



Commonwealth approval EPBC 2013/6963 conditions compliance tracking and management annual report

**Nambucca Heads to Urunga Pacific Highway
Upgrade**

February 2023 – January 2024

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OFFICIAL

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Glossary / Abbreviations

Acronyms used in this document

Acronym	Definition
BEM	Benchmark Environmental Management
CAR	Corrective Action Request
CEMP	Construction Environmental Management Plan
Clear Milkvine	Marsdenia longiloba
Cryptic Forest Twiner	Tylophora Woollsii
Ecos	Ecos Environmental Pty Ltd
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999
ER	Environmental Representative - A suitably qualified and experienced person independent of project design and construction personnel employed for the duration of construction. The principal point of advice in relation to all questions and complaints concerning environmental performance.
NCR	Non Conformance Report
NGOMP	Norton and Griffin Offset Management Plan
SAP	Sensitive Area Plan
SES	Sandpiper Ecological Surveys
TFOMP	Threatened Flora Offset Management Plan
TFMP	Threatened Flora Management Plan
TFOS	Threatened Flora Offset Strategy

Introduction

1.1 Purpose of this document

The purpose of this document is to facilitate demonstration by Transport for New South Wales (TfNSW) of satisfactory compliance with the Commonwealth approval conditions for the Nambucca Heads to Urunga Pacific Highway Upgrade project with particular reference to Condition 24, which requires an annual report addressing compliance with each of the conditions of approval. The report covers the tenth period from February 2023 to January 2024.

For each condition, one or more actions are identified which, once implemented, will achieve satisfactory compliance with the condition. Where appropriate, the timing for completion of individual actions is identified.

For each action, the minimum relevant documentation to support demonstration of compliance is identified. This documentation would inform any future compliance audit.

Where an approval condition makes reference to information being provided to the Commonwealth Minister for the Environment, the associated action(s) assumes that this information will be provided, in the first instance, to the Commonwealth Department of the Environment.

1.2 Key dates

The timing for compliance with certain approval conditions is linked to specific dates as follows:

- Commonwealth approval: 26 November 2013
- Start of construction: 4 December 2013
- Completion of construction: 14 February 2018
- Expiry of Commonwealth approval 1 January 2031
- Publish 10th Annual Compliance Report 4 March 2024

1.3 Responsibility for compliance

Responsibility for compliance with all approval conditions sits with TfNSW.

1.4 NSW planning approval

Condition 29 (of the Commonwealth approval) provides for the use of plans, strategies or reports required under the NSW approval to satisfy the requirements of the Commonwealth approval, subject to provision of a separate document demonstrating how the document addresses the relevant Commonwealth approval requirements.

Specialists in the fields of flora and fauna have been engaged by TfNSW and the construction contractor to undertake various ecology-related management activities with regard to complying with the NSW planning approval and the CEMP. The following specialist had been engaged to undertake ecology related activities prior to the EPBC approval:

- Benchmark Environmental Management (BEM) has prepared an ecological monitoring program that addresses relevant matters in the NSW planning approval. The ecological

monitoring program has been incorporated into the CEMP for the contractor to implement during construction.

- Ecos Environmental (Ecos) has been engaged by TfNSW to prepare a Threatened Flora Translocation Program that addresses relevant matters in the NSW planning approval and has additionally been engaged by the contractor to provide advice on the implementation of the translocation program and provide specialist advice on flora to implement other CEMP requirements.
- Sandpiper Ecological Surveys (SES) has been engaged by the contractor to provide specialist advice on fauna to implement CEMP requirements.
- SES has been engaged by TfNSW to undertake the ongoing operational phase monitoring as required under the approved ecological monitoring program.

This document contains actions relevant to compliance with Commonwealth approval requirements.

1.5 Definitions for action status conditions

TBA	To Be Arranged - Further works required prior to starting action.
In progress	Action initiated but not yet complete.
Ongoing	Action in place but ongoing works required to ensure compliance.
Compliant	Action completed and compliant with Condition of Approval

1.6 Non-Compliances with EPBC Conditions

No non-compliances were recorded for the period February 2023 to January 2024.

Condition 1

The person taking the action must not clear more than:

- a) 171 ha of Koala habitat;
- b) 184 ha of Grey-headed Flying-fox habitat
- c) 166 ha of Spotted-tail Quoll habitat;
- d) 73 ha of habitat for the Swift Parrot and Regent Honeyeater; and
- e) 36 ha of habitat for the Cryptic Forest Twiner and Clear Milkvine.

Action	Timing	Status	Compliance evidence
1.1 Progressive review of area cleared	Regularly during construction	Compliant	Record of clearing numbers
1.2 Review outstanding clearing requirements at 75% clearing to confirm clearing limitation targets will be met	Construction (75% clearing)	Compliant	Memo provided 18-6-2014
1.3 Confirm clearing limitation targets have been met	Post-construction	Compliant	As built survey of actual clearing area.

Final Clearing Quantities (EN1 FDD + Additions)			
Habitat Type	Final Clearing Quantity (ha)	Limit (ha) as per Condition 1 Approval	Current Difference showing remaining habitat (ha) under Condition 1 Approval
Koala	157.89	171	13.11
Grey-headed Flying-fox	170.84	184	13.16
Spotted –tail Quoll habitat	71.40	166	94.60
Swift Parrot and Regent Honeyeater	71.40	73	1.60
Cryptic Forest Twiner and Clear Milkvine	34.11	36	1.89

Mainline clearing was completed during 2014. Small amounts of clearing were undertaken throughout 2015 and 2016.

Clearing has been completed and the table above (Final Clearing Quantities (EN1 FDD + Additions) shows the final figures for each habitat type. Clearing totals for each habitat type were less than the approved limits in accordance with Condition 1.

Condition 2

Within 30 days of the completion of *construction* works, the person taking action must:

- a) notify the Minister in writing of the completion of construction; and
- b) provide a report (supported by appropriate mapping) that clearly shows the location of all vegetation and EPBC species habitat cleared as a result of the action, and that demonstrates compliance with Condition 1.

Action	Timing	Status	Compliance evidence
2.1 Prepare works as executed Environmental and Clearing Plans to show extent of clearing.	Within 30 days of construction completion	Compliant	Report & supporting mapping provided
2.2 Calculate final clearing quantity and include in summary table.	Within 30 days of construction completion	Compliant	Report & supporting mapping provided
2.3 Provide written notification (letter) of completion of construction and report to Dept of the Environment	Within 30 days of construction completion	Compliant	Notification letter provided 7/03/18.

Completion of construction occurred on 14 February 2018. A report was produced and included in the February 2017 to January 2018 Annual Compliance report.

Condition 3

The person taking the action must undertake progressive rehabilitation of EPBC species' habitat in areas where temporary infrastructure is to occur or, where short term impacts are anticipated. Where appropriate, the landscaping / rehabilitation of these areas must be done in a manner that targets the needs and requirements of EPBC species.

Action	Timing	Status	Compliance evidence
3.1 Finalise urban design and landscape plan to capture rehabilitation and revegetation temporary works and areas of short term impact.	Pre-construction or prior to any works in EPBC species habitat areas during construction	Compliant	Urban Design and Landscape Plan
3.2 Implement rehabilitation / landscaping of affected areas as per landscape design.	Following cessation of use of affected areas	Compliant	No EPBC species habitat was cleared as part of the creation of temporary infrastructure

Note: Urban Design Landscape Plan was approved by NSW Department of Planning (DoP) in February 2015.

Landscape planting commenced on Wednesday 4th November 2015. All permanent landscaping works have been completed across the project. Ongoing maintenance works including weed management will be undertaken by the contractor for three years following construction completion under their deed requirements.

No EPBC species habitat was cleared as part of the creation of temporary infrastructure or short term impacts as part of the project.

All sites classified as Temporary Infrastructure for the project were located in areas where no confirmed EPBC habitat was located, and also no Biometric vegetation communities were cleared for the creation of these sites i.e. located in areas previously cleared for agricultural or Forestry purposes.

Condition 4

At completion of construction (and every three years thereafter for the life of this approval or until *the Minister* has agreed in writing that further revisions are no longer required) a progress report assessing the effectiveness of restoring habitat on site (in accordance with Condition 3) must be provided to *the Minister*.

Action	Timing	Status	Compliance evidence
4.1 Annual Compliance Report Number 3 to Dept of the Environment	March 2017	Compliant	SAP's showing temporary infrastructure was not located within EPBC Species habitat

Landscape planting commenced on Wednesday 4th November 2015. All permanent landscaping works have been completed across the project. Ongoing maintenance works including weed management will be undertaken by the contractor for three years following construction completion under their deed requirements.

No EPBC species habitat was cleared as part of the creation of temporary infrastructure or short term impacts as part of the project.

All sites classified as Temporary Infrastructure for the projects were located in areas where no confirmed EPBC habitat was located, and also no Biometric vegetation communities were cleared for the creation of these sites i.e. located in areas previously cleared for agricultural or Forestry purposes.

Condition 5

Prior to *commencement of the action* the person taking the action must engage a *suitably qualified expert* to:

- a) map any areas of habitat for EPBC species that lie adjacent to the construction zone;
- b) map the locations of known individuals of Clear Milkvine and Cryptic Forest Twiner that lie adjacent to the construction zone;
- c) map any areas of lowland rainforest of subtropical Australia that lie adjacent to the construction zone; and
- d) clearly mark exclusion zones along (or around) these areas on site.

Action	Timing	Status	Compliance evidence
5.1 Engage suitably qualified expert	Prior to start of construction	Compliant	Ecos Environmental mapped vegetation and habitat types with information included in SAPs.
5.2 SAPs to show required items	Prior to construction in affected areas	Compliant	SAPs drafted prior to start of construction. SAPs – amended as required with any updated information
5.3 Exclusion zones to be marked on site as appropriate	Prior to construction in affected areas	Compliant	Exclusion zone delineation installed prior to construction in affected areas and maintained as required. Ongoing compliance documented through surveillance checklist.
5.4 SAPs Updated	Construction	Compliant (last revised October 2014)	SAPs updated following new information or removal of sensitive area. Tracked through updated revision of the SAPs.

Condition 6

To mitigate and reduce indirect impacts on the *exclusion zones* identified as a requirement of Condition 5, the *person taking the action* must:

- a) ensure that temporary and high visibility fencing will be erected to restrict access to exclusion zones. Temporary fencing must be of a design appropriate to deter the passage of vehicles or placement of construction materials, equipment and waste, in exclusion zones where accidental incursion could reasonably occur;
- b) implement measures to prevent the spread or establishment of new or additional weed species, soil or plant pathogens into these exclusion zones as a result of construction;
- c) implement stormwater management measures to prevent the unintentional diversion or discharge of stormwater during both construction and operation over exclusion zones; and
- d) implement targeted measures for managing construction impacts to Cryptic Forest Twiner and Clear Milkvine associated with dust, sedimentation and erosion.

Action	Timing	Status	Compliance evidence
6.1 Implement protection measures:			
(a) Fencing of exclusion zones	During construction	Compliant	Exclusions zones installed prior to clearing. Exclusion delineation to be maintained until construction completion. Environmental surveillance checklist documenting compliance.
(b) Prevent spread of weeds, soil or pathogens	During construction	Compliant	CEMP measures include implementation of TfNSW best practice measures detailed in the biodiversity guidelines. Including plant wash down prior to entry onto site and separation and segregation of weed infested topsoil. Environmental surveillance checklist documenting compliance.

(c) Stormwater measures to prevent discharge of stormwater during construction and operation over exclusion zones	Detailed design and during construction	Compliant	Detailed design includes the retention and treatment of road runoff adjacent to sensitive areas. CEMP measures include implementation of best practice erosion and sediment controls during construction. Environmental surveillance checklist documenting compliance
(d) Implement target measures to manage construction impacts to threatened flora.	During construction	Compliant	Directly and indirectly impacted threatened flora removed from site through implementation of Threatened Flora Management Plan. CEMP includes best practice measures to manage dust and erosion and sedimentation impacts. Environmental surveillance checklist documenting compliance. Progressive revegetation to be undertaken to provide dense ground cover that excludes weeds. Revegetation checklists maintained monthly.
6.2 Monitor In-situ Roadside Threatened Flora	Every 6 months for the first two years and then yearly for 5 years.	Compliant - (Monitoring completed in Jan 2021)	Summary of roadside threatened plant monitoring was included in the 2022 annual EPBC Compliance Report Appendix 1.

Appendix 1 provided details of the results of the NH2U Year 5 (Operational phase) monitoring of Slender Marsdenia. Since the Year 3 report recommended cessation of monitoring of in-situ plants, no further evaluation of them is provided beyond that provided in the Year 4 report (Richards 2021), which showed that two of three performance indicators (PIs) had been met.

It should be noted, that all three PIs for Slender Marsdenia were met in Year 3, and the third PI was not met in Year 4. This fluctuation in survival and condition in Slender Marsdenia is discussed in more detail in the NH2U Year 5 Report (Appendix 1).

[Note- Mr Richards is a recognised species expert for slender marsdenia (*Marsdenia longiloba*) in accordance with Section 5.3 of the Biodiversity Assessment Method 2020.]

Condition 7

The *person taking the action* must engage a *suitably qualified expert* to undertake pre-clearing fauna searches within all areas proposed for disturbance, including: hollow bearing trees, logs, existing culverts and bridges, no earlier than 48 hours prior to the removal of vegetation occurring in that area to ensure that the area is free of the *Koala* and *Spotted-tail Quoll*.

Action	Timing	Status	Compliance evidence
7.1 Engage suitably qualified expert	Prior to start of construction	Compliant	Sandpiper Ecological Surveys engaged by contractor in accordance with SWTC Appendix 5.
7.2 Pre-clearing fauna searches identified as activity in fauna management plan (or equivalent)	Prior to start of construction	Compliant	BEM Ecological Monitoring Program
7.3 Undertake pre-clearing fauna searches as required	Prior to start of construction in specified areas	Compliant	Environmental surveillance checklist.

Sections 2.1 and 3.2 of the ecological monitoring program prepared by BEM and the approved CEMP addresses undertaking pre-clearing fauna searches and fauna relocation.

Section 5 of the ecological monitoring program prepared by BEM addresses reporting.

Condition 8

The *person taking the action* must implement measures to relocate and/or ensure the appropriate care of individuals of *EPBC species* that are identified during searches referred to in condition 7.

Action	Timing	Status	Compliance evidence
8.1 Provide for appropriate fauna relocation measures in CEMP documentation	Prior to construction	Compliant	Fauna rescue procedure contained with the FFMP. A specific koala relocation strategy has been prepared and forms an attachment to the Clearing and Grubbing Environmental Work Method Statement.
8.2 Relocate affected fauna as per procedures in ecological monitoring program	As part of pre-clearing activities	Compliant	Environmental surveillance checklist.

Note:

CEMP contains fauna rescue procedure and a specific koala relocation strategy was developed by SES in consultation with NSW EPA Senior Threatened Species Officer.

No EPBC fauna was relocated or EPBC threatened flora observed during the reporting period.

Condition 9

Prior to *commencement of the action* the person taking the action must engage a *suitably qualified expert* to collect baseline data on *local populations* of the *Koala* and *Spotted-tail Quoll*. The data must address the likely densities and distribution of these species within all habitat *adjacent to the construction* footprint that are likely to contain these species and that are likely to be adversely impacted by *the action* (as determined by a *suitably qualified expert*).

Action	Timing	Status	Compliance evidence
9.1 Engage suitably qualified expert	Prior to start of construction	Compliant	TfNSW engagement of BEM.
9.2 Review existing baseline data and assess adequacy with regard to specified matters for management of impacts on identified fauna species	Prior to completion of clearing.	Compliant	Short report or equivalent documenting review outcomes and any identified information gaps
9.3 Where substantive information gaps are identified, develop strategy to obtain required information	Prior to construction activity in adjacent to areas containing potential habitat for either of the two species	Compliant	Short report or equivalent documenting methodology used for monitoring, results of monitoring and compiling the new results with existing information.

Note:

BEM provided the report in August 2014 that consolidates actions 9.2 and 9.3. The report concluded that the local koala population in the vicinity of the Project corridor is of low density. Consequently, the available information is insufficient to determine an accurate estimate of the koala population. However, assuming there is a low density of koalas in the locality, the Project corridor appears to traverse only a small number of home ranges of individual koalas. The project design incorporates a combination of fauna exclusion fencing and fauna underpass structures within 500 metres of each sample site where koala activity was recorded. The Project is expected to have minimal impact on the viability of the local koala population by preventing direct mortalities during vegetation clearing and operation and by maintaining opportunities for safe koala movement across the Project corridor once operational.

In reference to Spotted Tail Quolls, no quolls were identified during the study. This is not definitive evidence that the species does not occur in the study area. Whether there is a resident population is uncertain but the distribution of records and presence of recent (2010) records are sufficient to conclude that quolls utilise the study area. Quolls are predicted to occur at low densities and with heightened awareness records may be obtained during construction or in the operational phase. Given the predicted occurrence of quolls the implementation of specific measures, such as underpasses and fauna fencing is warranted to enable quolls to effectively cross the upgraded highway.

Koala surveys completed by OEH (Jon Turbill) for Bellingen and Nambucca Shire Councils were also used to assess the need for fauna fencing. Following a meeting onsite, further fauna fencing was specified for the south of Oyster Creek. This followed Kola sightings to the immediate east of Oyster Creek during OEH monitoring. This fencing has been installed.

Condition 10

The person taking the action must construct and maintain fauna crossings and fencing in areas that are likely to benefit the Koala and Spotted-tail Quoll.

Action	Timing	Status	Compliance evidence
10.1 Provide for fauna crossings and fencing in detailed design	During design	Compliant	Final design showing required fauna crossings and fencing.
10.2 Construct fauna crossings and fencing	Construction	Compliant	As provided in previous Annual Compliance reports
10.3 Undertake regular maintenance of fauna crossings and fencing	Post-construction	Compliant	Annual reporting and/or maintenance inspection reports.

Note:

Construction of the permanent fauna fencing commenced in June 2015.

