Sydney Swans Head Quarters
Microbat Survey Report

Prepared for APP, on behalf of the Sydney Swans

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1. Introduction

1.1 Project description

Eco Logical Australia (ELA) were engaged by APP to undertake a microbat survey at Moore Park in Sydney to accompany a State Significant Development application for the proposed adaptive reuse of the Royal Hall of Industries (RHI) for a high-performance sport and community facility for the Sydney Swans.

1.2 Location

The subject site is located at 1 Driver Avenue, Moore Park and comprises a portion of two separate lots, legally described as Lot 3, DP861843 and Lot 52 of DP1041134. The site is owned by the Centennial Park and Moore Park Trust and is leased to the Sydney Swans for the purposes of the development.

Figure 1: Study area

The proposal will relate to the RHI building, and the associated courtyard area to the immediate south of the building. The proposed development area is in the south-western corner of the Entertainment Quarter precinct and has a direct frontage to Driver Avenue to the west, Lang Road to the south and Errol Flynn Boulevard to the east, an access road within the Entertainment Quarter precinct.

2. Methods

2.1 Potential roost search

A visual survey of potential microbat roosts at the RHI undertaken by ELA ecologist Kirsten Velthuis on 1 September identified five entry / exit points considered likely to provide access to potential microbat roosting habitat within the RHI:

1. Outside the western side of Door 7 - cavities around the gutter pipe going into the building façade with some faint vertical yellow staining on the wood panel below the pipe.
2. Outside the eastern side of Door 8 - cavities around the gutter pipe going into the building façade with some faint vertical black/brown staining on the bricks below the pipe.
3. Outside the south-eastern wall of the RHI - cavities around the gutter pipe that lead into the building façade and holes in the wood panelling at the top of the façade.
4. Outside the eastern turret of the RHI - cavities that lead into the turret and a long cavity located in a wood panel along the top of the building façade.
5. Inside the eastern turret - several cavities in the internal brick wall, as well as cavities within the wooden floor separating the turret from the 1st floor. Evidence of use by pigeons, as well as other animals (e.g. scats (of various sizes) evident). Rat bait has been used throughout the building and some of the scats could belong to rats.

Photos of these potential microbat entry/exit points are included in Appendix A.

There were other entry / exit cavities sighted, but most of these were quite large and showed evidence of use by pigeons or other birds and were not considered likely to be utilised by microbats.

2.2 Anabat detection survey

The visual survey was followed by unattended (passive) Anabat detection surveys of the five identified potential exit / entrance sites. This involved placing Anabat detectors at a suitable location on the ground or at elevated locations near the potential roost entrances / exits. Anabat detection began 30 minutes before sunset and continued until 3 hours after sunrise on each of the nights 25th to 29th September. Weather details during the survey were as below.

Table 1: Survey temperatures and rainfall

Survey Date	Max Temperature	Min Temperature	Rainfall (mm)
25 September 2019	21.9	9.7	none
26 September 2019	20.8	12.6	none
27 September 2019	25.3	13.9	none
28 September 2019	21.7	15.3	none
29 September 2019	21.21	11.3	Yes (data unavailable on BOM website)

2.3 Call analysis

Bat calls were analysed by ELA ecologist Alicia Scanlon using the program AnalookW (Version 4.2n 16 March 2017, written by Chris Corben, www.hoarybat.com). Alicia has over twelve years of experience in the identification of ultrasonic call recordings. Call identifications are made using regional based guides to the echolocation calls of microbats in New South Wales (Pennay et al 2004); and south-east Queensland and north-east New South Wales (Reinhold et al 2001) and the accompanying reference library of over 200 calls from Sydney Basin, NSW (which is available at http://www.forest.nsw.gov.au/research/bats/default.asp).

A sample of the calls were reviewed by ELA ecologist Dr Rod Armistead who has over five years of experience in the identification of ultrasonic call recordings. External review of a sample of calls was also undertaken by Greg Ford of Balance Environmental, who has over 20 years of experience in this field.

