the Flying-fox Roost Management Plan to be reflective of the broader suite of in-situ management techniques that have been used through South East Queensland.

Amended at Conservation and Environment Committee No. 2018(06) of 18 June 2018.

B. That the Chief Operating Officer (Works Parks and Recreation), in consultation with the Chairperson of the Conservation and Environment ~~, Works Parks and Sport~~ Committee and relevant Divisional Councillors develop a suite of Local Roost Management Plans for flying-fox roosts located on Council owned and/or managed land across the City over the next six (6) months for presentation at a future Conservation and Environment Committee.

Tim Shields
PLANNING OFFICER (BIODIVERSITY)

I concur with the recommendation/s contained in this report.

Kaye Cavanagh
ACTING SPORT RECREATION AND NATURAL RESOURCES MANAGER

I concur with the recommendation/s contained in this report.

Bryce Hines
ACTING FCHIEF OPERATING OFFICER (WORKS, PARKS AND RECREATION)

Conservation and Environment Committee	
Mtg Date: 21.05.2018	OAR: YES
Authorisation: Bryce Hines	

TS: TS
H:\Departmental\Commitee Reports\1804TS Management Options for Yamanto Flying-fox colony CR.docx

30 April 2018

M E M O R A N D U M

TO: ACTING SPORT RECREATION AND NATURAL RESOURCES MANAGER

FROM: PLANNING OFFICER (BIODIVERSITY)

RE: MANAGEMENT OPTIONS FOR YAMANTO FLYING-FOX COLONY – DIVISION 7

INTRODUCTION:

This is a report by the Planning Officer (Biodiversity) dated 30 April 2018 concerning future management actions for the Yamanto flying-fox colony.

BACKGROUND:

The Yamanto flying-fox colony extends across Deebing Creek, covering Box Street and Beechwood Drive and is located on private property and Unallocated State Land (being the Deebing Creek corridor). This roost has been raised as a concern by a number of residents previously, and more recently through an email to Mayor dated 18 March 2018.

Under Council's Flying-fox Roost Management Plan the Yamanto roost is classified as medium risk; which specifies - where a medium conflict roosts exists on private property Council may consider a partnership with the Queensland Government and landholders to undertake in-situ management actions on private land. Dispersal actions would only be considered under high risk scenarios.

In 2016, Council undertook works to create a distance buffer between residents and roosting flying-foxes. This was done by altering vegetation on the western and southern sides of Deebing Creek through removal of large woody weeds and selected trimming of native vegetation.

PURPOSE:

This report outlines a process for Council to be able to make an informed decision regarding the on-going management of the Yamanto Flying Fox Roost.

The report lists a suite of management options including the potential advantages, disadvantages and cost to Council for each.

All management options will need to be in accordance with Council's adopted Flying-fox Roost Management Plan (FFRMP), Flying-fox Roost Management Policy, the *Nature Conservation Act 1992 (Qld)* and its associated regulations and codes of practice, and the *Environmental Protection and Biodiversity Conservation Act 1999 (Cwth).*

Council is required to make a decision to either stand by the previous arrangement to do no further work at the Yamanto roost site, or to invest in further works selected from the options outlined below.

MANAGEMENT OPTIONS:

Option 1: Vegetation modification

Description:
Much of the vegetation removed in 2016 to create a physical buffer between roosting flying-foxes has regrown and may recreate the previous flying-fox habitat on the western and southern sides of Deebing Creek. The licence agreements signed by the participating residents in 2016 stated that on-going management of vegetation following completion of the initial works was the responsibility of the landholder. However, Council understands that this has not occurred.

Management option 1 is to undertake another round of vegetation modification to consolidate the buffer created in 2016 through removal of regrowth and woody weeds.

Advantages:
- This action was successful previously at this location;
- Removal of regrowth is relatively easy given the previous clearing of woody weeds;
- Some residents who participated in the initial works may be receptive to follow up actions.

Disadvantages:
- Vegetation modification works are dependent on when and where flying-foxes are located in a colony;
- On-going management of the site was not undertaken following the initial works, as specified in the licence agreement with residents;
- There are many areas within the creek corridor where vegetation management cannot occur under state legislation (ie: Riverine Protection Permits);
- Further action may not appease all residents, particularly where they feel impacts have been compounding over time and cite issues such as mental health impacts

Costs:
Works conducted in 2016 cost $60,000 for vegetation modification and weed removal on 14 properties and one bank of Deebing Creek.

Given the work has previously been done, it is expected that further vegetation management in these areas would cost $40,000-$50,000, depending on the presence and abundance of flying-foxes within the colony, as prices will increase where night works are required.

Option 2: Active dispersal

Description:
Active dispersal involves the continual use of accepted techniques in an attempt to permanently disperse flying-foxes from a colony. The actions that can be undertaken are regulated through the relevant State and Commonwealth legislation and associated guidelines, guiding the timing and type of actions. In addition, the success of the dispersal is highly variable as flying-foxes are extremely mobile and often travel short distances to form a new roost, or make use of another existing roost.

Active dispersal of the Yamanto colony would require Council staff or contractors, in agreement with landholders, to enter private property to conduct dispersal actions. To ensure a successful outcome native vegetation on private property and along Deebing Creek would need to be removed.

Advantages:
- If successful, permanently disperse flying-foxes from the current colony.

Disadvantages:
- High chance of failure;
- High risk and uncertainty of where flying-foxes will settle once dispersed;
- High risk of creating a new roost in close proximity to the current site or joining another existing or previous site such as Lorikeet Street Reserve or Queens Park Nature Centre;
- Effort is high cost and resource intensive in the immediate to short term;
- Dispersal actions will need to be recurring until all animals have left the roost site;
- Loss of native vegetation on private property and along Deebing Creek increasing a risk of bank erosion and regrowth of weed species;
- Noise disturbance to residents whilst undertaking the dispersal actions which may extend over a number of days to weeks. Actions are required to be undertaken before dawn or after dusk;
- Legislative constraints on the time of year when dispersal actions can be undertaken.

Costs:
Cost can be highly variable depending on a number of factors including:
- Size of colony and area requiring dispersal actions;
- Number of personnel required;
- Number of days required to undertake works;
- Whether dispersal actions are successful;
- Where dispersed flying-foxes land;
- Whether vegetation modification is required;
- The time a colony of flying-foxes has occupied a site for;

- Presence and abundance of local food sources.

When considering all of the factors above, upfront dispersals cost could be anywhere between $50,000 and $500,000. Given the large numbers of flying-foxes and area covered by the Yamanto colony, costs are likely to be in the hundreds of thousands. Given that the colony occupies the riparian area of the highly erosive Deebing Creek, complete vegetation removal may not be an option, so flying-foxes would continually be drawn back to the site. As such an ongoing yearly cost of $50,000 to $100,000 would be required.

Case studies:
The Melbourne Botanic Gardens is the best example of the amount of effort required to conduct a flying-fox dispersal where complete vegetation removal is not appropriate. Dispersal efforts were successful at a cost of over $3,000,000 with works ongoing to this day to ensure flying-foxes do not return to the gardens.

Other dispersals, such as in Charters Towers, have cost over $400,000 and are still considered unsuccessful.

Option 3: Extend distance buffer

Description:
Further works conducted within Deebing Creek to extend the buffer between residents on Beechwood Drive and Box Street. Further habitat is available for roosting on the Briggs Road side of Deebing Creek where conflict with landowners is substantially lower.

Works would potentially require additional remediation of Deebing Creek to minimise potential erosion.

Previous correspondence with the Department of Natural Resources and Mines indicates that additional works within the creek corridor (deemed to be Unallocated State Land) would require additional permits before vegetation clearing and potentially written approval from the Minister.

Advantages:
- Increase the effectiveness of previous buffering actions as a method for reducing the impacts;
- Push flying-foxes further from residences where current conflict occurs;
- Avoid the need to remove flying-foxes from the roost while reducing impacts on residents livelihoods;
- Existing Licence Agreements between Council and the majority of landholders in this area.

Disadvantages:
- Significant risk involved with further clearing of vegetation on Deebing Creek and increased erosion risk;

- Increased administration and potential delays to obtain permits required from the Department Natural Resources Mines and Energy with Ministerial approval;
- Pushing flying-foxes further towards Briggs Road and further from the creek corridor (through substantial removal of roosting vegetation) could potentially make the entire roost unsuitable and flying-foxes may begin roosting in different parts of Deebing Creek or more to another nearby site;
- Further works in Deebing Creek will remove a substantial portion of the heat stress refuge habitat within the Yamanto flying-fox colony, increasing risk of mortality at this location;
- Previous works at Yamanto flying-fox colony have shown that on-going maintenance of the site has not been undertaken by landholders;
- Council is unable to maintain the site as it is on private property and Unallocated State Land.

Costs:
- It is expected that costs would increase from the previous works, due to remediation works to reduce erosion risk on Deebing Creek post vegetation clearance;
- Potential expectation for Council to fund on-going maintenance works to ensure vegetation does not become suitable for roosting again.

Option 4: Artificial buffering (e.g. canopy mounted sprinklers)

Description:
Where complete removal of vegetation is not possible or desirable by residents, artificial buffers can be used. Currently, approved artificial buffers are mostly limited to the use of canopy mounted sprinklers. The arc of the sprinklers creates a zone that flying-foxes find non-desirable and are not likely to roost in. Sprinklers can be mounted along a boundary of a property or along the current edge of a colony to push or nudge roosting flying-foxes in the desired direction. This technique was recently trialled in the Queens Park Nature Centre with anecdotal success.

Council can consider giving ownership of the sprinklers to residents, allowing the residents to decide when to turn them on and off. Council may also consider subsidizing water costs to residents.

Advantages:
- Non offensive buffering effect;
- Can retain trees and aesthetic value and other vegetation whilst still making trees undesirable for roosting;
- Can be very selective and target specific trees for buffering;
- Can give residents ownership and sense of power with managing the issues;
- The technique has been used successfully by other local authorities at trail sites.

Disadvantages:
- Requires additional permits under the Nature Conservation Act beyond Council's current as-of-right provisions;

- Will require a commitment from all landholders to ensure there is no "gap" in the artificial buffer;
- Will not completely remove the impacts of smell and mess from a colony;
- Costs and works are ongoing indefinitely;
- Can be logistic difficulties in installation.

Costs:
Refer to Sunshine Coast case study below.

Case studies:
Sunshine Coast Regional Council has installed an extensive series of canopy mounted sprinklers at one of their most contentious flying-foxes colonies. The council used a line of sprinklers on either side of the colony where houses ran adjacent and pushed the colony towards the middle of the site. Sunshine Coast gave control of the sprinklers to the residents and subsidised water costs. The Council had to hire professional tree climbers to install the sprinklers.

During the first year of the project Sunshine Coast Regional Council spent approx. $60,000, including equipment purchase, installation costs and water costs.

Option 5: Subsidy program (double glazing and other services)

Description:
A subsidy program would provide an option for residents living directly next to an active flying-fox roost to receive a subsidy towards a pre-determined set of products or services. The subsidy would only be available to residents who immediately adjoin an active roost site and can demonstrate a significant financial or health impact. The subsidy would cover products or services that can reduce in-situ impacts of roosting flying-foxes on residents such as noise and smell. These may include:

- Air fresheners;
- Car covers;
- Clotheslines covers;
- High pressure water cleaners;
- Professional solar panel cleaning;
- Double glazing windows.

Advantages:
- Solutions can be tailored to the needs of an individual based on their main grievances;
- Relatively inexpensive;
- Can increase resident satisfaction with Council actions, creating a working relationship.

Disadvantages:
- Different methods may have varying level of effectiveness;
- The set of products or services may not appease residents of the flying-fox colony;
- Determining an appropriate subsidy to be made available to residents;
- Residents may still be restricted for use of their outdoor areas.

Costs:
Costs vary greatly depending on the following:

- Number of residents to take up the subsidy;
- The willingness and uptake of residents;
- Amount of subsidy provided to each applicant.

Case studies:
Noosa Council subsidy program

Noosa Council trialled a subsidy program for one of its flying-fox colonies that was offered to 55 affected residences within 75m of the colonies extent.

After a three month trial, residents were surveyed to gauge their satisfaction with the services provided. The most important finding was that the program had successfully reduced the majority of residents concerns with regard to living near a flying-fox colony:

Previous impact of FF on their lifestyle = 7.6/10

Current impact of FF on their lifestyle = 3.2/10

CONCLUSION:

A suite of management options are available to Council, each of which has distinct advantages and disadvantages. No one option is likely to be 100% effective at reducing the direct and indirect impacts of roosting flying-foxes on the livelihood of Yamanto residents.

If Council decides to undertake further works, that Option 1 - Vegetation Modification be considered in the first instance, with a proposal for Option 5 - Subsidy Program to be presented with additional cost details at a future Conservation and Environment Committee.

If Council decides to not undertake further works, that advice be provided to the affected residents in Beechwood Drive and Box Street.

RECOMMENDATION

Amended at Conservation and Environment Committee No. 2018(05) of 21 May 2018.

~~A. That Council implements Option 1 to undertake one more run of maintenance of the area along Deebing Creek that was subject to the previous vegetation modification works.~~

A. That Council contact all residents adjacent to the Deebing Creek Flying-Fox Colony and seek an update on their property management activities with regard to flying foxes.

B. That Council offer a subsidy program under the Environmental Weed Program to support impacted residents adjacent to all flying fox colonies.

C. That a regular meeting with impacted divisional councillors occur to discuss flying fox management plans.

~~B. That Council investigates the feasibility of a subsidy program to support impacted residents, as detailed in Option 5 of the report by the Planning Officer (Biodiversity) dated 30 April 2018.~~

Tim Shields
PLANNING OFFICER (BIODIVERSITY)

I concur with the recommendation/s contained in this report.

Kaye Cavanagh
ACTING SPORT RECREATION AND NATURAL RESOURCES MANAGER

I concur with the recommendation/s contained in this report.

Bryce Hines
CHIEF OPERATING OFFICER (WORKS, PARKS AND RECREATION)

IPSWICH FLYING-FOX ROOST MANAGEMENT PLAN

City of Ipswich

Document Control:

Version	Date issued	Reviewed by	Approved by	Date approved	Comments
FINAL		Kaye Cavanagh Craig Maudsley Bryce Hines Divisional Councillors			

Document location:	H:\SRNR\NR Strategic\Wildlife\Ipswich Flying-Fox Roost Management Plan
Document name:	Ipswich Flying-Fox Roost Management Plan
Document version:	FINAL
Author:	Natural Resources Team

Contents

Glossary of Terms:

Buffering: Creation or maintenance of a physical separation between humans and roosting flying-foxes aimed at reducing conflict with the surrounding area, providing visual separation or mitigating noise and smell.

Camp: a collection of flying-foxes sharing roosting space and congregating within close proximity. The fluidity of movement and turnover of individuals prevents flying-foxes from forming true colonies as listed above.

Roost: a tree, collection of trees, or other place where flying-foxes congregate from time to time for breeding or rearing dependent young. This does not include trees where flying-foxes may temporarily occupy for the purposes of feeding.

Maternity roost: a roost with a high proportion of pregnant females or females with dependent young.

Dependent young: are juvenile flying-foxes unable to independently fly.

Juveniles: are flying-foxes up to 6 months of age.

Management actions: non-lethal actions intended to stop flying-foxes from making use of a site or part of a site.

Place of residence: any form of dwelling on private property in which a person lives. This does not include sheds or any other constructs on private property.

Council owned and or managed land: any parcel of land that is owned by Council through any means, or land for which Council is trustee to another owner or has formal management responsibilities (Eg. a Conservation Park under the *Nature Conservation Act 1992*).

Private property: Any parcel of land owned by a member of the public or private company.

Public facilities: infrastructure or facilities used by the public for recreation or similar purposes. Such facilities could include public barbeques, benches and public toilets etc.

List of Acronyms:

ICC: Ipswich City Council

LGA: Local Government Area

EHP: Department of Environment and Heritage Protection (State)

UFFMA: Urban Flying-fox Management Area

HRR: High risk roost

MCR: Medium conflict roost

LCR: Low conflict roost

PRL: Preferred roost location

NER: Newly established roost

HRA: High risk action

HeV: Hendra virus

ABL: Australian bat lyssavirus

SoMI: Statement of Management Intent

FFMP: Flying-fox Management Plan

DMP: Damage Mitigation Permit

NCA: *Nature Conservation Act 1992* (State)

EPBC: *Environmental Protection and Biodiversity Conservation Act 1999* (Cth)

DAFF: Department of Agriculture, Forestry and Fisheries (State)

NES: National environmental significance

EFFMT: Electronic Flying-fox Monitoring Template

PPE: Personal Protective Equipment

NAT: Natural Areas Team (Council)

ACPA: *Animal Care and Protection Act 2001* (State)

VMA: *Vegetation Management Act 1999* (State)

1.0 Executive Summary

1.1 Background

An increasingly developed and urbanised landscape is driving an unprecedented level of contact between humans and flying-foxes. Loss of traditional feeding areas and extremes of climate are also factors driving flying-foxes and humans together. With increased contact community concerns around the implications of living in close proximity to flying-foxes have also elevated.

Subject to changes in season and food availability Ipswich may be home to between 4 and 10 flying-fox roosts located along water courses in urban, peri-urban or rural areas. Individual black and grey-headed flying-foxes may be present year round however roost numbers generally swell during Summer with the seasonal influx of little red flying-foxes. These expanded roosts and increased flying-fox numbers are also the trigger for elevated levels of community concern or conflict.

In 2013 the Queensland Government sought to provide greater legislative flexibility for managing flying-fox roosts in areas of high community conflict. Local governments were given a voluntary as-of-right authority allowing them, if they so choose, to implement additional management actions for flying-fox roosts within a defined urban area.

These management actions are limited to non-lethal methods and may only be undertaken in accordance with the statutory Code of Practice – *Ecologically sustainable management of flying-fox roosts*. Local governments were also advised to develop and publish a policy describing how they intended to manage flying-fox roosts within their defined urban area.

This management plan has been developed to advise and guide Council's management of current and future flying-fox roosts within the city. It contains the key information and management processes necessary to implement Council's recently adopted Statement of Management Intent – *Flying-fox Roost Management in Ipswich City*. The plan supports well informed, balanced and consistent flying-fox management actions both within and outside the defined urban area.

Central to implementation of the plan is a risk based approach to flying-fox roost management. This seeks a balanced delivery of Council's key policy objective:

"To protect the health, wellbeing and livelihoods of the residents of Ipswich City while recognising the important ecological role performed by flying-fox populations."

The plan identifies a series of 'risk based' roost management zones derived from escalating levels of community exposure to, or conflict with, roosting flying-foxes. Informed by an ongoing program of quarterly and 'conflict based' roost monitoring, actual levels of risk and associated requirements for management action are identified.

A hierarchical approach to management actions is then employed to achieve appropriate community outcomes whilst minimising the potential for unnecessary harm or disturbance to flying-foxes. This approach favours community education and minimal intervention strategies and maintains consistency with legislative requirements. Unless exceptional circumstances are identified, intrusive roost management actions including significant

vegetation modification and flying-fox dispersal will only be considered within high risk locations and after less intrusive actions have been tried and found to be unsuccessful.

The plan is also founded on the principle of case by case assessment of flying-fox roosts and conflict levels. Roosts are highly dynamic systems with the number, species composition and location of flying-foxes subject to seasonal, frequent and sometimes daily change. This dynamic requires that any management actions are based on individual site circumstances and actual risk levels *in situ*.

Under the plan, Council has a key responsibility for managing flying-fox roosts on lands under its ownership or control. In addition, where a roost occupies both Council land and adjacent private property, the plan identifies a range of mechanisms by which Council can work with and assist land owners. However, flying-fox matters located on State or Commonwealth lands are outside the scope of this plan and will be referred to the respective land managers.

Council will provide a package of support to private land owners with flying-fox roost management issues. The plan details an assistance package based on the provision of education materials, technical advice and referral to expert information sources. Council officers engaged in flying-fox management have found this approach highly successful in addressing much of the misinformation surrounding flying-foxes and easing community concerns.

Finally, all management actions developed and implemented through the management plan will be guided by a risk and benefit framework. This will consider the actual level of community risk, resource requirements and likelihood of success prior to identifying the most appropriate management action.

Some flying-fox management actions are particularly resource intensive and have a poor record for resolving the initial levels of conflict. Council will strive to avoid these high risk actions, thereby also decreasing the need for ongoing management actions in order to mitigate adverse outcomes of prior attempts – the so called treadmill effect.

1.2 Goals and Objectives

This plan is designed to guide Council's management of flying-foxes and, in particular, flying-fox roosts. It aims to ensure that any and all management actions are lawful, well informed and consistent throughout the city.

Council's primary objective through the implementation of this plan is to protect the wellbeing, health and livelihoods of the residents of Ipswich. At the same time Council will strive to conserve the cities flying-fox populations and the essential ecological roles they perform.

2.0 Background Matters

2.1 Flying-fox Species

Three of the four Australian flying-fox species have overlapping distributions which coincide with the south-east Queensland region as depicted in Figure 1. All roost in camps ranging in size from less than 100 to hundreds of thousands of individuals (Hall & Richards 2000). Roosts are generally located within dense vegetation with thick, often weedy understory, close to sources of water where humidity is high (Loughland 1993). Roost choice is also closely associated with the proximity and abundance to foraging resources.

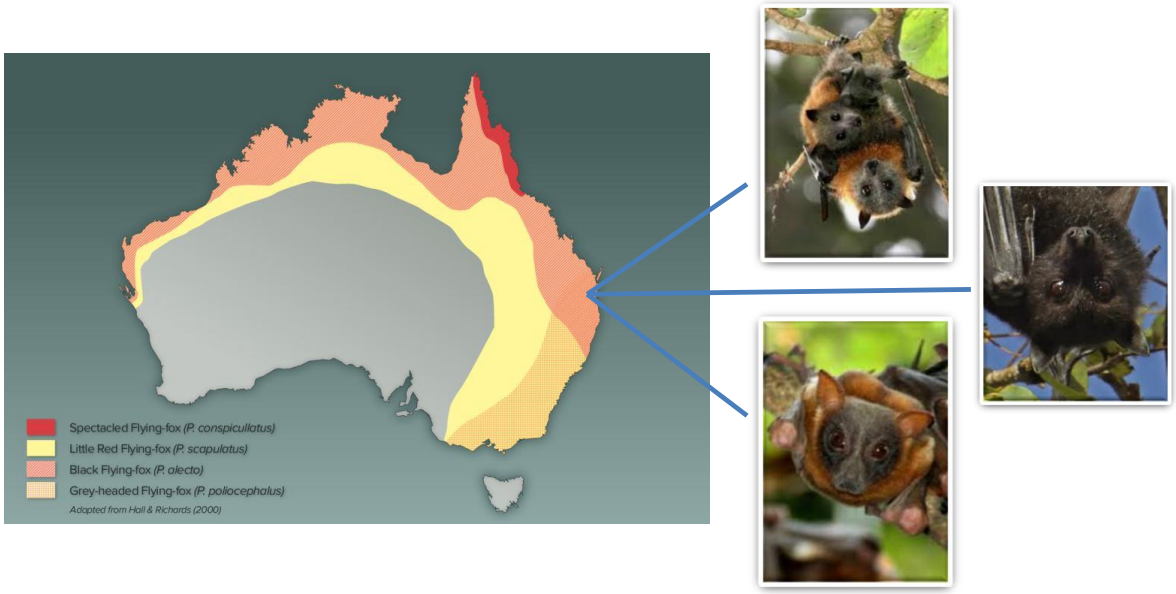


Figure 1. Distribution map of Australian flying-foxes and, clockwise from top, grey-headed flying-fox, black flying fox and little red flying-fox.

Both grey-headed and black flying foxes have a similar diet, feeding on various fruits, nectar and pollen (McDonald-Madden et al. 2005). They migrate long distances in response to available food supplies making them important pollinators and seed dispersers. Sharing of roost sites is also common and the two species are similar in size making them difficult to tell apart.

The behavioural ecology of flying-fox species ensures that roosts have a high degree of variability in species composition, numbers and distribution over time. Individual flying-foxes change roosts frequently and roost locations also change in response to food availability and site suitability. In addition, the little red flying-fox is nomadic in the region arriving and departing in tune with the summer flowering for eucalypt species. This variable and dynamic nature has considerable implications for roost management.

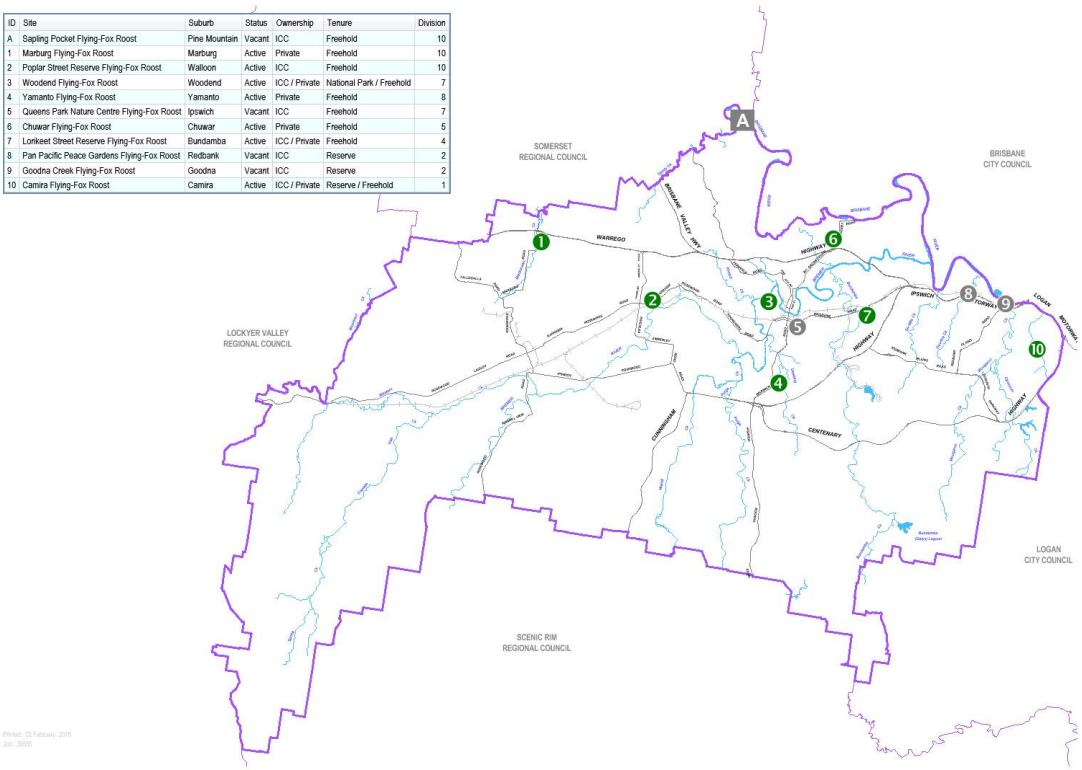
A more detailed description of flying-fox biology and behavioural ecology including a species identification key is provided in Section 6.1.

