The new Sydney Fish Market: Microbat Management Plan

Infrastructure NSW

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Abbreviations

Abbreviation	Description
ABLV	Australian Bat Lyssavirus
BC Act	*Biodiversity Conservation Act 2016*
EES	Environment, Energy and Science division of the Department of Planning, Industry and Environment
ELA	Eco Logical Australia Pty Ltd
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
MMP	Microbat Management Plan

1. Introduction

1.1 Proposal Background

Eco Logical Australia (ELA) have been engaged by Infrastructure NSW to prepare a Microbat Management Plan (MMP) for the proposed construction of a new Sydney Fish Market at Blackwattle Bay (the subject site).

The subject site is located at the head of Blackwattle Bay between the Pyrmont Peninsula and the foreshore of Glebe. It is situated less than 2 km west of Sydney's CBD and is partially within the City of Sydney Local Government Area.

The subject site comprises of a range of marine piles, wharves and jetties constructed from a mixture of materials including timber, concrete and steel. As such, the subject site includes structures both above and below the mean high-water mark. There are also several disused buildings located on the structure that are in variable condition, with some derelict and inaccessible and others relatively uncompromised. Drainage networks are present under the wharf and a culvert is located underneath the wharf at the western end of the subject site. Overall, the subject site covers an area of approximately 36,800 m² (Figure 1).

Infrastructure NSW are proposing to demolish all existing land and water-based structures on the subject site. The demolition works will include the removal of marine piles, wharves and jetties. Repairs to the existing sea wall will also be undertaken. Works include the relocation of all services and the construction of a new Sydney Fish Market including multiple land and water-based structures.

A range of targeted microbat surveys were carried out in preparation of the Biodiversity Development Assessment Report (BDAR) submitted with the development application. Additional bat surveys were carried out at the subject site by ELA between February and April 2020. These surveys included two separate ultrasonic detector surveys, diurnal visual inspection of the structures above and below the wharf structures, nocturnal emergence surveys of the structures from the water combined with ultrasonic recording and thermal imaging cameras, and searches for alternative microbat roosting habitat within a 2 km radius of the subject site.

The results of these surveys indicated that there is potential microbat roosting habitat present on site both within a derelict building and beneath the wharf structures (Figure 2– Figure 7). A small colony of *Myotis* macropus (Southern Myotis) and individuals or small numbers of *Miniopterus orianae oceanensis* (Large Bent-winged Bats) are likely to be roosting within the wharf structures, although the exact location of any roosts could not be determined due to the challenging access and complexity of the wharf structure. Access to the potential microbat roosting sites beneath the wharf structures is by boat and is restricted by the depth of water and the large number of densely positioned piles and cabling, pipes, cross supports and other structures.

This MMP sets out the measures required to manage risks to microbats prior to, during and post construction works. The proposed demolition and construction works have the potential to impact microbats in the following ways:

- Death / injury of individual bats during works – roosting bats can be easily overlooked during daylight when they are in torpor and will often remain in a roost when threatened during daylight hours rather than risk predation by leaving roosts during daylight.
- Loss of roosting habitat – a reduction in the amount of suitable roosting habitat locally available, may lead to increased competition or an overcrowding of remaining roosting resources.
- Disruption of reproductive behaviour – microbats may be susceptible to reduced breeding success if they are unable to locate a suitable alternative breeding roost.
- Disturbance during works – excessive noise (especially high pitched), dust and vibrations above the general background levels may cause bats to arouse more often during daylight hours. Microbats are nocturnal and any activity when they would normally be resting has potential to reduce energy reserves and ultimately lead to starvation and possibly eventually death.

1.2 Objective and Aims

The overarching objective of this MMP is to minimise impacts to threatened microbat populations as a result of the proposed demolition of land and water-based structures within the subject site and the subsequent construction of a new Sydney Fish Market. To achieve this the MMP:

- Identifies threatened microbat species listed under the NSW *Biodiversity Conservation Act 2016* (BC Act) or the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), known or likely to occur on site and listed in the BDAR prepared by ELA that may be potentially impacted by works.
- Reduces the potential for death or injury to microbat species as a result of the proposed works by excluding microbats from the subject site prior to works, and planning exclusion works for the least sensitive time of year for the species present or likely to be present.
- Provides details of microbat exclusion procedures and other management measures required to minimise any potential impacts to microbats for the duration of the works.
- Provides advice and design specifications for the installation of alternative microbat roosting habitat and the replacement of microbat roosting habitat within the new Sydney Fish Market or as close as possible to the subject site within Blackwattle Bay.
- Identifies the risks to construction personnel working in close proximity to microbat roosts.
- Outlines procedures for mitigating risks to construction personnel and provides agreed procedures for managing unexpected microbat finds during proposed works.
- Identifies monitoring and reporting requirements and/or responsibilities with respect to the actions outlined in this MMP.

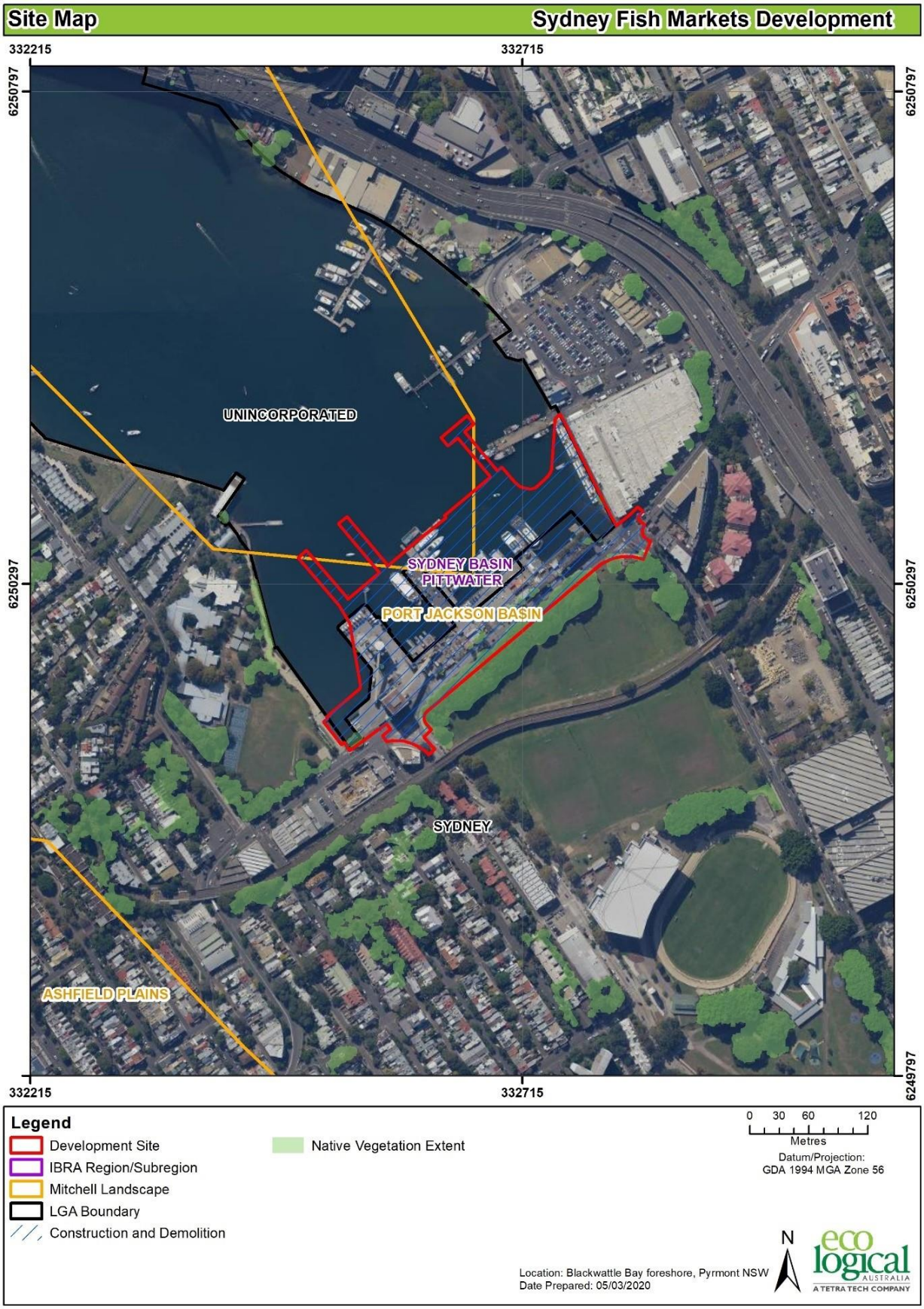

Figure 1: Location of the Subject site between Blackwattle Bay and the Pyrmont Peninsula

Figure 2: The Subject site and location of the new Sydney Fish Markets, showing location and range of potential microbat habitat on site

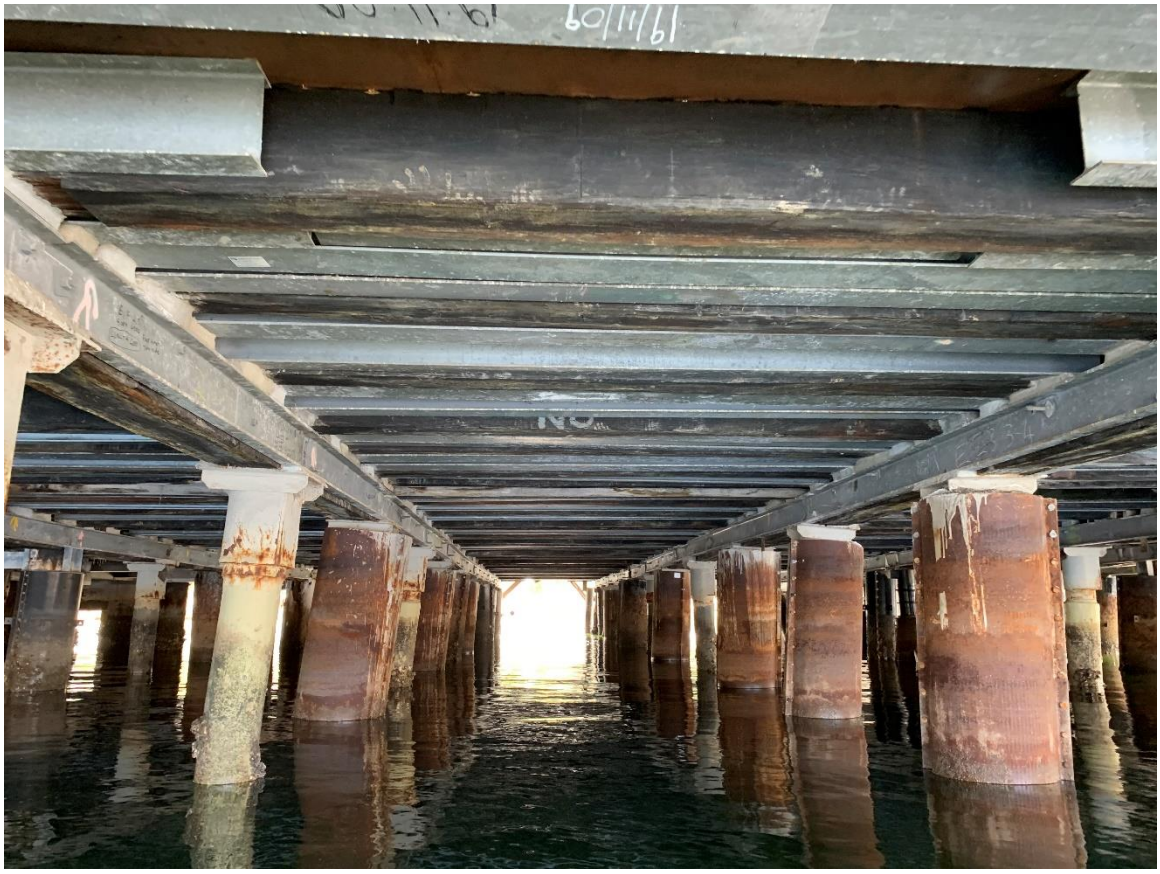

Figure 3: Marine piles and cross beams provide crevices that have the potential to be microbat roosting habitat

Figure 4: Degraded timber and concrete expansion joints that have the potential to be microbat roosting habitat at the Subject site.