Bat calls are analysed using species-specific call profile parameters including call shape, characteristic frequency, initial slope and time between pulses (Reinhold et al. 2001). To ensure reliable and accurate results the following protocols (adapted from Lloyd et al 2006) are followed:

- Search phase calls are used in the analysis, rather than cruise phase calls or feeding buzzes (McKenzie et al 2002). Cruise phase or feeding calls are labelled as being unidentifiable.
- Recorded calls containing less than three pulses are not analysed and these sequences are labelled as unidentifiable, being too short to confidently determine the identity of the species making the call (Law et al 1999)
- For those calls that are useful to identify the species making the call, two categories of confidence are used (Mills et al 1996):
    - Definitely present – the quality and structure of the call profile is such that the identity of the bat species making the calls is not in doubt
    - Potentially present – the quality and structure of the call profile is such that there is some / low probability of confusion with species that produce similar calls profiles
- Calls made by bats which cannot be used for identification purposes such as social calls, short and low-quality calls, cruise and approach phase calls are labelled as unidentifiable.
- Sequences labelled as unidentifiable are of inferior quality and therefore not able to be identified to any microbat species, they can however be used as an indicator of microbat activity at the site.
- *Nyctophilus* spp. (Long-eared bats) are difficult to identify confidently from their calls and no attempt is made to identify this genus to species level (Pennay et al 2004)
- The Free-tailed Bats (previously referred to as the genus *Mormopterus*) have recently undergone taxonomic revision (Reardon et al 2014) and published reference calls for this group of species (Pennay et al 2004) are believed to contain errors (Greg Ford pers comm.). This report uses nomenclature for Free-tailed bat species as referred to in Jackson and Groves (2015). The correlation between nomenclature used in this report and that used in NSW State legislation is presented in Table 2 below.
- Sequences not attributed to microbat echolocation calls (e.g. insect buzzes, wind, train and vehicle movement) were dismissed from the analysis.

Table 2: Correlations between current and previous nomenclature for the Free-tailed bats of NSW

Current Name (Jackson and Groves 2015)	Previous Name	Common Name	Biodiversity Conservation Act 2016 status
Austronomus australis	*Tadarida australis*	White-striped Free-tailed Bat	
Micronomus norfolkensis	*Mormopterus norfolkensis*	Eastern Coastal Free-tailed Bat	Vulnerable
Ozimops petersi	*Mormopterus* species 3 (small penis)	Inland Free-tailed Bat	
Ozimops planiceps	*Mormopterus* species 4 (long penis eastern form)	Southern Free-tailed Bat	
Ozimops ridei	*Mormopterus* species 2	Ride's Free-tailed Bat	
Setirostris eleryi	*Mormopterus* species 6	Bristle-faced Free-tailed Bat	Endangered

3. Results

The Anabat unit outside the eastern side of the RHI and the anabat unit outside the turret did not record any data on 29th September, resulting in 23 survey nights of data captured in total. There were 33 call sequences recorded during this survey. Of these, 29 (88%) were deemed useful, because the call profile was of sufficient quality and/or length to enable positive identification of bat species. The remaining four (12%) call sequences were either too short or of low quality, thus preventing positive identification of bat species.

Up to four species were identified during the survey; three species were identified as definitely present, and one species was identified as potentially present (Table 3). Examples of calls for each species is included in Appendix B.

One species listed under the NSW *Biodiversity Conservation Act 2016* (BC Act) was identified as definitely present, ***Miniopterus orianae oceanensis*** **(Large Bent-winged Bat).** No species listed under the Commonwealth *Environmental Protection and Biodiversity Conservation Act* 1999 (EPBC Act) were identified. Calls from Large Bent-winged Bat were the most commonly recorded during the survey, and they accounted for 21 of the 33 calls that were recorded; accounting for 64% of the positively identified call sequences.

Table 3: Microbat species and number of calls recorded at the RHI between 25 -29 September 2019.