2.2 Local Flying-fox Roosts

Subject to changes in season and food availability, Ipswich has been home to between 4 and 10 flying-fox camps in the past year. All are located in roosts found along natural or man-made water courses in urban, peri-urban and rural areas of the city as shown in Figure 2. The highest number of both camps and individual flying-foxes occurs during the summer months with the seasonal influx of little red flying-foxes.

During preparation of this plan a quarterly roost monitoring and mapping program was developed and implemented and individual roost histories prepared. This process identified a number of important temporal and spatial relationships leading to local roost development since the early 1980s. In addition, flying-fox roost numbers collected by the Department of Environment and Heritage and Council have been graphed, where available, for the same period.

Historical and ongoing monitoring of local roosts has been used to develop an accurate and useable knowledge base of flying-fox movements throughout the city. Future monitoring will provide up to date information on species numbers, distribution, seasonal dynamics and historical movements of flying-fox camps along with their proximity to places of residence, critical infrastructure or other sensitive facilities. Further information on Council's roost monitoring program as well as local roost histories and associated mapping and graphing is presented in Section 6.5 and 6.6 respectively.



ID	Site	Suburb	Status	Ownership	Tenure	Division
A	Sapling Pocket Flying-Fox Roost	Pine Mountain	Vacant	ICC	Freehold	10
1	Marburg Flying-Fox Roost	Marburg	Active	Private	Freehold	10
2	Poplar Street Reserve Flying-Fox Roost	Walloon	Active	ICC	Freehold	10
3	Woodend Flying-Fox Roost	Woodend	Active	ICC / Private	National Park / Freehold	7
4	Yamanto Flying-Fox Roost	Yamanto	Active	Private	Freehold	8
5	Queens Park Nature Centre Flying-Fox Roost	Ipswich	Vacant	ICC	Freehold	7
6	Chuwar Flying-Fox Roost	Chuwar	Active	Private	Freehold	5
7	Lonkeet Street Reserve Flying-Fox Roost	Bundamba	Active	ICC / Private	Freehold	4
8	Pan Pacific Peace Gardens Flying-Fox Roost	Redbank	Vacant	ICC	Reserve	2
9	Goodna Creek Flying-Fox Roost	Goodna	Vacant	ICC	Reserve	2
10	Camira Flying-Fox Roost	Camira	Active	ICC / Private	Reserve / Freehold	1

Figure 2: Flying-fox roost locations recorded within Ipswich City in 2013 – 2014. Roost status is based on monitoring data obtained in August 2014.

2.3 Public Health

In the past two decades the emergence of Hendra virus (HeV) and Australian bat lyssavirus (ABVL) has sparked health concerns within the community. While sometimes overstated, genuine risks may be present and community requests for management action resulting from fear of disease must be carefully considered and assessed.

In doing so Council will rely on advice and guidance from expert agencies such as Queensland Health and Biosecurity Queensland and ensure the public have access to the most up to date sources of information. Further information on disease risk and associated mitigation strategies is provided in Section 6.2.

The increase in heat related flying-fox mortality events represents a time of elevated threat to public health whilst also being a significant conservation challenge. During extreme heat events flying-foxes move in search of shade and may come to ground outside the roost area while still alive or recently deceased. These actions are likely to significantly increase the potential for contact with the public and their pets thereby elevating the potential disease risk. Further information on how Council will manage roost based heat mortality events is contained in Section 6.3.

With appropriate management, the risk of infection from flying-foxes is low. People should avoid assisting or handling flying-foxes directly. Sick, injured, or orphaned flying-foxes should be immediately reported to Bat Conservation and Rescue Queensland on 0488 228 134 or the RSPCA on 1300 264 625.

2.4 Legislation

All species of flying-fox in Queensland are protected under the State *Nature Conservation Act 1992* (NCA). Under section 88C of the Act a person cannot take (kill) or drive away flying-foxes or modify their roosts unless they are an authorised person or are authorised to do so under the Act.

Following recent amendments to the *Nature Conservation (Wildlife Management) Regulation 2006*, local governments in Queensland now have an as-of-right authority to manage flying-fox roosts in a defined Urban Flying-Fox Management Area (UFFMA), if they so choose. This authority includes the ability to actively disperse a flying-fox roost or conduct other non-lethal management actions without a Damage Mitigation Permit.

In addition, the grey-headed flying-fox is listed as a Vulnerable species under the Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act) making it a matter of National Environmental Significance (NES). It is an offence to undertake an action that is likely to have a 'significant impact' on a matter of National Environmental Significance without approval from the Australian Government Minister.

Further information on the statutory protections afforded to flying-foxes, associated species and roost management requirements and a map showing the UFFMA are contained in Section 6.4.

2.5 Council Policy

As part of the recent amendments to the *Nature Conservation Act 1999*, Councils were asked to develop a Statement of Management Intent (SoMI) for flying-fox roost management within their UFFMA. Ipswich City Council's SoMI was adopted on 22 April 2014 and describes a framework for management of existing and new flying-fox roosts within the city.

In particular, the SoMI provides the important policy aspects which are further developed and or delivered through this management plan.

These include the following matters:

- Council's policy will apply to flying-fox roosts located throughout the city (both within and outside of the UFFMA)
- Council will manage flying-fox roosts located on Council owned or managed land
- Management of roosts on State or Commonwealth land is outside the scope of Council's policy
- Where a roost occupies both Council land and adjacent private property, Council will work with the respective land owner/s to develop management solutions, consistent with this policy, and the flying-fox management plan
- A risk based assessment process will be used to determine the most appropriate roost specific management actions
- Due to the highly mobile and dynamic nature of flying-fox roosts any management actions will be considered and developed on a case by case basis
- A hierarchical approach to flying-fox roost management will be employed favouring education and minimal intervention strategies
- Intensive roost management actions including dispersals will only be considered after less intrusive actions have been tried and found to be unsuccessful
- Human health and wellbeing will be given primary consideration over the health and wellbeing of flying-foxes where significant conflict is found to exist between the two
- Council will support private property owners to manage flying-fox roosts on their land through a range of services including provision of education materials, technical support, research data and referral to expert information sources
- Council acknowledges that flying foxes perform an essential ecological role, pollinating and dispersing the seeds of native plants and maintaining forest health

A full copy of the SOMI is included as Appendix A.

3.0 The Management Approach

3.1 Risk Based Management

Flying-foxes roosting in large camps within urban and rural areas often generate community concerns and or conflict. Excessive noise at dusk and dawn, odour and risk of disease spread are a common cause of complaint. In addition, the rural areas of Ipswich have large numbers of horse owners for whom the potential spread of Hendra virus is also of concern.

Strong seasonal trends are also evident with public concerns spiking during the summer months, particularly with the arrival of little red flying-foxes. This is a key aspect of flying-fox management as this species is nomadic and changes roosts regularly. Concerns for large colonies of roosting flying-foxes are often allayed when little reds commence their northern migration at the end of summer.

The extent to which an individual roost creates a risk to public health or generates community conflict may depend on a number of factors. These can include species numbers and location, camp structure, camp health and surrounding land use. Media coverage and the level of knowledge and or sensitivity of the surrounding community are also important factors.

To protect public health while also maintaining a consistent approach to flying-fox roost management Council will employ a risk based management approach. This recognises that some land uses are less compatible with flying-fox roosts than others and that physical separation between people and roosting flying-foxes is an effective risk management tool.

The following sections describe a hierarchy of risk based management zones identified by the proximity of flying-foxes roosting on Council owned or managed land to a range of surrounding land uses. The policy setting and associated management actions considered applicable to each zone, along with their implications for flying-fox management, are further described in Sections 3 and 4.

3.1.1 High Risk Roosts

Flying-fox roosts may be located in areas that are considered to be in high conflict with the potential to have considerable adverse implications for the local community. Examples of such localities include roosts located on Council owned or managed land within 100 metres of sensitive public facilities such as:

- Hospitals
- Medical facilities
- Child care centres
- Aged care homes
- Schools
- High profile public places
- Formal equestrian facilities (or within 100m of unvaccinated horses)

- Aviation facilities

3.1.2 Medium Conflict Roosts

Flying-fox roosts located greater than 100 metres from sensitive facilities may still be capable of generating conflict within the community in certain circumstances. Roosting flying-foxes on Council owned or managed land will be considered to be in medium conflict where they meet with the following criteria:

- Located greater than 100 metres from a sensitive facility; and
- Within 50 metres of a place of residence or commercial facility; or
- Within 50 metres of an area where horses commonly graze; or
- Within 50 metres of public facilities such as barbeques and toilets

3.1.3 Low Conflict Roosts

Flying-fox roosts located on Council owned or managed land with a low potential for community conflict will be considered to be low conflict roosts. These roosts will generally have significant roost separation consistent with the following criteria:

- Located greater than 100m from a sensitive facility; and
- Between 50 to 100 metres from any place of residence or commercial facility; or
- Greater than 50 metres from an area where horses commonly graze; or
- Greater than 50 metres from public facilities such as barbeques and toilets

3.1.4 Preferred Roost Locations

In some situations roosting flying-foxes create minimal community conflict and should be left alone to perform their important ecological role as pollinators and seed dispersers. The former Sapling Pocket roost (described in Section 6.6.1) was a good example of a preferred roost location. Unfortunately, unnecessary intervention at this roost led to the creation of multiple subsequent roosts located in higher conflict zones.

Areas will be considered highly suitable, preferred locations for retaining roosting flying-foxes where they meet the following criteria:

- Greater than 100 metres from a sensitive facility; and
- Greater than 100 metres from any place of residence or commercial facility; and
- Greater than 100 metres from an area where horses commonly graze; and
- Greater than 100 metres from public facilities such as barbeques and toilets; or
- On a Protected Area declared under the *Nature Conservation Act 1992*.

3.1.5 Mapping of Risk Management Zones

Management zones will be mapped to assist determination of risk levels and suitable management action on an as required basis. In general, this process will closely follow mapping associated with Council's roost monitoring program described in Section 6.5. Due to the potential for elevated levels of community concern priority will be given to mapping roosts believed to be in High or Medium conflict.

All roosts on Council owned or managed land will have their risk zone mapped as part of the assessment process preceding the determination of any management action. Mapping of risk levels is a key tool which will assist Council to develop appropriate, balanced and consistent roost management actions across the city.

3.2 Land Tenure and Flying-Fox Management

Flying-fox camps are highly dynamic, roosts expand and contract are colonised or abandoned on a frequent basis. Flying-foxes are also blind to land tenure, moving or spilling from one to another in ignorance of the potential impacts and likely consequences. As such, land tenure, ownership and management provide clear boundaries around which flying-foxes, and in particular their roosts, can be managed.

The following section describes the relationship of this management plan to some of the key land tenures on which flying-foxes may roost. Where applicable, an outline of how Council intends to respond to flying-foxes roosting in these situations is also provided.

3.2.1 Commonwealth and State lands

The management of flying-foxes and their roosts on lands under Commonwealth and State control is beyond the scope of this management plan. Where these matters arise they should be discussed directly with the respective land owner or manager. Where feasible, Council will attempt to monitor camps on these land tenures from 'off-site'. While somewhat constrained, this approach will assist is maintaining a knowledge base regarding the size and status of local flying-fox camps.

3.2.2 Private Property

Under the *Nature Conservation Act 1992* individuals, community organisations or businesses may apply for a damage mitigation permit to conduct flying-fox management actions on private property. These are available directly through the Department of Environment and Heritage Protection (EHP), subject to land owner authority to take action on a roost.

In addition, any member of the public can now conduct a range of low impact activities provided their intent is not to disturb or move flying foxes and they comply with the Code of Practice – L*ow impact activities affecting flying-fox roosts.* Examples of these low impact activities include mowing, weeding and minor tree trimming under or near roost trees where flying-foxes are not present in the subject trees. Further information on low impact activities and damage mitigation permits is provided in Section 6.4.2.

It is important to note that these are matters for a private property owner to discuss directly with the EHP or self-assess in the case of low impact activities. Only in those circumstances where roosts adjoin Council property and meet the criteria of high risk will Council seek to work in partnership with the relevant agency or land owner to plan and implement site based management actions.

However, as detailed in Section 4.3, Council will assist private property owners with flying-fox management issues through provision of a range of support services. These include access to educational and research materials, technical advice regarding key management strategies and referral to sources of expertise on flying-fox management and public health.

At the same time, Council will endeavour to make land owners aware of the relative risks and likely outcomes of their proposed actions. In limited cases Council may provide technical assistance to land owners wishing to apply for a Damage Mitigation Permit, or similar approval process, but will not make application to the State or Commonwealth on behalf of a property owner.

3.2.3 Council Owned or Managed Land

Council is responsible for management of flying-fox roosts on land under its ownership and control. To maintain knowledge of their current status these roosts will be subject to regular monitoring and evaluation as described in Section 6.5. In addition, Council will remain cognisant of community concerns and expectations surrounding these roosts.

Requirements for roost interventions on Council land will be assessed on a case by case basis. In particular, Section 4.2 describes a Management Action Hierarchy which will be used to guide and inform the need for, and form of, any roost management action. This assessment processes will ensure Council achieves the goals and objectives established in its policy and management plan while also complying with legislative requirements.

Again, it must be stressed that roosts are highly dynamic and subject to frequent change. As such the Management Action Hierarchy will be used as a guide to be applied to a particular set of circumstances, at a given point in time.

Flying-fox roosts on Council owned or managed land which meets Preferred Roost Locations will be encouraged and embellished as flying-fox habitat. This process may involve works to enhance native vegetation, remove exotic (weed) vegetation and manage fire. A selection of flying-fox roost and feed plants suitable for revegetation in the Ipswich area is included at Appendix B.

In some circumstances works designed to formalise public access and educate visitors about flying-foxes may also be undertaken - as has historically occurred at Woodend Nature Centre. Where there is no more suitable location available, or dispersal action is considered a high risk, similar works aimed at site revegetation and or community education may also be undertaken at Low Conflict Roosts.

Council will avoid management actions and works believed likely to cause flying-foxes roosting on Council land to spill over onto private property. In particular, techniques such as ‘buffering’ will be used to encourage roosts to remain on Council property.

Roosts present on Council owned or managed land for two successive years will be considered to be permanent. Additional planning requirements at permanent roosts will be assessed on a case by case basis. At present only the Woodend Flying-Fox Roost, comprising Woodend Nature Reserve, Harlin and Macrae Street Reserves has an individual flying-fox management plan.

3.2.4 Adjoining Council Owned or Managed Land

Council will seek to work in co-operation with private property owners where roosts occupy Council owned or managed land and adjoining private property. Again, in these instances, the Management Action Hierarchy and Management Action Assessment Process described in Sections 4.2 and 4.4 will form the basis for evaluating the need for, and most appropriate form of, management action.

In these circumstances, Council will assist adjoining private property owners through provision of a range of support services. These include access to educational and research materials, technical advice regarding key management strategies and referral to sources of expertise on flying-fox management and public health.

Where Council believes a roost on Council land and adjoining private property requires management action, Council will seek to identify and implement management actions, in conjunction with property owners, consistent with Council's policy and this management plan. This may involve Council taking the lead in obtaining any permit approvals and or co-ordinating delivery of on ground works.

However, as detailed in Section 6.4.2, should a land owner be dissatisfied with Council's preferred course of management action, they may still apply for a damage mitigation permit directly through the Department of Environment and Heritage Protection (EHP), for their own property or subject to land owner permission.

3.3 Roost Management Strategies

Council is responsible for management of flying-fox roosts on land under its ownership and control. In addition, Council will seek to work with property owners where roosts occupy Council owned or managed land and adjoining private property.

The following section provides guidance on how Council will respond to flying-foxes roosting in a number of specific situations. It should be read in conjunction with the land tenure policies described above.

3.3.1 Preferred Roost Locations

Some flying-fox roosts create little or no community conflict. Flying foxes in these locations perform an essential ecological role, pollinating and dispersing the seeds of native plants and maintaining forest health. Unfortunately, historical management actions taken against these roosts have often resulted in flying-fox camps roosting in higher conflict areas, thus commencing a treadmill of ongoing and escalating management actions.

Council will not attempt to disturb, disperse or relocate flying-foxes from these Preferred Roost Locations. Where appropriate, Council will seek to educate the community on flying-foxes and the benefits of not disturbing preferred roosts.

Where such roosts occur on Council owned or managed lands they will be encouraged and embellished as fling-fox habitat. This process may involve works to enhance native vegetation, remove exotic (weed) vegetation, manage fire and engage with the community as discussed in Section 3.2.3.

3.3.2 Newly Established Roosts

The age of a roost is an important consideration prior to any management action. Once a flying-fox camp has been roosting permanently at a site for longer than 3 months it is thought the animals will develop an attachment to the site and become increasingly more difficult to remove (Welbergen 2014, pers comm., 9 Jan). Within this plan the term Newly Established Roost will be used to identify a flying-fox camp that has been roosting for less than 3 months in a new roost location that has never been previously recorded as occupied.

Council will attempt to restrict the formation of Newly Established Roosts on Council owned or managed land where this is likely to lead to medium to high levels of community conflict. Management actions used to deter newly formed roosts will be directly related to the management zone in which they are roosting.

Council will commence management action to deter flying-foxes from creating new roosts in either High or Medium Risk locations. Due to their more suitable location, no action will be taken where flying-foxes attempt to roost in a Low Risk or Preferred Roost location where escalation to a higher risk category is deemed unlikely.

Any management actions undertaken by Council to address Newly Established Roosts will also be subject to, and comply with, other relevant policies and strategies described in this management plan.

3.3.3 Low Conflict Roosts

Low Conflict Roosts have low levels of community conflict making them moderately suitable locations for roosting flying-foxes. However, due to the dynamic nature of flying-fox roosts, conflict levels may escalate over time. For this reason, Council will undertake frequent monitoring of Low Conflict Roosts located on Council owned or managed land and adjoining private properties.

Council will assess the need for management action in Low Conflict Roosts on a case by case basis using the relevant processes defined in Section 4. However, Council does not consider active dispersal or relocation of flying-foxes to be suitable management actions in these locations. Rather community education, low impact activities and, in selected circumstances, buffering between roosting flying-foxes and residences may be employed where necessary.

Where Low Conflict Roosts are located on Council owned or managed land keeping them low conflict, and preventing escalation to a higher conflict level will be the dominant management goal.

Further, where feasible, Council will seek to have these roosts achieve preferred roost location status.

3.3.4 Medium Conflict Roosts

Flying-fox camps roosting in areas classified as Medium Conflict will be assessed by Council for management action on a case by case basis using the Management Action Hierarchy described in Section 4.2.

In general, Council will strive to resolve or mitigate conflict between the community and roosting flying-foxes without the need for major vegetation modification or active dispersal. This will ideally be completed through community education and referral to expert sources of information such as Biosecurity Queensland and Queensland Health. Where roost specific action is considered necessary, vegetation modification works including buffering between roosting flying-foxes and areas of conflict may be employed.

Council's goal is to manage Medium Conflict roosts on Council owned or managed land to prevent them escalating to High Conflict. A higher level of management intervention may be considered where necessary to achieve this. Similarly, achieving a lower level of community conflict will also guide Council's management action.

3.3.5 High Risk Roosts

Where a flying-fox camp is roosting in an area classified as High Risk, Council will employ permissible measures to mitigate or resolve community conflict levels. Management actions will follow a hierarchical approach however assessment will be fast tracked through the Management Action Hierarchy Map (Figure 4) and Management Action Assessment Process (Figure 6). Relevant land tenure policies discussed in Section 3.2 will also be instrumental in determining the most appropriate management response.

Where a High Risk roost occupies Council land and adjacent private property, Council will seek to work in partnership with property owners to develop and implement management actions consistent with this plan. Preventing further escalation of High Risk roosts will be a key goal of any Council works.

In these situations, a successful management action will be one which reduces community conflict levels and, where feasible, moves the flying-foxes into an area of lower community conflict . An ideal outcome may be defined as the movement of flying-foxes from High Risk into an area classified as Low Conflict or Preferred Roost.

Where a High Risk Roost has been removed from Council land, additional works will be undertaken to prevent the flying-foxes return. Similarly, new Low Conflict or Preferred roosts on Council land will be managed to prevent escalation to a higher risk category.

Intrusive roost management actions such as significant vegetation removal, dispersals or relocations will be documented and evaluated through the outcome reporting process defined in Section 5.1.

4.0 Assessment & Management Action

4.1 Responding to Community Concerns

Members of the community may have concerns about living near flying-foxes or even having them flying around at night. As camps swell in Summer, and media coverage increases, Council may expect an escalation in community concerns and requests for intervention. To ensure that Council responds to community requests in a fair and balanced manner a community concerns flow-path has been developed. This focusses on gathering appropriate information to inform and guide Council's response including the provision of appropriate information and advice to the community.

The Community Concern Process Map depicted in Figure 3 separates community concerns into common categories such as noise, smell and fear of disease risk. Appropriate responses are then identified based on Council's SoMI and this plan. Where the most appropriate response is referral of the matter to expert agencies such as Queensland Health or Biosecurity Queensland these agencies are also identified.

Community concerns for flying-foxes roosting on Council owned or managed land will be subject to full assessment under this management plan.

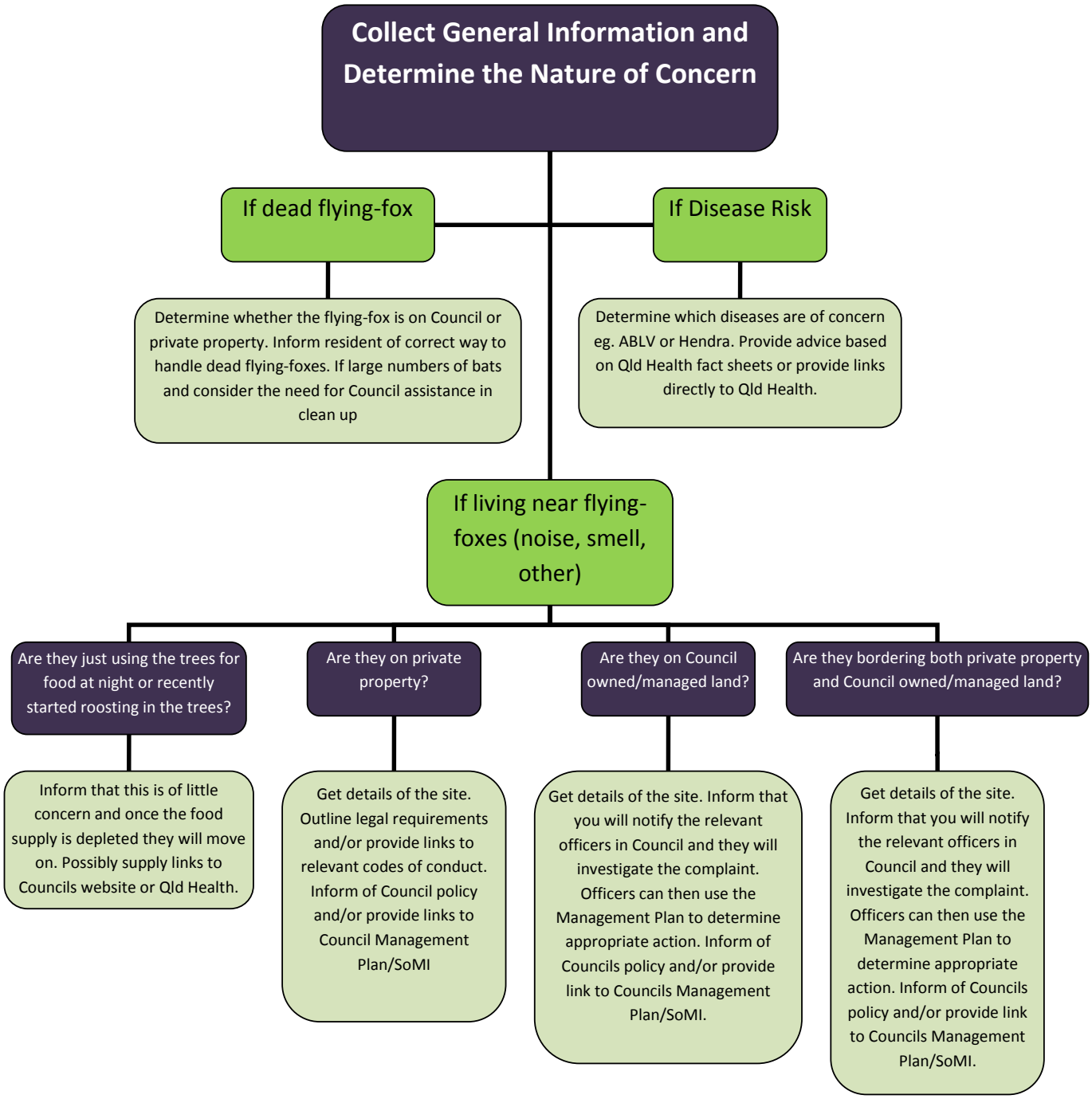


Figure 3: The Community Concern Process Map is used to inform and guide Council in considering and responding to community concerns for flying-foxes roost issues.

4.2 Management Action Hierarchy

Local governments now have an as-of-right authority to manage flying-fox roosts within a defined Urban Flying-Fox Management Area as discussed in Section 6.4.2. This potentially involves a broad range of roost management issues, land tenures, community interests, risk settings and costs.