Figure 5: Degraded timber posts and beams have potential to be roosting habitat for microbats

Figure 6: Some cement culverts and drains within the Subject site have potential to be microbat roosting habitat where the tide levels leave a gap of 1 m or more between the upper tidal limit and the top of the culvert

Figure 7: The derelict building at the northern end of the Subject site showing multiple potential entry / exit points into cavities within the building that could be used as microbat roosting habitat

2. Summary of Microbat Survey and Roost Assessment Conducted at the Subject Site

2.1 Aims and Objectives

During early 2020, ELA undertook several targeted surveys of the subject site in order to assess the potential for it to contain microbat roosting or breeding habitat as part of the assessment for the BDAR and to inform the preparation of this MMP. Due to the absence of Plant Community Types (PCTs) within the development site, no ecosystem credit or species credit species were predicted to occur. To determine the Likelihood of Occurrence of threatened species, a 10 km search of BioNet records of threatened species under the BC Act, and 10 km Protected Matters search for threatened species under the EPBC Act, was conducted.

These data base searches, and the advice provided by EES produced a list of six potentially affected microbat species:

- *Falsistrellus tasmaniensis* (Eastern False Pipistrelle)
- *Micronomus norfolkensis* (Eastern Coastal Free-tailed Bat)
- *Miniopterus australis* (Little Bent-winged Bat)
- *Miniopterus orianae oceanensis* (Large Bent-winged Bat)
- *Myotis macropus* (Southern Myotis)
- *Scoteanax rueppellii* (Greater Broad-nosed Bat).

Southern Myotis is listed as a species credit species with breeding habitat (i.e. wharf, culverts and buildings) and foraging habitat (waterbodies) considered present within the development site. The two Bent-winged Bats are dual species, however, suitable breeding habitat (i.e. caves) are not present in the development site. The remaining species are listed as ecosystem species and do not require targeted surveys consistent with BAM. However, targeted surveys for all microbats and microbat roosting habitat were conducted under the wharf structures and at one of the buildings and assessed as part of assessment of Prescribed Impacts.

Targeted microbat surveys were undertaken in accordance with the '*Species credit' threatened bats and their habitats NSW survey guide for the Biodiversity Assessment Methodology* (OEH 2018).

Targeted microbat surveys at the subject site included:

- diurnal external structure inspection of the buildings on 14 February 2020 for a total of 2 person hours
- 55 nights of acoustic recording across the site in two separate survey periods, between 17 and 20 February and between 27 and 30 March 2020
- diurnal external structure inspection by boat beneath the wharves on 27 March 2020 which categorised the microbat habitat present beneath the structure into high, medium and low value and searched for evidence of microbats or their roosts for a total of 8 person hours (Figure 2)
- diurnal inspection from the land (24 April 2020) and water (31 March 2020) of surrounding structures and potential microbat habitat (wharves, jetties, piles, culverts, bridges) within 2 km of the subject site for a total effort of 4 person hours

- emergence survey of the southern wharf at dusk from the water using three acoustic detectors and three thermal imaging cameras conducted by three ecologists on 8 April 2020 for a total survey effort of 4.5 person hours.

The aim of the targeted microbat surveys was to determine whether microbats are present within the subject site, determine which microbat species are present, and if they are likely to be roosting within the structures and buildings present within the subject site.

2.2 Summary of results of targeted surveys

2.2.1 Diurnal structure inspection of buildings

Visual surveys of the external surfaces of the buildings were conducted from the wharf to determine if the wharf or buildings within the development site contain potential openings into sheltered crevices that could be utilised by microbats as roosting habitat. The building structure at the northern end of the wharf is a derelict brick building that has been mostly boarded up but still has several obvious small entrances that could be used by microbats as roosting habitat. This survey found that potential microbat roosting and foraging habitat exists at the development site in the form of numerous gaps, cracks and crevices within the structure of the wharf and within one of the buildings on site.

2.2.2 Ultrasonic surveys

Analysis of the ultrasonic call profiles indicated that at least seven (7) and up to thirteen (13) different species of microbat were recorded ultrasonically at the Subject site (ELA 2020). This included up to four threatened species listed as vulnerable under the BC Act, *Miniopterus orianae oceanensis* (Large Bent-winged Bat), *Myotis macropus* (Southern Myotis), *Saccolaimus flaviventris* (Yellow-bellied Sheath-tailed Bat) and *Vespadelus troughtoni* (Eastern Cave Bat).

Based on the call profiles, *Miniopterus orianae oceanensis* (Large Bent-winged Bat) and *Myotis macropus* (Southern Myotis) both listed as Vulnerable under the BC Act were deemed to definitely be present within the study area. *Vespadelus troughtoni* (Eastern Cave Bat) and *Saccolaimus flaviventris* (Yellow-bellied Sheath-tailed Bat), which are also listed as Vulnerable under the BC Act, are potentially present within the study area. Three other non -threatened microbat species were also deemed to be definitely present within the study area and may also roost in the structures present on site; *Chalinolobus gouldii* (Gould's Wattled Bat), *Chalinolobus morio* (Chocolate Wattled Bat) and *Ozimops ridei* (Ride's Free-tailed Bat).

The calls of *Vespadelus troughtoni* (Eastern Cave Bat) overlap with those of other more common and non-threatened *Vespadelus* species known to occur in the Sydney Basin and could not be separated based upon the single call recorded at the south western end of the subject site. This species is known to roost in caves and mines and cliff lines. The development site does not support potential roosting or breeding habitat for this species.

The calls of *Saccolaimus flaviventris* (Yellow-bellied Sheath-tailed Bat) overlap with those of the more common and non-threatened *Austronomus australis* (White-striped Free-tailed Bat) and could not be separated based on the recorded call characteristics.

Southern Myotis is known to roost/breed and forage over water. Due to the time calls from Southern Myotis were recorded (prior to sunset and within 1 hour of sunset and sunrise), it is assumed that this species is roosting within the wharf structure. There is potential that the wharf may also provide

maternity roosting habitat. There were approximately 24 Southern Myotis calls per night recorded during the February 2020 surveys. It should be noted that the calls were recorded in relatively low frequency suggesting only small numbers of Southern Myotis are present. From comparison with long term monitoring data gathered by ELA at a range of known Southern Myotis roosts varying in size from 10 to over 200 bats, it is estimated that between 10 and 30 bats are currently roosting at the development site.

There were a small number (<10) of Large-Bent-winged Bat calls recorded in the ultrasonic data between 27 and 30 March. Calls from Large Bent-winged Bats were recorded both outside the building and beneath the wharf. The timing of one of those calls recorded beneath the wharf coincides with the return to roost period in the 2 hours before sunrise. It is therefore possible that an individual or small number of Large Bent-winged Bats (<10) may use the building and wharf as roosting habitat over winter or throughout the year as non-breeding roosting habitat.

The results of the ultrasonic survey are presented in Table 1. Species for which call profiles were definitive are labelled as definitely present (D) and those where there was some level of uncertainty are labelled as potentially present (P). Table 2 describes the ecology and habitat preferences for all six threatened species which have the potential to occur within the subject site, as well as an assessment of whether each of those species would potentially be affected by the proposed works.

Table 1: Results of acoustic microbat surveys at the Subject site (ELA 2020)

Scientific Name	Common Name	Presence
Austronomus australis	White-striped Free-tailed Bat	P
Chalinolobus gouldii	Gould's Wattled Bat	D
Chalinolobus morio	Chocolate Wattled Bat	D
*Miniopterus orianae oceanensis**	Large Bent-winged Bat	D
*Myotis macropus**	Southern Myotis	D
Nyctophilus geoffroyi	Lesser Long-eared Bat	P
Nyctophilus gouldii	Gould's Long-eared Bat	P
Ozimops ridei	Ride's Free-tailed Bat	D
Rhinolophus megaphyllus	Eastern Horseshoe Bat	P
*Saccolaimus flaviventris**	Yellow-bellied Sheath-tailed Bat	P
Vespadelus pumilus	Eastern Forest Bat	P
*Vespadelus troughtoni**	Eastern Cave Bat	P
Vespadelus vulturnus	Little Forest Bat	P

D = definitely present, P = potentially present (ultrasonic call profile overlaps with other species), *listed as Vulnerable under the BC Act.

2.2.3 Mapping of microbat habitat

On 27 March 2020 an inspection of the wharf structures conducted via boat mapped the microbat habitat across the site (Figure 2). This survey identified that the high conservation value microbat roosting habitat is primarily located within the western section of the site, beneath the largest wharf

currently occupied by Hanson. This wharf is approximately 100 m long and 50 m wide. It is constructed of concrete, timber and steel elements reflecting the history or additions and repairs made to the wharf over time. As a result, there are numerous cracks, gaps and crevices created by joins between materials and sections constructed at different times that provides roosting habitat for microbats. In addition, some of the timber elements are degraded and have split, contain fissures or hollowed cores. Some of the concrete elements have also started to delaminate, are peeling, cracked and have broken edges creating more potential microbat roosting habitat.

In contrast the remainder of the wharf structure to the north of the largest jetty is constructed largely of concrete with minimal joints and is generally of low value as microbat roosting habitat. Although there are several jetties projecting into Blackwattle Bay from this section, one of which is also approximately 100 m long and 20 m wide, potential microbat roosting locations are much fewer and less well developed.

2.2.4 Emergence survey

The emergence survey conducted on 8 April 2020 by three ecologists from the water targeted the largest wharf and associated drainage features that were identified in the mapping exercise as being of high conservation value as roosting habitat. Visual observations combined with ultrasonic recording and thermal imaging surveys were undertaken from outside a large culvert and along the edges of the wharf during a 1.5 hour period at dusk. A single microbat was observed flying from beneath the wharf at a time when the ultrasonic detector recorded the calls of Southern Myotis. These results further support the assumption that Southern Myotis are roosting beneath the wharf.

Table 2: Ecology and life history characteristics of six threatened microbat species known to occur or with the potential to roost within the subject site and likelihood of impacts.