All combined /dedicated fauna crossing have been completed and installation of the vertical and horizontal refuge poles that offer connection from the mitigation structures to the adjacent native vegetation. A total of 22 combined and 4 incidental crossing have been constructed on the project

The project scope has increased to include approximately 4km of additional permanent fauna fencing to be installed around the Waterfall Way intersection. The fencing will start at the Shortcut/South arm intersection and work its way to the northern most extent of the project. This followed the Koala road kill recorded in August 2014 immediately south of the existing Waterfall Way Interchange. This work was completed in the first half of 2016.

Fauna Fencing was completed in August of 2016.

Ongoing review and maintenance as required of the fauna fence and crossings continues during the operational phase.

Following a Spotted Tailed quoll strike in May 2021, TfNSW completed (September 2021) an extension of the floppy top fauna fence from approximate Chainage 80950 to tie into Short Cut Rd overpass bridge abutments on both the west and eastern side of the alignment. This was an extension of approximately 550 m on both sides of the NH2U alignment, and a total of approximately 1100m of additional fauna fence. This extension of the floppy top fauna fence has effectively created a 'closed' fauna fencing system of approximately 5km in this section of the NH2U project, from the northern Raleigh interchange south to the Kalang River Bridge

Condition 11

The *person taking the action* must engage a *suitably qualified expert* to advise on the design and location of *fauna crossings*, fencing and road medians, for the purpose of maintaining habitat connectivity and facilitating the safe passage of the *Koala* and *Spotted-tail Quoll* across the Pacific Highway.

A *suitably qualified expert* must also be engaged to design a comprehensive monitoring program that tests the *long term success* of these measures.

Action	Timing	Status	Compliance evidence
11.1 Design development in consultation with NSW EPA Biodiversity Specialist	During design	Compliant	Environmental Design Fauna Crossing Refinements report approved by NSW DP&I.
11.2 Engage suitably qualified expert to design monitoring program	Prior to start of construction	Compliant	TfNSW engagement of BEM
11.3 Prepare monitoring program	Prior to start of construction	Compliant	BEM Ecological Monitoring Program

Note:

Monitoring addressed via Section 3.5 of BEM ecological monitoring program.

The Before-After Control Versus Impact (BACI) design of the monitoring program requires the monitoring of the fauna crossings prior to the installation of the fauna fence (i.e. before the underpass structures become operational).

The first stage of the construction phase underpass monitoring was conducted in October and November 2014. The second stage was undertaken in February and March 2015.

Condition 12

To inform the *long term success of fauna crossings*, fencing and road medians the *person taking the action* must engage a *suitably qualified expert* to prepare a strategy for monitoring and recording any road kill sightings of the *Koala* and *Spotted-tail Quoll* along the *Pacific Highway*. Prior to *commencement of the action*, the road kill monitoring and recording strategy must be implemented.

Action	Timing	Status	Compliance evidence
12.1 Ecological Monitoring Program to include road kill monitoring and recording strategy	Prior to start of construction	Compliant	Section 3.5.3 of the Ecological Monitoring Program specifies road mortality monitoring and recording strategy
12.2 Implement strategy	Prior to start of construction and ongoing during construction	Compliant	Environmental surveillance checklist developed
12.3 Report on outcomes of monitoring strategy	Construction Post-construction	Compliant	Reporting of monitoring - Appendix 1 of this Annual Compliance Report includes outcomes of roadkill monitoring.

No recorded road kill of Koala or Spotted-tail Quoll occurred during the reporting period.

Condition 13

One year following the *completion of construction works*, the *person taking the action* must provide a report to *the Minister* detailing the success and/or failings of *fauna crossings*, fencing and road medians in achieving their intended purpose. The report must address (but need not be limited to):

- a) baseline data collected as a requirement of conditions 9 and 12;
- b) the number, design and location of fauna crossings, fencing and road medians, accompanied by maps and photographs;
- c) details of a monitoring program to determine the long-term success of fauna crossings, fencing and road medians (including timing, duration, methodology, and performance objectives);
- d) the success of fauna crossings to date; and
- e) a comparison of data / results from other projects involving upgrades to the Pacific Highway regarding the long-term success of fauna crossings and/or fencing;

The report must be updated on a three-yearly basis until the *long term success of fauna crossings* has been proven or *the Minister* has agreed in writing that further revisions are no longer required. All updated reports must be provided to *the Minister* within three years of the last report having being submitted.

Action	Timing	Status	Compliance evidence
13.1 Provide fauna crossings, fencing and road medians outcomes report to Dept of the Environment	February 2019	Compliant	Transmittal form (and any confirmation of receipt)
13.2 Provide updated fauna crossings, fencing and road medians outcomes report to Dept of the Environment	February 2022	Compliant	Transmittal form (and any confirmation of receipt). The Operational Phase Biodiversity Monitoring Report 2021 is available in Appendix 2 of the 2022 EPBC Compliance Report.
13.3 Provide updated fauna crossings, fencing and road medians outcomes report to Dept of the Environment	February 2024	Compliant	The Operational Phase Biodiversity Monitoring Report Year 7 2023 is available in Appendix 1 of this EPBC Compliance Report.

Condition 14

Should monitoring associated with conditions 11 to 13 demonstrate that the use of *fauna crossings* and/or fencing is not achieving its intended purpose or is having a detrimental effect upon *EPBC species* (as determined by *the Minister*), *the Minister* may request that the *person taking the action* implement alternative forms of mitigation and/or corrective actions to address the relevant impacts to *EPBC species*. Such measures must be implemented as requested.

Action	Timing	Status	Compliance evidence
14.1 Implement additional mitigation/corrective actions	As and when directed by the Minister	TBA	As directed by the Minister

No recorded road kill of Koala or Spotted-tail Quoll occurred during the reporting period.

Condition 15

The person taking the action must implement a salvage and translocation program for all individuals of *Clear Milkvine* and *Cryptic Forest Twiner* that are proposed to be cleared as a result of the action. Translocation procedures must be developed and implemented by a suitably qualified expert in accordance with *Guidelines for the Translocation of Threatened Plants in Australia* prepared by the Australian Network for Plant Conservation.

Action	Timing	Status	Compliance evidence
15.1 Engage suitably qualified expert	Prior to construction	Compliant	Engagement of Ecos to prepare Threatened Flora Management Plan.
15.2 Develop translocation procedures	Prior to construction	Compliant	Ecos TFMP developed in consultation with NSW EPA Biodiversity Specialist and approved by NSW DP&I.
15.3 Implement translocation procedures	During construction	Compliant	Annual reporting. First report completed January 2015. Second report completed January 2016, third report completed 2017, and fourth report completed 2018, fifth report 2019, sixth report 2020, and seventh report 2021.

Notes:

These two species are referenced in Section 2.7 (*Establishment of translocation areas*) of the BEM ecological monitoring program by their scientific names, ie *Marsdenia longiloba* (Clear Milkvine), and *Tylophora woolfsii* (Cryptic Forest Twiner).

A Threatened Flora Translocation Program was developed by Ecos in consultation with the NSW Biodiversity Specialist and approved by the NSW DP&I. The program includes a salvage and translocation program for all individuals of *Clear Milkvine* and *Cryptic Forest Twiner* that are proposed to be cleared and the program is considered to meet the requirements of Condition 15.

Condition 16

One year following the *completion of construction works*, the person taking the action must provide a report to *the Minister* detailing the long term success of the translocation program. The report must include, but need not be limited to:

- a) background information on translocated species (in relation to ecological requirements and life history);
- b) the scope of the translocation program (with respect to timing, duration, methodology, and objectives, as well as comprehensive details on the recipient translocation site(s) and how they meet the ecological requirements of each species);
- c) details of a comprehensive monitoring program to determine the long-term success of translocation; and
- d) the success of translocation to date.

Action	Timing	Status	Compliance evidence
16.1 Prepare translocation outcomes report addressing specified matters and other relevant matters	2019	Compliant	Feb 2019 EPBC annual compliance tracking report
16.2 Provide translocation outcomes report to Dept of the Environment	Feb 2019	Compliant	Transmittal form (and any confirmation of receipt) - Feb 2019 EPBC annual compliance tracking report

Condition 17

The report must be updated on a three-yearly basis to provide further insights on the *long-term success* of translocation. All reports must be provided to *the Minister* and made available on the *person taking the action's* website for the life of this approval or until *the Minister* has agreed in writing that further revisions are no longer required.

Action	Timing	Status	Compliance evidence
17.1 Update translocation outcomes report and provide to Dept of the Environment	February 2022	Complaint Final Monitoring and Report Submitted	Completed report Transmittal form (and any confirmation of receipt). (Appendix 1 Threatened Flora Monitoring Report 2021)

In accordance with the approved Threatened Flora Management Plan, the following performance indicators (PIs) are used to evaluate the threatened species translocations (salvage translocation and population enhancement):

- a) All directly impacted individuals of threatened species were salvaged and relocated to the receival sites.
- b) At least 60% of transplant and enhancement individuals are surviving after the first year, 50% after five years and 40% after eight years.
- c) At the end of the monitoring program (8 years), at least 50% of surviving individuals have a Condition Class of 3 or higher.

Slender Marsdenia

- a) All directly impacted Slender Marsdenia were salvaged and relocated to the receival sites.
- b) After eight years of monitoring, the mean survival rate (i.e. Condition Class 2 or better) of all Slender Marsdenia plants stands at **45.1%**, which exceeds the Performance Indicator for Year 8. The actual percentage of surviving plants is likely to be much higher, as many plants that currently lack an aerial stem (i.e. are currently in Condition Class 1) would still be alive and may resprout in the future. Many years of field observations of wild and translocated Slender Marsdenia plants by the author strongly indicates that this is a natural part of the life history of this species. As noted in the NH2U Year 4 report (Richards 2021) successful achievement of the PIs for this species is as dependent on climatic factors as much as anything else. A wet, mild 'La Niña' weather pattern arrived in October 2021 following a very dry 4-month period. It would be expected that more plants will produce aerial shoots, and be in better overall condition, should such a weather pattern persist.
- c) Probably for the above reasons, only the third Performance Indicator for Slender Marsdenia has not been met. Currently, 83 plants (**28%**) are in Condition Class 3 or greater. Despite this third PI not being met, the species expert (Peter Richards) considers that the translocation program for Slender Marsdenia has been successful, and there is a very high likelihood that the translocated population will persist into the future. The translocated Slender Marsdenia population is not exhibiting a trend of

continual reduction in plant numbers. Surviving plants appear to be established and would be expected to exhibit annual change in apparent health, depending upon prevailing climatic conditions. The third PI is problematic with regard to a plant such as Slender Marsdenia which can sporadically die back to its subterranean rhizome and not produce an aerial stem for more than 4 years (Richards 2019).

[Note- Mr Richards is a recognised species expert for slender marsdenia (*Marsdenia longiloba*) in accordance with Section 5.3 of the Biodiversity Assessment Method 2020.]

Condition 18

With reference to the *department's offset policy*, the *person taking the action* must provide for *the Minister's approval* a threatened flora offset strategy for the *Clear Milkvine* and *Cryptic Forest Twiner*, within 12 months of the date of this approval. *The Minister* will only approve the Threatened Flora Offset Strategy (TFOS), if it demonstrates how a threatened flora offset meeting no less than 90 % of the direct offset requirements (as determined *by the department* in accordance with the offset user guide) will be legally secured in perpetuity within two years of the date of this approval.

Note: At the time the offset required by condition 18 is submitted for approval, the person taking *the action* may ask the Minister to consider that the salvage and translocation program required by condition 15, meets 10% of the offset requirements for the *Clear Milkvine* and *Cryptic Forest Twiner*.

Action	Timing	Status	Compliance evidence
18.1 Prepare TFOS in accordance with Dept of the Environment offset policy and addressing specified matters	By 26 Nov 2014	Compliant	Completed TFOS
18.2 Submit TFOS to Dept of the Environment for approval	By 26 Nov 2014	Compliant Final Report approved by DoE 19/07/2016	Transmittal form (and any confirmation of receipt)

Action 18.1:

Tender assessment – (Complete)
 Draft for TfNSW review expected (Complete)
 TfNSW review (Complete)
 Final of the TFOS (Complete)

Action 18.2:

Submitted to DoE for approval 21/11/2014
 Comments received from DoE 02/09/2015
 Amended report provided to DoE 02/10/2015
 Variation letter submitted to DoE on 20/11/2015 to request the removal of a timeframe to secure the offset property in perpetuity and tie that in with the approval of the TFOMP.
 Comments received from DoE 30/11/2015
 TFOS was resubmitted in 2/6/2016
 The TFOS was approved by DoE on 19/07/2016 and was published on the projects website.

Condition 19

The *person taking the action* must provide a plan for the management and delivery of the offset requirements of the threatened flora offset to *the Minister* for approval no later than 30 June 2015. The Threatened Flora Offset Management Plan (TFOMP) must include, but need not be limited to:

- a) map(s) and shapefiles that clearly define the location and boundaries of the offset;
- b) details on the quality of the offset;
- c) information about Clear Milkvine and Cryptic Forest Twiner (in relation to ecology, biology and conservation status) to inform appropriate management actions;
- d) performance objectives and management actions that will enable maintenance and enhancement of Clear Milkvine and Cryptic Forest Twiner the offset and habitat covered by the plan;
- e) demonstration that any management actions to be undertaken will not adversely impact EPBC species (for example, this may apply to herbicide usage);
- f) a description of funding arrangements or agreements including work programs and responsible entities;
- g) an assessment of the baseline population and distribution for Clear Milkvine and Cryptic Forest Twiner within the offset, including:
 - (i) the number of plants protected and their location;
 - (ii) plant and habitat condition; and
 - (iii) age classes.
- h) measures for regular monitoring of the status of individuals of Clear Milkvine and Cryptic Forest Twiner and their habitat as measured against the baseline population and distribution, including:
 - (i) fluctuations in population size and distribution;
 - (ii) life cycle patterns
 - (iii) habitat requirements; and
 - (iv) response to disturbances and/or management actions.
- i) Provision to revise the approved threatened flora offset management plan in response to the findings of research associated with condition 20(h).
- j) The approved TFOMP must be implemented within seven days of its approval.

Action	Timing	Status	Compliance evidence
19.1 Prepare TFOMP addressing specified matters and other relevant matters	By 30 Jun 2015	Compliant	Completed TFOMP

19.2	Provide TFOMP to Dept of the Environment for approval	By 30 Jun 2015	Compliant (revised document was resubmitted to DoE on 7/11/2016) Plan approved 4/7/2017	Transmittal form (and any confirmation of receipt)
19.3	Implement TFOMP	Within 7 days of Minister's approval	Compliant	Annual reporting Gazettal of Yuraarla Flora Reserve on 15 April 2020.

Action 19.1:

GHD engaged and property surveys completed

An area within Boambee State Forrest has been identified and TfNSW are currently negotiating with State Forests regarding protection of this area in perpetuity as a Flora Reserve.

TfNSW wrote to DoE on 30/06/2015 requesting urgent consideration of the TFOS and seeking an extension of time to submit the TFOMP by 3 months, until 30/09/2015.

Action 19.2

TFOMP was submitted to DoE on the 02/10/2015 for approval.

Comments received from DoE on 30/11/2015.

The revised document was resubmitted to DoE on 7/11/2016.

TFOMP approved by DoE on 4 July 2017

Action 19.3

- Boambee SF (FCNSW) – TfNSW has paid the compensation funding to FCNSW. The new Yuraarla Flora Reserve was gazetted on 15 April 2020 (NSW Government Gazette No. 107 of 29 May 2020). This was provided to Post Approvals via email on 29 June 2020.

Condition 20

Within three months from the date of this approval, the person taking the action must provide to the Minister, a strategy that details how, and when, the Norton Offset Site and Griffin Offset Site (as described in the referral documentation), will be legally secured in perpetuity by the person taking the action.

If the EPBC species habitat cleared as a result of the action is less than the impacts described in the referral documentation, then any surplus biodiversity offset areas included in the offset management plans referred to in condition 19 and condition 21 could be secured as biodiversity offsets for other actions undertaken by the person taking the action and included in the offset strategies for those actions.

Action	Timing	Status	Compliance evidence
20.1 Prepare strategy to legally secure offset sites in perpetuity	By 26 Feb 2014	Compliant	Both Norton and Griffin sites have been purchased by TfNSW.
20.2 Provide strategy to Dept of the Environment	By 26 Feb 2014	Compliant	Letter provided to DoEE on 11-2-2014

Condition 21

Within 12 months from the date of this approval, the *person taking the action* must provide to *the Minister* for approval, a plan for the management of the Norton Offset Site and Griffin Offset Site. The Norton and Griffin Offset Management Plan (NGOMP) must be targeted to the ecological requirements of the *Koala, Grey-headed Flying-fox, Spotted-tail Quoll, Regent honey eater* and *Swift Parrot* and build upon the ideas and concepts described in the *referral*. The plan must include, but need not be limited to:

- a) map(s) and shapefiles that clearly define the location and boundaries of the offset sites;
- b) details on the quality of the offset with reference to all EPBC species this plan is intended to protect;
- c) information about the Koala, Grey-headed Flying-fox, Spotted-tail Quoll, Regent honey eater and Swift Parrot (in relation to ecology, biology and conservation status) to inform appropriate management actions;
- d) the results of targeted field surveys within both offset sites (undertaken at any ecologically appropriate time of the year) to assess habitat suitability and presence / absence of individuals in relation to the Koala, Grey-headed Flying-fox, Spotted-tail Quoll, Regent honey eater and Swift Parrot;
- e) clear performance objectives and management actions that will enable maintenance and enhancement of habitat within the offset area, as well as contribute to the better protection of individuals and/or populations of EPBC species onsite;
- f) an assessment of the baseline population for EPBC species which are detected within the offset area during field surveys;
- g) demonstration that any management actions to be undertaken will not adversely impact EPBC species (for example, this may apply to pest control);
- h) a description of funding arrangements or agreements including work programs and responsible entities;
- i) details of a comprehensive long term monitoring program for determining the effectiveness of management actions;
- j) commitments to undertake contingency measures and corrective actions in the event that performance objectives are not met; and
- k) anticipated timeframes for achieving performance objectives.
- l) The approved Norton and Griffin offset management plan must be implemented within seven days of its approval.