To guide Council through this process, and to achieve consistency with Council's SoMI and management plan, a Management Action Hierarchy has been developed (Figure 4). The hierarchy utilises the roost risk categories described in Section 3.1 to determine the priority setting and most appropriate form of management response.

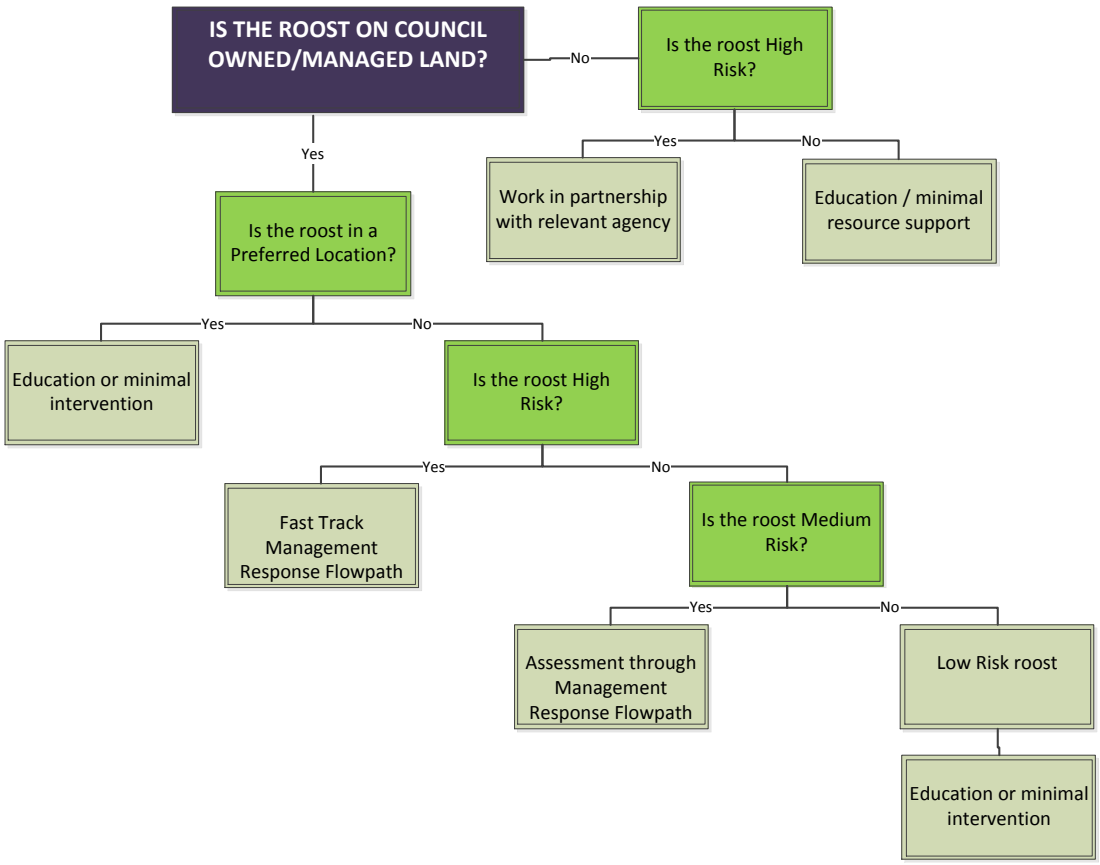


Figure 4: The Management Action Hierarchy Process Map displays the key considerations required, as discussed in Sections 3 and 4, to identify the most appropriate form of management action.

4.3 Potential Management Actions

The following section outlines the possible management actions which Council may take in relation to management of flying-fox roosts through implementation of this plan. Potential actions are presented in a hierarchical order from least to most intrusive.

As depicted in Figure 5 there is a strong historical correlation between increasing levels or roost intervention and increasing costs and risks. These aspects are clearly highlighted in the history of Australian flying-fox roost dispersals presented in Appendix C.

In general, Council will favour passive management actions such as education and minimal intervention. More intrusive actions will only be considered where passive management actions have been tried unsuccessfully. This approach is intended to balance community needs while ensuring management actions achieve cost and benefit requirements.

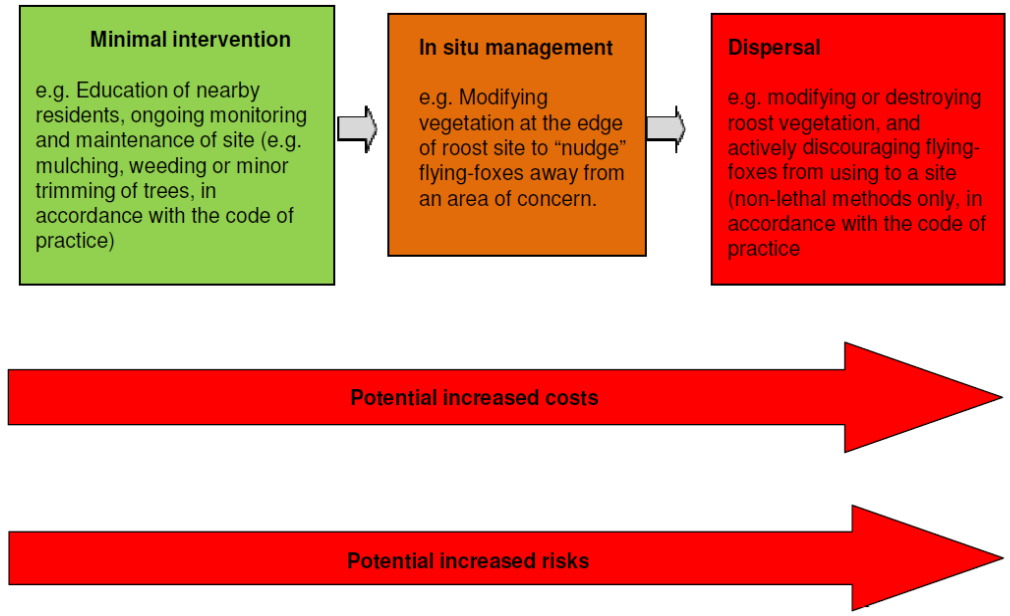


Figure 5. The relationship between escalating levels of roost intervention and the potential for increasing costs and risk of management action failure. Source: Department of Environment & Heritage Protection.

4.3.1 Education

Concern or fear for bats, often fed by common negative stereotypes, misinformation and prejudices is a common driver behind many flying-fox conflicts. In extreme examples this can develop into a specific phobia called chiroptophobia. In addition, the perceived health risk from flying-foxes is often blown out of proportion by the media (Thiriet 2005). Fortunately most fears are unfounded and may be readily addressed through access to accurate information and education sources.

Ipswich City Council believes that appropriate community education is the key to addressing many flying-fox related complaints. Of particular importance is educating the people about the actual level of health risk. Scientific evidence indicates the risk of viral infection from flying-foxes is significantly lower than commonly believed outside of particular contact groups such as wildlife carers and horse owners.

As discussed, Council will seek to link the Ipswich community with the most up to date information on flying-foxes and public health. Links to expert information sources including Queensland Health, Biosecurity Queensland and the RSPCA are included in this plan. Further, these information sources will be included in Council's flying-fox webpage and made available to concerned residents.

Particular effort will be directed to educating children about flying-foxes and personal health. It is hoped this will assist in breaking down the negative stereotypes and protect children from being accidentally bitten or scratched while attempting to handle flying-foxes. The All About Bats of Southern Queensland website produced by the Burnett Mary Regional Group is an excellent tool for educating children and adults alike. It contains a range of information sources and bat facts. In particular, flying-fox education kits for years 4 – 9 are suitable for incorporating into Council's environmental education program.

For further information please visit the All About Bats website:
http://www.allaboutbats.org.au/1/Home

Education with regards to the ecology and behaviour of flying-foxes is also important as this is often a key driver behind elevated community conflict. Noise and activity levels in roosts may become elevated at certain times of year such as breeding seasons however this is short lived. The nomadic habit of little red flying-foxes and their mass summer influxes is another key time of elevated conflict where Council may employ the local distribution of information flyers.

In certain circumstances a community may be better placed tolerating these short term annoyances rather than risking the elevated conflict levels which often follow intensive roost interventions. Council will continue to provide information to the community to assist them to live with flying-foxes.

Education is considered the most appropriate management action for the majority of flying-fox related matters on private and public land. Council will attempt to resolve flying-fox conflicts through a process of community education prior to considering more disruptive management actions. The Community Concern Process Map (Figure 3) and Management Action Hierarchy Process Map (Figure 4) indicate where Council will use education to resolve flying-fox conflict.

4.3.2 No Site Intervention

Careful investigation of the particular circumstances will determine whether a flying-fox roost requires on ground management intervention. In particular, it is important that management actions do not exacerbate the current situation and potentially lead to increased conflict levels.

Section 6 of this plan details the history of intervention at the Sapling Pocket roost and the subsequent formation of multiple urban roosts in Ipswich City. Under this plan the former Sapling Pocket roost would be considered a Preferred Roost Location. Unfortunately, alleged shooting raids

in 1984 effectively dispersed flying-foxes to multiple urban localities, mostly with higher levels of community conflict.

Appendix C documents the often poor outcomes associated with flying-fox dispersal actions in Australia. Flying-foxes often fail to leave the original site completely and frequently form new sites close by. In many cases, the first intervention commences a treadmill of expensive and unsuccessful actions and increasing community conflict.

In many instances a community is better placed accommodating low levels of noise and smell than risking the potential negative outcomes of on ground intervention. Seasonal considerations are also important with little red flying-foxes a prime example. Waiting out their short period of visitation may provide a better community outcome than risking creation of multiple roosts which may be recolonised next Summer.

4.3.3 Minimal Site Intervention

Minimal site intervention refers to activities authorised under the Code of Practice: Low impact activities affecting flying-fox roosts. Dependent on the need, these activities may be undertaken on Council owned or managed land at any time without further assessment via the Management Action Assessment Process described in Section 4.4.

Similarly, any person may undertake activities authorised under this code with property owner permission without applying for a Damage Mitigation Permit. However, it is crucial to reiterate that low impact activities are not associated with direct management actions regarding flying-fox roosts.

Council personnel, contractors or any person conducting low impact activities should keep a copy of the Code of Practice: Low impact activities affecting flying-fox roosts on their person. Familiarity with the Flying-Fox Roost Management Guideline prepared by EHP is also recommended to maintain legislative compliance, minimize disturbance to flying-foxes and protect human health whilst conducting activities.

4.3.4 Moderate (in-situ) Site Intervention

Moderate in-situ intervention refers to a range of vegetation modification works undertaken at or adjoining a flying-fox roost. These may be performed as stand-alone actions or in conjunction with active flying-fox dispersal or relocation attempts.

In these situations vegetation modification will be performed to modify or destroy an area of vegetation making it unsuitable for roost, to deter flying-foxes from using the roost, or to create a buffer to nearby residences or commercial facilities.

In the event where on site management action is required, moderate site intervention will be the preferred option. For example, where a flying-fox camp is roosting next to a child care centre or similar sensitive site, Council will consider the need for undertaking vegetation modification in an attempt to create a buffer zone between the sensitive site and the roost. Based on historical data on active flying-fox interventions this approach is considered more appropriate with less community risk than an attempt to disperse or relocate flying-foxes elsewhere.

Any moderate, in-situ management actions must comply with the Code of Practice: Ecologically sustainable management of flying-fox roosts. These actions should also be guided by the Flying-Fox Roost Management Guideline.

4.3.5 Active Dispersal or Relocation

Active dispersal refers to a coordinated attempt to drive flying-foxes away from a particular roost generally accompanied by significant vegetation modification to deter future colonization. In some cases this may incorporate relocation of flying-foxes to a preferred, target site.

Dispersal methods available to Council are generally established in the Code of Practice: *Ecologically sustainable management of flying-fox roosts* and include vegetation modification and the use of noise, lighting, smoke and similar deterrents.

Of all the potential management actions, dispersals and relocations require the most resources, are the most expensive and unpredictable and have the greatest risk of failure. As previously discussed, Appendix C documents the often poor outcomes associated with these management actions in Australia.

Some of the key risks associated with dispersal actions which Council will seek to avoid include:

- Splitting a camp of flying-foxes into two or more separate parts
- Moving a camp (in part of whole) into a higher risk management zone.
- Dispersing flying-foxes into adjacent private property or into High Risk Roosts
- Injuring flying-foxes or result in them coming to ground in public areas
- Resulting in the deaths of flying-foxes
- Injuries to Council personnel performing a dispersal action
- Exposing Council to potential litigation
- Failing a cost benefit analysis

The size of the flying-fox camp must also be carefully considered before commencing any management actions. Larger populations will likely be harder to move on and are obviously going to need a larger alternate roost which may not be available. For the purposes of flying-fox conservation, attempting to move a larger camp is logically going to have a greater adverse impact on the overall flying-fox population.

The likely success of any management action must be strongly considered against the risk of an adverse outcome. Avoiding high risk actions will also decrease the need for ongoing management actions in order to mitigate adverse outcomes of prior attempts – often referred to as the treadmill effect.

Attempts to remove or disperse a flying-fox camp are rarely successful. Often the animals will have developed attachment to a roost site and therefore remain at the site despite substantial levels of

disturbance (Thiriet 2005). Alternatively, flying-foxes may have nowhere else to go and will begin roosting in even less desirable locations, such as backyards. Many apparently successful management actions are confused with flying-foxes leaving on completely natural migratory patterns in response to changing food supplies (Thiriet 2005).

For these reasons Council will only consider active dispersal or relocation where all other management options have been exhausted and dispersing the flying-foxes is considered essential. As a general rule, the dispersal of flying-foxes will only be considered essential should the flying-foxes be located in a High Risk Roost. In addition, dispersal action will only be conducted in conjunction with compatible vegetation modification works.

4.3.6 Lethal Management Action

Lethal management actions are actions directly intended at killing or taking flying-foxes, often referred to a culling. Under current provisions these actions are not available to Councils.

Council views lethal management of flying-foxes as an ineffective, non-practical and unethical form of management. Lethal management will not be undertaken as part of this management plan.

4.4 Management Action Assessment Process

Identifying the most appropriate form of management action requires careful consideration of the underlying issues, particular circumstances, suite of potential actions, their likely outcomes, risk levels and costs. Council will use the Management Action Assessment Process depicted in Figure 6 to evaluate and determine the requirements for action on a case by case basis. The process map establishes a formal process for identifying balanced and consistent flying-fox roost management actions across the city.

Council has an obligation to ensure public monies are allocated and used in a responsible and efficient manner. As such, costs will form an important overlay to Council's determination of the most appropriate form of management action. In particular, Council will be vigilant to identifying and avoiding management actions which require costly, ongoing efforts with limited opportunities for a successful outcome.

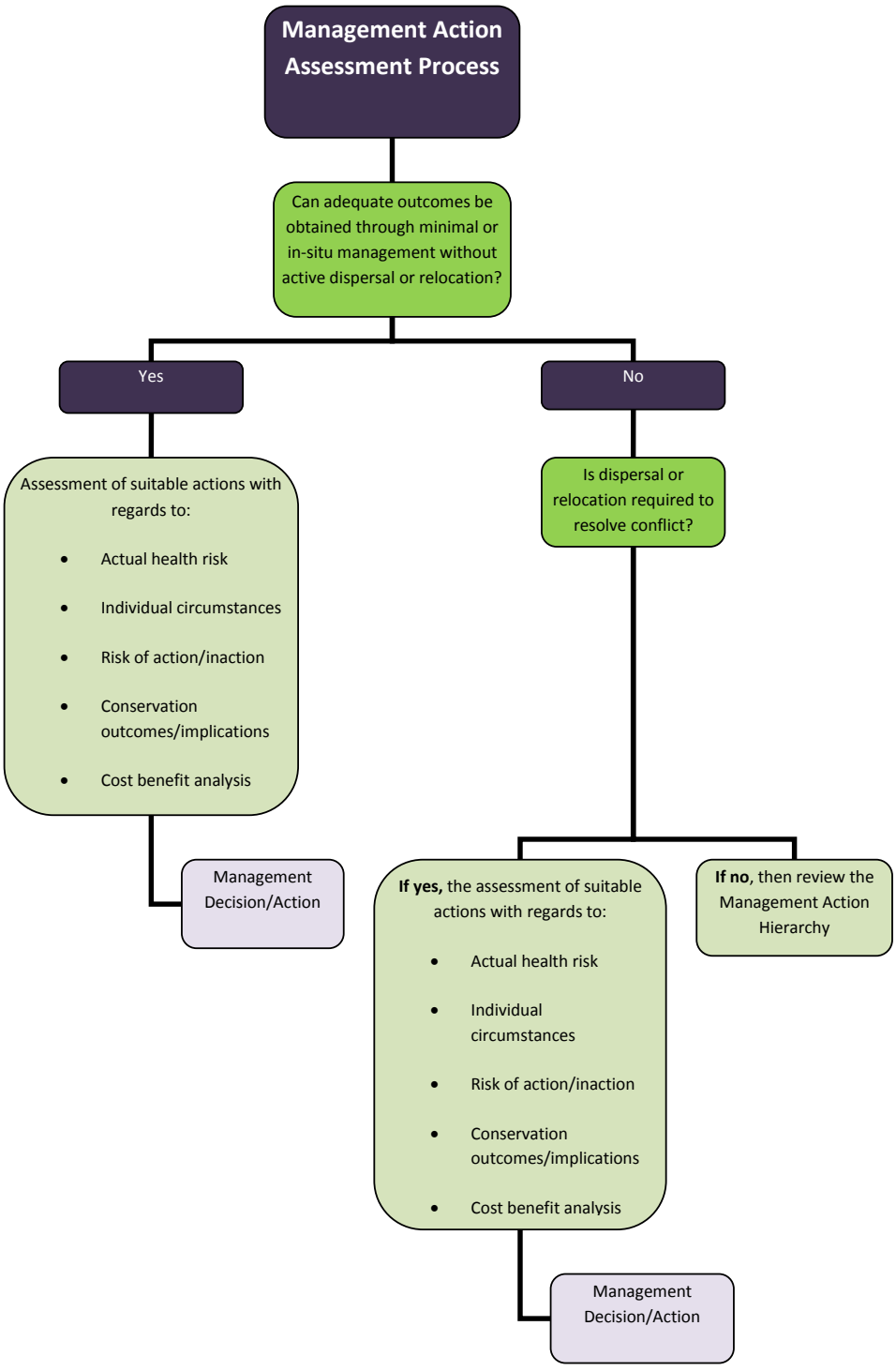


Figure 6: Management Action Assessment Process. Used to formally assess the need for, and suitability of, a management action where a situation cannot be resolved via minimal intervention or education.

5.0 Evaluation and Reporting

Managing flying-foxes is an extremely complex and resource intensive field of wildlife management. Many of the more popular actions historically used to manage flying-foxes have low documented success rates and frequently lead to increased community conflict and subsequent management action. The biology of flying-foxes, as single giant populations, also makes the success of local actions difficult to determine.

The overall success of this management plan will be evaluated against the goals and objectives established in Section 1.2. Clearly the level of community concern for flying-foxes in Ipswich will be a key evaluation criterion. This will be assessed in conjunction with evaluation of the distribution and risk categorisation of flying-fox roosts within the city. Specific on site management actions will be assessed against the goals of the respective management action.

All management actions, associated evaluation and reporting will be maintaining in a database. This will also form an important step in maintaining consistency and transparency in all management actions performed by Council.

5.1 Outcome Reports

Where Moderate (in-situ) Site Intervention or Active Dispersals are undertaken on Council land an outcome report will be produced. It anticipated the report will be based on the Outcome report template produced by EHP in the Flying-Fox Roost Management Guideline modified to the needs of Council. This will involve additional reporting of post action outcomes and cross referencing with Council's roost monitoring and risk management zones mapping process.

5.2 Costs

The costs associated with planning, implementing and monitoring flying-fox management actions can be substantial. In general, costs increase relative to the level of intervention. That is, minimal intervention actions such as education are relatively low cost in comparison with significant vegetation modification or dispersal actions which may have substantial ongoing costs.

A well document example of potential cost implications is the ongoing dispersal program conducted in the Melbourne Botanic Gardens. To date the program has costed in excess of $3,000,000 over a period of 7 years, with efforts still ongoing (Roberts et al. 2011). In addition, new areas of costs may be expected – the Australian Government's recent introduction of cost recovery arrangements for environmental impact assessments under the EPBC Act a case in point.

Costs are also closely linked with risks. Again, as management actions move from minimal intervention towards intrusive vegetation modification or dispersal the risk of potential failure increases. This is an important link to highlight as repetitive, highly intrusive management actions will require substantial, ongoing funding sources.

5.3 Review Period

This management plan will be subject to review 5 years from its adoption date. Should a change in legislation or policy render this plan unlawful, inaccurate or misleading an earlier amendment or review will need to be considered.

6.0 Supporting Information

6.1 Flying-fox Biology and Ecology

Australia's flying-foxes belong to Pteropodidae, a family of megabats also known as fruit bats. Three species visit south-east Queensland living in camps located in communal roosts. All of Australia's major cities along the east coast, along with many other towns, contain continuously occupied flying-fox roosts (Plowright et al. 2011). As a result of continuing urban development, a greater proportion of flying-fox camps are becoming urbanized (Parry-Jones & Augee 2001; Markus & Hall 2004; McDonald-Madden et al. 2005).

The overlap between humans and flying-fox camps is continuing to increase as the shift towards a more urbanized and developed landscape continues (Eby et al. 1999; Parry-Jones & Augee 2001). Following increased contact, the number of people concerned about the various implications of living in close proximity to flying-fox roosts has also grown.

Flying-foxes deliver important ecosystem services. Primarily this refers to their function as long distance dispersers and pollinators of numerous native plant species (Eby 1991; Fujita & Tuttle 1991). Flying-foxes have a pivotal role in the maintenance of various forested ecosystems (Hall & Richards 2000). The extent of foraging range, dispersal ability and migratory distances is dependent on the degree of diet specialization between individual species (Hall & Richards 2000; Markus & Hall 2004).

6.1.1 Black flying-fox

The black flying-fox, *Pteropus alecto*, ranges from sub-tropical to tropical latitudes spanning the entire northern coast and the majority of the East coast of Australia (Palmer & Woinarski 1999). The species is regarded as a generalist, feeding on a wide range of resources, including nectar, pollen and fruits (Richards 1995).

Like all flying-foxes in Australia, the black flying-fox roosts in large camps ranging in size from a few hundred to hundreds of thousands (Hall & Richards 2000). Roosts are generally located within dense vegetation with thick, weedy understory, close to sources of water where humidity is high (Loughland 1993). Roost choice is also closely associated with the proximity and abundance to foraging resources (Palmer & Woinarski 1999). Given that black flying-foxes are highly mobile, they often migrate large distances to follow the availability of foraging resources (Markus & Hall 2004).

Black flying-foxes give birth to only one young per year, as do other flying-fox species. The timing of births varies considerably based on location. Around South-East Queensland most births occur between October and November (Vardon & Tidemann 1998). Generally the peak birth rates for black flying-foxes are strongly associated with maximum food availability however other environmental factors may also be influential (Vardon & Tidemann 1998).

Approximately one third of black flying-foxes survive from birth to adult size (Vardon & Tidemann 2000). Given this mortality rate, it is estimated that each breeding female would need to produce six young in their lifespan to ensure a stable population - meaning all young would need to survive until

at least age seven (Vardon & Tidemann 2000). This raises concerns that *P. alecto* may be suffering rapid population decline leaving it more vulnerable to extinction (Vardon & Tidemann 2000).

Black flying-foxes are also vulnerable to mass mortality events following extreme heat events. A temperature above 37^{o}C has a substantial effect on flying-foxes and upwards of 42^{o}C is considered a critical point where mortality increases exponentially (Welbergen et al. 2008). These events have increased in frequency as black flying-foxes habituate areas further South where temperatures are highly variable and often spike in Summer (Welbergen et al. 2008). It is suggested that this southern expansion can be attributed to a decrease in the number of days with frost, which black flying foxes cannot tolerate, in southern parts of the East coast (Tidemann 1999).

6.1.2 Grey-headed flying-fox

The grey-headed flying-fox, *Pteropus poliocephalus*, is found only in Australia ranging along the East coast from Finch Hatton in the North to Melbourne in the South (Paris & Hazell 2005; Snoyman & Brown 2010). Interestingly this makes it the most southerly distributed member of the *Pteropus* genus (Peacock 2004). The distribution of grey-headed flying-foxes aligns with some of the most heavily populated areas of Australia, which often leads to conflict with residents who interact with the species (Snoyman & Brown 2010).

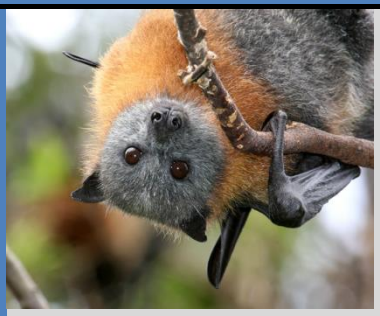
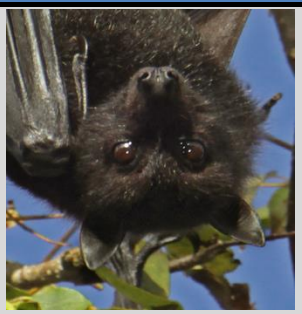
Their diet is very similar to the black flying-fox, feeding on various fruits, nectar and pollen (McDonald-Madden et al. 2005). Consequently grey-headed flying-foxes also migrate long distances in response to available food supplies (Tidemann & Nelson 2011). Like black flying-foxes they are also important pollinators and seed dispersers (Schmelitschek et al. 2009).

The grey-headed and black flying-foxes also share a number of other traits. Sharing of roost sites is common and the two species are similar in size and are often difficult to tell apart. Table 7 provides an identification key that can be used when trying to distinguish between the local species.

Grey-headed flying-foxes have an average life expectancy estimated at 7.1 ±3.9 years (Tidemann & Nelson 2011). Females generally have a single offspring annually around September to October. After the first few weeks young are left in camps while females leave to forage at dusk.