Scientific Name	Common Name	Present	BC Act status	EPBC Act status	Total calls
Austronomus australis	White-striped Free-tailed Bat	Definitely	Not listed	Not listed	2
Chalinolobus gouldii	Gould's Wattled Bat	Definitely	Not listed	Not listed	5
Chalinolobus gouldii / Ozimops ridei	Gould's Wattled Bat/ Ride's Free-tailed Bat	Potentially	Not Listed	Not listed	1
Miniopterus orianae oceanensis	Large Bent-winged Bat	Definitely	**Vulnerable**	Not listed	21
Unidentifiable					4
Total identifiable calls					29
Total calls recorded					33
Percentage identifiable calls					88%

Microbat activity at the site was extremely low with a microbat call recorded roughly every 9 hours of recording time on average throughout the 23 nights (276 hours) of survey.

It is also likely that the same bat was recorded on multiple Anabat units during each recording session because of the proximity of Anabat detectors to each other, which may have inflated the actual activity levels. There were very few long sequences recorded during the survey indicating that microbats were predominantly commuting past the site. There were no feeding buzzes recorded in the data.

The majority of calls (25 out 33 (81%)) were recorded between the hours of 10:00 pm and 4:00 am and it is likely that these calls were made by bats flying past the site. The earliest call that was recorded in

the evening was at 8:15 pm on a detector set beneath Door 7 on 26th September and was made by either a *Chalinolobus gouldii* (Gould's Wattled Bat) or *Ozimops ridei* (Ride's Free-tailed Bat).

There were three calls recorded between 5:30 am and 6:10 am on 27th September at anabat survey location 2 (door 8) made by the Large Bent-winged Bat. These calls indicate that the Large Bent-winged Bat could be roosting very close by and potentially within the RHI.

Results from each of the survey locations are presented in Table 4 to Table 7.

Table 4: Microbat species and number of calls recorded at Site 1, Door 7, 25 – 28 September 2019

Scientific Name	Common Name	Definitely present	Potentially present	Total calls
Chalinolobus gouldii / Ozimops ridei	Gould's Wattled Bat / Ride's Free-tailed Bat		1	1
Miniopterus orianae oceanensis	Large Bent-winged Bat	3		3
Unidentifiable				0
Total identifiable calls				4
Total calls recorded				4
Percentage identifiable calls				100%

Table 5: Microbat species and number of calls recorded at Site 2, Door 8, 25 – 29 September 2019

Scientific Name	Common Name	Definitely present	Potentially present	Total calls
Austronomus australis	White-striped Free-tailed Bat			1
Chalinolobus gouldii	Gould's Wattled Bat			1
Miniopterus orianae oceanensis	**Large Bent-winged Bat**	11		11
Unidentifiable				1
Total identifiable calls				13
Total calls recorded				14
Percentage identifiable calls				93%

Table 6: Microbat species and number of calls recorded at Site 3, outside the south- eastern wall, 25 – 28 September 2019

Scientific Name	Common Name	Definitely present	Potentially present	Total calls
Austronomus australis	White-striped Free-tailed Bat	1		1
Chalinolobus gouldii	Gould's Wattled Bat	1	1	2
Miniopterus orianae oceanensis	**Large Bent-winged Bat**	3		3
Unidentifiable				0
Total identifiable calls				6
Total calls recorded				6

Scientific Name	Common Name	Definitely present	Potentially present	Total calls
Percentage identifiable calls				100%

Table 7: Microbat species and number of calls recorded at Site 4, outside the eastern turret, 25 – 28 September 2019

Scientific Name	Common Name	Definitely present	Potentially present	Number
Chalinolobus gouldii	Gould's Wattled Bat	2		2
Miniopterus orianae oceanensis	**Large Bent-winged Bat**	4		4
Unidentifiable				3
Total identifiable calls				6
Total calls recorded				9
Percentage identifiable calls				67%

There were no calls recorded at Site 5, inside the eastern turret.

4. Interpretation of survey results

The potential presence of Large Bent-winged Bat within the study area requires further consideration. There are Large Bent-winged Bat records on the NSW Bionet Atlas within a 10 km radius of the study area.