Scientific Name	Common Name	BC Act	Distribution	Habitat requirements	Definitely present / Potentially present	Roost preference	Affected species assessment
Falsistrellus tasmaniensis	Eastern False Pipistrelle	V	Eastern NSW, from SE Qld to Tasmania	Most often recorded in tall and wet forests with tall trees greater than 20m in height (Churchill 2008; Law et al. 2008). Females are pregnant in late spring to early summer (Churchill 2008; Law et al. 2008).	Potential	Hollow / Subterranean and buildings on occasion	Not an affected species. Not recorded ultrasonically. The buildings on site do not provide significant roosting or breeding habitat for this species.
Miniopterus australis	Little Bent-winged Bat			Prefers well-timbered areas including rainforest, wet and dry sclerophyll forests, Melaleuca swamps and coastal forests (Churchill 2008).	Potential	Subterranean / Hollow on occasion	Not an affected species. Not recorded ultrasonically during surveys for this report. May forage over the site and use land and water-based structures for roosting occasionally.
Miniopterus orianae oceanensis	Large Bent-winged Bat	V	In NSW it occurs predominately east of the Great Dividing Range.	Rainforest, wet and dry sclerophyll forest, monsoon forest, open woodland, paperbark forests and open grassland.	Definitely	Subterranean	Affected species. Definitely recorded ultrasonically during surveys for this report and likely to roost and forage within the study area. May use land and water-based structures for roosting.

Scientific Name	Common Name	BC Act	Distribution	Habitat requirements	Definitely present / Potentially present	Roost preference	Affected species assessment
Myotis macropus	Southern Myotis	V	In NSW, found in the coastal band. It is rarely found more than 100 km inland, except along major rivers.	Foraging habitat is waterbodies (including streams, or lakes or reservoirs) and fringing areas of vegetation up to 20m.	Definitely	Subterranean / Hollow	Affected species. Definitely recorded ultrasonically during surveys for this report and assumed to roost, forage and potentially breed within the land and water-based structures of the subject site.
Saccolaimus flaviventris	Yellow-bellied Sheath-tailed Bat	V	Wide-ranging distribution across Australia. A summer migrant to southern states, including NSW from January - April.	Almost all habitat types.	Potential	Hollow	Not an affected species. Potentially recorded ultrasonically during surveys for this report and likely to forage over the study area. May roost in tree hollows near the subject site.
Scoteanax rueppellii	Greater Broad-nosed Bat	V	In NSW found along the east coast spreading further inland to the Northern Tablelands.	Associated with moist gullies in mature coastal forest, or rainforest, east of the Great Dividing Range (Churchill 2008), tending to be more frequently located in more productive forests (Hoye & Richards 2008).	Potential	Hollow / buildings	Not an affected species. Not recorded ultrasonically. The buildings on site do not provide significant roosting or breeding habitat for this species.

2.3 Discussion

The results of the targeted microbat survey and impact assessment undertaken by ELA (2020) at the subject site indicate that:

- The site contains multiple potential microbat roost locations within the wharf structures and within the derelict building that could be used throughout the year by a range of microbat species (Figure 2)
- The exact location of any microbat roosts have not been able to be identified at the subject site
- Access to the underside of the wharf structure is by boat and is limited by shallow water and the close proximity of supporting piles. This, combined with the sheer number of potential microbat roosting locations prevents a complete visual assessment of all potential microbat roosting habitat at the subject site
- The derelict building and wharf structures on site represent microbat roosting habitat (Figure 2 – Figure 7) for at least two threatened subterranean roosting microbat species recorded on site during surveys:
    - Large Bent-winged Bat
    - Southern Myotis.
- It is estimated that between 10 and 30 Southern Myotis roost at the subject site with the most likely location assumed to be towards the landward end of the largest wharf at the western end of the site
- The wharf structures and to a lesser extent the derelict building at the subject site also represent potential breeding habitat for Southern Myotis which is known to occur on site and commonly roosts and breeds in similar structures.
- It is estimated that less than 10 Large-Bent-winged Bats may use the site as a non-breeding roost throughout the year or as winter roosting habitat
- From the number of potential roosting spaces available at the site, it is estimated that a colony of approximately 150 Southern Myotis could be accommodated, assuming that the colony would utilise several different roosting locations within the wharf structures (but primarily within the largest wharf at the western end of the site).
- Several other threatened microbat species have the potential to roost in the building or wharf structures on site but were not recorded during surveys and are unlikely to be impacted by proposed works:
    - Eastern Coastal Free-tailed Bat
    - Eastern False Pipistrelle
    - Greater Broad-nosed Bat
    - Little Bent-winged Bat.
- There were several non-threatened microbat species recorded on site that also have the potential to roost within the derelict building or wharf structures:
    - Chocolate Wattled Bat
    - Gould's Wattled Bat
    - Ride's Free-tailed Bat

Large Bent-winged Bats are subterranean roosting species known to occur within the subject site. Large Bent-winged Bats congregate in large numbers at a few known and often shared maternity caves over spring and summer to breed and raise young and disperse to winter hibernation roosts in autumn

(Churchill, 2008). Large Bent-winged Bat winter hibernation roosts can be up to 300 km away from maternity roosts. A known Large Bent-winged Bat winter roost is found in Summer Hill, 5km from the subject site.

Large Bent-winged Bats were confirmed as occurring at the subject site and one call was recorded within the 2 hours preceding sunrise indicating that an individual or small number (<10) of this species could be roosting on site but there was no roosting location confirmed (ELA 2020). This species is likely to forage over the subject site and individuals or small numbers of bats may roost within either the land or water-based structures on site. The concrete structures, building and culvert do represent potential roosting habitat for Large Bent-winged Bats. These features are unlikely to constitute significant breeding habitat because of the limited capacity to accommodate the large numbers of Bent-winged Bats required to generate enough heat in the maternity roosts for the development of young.

Southern Myotis roost in subterranean habitats such as bridges, stormwater culverts, tunnels, bunkers, mines and drains. This species has a strong association with permanent waterways and consistently roost in close proximity to water (Churchill, 2008; Campbell, 2009). This species forages exclusively over water, trawling the surface for small insects and aquatic species such as fish and crustaceans (Barclay & Harder 2003).

Southern Myotis were confirmed as occurring at the subject site and from the timing of the recorded calls and observations made during emergence surveys, this species is known to be roosting beneath the wharf but the exact location of the roost was unable to be confirmed (ELA 2020). This species is known to forage over the waters of Sydney Harbour, with a maternity roost and the nearest foraging 'hot spot' located in the western harbour approximately 4 km from the subject site (Gonsalves and Law 2017).

Gonsalves and Law (2017) found that the waters of the southern bays of the western harbour precinct (Rozelle Bay, Blackwattle Bay and Pirrama Park and surrounding Goat Island) recorded much lower Southern Myotis activity and foraging levels than those recorded at the nearby maternity roost. Activity levels of Southern Myotis in the studies completed for this assessment in Blackwattle Bay were in the order of 24 calls per night which is significantly higher than activity levels recorded in Blackwattle Bay by Gonsalves and Law (0 – 1.2 calls per night) during their study conducted in 2015. Activity levels at the known maternity roost (containing approximately 50 Southern Myotis) as reported by Gonsalves and Law (2017) were in the order of 234 – 312 calls per night.

Given the cessation of marine activities and some of the land-based industries at the subject site over the past couple of years, it is possible Southern Myotis activity at the site has increased in response to the decreased disturbance levels. As the population size of the Southern Myotis maternity roost 4 km from the site increases, the likelihood of splinter roosts associated with the maternity colony being created within nightly foraging range (4 – 12 km) also increases where suitable roosting and foraging habitat is present. The concrete structures, culverts and timber marine piles at the subject site do represent potential roosting and maternity habitat for Southern Myotis.

2.4 Investigation of Locations for Installation of Compensatory Habitat

Prior to enacting an exclusion, alternative roosting habitat for microbats that will be displaced by the exclusion must be installed or located. It is important to note that many species of microbat change roosts regularly and depend upon a series of roosts within nightly foraging range for their survival. It is

assumed that all species of microbat will have knowledge of at least one other alternative roost site within nightly foraging range of the known roost location.

Recent studies have shown that Southern Myotis roosts in particular can be permanently inhabited with little or no movement away from the maternity roost throughout the year (Gonsalves and Law 2017, Gorecki 2019, in prep). Some Southern Myotis roosts can also be historically inhabited over many generations and in such cases, individuals can be very reluctant to roost elsewhere (Alicia Scanlon, pers comm.).

Compensatory habitat for Southern Myotis often takes the form of bat boxes installed beneath suitable structures. It is critical to carefully consider the location for installation of bat boxes in order for them to provide suitable alternative habitat for the target species. Important considerations relating to the selection of a suitable location for installation include:

- insulation from rain, wind, light and extremes of temperature
- directly over water (a requirement specifically for Southern Myotis roosting habitat)
- free from human disturbance
- provide some protection from predators
- the ability to view the interior of the bat box to allow for ease of monitoring, and
- tenure of the structure to which the bat boxes will be attached.

During April 2020, ELA inspected five sites located within 2 km of the Subject site to determine their suitability for the installation of compensatory bat boxes (Table 3 and Figure 8). A range of features of each site were inspected and recorded to provide an assessment of how suitable they would likely be as locations for compensatory bat roosting boxes. Two potential locations were identified with the closest most suitable locations determined to be:

- a timber wharf extending around Pirrama Park at Johnston's Bay (Figure 9 – Figure 11)
- a concrete bridge over White's Creek under The Crescent / City West Link at the head of Rozelle Bay (Figure 12).

Both of these locations are approximately 1.5 km from the Subject site and no suitable locations were found any closer to the Subject site.

The wharf at Johnston's Bay provides protection from the weather and predators, is relatively free from human disturbance, is directly over water, and has multiple suitable locations for the installation of bat boxes (Figure 9 – Figure 11). The site encircles Pirrama Park and has options for placing boxes on a northerly, easterly and westerly outlook. Light levels in the afternoon need to be examined before boxes are installed at this location.

The timber wharf near the pontoon area of Pirrama Park has wooden beams approximately 1-2 meters above the mean high-water mark providing enough space for boxes to be installed and allowing enough free air space for bats to drop out and fly before contacting the water (Figure 10). Brackets for the boxes could be drilled into the timber beams. In addition, underneath the pedestrian area on the landward side of some remnant wooden piers, the wooden beams and metal joins underneath the wharf provide another potential location for the installation of bat boxes. There are also sections of steel beam which have a gap between each beam large enough to accommodate bat boxes. Installation and inspection of bat boxes would need to be conducted by boat.

The concrete bridge over White's Creek under The Crescent / City West Link at the head of Rozelle Bay provides good protection from the weather and predators, is relatively free from human disturbance, is directly over water, and has multiple suitable locations for the installation of bat boxes (Figure 12). Installation and inspection of bat boxes would need to be conducted by boat.

Figure 8: Map showing the locations within 2 km of the Subject site inspected and assessed for their suitability as receptor sites for compensatory roosting habitat in the form of bat boxes

Figure 9: Section of the jetty at Pirrama Park, Johnstons Bay providing an example of a potential receptor site for compensatory bat boxes.

Figure 10: Section of the jetty at Pirrama Park, Johnstons Bay showing the timber elements which could provide a suitable point of attachment for compensatory bat boxes

Figure 11: View of the timber pedestrian jetty encircling Pirrama Park, Johnstons Bay that has been identified as a potential location for installation of compensatory bat boxes.

Figure 12: Concrete bridge over White's Creek beneath The Crescent / City West Link, Rozelle Bay that has been identified as a suitable receptor location for compensatory bat box installation.