Loss of foraging and roosting sites due to urbanisation, forestry and agriculture has led to a rapid decrease in the size of the grey-headed population (Duncan et al. 1999). It is estimated that numbers are 35% lower than they were a decade ago (Eby & Lunney 2002). Grey-headed flying-foxes appear to have a greater capacity to deal with extreme heat events compared to the black, although they too often perish in heatwave events.

Other human influences are also concerning. In a study, Tidemann and Nelson (2011) found that 18.6% of their grey-headed study sample died of electrocution and nearly 10% died from entanglement in either fruit-tree protective netting or barbed wire. The grey-headed flying-fox is currently listed as a vulnerable species under the Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Distinguishing Characteristic	Grey-headed Flying-fox (*Pteropus poliocephalus)*	Black Flying-fox (*Pteropus alecto*)	Little red flying-fox (*Pteropus scapulatus*)
Photos	 Image: Vivian Jones	 Image: Vivian Jones	 Image: Brandon Keim
Head	Head covered in light grey fur. Large, dark brown eyes.	Head covered in thick black fur. Large, dark brown eyes.	Thinner fur ranging from dark brown to a light grey in colour. Large, dark, brown eyes. Ears very prominent.
Neck	Thick, prominent, scarf like band of bright orange fur, wrapping the entire neck. Sharp colour contrast between head, neck and the rest of the body.	Often messy patches of dark brown to dark orange fur on the back of the neck. Does not wrap the entire neck.	Thin, auburn coloured hair, which often wraps the entire neck. Contrast between head, neck and body fur, not as pronounced as P.*poliocephalus*.
Body	Long, light to dark grey fur extending from the base of the neck to the toes. Often a similar colour to the head. Weight between 600-1000g.	Shorter, dark black fur, spanning from the head to the inner thighs. Legs and ankles are hairless. Weigh between 600-1000g.	Light to dark brown fur (sometimes dark reddish) spanning from the neck to the thighs. Legs are hairless. Significantly smaller, weighing between 200-600g.
Wings	Large black wings, connected from the forefingers to the ankles. Wings are opaque.	Large black wings, connected from the forefingers to the ankles. Wings are opaque.	Smaller, lighter coloured wings. Wings are semi-transparent.
Roost Behaviour	Often roost in the mid to lower canopy. Roost wingspan apart.	Often roost higher than other flying-fox species. Roost wingspan apart.	Always found roosting in the lower canopy, wherever space is available. Roost in tight clusters.

Note: When nursing young, all species of flying-fox rest their babies on the inside of the wings attached to either armpit. Young are easily spotted in flight or when observing from below roosting adults.

Figure 7. Flying-Fox Species Identification Key

6.1.3 Little red flying-fox

The little red flying-fox has the widest geographical range of Australia's flying-foxes encompassing more than 3-5 million km² across a variety of different climates (Hall 1987). Little reds are highly migratory and are considered to be nomadic, changing roosts frequently. It has been suggested that the little red flying-fox exists as one giant metapopulation, based on the little genetic variation between sub-populations (Sinclair et al. 1996).

Considering they have an overall population estimated in the millions, roosts tend to swell in size when little red flying-foxes arrive (Sinclair et al. 1996). Similar food sources are also shared with other flying-fox species, as is the trend of moving to follow the changing food supply (EHP 2011). Unlike the other two species, little reds do not often consume fruit as part of their diet (Birt et al. 2008).

Little reds are the smallest flying-foxes in Australia, with large males weighing around 550g, and the majority between 200-600g (Sinclair et al. 1996). They are easily distinguished next to other species due to their smaller size, reddish brown body fur, semi-transparent wings and hairless legs (See Figure 7).

Mating season also differs from the other species, with the majority of mating occurring in November-December (O'Brien 1993). Gestation periods usually last 5 months with young being born in April and May (O'Brien 1993).

Whilst black and grey-headed flying-foxes usually roost arm's length apart, little reds clump together with numerous individuals on a single branch (EHP 2011). They also roost lower to the ground than other flying-fox species (EHP 2011). In general, little red flying-foxes have been poorly studied, with the majority of academic focus centred on their grey-headed counterparts. However, the little red flying-foxes are currently considered to be of least concern from a conservation perspective.

In south-east Queensland little red flying-foxes are largely a Summer species arriving and departing in concert with seasonal flowering of eucalyptus species.

6.1.4 The variable nature of Flying-fox Camps

Flying-fox camps are highly variable in species composition, numbers and distribution over time. The seasonal migration of nomadic little red flying-foxes is one of the main reasons for this variation. Camps often swell in size dramatically with their Summer influx but their seasonal residency often means that these changes are short lived. This is a key factor for consideration in any management action. A large proportion of flying-fox related complaints are driven by this seasonal influx meaning resource intensive and expensive management actions may be inappropriate and unnecessary.

The behavioural ecology of flying-fox species also causes variability. Their ability to fly and tendency to migrate large distances in search of food means that many flying-foxes change their roosting site frequently. A study by Tidemann and Nelson (2004) followed two radio collared grey-headed flying-foxes with results supporting this variability. One of the tracked flying-foxes moved from Dallis Park near Murwillumbah in April 2000 and roosted in a total of 15 other roosts before returning to its original roost in September 2000 (Tidemann & Nelson 2004). Another flying-fox made similar movements between 7 different roosts (Tidemann & Nelson 2004). Both flying-foxes travelled more

than 2,000km between roosts during this period, and moved through 4° (440km) of latitude (Tidemann & Nelson 2004).

This variable and dynamic nature has considerable implications for roost management. Given the large swings in roost population sizes, assessing the requirements, best form and success of management action can be difficult. Often, successful flying-fox relocations have been confused with the animals moving and or migrating based on their natural behaviour (Thiriet 2005). In addition, after a roost is emptied by dispersal attempt flying-foxes are frequently recorded moving back a few days or weeks later.

Recent events recorded in Ipswich provide an insight into the dynamic and variable nature or flying-fox roosts. Following a heat related mortality event in the Queens Park Nature Centre in January 2014, nearly the entire camp, totalling over 3,000 flying-foxes succumbed to heat stress. However, less than a week later, the site was recolonized with more flying-foxes than had ever been previously recorded. Further, while planning a dispersal of this roost, Council officers recorded changes in flying-fox species composition, total numbers and roosting locations on a frequent and sometimes daily basis.

For these reasons case by case assessment of flying-fox roosts and any associated community conflict is a key principle build into this plan. This approach is considered essential to identify and implement the most appropriate, site specific management action without further exacerbating conflict levels.

6.1.5 Flying-fox breeding cycles

Flying-fox breeding cycles have a major influence on dynamics within the roost. In addition, a number of animal welfare considerations, statutory requirements and best practice considerations are associated with species during mating, birthing or raising of young.

The following table is based on (Birt 2005), and shows the critical periods in the lifecycle of local flying-fox species. Disturbance, particularly sustained, in the form of dispersal or relocation attempts should be avoided during mating and birthing seasons to avoid lifecycle impacts. However, breeding cycles may be varied in response to environmental conditions and nutritional stress so site specific assessment is important prior to planning any management action.

Table 1. Critical periods in the fling-fox life cycle and associated management considerations.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
GHFF												
BFF												
LRFF												
	Birthing & lactating - sustained disturbance may lead to late term abortion, dependent young abandoned											
	Mating period - disturbance may disrupt number of successful matings, territory and harem formation											
	Non breeding cycle - most suitable time for roost management action											

As can be seen from the table, the breeding cycle of little red flying-foxes is not aligned with that of black and grey-headed. Where all three species are present in a roost opportunities for intensive roost management actions such as vegetation removal or dispersal are significantly restricted.

6.2 Flying-foxes and Public Health

The perceived health risk from flying-foxes is often blown out of proportion by the media (Thiriet 2005). However, genuine risks may be present and community requests for management action resulting from fear of disease must be carefully considered and assessed. Council must assess whether the risk of infection from flying-foxes has the potential to become realized and what mitigation strategies and actions are appropriate. In doing so Council will rely on expert agencies such as Queensland Health and Biosecurity Queensland and ensure the public have access to the most up to date sources of information.

While flying-foxes may carry viruses and bacteria which can be harmful to humans, with appropriate management, the risk of infection is low. People should avoid assisting or handling flying-foxes directly. If you find a sick, injured, orphaned or dead flying-fox immediately call the RSPCA on 1300 264 625, the Department of Environment and Heritage Protection on 1300 130 372 or Bat Conservation and Rescue Queensland on 0488 228 134.

In the past two decades the emergence of Hendra virus (HeV) and Australian bat lyssavirus (ABVL) has sparked health concerns within the community. Infected flying-foxes rarely exhibit any signs of either disease however infection can sometimes be associated with neurological symptoms and paralysis of the hind limbs (Parsons 2014 pers. comm., Feb 18).

The rapid emergence of human pathogens from a single host genus in a short period of time suggests that recent changes in host ecology may play a role in their emergence (Plowright et al. 2008). Namely this refers to the increasing urbanisation of the flying-fox roosts due to large scale development and deforestation (Wynne & Wang 2013). Logically the emergence of these viruses has coincided with increasing human to bat contact meaning that the recent discovery of these diseases does not necessarily indicate that they are newly developed (Tidemann et al. 1997).

In general, the potential for disease exposure from infected flying-foxes does not relate to the size of the flying-fox camp (Streicker 2013). A commonly stated management approach where flying-foxes generate community conflict is to reduce the size of populations through culling or dispersal as an attempt to reduce disease exposure. However, studies have shown that culled camps often display a higher viral exposure than other camps due to the increased dispersal and spread (Streicker et al. 2012; Blackwood et al. 2013).

6.2.1 Hendra Virus (HeV)

A sudden outbreak of acute respiratory syndrome amongst thoroughbred horses in the Brisbane suburb of Hendra in 1994 led to the discovery of a new virus from the family Paramyxoviridae (Field et al. 2001). The disease subsequently named Hendra virus led to the death of 13 horses in the first outbreak as well as the death of a horse trainer (Field et al. 2001).

Following the initial case, 13 other outbreaks have been recorded, each of them resulting in the death of horses (Plowright et al. 2013). Five of these events have also seen transfer to humans, each leading to illness or death (Plowright et al. 2013). The transmission of the virus from flying-foxes to horses is presumed to be through consumption of pasture or feed which is contaminated with flying-fox urine, saliva, faeces and/or placental fluids (Halpin et al. 2000).

Horse owners should be vigilant and note any signs of infections, including increased temperature, respiratory distress and/ or neurological signs. In these circumstances, horse owners should contact their local veterinarian and/or Qld Health for advice. Horse owners should also note that a vaccine is available to immunise horses prior to exposure to the virus. No post-exposure treatments are readily available.

Transmission from infected horses to humans is rare indicating that very specific and extreme conditions are required. Until the horse is examined and cleared by a veterinarian, horse owners should limit contact with sick horses and avoid contact with any body fluid, including nasal discharge. If horse owners are concerned about their own health, they should contact their doctor or their local public health unit immediately.

Queensland Health advises that there is no evidence of human-to-human transmission of Hendra virus. Testing of people who have come in contact with a person infected with the Hendra virus, including health care workers and family contacts, has shown no evidence of the virus. There is also no evidence that the virus can be passed directly from flying-foxes to humans, from the environment to humans, from humans to horses, or that it is airborne (Queensland Health 2012).

For further information on the risk of HeV visit the Department of Agriculture, Fisheries and Forestry (DAFF) website: Hendra virus. Or view the Queensland Health Fact Sheet: http://access.health.qld.gov.au/hid/InfectionsandParasites/ViralInfections/hendraVirusInfection_fs.pdf.

6.2.2 Australian Bat Lyssavirus (ABL)

Whilst screening for HeV in the 1990's, researchers also discovered a lyssavirus, closely related to the classical rabies virus, which is now known as Australian bat lyssavirus. Though extremely rare, ABL is often fatal to humans who become infected. An animal handler became the first recorded human death in 1996 (Fraser et al. 1996).

Since this time two other people have died as a result of ABL, all of whom were either bitten or scratched by an infected bat (Queensland Health 2013). Being bitten or scratched is the only currently known way of becoming infected with ABL. However, any contact with bat faeces, blood or urine should be avoided despite the minimal contamination risk. Fortunately, living in close proximity to, playing or walking near bat roosting areas are not considered to represent an exposure risk (Queensland Health 2013).

It is essential that no person attempt to handle a bat unless they are a qualified and immunized professional. If you find a sick, injured, orphaned or dead flying-fox immediately call the RSPCA on 1300 264 625, the Department of Environment and Heritage Protection on 1300 130 372 or Bat Conservation and Rescue Queensland on 0488 228 134.

Those who come into frequent contact with flying-foxes can receive a pre-exposure vaccination that is an effective safeguard for ABL. A similar post-exposure vaccination is available for those who are bitten or scratched by a flying-fox along with procedures developed by Queensland Health. Although the disease is very serious with potentially fatal consequences, if the correct procedures are followed it is very treatable.

All four species of Australian flying-foxes are known to carry ABL (DAFF 2013). Although nearly all bats have the potential to carry the virus it is actually uncommon, with less than 1% of flying-foxes infected at any time (DAFF 2013).

For further information on ABL view the Queensland Health fact sheet: http://access.health.qld.gov.au/hid/InfectionsandParasites/ViralInfections/australianBatLyssavirus_fs.pdf. Or visit the DAFF website: australian-bat-lyssavirus-overview.

6.3 Heat Related Mortality Events

Extreme heat events have been known to periodically impact significantly on flying-fox populations, often resulting in large mortality events (Welbergen et al. 2008). Black flying-foxes are particularly vulnerable being a species of the tropics where uniformity of temperature is the norm. Ipswich's wide ranging extremes which can spike dramatically to over 40°C have on occasion had a dramatic impact with high species mortalities.

It is also suggested that black flying-foxes have lower physiological limits than other species (Welbergen et al. 2008). Observations reveal that dependent young and females are also more vulnerable in a heat event (Welbergen et al. 2008). Losing adult females and dependent young may have dramatic impacts not only on the current generation, but also on the next generation, through loss of reproductive capacity.

The critical trigger point, above which mortality will increase exponentially, is 43°C (Department of Environment and Heritage 2014; Welbergen 2014, pers comm., 9 Jan). Contrary to popular belief, these animals are not dying from dehydration, but suffering from organ failure and body shutdown due to extended periods of heat stress.

In 1994, Ipswich recorded its highest ever temperature at 44.3°C, which was followed by the deaths of around 1,000 flying-foxes from throughout the city (Welbergen et al. 2008). A similar event in 2000 (40.7°C) killed around 500 individuals (Welbergen et al. 2008).

In January 2014, a series of days over 40°C peaked at 43.9°C on Saturday 4th. This heatwave resulted in unprecedented loss of flying-foxes with almost every roost within the city suffering substantial losses. Worst hit were the roosts located at Lorikeet Street Reserve, Pan Pacific Peace Gardens, Woodend Flying-fox Precinct and the Queens Park Nature Centre, all of which lost the majority of their black flying-fox populations.

Estimated mortalities of approximately 15,000 were collected at this time as detailed in Table 2. An additional unknown number of flying-foxes perished on private property, high in trees or at unknown locations. Information collated by Welbergen et al. (2014) suggests that around 45,500 flying-foxes perished throughout the entire south-east Queensland region as shown in Figure 8.

Unfortunately around 98% of mortalities were black flying-foxes, with the remainder being grey-headed and a few little reds. The combined estimate of black flying-fox mortalities in south-east Queensland indicates this species has suffered a major population decline. The loss of large numbers of juveniles will also impact on the future viability of the species.

In areas of Australia where mass mortality events have occurred, temperatures have noticeably increased by around 0.17^{o}C per decade (Jones et al. 1999). This trend is expected to continue increasing and it is therefore assumed that the frequency and intensity of extreme weather events will also increase (Easterling et al. 2000). In Ipswich, which encompasses the southern part of the black flying-fox range, these extreme heat mortality events are also likely to increase and potentially become more severe.

Table 2: Overall estimate of flying-fox deaths from 04/01/2014 to 14/01/2014 within the Ipswich LGA sorted by roost site. The comments section outlines the relative proportions of the total made up by members of each species.

LGA	Roost Site	Longitude	Latitude	Number of Mortalities (as of 8:37am 14 Jan 201	Comments
Ipswich	Woodend Flying Fox Precinct, Coalfalls	152.7485	-27.6031	214	93%Bff; 7%Ghff. Small proportion of black popualtion.
Ipswich	Pilny Reserve, Camira	152.9206	-27.6315	37	100% Bff; Have not roosted here recently.
Ipswich	Mill Reserve, Camira	152.9228	-27.6315	211	98%Bff; 1%Ghff; 1% Lrff. Plus 1000's on priavte property.
Ipswich	Pan Pacific Peace Gardens, Redbank	152.880163	-27.599624	2119	95%Bff; 4%Ghff; 1%Lrff. Nearly all the blacks in park.
Ipswich	Lorikeet Street Reserve, Bundamba	152.81273	-27.612423	1203	87%Bff; 12%Ghff; 1%Lrff. 100% of Blacks in reserve.
Ipswich	Queens Park Nature Centre, Ipswich	152.767861	-27.619142	3474	Mostly blacks. Quantitative proportion not available.
Ipswich	Poplar Street Reserve, Walloon	152.67271	-27.602959	51	98%Bff; 2%Ghff. 25% of entire roost.
Ipswich	Brodzig Road, Chuwar	152.791081	-27.56709	1000	Presumed black. Only 1 Bff left at site.
Ipswich	Box Street, Yamanto	152.755601	-27.651449	551	98%Bff; 1%Ghff; 1% Lrff
Ipswich	Additional (not recognized roosts)	NA	NA	604	Smith Park, 74 Addison Road (on footpath), Scholtes Park
Ipswich	Private Property (General Collection)	NA	NA	5300	Mostly blacks. Quantitative proportion not available
				Total: 14764	

Figure 8: Locations around south-east Queensland recorded as having flying-fox deaths after the January 4, 2014 heat related mortality event. Image Justin Welbergen (2014).

6.3.1 Preparation for Heat Related Mortality Events

Future heat mortality events are a key species management issue, particularly for flying-fox roosts located on Council owned or managed land. Maximum daily temperature forecasts in excess of 37^{o}C are a sign that additional roost based management actions may be required. Heat stressed or deceased flying-foxes coming to ground are a source of significant community concern. In the past, lack of public education concerning these events has led to a number of people being unnecessarily bitten, scratched and exposed to potential infection.

Welbergen et al. (2008) described various signals and behaviours exhibited by flying-foxes suffering from heat stress during the heat events of 2002. The actions were noted in the following order:

I. Fanning with wings

II. Seeking shade

III. Panting; and

IV. Spreading their saliva

Often, after these stages, species unable to cope with temperatures were observed to descend or drop from branches some 15-20 minutes later. The timing and extent of these flying-fox behaviours,

as well as the number of mortalities, will depend not only on the temperature of the day as a whole but also the influence of the micro climate within a particular roost (Welbergen et al. 2008).

Of particular importance to flying-fox survival are good canopy cover for shade and access to water. Past mortality events have revealed that camps with access to a large water body, thick understory and denser canopy cover retain a larger proportion of the population after an event (Stanvic et al. 2013).

Where an extreme heat event is anticipated Council will provide advice to the public via the website. This will alert the public to the possibility of large amounts of heat stressed or deceased flying-foxes coming to ground or falling from trees. Advice will also be provided on recommended handling and clean up procedures where required.

Where roosts are located on Council owned or managed land efforts will be put in place to minimise contact between heat affected flying-foxes and the public. Subject to the nature of the heat event this may entail measures such as additional park signage, area access restrictions or park closures.

Council will also work closely with local wildlife carers and bat conservation groups to rescue and rehabilitate heat affected flying-foxes and orphaned young where appropriate. Following the 2014 heat event in Ipswich, Bat Conservation and Rescue Queensland did a terrific job rescuing and rehabilitating over 200 orphaned flying-foxes.

6.3.2 Mitigating Heat Related Mortality Events

During an extreme heat event, significant caution should be exercised by any persons entering a flying-fox roost, particularly whilst temperatures are above 37^{o}C. Whilst flying-foxes are suffering from heat stress, human disturbance may push them beyond their limits and greatly increase the chances of mortality.

Persons attempting to undertake animal welfare actions during these events should take note of the guideline *Managing Heat Stress in Flying-fox Colonies* available via the following link: http://www.fourthcrossingwildlife.com/HeatStress-StanvicMcDonaldCollins.pdf The guideline describes the protocols and practices which may be employed including the use of misting or spraying. Case studies highlighted in the guideline indicate the success of properly and executed animal welfare actions during historical heat events.

Animal welfare activities undertaken during heat events must be careful to ensure that any actions aimed at minimising flying-fox suffering do not inadvertently cause them any additional stress. For example, if spraying or misting leads to flying-foxes leaving the roost, or showing signs of greater heat stress, the action could not only worsen the situation for the animals, but also constitute a breach of the *Nature Conservation Act 1992*.

It is critical that live flying-foxes should only be handled by appropriately vaccinated persons who have undergone training in bat handling. This may include Council staff provided they meet the necessary requirements. Additional procedures for dealing with injured or orphaned flying-foxes on Council land have recently been put in place and this process will continue where a need is identified.

6.3.3 Record Keeping and Information Sharing

Accurate record keeping is important if the full impact of extreme heat events on flying-fox populations is to be better understood. Post heat event, Council will collect and count deceased flying-foxes on Council owned or managed land. Subject to the severity of the event Council may also consider clean up assistance to private property owners.

Council will record the following data:

- Number of mortalities by roost
- Percentage of mortalities by species (eg 95% black: 4% grey-headed: 1% little red)
- Number of orphans rescued

This information will assist in determining the impact the heat event has had on individual species at a local level. Council will make this data available to other agencies for the purposes of researching the impact of heat events on flying-fox species at the national or population level. This is important to ensure the protections afforded to individual flying-fox species appropriately reflects their threat of extinction in the wild.

6.4 Relevant Legislation

6.4.1 Commonwealth Legislation

The grey-headed flying-fox *Pteropus poliocephalus* is listed as a Vulnerable species under the Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act) making it a matter of National Environmental Significance (NES). The Commonwealth cites significant population declines of approximately 30% in recent decades and a need to increase recovery efforts in its justification for listing the species. It is an offence to undertake an action that is likely to have a 'significant impact' on a matter of National Environmental Significance without approval from the Australian Government Minister.

The Draft EPBC Act Policy Statement: *Camp management guidelines for the Grey-headed and Spectacled flying-fox* is intended to ensure that there are no significant impacts on EPBC Act listed flying-fox species due to actions to manage their camps. The policy describes which camp based actions are likely to have a significant impact thereby necessitating referral to the Minister.

Minor or routine camp management activities are unlikely to cause significant impact or require EPBC Act approval, regardless of the camp size or significance, provided they are not intended to disperse or clear the flying-fox camp. Examples of these activities include:

- mowing of grass and similar grounds-keeping actions
- application of mulch or removal of leaf litter or other material on the ground
- weed removal, minor trimming of understorey vegetation or the planting of vegetation
- removal of tree limbs or a small proportion of the whole trees in a camp if they are significantly damaged and pose a health and safety risk, as determined by a qualified and experienced arborist
- minor habitat augmentation for the benefit of the roosting animals

- installation of signage or similar-scale infrastructure
- passive recreation (i.e. low noise recreation)
- noisy events of limited duration, such as firework displays or outdoor performances
- educational activities, such as study or observation of roosting flying-foxes

A network of nationally important flying-fox camps has been identified as important to maintaining a viable national population of grey-headed flying foxes. These camps are defined by size criteria, consistency of occupation and the importance of an ongoing network of large roost sites to the species recovery.

Proponents are required to check the *Nationally Important Camps of Grey-headed Flying-fox* mapping prior to undertaking any action at a camp. Maps are subject to frequent change and are updated with data from the National flying-fox monitoring program.

Further information on the *Nationally Important Camps of Grey-headed Flying-fox* mapping is available via the following link: http://www.environment.gov.au/system/files/pages/0f6f5576-50e8-4e02-be7c-18e7d3ad7f23/files/map-grey-headed-flying-fox-nationally-important-camps.pdf

Actions identified as having the capacity to directly or indirectly impact on nationally important flying-fox camps are described as:

- *in situ* management actions (which are not minor or routine in nature) intended to retain the camp whilst reducing conflict between flying foxes and people
- Clearing of vegetation in a flying-fox camp
- Dispersal of flying foxes through disturbance by noise, water, smoke or light
- Indirect actions that result in flying foxes permanently vacating a camp eg loud activities, changes to the water table and associated vegetation changes etc.

A system of best practice mitigation standards is provided for all actions conducted at nationally important camps with the exception of routine camp management. The standards acknowledge that risk of significant impact increases with flying-fox camp size necessitating a hierarchical approach to risk assessment and planning. It is also acknowledged that the Queensland *Code of Practice: Ecologically sustainable management of flying-fox roosts* (2013) is considered to achieve a similar outcome. In circumstances where best practice mitigation standards are not applied, significant impacts are likely and approval under the EPBC Act should be sought.

On 1 October 2014 the Australian Government introduced cost recovery arrangements for environmental impact assessments under the EPBC Act. At the time of writing this plan the current fee for lodgement of a referral application was $7,352. In addition base and complexity fees may also apply where a proposed project proceeds to the assessment stage.

Further information on the *Draft EPBC Act Policy Statement: Camp management guidelines for the Grey-headed and Spectacled flying-fox* is available via the following link: http://www.environment.gov.au/system/files/pages/0f6f5576-50e8-4e02-be7c-18e7d3ad7f23/files/flying-fox-policy-statement.pdf

6.4.2 State Legislation

All species of flying-fox in Queensland are protected under the state *Nature Conservation Act 1992* (NCA). Under section 88C of the *Nature Conservation Act 1992* a person cannot take (kill) or drive away flying-foxes or modify their roosts unless they are an authorised person or are authorised to do so under the Act. Note that a roost is defined as a tree or other place where flying foxes congregate from time to time to breed or rear there young.

Following amendments to the *Nature Conservation (Wildlife Management) Regulation 2006* enacted on 29th of November 2013, local governments in Queensland now have an as-of-right authority to manage flying-fox roosts in a defined Urban Flying-Fox Management Area (UFFMA), if they so choose.