Large Bent-winged Bats are subterranean roosting species. Large Bent-winged Bats congregate in large numbers at a few known maternity caves outside of the Sydney Basin over spring and summer to breed and raise young and disperse to winter hibernation roosts up to 300 km away from maternity roosts in autumn (Churchill, 2008). The RHI does not constitute breeding habitat for Large Bent-winged Bats, as they are not known to breed in buildings. Also, large aggregations (1000's) of Large Bent-winged Bats are required to sustain a maternity roost. Therefore, it would be obvious within or outside the RHI, if the subject site was being used as a breeding roost for this species.

Large Bent-winged Bats were the most commonly species recorded. No calls were recorded prior to 10:00 pm, but there were three calls from this species recorded between 5:30 am and 6:10 am from anabat survey location 2 (Door 8) on 27th September. This result suggests that Large Bent-winged Bats are roosting nearby, and it is possible that individuals or small numbers were roosting within the RHI. Large Bent-winged Bats are likely to forage in proximity to the RHI building, including in adjacent Moore Park and Centennial Park.

5. Survey limitations

Calls were only positively identified when the defining characteristics were present and there was no chance of confusion between species with overlapping and/or similar calls. In this survey, there were some call sequences that could not be positively identified to species level. Further, some species recorded in this survey can have call profiles that overlap with other species. When overlap occurs, species with similar call profiles are assigned to multi species groups of two or three potential species depending on the characteristics displayed in the recorded call sequences. Calls with intermediate characteristics were assigned mixed species labels.

The species recorded in this survey with overlapping call profiles are described below.

Chalinolobus gouldii (Gould's Wattled Bat) and *Ozimops ridei* (Ride's Free-tailed Bat) have calls that overlap in the range 28.5 kHz and 33 kHz. Free-tailed Bat species calls are flat in shape with an initial slope (S1) of less than 100 octaves per second (OPS) separating them from Gould's Wattled Bat whose calls are curved with an S1 greater than 200 OPS. Gould's Wattled Bat was distinguished by a frequency of 27.5 – 32.5 kHz and alternation in call frequency between pulses. There was a single short call sequence recorded which did not show any alternation in call frequency and had an OPS between 100 and 200 and this call was labelled as Gould's Wattled Bat / Ride's Free-tailed Bat.

Large Bent-winged Bat calls overlap in frequency with those of *Vespadelus regulus (Southern Forest Bat)* and *V. darlingtoni* (Large Forest Bat) in the Sydney Basin. The calls of Large Bent-winged Bats can be separated from the Forest Bats by a down-sweeping tail which neither of the Forest Bats displays (generally being up-sweeping or absent). Large Bent-winged Bat calls are often variable in pulse shape and time between pulses whereas the Forest Bats commonly have regular pulses evenly spaced pulses.

6. Conclusions and recommendations

Calls of up to four species of microbats were recorded during the anabat survey of the RHI. This included calls of the Large Bent-winged Bat, a threatened species listed as Vulnerable under the BC Act.

Under the BC Act, the Large Bent-winged Bat is a dual credit species (an ecosystem credit and species credit species), but it is a species credit species for breeding habitat only.

This report identified that the RHI does not constitute breeding habitat for Large Bent-winged Bats. This is because this species is not known to breed in buildings and no evidence of large aggregations (1000's) of Large Bent-winged Bats (required to sustain a maternity roost) has been found at the RHI.

However the survey findings indicate that Large Bent-winged Bats forage in proximity to the RHI building and it is possible that individuals or small numbers of Large Bent-winged Bats use the RHI as roosting habitat.

This constitutes the following potential prescribed biodiversity impact on this species under the BC Act:

- Human-made structures which is used as a habitat feature by a threatened species