Table 3: Results of a diurnal land and water-based survey of five potential sites for installation of compensatory habitat within 2 km of the Subject site (see Figure 8 for locations)

Location	Summary of habitat available at site	Suitable/Unsuitable
Pirrama Park – Johnstons Bay	Timber and concrete wharf and jetty structure. Multiple potential receptor locations. The timber wharf near the pontoon area has some wooden beams approx. 1-2m above the water. Boxes could be drilled into the wood here. Underneath the pedestrian area on landward side of remnant wooden piers there are some wooden beams and metal joins underneath the wharf the whole way along which may be appropriate to install boxes. Sections of steel beam which had a gap – boxes could be installed here either by attachment around the gap or putting a box within the gap. Locations on the water side of the old derelict pontoon are fairly exposed to light and weather as the pontoon covers a small surface area (< 16 m^2). All areas under the wharf could be investigated further as potential box locations	Suitable
Whites Creek – The Crescent	Concrete bridge spanning White's Creek with approximately 1m clearance from mean high-water level.	Suitable
Whites Creek – Train Tunnel	Brick arch bridge with graffiti at base on either side of arch. Site prone to human disturbance and higher than desirable light levels.	Unsuitable
Whites Creek – Brenan Street	Concrete bridge with a lot of graffiti. Water level very low. High potential for disturbance and vandalism.	Unsuitable
Johnstons Creek – The Crescent	Concrete bridge with lots of graffiti, however less prone to disturbance and vandalism due to a fence.	Unsuitable

3. Microbat Management Plan

3.1 Approach

The exclusion of microbats from the subject site is required because of the risk of injury and death to microbats from the proposed removal of land and water-based structures. The exclusion should be undertaken using methods considered to be best practice by leading bat experts. Given the large number of potential roost spaces and the difficulties of accessing and inspecting them it is unlikely that the supervising ecologist could be certain that the potential roosting habitat is bat free based upon diurnal visual inspection. For this reason, the exclusion must be undertaken gradually and in a staged manner, with sections of the land and water-based structures incrementally excluded to bats over a multi-night period.

Key actions outlined in the MMP involve the following main tasks:

- A project ecologist should be appointed by Infrastructure NSW to ensure the MMP is delivered according to specifications. An ecologist is considered to be an individual with a minimum of five years extensive experience in microbat ecology and management and will have undertaken at least three successful roost exclusions previous to this work. They will hold a NPWS Scientific Licence and Animal Care and Ethics Committee approval as well as current Australian Bat Lyssavirus (ABLV) vaccination (immunity levels tested and acceptable within the last 2 years).
- The exclusion of bats from roosting habitat at the subject site must be planned to avoid periods of time when the species of bats present at the site are most sensitive to disturbance. During the maternity season, disturbance may result in the abandonment or death of juvenile bats. During the extended torpor season over winter, microbats are vulnerable to loss of energy reserves if they are roused from torpor on a too regular basis.
- Installation of alternative compensatory bat roosting habitat in the form of bat boxes.
- A requirement to re-instate or create permanent microbat roosts within the newly built structure so that it contains roosting spaces for 180 Southern Myotis which is the estimated Southern Myotis roosting capacity of the existing structure with an additional 15% buffer.
- Staff environmental inductions which advise contractors of the biodiversity values present onsite, risks to human health and safeguards for dealing with unexpected finds.
- Adaptive management techniques involving close communication between the project ecologist, contractors and client, monitoring and corrective actions. Adaptive management requires flexibility specifically where monitoring determines that microbats are not responding to interventions in an expected manner and additional mitigation actions may be required.

3.2 Timing

The proposed exclusion works must be undertaken and completed outside the breeding season for Large Bent-winged Bats and Southern Myotis (early – mid September to March) or over wintering period (June to August). Exclusion works may therefore only occur from late-March – end of May, providing any juvenile Southern Myotis present are flying independently; or very early in September before microbats have established maternity roosts, providing that temperatures have warmed enough to allow for nightly microbat foraging. Once the exclusion is in place and the land and water-based structures on site have been cleared of bats, works can be undertaken at any time of year.

The potential for injury and death to microbats would be much higher during the breeding period due to the presence of dependant young and/or juveniles. There is a high risk that attempts to remove juveniles from the roost are more likely to result in death or injury due to stress. At the end of the breeding season and before winter, non-breeding males disperse to alternate roost sites and food availability is still relatively high, allowing microbats to build up fat stores for the coming winter.

Microbat exclusions will be planned for a period of mild temperatures (warmer evenings, little or no wind, no rain) with a view to providing ideal foraging conditions for microbats. Microbats can remain in a roost and in torpor for more than 2 weeks during winter and up to 5 days during summer (Geiser and Kortner 2010) but are likely to emerge to forage every night or every few nights when the weather conditions are favourable. The staged exclusion proposed for the subject site will be undertaken over a minimum three-night period for Stage 1 (if required) and minimum five night period for Stage 2 when bats are likely to be foraging, as outlined in Section 3.3.2. This is to allow any bats in torpor to wake naturally and exit the roost before it is excluded to them.

Roost exclusion would not occur during forecast periods of heavy rain (>20 mm in 24 hours according to the Bureau of Meteorology).

Exclusion devices should be installed at least 1 week prior to commencement of works to ensure microbats are not continuing to try to return to the roosts within the subject site.

3.3 Roost Exclusion Methodology

The following exclusion process would be applied to the land and water-based structures within the subject site. Exclusion aims to remove microbat access to the potential roost habitat on site. The objective of controlled roost habitat exclusion is to prevent injury or mortality to roosting microbats and avoid impacts to maternity or overwintering colonies of microbats.

3.3.1 Installation of alternative compensatory habitat

Alternative compensatory habitat should be installed at either or both of the suitable identified locations within 2 km of the subject site least one week, but preferably one month prior to any exclusion or construction activities commencing at the subject site. Roost selection by microbats is poorly understood in Australia and there is evidence to suggest that a range of factors including very subtle microclimatic variables influence the selection process. For this reason, there is no guarantee that a bat box will be inhabited by microbats displaced from existing roosts despite careful selection of an alternative location for bat box placement. It is therefore recommended that several alternative roosting options be provided.

A ratio of 1 loss of habitat to 4 alternative compensatory bat boxes placed at more than one location is recommended in this situation. Based upon the estimated number of between 10 and 30 Southern Myotis roosting within the subject site and the large number of potential roosting locations present, four x four-chamber microbat roosting boxes (estimated capacity of 30-50 microbats each) should be installed in at least two separate locations within 2 km of the existing roosts prior to the commencement of exclusion process. This will provide a range of roosting options similar to that available within the subject site but allow microbats to select the most suitable alternative roosting locations for their needs and will also allow for movement of the colony between bat boxes / locations. Provision of bat boxes in close proximity to the existing roosts ensures that any bats attempting to return to the existing

structures later in the morning following the nocturnal exclusion are not caught short and have a safe location in which to roost during the day light hours.

Appendix B provides detail of four chambered microbat roosting boxes available from Hollow Log Homes (Figure 15). It is preferable for any bat boxes to be installed on brackets so that they can be temporarily moved when maintenance or repairs to the host structure are required and to allow for future management of the roosting habitat.

All bat boxes installed must have a unique identifier and the following data recorded for future monitoring and reporting:

- Date installed
- Unique ID number or code
- Easting and northing
- Name of drainage line, or closest drainage line
- Box type
- Aspect
- Box height above ground
- Distance to water
- Structure type
- Structure size
- Structure composition (concrete / timber).

It will be important to monitor the compensatory habitat to determine whether the bat boxes have been successful and are being utilised by microbats on an ongoing basis for a range of life cycle functions. Details of the required monitoring are provided in Section 8.

3.3.2 Exclusion process

Roost exclusion of such a large and complex site with challenging site access can best be achieved in stages. At this time, the only means of accessing the potential roosts so that they can be inspected is by boat. Even with a boat not all potential roost spaces are able to be safely accessed due to the configuration of piles beneath the wharf structures and the shallow depth of the water. A procedure to safely access any roosts in this manner and to install exclusion devices will need to be developed by the engaged ecologist.

The exclusion methodology developed for this MMP relies heavily on the assumption that progressively reducing microbat access to potential roosting locations under conditions when they should be active encourages them to leave the site to find suitable roosts elsewhere of their own accord. Without the ability to visually inspect every potential roost site and be certain that an excluded space is bat free, adequate time has been allowed to minimise the risk that a microbat in torpor would be trapped inside the structure. Equipment that provides additional information on microbat activity to supplement the minimal visual information obtainable by the ecologists conducting the exclusion at the subject site will be invaluable in implementing this MMP. Devices that allow for real time viewing of ultrasonic recordings (e.g. Echo Meter Touch) and detection of microbats through the use of thermal imaging cameras, along with standard inspection tools such as torches, burrow scopes and digital cameras would assist in quantifying microbat activity during the exclusion process.

The wharf structures will be excluded by erecting curtains along all sides of each of the wharf structures which will prevent entry by any microbat. It will be impractical to attempt to individually exclude bats from every potential roosting location beneath the wharves because of the difficulties in safely accessing the site and the large number of potential roosting locations present. Exclusion of the derelict building will be undertaken by installing one-way valves over all potential entrances and leaving them in place for a minimum of three nights, following which each entry point will be permanently sealed.

The subject site can be divided into surface features (the derelict building) and below deck features (everything underneath the deck of the wharves and jetties). The below deck features can be further divided into an eastern and western section, with the highest value microbat roosting habitat present in the western section of the site (Figure 2). Each section will be excluded separately over multiple nights with the exclusion of the eastern and lower value roosting habitat (Stage 1) undertaken before exclusion of the western section (Stage 2) and finally exclusion of the derelict building (Stage 3).

Stage 1 (eastern section of subject site) and Stage 2 (western section of subject site)

Exclusion of both the eastern and western sections of the subject site will commence during daylight hours when the curtain can be installed on all sides of the wharf structures. It is expected that the exclusion of the eastern section of the subject site will be undertaken over three consecutive nights and mornings before exclusion is conducted on the western section. A curtain must also extend from the edge of the wharf structures to the seawall running along the southern edge of the site, screening off the eastern section from the western section of the site.

It is expected that the exclusion of the western section will be undertaken over five consecutive nights and mornings owing to the greater amount of potential bat roosting habitat present.

As the curtain is being installed it will be possible to undertake a cursory visual inspection of the under surface of the wharf structures for microbats and document any findings. It is noted that it will not be possible owing to time and tide constraints and access issues to visually inspect all potential roost spaces. A gap in the curtain 2 m wide will be left open (with curtain material rolled up on the deck of the wharf) every 20 -30 metres. These gaps will allow any microbats roosting within the structures being excluded to exit. The gaps will also allow observers to enter the excluded space beneath the wharf and inspect it for the presence of microbats following emergence surveys conducted in conjunction with installation of exclusion devices.

Following installation of the curtains, an emergence survey including ultrasonic recording must be undertaken outside each of the gaps remaining in the curtain each night for three nights until on the final night following the emergence survey, the curtains will be completely drawn leaving no gaps. The emergence survey should commence 30 minutes prior to sunset and continue until the ecologist is satisfied that all bats have emerged from the roost, or until there has been a period of sustained inactivity (generally within 60-90 minutes of sunset). The number of microbats recorded exiting the site will be documented.