Action	Timing	Status	Compliance evidence
21.1 Prepare NGOMP addressing specified matters and other relevant matters	By 26 Nov 2014	Compliant	Completed NGOMP

21.2	Provide NGOMP to Dept of the Environment	By 26 Nov 2014	Compliant - submitted to DoE on the 11/12/14 Re-submitted on the 23/12/16 Plan Approved 5/7/2017	Transmittal form (and any confirmation of receipt)
21.3	Implement NGOMP	Within 7 days of Minister's approval	Compliant	Annual update / reporting Execution of BioBanking Agreements. Retirement of ecosystem credits.

Note:

It is assumed that satisfactory documentary evidence of implementation of the NGOMP would be provided through annual reporting.

Action 21.1:

Prepare brief for tender (Complete)

Tender assessment (Complete);

Draft for TfNSW review (Complete);

TfNSW review (Complete)

Action 21.2:

Final - (Complete)

Submitted to DoE for approval on the 11/12/14.

Comments received from DoE on February 2016

NGOMP re-submitted for approval on 23 December 2016.

NGOMP approved by DoE on 5 July 2017

Action 21.3:

- Norton (TfNSW) and Swain (private) – BioBanking Agreements have been executed by OEH and registered on title. The Swain BBA became active in February 2019, after TfNSW purchased the ecosystem credits. The ecosystem credits for Swain were retired by TfNSW on 2 September 2021. Norton became active in late February 2021 after being on-sold. TfNSW retired the required ecosystem credits from the Norton offset property on 2 September 2021.
- Griffin (TfNSW) – TfNSW transferred the land title and associated management funding to NPWS in late 2021. NPWS confirmed receipt of the site and management funding on 27 September 2022. On 23 February 2024, NPWS confirmed the site is 'awaiting gazettal'.

Condition 22

Within one month after the commencement of *the action*, the *person taking the action* must advise *the Department* in writing of the actual date of commencement.

Action	Timing	Status	Compliance evidence
22.1 Provide written advice to Dept of the Environment of actual date of commencement	4 Jan 2014	Compliant	Signed copy of letter on TfNSW letterhead. Provided to DoEE on 4-1-2014.

Condition 24

Within three months of every one year anniversary of the commencement of the action, the person taking the action must publish a report on their website addressing compliance with each of the conditions of this approval, including implementation of any management plans as specified in the conditions. Documentary evidence providing proof of the date of publication and noncompliance with any of the conditions of this approval must be provided to the Department at the same time as the compliance report is published.

Action	Timing	Status	Compliance evidence
24.1 Prepare compliance report and upload to project website	By 4 Mar 2015	Compliant	Report uploaded to project website. Advice provided to Dept on date of publication and any non-compliances.
24.2 Prepare compliance report and upload to project website	By 4 Mar 2016	Compliant	Report uploaded to project website. Advice provided to Dept on date of publication and any non-compliances.
24.3 Prepare compliance report and upload to project website	By 4 Mar 2017	Compliant	Report uploaded to project website. Advice provided to Dept on date of publication and any non-compliances.
24.4 Prepare compliance report and upload to project website	By 4 Mar 2018	Compliant	Report uploaded to project website. Advice provided to Dept on date of publication and any non-compliances.
24.5 Prepare compliance report and upload to project website	By 4 Mar 2019	Compliant	Report uploaded to project website. Advice provided to Dept on date of publication and any non-compliances.
24.5 Prepare compliance report and upload to project website	By 4 Mar 2020	Compliant	Report uploaded to project website. Advice provided to Dept on date of publication and any non-compliances.
24.5 Prepare compliance report and upload to project website	By 4 Mar 2021	Compliant	Report uploaded to project website. Advice provided to Dept on date of publication and any non-compliances.

24.5	Prepare compliance report and upload to project website	By 4 Mar 2022	Compliant	Report uploaded to project website. Advice provided to Dept on date of publication and any non-compliances.
24.5	Prepare compliance report and upload to project website	By 4 Mar 2023	Compliant	This Report uploaded to project website. Advice provided to Dept on date of publication and any non-compliances.
24.5	Prepare compliance report and upload to project website	By 4 Mar 2024	Compliant	This Report uploaded to project website. Advice provided to Dept on date of publication and any non-compliances.

Condition 25

Upon the direction of the Minister, the person taking the action must ensure that an independent audit of compliance with the conditions of approval is conducted and a report submitted to the Minister. The independent auditor must be approved by the Minister prior to the commencement of the audit. Audit criteria must be agreed to by the Minister and the audit report must address the criteria to the satisfaction of the Minister.

Action	Timing	Status	Compliance evidence
25.1 Identify potentially suitable auditor(s)	On direction of the Minister	TBA	Tenderer(s) proposal(s) documenting expertise
25.2 Provide auditor's details to Dept of the Environment for approval	On direction of the Minister	TBA	Transmittal form (and any confirmation of receipt)
25.3 Auditor to develop audit criteria	Following receipt of Minister's approval	TBA	Completed audit criteria
25.4 Provide audit criteria to Dept of the Environment for approval	Following receipt of Minister's approval	TBA	Transmittal form (and any confirmation of receipt)
25.5 Conduct audit and document findings	Following receipt of Minister's approval	TBA	Completed audit report
25.6 Provide audit report to Dept of the Environment	At completion of audit	TBA	Transmittal form (and any confirmation of receipt)

No independent audit of compliance has been requested from *the Minister* to date.

Condition 26

If the person taking the action wishes to carry out any activity otherwise than in accordance with the TFOS, TFOMP, or NGOMP as specified in these conditions, the person taking the action must submit to the Department for the Minister's written approval a revised version of that TFOS, TFOMP, or NGOMP. The varied activity shall not commence until the Minister has approved the varied TFOS, TFOMP, or NGOMP in writing. The Minister will not approve a varied TFOS, TFOMP, or NGOMP unless the revised TFOS, TFOMP, or NGOMP will result in an equivalent or improved environmental outcome over time. If the Minister approves the TFOS, TFOMP, or NGOMP then that TFOS, TFOMP, or NGOMP must be implemented in place of the TFOS, TFOMP, or NGOMP originally approved.

Action	Timing	Status	Compliance evidence
26.1 Assess potential departure(s) from TFOS, TFOMP and/or NGOMP as relevant	As required	TBA	Consistency assessment
26.2 Revise TFOS, TFOMP and/or NGOMP as relevant	As required	TBA	Revised TFOS, TFOMP and/or NGOMP as relevant
26.3 Provide revised TFOS, TFOMP and/or NGOMP as relevant to Minister for approval	As required	TBA	Transmittal form (and any confirmation of receipt)
26.4 Implement revised TFOS, TFOMP and/or NGOMP as relevant in accordance with the Minister's written approval	Prior to any action that would not be consistent with the original approval or subsequent modified approval(s)	TBA	Annual reporting

Condition 27

If the Minister believes that it is necessary or convenient for the better protection of listed threatened species and communities to do so, the Minister may request that the person taking the action make specified revisions to TFOS, TFOMP, or NGOMP specified in these conditions and submit the varied TFOS, TFOMP, or NGOMP for the Minister’s written approval. The person taking the action must comply with any such request. The revised approved TFOS, TFOMP, or NGOMP must be implemented. Unless the Minister has approved the TFOS, TFOMP, or NGOMP, then the person taking the action must continue to implement the TFOS, TFOMP, or NGOMP originally approved, as specified in these conditions.

Action	Timing	Status	Compliance evidence
27.1 Revise TFOS, TFOMP and/or NGOMP as relevant as per directed by the Minister	As directed by the Minister	TBA	Completed revised TFOS, TFOMP and/or NGOMP as relevant
27.2 Provide revised TFOS, TFOMP and/or NGOMP as relevant to Dept of the Environment for approval	As directed by the Minister	TBA	Transmittal form (and any confirmation of receipt)
27.3 Implement revised TFOS, TFOMP and/or NGOMP as relevant in accordance with Minister’s written approval	As directed by the Minister	TBA	Annual reporting

Condition 28

If, at any time after five years from the date of this approval, the person taking the action has not substantially commenced the action, then the person taking the action must not substantially commence the action without the written agreement of the Minister.

Action	Timing	Status	Compliance evidence
28.1 Obtain written agreement of the Minister to substantially commence the project	As required after 25 Nov 2018	Compliant	Minister's written agreement. Action substantially commenced on the 4 December 2013

Condition 29

Unless otherwise agreed to in writing by the Minister, the person taking the action must publish all management plans and reports referred to in these conditions of approval on their website. Each management plan or report must be published on the website within 1 month of being approved, or where approval is not required, on the same day as the report is provided to the Minister.

Note

Any plan, strategy or report that has been prepared as a requirement of a state legislation approval (in relation to the action) may be used to satisfy the requirements of any of the above conditions, providing the relevant criteria have been met (as specified in these conditions). Where the option is employed, the plan, strategy or report must be accompanied by a standalone document detailing where each of the relevant criteria have been addressed within that plan, strategy or report. This note is particularly relevant to conditions 13, 16, 17, 19, 21 and 25.

Action	Timing	Status	Compliance evidence
29.1 Upload approved NGOMP to project website (21)	Within 1 month of the Minister's approval	Compliant	NGOMP uploaded to project website
29.2 Upload approved TFOMP to project website (19)	Within 1 month of the Minister's approval	Compliant	TFOMP uploaded to project website
29.3 Upload fauna crossings, fencing and road medians outcomes report to project website (13)	1 year following construction completion	Compliant	Report uploaded to project website
29.4 Upload translocation outcomes report to project website (16)	1 year following construction completion	Compliant	Report uploaded to project website
29.5 Upload updated fauna crossings, fencing and road medians outcomes report to project website (13)	Every 3 year following 29.3 report as above	Compliant	2023/24 Report uploaded to project website and included in the 2023 Report as Appendix 1.
29.6 Upload updated translocation outcomes report to project website (17)	Every 3 year following 29.4 report as above	Compliant	2021/22 Report uploaded to project website and included in the 2022 Report as Appendix 1.

Appendix 1 – NH2U Underpass, adjacent habitat and roadkill monitoring, Year Seven (2023)



Transport
**Roads & Maritime
Services**

Nambucca Heads to Urunga (NH2U)

Annual Monitoring Report- Operational Phase, Year
Seven (2023)

Transport for New South Wales | February 2024



Pacific Highway upgrade: Nambucca Heads to Urunga (NH2U)

Underpass and adjacent habitat
monitoring – operational phase year
seven (2023)



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Date	Version	Status	Sent to	Represent	Delivered Format	Dispatched By
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Report prepared for:

Transport for New South Wales



Cover Photo: Koala making a complete crossing heading west at Access G underpass during spring year 7 monitoring.

Disclaimer: This report has been prepared in accordance with the scope of services described in the contract or agreement between Sandpiper Ecological Surveys (ABN 82 084 096 828) and TfNSW. The report relies upon data, surveys and measurement obtained at the times and locations specified herein. The report has been prepared solely for use by TfNSW and Sandpiper Ecological Surveys accepts no responsibility for its use by other parties. Sandpiper Ecological Surveys accepts no responsibility or liability for changes in context, meaning, conclusions or omissions caused by cutting, pasting or editing the report.

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1. Introduction

Transport for NSW (TfNSW), in conjunction with Lendlease Engineering (LLE) commenced the upgrade of the Pacific Highway between Nambucca Heads and Urunga in 2013. The Nambucca Heads to Urunga (NH2U) upgrade is located on the mid-north coast of New South Wales and covers a 22-kilometre section of highway stretching from Link Road at Nambucca Heads to Waterfall Way, north of Urunga (Figure 1). The project was opened to traffic in July 2016 and construction was completed in February 2018.

The Minister for Planning approved the NH2U upgrade under Part 3A (now repealed), Section 75J of the *Environmental Planning and Assessment Act 1979* (EP&A Act) on 19 July 2011 subject to the Minister's Conditions of Approval (CoA) being met. The project was granted approval under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) on 21 November 2013. As part of the obligations under the Minister's CoA B10, an Ecological Monitoring Program (EMP) was to be produced and implemented. Transport for NSW engaged Benchmark Environmental Management to prepare the EMP and in June 2013 the plan was finalised (Benchmark 2013). The EMP and threatened species management strategies outline the detailed monitoring requirements to satisfy the Minister's CoA.

The EMP specified that the following mitigation measures be monitored during construction and operation:

- Pre-clearing and clearing procedure;
- Fauna underpass structures and exclusion fencing;
- Widened vegetated medians;
- Nest box installation;
- Landscape rehabilitation;
- Protection of in-situ flora populations; and
- Establishment of translocation areas.

1.1 Scope

As outlined in the project EMP (Benchmark 2013), operational phase biodiversity monitoring intends to investigate the effectiveness of habitat connectivity mitigation measures (i.e., fauna underpasses, vegetated medians and exclusion fencing). A requirement of the EMP was construction phase (Year three) monitoring of underpasses, which was conducted in spring 2014 and autumn 2015 (Sandpiper Ecological 2015a). The construction phase monitoring established a baseline dataset of fauna recorded adjacent to the alignment and refined methods for underpass monitoring that have been adopted during the operational phase. It also provided an opportunity to monitor underpasses prior to installation of exclusion fence. In May 2017, Sandpiper Ecological Surveys (SES) was engaged to conduct biodiversity monitoring as part of the operational phase of the NH2U upgrade. Monitoring included assessing the effectiveness of the widened vegetated medians, fauna underpass structures and exclusion fencing which have been reported on in year two (2018), three (2019) and five (2021) of operational phase monitoring (Sandpiper Ecological 2019, 2020a, 2022). The following report discusses the results of year seven (2023) operational monitoring of fauna underpasses and exclusion fencing. Vegetated median monitoring was completed in year 5 (2021) as per the EMP requirements. The results are discussed in relation to the potential indicators of success detailed in the EMP (Benchmark 2013), and recommendations provided.

1.1.1 Fauna underpasses and exclusion fence monitoring

Underpasses and exclusion fence have been installed at NH2U “to maintain the viability of local populations of terrestrial fauna by facilitating wildlife movement between proximate areas of habitat either side of the Upgrade corridor” (Benchmark 2013). The EMP also stipulates that where possible underpass structures will be designed to accommodate use by threatened fauna species including the spotted-tailed quoll (*Dasyurus maculatus*), brush-tailed phascogale (*Phascogale tapoatafa*) and koala (*Phascolarctos cinereus*). To assess the effectiveness of exclusion fencing and underpass structures the EMP outlines potential indicators of success. These include:

- Low rates of use of fauna underpasses and adjacent habitats by feral predators;
- High levels of fauna underpass use by a wide variety of native fauna species;
- Evidence of use by dispersing individuals and different age cohorts;
- Use by cover-dependent species and species with low mobility; and
- Low incidence of fauna road strike mortality.

The monitoring program included seven fauna underpasses and one reference underpass (Table 1). The seven underpasses included six Reinforced Concrete Box Culverts (RCBCs) and one bridge over the railway line. The reference site was a series of RCBCs on the old Pacific Highway at McGrath’s Creek. In 2021, the railway bridge was replaced due to access restrictions imposed by the Australian Rail Track Corporation and a bridge structure further north (Martell’s bridge) was selected as a suitable replacement (Table 1, Figure 1). Monitored underpasses were named Tyson’s, Access G, Martell’s North, Martell’s South, Martell’s Bridge, Dalhousie, Burke’s, and McGrath’s (Figure 1, Table 1). All structures, apart from Burkes, were combined underpasses that provide the dual function of fauna passage and drainage. Burkes was a dedicated underpass. Dalhousie and Tyson’s underpasses consist of corresponding culverts (split) on either side of a vegetated median. Dual cells (culverts side by side) were present at the Tyson’s and Access G underpasses, with the remaining sites being single cell underpasses (Table 1). The McGraths reference site was a three-cell drainage culvert beneath the old Pacific Highway.

Floppy top fauna exclusion fence is connected to all monitored structures, except McGraths, and extends for most of the alignment. The purpose of exclusion fence camera monitoring was to determine which species move through the fence and compare species encountering the fence with those recorded in nearby underpasses.

Table 1: Location, type and size of monitored underpasses on the NH2U alignment. MOF = Moist open forest, DOF = Dry open forest, CI = Cleared land, SF = Swamp forest, R = Riparian forest. *Details to be confirmed.

Chainage & Habitat	Location	Type	Purpose	Culvert arrangement	Length	No. & Size (# x W x H)
68470 (SF/MOF/DOF)	Burke’s	RCBC	Dedicated	Single	72.4	1 x 3.6 x 2.4 4 x 3.6 x 1.2
73800 (R/DOF)	Dalhousie	RCBC	Combined	Split	36.5 (SB) 42 (NB)	1 x 2.4 x 2.4
Chainage (MOF)	Martell’s	Bridge	Combined	Single	*	*
75250 (MOF)	South Martell’s	RCBC	Combined	Single	67.4	1 x 3 x 3
75800 (MOF)	North Martell’s	RCBC	Combined	Single	75.7	1 x 3 x 3
78800 (MOF/CI)	Access G	RCBC	Combined	Dual	58.9	2 x 2.4 x 3.0
80220 (MOF)	Tyson’s	RCBC	Combined	Split/dual	27 (SB) 25 (NB)	2 x 3 x 2.1
Off site (MOF/R)	McGrath’s	RCBC	Combined	Dual	18	3 x 2.4 x 1.5

1.2 Study area

The NH2U project extends for 22km from Link Road, Nambucca Heads in the south to Waterfall Way, Urunga in the north. The single reference and seven impact sites monitored during 2023 were spaced along the NH2U Pacific Highway upgrade alignment between chainage 68470 (Burke's) and 80220 (Tyson's Flat) (Figure 1). The context of each impact site differed and included: vegetated median (Dalhousie & Tyson's); underpass with adjoining service roads (Burke's); combined structures situated within vegetated medians (Dalhousie and Tyson's) and a small bridge underpass (Martells bridge). The reference site at McGrath's Creek was located under the old Pacific Highway, 280m east of the alignment (Figure 1).



Figure 1: Location of underpass structures monitored during year seven operational monitoring at NH2U, 2023.

2. Methods

2.1 Survey timing and effort

Year seven operational monitoring was conducted in autumn and spring 2023. The autumn monitoring period extended from 21 March to 5 June and the spring period from 26 September to 22 November.