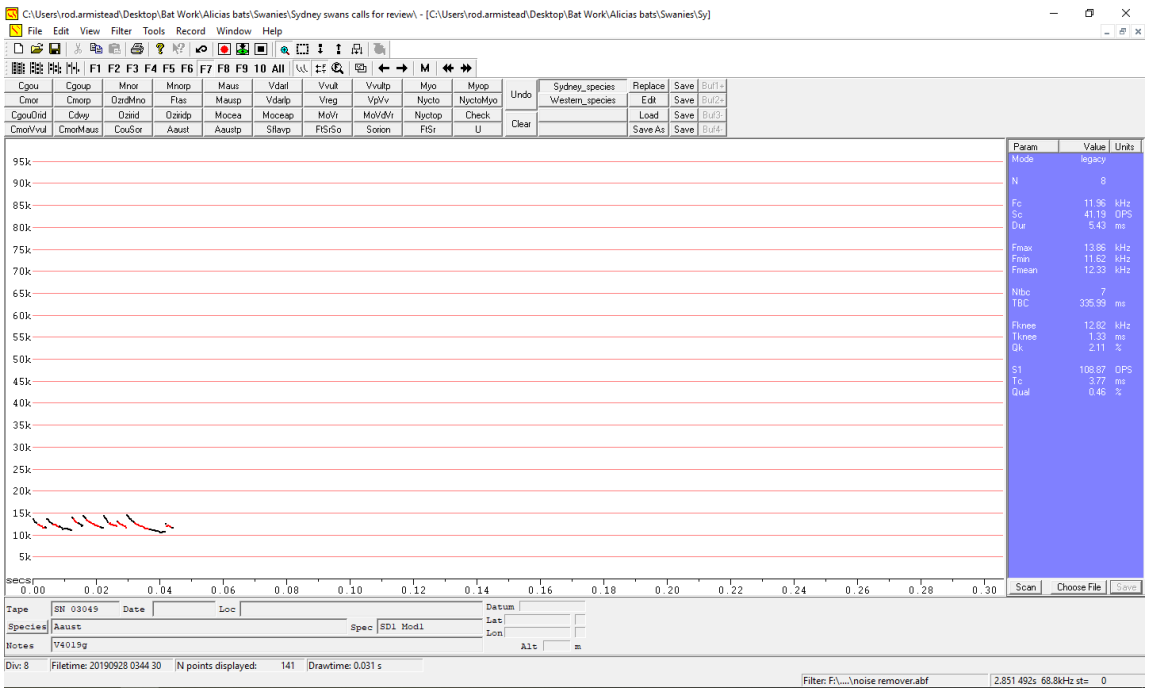
A Biodiversity Development Assessment Report (BDAR) will be required to assess prescribed biodiversity impacts for threatened species, as well as impact on native vegetation and habitat for threatened species, in line with the Biodiversity Assessment Method (BAM).

Appendix A : Anabat survey location photos

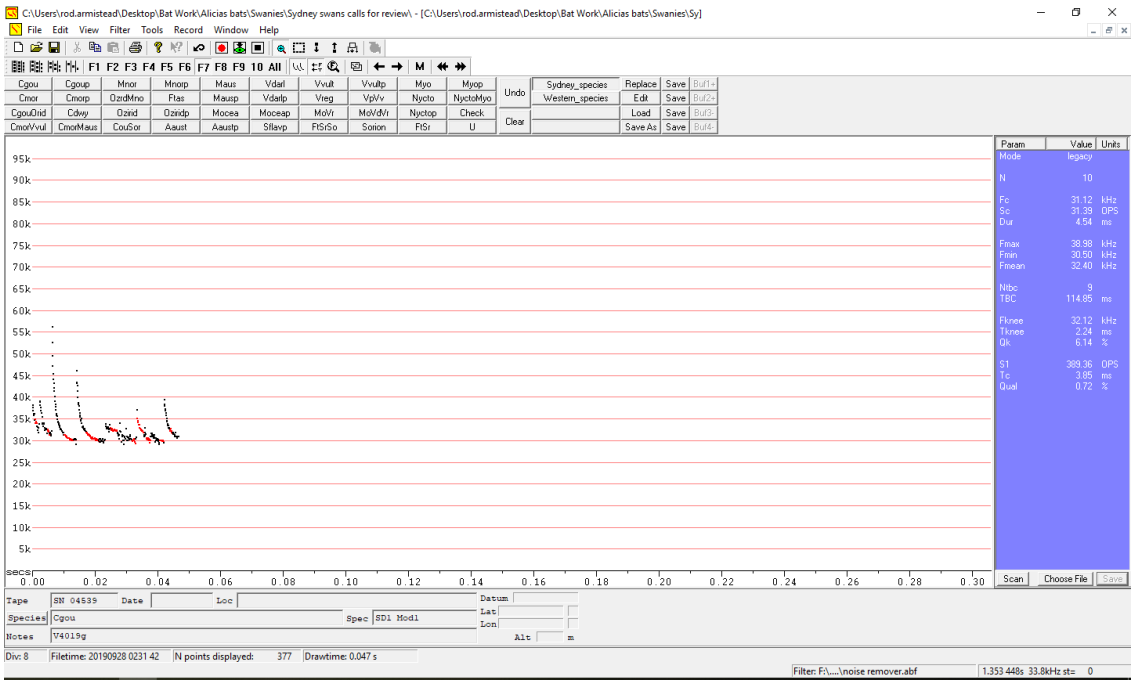
Anabat survey location	Photo
1: Near Door 7	
2: Near Door 8	