A follow-up inspection of the excluded space beneath the wharf structures would then be undertaken at the conclusion of the emergence survey to determine whether any microbats remain roosting within the excluded space. Use of a thermal imaging camera will enable a more accurate emergence surveys to be undertaken and assist in conducting post emergence inspections. The exclusion will be undertaken gradually and in a staged manner with the gaps in the curtain progressively blocked off each night over

a three-night period for the eastern section and a five-night period for the western section. This process encourages bats to find roosts elsewhere, limiting the number of bats left without a roost once the curtains are fully drawn around the entire structure enclosing all gaps.

Pre-dawn surveys should be made at the site by the ecologists each morning following an evening emergence survey and curtaining event. The pre-dawn surveys will occur over a 1.5-hour period prior to sunrise to determine whether any microbats have returned, rescue any microbats roosting in unsafe places, and to assess the integrity of the exclusion devices. Any microbats roosting in unsafe places will be captured by hand, held in a calico bag (containing no more than a single microbat of the same species) in a cool, dark, quiet place for the day until they can be released at the site after dark. Any breaches of the exclusion devices will be noted and marked for repair later that evening.

This process will be repeated each evening of the three night (Stage 1) or five night schedule (Stage 2). On the final evening once the ecologist is satisfied that all bats have left the roost or 1.5 hours have passed since observations began, and a post emergence survey inspection is completed within the excluded space resulting in no microbat detections, the curtains can be fully drawn over all the gaps. Pre-dawn observations are required on all mornings following an evening change to exclusion devices with the final morning check to ensure that that no microbats obviously remain within the excluded space and to check the integrity of the curtains on the final morning.

The curtains will remain in place until the day that demolition works commence. The ecologist will need to conduct periodic diurnal inspections of the curtains to ensure the exclusion devices continue to function as intended and the structures remain free of microbats. The time frame for inspection of exclusion devices is one week after the completion of the exclusion, then once every four week after that prior to commencement of works. Inspection of the exclusion devices should also occur immediately following any periods of extreme weather (rainfall of > 50 mm in a 24-hour period, wind speeds of greater than 40 km / hr). Inspection of the exclusion devices should then occur on the day demolition of the structure is to commence.

If the final early morning inspection records microbats within the structures, the process described above will be repeated and actions taken to rectify the breach after emergence of the microbats. Any evening changes made to the exclusion devices will always be followed by a morning inspection as outlined above.

It is important to note that additional time may be required to complete the exclusion if the ecologist is not satisfied that the wharf structures are free of bats following the three night (Stage 1) and five night (Stage 2) schedules described above as discussed in the Adaptive Procedures Section 4.1. If microbat activity is not reducing at the Subject site as the exclusion is progressing, additional diurnal and nocturnal survey effort may be required to try and locate specific roosting locations or dissuade microbats from roosting within the structures.

If specific roosting locations can be located during these additional surveys, it will allow one-way valves to be installed which will ensure that bats can exit from but not return to a roost and the exclusion can proceed for a further three nights before being completed following the installation of one-way valves. If roosting locations cannot be located because they are inaccessible, alternative mitigation measures that discourage bats from roosting beneath the wharf structures may be required alongside continued progressive exclusion until microbat activity levels have reduced to levels that the ecologist considers acceptable for completing the exclusion. Alternative mitigation measures may include 24 hour

illumination of the underside of the wharf structures with day makers or similar lights and / or installing a constant spray of water over the underside of the wharf structures or along the edge of the wharf structures.

Stage 3 Derelict building

The process of exclusion for the derelict building relies upon installation of one-way valves over all potential entry points for a period of two to three nights that will allow bats to exit but not re-enter the building followed by installation of barriers that will completely seal up all entry points.

In a similar manner to the process described above for exclusion of the below deck features, one-way valves made from heavy duty plastic sheeting will be installed over all entry points on the derelict building during daylight. Following this an emergence survey including ultrasonic recording should be undertaken outside each of the one-way valves each night for three nights. If no bats are recorded exiting the building on the final night, the entry points can be permanently sealed on the following morning. The emergence survey should commence 30 minutes prior to sunset and continue until the ecologist is satisfied that all bats have emerged from the roost, or until there has been a period of sustained inactivity (generally within 60-90 minutes of sunset). The number of microbats recorded exiting each entry point will be documented each night.

If bats are recorded exiting an entry point via a one-way valve on the third evening, the one-way valve will be left in place and emergence surveys carried out until no bats are observed emerging from the entry point. A one-way valve may only be permanently sealed on the morning following an emergence survey where no bats have been observed exiting the entry point and if the one-way valve has been in place for a minimum of three nights.

3.3.3 Exclusion devices

There are a number of materials that can be used to exclude microbats from a roost. The choice of a reinforced heavy duty polyethylene sheeting which is tear resistant and 240 GSM for use on the below deck features is dictated by the need for a permanent, waterproof barrier that will remain in place through tidal fluctuations, will not degrade in sunlight or with exposure to seawater, is durable and flexible enough to withstand the range of weather conditions expected at the Subject site, is able to be cut and shaped according to need, is manoeuvrable enough to be handled without heavy plant or mechanical assistance, and is cost effective.

In the case of the below deck features of the Subject site, the exclusion is temporary and will remain in place until all structures are demolished during construction works. The exclusion device will effectively be a curtain hanging from the top of the wharf structures down into the water creating a barrier which prevents microbats from entering the space beneath the wharves and gaining access to any roosting habitat contained therein. The curtain will be weighted so that it remains permanently submerged at the base and will be held together at any joins so that no gaps large enough to allow microbat entry are present. Appendix A provides product data and supplier details for the exclusion material appropriate for use at the Subject site. This heavy-duty plastic sheeting has been used successfully on numerous microbat exclusions.

Heavy duty black plastic sheeting commonly used by builders is recommended for any one-way valves that are required to be installed. The one-way valves only need to remain in place for a short period of time (3- 5 days), following which they will be replaced by a more permanent barrier. The materials used

to create a permanent barrier can range from expanding foam to sections of timber affixed over the entry point.

3.3.4 Inspection and maintenance of exclusion devices

An email is to be sent to the project engineer / site supervisor following completion of the exclusion process confirming that the exclusion is complete and providing photos and descriptions of the exclusion devices that have been installed. An action log will be kept during the exclusion process and for any monitoring inspections conducted between the exclusion and commencement of works. This log will be submitted to the project engineer / site supervisor upon completion of the project as part of the reporting requirements. The exclusion log will contain the following information:

- Action undertaken
- Date
- Personnel involved
- Results / outcomes against performance measures
- Effort / time on site
- Adaptive / alternative procedures required / recommended.

Exclusion devices installed on the below deck features would need to be monitored one week after installation, and then monthly by the project ecologist prior to works to ensure they remain effective in excluding bats, as well as following any high rainfall, high wind or flood events (> 50 mm in 24 hours and wind speeds > 40 km / hr).

Exclusion devices installed on the derelict building should be monitored by the site supervisor and checked immediately prior to commencement of works as it should be obvious whether the permanent barrier has remained intact. These exclusion devices will only need inspection by the ecologist if any breaches have been identified.

It will be critical that contractors ensure the all exclusion devices remain secure and in place until the removal of the land and water-based structures is undertaken.

3.4 Actions during construction

3.4.1 Site induction

All staff and contractors undertaking construction works at the subject site should be made aware of the environmental sensitivity of the site and the potential presence of threatened microbat species prior to commencing work. An environmental induction led by the site supervisor should be undertaken as part of pre-start meetings. Pictures of microbats (provided by the project ecologist) should be placed in the crib room as a reference and the location of potential microbat roosts (culverts, drains, wooden cross beams and pylons) marked on site maps / design drawings displayed on site. Staff should be briefed on what to do in the event of an unexpected find of microbats. Some microbats carry diseases that can be lethal to humans if untreated, and inexperienced / unvaccinated people should never handle bats (See Section 4.2. for the unexpected finds procedure).

3.4.2 Daily Inspection

A daily check of the exclusion devices at the Subject site is to be undertaken by the site supervisor prior to commencement of works, with each check being recorded. If the exclusion devices are not secure the site supervisor must contact onsite environmental staff, who will contact the project ecologist immediately so that the breach can be inspected and repaired as soon as possible. No works are to commence if the exclusion device(s) are not secure. Works at the subject site can only recommence once the ecologist provides advice that the site is secure and free of roosting microbats.

If a breach of the exclusion devices has occurred, the exclusion methodology outlined in Section 3.3.2 will be followed by the project ecologist over a single night. The breach will be repaired following conclusion of evening emergence survey and a dawn inspection of the repaired exclusion device(s) will be undertaken.

3.4.3 Pre-works inspections by project ecologist

Given that the details of how the demolition process will be undertaken have not yet been finalised, it is imperative that the project ecologist discusses the approach with Infrastructure NSW and the contractor(s) engaged to complete the works prior to the commencement of works to ensure the site remains free of microbats for the duration of works. Current advice suggests that the demolition will be undertaken over an 8 – 9 month period, commencing in June 2020 and concluding in February 2021.

The demolition process is likely to involve progressive removal of saw cut sections of the deck of the wharf structures from the seaward end to the landward end using cranes based either on the deck or on barges. Following this, the supporting piles will be removed by excavators on barges or remaining sections of deck. Finally, the remaining section of deck will be cut from the seawall and removed. The seawall is to be retained (if structurally intact) and any repairs to the seawall will be completed prior to construction of the new Sydney Fish Markets.

Removal of the deck is the part of the demolition with the most risk of harm to microbats, because as sections are removed on a daily basis it exposes potential roost spaces beneath the remaining part of the structure. If access to the newly exposed sections of deck are not sealed off prior to nightfall, there is a risk that microbats will return and roost within any accessible roost spaces during the night.

A pre-works inspection for microbats within the area due to be demolished during the day would be undertaken by the site ecologist on the first morning that demolition works are to commence. The inspection would include arranging boat access to the site, actively looking for microbats and / or signs of their presence using a torch / burrow scope within the excluded space beneath the wharf structures and will include removing / lifting the exclusion devices over the section of wharf proposed to be worked on during that day to allow works to occur. A return visit by the ecologist will be required in the afternoon prior to the conclusion of works to advise on and assist with how to reposition the exclusion devices on a daily basis in such a way that there will be no access for roosting microbats to the structure for the duration of demolition.

It is recommended that the project ecologist returns to site the following morning to conduct a pre-works inspection for microbats and to check whether the exclusion devices re-instated after demolition works the previous day have been successful. This process may need to be repeated until the ecologist is satisfied that the works area is being adequately excluded to microbats at the conclusion of each day's work. It is also recommended that the project ecologist repeats this process (afternoon supervision / assistance with exclusion device replacement followed by a morning pre-works inspection) where there

will be a major change in the way that the exclusion devices need to be re-positioned because of the shape of the section of wharf being demolished.

The intention is that construction crews will re-instate exclusion devices at the end of each day for the majority of the demolition process and that this will be documented daily by the site supervisor. Where uncertainty over the placement of exclusion devices exists, advice from the project ecologist is to be sought and a visit to site may be required.

A pre-works inspection for microbats beneath the section of the largest wharf identified as high conservation value habitat in Figure 2 must be undertaken by the site ecologist on the morning demolition is due to commence in that area.