This authority includes the ability to actively disperse a flying-fox roost or conduct other non-lethal management actions without a Damage Mitigation Permit. All management actions must comply with the Code of Practice: *Ecologically sustainable management of flying-fox roosts*: http://ehp.qld.gov.au/wildlife/livingwith/flyingfoxes/pdf/cp-wl-ff-roost-management.pdf.

The Code of Practice sets out the prescribed methods for management actions for local government, including:

- The Department of Environment and Heritage Protection must be notified at least two business days prior to commencing any management *actions* by completion of the flying-fox roost management notification form on the EHP website.
- No roost tree may be destroyed or modified when there are flying-foxes in the tree, or when flying-foxes are near to the tree and likely to be harmed as a result of the destruction or modification.
- All management actions must immediately cease and EHP is to be immediately notified if flying-foxes appear to have been killed or injured.
- During management actions any attempt to drive away flying-foxes:
    - Must be properly coordinated to ensure all actions are lawful and in compliance with this code.
    - May only commence after advice from a person knowledgeable about flying-fox behaviour, or with such a person present.
    - May only occur in the early evening and/or early morning.
    - When being carried out in the early evening, must commence immediately prior to the dusk fly out at a roost and continue for no longer than 2 hours.
    - When being carried out in the early morning, must commence immediately when flying-foxes start returning to a roost from foraging activities, and continue for no longer than 3 hours; and
    - Must be limited to the non-lethal deterrence methods such as noise and light.

Additional, non-code, considerations relate to important flying-fox life cycle events including breeding seasons and dependent young.

The UFFMA, includes lands designated under Council's planning scheme as having a residential or commercial urban purpose with the inclusion of a 1km buffer as shown as Figure 9. The UFFMA does

not include public recreational areas, open spaces or industrial areas unless they are covered by a 1km buffer zone around a residential or urban area.

A management action refers to a non-lethal action intended to stop flying-foxes from making use of a site or part of a site and includes vegetation modification, destruction or active dispersal. Although a permit is no longer required by local governments under the NCA, other relevant legislation such as the *Commonwealth Environmental Protection and Biodiversity Conservation Act 1999*, *Animal Care and Protection Act 2001* and *Vegetation Management Act 1999*, may still apply.

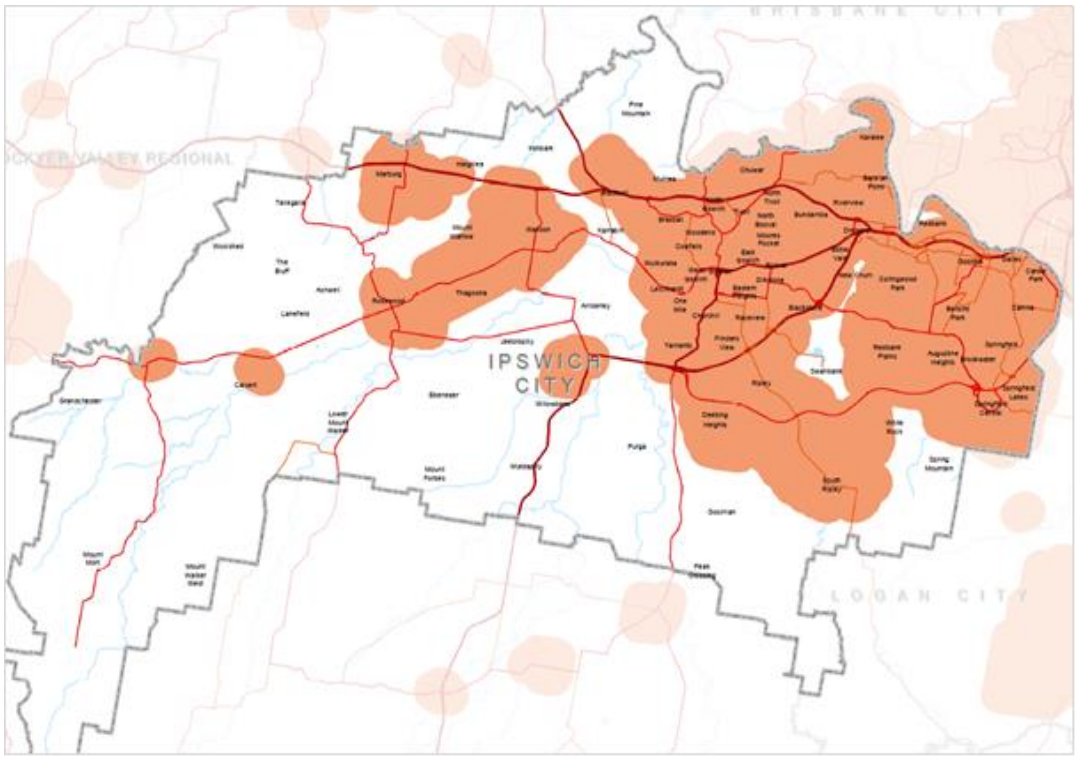


Figure 9. The Urban Flying-Fox Management Area for Ipswich City created by the Department of Environment and Heritage Protection (EHP 2013). Areas where Council may apply additional powers without the need for a Damage Mitigation Permit under the *Nature Conservation Act 1992* are highlighted Orange.

The as-of-right powers are only applicable to local governments. Individuals or other organizations wishing to undertake vegetation modification or dispersal action on their property must still apply for a Damage Mitigation Permit (DMP) under the NCA. Local governments wishing to either conduct non-code compliant activities within a UFFMA or manage a roost outside of the UFFMA will be required to obtain a flying-fox roost management permit from EHP.

While the as-of-right is solely for councils, where councils choose not to act, individuals, community organisations or businesses can still apply for a damage mitigation permit directly through the Department of Environment and Heritage Protection (EHP), subject to land owner authority. In considering the public interest, EHP may have regard to any reasons given by the council not to take action on the roost.

An additional self-assessable authority exists for councils and community members to conduct low-risk management activities in accordance with a Code of Practice – low impact activities affecting flying-fox roosts. This code sets out the prescribed methods for low impact activities that a person may undertake at a flying-fox roost including:

- No roost tree may be trimmed when there are flying-foxes in that part of the tree being trimmed, or when flying-foxes are near to the tree and likely to be harmed as a result of the trimming.
- Any trimming of roost trees must be limited to 10% of the total canopy of the roost.
- Low impact activities must immediately cease, and EHP be immediately notified, if a flying-fox appears to have been killed or injured; and
- Where low impact activities are required to be undertaken during the day time, works must immediately cease and EHP be immediately notified if 30% or more of the adult flying-foxes leave the roost for five minutes or more.

Any member of the public can conduct these low impact activities provided their intent is not to disturb or move flying foxes and they comply with the code of practice above. Examples of low impact activities include mowing, weeding and minor tree trimming under or near roost trees where flying-foxes are not present in the subject trees.

Any person planning to conduct management actions or low-impact activities should also refer to the *Flying-Fox Roost Management Guidelines* before conducting any activities. This document provides guidance and recommendations for how to best conduct and coordinate any management actions or low-impact activities. The Flying-Fox Roost Management Guideline can be accessed at: http://ehp.qld.gov.au/wildlife/livingwith/flyingfoxes/pdf/gl-wl-ffrm.pdf.

Lawful flying-fox management actions involving vegetation modification or removal are not automatically exempt under other State legislation. The follow pieces of legislation should also be consulted during planning of any actions:

- *Animal Care and Protection Act 2001*
- *Vegetation Management Act 1999*
- *Water Act 2000* (Riverine Protection Permit)
- *Nature Conservation Act 1992*

In relation to animal welfare issues the *Animal Care and Protection Act 2001*, Section 6, states that the Act is not applicable to an animal in the wild and protected under the *Nature Conservation Act 1992* or an animal that is the property of the state under the relevant act. Section 6A specifies that if an action is authorised under the NCA, a person cannot commit an offence under the Animal Care and Protection Act. Should an action not be lawful under the NCA, it could also be an offence under the Animal Care and Protection Act.

6.5 Roost Monitoring Program

Flying-foxes and their roosts are highly dynamic, changing frequently with season and the local availability of food sources. Gaining an understanding of flying-fox ecology and management requires frequent, structured monitoring at the national (population) and local (roost) level.

Local roost monitoring is important for maintaining an accurate and useable knowledge base of flying-fox movements throughout the city. In the preparation of this plan local roosts on Council land were subject to 4 formal monitoring sessions between December 2013 and August 2014. Data obtained from this program is presented in Figures 11-16. These figures are intended to display the dynamic nature of local flying-fox roosts during this time and are not an accurate record of current or future flying-fox distribution.

Regular monitoring will provide information about species numbers and distributions throughout the city. Further, regular monitoring will advise on seasonal and historical movements of flying-fox camps, roost boundaries and their proximity to places of residence, critical infrastructure or other sensitive facilities.

To assist field identification of individual species (grey-headed and black flying-foxes may be easily confused) a species identification key has been developed and is found in Figure 7.

6.5.1 Monitoring Periods and Timing

Council will monitor flying-fox roosts located on Council owned or managed land on a structured quarterly, Summer season and 'as required' basis. Quarterly monitoring will be undertaken in February, May, August and November each year. These times align with the National Flying-fox Monitoring Programme conducted by the Commonwealth Scientific and Industrial Research Organisation (CSIRO).

Additional monitoring will be conducted throughout the Summer months. Local flying-fox camps often swell at this time with the seasonal influx of little red flying-foxes. This is also the time when community concerns are heightened and requests for Council interventions peak. Monitoring the movements of little reds will increase understanding of their roost dynamics and interactions with other flying-fox species increasing Councils ability to respond to community concerns.

In addition, where a flying-fox roost is identified as being of medium or high conflict additional monitoring will be undertaken to advise and inform potential management action.

Further information on the National Flying-Fox Monitoring Programme is available from the Department of Environment website at:
http://www.environment.gov.au/biodiversity/threatened/species/flying-fox-monitoring

6.5.2 Data Collection and Sharing

To collect, maintain and retrieve data in a timely and consistent manner Council has developed an electronic field monitoring template and associated database. A mobile tablet is used in the field to record data on the following parameters:

- Species present

- Population estimate for each species
- Determination of breeding status
- Presence of young or juveniles
- Roost habitat condition
- Area occupied by roosting flying-foxes

Survey reports from the mobile tablet are downloaded directly into a central database and linked spatially through Council's Geographical Information System (GIS). An example monitoring survey report is attached as Appendix D.

For quarterly monitoring, and at other times where required, field surveyors will also prepare a map of the roost location and extent similar to those illustrated in Section 6.6. In this way data on a particular roost is available via either the historical roost identifier in the database (eg Woodend Flying-Fox Roost) or via the spatial GIS link.

Compiling and analysing mapped roost extents and survey data is a useful tool for tracking and identifying historical changes and patterns in roost occupation and dynamics over time. Some of the key information themes which may be analysed from this data include:

- Species type present
- Historic extents of individual flying-fox roosts
- Quarterly flying-fox roost extents
- Seasonal occupancy and roost extents
- Percentage of time a particular roost is occupied

Where field surveyors find a roost, or part thereof, is not accessible due to private property or other access constraints, a best estimate is made from the nearest accessible point. Roost monitoring will also be undertaken in manner which minimises the species stress levels. In particularly, times when flying-foxes are mating, carrying young or raising juveniles will be avoided along with days where the maximum temperature exceeds 37^{o}C. Importantly, Council's roost monitoring program can largely be conducted from the roost outskirts and direct access below roosting flying-foxes is largely avoidable.

Persons engaged in Council's roost monitoring program will be required to wear appropriate Personal Protective Equipment including a broad brimmed hat, sunglasses, long-sleeved shirt, long pants and sturdy boots. While survey staff are not required to be immunized against Australian Bat Lyssavirus they should be knowledgeable about the risks of infection and have completed an appropriate risk assessment.

Data from Council's roost monitoring program will be shared with the CSIRO, EHP, research institutions and other local governments where it is able to assist greater understanding of flying-fox movements, responses to management actions, population status and health.

6.6 Flying-fox Roosts within Ipswich City

Subject to changes in season and food availability, Ipswich has been home to between 4 and 10 flying-fox camps in the past year. All are located in roosts found along natural or man-made water courses in urban, peri-urban and rural areas of the city as shown in Figure 2. The highest number of both camps and individual flying-foxes occurs during the summer months with the seasonal influx of little red flying-foxes.

Research undertaken in the preparation of this plan has identified a number of temporal and spatial associations between local roosts. While some linkages are more certain than others a historical pattern of large roosts splintering into multiple smaller roosts emerged as illustrated in Figure 10.

This first commenced with the mass movement of flying-foxes from Sapling Pocket to Woodend following a dispersal action in 1984. Following degradation of roosting habitat at V number of smaller local roosts have emerged. In several instances roost based ma appear to have been the key driver for new roost development.

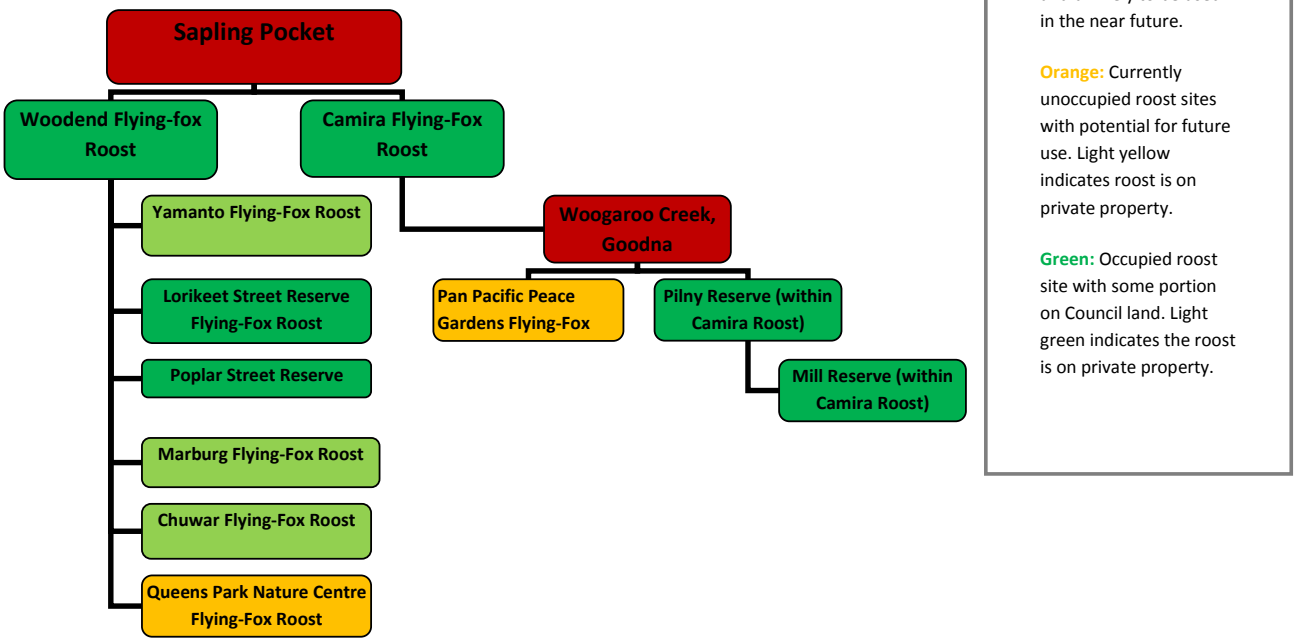


Figure 10: Flow chart of probable flying-fox roost site habituation throughout the city of Ipswich. Green sites were occupied during the August 2014 monitoring run. Yellow sites have been occupied as late as 2013 but unoccupied in recent history – these have the potential to resume active status in the near future. Red sites are roosts no longer occupied and have not been active in recent history.

6.6.1 Sapling Pocket Flying-Fox Roost

Sapling Pocket is a large area of dry vine scrub located in the suburb of Pine Mountain on the Brisbane River, around 14kms from the Ipswich CBD (See Figure 2). The area is rural or natural in nature and at times was believed to house a camp containing hundreds of thousands of flying-foxes.

In 1984 large scale human disturbance and alleged shooting raids performed by members of the public resulted in the majority of the camp dispersing to other locations around the city. At the time a gravel extraction company had been active at the site for a number of years and land clearing from their operations may also have resulted in significant disturbance. In recent history, Sapling Pocket is considered to be the 'mother' of all camps in Ipswich and its demise is likely responsible for subsequent development of many of the smaller camps in Ipswich and, potentially, surrounding local government areas.

It is presumed that some flying-foxes continued using the site after the 1984 events, although this poorly understood. The last recorded survey of the site conducted by the Department of Environment and Heritage Protection (EHP) in 2010 estimated around 2100 black and 4900 grey-headed flying-foxes. Ipswich City Council has not actively monitored Sapling Pocket in recent times as its isolation has meant there were no community concerns, whether flying-foxes have been permanently located at the site or not.

6.6.2 Chuwar Flying-Fox Roost

In 2011, Council was informed of several hundred flying-foxes roosting on private property at Brodzig Road, Chuwar. The camp was located on a small island located in the middle of a dam.

The camp size ranged from around 100-200 black flying-foxes until September 2012, after which the roost was empty. EHP records indicate the site remained empty until August 2013. Following an influx of little red flying-foxes in December 2013 the camp reached a population size of approximately 1,000 flying-foxes comprising both little reds and blacks. The camp remained relatively low-key with sporadic records of public complaints from adjoining property owners.

Following the heat related mortality event in early January 2014, all bar one black flying-fox perished on the site and contractors were hired to clear the property of dead flying-foxes (Appendix C). On the 23rd of January 2014 the roost was recorded empty following the exodus of little red flying-foxes, potentially on their natural migration. Data collected by the Department of Environment and Heritage indicates that flying-foxes recolonised the site in mid-2014.

6.6.3 Marburg Flying-Fox Roost

The presence of several hundred flying-foxes roosting on private property at Marburg was brought to Councils attention in January 2014. However, there is anecdotal evidence the camp may have been established for at least a couple of years.

A number of black flying-foxes were visible from Kennedy Street. However, it is not possible to determine whether other species are present or gain an accurate estimate of population size due to private property access requirements. To date Council is not aware of any community concerns associated with this camp.

6.6.4 Woodend Flying-Fox Roost

Following the exodus from Sapling Pocket circa 1984, thousands of black and grey-headed flying-foxes colonised areas of Woodend and Coalfalls around 12km to the South and less than 2km from the Ipswich CBD. By 1988, following an influx of around 200,000 little red flying-foxes, community

concern regarding the camp became a pressing issue. After several failed attempts at dispersing the camp in 1989, and a successful injunction taken out by a member of the public, Ipswich City Council sought to manage the area for the purposes of flying-fox conservation.

This was the start of a concerted effort by Council and the State Government to manage flying-foxes at the site. A property was purchased and gazetted as the Ipswich *Pteropus* Conservation Park with Council as trustee on behalf of the State. A residence on site was modified to provide visitor interpretive facilities on the outside with meeting rooms inside. A range of community consultation initiatives and on ground rehabilitation activities followed.

In 2005 a Memorandum of Understanding was signed between Council, the State Government and community conservation group Noah's Ark. This aimed to achieve co-ordinated management of flying-foxes within the Woodend Flying-Fox Precinct comprising a range of public and private properties located between Macrae Street and the Bremer River. Further works to improve habitat condition and engage with the community were undertaken on both the conservation park and Noah's Ark properties.

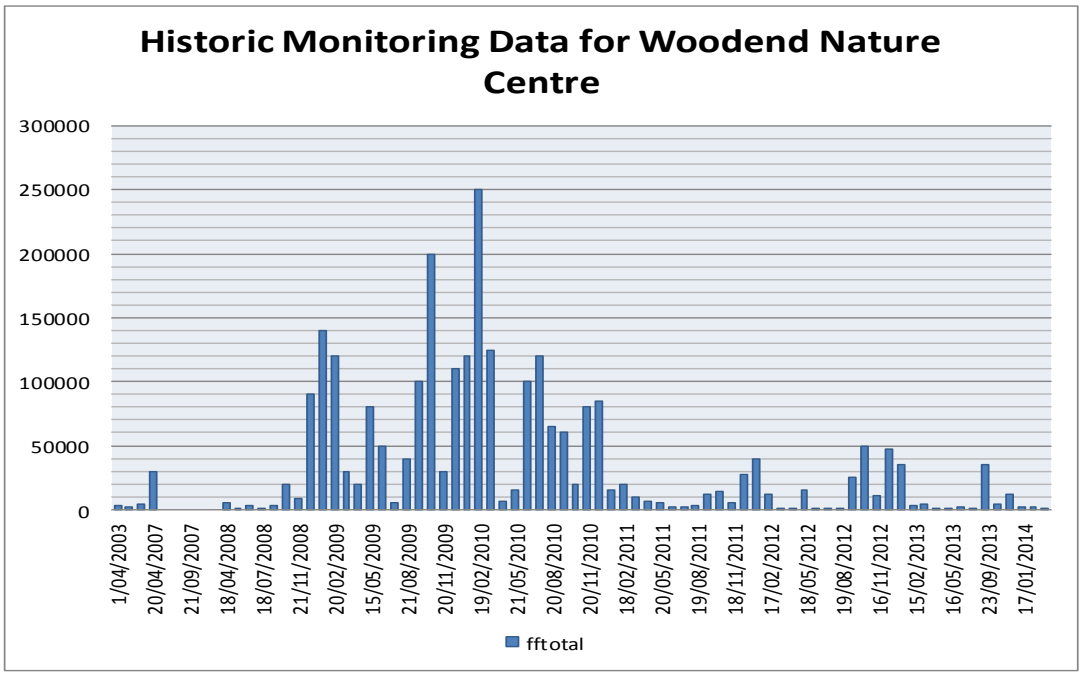
The number, species composition and distribution of flying-foxes have varied dramatically since the 1980's when the camp first established. As of the year 2000, an estimated 500,000 flying-foxes were using all parts of the precinct. Since the early 2000's numbers have steadily decreased, being particularly low between 2003 and 2009. This decrease was attributed to the stripping of vegetation - caused by enormous numbers of flying-foxes present coupled with the little reds tendency to cluster together in tight groups.

However numbers spiked again during the period of 2009 and 2011 but noticeably never reached the 500,000 seen in the year 2000. Following substantial declines at Woodend in 2008, 2010 and 2011, several other smaller camps began appearing throughout the city.

The precinct was also heavily impacted by the flying-fox heat mortality event in January 2014. Over 2000 individuals were killed, the majority being black headed flying-foxes. The historical numbers recorded at Woodend are depicted in Graph 1 with the total extent of roost occupied, at various times since circa 1984 shown in Figure 11.

The presence of flying-foxes within close proximity to places of residence has resulted in ongoing conflict with some residents. The southern parts of the precinct, including parts of Macrae and Harlin Road Reserves, are subject to regular requests for Council action. Most recently, Council works undertaken in Harlin Road Reserve have created a tree free buffer between roosting flying-foxes and an adjacent residence.

Despite this history it should be noted that the majority of residents in this area have lived peacefully with the flying-fox presence for several decades. The area has attracted community conservation interest through Noah's Ark and some residents foster orphaned flying-foxes through the Orphan Native Animal Rear and Release Association. The site has also featured in Sir David Attenborough's 'Life on Earth' series of documentaries.



Graph 1: Historic records of flying-foxes at Woodend Nature Centre based on Department of Environment and Heritage Protection (2003-2013) and Ipswich City Council (2013-2014) monitoring data.