2.2 Adjacent habitat surveys

2.2.1 Baited camera traps

Scoutguard KG680V and bushnell cameras were deployed in habitat adjoining each underpass. One camera was installed on a tree on the east and west side of each underpass within 50m of the underpass entrance and orientated towards a bait station containing chicken and tuna oil (Plate 1). Four cameras (2/side) were installed at McGrath's Creek control site to detect fauna on both sides of the creek. Cameras were set to take a burst of three photos with a ten-second delay between activation. Cameras were installed at approximately 0.5m above ground and positioned 2.5m from a bait station. Cameras were deployed for four weeks during each sampling period (i.e. autumn and spring) and were operational during the period of underpass monitoring. For full details please see Appendix B, Table B1.

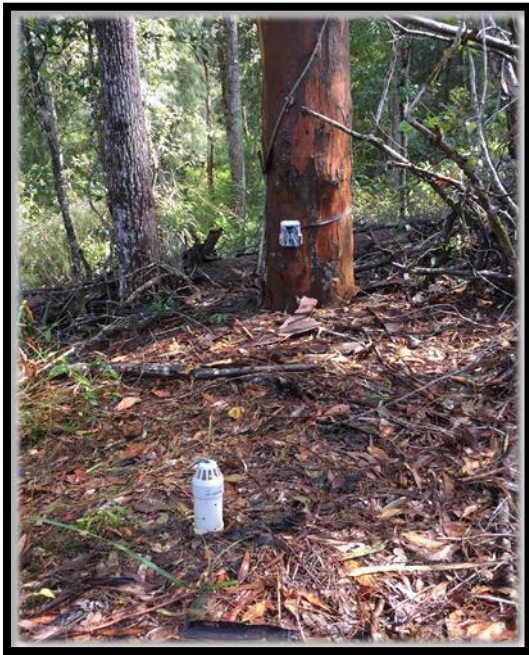


Plate 1: Adjacent habitat camera trap set up showing camera mounted on a tree directed at a bait station.

2.2.2 Diurnal and nocturnal active searches

Diurnal and nocturnal active searches were conducted within a one-hectare area of habitat adjoining each side of each underpass. Diurnal searches were focused on detecting herpetofauna (i.e. reptiles and frogs) and were generally conducted during late morning/early afternoon. Sampling involved ecologists searching for fauna

under logs, ground vegetation, leafy debris, decorticating bark, and hollow logs. Any animals observed or captured were identified to species level (if possible) and released at the point of capture.

Nocturnal surveys involved two ecologists spotlighting fence lines, the forest edge, tracks and sections of intact forest where applicable. Fauna were detected by sight, behaviour, call and identified to species or genus level. All fauna and signs of fauna, along with standard weather variables (i.e. wind, rain, relative humidity, cloud cover and air temperature) were recorded during diurnal and nocturnal searches. Each site was sampled twice during autumn and spring for a minimum of one person hour/sample. A total of 32 person-hours were spent conducting diurnal and nocturnal searches in each season. For full details please see Appendix B, Table B2 and B3.

2.3 Underpass monitoring

2.3.1 Camera monitoring

A combination of Reconyx HC 500 and Swift Enduro cameras were installed in underpasses to monitor fauna use. Reconyx cameras were set to take a series of three photos with no delay between activation and Swift Enduros recorded 10 seconds of video with no delay between activations. Each cell that supported fauna furniture had a Reconyx HC 500 installed centrally on the horizontal rail facing east and a Swift Enduro camera installed centrally on vertical fauna furniture post or culvert wall at approximately 300mm above floor level, facing east. A single Enduro camera was installed in cells without fauna furniture. All cameras were housed in security cases. At the McGraths Creek reference site, due to the higher likelihood of inundation, two Scoutguard KG680V cameras were installed on star pickets at the eastern entrance to the culvert facing the entrance (i.e. facing west). A total of 23 cameras were deployed during each monitoring event for a minimum duration of eight weeks, with batteries and SD cards checked and/or swapped after four weeks.

During the autumn monitoring phase, cameras were installed on 21 March and retrieved 77 days (11 weeks) later on the 5 June 2023. Of the 23 cameras across eight sites, 74% met the 8-week operational requirement, with 65.2% of cameras exceeding it. In spring, cameras were installed on the 25-26 September and retrieved from the 22-24 of November 2023, marking a deployment period ranging from 57 to 59 days. During spring 91% of fulfilled the operational requirement, with 43.5% exceeding the minimum active days. Camera effort during autumn was compromised was due to camera inundation (2 incidents), battery fatigue (2), SD card errors (2), and camera malfunctions (1). In the spring period, the reasons included and camera malfunction (2) (Table 2). For full details please see (Appendix B, Table B4).

Table 2: Camera effort for NH2U underpass monitoring in year seven, 2023. ^{CE}=card error, ^I= camera inundated, ^{*}= camera malfunction and ^B= battery fatigue.

Site	Location	No. days active (autumn)	No. days active (spring)	Total days active
Burkes	Gound	76	57	133
Burkes	Furniture	43 ^{CE}	57	100
Mcgraths	North	43 ^I	57	100
Mcgraths	South	42 ^B	29 [*]	71
Martell's South	Gound	76	57	133
Martell's South	Furniture	76	57	133
Martell's North	Gound	76	57	133
Martell's North	Furniture	76	0 [*]	76
Tyson's east	Ground	76	56	132

Site	Location	No. days active (autumn)	No. days active (spring)	Total days active
Tysons east	Furniture	76	56	132
Tysons east	Split ground	56	56	112
Tysons west	Ground	76	56	132
Tysons west	Furniture	76	56	132
Tysons west	Split ground	0 [*]	56	56
Access G	Ground	76	56	132
Access G	Furniture	0 ^{CE}	56	56
Access G	Split ground	76	56	132
Dalhousie east	Gound	76	59	135
Dalhousie east	Furniture	76	59	135
Dalhousie West	Gound	76	59	135
Dalhousie West	Furniture	76	59	135
Martells bridge	Ground	52 ^B	57	109
Martells Bridge	Ground	58 ^I	57	115

2.3.2 Sand pad monitoring

To complement camera monitoring, sand pads were installed in the center of each cell at each site. Sand pads were installed using a 1:1 mix of brickie’s sand and beach sand and smoothed out with a cement trowel at the start of monitoring and after each inspection (Plate 2). Pads were approximately 1m wide and 50mm deep. A small channel (200mm wide) was left in the center of pads in combined structures to allow for drainage. Sand pads were monitored for a minimum of four consecutive days during each monitoring period. The change in method from previous years (when pads were checked weekly) was to align sampling with the method used on the Warrell Creek to Nambucca Heads (WC2NH) project and reduce the loss of data from washouts.

During each inspection, pads were systematically scanned for prints with the aid of a hand-held torch if required. An ecologist with experience identifying fauna tracks inspected each pad. Tracks were identified to species, genus, or group and the number and direction of crossings recorded. Repeated washouts occurred at several sites in autumn, resulting in some data loss; however, cameras remained active during this period. For full details please see Appendix B, Table B5.



Plate 2: Sand pad installation at Tyson's underpass.

2.3.3 Scat and track searches

An ecologist searched each underpass for scats and tracks on three occasions during the autumn and spring sample periods. The search involved a slow systematic traverse of each culvert using a hand-held spotlight (Led Lenser P14). Fauna furniture, the culvert floor, and joints were targeted. Sand pads and areas of accumulated fine sediment were targeted for tracks. Tracks and scats were identified in situ, with reference to Triggs (2004) and the ecologist's experience or photographed and sent to colleagues for identification. For full details please see Appendix B, Table B6.

2.3.4 Frog survey

Frog surveys of underpasses were conducted when conditions were conducive to frog dispersal (i.e. after or during rainfall and when relative humidity exceeded 80%). Each survey involved a foot-based traverse of the underpass entrance and structure by two ecologists with spotlights for a period of approximately 20 person minutes. Weather variables and detected frogs were recorded on a standard proforma. For full details please see Appendix B, Table B7.

2.3.5 Hair funnels

Two hair funnels were installed on fauna furniture at sites containing fauna furniture (i.e. all sites except McGrath's). Funnels were baited with peanut butter, oats and honey and left in situ for a minimum of two weeks per monitoring event. Wafers were collected and sent to Scatsabout Hair Identification for analysis. For full details please see Appendix B, Table B8.

2.4 Exclusion fence monitoring

Fence cameras were installed at all sites except McGraths. The setup involved installation of a camera on each side of each culvert entrance (total of 28 cameras). Cameras were attached to a bracket fixed to a fence post at approximately 400mm above ground and orientated along the fence towards the underpass entrance (Plate

3). Distance from the culvert entrance ranged from 10m to 60m and depended on obtaining a reasonable line of sight. Ground vegetation was trimmed using pruning shears and a brushcutter at all sites in autumn to improve visibility and reduce the incidence of false triggers. A combination of scoutguard KG680V and swift 3c cameras were used at all sites. Cameras were scheduled to arm at 4pm and disarm at 9am. Cameras were set to take a series of three photos with a ten second delay between activation. See full details of exclusion fence monitoring in Appendix B, Table B9.



Plate 3: Typical exclusion fence camera set up. It shows a Scoutguard KG680V camera attached to a steel bracket fixed to a fence post.

2.5 Road-kill monitoring

Prior to the year five Autumn 2021 monitoring event the road mortality survey method was revised to ensure compliance with the updated TfNSW Traffic Control at Worksites Manual. The updated guidelines require vehicles to be parked 3 m from (& behind) a wire rope barrier, 11 m from the fog line if there is no wire rope barrier, and pedestrians to walk 3 m behind the wire rope. These distance restrictions could not be achieved using the former method which involved a foot-based traverse of a 500m section of alignment on both sides of the road around each underpass.

Road-kill surveys were conducted by a team consisting of a driver and an ecologist passenger who had experience identifying road-killed fauna. The surveys were conducted from a moving vehicle driven at a speed of 80-90km/hr in the left lane. The vehicle was equipped with an amber light (flashing) and a warning sign (Plate 1) to alert other drivers.

Surveys were conducted on two occasions during autumn and spring 2023. During each survey, the ecologist scanned the road surface and shoulder for any road-killed fauna. If any fauna was detected, the species or fauna group was recorded using the internal GPS of a smart device, and the waypoint was recorded in Australia Topo Maps android application.

Potential target species, that is spotted-tailed quoll, koala and brush-tailed phascogale were inspected more closely from a safe location. At the end of each survey, the data were uploaded as a CSV file from Australia Topo maps application and recorded into Microsoft Excel on a desktop computer for further analysis.

Broad size classes used to group fauna included:

- Small mammal – rodent, juvenile bandicoot
- Medium mammal – bandicoot, brushtail possum, ringtail possum, cat
- Large mammal – wallabies and kangaroos
- Small bird – noisy miner, honeyeaters
- Medium bird – magpies, pigeons, frogmouth, swamp hen, ducks
- Large bird – ibis, large forest owl, egret

The road-kill data was also divided into two categories. The first category includes species that exclusion fences do not stop, such as birds, small reptiles, frogs, small mammals, and flying-foxes. The second category includes species that would be blocked by an effective exclusion fence from accessing the alignment. These species are:

- Macropods
- Bandicoots
- Possums
- Canids
- Felines
- Leporidae (rabbits and hares)
- Freshwater turtles
- Goannas

Freshwater turtles are in the second category as well-designed exclusion fence with a ground return should stop individuals accessing the alignment. Juvenile lace monitors can go through fences, however they are rarely recorded making long ground movements and therefore have been included as a species likely to be blocked by exclusion fence. For full details please see Appendix B, Table B10.



Plate 4: Work vehicle with signage, flashing amber light and indicators

2.6 Habitat Assessment

A habitat assessment was conducted on both sides of each underpass site. Assessments involved one ecologist recording habitat type, dominant canopy, mid-story, and groundcover species. For full details please see Appendix B, Table B11.

2.7 Image review and analysis

All underpass, adjacent habitat and exclusion fence camera images were uploaded to a computer and viewed using Windows Photo Viewer©. An ecologist reviewed all images with reference to standard field guides (i.e. Menkhorst & Knight 2003; Pizzey & Knight 2007). Input from multiple ecologists was sought to identify some images. For full details of fauna detected in underpasses please see Appendix B, Table B12.

2.7.1 Adjacent habitat

Fauna detected in adjacent habitat was scored on a presence-absence basis. All detections are presented in Appendix B, Table B13.

2.7.2 Underpasses

Fauna detected in underpasses were assigned to one of two movement types, “complete” or “incomplete” crossing:

- A complete crossing was scored when an animal showed directional movement when detected by the centrally mounted camera.
- An incomplete crossing was scored when an animal showed no directional movement (i.e. remained stationary in front of camera) or passed the camera but returned within 10 minutes.

Crossing definitions are consistent with those used at other Pacific Highway monitoring sites (e.g. Sandpiper Ecological 2023) and crossing structure research programs (e.g. Soanes *et al.* 2015). Further, the method represents a conservative approach to the identification of complete crossings. Data recorded for each active image included: site, date, time, species, accuracy (definite 90%+ certainty, probable 75-90% certainty, and possible 60-75% certainty), movement direction (east, west, no directional movement (animal stationary, returned)), number of images and image numbers. A hierarchical approach was adopted to species identification that included: species, genus or group. Microbats were recorded as presence only due to their transient nature and none-reliance on underpasses for thoroughfare. These data are presented in Appendix B, Table B6.

To adequately assess “use of underpasses” as per the project aim, “complete crossing” was used as the standard as it encompasses the purpose of fauna underpasses (i.e. A structure that allows fauna to move safely from one side of a road to the other). To account for variations in survey effort (camera activity periods) between sites, complete crossings/week and complete crossings/week/underpass were adopted. Complete crossings were calculated by summing the number of crossings at each site and then dividing by the total activity period of all cameras at each respective site. This method ensures an accurate representation of crossing frequency relative to monitoring effort. Birds and microbats were excluded from analysis as they do not require underpasses for thoroughfare. Complete crossings were calculated and presented in relation to monitoring periods (i.e. operational 2018 vs 2019), taxa (i.e. bandicoots, possums and wallabies) and sites (i.e. McGraths, Burkes and Dalhousie).

One potential indicator of success identified in the EMP was use of underpasses by cover-dependent species and species with low mobility, yet no specification was given for which species this encompasses. Therefore, it has been inferred that low-mobility fauna includes species whose movements are constrained by their size or behaviour and includes frogs, small reptiles (excluding the goanna and water dragon), some species of rodents (bush rat, swamp rat, house mouse and water rat), and bandicoots. When species-specific identification was not possible, rodents were documented as 'rodent spp.' and their status as either introduced or native remained "undefined". This approach was adopted due to the difficulty in consistently distinguishing between *Rattus rattus* (black rat), *Rattus fuscipes* (bush rat), and *Melomys cervinipes* (fawn-footed melomys) from camera footage. Black rats tend to traverse open space and have been excluded from the cover dependent classification.

2.7.3 Exclusion fence

Data recorded from fence camera detections included species identification, direction of movement, and interactions with the fence. Movements were classified as along the fence towards the underpass (TU), along the fence away from the underpass (AFU), towards adjacent habitat (or towards forest) indicating movement away from the fence (TF), and non-directional (NDM) where fauna were observed to remain stationary for the video's duration without any directional movement. Interactions with the fence were noted, such as climbing through or up the fence. These data are detailed in Appendix B, Table B14.

3 Results

3.1 Underpass Monitoring

3.1.1 Camera monitoring

Year seven species diversity and native fauna use

Twenty species and nine fauna groups were confirmed making complete crossings (cc) at NH2U during year seven operational phase camera monitoring (Table 3). Fauna groups included ten taxa identified to genus or group - *Antechinus* spp., rodent spp., bandicoot spp., snake spp., *Egernia* spp., lizard spp., *Trichosurus* spp., medium mammal spp., small mammal spp. and macropod spp. (Table 3). Rodent, bandicoot and *Trichosurus* spp. likely belong to confirmed species in Table 3 (i.e., *Trichosurus* spp. either short-eared brushtail possum or common brushtail possum). Of the fauna recorded, thirteen were native species with four native fauna groups also recorded (Table 3). The diversity of fauna using underpasses was highest among impact sites including Tyson's with 23 species/groups, followed by Dalhousie (18 species/groups) and Martells south and Access G (15 species/groups), Burkes (13 species/groups), Martell's North (10 species/groups) and Martell's bridge (3 species/groups) (Table 3). Five introduced species were also recorded including feral predators (cat, dog and red fox) and introduced rodents (black rat and house mouse; Table 3).

Complete crossings (CC) by native species were observed at all sites with the frequency of crossings differing among the underpass locations. Tyson's recorded the highest native fauna use with an average of 5.06 CC per week (Figure 2: Total complete crossings (cc)/week/site by native species, feral predators (cat, dog, red fox) introduced rodents (combined black rat and house mouse), and rodent spp. (unconfirmed whether native or introduced) at each site during year seven (combined autumn and spring) operational monitoring, NH2U, 2023. K = indicates complete crossing by koala. Figure 2). Access G and Martell's South also showed considerable activity with 4.88 and 4.03 CC per week, respectively (Figure 2). Martell's Bridge and McGrath's exhibited notably fewer crossings by native fauna, at 0.13 and 0.41 CC per week, respectively. Martell's Bridge was the only site where crossings by native species were not the most frequent, with feral predators,

particularly dogs, being more prevalent. Across all other sites, crossings by native fauna were more common than those by feral predators and introduced or undefined rodents (Figure 2).

Short-eared brushtail possum was the most frequently recorded native species with a total of 9.01cc/week across all sites (Table 3). This was followed by *Antechinus* spp. (5.43cc/week), lace monitor (3.83cc/week) and bandicoots (including long-nosed and bandicoot spp.) with 3.37 cc/week (Table 3).

Noteworthy detections included a koala using the culvert floor (ground) and furniture to make complete crossings at Tyson's and using the culvert floor to make a complete crossing at Access G (Table 3, Plate 5). No other threatened fauna were recorded during underpass monitoring in Year seven.

Table 3: Complete crossings/week/site made by each species/group at each of the eight underpasses monitored on the NH2U upgrade during year five operational monitoring. Species in bold denote threatened species, ^=Cover dependent species, FF= fauna furniture, G = ground (culvert floor) N = north and S = south. Martell's bridge and McGrath's did not contain fauna furniture. See Appendix B, Table B11 for all data.