If during any of the pre-works inspections microbats are identified roosting beneath the wharf, the ecologist may elect to retrieve isolated bats (if possible) that are alive and healthy from the work area to allow works to continue. The bats will be held in a calico bag (no more than a single microbat to be held in each bag) that will be hung during the day in a cool, dark, well ventilated place and released at the point of capture once the work area is secured and excluded to microbats. This should only be undertaken if microbats can be safely captured and released on the night after they were captured. Bats should not be held for more than 12 hours.

If it is not possible to capture and remove the bats, an exclusion zone will be set up by the ecologist and no works can occur in that area until approved by the project ecologist. The exclusion methodology outlined in Section 3.3.2 will be followed that evening by the project ecologist over a single night. Any breaches to the exclusion devices will be repaired following conclusion of the evening emergence survey, and a dawn inspection of the repaired exclusion device(s) will be undertaken. Provided the ecologist is satisfied that no microbats can access roosts beneath the wharf and that the repaired exclusion devices are functional approval will be given to re-commence works in that area. This process may need to be repeated until the ecologist is satisfied that the structure remains excluded to microbats and that no microbats are roosting in the works area.

Microbats or evidence of their presence can manifest in a range of ways and works staff should be made aware of these signs as part of the site induction process. A set of visual aids for use in the induction process is included as part of this MMP. Evidence of microbat occupancy includes the following:

- Visual (diurnal) observations of singles or clusters of roosting microbats hanging from the ceiling or roof space or walls, or lying within horizontal crevices in structures such as bridges, culverts, derelict mines, tunnels, old buildings, chimneys.
- Visual (nocturnal) observations of bats flying from or returning to a structure at dusk and dawn, respectively.
- Audible sounds made by roosting bats include a chattering clicking type noise often heard around dusk and dawn or if bats are disturbed in a roost. Any suspicion of unusual noises within the structures will cause works to stop and must be investigated further by the project ecologist with appropriate equipment to allow identification of the cause of the sound (should include a hand-held ultrasonic call recorder).
- Guano (bat dung / scats) will be present if bats are utilising a roost, even just for a couple of days. Often guano collects immediately under the roost site or sticks to the structure walls under the roost or around the entrances to a roost.
- Staining (urine) may be present where bats frequently access a roost.

- Bat bugs (ectoparasites) or their casings are frequently observed throughout microbat roosts and take the form of tiny tick like or spider like invertebrates.
- Any Welcome Swallow or Fairy Martin nests – mud and earth constructed bird nests are relatively common on bridge and culvert structures and should be investigated as some bat species will utilise disused nests as roost sites.

No works should commence if roosting bats are found or heard within a work area and all works should stop if bats are observed flying from a roost or around the works site during daylight. Unexpected finds of microbats should be reported immediately to onsite environmental staff, site supervisor and the supervising ecologist who will advise the best course of action. In the first instance, photographs, if possible and practical should be taken and then sent to the project ecologist to identify the microbats and to determine what actions are required.

3.5 Permanent replacement habitat

The creation of permanent microbat roosting habitat within or as near as possible to the new Sydney Fish Market is required to replace the loss of roosting habitat for Southern Myotis (also known as 'The Fishing Bat') from the existing wharf structures at Blackwattle Bay. The permanent microbat roosting habitat created should have a minimum carrying capacity 15% greater than that of the original roosts to allow for errors in estimating the roost carrying capacity based upon the inability to conduct a thorough visual assessment because of access issues to the underside of the wharf structures. The current colony size is estimated to be 10-30 bats, with the roost carrying capacity estimated to be up to 150 bats. The permanent roosting habitat should allow for movement between roosting locations. It is recommended that permanent microbat roosting habitat with a capacity of 180 bats is installed at the new Sydney Fish Markets. It is also recommended that this habitat is spread over a number of locations at the new Sydney Fish Market to provide bats with a range of roosting locations similar to the scenario present at the existing development site. In this way, roosting bats can select the location which most suits their needs at different times of the year as each location will have a slightly different microclimatic regime to other locations.

When looking for suitable places to locate Southern Myotis roosting habitat the following is a general guide:

- Darkness and protection from the elements are critical – the cavity / space / bat box needs to ensure that it is not open to the sky and includes shelter space that is out of the wind
- Insulation / thermal mass – wooden and concrete materials are the preferred substrates for a roost because they dampen environmental conditions and provide a relatively stable roost environment
- Minimal access to the cavity / space / bat box by anything other than flying animals - ideally the roost space / cavity / bat box will be located on the obvert (underside) of a culvert / bridge / wharf / jetty / structure such that snakes, rats, cats, foxes etc cannot climb or crawl into the cavity / space / bat box or reach a position immediately in front of the entrance from where predation could occur. This generally means locating it at least 2 m from the edge of any structure particularly where a structure is attached to land and / or > 1.5m directly above the water.
- Bats prefer to be as far from the edges of any structure as possible if they have a choice of where to roost, so select a point equidistant from the edges and from land

- Clear flight lines to / from the entrance of the cavity / space / bat box entrance with at least 1 square metre of free air space surrounding the entrance
- Proximity to foraging habitat –directly over water or within 100 m of it, but no closer than within 1.5 m above mean high water mark – this gives bats space to drop out of a roost and commence flying
- Minimal disturbance by human or boat traffic / movement, lights, vibrations, high-pitched noises – bats can become habituated to a certain amount of background noise (high pitched noises are not well tolerated compared to low pitched noises) and people / boat movements, but do not like to roost where a light shines directly onto the entrance of a roost or where vehicles / boats / people are moving randomly in their direct line of flight close to a roost.

The plans for the new Sydney Fish Markets have been reviewed and found to contain no suitable structural areas that could be used to create 'in situ' habitat that mimics and would replace the roost habitat that is to be removed during the demolition and construction works. The only areas of the new build that will be directly over water are the pedestrian decking and the wharves for the new Ferry Terminal and recreational boats. Neither of the wharves is suitable because the disturbance level will be too high and the wharves too close to mean high water level to allow bat box install.

It is suggested that several bat boxes be installed under the pedestrian decking at the south-western end of the new building at the completion of works. There may also be opportunities to install some boxes under the pedestrian decking at the north-eastern end of the new build, closer to where the existing Sydney Fish Markets are located. Other potential options for box install at the head of Blackwattle Bay include nearby wharves, jetties, bridges and culverts that would need to be inspected and evaluated against the criteria listed above prior to be selected as suitable locations.

In the same way that the compensatory habitat will be installed prior to the exclusion process it is preferable to install boxes on brackets / supporting rails so they can be more easily removed / moved if required for structural maintenance or roost management purposes. In this case there would ideally be several separate locations under the deck / wharf / jetty / structure with supporting rails and boxes installed so that removal or exclusion of bats from a single box would mean that bats still had alternative habitat they are already familiar with in place.

The final suite of permanent microbat habitat features incorporated into the newly built structure will be agreed upon by InfrastructureNSW in consultation with the project ecologist(s). InfrastructureNSW, the contractor responsible for building the new Sydney Fish Markets and the project ecologist engaged to implement the MMP will need to discuss and agree upon bat box locations and attachment methodologies prior to commencing the build and continue to communicate throughout the build to ensure the bat boxes are installed at the completion of the build in the most suitable locations

4. Contingency Measures

Wild animals can display unpredicted and unexpected behaviours, therefore this MMP must be flexible in its application so that a range of potential outcomes can be dealt with in accordance with Department of Planning Industry and Environment scientific licencing and Animal Care and Ethics Committee approvals.

4.1 Adaptive Procedures

The procedures of this plan may be adapted in response to factors such as microbats remaining in the roosting habitat at the Subject site and not emerging to forage, which would have implications for the length of time it takes to exclude microbats from the land and water-based structures.

The aim is to facilitate the identification of the best course of action for the particular situation, including time and logistical constraints, as well as the biological constraints posed by the microbats. This would require open communication between the work supervisor, project engineer / site supervisor, onsite environmental staff and the project ecologist.

Microbats are wild animals and do not always behave in the ways we expect or predict. Management plans need to be adaptable enough to react to situations as they arise and deal with a range of possible outcomes. Modifications to the procedures outlined in this plan may be undertaken provided there has been consultation with the supervising ecologist. The aim of this clause is to allow for the identification of the best course of action to facilitate construction given time and logistical constraints as well as ecological constraints imposed by the affected microbat species.

4.2 Capturing and releasing healthy microbats

If healthy microbats are discovered during works or observed flying from a roost site or around the works site during daylight, works will be stopped immediately and the site supervisor, onsite environmental staff, project engineer / site supervisor and supervising ecologist all informed. This is the responsibility of all site personnel. Works that are disruptive to microbats include those which create excessive noise (particularly high-pitched), vibration or light and heat sources, or give off smoke or other potentially noxious gases.

The supervising ecologist may elect to retrieve isolated bats (if possible) that are alive and healthy from the work area to allow works to continue. The bats will be held in a calico bag (no more than a single microbat to be held in each bag) that will be hung during the day in a cool, dark, well ventilated place and released at the point of capture once the work area is secured and excluded to microbats. This should only be undertaken if microbats can be safely captured and released on the night after they were captured. Bats should not be held for more than 12 hours.

If it is not possible to capture and remove the bats, a suitable exclusion zone will be set up by the supervising ecologist and no works will be undertaken within that zone until specifically directed by the supervising ecologist. The exclusion methodology outlined in Section 3.3.2 will be followed that evening by the project ecologist over a single night. Any breaches to the exclusion devices will be repaired following conclusion of the evening emergence survey, and a dawn inspection of the repaired exclusion device(s) will be undertaken. Provided the ecologist is satisfied that no microbats can access roosts beneath the wharf and that the repaired exclusion devices are functional approval will be given to re-

commence works in that area. This process may need to be repeated until the ecologist is satisfied that the structure remains excluded to microbats and that no microbats are roosting in the works area.

Bats should not be handled by unvaccinated ((Australian Bat Lyssavirus (ABLV)) and inexperienced persons. Suitable Personal Protective Equipment (PPE) is required to be worn to prevent bats biting or scratching the handler and to avoid contact with excrement from bats. Whilst very rare, some microbats carry diseases that can be lethal to humans if untreated. Photos are the first and best course of action to help identify microbats and should be supplied to onsite environmental staff and the project ecologist. If a non-vaccinated person does get bitten or scratched by a microbat, they must seek immediate medical attention. A post ABLV exposure vaccine is available and, if administered promptly and appropriately, will be effective in preventing the disease from developing.

Any evidence of a roosting microbat should be documented, photographed and actions recorded with onsite works staff and directed to the project ecologist for further action.

4.3 Injured or dead microbats

If microbats are found unexpectedly injured or dead in a works area, all works in the immediate area should cease and the site supervisor, onsite environmental staff, project engineer / site supervisor and supervising ecologist must be informed. Any evidence of injured or dead microbats should be documented, photographed and actions recorded with onsite works staff and directed to the project ecologist for further action. A suitable exclusion zone will be set up by the supervising ecologist and no works will be undertaken within that zone until specifically directed by the supervising ecologist.

Injured bats will be removed and taken to a local veterinarian or wildlife carer experienced in the care and handling of microbats by the project ecologist. Taronga Zoo is also an option as they have a fully qualified and experience veterinary team on hand who can properly handle any situation that arises. Options for treatment and future release would be decided and then documented by the supervising ecologist. Costs for treatment would be the responsibility of the contractor. Dead microbats will be collected by the project ecologist (using gloves and a plastic bag) and retained for lodgement with the Australian Museum.