Anabat survey location	Photo
3: South-eastern facade	
4: Eastern turret and facade	
5: Inside eastern turret	

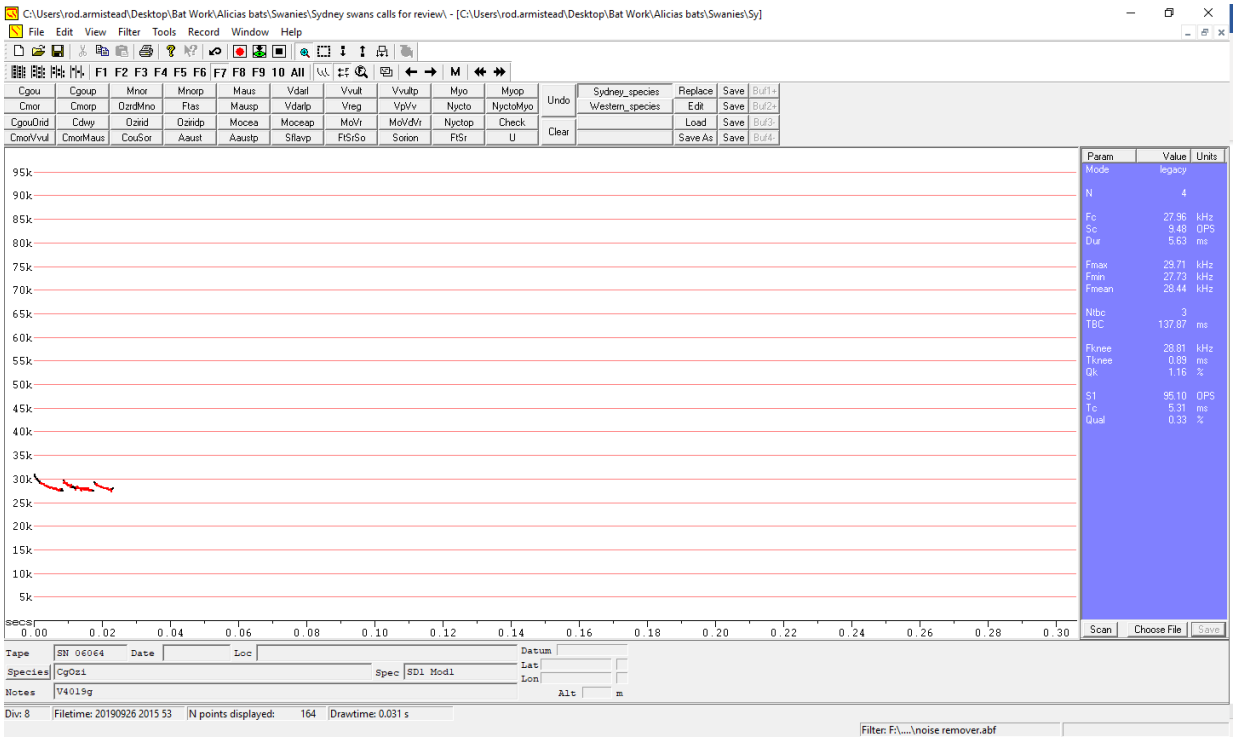
Appendix B Examples of Call Profiles



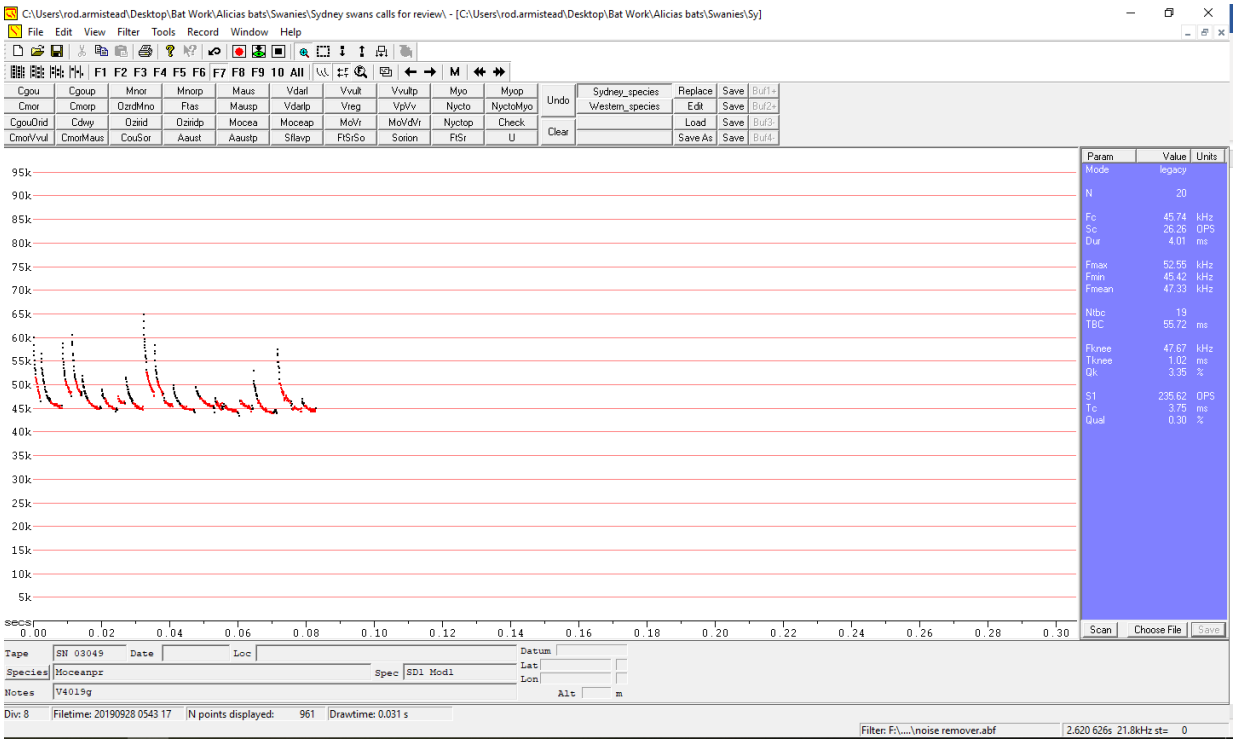
Call profile for *Austronomus australis* (White-striped Free-tailed Bat) recorded beneath Door 8 of the Royal Hall of Industries at 03:44 (3:44 am) on 28 September 2019.



Call profile for *Chalinolobus gouldii* (Gould's Wattled Bat) recorded outside the Turret of the Royal Hall of Industries at 02:31 (2:31 am) on 28 September 2019.



Potential call profile for *Chalinolobus gouldii* (Gould's Wattled Bat) or *Ozimops ridei* (Ride's Free-tailed Bat) recorded beneath Door 7 of the Royal Hall of Industries at 20:15 (8:15 pm) on 26 September 2019.



Call profile for *Miniopterus orianae oceanensis* (Eastern Bent-winged Bat) recorded beneath Door 8 of the Royal Hall of Industries at 05:43 (5:43 am) on 28 September 2019.

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