Species and fauna groups	Site and camera location																Total cc/week/spp.
	Access G		Burke's		Dalhousie		Martell's N		Martell's S		Martell Bridge		McGraths		Tyson's		
	FF	G	FF	G	FF	G	FF	G	FF	G	N	S	N	N	FF	G	
Native mammals																	
Short-beaked echidna	-	-	-	-	-	0.13	-	-	-	0.21	-	-	0.07	-	-	0.21	0.41
<i>Antechinus</i> spp.^	2.92	0.13	0.16	-	0.18	0.16	-	-	0.11	0.05	-	-	-	-	1.72	0.33	5.43
Long-nosed bandicoot^	-	0.24	-	0.68	-	-	-	0.05	0.16	1.63	-	-	-	-	-	-	2.76
Bandicoot spp.^	-	0.16	-	0.11	-	0.03	-	-	0.05	0.26	-	-	-	-	-	0.03	0.61
Koala	-	0.11	-	-	-	-	-	-	-	-	-	-	-	-	0.03	0.01	0.13
Short-eared brushtail possum	2.39	0.03	0.05	0.16	0.93	0.10	-	0.16	3.05	0.26	-	-	0.21	-	1.67	0.26	9.01
Common brushtail possum	-	-	0.37	-	0.08	-	-	-	1.05	-	-	-	-	-	0.16	0.07	1.66
<i>Trichosurus</i> spp.	-	0.03	-	-	0.05	0.10	-	-	0.26	-	-	-	-	-	0.58	0.26	1.03
Swamp wallaby	-	-	-	0.05	-	-	-	-	-	-	-	0.26	-	-	-	0.03	0.31
Macropod spp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.01	0.00
Fawn-footed melomys^	-	0.03	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.03
Bush rat^	-	-	-	0.26	-	-	-	-	-	-	-	-	-	-	0.13	0.06	0.40
Water rat^	-	0.74	-	0.21	-	0.62	-	0.84	-	0.05	-	-	0.07	-	-	0.58	2.54
Small mammal spp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.03	-	0.03
Medium mammal spp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.05	-	0.05
Introduced and undefined rodents																	
Black rat^	-	0.50	-	0.89	-	2.05	-	0.37	1.00	1.84	-	-	0.21	-	1.41	2.71	8.27
House mouse^	-	0.03	-	0.11	-	0.05	-	-	-	-	-	-	-	-	-	0.01	0.18
Rodent spp.^	-	0.45	0.11	0.53	0.03	0.60	-	0.53	0.42	0.53	-	-	-	-	0.61	0.36	3.79
Feral predators																	
Dog	-	-	-	0.05	-	0.13	-	0.26	0.11	-	1.10	0.39	-	-	-	-	2.03
Fox	-	0.03	-	0.16	-	0.03	-	0.21	0.11	0.95	0.06	0.19	-	-	-	0.04	1.73
Cat	-	0.11	-	-	-	0.03	-	-	-	-	-	-	-	-	-	-	0.13
Reptiles																	
<i>Egernia</i> spp.^	-	-	-	-	0.16	-	-	-	-	-	-	-	-	-	0.03	-	0.18
<i>Egernia mcphreei</i> ^	-	-	-	-	-	0.05	-	-	0.11	-	-	-	-	-	0.45	-	0.61
Eastern water dragon	0.05	0.95	-	-	0.03	0.34	-	0.05	-	0.11	-	-	-	-	0.08	0.88	1.61
Lace monitor	0.48	0.58	-	-	0.49	0.41	0.09	0.58	0.53	0.37	-	-	0.14	-	0.16	1.52	3.83
Lizard spp.^	-	-	-	-	-	0.03	-	-	-	-	-	-	-	-	-	-	0.03

Species and fauna groups	Site and camera location															Total cc/week/spp.		
	Access G		Burke's		Dalhousie		Martell's N		Martell's S		Martell Bridge		McGraths		Tyson's			
	FF	G	FF	G	FF	G	FF	G	FF	G	N	S	N	N	FF		G	
Red-bellied black snake	-	-	-	-	-	-	-	-	-	-	-	-	-	0.14	-	-	0.03	0.14
Snake spp.	-	-	-	-	-	-	-	0.11	-	-	-	-	-	-	-	-	0.01	0.11
Coastal carpet python	-	-	-	-	-	-	-	-	-	-	-	-	-	0.07	-	-	-	0.07
Total no. species/groups	15		13		18		10		15		3		7		23		47.10	



Plate 5: Images of fauna utilising underpasses during year seven monitoring. Koala crossing using the culvert floor at Access G (Top left). Koala using the fauna furniture at Tyson's (Top right). Dog crossing at Martell's Bridge (Middle Left). Short-beaked echidna using the culvert floor at Tyson's (Middle right). Two short-eared brushtail possums using the fauna furniture at Dalhousie (Bottom Left). Red-bellied black snake using the culvert floor at Burkes (Bottom Right).

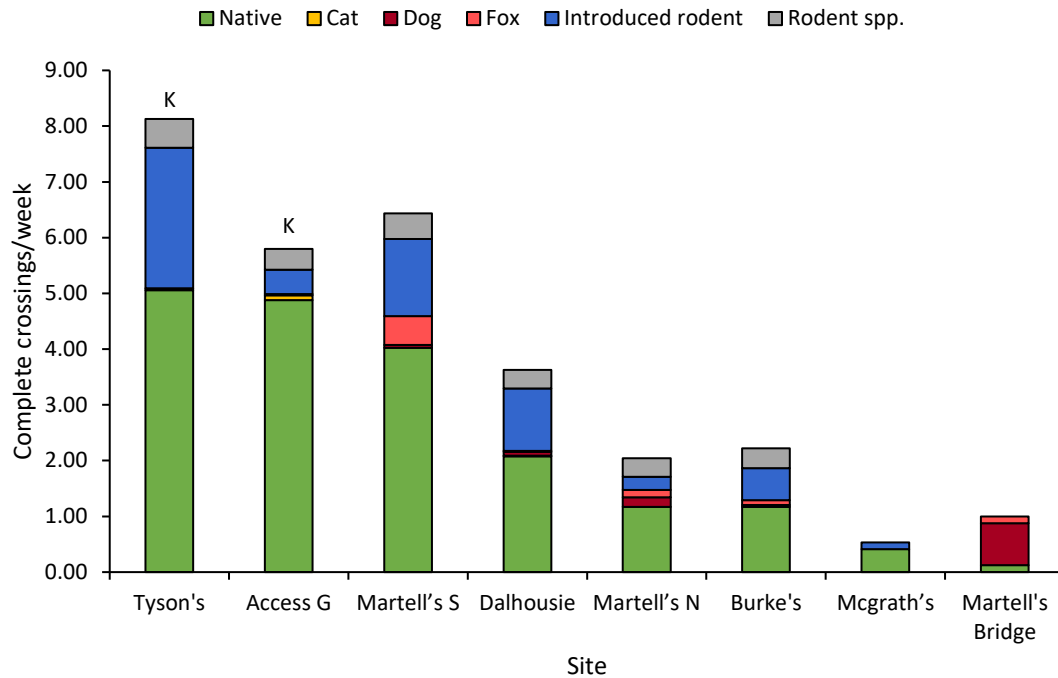


Figure 2: Total complete crossings (cc)/week/site by native species, feral predators (cat, dog, red fox) introduced rodents (combined black rat and house mouse), and rodent spp. (unconfirmed whether native or introduced) at each site during year seven (combined autumn and spring) operational monitoring, NH2U, 2023. **K** = indicates complete crossing by koala.

Year seven use by cover dependent species with low mobility

Six species and a further five cover-dependent fauna groups (see classification in methods) were recorded using underpasses at NH2U during year seven monitoring (Table 3). Of the species recorded two were introduced and included the black rat (8.27cc/week) and house mouse (0.18cc/week) (Table 3). Fauna groups included antechinus spp., bandicoot spp., rodent spp., *Egernia* spp. and lizard spp. In order of use, records of native cover dependent species included *Antechinus* spp. (5.43 cc/week), long-nosed bandicoot (2.76cc/week), *Egernia mcpheeii* (0.61cc/week), bush rat (0.4 cc/week), *Egernia* spp. (0.18cc/week), and fawn-footed melomys (0.03cc/week). Rodents (rodent spp.) which could not be positively identified to species level were recorded at a rate of 3.79cc/week. No frogs were recorded using underpasses during camera monitoring.

Year seven feral predator activity

Feral predators were recorded at all impact sites with no detections at the McGraths creek reference site (Figure 3). The highest combined use across all sites was recorded for dog (1.07cc/week), followed by red fox (0.93cc/week) and cat (0.10cc/week) (Figure 3). Dog was recorded at five sites with the highest use at Martell's Bridge (0.75cc/week) and Martell's North (0.17cc/week) (Figure 3). Fox was recorded at all sites (except McGrath's) with the highest activity at Martell's South (0.51cc/week) and Martell's North (0.13cc/week) (Figure 3). Cat was recorded at two sites and exhibited relatively low use of underpasses ranging from 0.09cc/week at Access G and 0.01cc/week at Dalhousie (Figure 3).

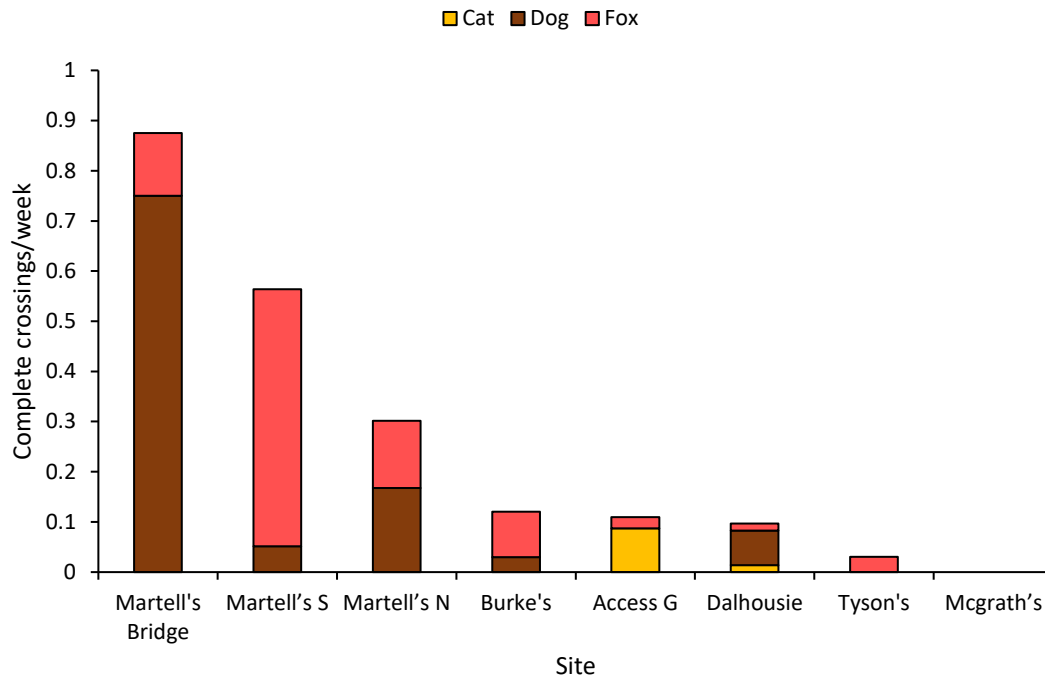


Figure 3: Complete crossings (cc)/week/site by feral predators during operational monitoring of underpasses at NH2U, 2023.

Trends in underpass use by native fauna during operational monitoring

Underpass use by native fauna has progressively increased from years two to seven of operational monitoring (Figure 4). Initially the underpass usage rate of 0.47 ± 0.42 cc/week/site in year two increased to 1.14 ± 0.74 cc/week/site in year three. This upward trend persisted, reaching 2.33 ± 1.43 cc/week/site in the year five with a slight increase to 2.36 ± 1.99 cc/week/site in year seven. Overall, the trend suggests a rapid initial increase in the usage of underpasses during the earlier years (years two, three and five), followed by a stabilisation in the usage rate from years five to seven (Figure 4).

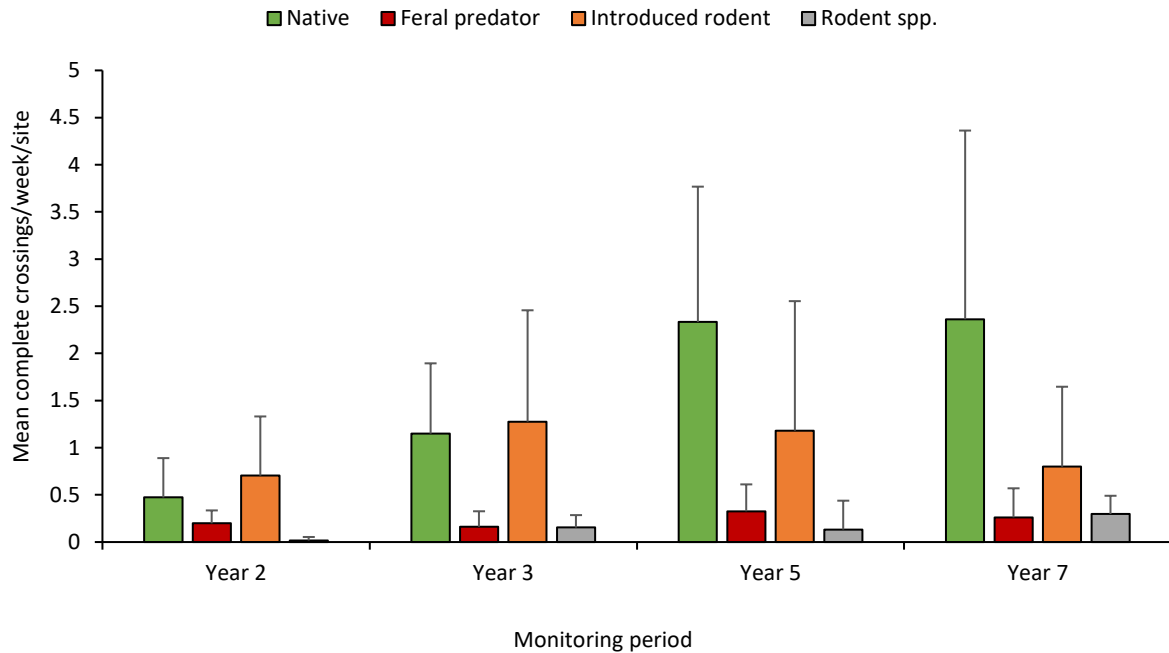


Figure 4: Mean (+SD) number of complete crossings (cc)/week/site by natives, feral predators (combined cat, dog, red fox), introduced rodents (black rat and house mouse) and other rodents (rodent spp. = unidentified rodents) during operational monitoring at NH2U, 2023. Year two = 2018, Year three = 2019, Year five = 2021 and Year seven = 2023.

Ten native fauna species/groups constituted >90% of the recorded complete crossings for native fauna during each year of operational monitoring (Figure 5). In order of use, this included the short-eared brushtail possum, antechinus spp., lace monitor, eastern water dragon, water rat, short-beaked echidna, *Trichosurus* spp. (either short-eared or common brushtail possum), long-nosed bandicoot, bandicoot spp. (either long-nosed bandicoot or northern brown bandicoot), and swamp wallaby (Figure 5). Short-eared brushtail possum usage remained relatively high throughout the monitoring period, peaking at 33.71% in year three. Water rat and *Antechinus* spp. tended to increase over time, with *Antechinus* spp. peaking at 26.40% in year five. In contrast, the swamp wallaby and eastern water dragon exhibited a general decline in their use of the underpasses over time (Figure 5). Lace monitor, long-nosed bandicoot, bandicoot spp., short-beaked echidna, and *Trichosurus* spp. showed some variability in their usage patterns but remained relatively constant overall (Figure 5).

Two threatened species have been recorded using underpasses at NH2U including spotted tailed quoll and koala. Spotted tailed quoll was recorded using the furniture to make a complete crossing at Martell's south once in year three (Sandpiper, 2020a). There has been a gradual temporal increase in koala usage of the underpasses (Figure 6). No koalas were observed in the second year of operational phase monitoring, with an initial rate of 0.001 ± 0.002 cc/week/site recorded in year three (Figure 6). This rate increased to 0.004 ± 0.008 cc/week/site in year five and further to 0.013 ± 0.03 cc/week/site in year seven with records of complete crossings at Access G and Tyson's (Table 3). Previous operational monitoring records include two complete koala crossings at the Dalhousie and Martell's North underpasses in spring year five. Koala crossings have now been confirmed at four of the seven impact sites (Tyson's, Dalhousie, North Martell's and Access G), with confirmed crossings at Tyson's in years three, five, and seven.

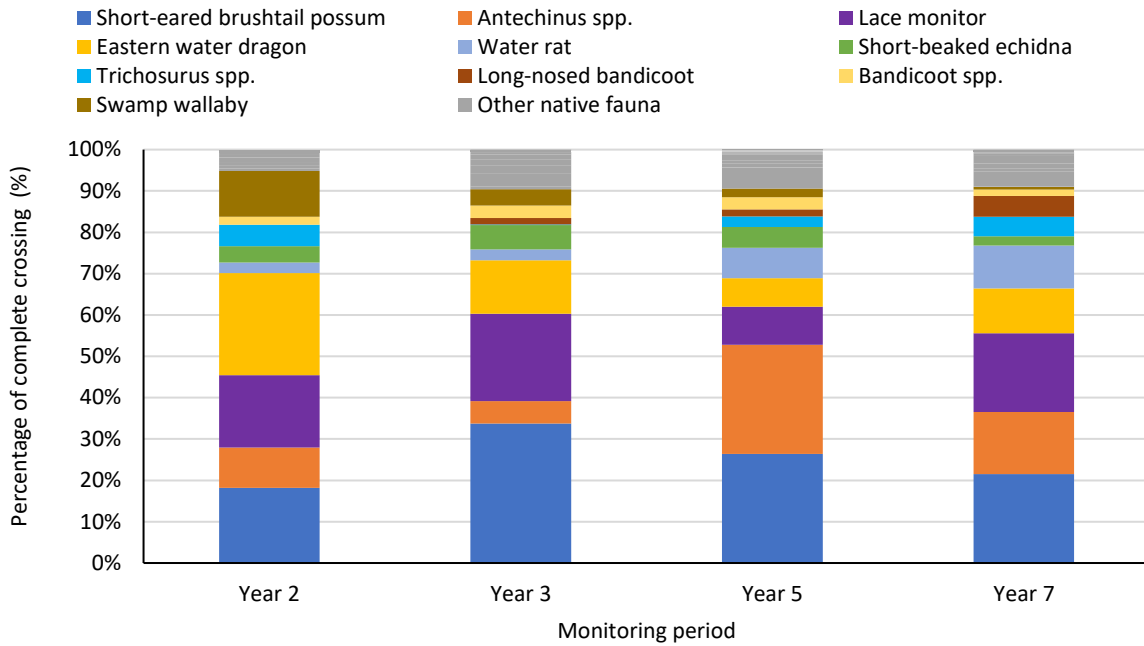


Figure 5: Percentage of complete crossings for the ten most frequently recorded native species or groups during operational monitoring at NH2U. Data represent the proportion of total crossings completed by each species. Year two = 2018, Year three = 2019, Year five = 2021, Year seven = 2023.