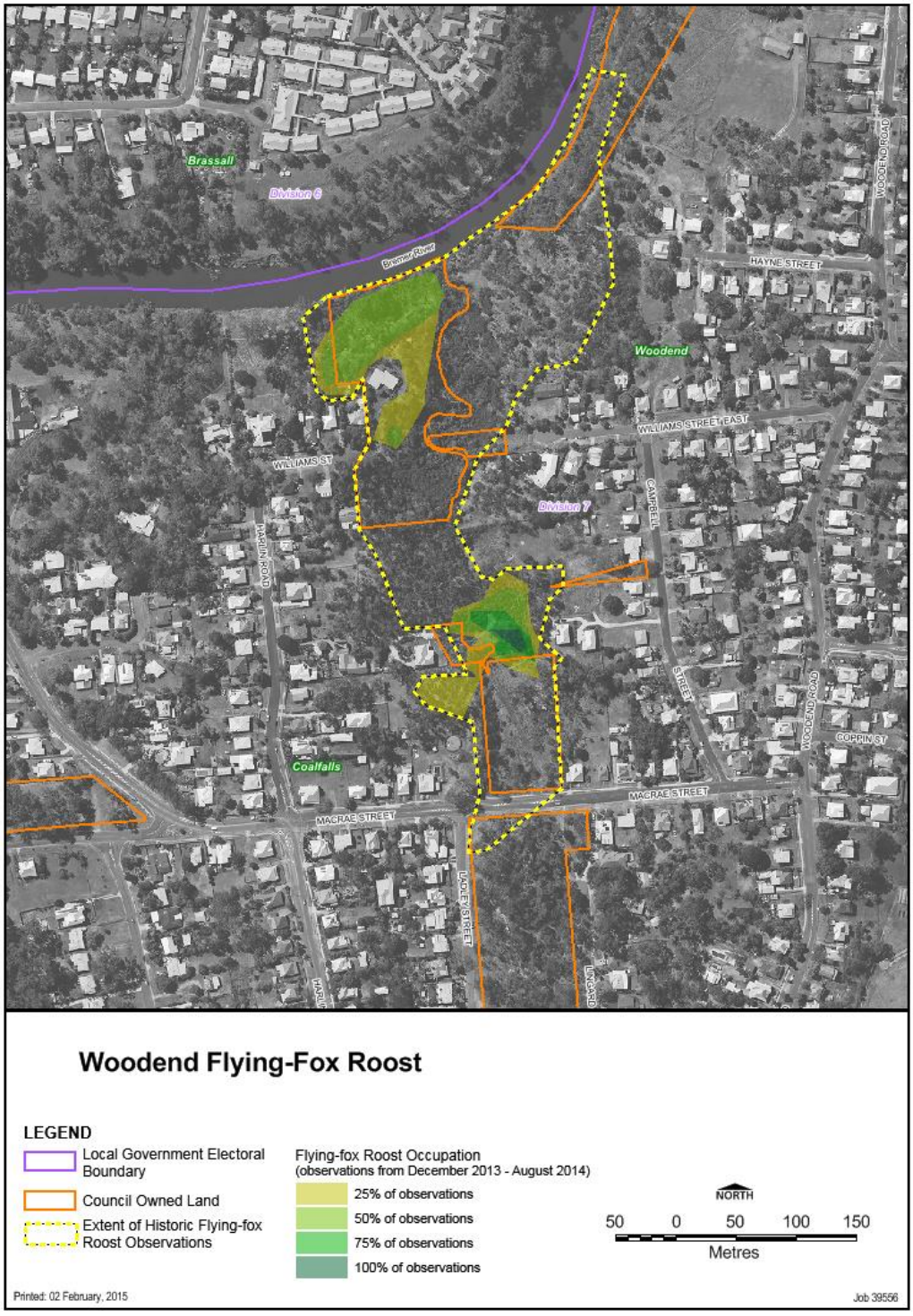


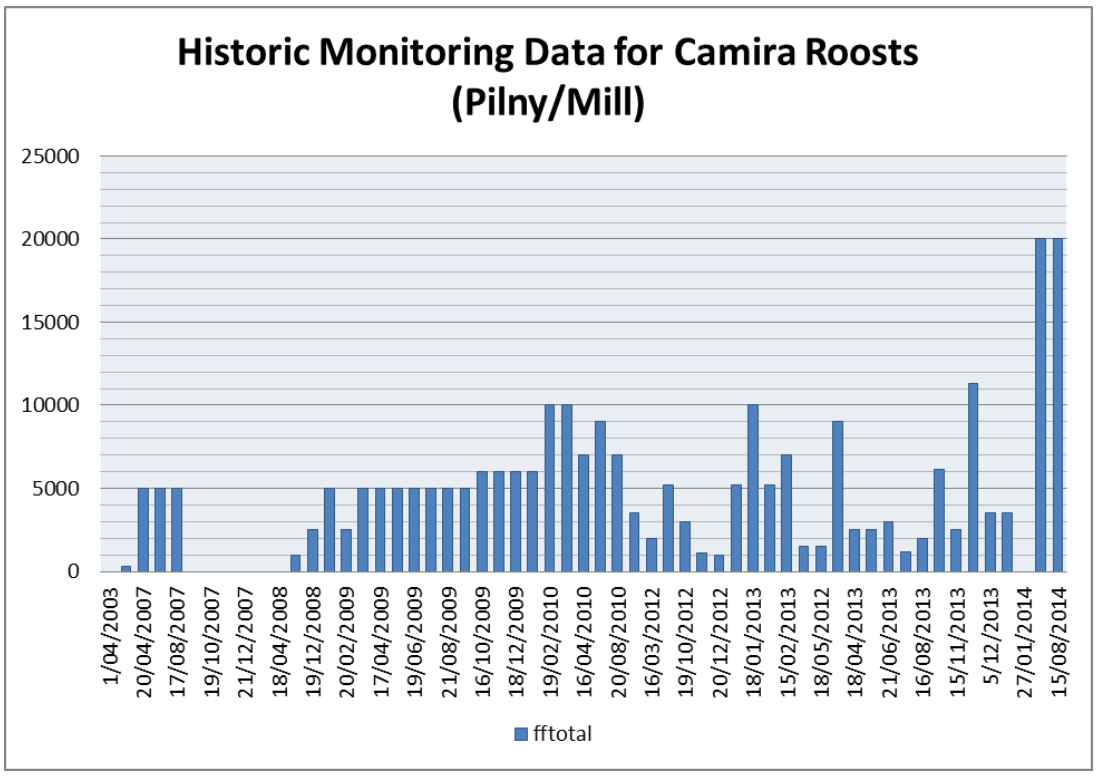
Figure 11. Aerial plan of the Woodend Flying-fox Precinct showing historic extent of recorded flying-fox roost observations along with roost occupation data recorded between December 2013 and August 2014.

6.6.5 Camira Flying-Fox Roost (incorporating Pilny and Mill Reserves)

Pilny Reserve and other areas of Camira are believed to be a long-term historic roosting site for flying-foxes that may have also formed after the demise of the Sapling Pocket camp as shown in Figure 10. However, an accurate history of flying-foxes in Pilny Reserve prior to the year 2000 is difficult to obtain.

The reserve is believed to have been used temporarily throughout recent history. Graph 2 displays this effectively, with large gaps in time where very few flying-foxes have been found in the reserve. The majority of flying-foxes present in Pilny Reserve prior to 2003 are believed to have moved to a roost along Woogaroo Creek in Goodna, around 3.5kms away. The Woogaroo Creek roosting site was eventually cleared of vegetation and in 2009 many flying-foxes returned to Pilny Reserve and other areas around Camira.

Since early 2014, no flying-foxes have been noted roosting in Pilny Reserve, hence it's listing as unoccupied in Figure 10. However, around 20,000 flying-foxes have been observed roosting in nearby Mill Reserve and along several private properties on Siesta Street and Addison Road as depicted in Figure 12. Mill Reserve and neighbouring properties were vacated briefly over the summer of 2013-2014 before flying-foxes returned in April 2014.



Graph 2: Historic records of flying-foxes at Pilny and Mill Reserves based on Department of Environment and Heritage Protection (2003-2013) and Ipswich City Council (2013-2014) monitoring data.

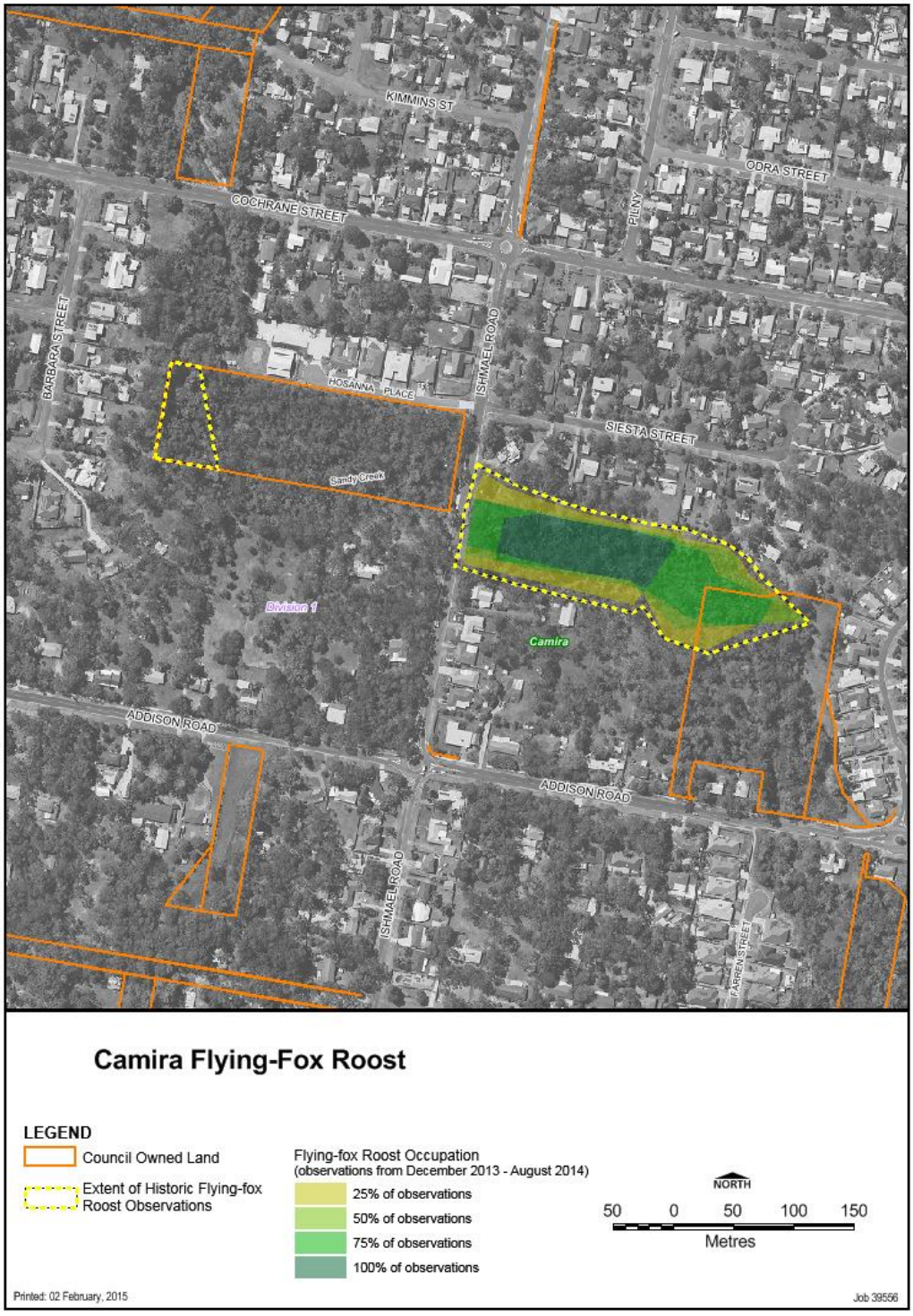


Figure 12. Aerial plan of the Camira Roost (incorporating Mill and Pilny Reserves) showing historic extent of flying-fox roost observations along with roost occupation data recorded between December 2013 and August 2014.

6.6.6 Pan Pacific Peace Gardens Roost

Pan Pacific Peace Gardens, located in Redbank, was a relatively new roost around 12kms east of the Ipswich CBD. The park is largely used as a recreation and picnic destination and was constructed to commemorate soldiers of World War II as well as representing Ipswich's history through other memorial plantings.

It may be inferred from historical records that Pan Pacific was colonised by flying-foxes following the clearance of vegetation at the nearby Woogaroo Creek roost in Goodna circa 2009. The camp grew steadily in size until an influx of little red flying-foxes in late 2013 caused it to swell drastically.

On 23 December 2013, the camp was estimated to have 11,000-12,000 flying-foxes with around 80% of these being little reds. The population reached its maximum recorded size and extent at that time (Figure 14). Despite the large numbers of flying-foxes present in a high visitor area, no history of community complaints was recorded from this park.

Monitoring conducted in January 2014 noted that the camp had decreased substantially in size following a heat related mortality event and was only occupying the most southerly section of the park adjacent to the Ipswich motorway. This declining trend continued until the site was eventually recorded as empty on the 28th of January 2014.

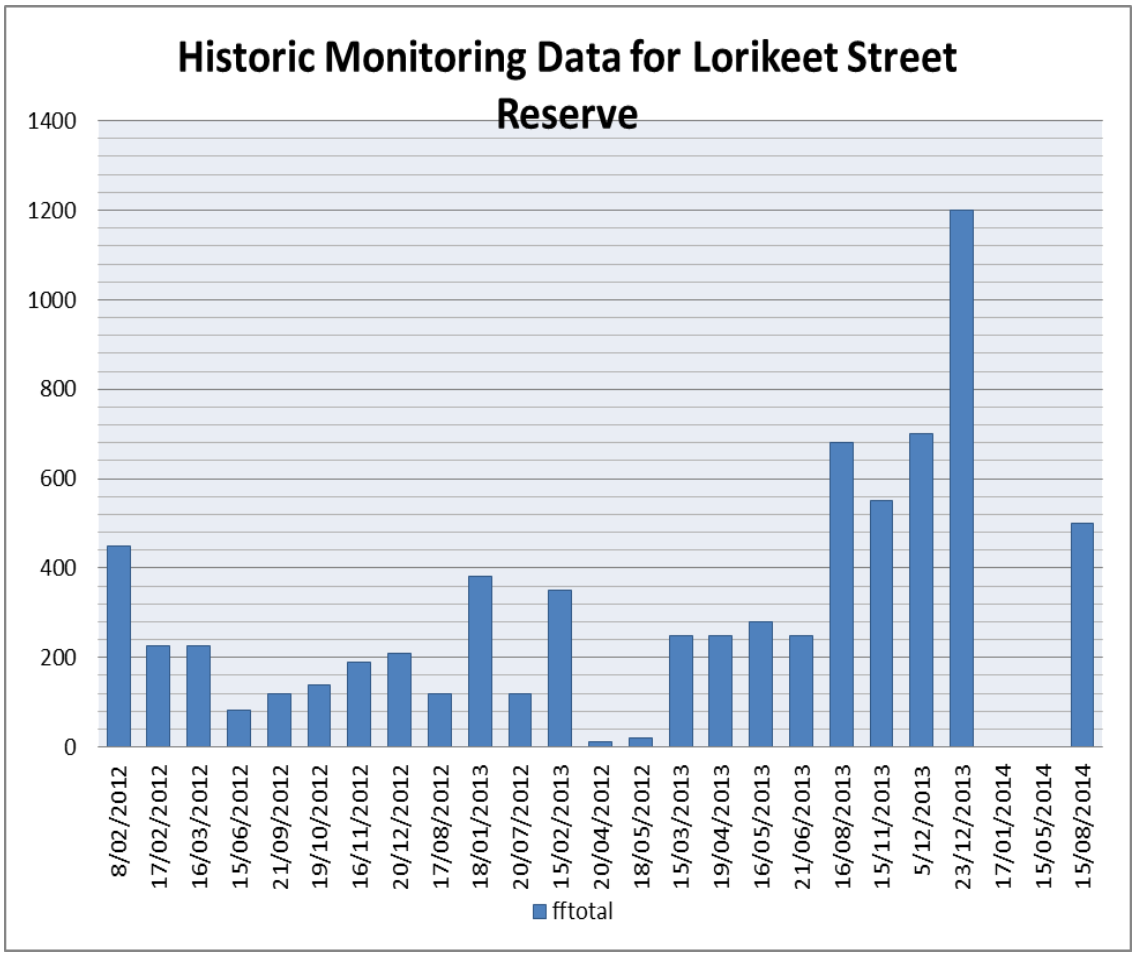
6.6.7 Lorikeet Street Reserve Flying-Fox Roost, Bundamba

Lorikeet Street is a narrow reserve located in Bundamba which contains an unnamed tributary of Bundamba Creek. Council was first informed of this camp in 2011 and EHP commenced monitoring the site in 2012. Of note, initial colonisation of this site occurred around the same time that the Woodend camp was undergoing a sizeable population decrease as depicted in Graph 1.

The population at Lorikeet Street remained steady at around 400 flying-foxes, comprised of a mix of grey-headed and blacks, until the middle of 2013. Following the arrival of little red flying-foxes in December 2013 the population reached a high of around 1,500 comprising all three flying-fox species (Graph 3).

During this time hundreds of flying-foxes were also roosting in adjacent private properties along Oak, Paice and Thompson Streets as depicted in Figure 13. The close proximity to people's homes resulted in elevated levels of community concern and some requests for Council to take action. However, other local property owners indicated they were aware of the flying-fox presence but had no concerns.

Things changed dramatically following an extreme heat event in early 2014. The camp suffered heavy mortalities and very few flying-foxes remained. On 13 January 2014 Lorikeet Street Reserve was noted as being empty. However monitoring conducted in August 2014 recorded a similar number and extent of roosting flying-foxes to August 2013 - prior to the heat event.



Graph 3: Historic records of flying-foxes at Lorikeet Street Reserve based on Department of Environment and Heritage Protection (2012-2013) and Ipswich City Council (2013-2014) monitoring data.

Figure 13. Aerial plan of Lorikeet Street Reserve showing flying-fox roost observations recorded between December 2013 and August 2014.

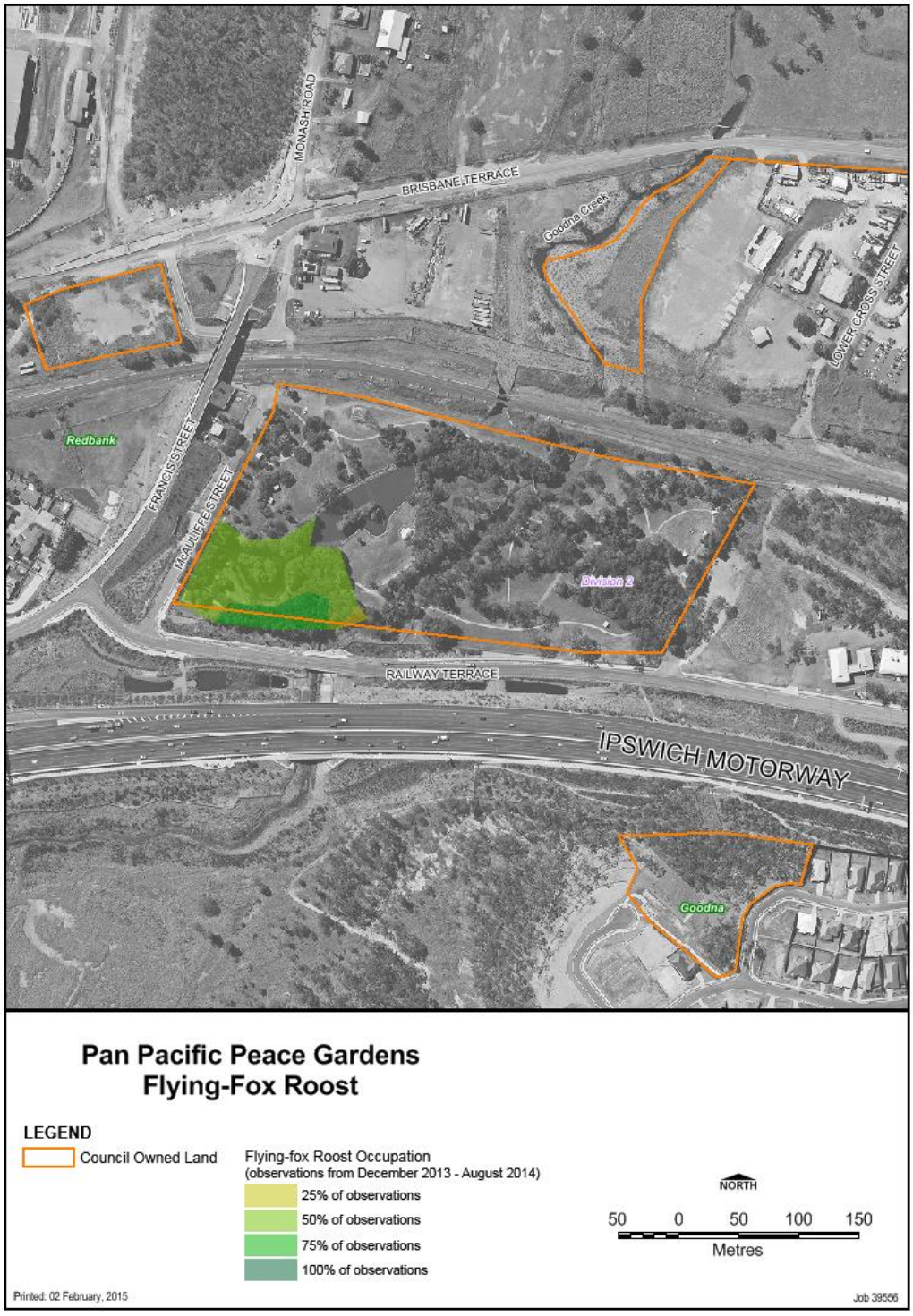


Figure 14. Aerial plan of Pan Pacific Peace Gardens showing flying-fox roost observations recorded between December 2013 and August 2014.

6.6.8 Queens Park Nature Centre Roost

Queens Park Nature Centre is a major tourist attraction for the city of Ipswich displaying a large variety of Ipswich's native wildlife and some domestic animals. In 2012 several hundred flying-foxes began roosting in trees above the Nature Centre's water feature. Due to high levels of public visitation the presence of flying-foxes drew local media coverage and sparked a mixed community reaction.

Like Lorikeet Street Reserve roost, the colonization of flying-foxes in Queens Park is believed to be linked with the decrease in flying-fox numbers at the Woodend Flying-fox Precinct in 2011 and 2012. Woodend is around 2.5 km west of Queens Park.

For the majority of 2013 the Queens Park camp comprised a total of 250 black flying-foxes, however this number began to rise in August and reached over 1,000 flying-foxes by December. This increase comprised a mass arrival of little red flying-foxes in addition to a steady increase in black flying-foxes and arrival of several grey-headed.

In January 2014 Queens Park Nature Centre was hit hard by a heat mortality event that killed the majority of the flying-foxes as detailed in Section 6.3.To the astonishment of Council staff the Nature Centre was quickly recolonized. Within a week a new population record was set with more than 2,000 black flying-foxes present.

Concerns for the health of visitors, staff and animals at the Nature Centre continued to grow until an influx of around 7,000 little red flying-foxes swelled the roost in March 2014 as shown in Figure 15. At this time Council decided to take intervention in the form of roost vegetation removal and active dispersal of flying-foxes.

The proposed management actions were not considered to represent a significant impact under the EPBC Act and all works were undertaken in accordance with the Code of Practice: *Ecologically sustainable management of flying-fox roosts.* Following limited removal of roost vegetation, dispersal activities were conducted as flying-foxes returned to roost over three consecutive mornings in early April. A combination of flood lighting (road-works type), noise deterrence and people presence was employed.

Over half the colony was dispersed on the first morning with the balance dispersed by the completion of the third morning. While the destination of the flying-foxes was not actively tracked both the Box Street, Yamanto and Woodend colonies (the only other active local roosts) recorded increased numbers around this time.

To date, flying-foxes have not returned to the Nature Centre however future attempts to recolonise this site may be anticipated. To accommodate some future flying-foxes presence within the facility Council has implemented are range of additional staff procedures for dealing within dead, sick or injured flying-foxes in a public setting.

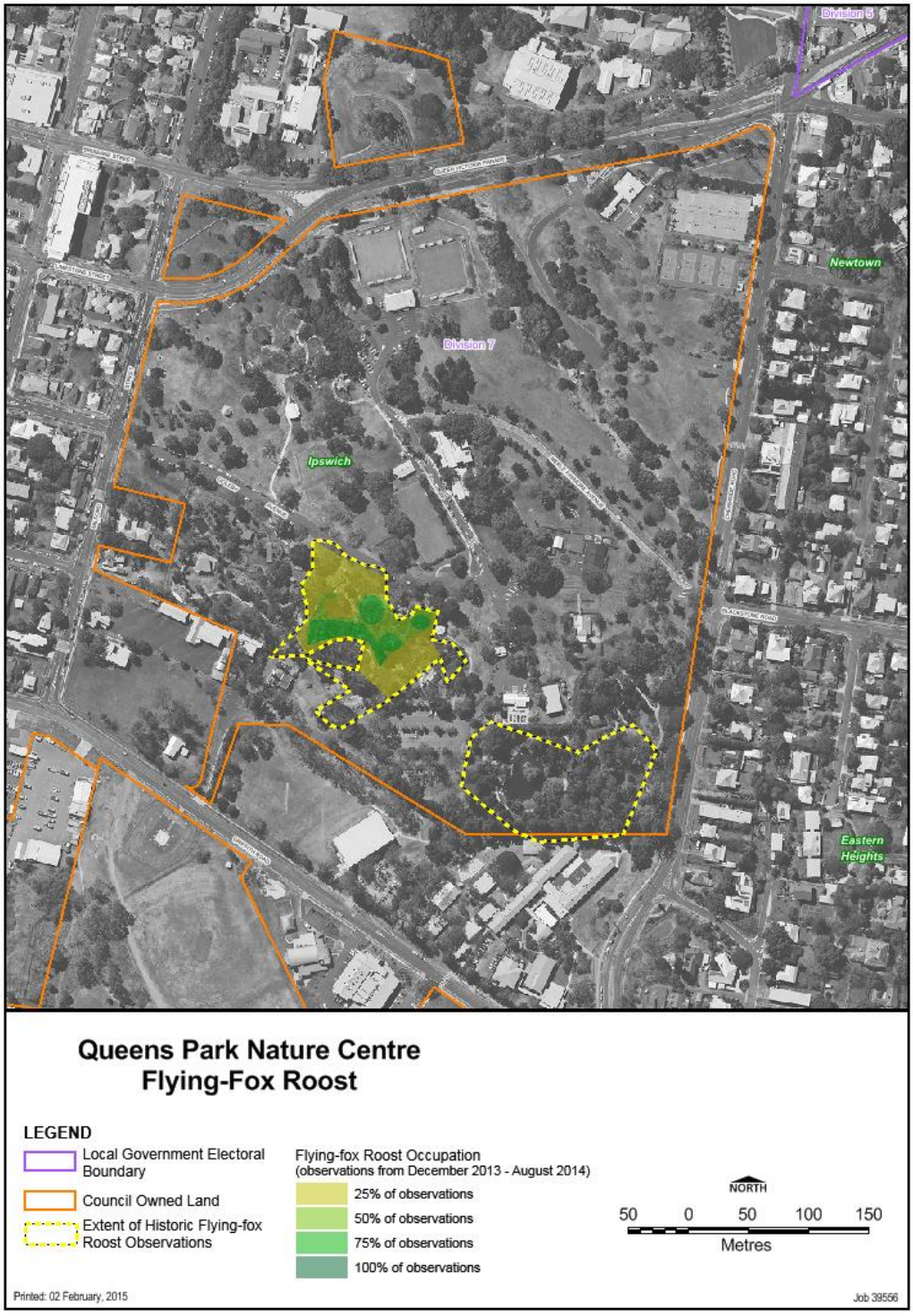


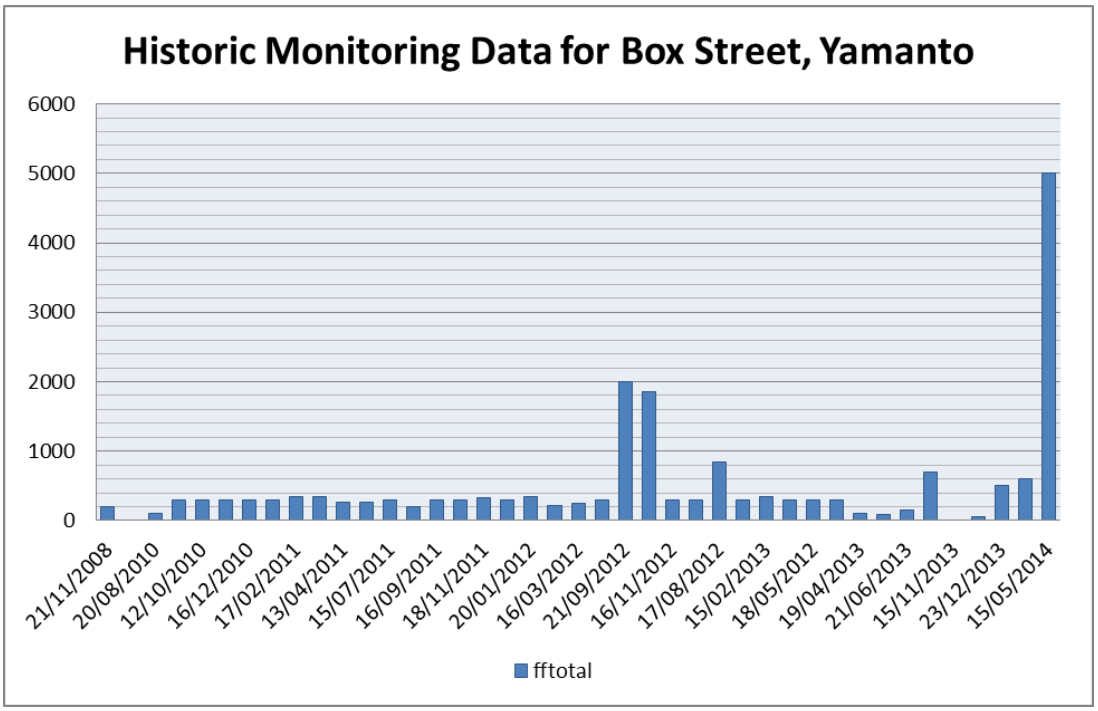
Figure 15. Aerial plan of Queens Park Nature Centre showing historic extent of flying-fox roost observations along with flying-fox roost observations recorded by Ipswich City Council between December 2013 and August 2014.