5. Risks

Some of the procedures detailed within the plan pose various risks to human safety. The key risks include:

- contact with microbats
- working along a waterway
- working at night
- working at heights.

These risks are to be addressed by the project ecologist through preparation of a Safe Work Method Statement (SWMS) that outlines control measures required to eliminate or reduce the risks to acceptable levels.

5.1 Exposure to diseases such as Australian Bat Lyssavirus (ABLV)

Some microbats carry diseases that can be lethal to humans if untreated. Bats should not be handled by unvaccinated ((Australian Bat Lyssavirus (ABLV)) and unexperienced persons. Photos are the first and best course of action to help identify microbats and should be supplied to onsite environmental staff and the project ecologist.

Even if previously vaccinated against ABLV, if a person is bitten or scratched by a bat anywhere, they should:

- immediately wash the wound thoroughly with soap and water for at least five minutes - proper cleansing of the wound reduces the risk of infection
- apply an antiseptic with anti-virus action such as povidone-iodine, iodine tincture, aqueous iodine solution or alcohol (ethanol) after washing
- seek medical attention as soon as possible to care for the wound and to assess the risk of infection.

Anyone determined to be at risk of infection, regardless of vaccination status, would require treatment consisting of a combination of rabies immunoglobulin and rabies vaccine. Unvaccinated people will require an injection of rabies immunoglobulin as soon as possible and a series of either four or five rabies vaccine injections over one month. Fully vaccinated people usually require two further doses of the ABLV vaccine, but this will be dependent on exposure and current antibody counts. NSW Public Health Units will assess the risk and, where indicated, arrange for rabies vaccines and immunoglobulin to be delivered to a relevant GP or hospital.

The project ecologist and any other ecologists working on site must be vaccinated against Australian Bat Lyssavirus and wear gloves if handling microbats. The equipment and procedures for dealing with potentially infected persons outlined above must be detailed within the SWMS. Appropriate bat rescue equipment/ PPE must be available on site before works commence (cotton bags, gloves, soap and water to wash hands).

Controls to eliminate or reduce the remaining key risks identified above are commonly encountered on construction projects and should be adequately addressed in the SWMS prepared by the project ecologist.

6. Roles and Responsibilities

The construction personnel, project ecologist, project manager and environmental officer form a team that work together to achieve short-term management of microbats at the subject site through delivery of the MMP.

The project engineer / site supervisor is responsible for:

- notifying the project ecologist if there are any changes to the scope of works or works schedule
- including the actions outlined in the MMP in the Construction Environmental Management Plan (CEMP) or Site Environmental Management Plan (SEMP)
- ensuring the location of potential microbat roosts are marked on site maps or drawings
- notifying the project ecologist of the proposed date for removal of land-based structures
- notifying the project ecologist of the proposed date for removal of water-based structures
- immediately notifying the project ecologist in the event of any unexpected finds of microbats during works (alive and healthy, injured or dead)
- covering the costs associated with rehabilitation and release of any microbat injured during the course of works
- ensuring monitoring of any new microbat habitat is undertaken (if required) and reported.

The project ecologist is responsible for:

- providing basic information and pictures of microbats to be included in the environmental induction and to be kept in the crib room and available to all site personnel
- preparing a SWMS and undertaking daily Toolbox Talks for the implementation of the MMP
- procuring exclusion material
- maintaining an action log in relation to activities related to the implementation of the MMP
- monitoring and installing exclusion devices (may require assistance from construction personnel to conduct the permanent exclusion)
- conducting a pre-works inspection of the land and water-based structures being removed
- conducting daily pre-works inspections of the land and water-based structures being removed if removal works will be undertaken over multiple days and the works site could provide potential roosting habitat for microbats
- providing regular updates to the project manager and site supervisor on the progress of works
- dealing with any unexpected finds of microbats on site, including provision of advice, attendance at site at short notice, rescue, handling, and release of healthy bats, transfer of injured bats to an appropriate wildlife carer and lodgement of dead microbats with the Australian Museum
- reporting on the outcomes of the MMP within one month of completion of works
- undertaking and reporting on monitoring of any new microbat habitat.

The project ecologist is to provide guidance to the project manager such that the aims of the MMP are achieved and impact to microbats are minimised.

The contractor site supervisor is responsible for:

- conducting environmental inductions for all personnel working on site
- providing the relevant materials on site to deal with the immediate care of bites and scratches from microbats
- marking off any sensitive areas to prevent access to all non-essential personnel during works,
- conducting daily checks of the exclusion devices during the works period
- notifying the project ecologist if the exclusion devices are not secure
- notifying the project manager of the proposed dates for removal of land and water-based structures identified as potential microbat habitat within the subject site
- stopping works on site in the event of any unexpected finds of microbats during works (alive and healthy, injured or dead)
- notifying the project manager of any unexpected finds of microbats during works (alive and healthy, injured or dead)
- maintaining a suitable exclusion zone around any unexpected finds on the advice of the project ecologist.

Construction staff and contractors are responsible for:

- attending site inductions including the environmental induction
- avoiding any sensitive areas marked off within the work site
- assisting the project ecologist with installation of a permanent exclusion device (if required)
- stopping works immediately and notifying the site supervisor, project manager and environmental officer in the event of any unexpected finds of microbats during works (alive and healthy, injured or dead).

7. Reporting and Communication

The project engineer and contractor site supervisor will be kept informed via regular email and phone updates of progress and key milestones throughout the implementation of the MMP by the project ecologist. An action log summarising all site works undertaken will be maintained by the project ecologist. The action log will be a record of the actions taken, personnel responsible, timing, results as measured against performance measures and decisions made regarding adaptive measures (if required) during the installation and monitoring of exclusion devices. The action log will be included in final project report.

A final project report outlining the actions taken in implementing the MMP and the success or otherwise of the MMP in mitigating impacts to microbats, including recommendations for improvements to the process that could be employed on future projects, will be submitted one month following the completion of the exclusion process.

Table 4 below outlines the main actions required in implementing the MMP, this will form the basis of the action log.

Table 4: Action log summary table to be included in the final report for exclusion over 5 days (scalable for exclusions over 3 days).

Management Measures	Details	Timing	Performance Indicators	Responsibility
Site inspection	Project inception	Commencement of project	Completed and documented	Project ecologist, site supervisor, project engineer
Environmental induction	Discussion of risks involved and safety procedures	Commencement of project	All relevant staff inducted	Project ecologist, site supervisor, project engineer, contractors and all site personnel
Action log	Commence logging actions	Commencement of project	Completed and documented	Project ecologist
Procure exclusion materials	Purchase suitable materials	At least two weeks prior to exclusion	Exclusion materials stored at office of project ecologist	Project ecologist
Exclusion – Day 1	First diurnal inspection and install of exclusion devices	Late March – May or early Sept	Correct time of year	Project ecologist
	Emergence survey	After diurnal inspection	Completed and documented	Project ecologist
	Inspection following emergence survey	After emergence survey	Completed and documented	Project ecologist
	Dawn inspection	Morning of Day 2	Completed and documented	Project ecologist
Exclusion – Days 2 - 4	Second, third and fourth diurnal inspection	Late March – May or early Sept	Correct time of year	Project ecologist

Management Measures	Details	Timing	Performance Indicators	Responsibility
	Emergence survey	After diurnal inspection	Completed and documented	Project ecologist
	Inspection following emergence survey	After emergence survey	Completed and documented	Project ecologist
	Incremental closure of exclusion device	After nocturnal inspection	Completed and documented	Project ecologist
	Dawn inspection	Morning of Day 3, 4 & 5	Completed and documented	Project ecologist
Exclusion – Day 5	Final diurnal inspection	Late March – May or early Sept	Correct time of year	Project ecologist
	Emergence survey	After diurnal inspection	Completed and documented	Project ecologist
	Inspection following emergence survey	After emergence survey	Completed and documented	Project ecologist
	Completion of exclusion device	After nocturnal inspection	Completed and documented	Project ecologist
	Dawn inspection	Morning of Day 6	Completed and documented	Project ecologist
Permanent exclusion (relevant to derelict building only)	Install permanent exclusion device	Moring following completion of exclusion	Completed and documented	Project ecologist
Notification	Email to PM to confirm exclusion complete	Day that exclusion is completed	Completed and documented	Project ecologist
Exclusion monitoring	Inspect exclusion device and email results to project manager	One week following completion of exclusion	Exclusion device secure	Project ecologist
Exclusion monitoring	Inspect exclusion device and email results to project manager	Monthly following completion of exclusion and up to commencement of works Following extreme weather events	Exclusion device secure	Project ecologist
Pre-works inspection	Inspect exclusion devices and email results to project manager	First day of any land and water-based structure removal prior to works, first day of removal of high conservation value sections of wharf structures prior to works (Figure 2)	Exclusion device secure and no microbats present at start of daily works	Project ecologist

Management Measures	Details	Timing	Performance Indicators	Responsibility
Exclusion device re-instatement on first day of works	Assist and advise contractors on method for re-instatement of exclusion devices at conclusion of first day of works	Afternoon on first day of demolition and following morning, may need to be repeated on successive afternoons/mornings until ecologist satisfied that process is being completed successfully; if changes to method of re-instatement of exclusion devices is required; at request of site supervisor if uncertainty exists over re-instatement of exclusion devices	Exclusion devices secure and no microbats present at start of daily works	Project ecologist
Daily works inspection	Inspect exclusion device and inform project ecologist if action required	Daily during works on Subject site	Exclusion device secure	Site supervisor
Remove exclusion devices at start of daily works and re-instate at end of daily works	Remove exclusion device for active works area to allow works, re-instate at end of day	Immediately prior to commencing removal of sections of the structure, at conclusion of daily works	Works commence daily without interruption or unexpected finds of microbats	Site supervisor under advice and direction of Project ecologist
On-site ecologist for exclusion device advice / placement, unexpected finds	Advise contractors on exclusion device re-instatement at end of daily works and attend site when required to assist or deal with unexpected finds of microbats	As required	Ecologist responds in a timely manner to any issues	Project ecologist
Reporting	Prepare a report outlining actions undertaken	Within one month following removal of structures on site	Completed and documented	Project ecologist
Monitoring of bat boxes and new structures	Diurnal and nocturnal inspection including ultrasonic recording of Subject site once in winter and once in summer each year for two years following construction	Following completion of all works	Completed and documented	Project ecologist

Management Measures	Details	Timing	Performance Indicators	Responsibility
Monitoring report (if required)	Prepare a report outlining monitoring actions and results	Within one month following completion of monitoring	Completed and documented	Project ecologist

8. Monitoring

The objectives of monitoring are to:

- Ensure no microbats are harmed by the construction works.
- Identify the need to adjust the exclusion methodology to minimise impacts to microbats.
- Identify whether the microbat management actions have been implemented and gauge their success.
- Provide further recommendations for consideration on future projects with similar impacts on threatened microbats.