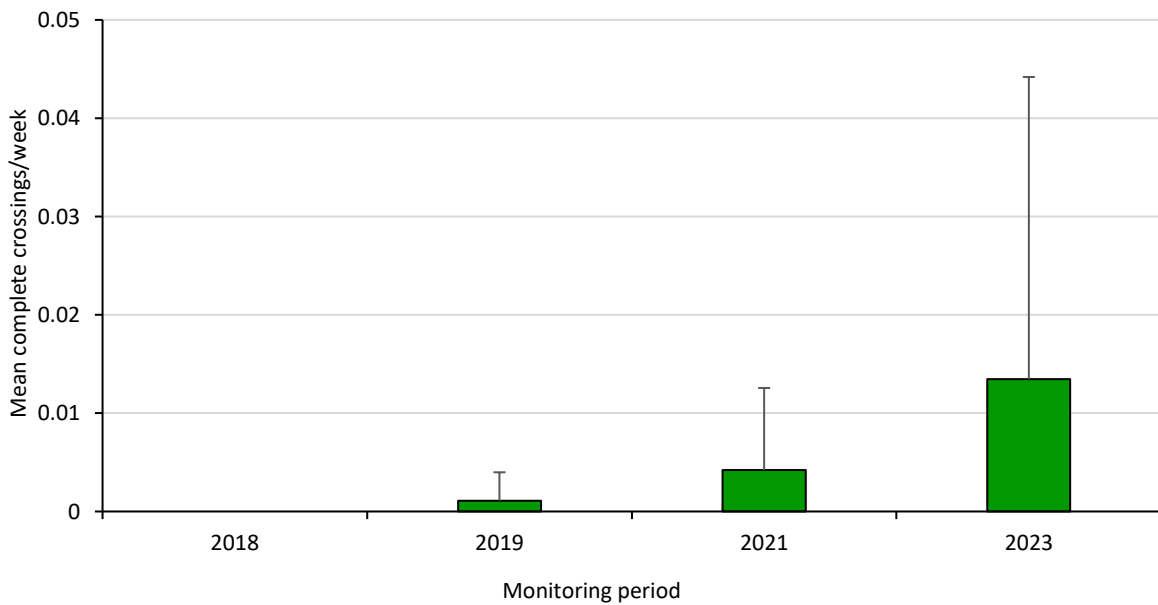


Figure 6: Mean (+SD) number of complete crossings (cc)/week/site by koala during operational monitoring at NH2U. Year two = 2018, Year three = 2019, Year five = 2021 and Year seven = 2023. No crossings were recorded in 2018.

Trends in underpass use by introduced rodents and feral predators during operational monitoring

Underpass usage by rodents has been variable during operational monitoring (Figure 4). Usage by introduced rodents showed an initial increase from 0.70 ± 0.63 cc/week/site in year two to a peak of 1.28 ± 1.18 cc/week/site in year three, before experiencing a decline to 1.18 ± 1.37 cc/week/site in year five and further to 0.80 ± 0.85 cc/week/site by Year seven (Figure 4). In contrast, rodent spp. usage remained relatively low initially at 0.02 ± 0.04 cc/week/site in year two, then increased to 0.15 ± 0.13 cc/week/site in year three, slightly decreased in year five, and increased to 0.30 ± 0.19 cc/week/site in year seven (Figure 4).

Underpass use by feral predators varied between monitoring years and between species (cat, dog, red fox). In Year two, the general feral predator usage was relatively low at 0.20 ± 0.14 cc/week/site (Figure 7). Usage decreased slightly in Year three to 0.16 ± 0.16 cc/week/s with a notable decrease in dog usage from 0.08 ± 0.14 cc/week/site to 0.02 ± 0.04 cc/week/site, alongside an increase in cat usage to 0.09 ± 0.16 cc/week/site (Figure 7). Feral predator use increased in Year five to 0.33 ± 0.28 cc/week/site which was largely influenced by an increase in dog and fox usage to 0.16 ± 0.25 cc/week/site and 0.16 ± 0.16 cc/week/site, respectively, while cat usage declined to 0.01 ± 0.02 cc/week/site (Figure 4 and Figure 7). Overall feral predator usage declined by 21% from year five to Year seven when the combined rate was 0.26 ± 0.31 cc/week/site. This decline was due to a minor reduction in dog and fox usage, while cat usage remained low.

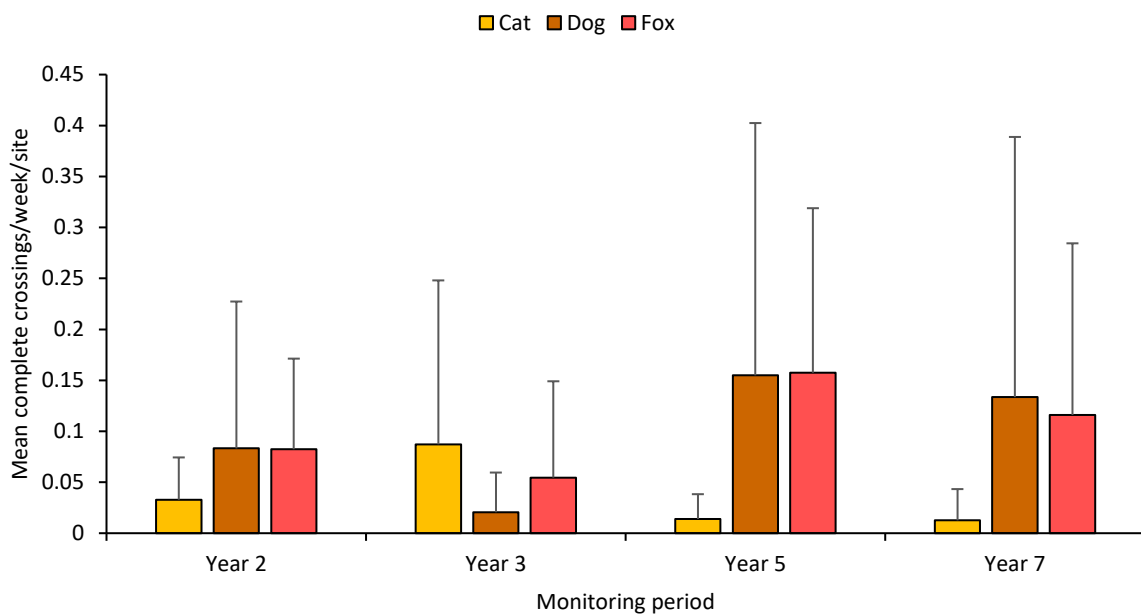


Figure 7: Mean (+SD) number of complete crossings (cc)/week/site by cat dog and red fox during operational monitoring at NH2U, 2023. Year two = 2018, Year three = 2019, Year five = 2021 and Year seven = 2023

3.1.2 Sand pad monitoring

Seven species and five fauna groups were recorded during sand pad monitoring of underpasses (Appendix B, Table B5). Species included dog, cat, fox, house mouse, water rat, water dragon and lace monitor. Fauna groups included rodent spp., frog spp., brushtail possum spp., *Antechinus* spp. and bird spp. Frog spp. tracks were observed at Martell's North underpass and were only instance of fauna underpass usage not captured by camera monitoring. Sandpads were not installed at the McGrath's reference site due to inundation in both sample periods.

3.1.3 Scat and track search

Seven species and eight fauna groups were recorded during scat and track surveys in 2023. Scats and/or tracks were recorded for the following species, fox, cat, dog, water rat, lace monitor, eastern water dragon and red-necked wallaby (Appendix B, Table B6). All fauna other than red-necked wallaby were detected during underpass camera monitoring. No scat and track data were collected at the McGrath's control site due to inundation in both sample periods.

3.1.4 Frog survey

In year seven, nine frog species were recorded in habitat adjoining underpasses (see Table 4). During the spring monitoring period, two frog species were recorded in underpasses. A striped marsh frog (*Limnodynastes peronii*) was recorded on the culvert apron at North Martells, and a great barred frog (*Mixophyes fasciolatus*) was recorded within the South Martells underpass. The presence of great barred frog is an important record as there is limited data on underpass use by members of the *Mixophyes* genus. Full details of frog surveys are provided in Appendix B, Table B8.

3.1.5 Underpass hair funnels

Seven species and a further two fauna groups were detected via hair analysis from hair funnels. Species included black rat, brown antechinus (*A. stuartii*), bush rat, house mouse, long-nosed bandicoot or northern brown bandicoot (could not be differentiated between the two species) common brushtail possum, and swamp wallaby (see Appendix B, Table B9 for full details). Other fauna groups included *Antechinus* spp. and *Trichosurus* spp. All species/groups detected by hair funnels were recorded using underpasses by cameras with the presumption that *Antechinus* spp. are brown antechinus.

3.2 Adjacent Habitat Surveys

Adjacent habitat surveys recorded the presence of 34 distinct species, three genera (*Trichosurus* spp., *Lampropholis* spp., *Antechinus* spp.), and an additional five fauna groups (Appendix B, Table B2). Species were identified through camera trap monitoring, active searches, and spotlighting, undertaken as part of the operational monitoring conducted in year seven. The diversity of fauna at impact sites ranged from ten species/genera at Tyson's to 25 at Access G. McGrath's (reference site) recorded a total of 12 species/genera, eight of which were mammals (Appendix B, Table B12).

Distinct species recorded within adjacent habitat during year seven included 15 (41.7% of all species recorded) native mammals, seven (19.4%) frogs, nine (25%) reptiles, and five (13.9%) introduced mammals. Birds were not recorded during adjacent habitat surveys. Most mammals were detected via camera trap monitoring with frogs and reptiles typically recorded during nocturnal surveys and active searches respectively (Appendix B, Table 12). Noteworthy detections included a koala on the eastern side of Tyson's underpass during autumn

2023 nocturnal surveys, and probable koala scat recorded on the western side of the Burke's underpass during spring 2023 active searches (See Appendix B, Table B2 and Table B3).

3.2.1 Baited camera traps

A total of fifteen species and three genera (*Antechinus* spp., *Trichosurus* spp. and *Lampropholis* spp.) and a further three fauna groups (Bandicoot spp., wallaby spp. and rodent spp.) were detected by cameras installed in adjacent habitat (Appendix B, Table B2). Eight species (53%) were native mammals, four (27%) were introduced mammals, and three (20%) were reptiles. No threatened species or amphibians were recorded (Appendix B, Table B12).

3.2.2 Active searches

Active searches recorded fourteen species, three genera (*Antechinus* spp., *Trichosurus* spp. and *Lampropholis* spp.) and two fauna groups (Wallaby spp. and bandicoot spp.) (Appendix B, Table B2). Species detections included six (~43%) reptiles, three (~21%) native mammals, three frogs (~21%), and two introduced species (~13%, dog and fox scat). Reptile species recorded included yellow-faced whipsnake, eastern water dragon, land mullet, lace monitor, grass skink and garden sun-skink. (Appendix B, Table B2).

3.2.3 Spotlighting

A total of sixteen species, one genera (*Trichosurus* spp.) and four fauna groups (macropod spp., wallaby spp., bandicoot spp. and small snake spp.) were recorded during spotlight surveys in adjacent habitat. Species richness was comprised of seven frogs (44%), seven mammals (44%), one reptile (6%) and one introduced (6%) (Appendix B, Table B2). Frog species included: eastern dwarf tree frog, common eastern froglet, red-backed toadlet, Peron's tree frog, tusked frog, Tyler's tree frog and striped marsh frog. Three mammal species were recorded in addition to those from baited and underpass camera monitoring including common ringtail possum, feathertail glider (*Acrobates* spp.) and sugar glider (Appendix B, Table B3).

3.3 Operational underpass and adjacent habitat comparison

Sixty-one species and unique genera have been confirmed within adjacent habitat and underpasses. Of these, 34 species/genera (or 56%) have been recorded using underpasses across all survey years (year two, three, five and seven) (Table 4). The proportion of mammals recorded in both adjacent habitat and underpasses was 92% with long-nosed potoroo and rusa deer the only mammal species recorded in adjacent habitat but not in underpasses (Table 4). Year seven was the first time rusa deer have been recorded in adjacent habitat and are not a targeted species for underpasses. Long-nosed potoroo, which is listed as endangered by the *Biodiversity Conservation Act 2016* has been recorded on two occasions near the Tyson's underpass, yet not within the underpass. To date, three species of frog (great barred frog, striped marsh frog & green tree frog) were recorded using underpasses, while fifteen species were reported in adjacent habitat (Table 4). Further, 22 reptile species/groups were recorded during monitoring, with nine, or 41% confirmed using underpasses (Table 4).

Table 4: Species and unique genera recorded in adjacent habitat and using underpasses during year two, three, five and seven monitoring at NH2U. Due to duplication between species and fauna groups (e.g. wallaby spp. includes both red-necked and swamp wallaby), only confirmed species and unique genera have been included. Fauna that does not require underpasses for thoroughfare have also been excluded (e.g. birds and gliders) Bold text denotes threatened species. † = Introduced species. # = Species presence assumed due to detection in only the underpass. Pr = probable records based on hair funnel analysis

Species	Underpass	Adjacent habitat
Mammals		
Short-beaked echidna	X	X
Brown antechinus	X	#
Spotted-tailed quoll	X	#
Long-nosed bandicoot	X	X
Northern brown bandicoot	X	X
Koala	X	X
Common ringtail possum	X	X
Short-eared brushtail possum	X	X
Common brushtail possum	X	X
Long-nosed potoroo		X
Red-necked Wallaby	X	X
Swamp wallaby	X	X
Eastern grey kangaroo	X	X
Water rat	X	X
Bush rat	X	X
Swamp rat	X	#
House mouse [†]	X	X
Black rat [†]	X	X
Fawn-footed melomys	X	X
Dog [†]	X	X
Red fox [†]	X	X
Cat [†]	X	X
Cow	X	#
Rusa deer [†]		X
Sub-total mammals	22	24
Reptiles		
Lace monitor	X	X
Eastern water dragon	X	X
Land mullet	X	X
Blue-tongue lizard		X
Burtons legless lizard		X
Garden sun-skink	X	X
Red-tailed skink		X
Eastern crevice skink	X	X
Bar-sided skink		X
Rainbow skink		X
Common garden skink		X
<i>Lampropholis</i> spp.		X
<i>Concinnia</i> spp.		X
<i>Eulamprus</i> spp.		X
<i>Egernia</i> spp.	X	#
Coastal carpet python	X	X
Bandy bandy		X
Yellow-faced whipsnake		X

Species	Underpass	Adjacent habitat
Eastern small-eyed snake		X
Red-bellied black-snake	X	X
Marsh snake		X
Green tree snake	X	X
Sub-total reptiles	9	22
Frogs		
Eastern dwarf tree frog		X
Common eastern froglet		X
Striped marsh frog	X	X
Peron's tree frog		X
Red-backed toadlet		X
Graceful tree frog		X
Green tree frog	X	#
Broad-palmed rocket frog		X
Whirring tree frog		X
Great barred frog	X	X
Tusked frog		X
Striped rocket frog		X
Revealed frog		X
Tyler's tree frog		X
Smooth toadlet		X
Sub-total frogs	3	15
Total	34	61

3.4 Exclusion Fence Monitoring

A total of 114 fauna detections including nine species, one genus, and two fauna groups were recorded during fauna fence monitoring in year seven (Appendix B, Table B13). The most recorded species and fauna groups were rodent spp. 22 detections, followed by swamp wallaby (14 detections) and dog (13 detections; Appendix B, Table B13). All species/groups were recorded using underpasses (Table 8).

Fauna exhibited movement away from underpass on 42 occasions (37% of detections), towards underpass on 29 occasions (25%), towards the forest on 22 occasions (19%), and non-directional movement on seven occasions (19%) (Appendix B, Table B14).

3.5 Road-kill Monitoring

A total of 35 individuals were recorded at an average rate of 0.40 individuals/km at NH2U during autumn and spring surveys (n=8) (Appendix B, Table B10, Figure 8). Of the 35 individuals, 22 were fauna that should be excluded by the fauna fence, including bandicoot (10 records), wallaby (4 records), medium mammal (either bandicoot, possums, Leporidae spp. or cat 4 records), possum (2), red fox (1) and freshwater turtle (1) (Appendix B, B10). The remaining records were individuals that are not typically impeded by exclusion fence including, birds (10 records), reptile (2), and rodent (1) (Appendix B, Table B10). No threatened fauna species were recorded during road-kill surveys or opportunistically during year seven.

The road-kill rate increase marginally from 0.34 ± 0.18 in year five to 0.40 ± 0.09 individuals/km in year seven (Figure 8). Road-kill rates for fauna not impeded by exclusion fences (i.e., birds, rodents, small reptiles) remained relatively consistent, with a slight decrease from 0.16 ± 0.11 individuals/km in year five to $0.15 \pm$

0.08 individuals/km in year seven. In contrast, road-kill rates for fauna typically impeded by exclusion fences increased from 0.18 ± 0.14 individuals/km to 0.25 ± 0.06 individuals/km during the same period.