6.6.9 Yamanto Flying-Fox Roost

Yamanto is home to a camp of flying-foxes located predominantly on private property just south of the Ipswich CBD. Some confusion surrounds the history of this small camp as it was only brought to Councils attention in 2011, whereas EHP had been monitoring the site since at least 2008. Although it is again presumed that this camp may have formed in the aftermath of flying-foxes periodically vacating the Woodend Precinct.

EHP estimates that at its height this camp contained 2,000 flying-foxes with 75% of these being grey-headed. Justin Welbergen from James Cook University visited the camp in January 2014 following a heat wave and estimated a population of some 5000 flying-foxes (Graph 4). He noted that around 550 flying-foxes were killed at the site, 98% of which were black flying-foxes.

Detailed inspections by Council officers have not been undertaken as the roost is largely on private property. It is believed that EHP continues to monitor the roost.



Graph 4 Historic records of flying-foxes at Yamanto based on Department of Environment and Heritage Protection (2008-2013) and Welbergen 2014 monitoring data.

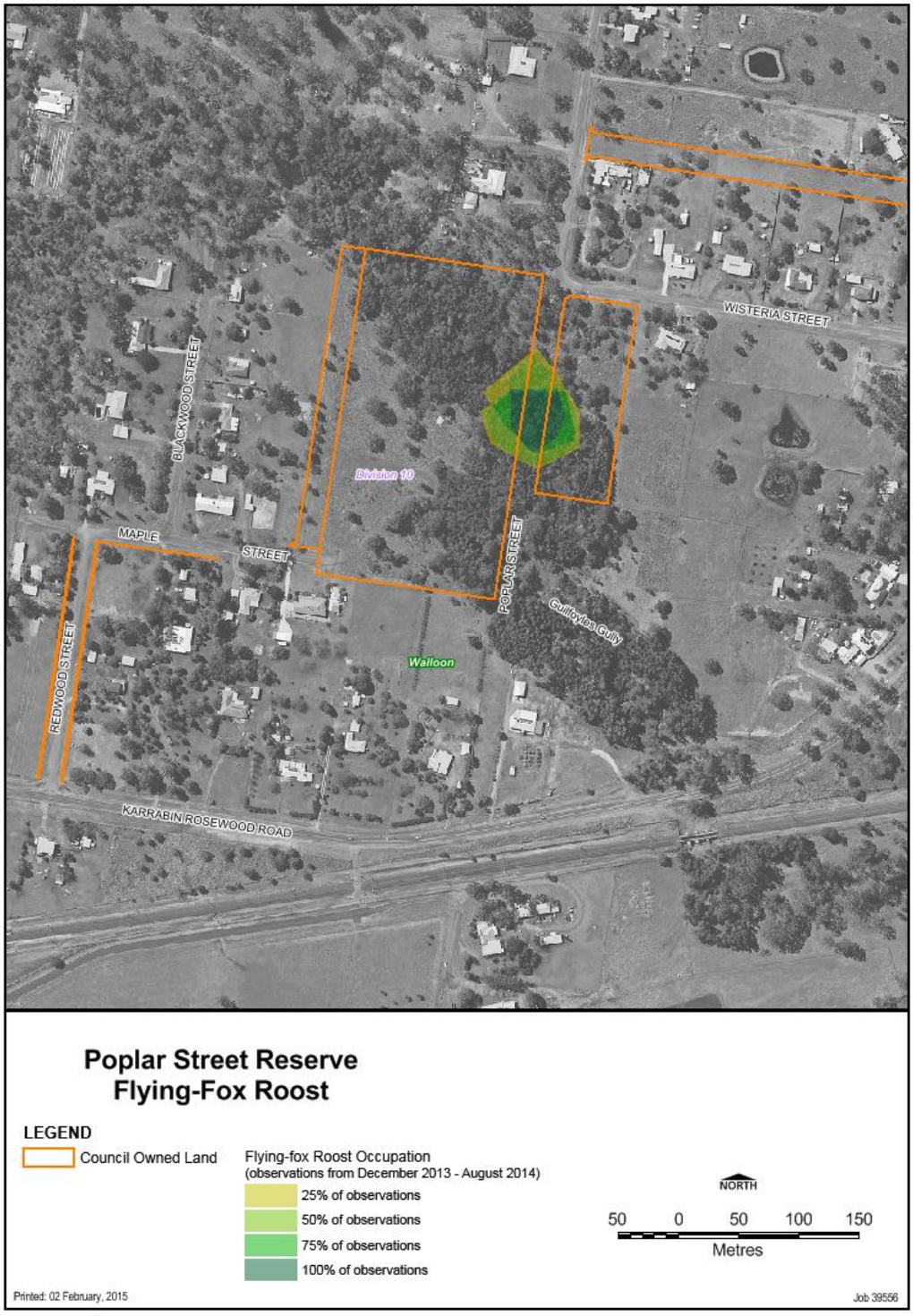


Figure 16. Aerial plan of Poplar Street Reserve showing flying-fox roost observations recorded by Ipswich City Council between December 2013 and August 2014.

6.6.10 Poplar Street Reserve Flying-Fox Roost

Poplar Street Reserve is located around 9kms west of Ipswich city along Guilfoyles Gully in the suburb of Walloon. Flying-foxes were first noted roosting in the reserve after a routine Council inspection in 2010. This colonisation date also aligns closely with the 2010 population collapse at the Woodend Precinct.

In late 2013, Council estimated that there were 350-400 flying-foxes roosting in the reserve. This camp is generally dominated by grey-headed flying-foxes with smaller numbers of blacks and periodic influxes of little red flying-foxes. Following a heatwave in January 2014, 51 flying-fox mortalities were recorded – mostly black headed.

On the 29th of January 2014 the reserve was recorded as empty however by May, after 4 months with no flying-foxes, the site was active again comprising around 1,000 bats (60% grey-headed; 40% black). A similar number and species balance was recorded during the August 2014 monitoring run.

In general the area used by roosting flying-foxes has a sizeable buffer to adjoining residences as depicted in Figure 8. However, the proximity of horses to the flying-fox camp has generated concerns for potential transmission of the Hendra virus. A grazing lease over the reserve was terminated in 2010 by agreement between Council and the leasee. In addition, a number of surrounding properties also contain horses. To date there have been no community concerns raised in relation to this camp.

7.0 Further Information

Information on living with flying-foxes: Living with Flying-foxes

Bat Conservation and Rescue Queensland: http://www.bats.org.au/

Wildlife Queensland: http://www.wildlife.org.au/wildlife/speciesprofile/mammals/flyingfox/

Australasian Bat Society: http://ausbats.org.au/

Brisbane City Council: http://www.brisbane.qld.gov.au/2010%20Library/2009%20PDF%20and%20Docs/4.Environment%20and%20Waste/4.7%20Wildlife/environment_and_waste_flying_foxes_CAS_2010_d4.pdf

NSW Government Department of Environment and Heritage: http://www.environment.nsw.gov.au/animals/flyingfoxes.htm

Hall, L & Richards, G 2000, *Flying-foxes: Fruit and Blossom Bats of Australia*, University of New South Wales Press, Sydney.

8.0 References

Baldock, FC, Douglas, IC, Halpin, K, Field, H, Young, PL & Black, PF 1996, 'Epidemiological investigations into the 1994 equine morbillivirus outbreaks in Queensland, Australia', *Sing Veterinary Journal*, vol. 20, pp.57-61.

Birt, P, McCoy, M & Palmer, C 2008, 'Little red flying-fox', in Van Dyck & Strahan, R (eds.), *The mammals of Australia*, Reed New Holland, Sydney, pp. 446-447.

Birt, P, 2005, 'Woogaroo Creek Flying-Fox Situation Assessment ', A final report to the Ipswich City Council.

Blackwood, JC, Streicker, D, Altizer, SA & Rohani, P 2013, 'Resolving the roles of immunity, pathogenesis and immigration for rabies persistence in vampire bats', *Proceedings of the National Academy of Sciences U.S.A*, doi: 10.1073/pnas.1308817110.

Department of Agriculture, Fisheries and Forestry 2013, *Australian bat lyssavirus overview*, viewed 16 December 2013, <http://www.daff.qld.gov.au/animal-industries/animal-health-and-diseases/a-z-list/australian-bat-lyssavirus/australian-bat-lyssavirus>

Department of Environment and Heritage 2014, *Flying-foxes: Heat stress in flying-foxes*, NSW Government, viewed 13 February 2014, <http://www.environment.nsw.gov.au/animals/flyingfoxes.htm>

Department of Environment and Heritage Protection 2011, *Little red flying-fox*, viewed 4 December 2013, < http://www.ehp.qld.gov.au/wildlife/animals-az/little_red_flyingfox.html>

Duncan, A, Baker, GB & Montgomery, N 1999, *The Action Plan for Australian Bats*, Environmental Australia, Canberra.

Easterling, DR, Evans, JL, Groisman, PY, Karl, TR, Kunkel, KE & Ambenje, P 2000, 'Observed variability and trends in extreme climate events', *Bulletin of the American Meteorological Society*, vol. 81, pp.417-425.

Eby, P 1991, 'Finger-winged night workers; managing forests to conserve the role of grey-headed flying foxes as pollinators and seed dispersers', in Lunney, D (eds.), *Conservation of Australian Forest Fauna*, Royal Zoological Society, Sydney, pp.91-100.

Eby, P, Richards, G, Collins, L & Parry-Jones, K 1999, 'The distribution, abundance and vulnerability to population reduction of a nomadic nectativore, the grey-headed flying-fox *Pteropus poliocephalus* in New South Wales, during a period of resource concentration', *Austral Zoology*, vol. 31, pp.240-253.

Eby, P & Lunney, D 2002, 'Managing the grey-headed flying fox *Pteropus poliocephalus* as a threatened species: a context for the debate', in Eby, P & Lunney, D (eds.), *Managing the Grey-headed Flying-fox as a Threatened Species in NSW*, Royal Zoological Society, Sydney, pp.240-250.

Field, H, Young, P, Yob, JM, Mills, J, Hall, L & McKenzie, J 2001, 'The natural history of Hendra and Nipah viruses', *Microbes and Infection*, vol. 3, pp.307-314.

Fraser, GF, Hooper, PT, Lunt, RA, Gould, AR, Gleeson, LJ, Hyatt, AD, Russell, GM & Attenbelt, J 1996, 'Encephalitis caused by a Lyssavirus in fruit bats in Australia', *Emerging Infectious Diseases*, vol. 2, no. 4, pp.327-331.

Fujita, MS & Tuttle, MD 1991, 'Flying foxes (Chiroptera: *Pteropodidae*): threatened animals of key ecological and economic importance', *Conservation Biology*, vol. 5, pp.455-463.

Hall, LS 1987, 'Identification, distribution and taxonomy of Australian flying-foxes (Chiroptera: Pteropodidae)', *Australian Mammals*, vol. 10, pp.75-79.

Hall, LS & Richards, GC 2000, *Flying-foxes: Fruit and Blossom Bats*, University of New South Wales Press, Sydney.

Hall, LS & McKenzie, N 2008, '*Pteropus scapulatus*', in IUCN 2013, *IUCN Red List of Threatened Species*, vol. 2013.2, <http://www.iucnredlist.org/details/18758/0>, viewed 4 December 2013.

Halpin, K, Young, PL, Field, HE & McKenzie, JS 2000, 'Isolation of Hendra virus from *Pteropid* bats: a natural reservoir of Hendra virus', *Journal of General Virology*, vol. 81, pp.1927-1932.

Jones, PD, Parker, DE, Osborn, TJ & Briffa, KR 1999, 'Global and hemispheric temperature anomalies – land and marine instrument records', in Carbon Dioxide Information Analysis Centre (ed), *Trends:* a compendium of data on global change', Oak Ridge National Laboratory, U.S. Department of Energy, Oak Ridge, Tennessee.

Markus, N & Hall, L 2004, 'Foraging behaviour of the black flying-fox (*Pteropus alecto*) in the urban landscape of Brisbane, Queensland', *Wildlife Research*, vol. 31, pp.345-355.

McDonald-Madden, E, Schreiber, ESG, Forsyth, DM, Choquenot, D & Clancy, TF 2005, 'Factors affected the grey-headed flying fox (*Pteropus poliocephalus*: Pteropodidae) foraging in the Melbourne metropolitan area. Australia', *Austral Ecology*, vol. 30, pp.600-608.

O'Brien, GM 1993, 'Seasonal reproduction in flying-foxes reviewed in the context of other tropical mammals', *Reproduction, Fertility and Development*, vol. 5, pp.499-521.

Palmer, C & Woinarski, JCZ 1999, 'Seasonal roosts and foraging movements of the black flying-fox (*Pteropus alecto*) in the Northern Territory: resource tracking in a landscape mosaic', *Wildlife Research*, vol. 26, pp.823-838.

Paris, KM & Hazell, DL 2005, 'Biotic effects of climate change in urban environments: The case of the grey-headed flying-fox (*Pteropus poliocephalus*) in Melbourne, Australia', *Biological Conservation*, vol. 124, pp. 267-276.

Parry-Jones, KA & 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*, vol. 26, pp.47-55.

Peacock, L 2004, 'Roost preference of the grey-headed flying fox', Thesis, University of Sydney.

Plowright, RK, Sokolow, SH, Gorman, ME, Daszak, P & Foley, JE 2008, 'Causal inference in disease ecology: investigating ecological drivers of disease emergence', *Frontier in Ecology and the Environment*, vol. 6, pp.420-429.

Plowright, RK, Foley, P, Field, HE, Dobson, AP, Foley, JE, Eby, P & Daszak, P 2011, 'Urban habituation, ecological connectivity and epidemic dampening: the emergence of Hendra virus from flying-foxes (*Pteropus* spp.)', *Proceedings of the Royal Society B*, vol. 278, no. 1725, pp.3703-3712.

Queensland Health 2012, *Hendra Virus Infection*, a Queensland Health Fact Sheet, version. 26, 27 September 2012, Queensland Government.

Richards, GC 1995, 'A review of ecological interactions of fruit bats in Australian ecosystems', in Racey, PA & Webb, Swift, SM (eds.), *Ecology, evolution and behaviour of bats*, Oxford Scientific Publications, Oxford, pp.79-96.

Roberts, BJ, Eby, P, Catterall, CP, Kanowski, J & Bennett, G 2011, 'The outcomes and costs of relocating flying-fox camps: insights from the case of Maclean, Australia', in Law, B, Eby, P, Lunney, & Lumsden, L (eds.), *The Biology and Conservation of Australasian Bats*, Royal Zoological Society of NSW, Mosman.

Schmelitschek, E, French, K & Parry-Jones, K 2009, 'Fruit availability and utilization by grey-headed flying foxes (Pteropodidae: *Pteropus poliocephalus*) in a human-modified environment on the south coast of New South Wales, Australia', *Wildlife Research*, vol. 36, pp.592-600.

Sinclair, EA, Webb, NJ & Marchant, AD & Tidemann, CR 1996, 'Genetic variation in the little red flying-fox *Pteropus scapulatus* (Chiroptera: Pteropodidae): Implications for management', *Biological Conservation*, vol. 76, pp.45-50.

Snoyman, S & Brown, C 2010, 'Microclimate preferences of the grey-headed flying-fox (*Pteropus poliocephalus*) in the Sydney region', *Australian Journal of Zoology*, vol. 58, pp.376-383.

Stanvic, S, McDonald, V & Collins L 2013, *Managing Heat Stress in Flying-fox Colonies*, viewed 24 January 2014, < http://www.ozarkwild.org/docs/Heat-Stress25-10-13.pdf>

Streicker, DG, Recuenco, S, Valderrama, W, Benavides, JG, Vargas, I, Pacheco, V, Condori, RE, Montgomery, J, Rupprecht, CE, Rohani, P & Altizer, S 2012, 'Ecological and anthropogenic drivers of rabies exposure in vampire bats: implications for transmission and control', *Proceedings of the Royal Society Biological Sciences*, vol. 279, pp.3384-3392.

Streicker, DG 2013, 'From persistence to cross-species emergence of a viral zoonosis', *Science*, vol. 342, pp.1885-1886.

Tidemann, CR, Vardon, MJ, Nelson, JE, Speare, R & Gleeson, LJ 1997, 'Health and conservation implications of Australian bat *Lyssavirus*', *Australian Zoologist*, vol. 30, no. 3, pp.369-376.

Tidemann 1999, 'Biology and management of the grey-headed flying-fox, *Pteropus poliocephalus*', *Acta Chiroptera*, vol. 1, pp.151-164.

Tidemann, CR & Nelson, JE 2004, 'Long-distance movements of the grey-headed flying-fox (*Pteropus poliocephalus*)', *Journal of Zoology*, vol. 263, no. 2, pp.141-146.

Tidemann, CR & Nelson, JE 2011, 'Life expectancy, causes of death and movements of the grey-headed flying-fox (*Pteropus poliocephalus*) inferred from banding', *Acta Chiropterologica*, vol. 13, no. 2, pp.419-429.

Thiriet, D 2005, 'The relocation of flying-fox colonies in Queensland', *Environmental Planning and Law Journal*, vol. 22, pp.231-239.

Vardon, MJ & Tidemann, CR 1998, 'Reproduction, growth and maturity in the black flying-fox, *Pteropus alecto*, (Megachrioptera: Pteropodidae)', *Australian Journal of Zoology*, vol. 46, pp.329-344.

Vardon, MJ & Tidemann, CR 2000, 'The black flying-fox (*Pteropus alecto*) in north Australia: juvenile mortality and longevity', *Australian Journal of Zoology*, vol. 48, pp.91-97.

Welbergen, JA 2005, 'The social organisation of the grey-headed flying fox, *Pteropus poliocephalus*', Ph.D. Thesis, The University of Cambridge.

Welbergen, JA, Klose, SF, Markus, N & Eby, P 2008, 'Climate change and the effects of temperature extremes on Australian flying-foxes', *Proceedings of the Royal Society Biology,* vol. 275, pp.419-425.

Welbergen, JA, Booth, C & Martin, J 2014, *Killer Climate: tens of thousands of flying-foxes dead in a day*, The Conservation, viewed 26 February 2014, <https://theconversation.com/killer-climate-tens-of-thousands-of-flying-foxes-dead-in-a-day->

West, C 2006, 'Contemporary issues in managing flying-fox camps', in Eby, P & Lunney, D (eds.), *Managing the Grey-headed Flying-fox as a Threatened Species in NSW*, Royal Zoological Society of NSW, Mosman, pp.176-195.

Wynne, JW & Wang, L 2013, 'Bats and viruses: Friend or Foe?', *PLOS Pathogens*, vol. 9, no. 10, pp.1-4.

9.0 Appendices

Appendix A – Council's Statement of Management Intent

City of Ipswich	**STATEMENT OF MANAGEMENT INTENT - FLYING-FOX ROOST MANAGEMENT IN IPSWICH CITY**	Version: 1.1 Document No.:

1.1 Objective:
To protect the health, wellbeing and livelihoods of the residents of Ipswich City while recognising the important ecological role performed by flying-fox populations.

1.2 Regulatory Authority:
Under recent changes to the State *Nature Conservation Act 1992*, and associated regulations, Councils have a voluntary as-of-right authority allowing them, if they so choose, to implement additional management actions for flying-fox roosts in a defined urban area. The as-of-right management actions are limited to non-lethal methods, and may only be undertaken in accordance with the statutory *Code of Practice – ecologically sustainable management of flying-fox roosts*.

In administering the as-of-right authority Councils must still abide with a range of other legislation and policy. Key among these are protections afforded to the Grey-headed flying-fox under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* which is not affected or diminished in any way by the State changes.

1.3 Policy Scope:
This document establishes a policy framework for management of existing and new flying-fox roosts located within the city. The State provisions define areas within Council's planning scheme having a residential or commercial purpose, including a buffer of one (1) kilometre, as the Urban Flying Fox Management Area (UFFMA)*. Council's policy will apply to roosts located both within and outside of the UFFMA.

Council will manage flying-fox roosts located on Council owned or managed land. In addition, where a roost occupies both Council land and adjacent private property, Council will work with the respective land owner/s to develop management solutions, consistent with this policy, and the subsequent flying-fox management plan. A hierarchical approach to flying-fox roost management will be employed favouring education and minimal intervention strategies developed on a case by case basis.

Council will support private property owners to manage flying-fox roosts on their land. A city-wide flying-fox management plan will underpin the provision of a range of services for private land owners including:

- Provision of education materials

- Provision of technical support
- Provision of research data and support
- Referral to expert information sources

In exceptional circumstances Council may assist a private property owner to develop and implement a roost specific management action. These situations will be identified through risk assessment processes applied on a case by case basis as detailed in the section of this policy titled Management Plan.

A number of flying-fox matters are outside the scope of this policy including any management of roosts or flying-foxes matters in association with:

- State owned or managed land
- Commonwealth owned or managed land

Management of flying-foxes in these locations should be discussed with the respective land owner or manager. Further, this policy clarifies Council's role in relation to a number of additional matters of flying-fox management and human health.

1.4 Policy Statement:

The following key policy statements will guide Council's management of flying-fox roosts and associated management issues and actions:

- Human health and wellbeing will be given primary consideration over the health and wellbeing of flying foxes where significant conflict is found to exist between the two;
- Flying foxes perform an essential ecological role, pollinating and dispersing the seeds of native plants and maintaining forest health;
- Due to the highly mobile and dynamic nature of flying-fox roosts any management actions will be considered and developed on a case by case basis;
- Council will follow a hierarchical approach to flying-fox roost management favouring education and minimal intervention;
- A risk based assessment process will be used to determine the requirement for any roost specific management actions;
- Roost specific actions including dispersals will only be considered after less intrusive actions have been tried and found to be unsuccessful. Dispersals have a low documented success rate in Australia with significant potential to exacerbate the existing situation; and

<u>Management Plan</u>

Council will develop a city-wide flying-fox management plan for existing and new roosts located within and outside the UFFMA. The plan will contain the necessary information required to guide and support well informed, balanced and consistent flying-fox management actions.

Key elements to be developed and implemented through the plan will include:

- Quarterly monitoring of roost locations, species and numbers on Council owned and managed land;
- Risk based management zones and strategy development for roosts are defined as

being:

- 'High risk' if located within 100 metres of sensitive sites such as schools, medical and formal equestrian facilities;
- 'Medium conflict' if located within 50 metres of residential or commercial development and greater than 100 metres from a sensitive site;
- 'Low conflict' if located greather than 50 to 100 metres of residential or commercial development and greater than 100 metres from a sensitive site;
- 'Preferred roost locations' if located on protected areas declared under the *Nature Conservation Act 1992,* for which Council is trustee, or greater than 100 metres from residential or commercial development; and
- 'New roosts' where a site is occupied for less than three (3) months with no previous roosting history.

- Mapping of historical and current roost areas and management zones in association with Council owned and managed land;
- Roost histories incorporating locations, species composition, population numbers, major roost changes, actions, interventions and associated outcomes;
- A community consultation strategy based on Council's hierarchical approach to flying-fox roost management;
- A package of support for private land owners with flying-fox issues delivering educational and research materials and technical support
- The legislative framework associated with flying-fox and associated habitat management; and
- A risk and benefit framework for management actions.

1.5 Roles and responsibilities

In addition to Council a number of agencies and organisations play an important role in the management of flying foxes.

Flying-fox biology and management

Further information on flying foxes, their biology and management options for roosts located on private property are available from the Department of Environment and Heritage Protection.

Health and Safety

For up to date information on flying-fox related human health matters residents are advised to contact the Queensland Health hotline.

Flying-fox rescue

Residents are advised never to touch or attempt to aid a sick or injured flying-fox. For assistance with sick or injured flying foxes contact Bat Conservation and Rescue Queensland.

1.6 Definitions:

Urban Flying Fox Management Area (UFFMA) – those land parcels defined within a local government planning scheme as having a residential or commercial purpose with the addition of a one (1) kilometre buffer.