Monitoring of the potential habitat at the subject site, any bat boxes installed as compensatory habitat and exclusion devices would be undertaken by the project ecologist as follows:

- immediately prior to commencing exclusion (bat boxes only)
- daily during the exclusion process (structures, exclusion devices and bat boxes)
- one week following the completion of the exclusion process (structures, exclusion devices and bat boxes)
- once per month until removal of land and water-based structures occurs (structures, exclusion devices and bat boxes)
- once on the first day any land or water-based structures identified as potential microbat habitat are scheduled to be removed (structures, exclusion devices and bat boxes)
- once on the first day that high conservation value habitat beneath the largest wharf (Figure 2) is to be removed (structures, exclusion devices and bat boxes)
- at the request of the site supervisor where uncertainty exists around exclusion device placement or unexpected finds occur (structures only)
- quarterly monitoring of compensatory bat boxes during the construction period (bat boxes only)
- once at the completion of the project to determine whether microbat habitat exists in the newly created structures, and whether microbats have inhabited any of the compensatory bat boxes (structures and bat boxes)
- twice per year in years 1, 3 and 5 following the completion of works (winter and summer) if microbat habitat is present within the new Sydney Fish Market and for any bat boxes installed as compensatory habitat (structures and bat boxes).

8.1 Monitoring methodology

Monitoring during exclusion and post construction involves diurnal and nocturnal visual inspections of the potential habitat on site by a suitably qualified ecologist with experience in microbats using torches, burrow scopes and cameras, as well as emergence surveys, ultrasonic recording and use of thermal imaging cameras during emergence.

In the case where permanent microbat habitat created within the newly built structure proves difficult to monitor visually during the day, it may be necessary to include a nocturnal emergence survey incorporating ultrasonic recording for a period of up to 1.5 hours during each monitoring event. Information to be recorded during each monitoring event includes:

- unique identifier for each structure, bat box or roost feature
- date and time of inspection
- name of surveyor
- number of microbats present
- species of microbats present
- indications of breeding activity
- occurrence of ectoparasites / bat bugs
- evidence of occupation (guano)
- condition of roost feature
- weather conditions
- photographs of roosting microbats.

Details of all monitoring inspections would be recorded in the log of actions and emailed to the project manager following each monitoring inspection. The action log (Table 4) would be appended to the final report compiled by the project ecologist and provided to the project manager within one month upon completion of the project.

8.2 Performance measures

The project would be considered successful if there are no microbats injured or harmed as a result of the exclusion process and construction works. If microbat habitat is present within the new structures on site, post-construction monitoring will document the nature of this habitat and provide information on evidence for use of this habitat by microbats. Uptake of alternative compensatory habitat provided in the surrounding landscape in the form of bat boxes will also be documented. These measures will be deemed successful if there is evidence of sustained use of any newly created microbat roosting habitat in the new structures or within the boxes by Southern Myotis and / or use of the new habitat or boxes as a maternity roost by southern Myotis.

It is noted that even if potential microbat roosting habitat is present within the new structures on site, there may be no evidence of microbats found during any of the post construction monitoring inspections. It is known that it can take years for microbats to take up newly created roosts or bat boxes.

8.3 Monitoring report

An annual monitoring report summarising the results of the post construction monitoring events would be prepared by the project ecologist. This will be completed within one month following the conclusion of each year of monitoring (comprising the two post construction monitoring events conducted in summer and winter). The monitoring report would include a brief description of the background to the project, details of the microbat habitat lost, details of compensatory habitat installed and details of any microbat habitat present in the new structures, aims and objectives of the monitoring, monitoring methodology, results of monitoring events and recommendations for future improvements to MMPs.

9. Potentially occurring microbat species photographs

Figure 13: *Miniopterus orianae oceanensis* Large Bent-winged Bats (Vulnerable species under the NSW BC Act). Photo taken by Alicia Scanlon.

Figure 14: *Myotis macropus* Southern Myotis roost with unfurred pup in centre of photo (Vulnerable species under the NSW BC Act). Photo taken by Alicia Scanlon.

10. References

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Appendix A Exclusion Material Product Specification Sheet

BURWELL TECHNOLOGIES

Product Data Sheet

Envirogard

Scaffold and Containment Sheeting

Burwell ENVIROGARD is Reinforced Heavy Duty Polyethylene Sheeting used for weatherproofing and containment of Dust, Debris and Blasting Media to protect workers, job sites and the environment in Abrasive Blasting, Painting and Building Construction applications.

Specifications and Technical Data

ENVIROGARD is a Clear, Heavy Duty Polyethylene Sheeting over a tear resistant 1500 denier polypropylene reinforcing grid mesh. Three 50mm wide Reinforcement Bands with pre-punched grommets are fitted lengthwise on each roll for increased strength and security. Only ENVIROGARD has Eyelet Bands with Die-Cut Grommet points spaced every 200mm for super adjustable scaffold attachment.

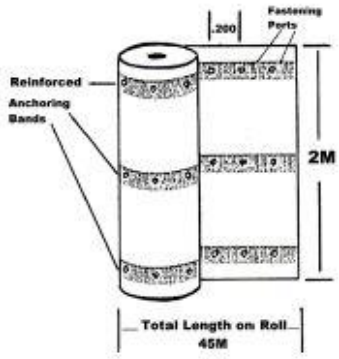
ENVIROGARD adjustable E-Z Ties are designed to pierce through the Die-Cut Grommet and secure the Sheeting to the Scaffold structure.

Panels of ENVIROGARD Scaffold Sheeting can be affixed together to form a single sheet airtight enclosure that meets SSPC Class 1 Containment.

Composition	1500 Denier Polyester yarn encased in low density clear Polyethylene Film.
Temperature Performance	-40ºC to +80ºC
UV Protection	Maximum UV Stabilisers for high durability
Light Transmission	Approximately 80%
Roll Size/Weight	2m Wide x 45m Long @ 240gsm
	4m Wide x 45m Long @ 240gsm
	2m Wide x 45m Long @ 180gsm
Thickness	0.26mm (.010")
Puncture Strength	500N

Exclusive Features

- ENVIROGARD'S three strategically placed reinforcement bands with pre-punched grommets make it the strongest and easiest to erect sheeting on the market.
- Available in FLAME RETARDANT and NON-FLAME RETARDANT styles.
- The unique EZ-TIE is the fastest and easiest way to secure scaffold sheeting directly to any standard scaffold. EZ-TIE is re-useable, adjustable and accessible from the front of the scaffold beam.
- The SCREW LOC connector is the smartest and simplest way to join multiple overlapping panels of ENVIROGARD sheeting.
- ENVIROGARD transparent sheeting provides the ultimate protection for dust and debris containment whilst maximizing light transmittal for an optimum working environment.
- ENVIROGARD containment sheeting is waterproof, tear resistant, impermeable, mildew resistant, UV stabilized, resistant to most chemicals/salts and acids and TOTALLY RE-USEABLE.



For more information: **1300 287 935** / mail@burwell.com.au / www.burwell.com.au

Appendix B Microbat habitat replacement

Figure 15: Four chamber microbat box constructed from recycled plastic (Cyplas™) and available from Hollow Log Homes (www.hollowloghomes.com)

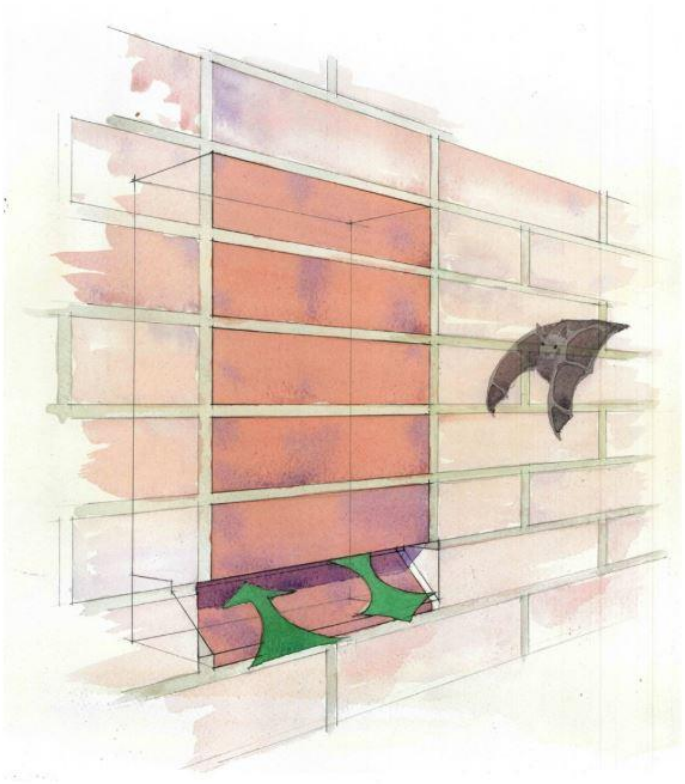


Figure 16: Microbat roost habitat design for use in the walls of solid structures and suitable for a range of cavity roosting and subterranean roosting microbat species

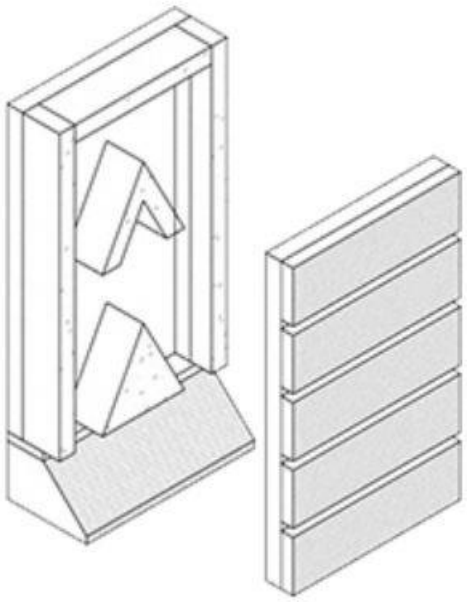


Figure 17: Internal cut away view and design features for the microbat roosting habitat

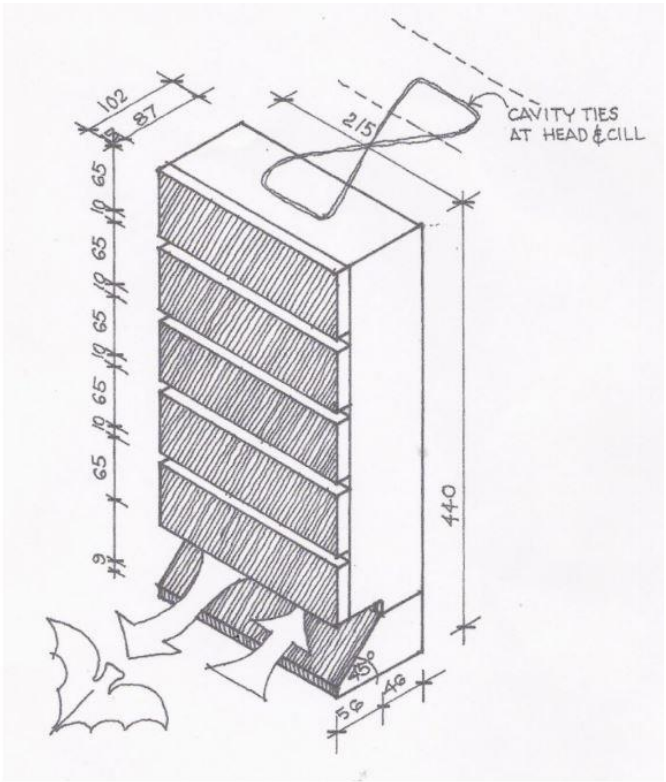


Figure 18: Design specifications for the microbat roosting habitat

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