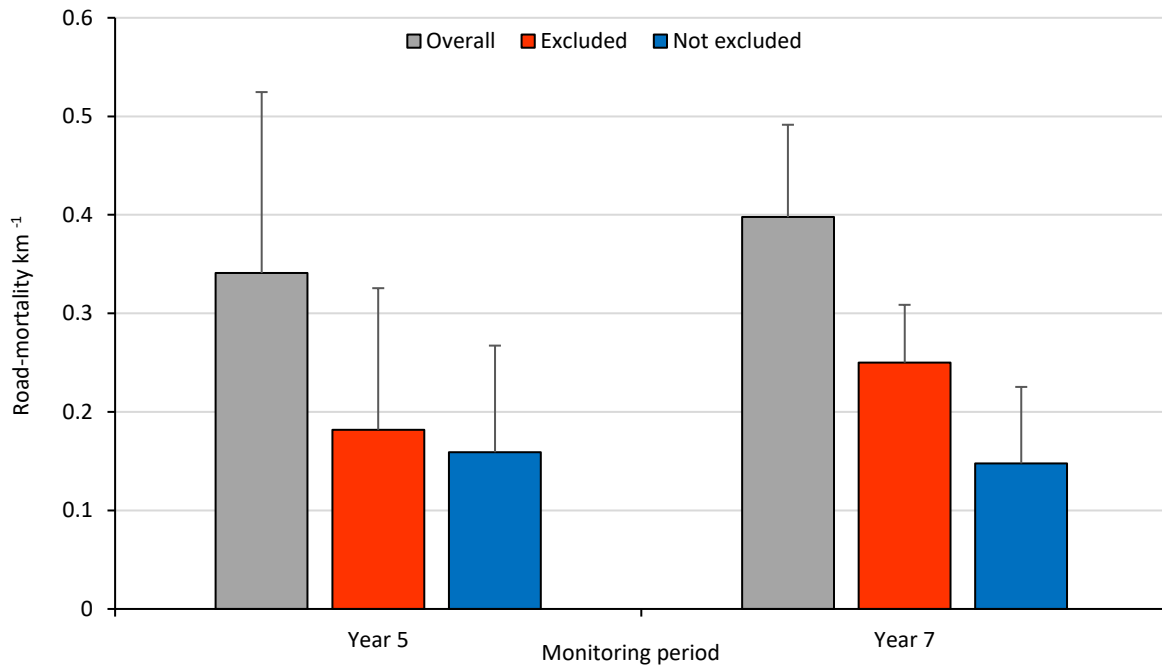


Figure 8: Annual comparison of mean fauna road-mortalities per km (+SD) during years 5 and 7 of operational monitoring at NH2U, n=4 for each year. Data from years 2 and 3 are excluded due to the method change from pedestrian to vehicle-based surveys starting in year five.

3.6 Habitat Assessment

Habitat adjoining the sample sites has undergone negligible change since year five monitoring. Results of habitat assessment can be found in Appendix B, Table B11.

4 Discussion

Results of year seven operational phase monitoring are discussed with reference to the performance criteria described in the Ecological Monitoring Program (Benchmark 2013) and outlined in section 1.2 of this report.

4.1 Underpass and exclusion fencing monitoring

4.1.1 Low rates of use of fauna underpasses and adjacent habitats by feral predators

Year seven operational underpass monitoring at the NH2U site recorded three feral predator species (cat, dog, and red fox) utilising underpasses. The EMP (Benchmark 2013) lacks a clear definition for "low rates of use" of underpasses by feral predators. Underpass use by feral predators at the nearby Warrell Creek to Nambucca Heads (WC2NH) project was deemed high when a combined feral predator usage rate of 1.79 ± 1.34 crossings per week per site was recorded (Sandpiper Ecological 2021). In contrast, usage rates by feral predators at NH2U in year seven was substantially lower, at 0.26 ± 0.31 crossings per week per site, constituting approximately 5% of total crossings. In the case of the WC2NH project high feral predator use prompted implementation of a predator control program, which reduced predator visitation to underpasses.

Underpass usage by feral predators has changed temporally, with an upward trend observed from year two to year five, followed by a 21 % decline in year seven. Fluctuations in feral predator populations are known to be influenced by environmental conditions and prey availability (Scroggie *et al.*, 2018; Lentic *et al.*, 2010). The reduction in feral predator activity between years five and seven may be a result of drier weather conditions that persisted from February through to November 2023 leading to a lower abundance of prey (Johnson and Vanderwal 2009). The increase in complete crossings recorded from year three to year five further supports a climate-related influence on visitation with year three occurring during a severe drought and year five during a La-Nina year.

Fox and dog comprised approximately 90% of feral predator underpass usage in year seven, continuing a trend from year five, with the highest activity observed at Martell's Bridge, Martell's North, and Martell's South. In contrast, cat demonstrated relatively low usage, recorded at two sites only (Dalhousie and Access G). Monitoring data may not accurately reflect predator abundance in adjacent habitat as individual animals may repeatedly use underpasses. For instance, at WC2NH site 3, approximately 95% of cat detections were attributed to a single (identifiable) individual, which resided close to the underpass (Sandpiper Ecological 2023).

Year seven data also highlighted spatial segregation in underpass utilisation patterns among feral predators. Dog and fox exclusively used underpasses located south of the Kalang River, including Martell's North, Martell's South, Martell's Bridge, Dalhousie, and Burkes, with minimal cat activity in these areas, apart from occasional crossings at Dalhousie. Most cat crossings occurred at Access G, located north of the Kalang River. This distinct separation in underpass usage is likely due to a combination of factors, such as the natural barrier posed by the Kalang River, interactions between mesopredators (Lentic *et al.*, 2010), varying land use patterns across the project, and variability in local prey abundance. Notably, feral predators were detected at all impact sites yet not the McGraths reference site. The absence of feral predators at McGraths most likely due to the absence of an exclusion fence, regular inundation, and the ease of crossing at the old highway.

Within the NH2U underpasses, there was no evidence of predation by feral predators. Importantly, no instances of predation on designated target species, such as koala or spotted-tailed quoll were recorded. The predation of koalas by wild and domestic dogs is well-documented (Lunney *et al.*, 2004, 2007), though there is no evidence of fox predation on adult koalas, as they typically target smaller prey (Stobo-Wilson *et al.*, 2021). Furthermore, no evidence was found to support the prey-trap hypothesis, aligning with multiple studies that

have also failed to find evidence in favour of this hypothesis (Little *et al.*, 2002; Martinig *et al.*, 2020; Goldingay *et al.*, 2022).

Aside from predation, the use of underpasses by feral predators may lead to avoidance by native fauna (Little, 2003). Notably, sites such as Access G and Tyson's, which recorded the lowest incidence of feral predator crossings, also exhibited the highest rates of complete crossings by native species. And koalas were exclusively recorded at sites situated to the north of the Kalang River (Tyson's and Access G), where foxes and dogs were absent. While this is an interesting observation, attributing the increased native fauna crossings, including koala movements, solely to the absence of feral predators is questionable. The observed variations in feral predator distribution and activity can be attributed to multiple factors. These include the natural barrier presented by the Kalang River, diverse land use patterns and habitat types within the project area, and fluctuations in the presence and abundance of various prey species across the landscape.

4.1.2 High levels of fauna underpass use by a wide variety of native fauna species

During the operational monitoring (years two, three, five and seven), a diverse array of native species and unique genera have been recorded using underpasses. Among the 62 species and unique genera identified in adjacent habitats, 35 (or 56%) have been recorded using underpasses. This proportion of underpass usage is notably high, exceeding that observed in the Sapphire to Woolgoolga project (ranging from 23% to 50%), and is consistent with the results from the adjacent WC2NH project (57%), (Sandpiper Ecological 2018 & 2023).

Particularly encouraging is the underpass usage by 92% of the mammal species and nearly 50% of the reptile species recorded within the NH2U area. Additionally, three frog species, namely the great barred frog, striped marsh frog, and green tree frog, have been recorded within underpasses, representing 21% of the frog species detected in adjacent habitats. This contrasts with the WC2NH project, where no frogs have been confirmed using underpasses (Sandpiper Ecological 2023). Infrequent detection of frogs may be due to the limitations of camera traps rather than an avoidance of underpasses with the three species recorded in year 7 detected by active searches.

Year five and seven operational phase monitoring provided evidence of a slight temporal increase in underpass use by native species from 2.33 ± 1.43 cc/week/site in the year five to 2.36 ± 1.99 cc/week/site in year seven. The result is not unexpected as use by native fauna is likely to increase over time as site features improve, and the trend is consistent with underpass monitoring at WC2NH and Woolgoolga to Ballina (Sandpiper Ecological 2023, 2022). Improved site features include sedimentation of scour protection and increased vegetation cover around culvert entrances (Sandpiper 2022). Furthermore, the increase in underpass utilisation has coincided with improved weather conditions linked to La Niña events that occurred between early 2020 and August 2022. These conditions may have contributed to enhanced breeding success among native species, subsequently leading to greater use of underpasses like what has been recorded at WC2NH (Sandpiper Ecological 2023).

The frequency of native fauna crossings varied amongst sites, with impact sites typically exhibiting the highest use. Among the species identified at impacted sites, short-eared brushtail possum and *Antechinus* spp. have been the predominant contributors to native fauna crossings in year five and seven. Both species have predominately been recorded on the fauna furniture, underscoring the importance of this underpass feature in facilitating movement of native scansorial fauna, as documented at WC2NH (Sandpiper Ecological 2023). The early detection of underpass usage in 2018, coupled with minimal sightings from exclusion fence monitoring, indicates a potential habituation of brushtail possums to underpass structures rather than a "funnelling" effect by the fauna fences. Similar rapid habituation responses have been documented for other species, such as bandicoots and rodents, highlighting a broader pattern of adaptability (Bond and Jones 2008). Furthermore, the variability in underpass usage among sites may also be influenced by site-specific features and the presence or abundance of species known to utilise underpasses (Clevenger & Waltho 2003). There is

evidence to show that even within areas of relatively homogenous habitat a species use of underpasses can vary substantially (Goldingay *et al.* 2022).

Additionally, the level and diversity of fauna use at sites like Tyson's, Dalhousie, Martell's South, and Access G may be influenced by their landscape position. These sites, located within large, continuous tracts of moderate to high-quality habitat featuring dense ground vegetation and abundant woody debris near creeks or drainage lines, recorded the highest species richness and use. Such habitats, especially riparian strips, are vital for fauna, serving as corridors through landscapes and sources of shelter, water, and prey (Lada *et al.*, 2008).

4.1.3 Evidence of use by dispersing individuals and different age cohorts

Use by different age cohorts is difficult to confirm using the methods applied at NH2U. Other methods such as mark-release-recapture would be required to provide definitive proof of use by dispersing individuals and different age cohorts. Such a survey is not warranted at NH2U.

4.1.4 Use by cover-dependent species and species with low mobility

Eight cover-dependent and/or low mobility species have been recorded using underpasses at NH2U, with an additional sixteen recorded in the adjacent habitat. Low occurrence of frogs and reptiles is most likely due to the inability of cameras to detect these species as opposed to avoidance of underpasses. This shortfall is overcome to some extent by using other survey methods like sand pads, targeted frog survey, and scat and track surveys. Targeted frog surveys have recorded three frog species within underpasses to date including, striped marsh frog, great barred frog and green tree frog. Frog tracks were also recorded during sand pad monitoring at North Martell's.

The culvert floor and furniture were both used by cover dependent species. Fawn-footed melomys, *Antechinus* spp., and eastern crevice skink predominantly used fauna furniture, highlighting the value of this feature in providing connectivity for cover dependent species. The increasing presence of lizards, such as eastern bearded dragon and land mullet, using the culvert floor in year five is encouraging, as these species tend to have small home ranges and predominantly reside in habitat with dense cover. Notably, records of bandicoots using the culvert floor were far lower at NH2U (1.43 cc/week) in comparison to WC2NH (6.54 cc/week; Sandpiper Ecological 2023), with few records at sites with extensive scour protection such as Dalhousie, Tyson's and North Martell's. The difference between the two projects is likely due to the retention of vegetation close to underpass entrances at WC2NH and our findings highlight the importance of establishing cover within scour protection. Vegetation is beginning to grow within scour protection at NH2U.

4.1.5 Low incidence of fauna road strike

The road-kill rate recorded at NH2U in 2023 was 0.4 individuals per kilometre per week which has seen an increase from the monitoring in year five and was found to be comparable to that of the adjoining WC2NH section of the upgrade (Sandpiper Ecological 2024). Notably, approximately 50% of the WC2NH upgrade is unfenced, in contrast to the almost entirely fenced NH2U alignment. The observed increase in bandicoot road-kill is likely due to the enhanced climatic conditions since 2021, which have led to an increase in the abundance and mobility of bandicoots (Vernes and Pope 2009). Furthermore, the decomposition of mulch on slopes and embankments has resulted in favourable foraging grounds within the road corridor, in line with findings at WC2NH (Sandpiper Ecological 2024). Importantly, no threatened fauna were recorded during the road-kill surveys, and a reduction in road-kill incidents was observed following the extension of the exclusion fence by 550 metres northwards on both sides of the alignment to meet the Short Cut Road overpass in 2021.

4.2 Targeted Threatened Species

4.2.1 Scansorial threatened species

No threatened scansorial mammals were recorded during year seven monitoring. In autumn of year five monitoring, a spotted-tailed quoll was confirmed using fauna furniture at Martell's South. Previously, spotted-tailed quolls had been recorded using the underpass floor at several sites in north-east New South Wales (i.e. Glenugie 2016 & 2019, Oxley Highway to Kempsey 2018, and Coolongolook 2000), although use tends to be sporadic, which is likely due to the species low density and large home range. The low density of quolls is supported by Bionet data with very few records near the NH2U alignment since 2000. No brush-tailed phascogales have been recorded during operational phase monitoring. This finding is not unexpected as the study area is largely unsuitable for that species (Sandpiper Ecological 2019).

4.2.2 Arboreal threatened species

During year seven monitoring koala was recorded making complete crossings at Tyson's and Access G, using the culvert floor, with an additional record of a koala using the fauna furniture to travel west at Tyson's. Previous operational monitoring records include two complete koala crossings at the Dalhousie and Martell's North underpasses in spring 2021/ Koala crossings have now been confirmed at four of the seven impact sites, with confirmed crossings at Tyson's in years three, five, and seven. The observed crossings underscore the utility of the underpasses in enabling koala movement, especially considering the low population density of koalas in adjacent habitat (Sandpiper Ecological 2020).

4.2.3 Other threatened species

In 2021, long-nosed potoroo was detected in habitat to the east of Martell's North. This record adds to previous detections in adjacent habitat at Tyson's in 2018 and 2019 (Sandpiper Ecological 2019 and 2020a) and west of Dalhousie in 2015 (Sandpiper Ecological 2015a). Potoroos are known to utilise underpasses (see Sandpiper Ecological 2015b, AMBS 2002) and the absence of records at NH2U may be due to the timing of monitoring, short duration of monitoring, and or low local abundance of potoroos. Continuation of underpass monitoring in year nine (2025) would increase the likelihood of detecting potoroos.

5. Contingency measures and recommendations

5.1 Contingency Measures

Contingency measures are summarised in Table 5.

Table 5: Potential problems outlined in the EMP and possible contingency measures. Mitigation measures applicable to the project are addressed in bold text in table below.

Problem	Contingency/Corrective Action	Proposed action
High rates of feral predator activity;	Control program	No action required as feral predator activity is not regarded as "high".
Low levels of native fauna movement and species diversity in underpasses;	Modify habitat structure near underpass entrances and/or modify	No action required as species richness of fauna using underpasses is equivalent or superior to other Pacific Highway monitoring sites.

	underpass fauna furniture	
No use of underpasses by cover-dependent species or species with low mobility or target threatened species	Modify or add potential groundcover resources	No action required as underpasses are used by several cover dependent and low mobility species.
High rates of fauna road mortality.	Modify exclusion fencing design, location or extent depending on the species and location of mortalities	No action required as road mortality rates are equivalent or less than recorded on other sections of the Pacific Highway. The moderate incidence of vehicle strike for species that should be blocked by exclusion fence justifies the need to continue monitoring as per the EMP.

5.2 Recommendations

Recommendations are summarised in Table 6.

Table 6: Recommendations based on findings from year seven operational phase monitoring and response from TfNSW.

Number	Recommendation	Transport for NSW Response
1.	Continue operational phase monitoring in year nine as specified in the EMP.	TfNSW agrees with recommendation

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Appendix A – Scientific names

Table A1: Common and scientific names for all species recorded during operational phase monitoring on NH2U.