Management actions – non lethal actions intended to stop flying-foxes from making use of a site or part of a site. * Mapping is available from the Department of Environment & Heritage website at http://ehp.qld.gov.au/wildlife/livingwith/flyingfoxes/maps/ipswich-city.pdf **1.7 Policy Author:** Planning Officer (Biodiversity)
Date of Council resolution: 22 April 2014 **Committee Reference and date:** Policy and Administration Board No. 2014(03) of 1 April 2014 - City Management and Finance Committee No. 2014(04) of 15 April 2014 **No of resolution:** 2 **Date to be reviewed:** 22 April 2016

Appendix B – Flying-Fox Friendly Plant List

Subject to the suitability of the site, some suggested roosting and feeding trees for the Ipswich area include:

- White Cedar *Melia azedarach*
- Endemic Fig trees *Ficus* spp.
- Queensland Blue Gum *Eucalyptus tereticornis*
- Lemon-scented Gum *Corymbia citriodora*
- Grey Gum *Eucalyptus major*
- Grey Ironbark *Eucalyptus siderophloia*
- Narrow-leaved Ironbark *Eucalyptus crebra*
- Gum-topped Box *Eucalyptus molucanna*
- Broad-leaf Apple *Angophera subvelutina*
- Rough-barked Apple *Angophera floribunda*
- Pink Bloodwood *Corymbia intermedia*
- Silver-leafed Ironbark *Eucalyptus melanophloia*
- Silky Oak *Grevillea robusta*
- Broad-leaved Paperbark *Melaleuca quinquenervia*
- Weeping Bottlebrush *Callistemon viminalis*
- River Oak *Casuarina cunninghamii*
- Weeping Lilly Pilly *Waterhousia floribunda*
- Black Tea-tree *Melaleuca bracteata*
- Brush Cherry *Syzygium australe*
- Native Laurel *Pittosporum undulatum*
- Soap Tree *Alphitonia excelsa*
- Black Bean *Castanospermum australe*

Appendix C - Dispersal Case Studies

Using dispersal or relocation of flying-fox camps as a management approach can have considerable costs and their success is often questionable (West 2002; Nelson 2008). Nevertheless, dispersal of flying-foxes is both a common and popular method of flying-fox management with significant historical analysis within the scientific literature.

Table 1 was taken from Australasian Bat Society (2013) and lists all recorded and published attempts at flying-fox dispersals in Australia. One clear conclusion which can be drawn from the data is the huge expense, and low success, of dispersal actions which do not incorporate vegetation modification. Vegetation modification, although also expensive, appears to be the only clear way of removing flying-fox conflict from the original site efficiently. Of note, in areas such as Charters Towers where there was refusal to modify the vegetation, repeated and ongoing dispersal efforts were ineffective.

Table 1: List of all recorded and published attempts at flying-fox dispersals in Australia. Taken from Australasian Bat Society (2013). A full list of referenced case studies is provided at the foot of the table.

Location	Species	FF population estimate at time of dispersal	Method	Did the animals leave the local area?	Did the local population reduce in size?	How far did they move?	Were new camps formed (number of new camps if known)?	Number of separate actions	Cost (if known)	Was conflict resolved at the original site?	Was conflict resolved for the community?	Source+
Barcaldine, Qld	R	>50,000	VN	no	no	≈2 km	yes (1)	trees in township felled		yes	no	a,b
Batchelor, NT	B	200	BNS	no	no	<400 m	yes (1)	2		yes	yes	c,d
Boyne Island, Qld	BR	25,000	LNS	no	no	<500 m	yes (2)	3		yes	no	e,f,g
Bundall, Qld	GB	<1600	V	no	no	uk, but 6 camps were within 5 km	yes (2)	1 action over 21 days		yes	yes	h,i,j, k
Charters Towers, Qld	RB	variable	HLNPOW	no	no	200 m	no (returned to original site)	repeated since 2000	>$500,000	no	no	l,m
Dallis Park, NSW	BG	28,000	V	no	yes	300 m	yes (1)	2		yes	no	n
Duaringa, Qld	R	>30,000	VNFO	no	no	400 m	yes	1	$150,000	yes	uk	o
Gayndah, Qld	RB	200,000	VN	no	no	600 m	yes	3 actions, repeated		yes	no	i
Maclean, NSW	BGR	20,000	NS	no	no	350 m	yes (7)	>23	>$400,000 and ongoing	no	no	n
Mataranka, NT	BR	>200,000	BHLNOSW	no	no	<300 m	uk	>9		no	no	n
North Eton, Qld	B	4800	VNFB	uk	no	<1.5 km initially	yes (≈4 majority temporary)	2	$45,000	yes	yes (conflict at one site)	j,p,q,r

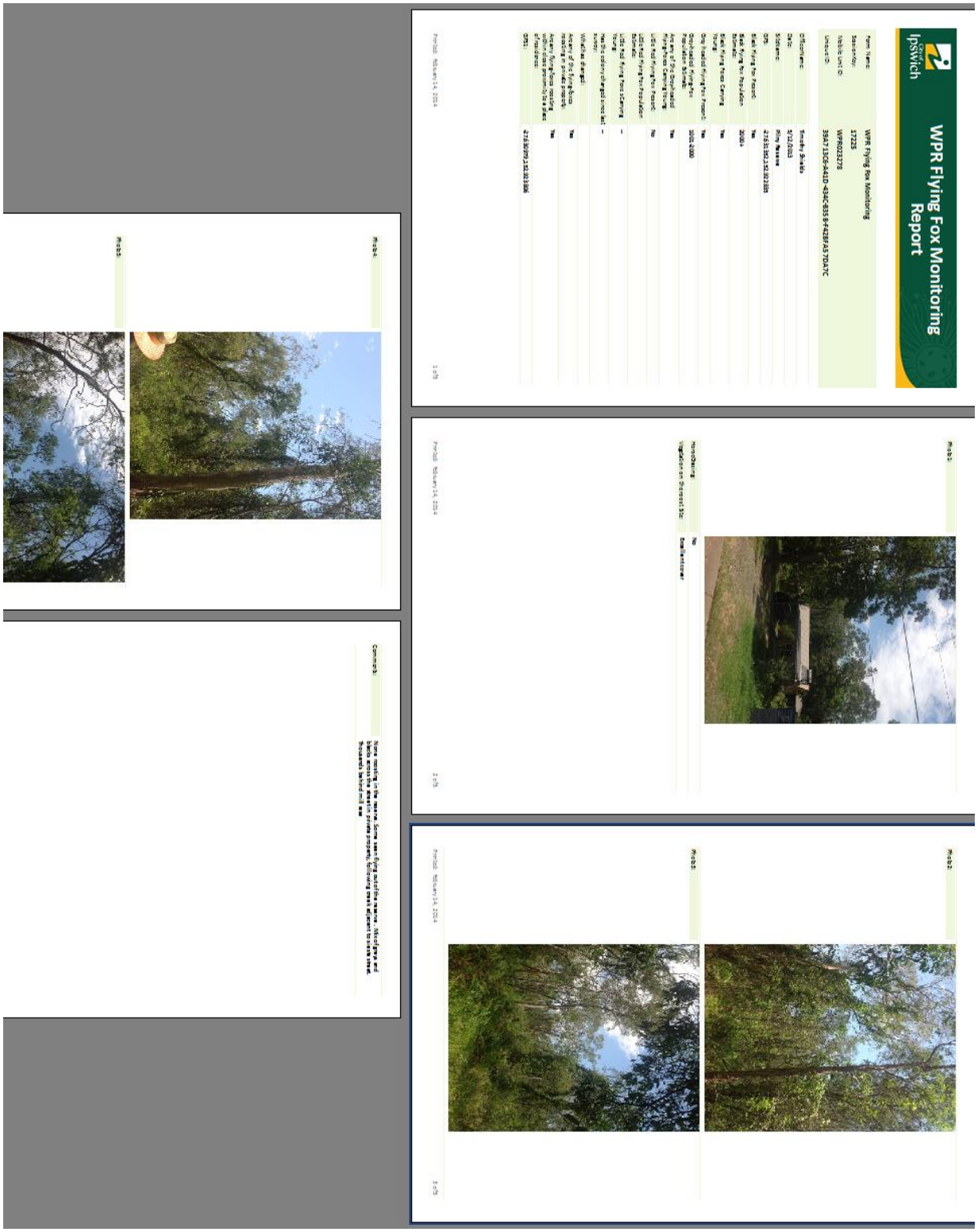
Location	Species	FF population estimate at time of dispersal	Method	Did the animals leave the local area?	Did the local population reduce in size?	How far did they move?	Were new camps formed (number of new camps if known)?	Number of separate actions	Cost (if known)	Was conflict resolved at the original site?	Was conflict resolved for the community?	Source+
Royal Botanic Gardens, Melbourne, Vic	G	30,000	NS	no	no	6.5 km	yes (2)	approx daily for 6 mths	$3 million	yes	yes, ongoing management required	m
Royal Botanic Gardens, Sydney, NSW	G	3,000	LNPOW	no	no	4 km	no	ongoing daily actions for 12 mths	>$1 million and ongoing	yes	yes	m,s,t
Singleton, NSW	GR	500	LNUW	no	no	<900 m	no (returned to original site	>3	$117,000 and ongoing	no	no	n,u
Townsville, Qld	BR	35,000	BNS	no	no	400 m	no (returned to original site)	5		no	no	n
Warwick, Qld	GRB (dispersal targeted R)	200,000	NLBP	no	no	≈1 km	no (site known to be previously occupied by GB)	5 days	$28,000	yes	no (complaints persisted until migration)	h,v,w
Young, NSW	L	<5000	VN	no	no	<600 m	yes (1)	uk		yes	no	x

* G = grey-headed flying-fox; B = black flying-fox; R = little red flying-fox
# B = "birdfrite"; F = fog; H = helicopter; L = lights; N = noise; P = physical deterrent; O = odour; S = smoke; U = ultrasonic sound; V = extensive vegetation removal; W = water.
[a] Storm Stanford (Wildlife carer, pers. comm. 2013); [b] Louise Saunders (BCRQ, pers. comm. 2013); [c] Phillips *et al.* (2007) Displacement of Black flying-foxes *Pteropus alecto* at Batchelor, Northern Territory *Australian Zoologist* 34: 119-124; [d] John McCarthy (Northern Territory Government, pers. comm. 2010); [e] Roberts (2006) *Management of Urban Flying-fox Camps: Issues of Relevance to Camps in the Lower Clarence, NSW.* Valley Watch Inc., Maclean; [f] Information from Gladstone Regional Council in 2010 and 2013; [g] Joe Adair (formerly DEHP, pers. comm. 2010); [h] Trish Wimberly (Australia Bat Clinic pers. comm. 2013); [i] Information obtained from Department of Environment and Heritage Protection (DEHP) in 2013; [j] Billie Roberts unpublished data; [k] Information from Ecosure [l]Scott Sullivan (DEHP, pers. comm. 2010); [m] Information from Charters Towers Regional Council in 2010 and 2013; [n] Roberts *et al.* (2012b) and additional references within; [o] Perry Deeds (Central Highlands Regional Council, pers. comm. 2013); [p] Jarmaine (2010) *Species Management Plan,* Mackay Regional Council; [q] Heidi Jarmaine (Mackay Regional Council, pers. comm. 2013); [r] Daryl Barnes (Walkerston resident, pers. comm. 2013) [s] Peggy Eby (Ecologist, pers. comm. 2013) [t] John Martin (Sydney RBG, pers. comm. 2013); [u] Singleton Council Meeting Minutes; [v] Information from the Southern Downs Regional Council in 2013; [w] Tim Low (pers. comm. 2013); [x] Young Shire Council.

It is also important to note that when flying-foxes are removed from the original site, community conflict is rarely resolved. Thiriet (2005, pg. 233) sheds some light on why this might be the case: "If they leave, it is more likely to be as a result of seasonal migration. Generally they return a few weeks or months later. In some circumstances, relocation exercises simply result in the animals dispersing into even less suitable sites such as nearby private yards".

In light of the challenges around flying-fox dispersal Roberts et al. (2011, pg. 284) recommend determining the "magnitude of the perceived problem before exploring potential management options, including relocation. For example, if noise, smell and faeces from a camp affect only a small number of residents, then more local-scale mitigation options such as creating buffers between houses and roosting flying-foxes or constructing sound barriers may be more effective solutions than attempted wholesale relocation of a camp".

Appendix D – Sample of Electronic Flying-fox Monitoring Template



Flying-fox Management Plan – Lorikeet Street Reserve

CONTEXT:

This management plan has been developed to provide strategies and actions to minimise the impacts of roosting flying-foxes within Lorikeet Street Reserve on adjacent residents along Paice Street, Oak Street and Thompson Street, Bundamba.

HISTORY:

Council first became aware of flying-foxes in Lorikeet Street Reserve in 2011 with formal monitoring commencing in 2012. Timing suggests that this colony is one of many in South east Queensland that formed after food shortages in 2010 and has since remained active.

Lorikeet Street is a mixed use colony containing black and grey headed flying-foxes in addition to summer influxes of little red flying-foxes. The colony typically stays below 500 animals with occasional spikes of up to 2000 animals depending on availability of surrounding food sources. Flying-foxes use a variety of tree and shrub species within the reserve for roosting, including large native eucalypts, weeds and non-endemic planted species from the wet tropics.

The reserve has been highly affected by heat waves in the past. The heat waves in January 2014 killed over 1200 flying-foxes in Lorikeet Street Reserve, close to 100% of the colony. A large influx of little red flying-foxes in summer 2015-2016 caused extensive destruction within the reserve, including the complete stripping of several roosting trees.

The area of occupation for the colony is highly variable, however most animals can typically be found throughout the middle of the reserve, as illustrated below:

COMMUNITY CONCERN:

Council has received a series of complaints from residents adjacent to Lorikeet Street Reserve, many of whom also have flying-foxes on their own property. Complaints occur primarily in summer (Nov-March) when little reds frequent the colony. This also correlates with peak flowering and fruiting season as well as breeding season for the larger species, thus creating a typically larger and noisier colony.

The most common cause for complaint is concerns regarding the noise and smell of the flying-fox colony and how this affects the lifestyle and mental health of the residents. Loss of sleep, inability to use backyards and alleged decreases in property value are often cited as secondary impacts to noise and smell. Mess from flying-fox guano is also a repeated concern, with particular reference to restrictions to laundry practices and inconvenience associated with repeatedly cleaning cars and houses.

Disease risk has been mentioned as a concern of several occasions. In these instances education and facilitation of correct information has been sufficient to reduce concern.

Destruction of vegetation by flying-foxes roosting within the reserve has also been cited as a concern.

MANAGEMENT OPTIONS:

Following recent amendments to the *Nature Conservation (Wildlife Management) Regulation 2006*, local governments in Queensland now have an as-of-right authority to manage flying-fox roosts in a defined Urban Flying-Fox Management Area (UFFMA), if they so choose. This authority includes the ability to actively disperse a flying-fox roost or conduct other non-lethal management actions without a Damage Mitigation Permit.

Under the Ipswich City Council Flying-fox Roost Management Plan, Lorikeet Street Reserve is classified as a medium conflict roost. The goal in medium conflict roosts is to resolve or mitigate impacts between the community flying-foxes without major vegetation modification or active dispersal. Options include creation of vegetative buffers, public education and other mitigation measures. Management options such as dispersal and more intensive vegetation modification are treated as last resort options.

PROPOSED ACTIONS FOR LORIKEET STREET RESERVE:

Lorikeet Street Reserve has a range of competing interests including scenic amenity, local green space and biodiversity values. Any management action prescribed for the reserve relating to flying-fox management must account for these interests and not compromise them.

Vegetation Modification

Vegetation modification is prescribed for small areas of the reserve that are consistently used by flying-foxes, with particular emphasis on consistently affected residences at 2,4,6,8 and 10 Oak

Street. Vegetation in this area will require both Council action within the reserve and joint action on private property to be successful. As part of this vegetation modification the following is suggested:

- Removal of consistently used roosting trees close to houses on Oak Street
- Removal of weed species within the reserve, including Singapore daisy, purple succulents and exotic grasses

Work on private properties is subject to approval from the landholder and agreement with Council. Removal of these trees can be partially funded by Council subject to signing of a Licence Agreement between the two parties.

Any vegetation modification must comply with the Queensland Flying-fox Management Guideline, with particular emphasis on animal welfare and breeding seasons.

Heat Street Refuge

Densely vegetated areas on and behind 17 Paice Street are not used regularly as roosting vegetation for flying-foxes but have proven to be successful refuge areas during heat events. As such this area should remain in its current state for periodic refuge during 40^{o}C+ days.

Similarly dense areas behind 12 Paice Street provides valuable shade habitat during heat events. While retention of this habitat is recommended, this area can be considered as part of Joint Vegetation Modification should the landholder desire the removal of this vegetation.

The large hoop pine at the back of the reserve adjacent to 14-16 Thompson Street has also been identified as a crèche and maternity tree and should not be removed for any reason.

Creek Rehabilitation

Plantings completed or in progress throughout the creek area will not be altered or interfered with as a result of this management plan. Plantings in this project thus far have included species that are not likely to be suitable for flying-fox roost trees e.g. sandpaper figs and reed species.

Bushland Maintenance

In Bushland Maintenance zones current reserve management practice will remain in place. Flying-foxes use some of these areas occasionally, in particular during summer months. Vegetation modification is not currently recommended for these areas but can be reassessed on an as needs basis.

LEGISLATIVE RESTRICTIONS FOR RESIDENTS:

A self-assessable authority exists for councils and community members to conduct low-risk management activities in accordance with a Code of Practice – low impact activities affecting flying-fox roosts. This code sets out the prescribed methods for low impact activities that a person may undertake at a flying-fox roost including:

- No roost tree may be trimmed when there are flying-foxes in that part of the tree being trimmed, or when flying-foxes are near to the tree and likely to be harmed as a result of the trimming.
- Any trimming of roost trees must be limited to 10% of the total canopy of the roost.
- Low impact activities must immediately cease, and EHP be immediately notified, if a flying-fox appears to have been killed or injured; and
- Where low impact activities are required to be undertaken during the day time, works must immediately cease and EHP be immediately notified if 30% or more of the adult flying-foxes leave the roost for five minutes or more.

Examples of low impact activities include mowing, weeding and minor tree trimming under or near roost trees where flying-foxes are not present in the subject trees.

Residents can also apply for a Damage Mitigation Permit should they feel that additional and more intensive actions are required.

RECOMMENDED ACTIONS FOR RESIDENTS:

There are a number of things that affected residents can also do to mitigate the impacts of living next to a flying-fox colony, particularly when concerned with issues such a noise, smell and mess.

This includes:

- Use of car covers, garages and car shelters to reduce the impact of guano on vehicles
- Invest in a clothesline cover to reduce the impact of guano on washing
- Invest in high pressure cleaners to clean outdoor areas and furniture
- Use air condition and/or fans on hot, wet and humid days where smell is likely to be exacerbated.
- Using free plant allocations to plant a layer of aromatic plants can be an effective way to screen flying-foxes away from a particular area

TIMING:

Flying-foxes in Lorikeet Street Reserve will be monitored regularly throughout the coming months to determine the most appropriate time to conduct works. Particular attention needs to be payed to where mothers with dependent young are crèching their offspring during the night. Until it can be confirmed that no flying-foxes will be present in trees during the night, any vegetation modification works cannot commence. Given the late season babies in the colony this may not be until May or later. Flying-foxes may also leave the roost temporarily during winter, presenting ideal conditions for vegetation modification.

AFFECTED RESIDENTS:

The following have been identified as immediately affected residents. Other residents in Paice Street, Oak Street and Thompson Street may also become impacted temporarily, particularly during summer high season.

Lot on Plan	Owner	Address
29RP22431	[redacted]	[redacted]
62RP22431	[redacted]	[redacted]
63RP22431	[redacted]	[redacted]
64RP22431	[redacted]	[redacted]
65RP22431	[redacted]	[redacted]
66RP22431	[redacted]	[redacted]
67RP22431	[redacted]	[redacted]
68RP22431	[redacted]	[redacted]
69RP22431	[redacted]	[redacted]
70RP22431	[redacted]	[redacted]
71RP22431	[redacted]	[redacted]
81RP22431	[redacted]	[redacted]
80RP22431	[redacted]	[redacted]
79RP22431	[redacted]	[redacted]
78RP22431	[redacted]	[redacted]

Code of Practice

Ecologically sustainable management of flying-fox roosts

Nature Conservation Act 1992

Queensland Government

Prepared by: Conservation and Biodiversity Operations Branch, Department of Environment and Science

Approved in accordance with section 174A of the *Nature Conservation Act 1992*

Acknowledgements

This code of practice has been prepared by the Department of Environment and Science in consultation with local government representatives, both elected and official, conservation groups, relevant government agencies, ecological consultants and members of the public.

November 2013

1. Purpose and operation of this code

1.1 The purpose of this Code of Practice— Ecologically sustainable management of flying-fox roosts **('the Code') is to ensure that the chance of *management actions* under this code resulting in harm to** flying-foxes is minimised and that appropriate welfare standards are upheld.

1.2 This code sets out how, in the course of undertaking *management actions* at flying-fox roosts in accordance with section 41A of the Nature Conservation (Wildlife Management) Regulation 2006, local government, may:

1.2.1 destroy a flying-fox roost

1.2.2 drive away, or attempt to drive away, a flying-fox from a flying-fox roost

1.2.3 disturb a flying-fox in a flying-fox roost.

1.3 This code also applies to persons or local governments operating under a flying-fox roost management permit, where the permit requires them to comply with this code.

2. Prescribed methods for management actions

2.1 The Department of Environment and Science (DES) must be notified at least two business days prior to commencing any *management actions* by completion of the flying-fox roost management notification form on the DES website. However, management actions may be commenced earlier than two business days following completion of the flying-fox roost management notification form on the DES website if an *authorised person* gives written notice to that effect.

2.1.1 This notification is valid for all dispersal activities conducted in relation to a roost within a two week timeframe from the date of notification, including dispersal activities conducted at a different location which are required to manage any impacts from dispersing the target roost.

2.1.2 If commencement or continuation of activities is delayed beyond this two week timeframe, a further notification advising the new proposed commencement date and time is required.

2.2 No roost tree may be destroyed or modified when there are flying-foxes in the tree, or when flying- foxes are near to the tree and likely to be harmed as a result of the destruction or modification.

2.3 All *management actions* must immediately cease, and DES be immediately notified if flying-foxes appear to have been killed or injured.

2.4 During *management actions*, any attempt to drive away flying-foxes:

2.4.1 Must be properly coordinated to ensure all actions are lawful and in compliance with this code

2.4.2 May only commence after advice from a *person knowledgeable about flying-fox behaviour*, or with such a person present

2.4.3 May only occur in the early evening and/or early morning

2.4.4 When being carried out in the early evening, must commence immediately prior to dusk 'fly-out' at a roost and continue for no longer than 2 hours

2.4.5 When being carried out in the early morning, must commence immediately when flying-foxes start returning to a roost from foraging activities, and continue for no longer than 3 hours

2.4.6 Must be limited to the non-lethal deterrence methods of smoke, noise, light, foggers, BirdFrite and 'scarecrow' type devices only.

3. Definitions

Act— the *Nature Conservation Act 1992*.

Authorised person— means any of the following—

(a) the chief executive, performing functions under the Act

(b) a public service employee of the department performing functions under the Act for the chief executive

(c) a conservation officer who is not an employee of the department and who is performing functions under the Act for the chief executive.

Management actions— means non-lethal actions intended to stop flying-foxes from making use of a site or part of a site, and include destroying and/or modifying vegetation at a site, as well as coordinated action to drive flying-foxes away from a site.

Person knowledgeable about flying-fox behaviour— means a person able to demonstrate experience of, or a methodology for:

(a) classifying flying-fox species

(b) assessing flying-fox population numbers in particular roosts

(c) identifying flying-fox breeding cycles including evidence of breeding and rearing activity in particular roosts

(d) recognising signs of distress in, or harm to, flying-foxes.

Roost or **flying-fox roost**— means a tree or other place where flying-foxes congregate from time to time for breeding or rearing their young.

Code of Practice

Low impact activities affecting flying-fox roosts

Nature Conservation Act 1992

Queensland Government

Prepared by: Nature Conservation Services Branch, Department of Environment and Science

Approved in accordance with section 174A of the *Nature Conservation Act 1992*

Disclaimer

This document has been prepared with all due diligence and care, based on the best available information at the time of publication. The department holds no responsibility for any errors or omissions within this document. Any decisions made by other parties based on this document are solely the responsibility of those parties. Information contained in this document is from a number of sources and, as such, does not necessarily represent government or departmental policy.

If you need to access this document in a language other than English, please call the Translating and Interpreting Service (TIS National) on 131 450 and ask them to telephone Library Services on +61 7 3170 5470.

This publication can be made available in an alternative format (e.g. large print or audiotape) on request for people with vision impairment; phone +61 7 3170 5470 or email <library@DES.qld.gov.au>.

Acknowledgements

This code of practice has been prepared by the Department of Environment and Science in consultation with local government representatives, both elected and official, conservation groups, relevant government agencies, ecological consultants and members of the public.

November 2013

1. Purpose and operation of this code

1.1 The purpose of this Code of Practice— Low impact activities affecting flying-fox roosts ('the Code') is to ensure that the chance of low impact activities under this code resulting in harm to flying-foxes is minimised and that appropriate welfare standards are upheld.

1.2 This code sets out how a person may undertake *low impact activities* at a flying-fox roost anywhere in the State of Queensland in accordance with section 41B of the Nature Conservation (Wildlife Management) Regulation 2006.

1.3 This code is developed under section 174A of the *Nature Conservation Act 1992* ('the Act').

2. Prescribed methods for low impact activities

2.1 No roost tree may be trimmed when there are flying-foxes in that part of the tree being trimmed, or when flying-foxes are near to the tree and likely to be harmed as a result of the trimming.

2.2 Any trimming of roost trees must be limited to 10% of the total canopy of the roost.

2.3 Low impact activities must immediately cease, and DES be immediately notified, if a flying-fox appears to have been killed or injured.

2.4 Where low impact activities are required to be undertaken during the day time, works must immediately cease and DES be immediately notified if 30% or more of the adult flying-foxes leave the roost for five minutes or more.

3. Definitions

Low impact activities— means mulching, mowing or weeding under or near roost trees, and/or minor trimming of roost trees, where the activities are not directed at destroying a flying-fox roost, driving away, or attempting to drive away, a flying-fox from a flying-fox roost, or disturbing a flying-fox in a flying-fox roost.

Roost or **flying-fox roost**— means a tree or other place where flying-foxes congregate from time to time for breeding or rearing their young.