Species	Scientific name
Koala	<i>Phascolarctos cinereus</i>
Short-beaked echidna	<i>Tachyglossus aculeatus</i>
Common brushtail possum	<i>Trichosurus vulpecula</i>
Short-eared brushtail possum	<i>Trichosurus caninus</i>
Brushtail possum sp.	<i>Trichosurus sp.</i>
Common ringtail possum	<i>Pseudocheirus peregrinus</i>
Sugar glider	<i>Petaurus breviceps</i>
Squirrel Glider	<i>Petaurus norfolcensis</i>
Yellow-bellied glider	<i>Petaurus australis</i>
Feathertail glider sp.	<i>Acrobates spp.</i>
Fawn-footed melomys	<i>Melomys cervinipes</i>
Water rat	<i>Hydromys chrysogaster</i>
Bush rat	<i>Rattus fuscipes</i>
Swamp rat	<i>Rattus lutreolus</i>
Rat spp.	<i>Rattus spp.</i>
Rodent spp.	<i>Rodentia spp.</i>
Yellow-footed antechinus	<i>Antechinus flavipes</i>
Brown antechinus	<i>Antechinus stuartii</i>
Dusky antechinus	<i>Antechinus swainsonii</i>
Antechinus spp.	<i>Antechinus spp.</i>
Eastern bent-wing	<i>Miniopterus orianae oceanensis</i>
Microbat spp.	
Swamp wallaby	<i>Wallabia bicolor</i>
Red-necked wallaby	<i>Macropus rufogriseus</i>
Eastern Grey Kangaroo	<i>Macropus giganteus</i>
Wallaby spp.	
Long-nosed potoroo	<i>Potorous tridactylus</i>
Macropod spp.	
Long-nosed bandicoot	<i>Parameles nasuta</i>
Northern brown bandicoot	<i>Isodon macrourus</i>
Bandicoot spp.	
Grey-headed flying-fox	<i>Pteropus poliocephalus</i>
Black flying fox	<i>Pteropus alecto</i>
Flying-fox spp.	<i>Pteropus spp.</i>
Eastern small-eyed snake	<i>Rhinoplocephalus nigrescens</i>
Red-bellied black-snake	<i>Pseudechis porphyriacus</i>
Marsh snake	<i>Hemiaspis signata</i>
Carpet python	<i>Morelia spilota</i>
Green tree snake	<i>Dendrelaphis punctulatus</i>
Yellow-faced whipsnake	<i>Demansia psammophis</i>
Eastern water dragon	<i>Physignathus lesueurii</i>
Eastern bearded dragon	<i>Pogona barbata</i>
Lace monitor	<i>Varanus varius</i>
Eastern crevice skink	<i>Egernia mcphreei</i>
Land mullet	<i>Bellatorias major</i>
Burtons legless lizard	<i>Lialis burtonis</i>
Blue-tongue lizard	<i>Tiliqua scincoides</i>
Garden sun-skink	<i>Lampropholis delicata</i>
Grass sun-skink	<i>Lampropholis guichenoti</i>
Lampropholis spp.	<i>Lampropholis spp.</i>
Bar-sided skink	<i>Concinnia spp.</i>
Scincidae spp.	<i>Scincidae spp.</i>
Clicking froglet	<i>Crinia signifera</i>
Toadlet spp.	<i>Uperolia spp.</i>
Red-backed broodfrog	<i>Pseudophryne coriacea</i>
Tusked frog	<i>Adelotus brevis</i>
Great barred frog	<i>Mixophyes fasciolatus</i>
Striped marsh frog	<i>Limnodynastes peronii</i>
Whirring tree frog	<i>Litoria revelata</i>
Eastern sedge frog	<i>Litoria fallax</i>
Emerald-spotted tree frog	<i>Litoria peronii</i>

Species	Scientific name
Laughing tree frog	<i>Litoria tyleri</i>
Striped rocket frog	<i>Litoria nasuta</i>
Broad-palmed rocket frog	<i>Litoria latopalmata</i>
Graceful tree frog	<i>Litoria gracilentata</i>
Tree frog spp.	<i>Litoria spp.</i>
Tawny frogmouth	<i>Podargus strigoides</i>
Barn owl	<i>Tyto delicata</i>
Southern boobook	<i>Ninox boobook</i>
Powerful Owl	<i>Ninox strenua</i>
Australian owl nightjar	<i>Aegotheles cristatus</i>
Grey goshawk	<i>Accipiter novaehollandiae</i>
Noisy pitta	<i>Pitta versicolor</i>
Glossy-black cockatoo	<i>Calyptorhynchus lathami</i>
Wonga pigeon	<i>Leucosarcia melanoleuca</i>
Pacific emerald dove	<i>Chalcophaps longirostris</i>
Eastern whipbird	<i>Psophodes olivaceus</i>
Eastern yellow robin	<i>Eopsaltria australis</i>
Australian brush turkey	<i>Alectura lathami</i>
Rufous fantail	<i>Rhipidura rufifrons</i>
Grey fantail	<i>Rhipidura albiscapa</i>
Superb fairywren	<i>Malurus cyaneus</i>
Variagated fairywren	<i>Malurus lamberti</i>
Fairywren spp.	
Welcome swallow	<i>Hirundo neoxena</i>
Australian logrunner	<i>Orthonyx temminckii</i>
Red-browed finch	<i>Neochmia temporalis</i>
Sacred kingfisher	<i>Todiramphus sanctus</i>
Azure kingfisher	<i>Ceyx azureus</i>
Grey shrike thrush	<i>Colluricincla harmonica</i>
Yellow-faced honeyeater	<i>Caligavis chrysops</i>
Lewin's honeyeater	<i>Meliphaga lewinii</i>
White-cheeked honeyeater	<i>Phylidonyris niger</i>
Yellow thornbill	<i>Acanthiza nana</i>
White-browed scrubwren	<i>Sericornis frontalis</i>
Australian magpie	<i>Cracticus tibicen</i>
Laughing kookaburra	<i>Dacelo novaeguineae</i>
Buff-banded rail	<i>Gallirallus philippensis</i>
Dollarbird	<i>Eurystomus orientalis</i>
Pacific black duck	<i>Anas superciliosa</i>
Striped gudgeon	<i>Gobiomorphus australis</i>
Mosquito fish	<i>Gambusia affinis</i>
House mouse	<i>Mus musculus</i>
Black rat	<i>Rattus rattus</i>
Red fox	<i>Vulpes vulpes</i>
Dog	<i>Canis lupus familiaris</i>
Cat	<i>Felis catus</i>
Cow	<i>Bos taurus</i>
Human	<i>Homo sapien</i>

Appendix B – Survey data

Table B1: Effort of adjacent habitat cameras during autumn and spring at NH2U, 2023.

Site	Location	Easting	Northing	Season	Install	Retrieve	Status	Battery (%)	No.vids	Date last vid (if flat)	Active days	Comments
Access G	East	498011	6626188	Autumn	22/03/2023	2/05/2023	Flat	0	38	ND	41	
Access G	West	497884	6626184	Autumn	22/03/2023	2/05/2023	Flat	0	92	2/04/2023	11	
Burkes	East	500375.3	6616785	Autumn	22/03/2023	3/05/2023	Flat	0	1097	31/03/2023	9	
Burkes	West	500233	6616841	Autumn	22/03/2023	3/05/2023	Active	90	427	-	42	
Dalhousie	East	499805	6622024	Autumn	22/03/2023	2/05/2023	NR		198	21/04/2023	30	
Dalhousie	West	499620.7	6621973	Autumn	22/03/2023	2/05/2023	NR		30	2/05/2023	41	
Martells Bridge	West	498835	6622534	Autumn	22/03/2023	2/05/2023	Active	90	88	-	41	
Martells bridge	East	498876	6622628	Autumn	22/03/2023	2/05/2023	Active	90	84	-	41	
Mcgraths	East	500743	6619939	Autumn	22/03/2023	3/05/2023	Flat	0	60	25/04/2023	34	
Mcgraths	West	500698	6619947	Autumn	22/03/2023	3/05/2023	Flat	0	0	-	42	
North Martells	East	498407	6623447	Autumn	22/03/2023	2/05/2023	Flat	0	1808	26/03/2023	4	
North Martells	West	498290	6623361	Autumn	22/03/2023	3/05/2023	Flat	0	887	3/05/2023	42	
South Martells	East	498603	6622918	Autumn	22/03/2023	2/05/2023	Flat	0	57	6/04/2023	15	
South Martells	West	498529	6622837	Autumn	22/03/2023	4/05/2023	Active	90	309	-	43	
Tyson's	East	498736	6627385	Autumn	22/03/2023	2/05/2023	Flat	0	7	27/03/2023	5	
Tyson's	West	498623	6627442	Autumn	22/03/2023	2/05/2023	Flat	0	1	30/03/2023	8	
Access G	East	498011	6626188	Spring	25/09/2023	26/10/2023	Flat	0	Check	-		
Access G	West	497884	6626184	Spring	25/09/2023	26/10/2023	Active	66	91	-	31	
Burkes	East	500375.3	6616785	Spring	25/09/2023	26/10/2023	Flat	0	Check	-		
Burkes	West	500233	6616841	Spring	25/09/2023	26/10/2023	Active	66	97	-	31	
Dalhousie	East	499805	6622024	Spring	25/09/2023	26/10/2023	Active	Uk	Check	-	31	Cam not turning on but red light works
Dalhousie	West	499620.7	6621973	Spring	25/09/2023	26/10/2023	Flat	0	Check	-		
Martells Bridge	West	498835	6622534	Spring	26/09/2023	26/10/2023	Flat	0	Check	-		
Martells bridge	East	498876	6622628	Spring	26/09/2023	26/10/2023	Active	66	40	-	30	
Mcgraths	East	500743	6619939	Spring	25/09/2023	26/10/2023	Active	33	24	-	31	
Mcgraths	West	500698	6619947	Spring	25/09/2023	26/10/2023	Active	66	117	-	31	
North Martells	East	498407	6623447	Spring	25/09/2023	26/10/2023	Flat	0	Check	-		
North Martells	West	498290	6623361	Spring	25/09/2023	26/10/2023	Flat	0	Check	-		
South Martells	East	498603	6622918	Spring	26/09/2023	26/10/2023	Active	100	291	-	30	
South Martells	West	498529	6622837	Spring	26/09/2023	26/10/2023	Active	uk	Check	-		Cam not turning on but flashing red still
Tyson's	East	498736	6627385	Spring	25/09/2023	26/10/2023	Active	33	20	-	31	
Tyson's	West	498623	6627442	Spring	25/09/2023	26/10/2023	Active?	uk	Check sd	-		Cam not turning on but flashing red still

Table B2: Daytime searches of adjacent habitat data during year seven NH2U monitoring, 2023. Msb = moves small branches, Mlb = moves large branches, RL = rustles leaves, Pseud. = Pseudophryne species, Lim = Limnodynastes species, Lit = Litoria species, Poss = possible, Prob = probable, E. water dragon = Eastern water dragon.

Location	Side	Obs. No.	Season	Date	Staff	Vis	Wind	Rain	Temp	Humidity	Start	Finish	Species	Comment
Tyson's	East	1	Autumn	22/03/2023	LA/EL	Good	Nil	Nil	19.3	94	945	1015	Nil	Nil
	West	1	Autumn	22/03/2023	LA/EL	Good	Nil	Nil	19.3	94	1017	1047	Nil	Nil
	East	2	Autumn	2/05/2023	AE EL	Good	Nil	Nil	21.5	52	13:00	13:15	Lampro, wallaby scat, bandicoot scat	Nil
	West	2	Autumn	2/05/2023	AE EL	Good	Nil	Nil	21.5	52	12:40	12:55	Bandicoot dig	Nil
Access G	East	1	Autumn	22/03/2023	LA/EL	Good	Nil	Nil	19.3	94	11:03	11:33	Antechinus scat, C. signifera (pond)	Nil
	West	1	Autumn	22/03/2023	LA/EL	Good	Nil	Nil	19.3	94	11:35	12:05	Nil	Nil
	East	2	Autumn	2/05/2023	AE EL	Good	Nil	Nil	21.5	52	13:23	13:38	Wallaby scat, EG scat, lampro	Nil
	West	2	Autumn	2/05/2023	AE EL	Good	Nil	Nil	21.5	52	13:45	14:00	Redback toadlet hc,scat fox btp spp., bandicoot dig	Nil
Nth Martells	East	1	Autumn	21/03/2023	EL/LA	Good	Nil	Nil	23.8	80	1123	1153	Wallaby scat, Medium reptile scat, lit fallax (pond)	Nil
	West	1	Autumn	21/03/2023	EL/LA	Good	Nil	Nil	23.8	80	1201	1231	C. signifera (pond), small reptile scat	Nil
	East	2	Autumn	3/05/2023	AE EL	Good	Nil	Nil	25.8	39	14:58	14:13	Fox scat, wallaby scat, reptile scat	Nil
	West	2	Autumn	3/05/2023	AE EL	Good	Nil	Nil	25.8	39	15:15	15:30	Wallaby scat, bandicoot digs	Nil
Sth Martells	East	1	Autumn	21/03/2023	EL/LA	Good	Nil	Nil	23.8	80	1302	1332	Antechinus scat, bandicoot digs	Nil
	West	1	Autumn	21/03/2023	EL/LA	Good	Nil	Nil	23.8	80	1201	1231	Fox scat, bandicoot digs	Nil
	East	2	Autumn	4/05/2023	AE EL	Good	Nil	Nil	20.5	51	1557	1612	Btp scat	Nil
	West	2	Autumn	4/05/2023	AE EL	Good	Nil	Nil	20.5	51	1631	1646	Lampro, bandicoot dig, reptile scat	Nil
Dalhousie	East	1	Autumn	22/03/2023	LA/EL	Good	Nil	Nil	19.3	94	13:04	13:34	Rodent scat, lampropholis spp. x 10	Nil
	West	1	Autumn	22/03/2023	LA/EL	Good	Nil	Nil	19.3	94	13:44	14:14	Nil	Nil
	East	2	Autumn	2/05/2023	AE EL	Good	Nil	Nil	21.5	52	15:40	15:55	Bandicoot dig	Nil
	West	2	Autumn	3/05/2023	AE EL	Good	Nil	Nil	25.8	39	14:18	14:33	Fox scat, bandicoot dig, several lampro, wallaby scat	Nil
Burkes	East	1	Autumn	21/03/2023	EL/LA	Good	Nil	Nil	23.8	80	9:15	9:45	Lampropholis spp. wallaby scat	Nil
	West	1	Autumn	21/03/2023	EL/LA	Good	Nil	Nil	23.8	80	9:47	10:13	Wallaby scat, Btp scat, small reptile scat	Nil
	East	1	Autumn	4/05/2023	AE EL	Good	Nil	Nil	20.5	51	14:01	14:16	Lampropholis multiple	Nil
	West	1	Autumn	4/05/2023	AE EL	Good	Nil	Nil	20.5	51	14:18	14:33	2x wallaby's, wallaby scat	Nil
Martells bridge	East	1	Autumn	22/03/2023	LA/EL	Good	Nil	Nil	19.3	94	12:17	12:47	Yellow-faced whip snake, dog tracks	Nil
	West	1	Autumn	22/03/2023	LA/EL	Good	Nil	Nil	19.3	94	12:54	13:24	Nil	Nil
	East	2	Autumn	3/05/2023	AE EL	Good	Nil	Nil	25.8	39	13:34	13:49	Lampro several, bandicoot digs, fox track, wallaby scat	Nil
	West	2	Autumn	3/05/2023	AE EL	Good	Nil	Nil	25.8	39	13:14	13:29	Bandicoot dig, yellow whipsnake, several lampro	Nil
Mcgraths	East	1	Autumn	21/03/2023	EL/LA	Good	Nil	Nil	23.8	80	1020	1050	Nil	Nil
	West	1	Autumn	21/03/2023	EL/LA	Good	Nil	Nil	23.8	80	1055	1010	Nil	Nil

Location	Side	Obs. No.	Season	Date	Staff	Vis	Wind	Rain	Temp	Humidity	Start	Finish	Species	Comment
	East	2	Autumn	3/05/2023	AE EL	Good	Nil	Nil	25.8	39	16:49	16:04	Lampropholis	Nil
	West	2	Autumn	3/05/2023	AE EL	Good	Nil	Nil	25.8	39	16:10	16:25	Nil	Nil
Tysons	East	1	Spring	25/09/2023	AE EL	Good	MSB	Nil	21	57	1553	1608	Litotia fallax hc, btp scat, wallaby spp. Scat, bandicoot digs	Low water
	West	1	Spring	25/09/2023	AE EL	Good	MSB	Nil	21	57	1610	1625	Bandicoot scat, bandicoot digs, wallaby scat	Nil
	East	2	Spring	28/09/2023	AE EL	Good	Nil	Nil	23	66	1415	1430	Amphibian scat, btp scat, wallaby scat, l. fallax hc, lampropholis	Nil
	West	2	Spring	28/09/2023	AE EL	Mod	Nil	Nil	23	66	1433	1448	Wallaby scat, bandicoot digs	Scattered clouds
Access G	East	1	Spring	25/09/2023	AE EL	Good	MSB	Nil	21	57	1635	1650	Lampropholis, wallaby scat, bandicoot dig, turkey mound, litoria fallax hc	Nil
	West	1	Spring	25/09/2023	AE EL	Good	MSB	Nil	21	57	1652	1707	Bandicoot dig, bandicoot scat, swamp wallaby, wallaby scat	Nil
	East	2	Spring	28/09/2023	AE EL	Mod	Nil	Nil	23	66	1458	1513	Bandicoot digs, wallaby scat, lampropholis multiple, l. fallax	Scattered clouds
	West	2	Spring	28/09/2023	AE EL	Mod	Nil	Nil	23	66	1514	1529	Reptile spp. sm, reptile scat, bandicoot digs, wallaby scat, lampropholis multiple	Scattered clouds
Nth martells	East	1	Spring	26/09/2023	AE EL	Good	RL	Nil	26	43	1408	1423	Fox scat, lampropholis, wallaby scat, sml reptile scat, bandicoot dig	Nil
	West	1	Spring	26/09/2023	AE EL	Good	RL	Nil	26	43	1425	1440	Bandicoot digs, wallaby scat, lampropholis	Nil
	East	2	Spring	28/09/2023	AE EL	Mod	Nil	Nil	22	67	1236	1251	Lampropholis multiple, wallaby scat, fox scat	Scattered clouds
	West	2	Spring	28/09/2023	AE EL	Good	Nil	Nil	22	67	1253	1310	Lampropholis multiple, wallaby scat, bandicoot dig	Nil
Sth martells	East	1	Spring	26/09/2023	AE EL	Good	RL	Nil	23	56	1621	1636	Fox, wallaby scat, bandicoot digs, btp scat	Nil
	West	1	Spring	26/09/2023	AE EL	Good	RL	Nil	23	56	1605	1620	L. Fallix hc, bandicoot digs, wallaby scat	Nil
	East	2	Spring	28/09/2023	AE EL	Good	Nil	Nil	22	67	1327	1342	Btp. Scat, lampropholis multiple, wallaby scat, bandicoot dig	Nil
	West	2	Spring	28/09/2023	AE EL	Good	Nil	Nil	22	67	1343	1358	L. Fallax hc, lampropholis multiple, bandicoot dig	Nil
Dalhousie	East	1	Spring	26/09/2023	AE EL	Good	RL	Nil	24	52	1305	1320	Bandicoot digs, wallaby scat, l. Fallax hc, lampropholis multiple, lace monitor	Nil
	West	1	Spring	26/09/2023	AE EL	Good	RL	Nil	24	52	1327	1342	Bandicoot digs, lampropholis multiple, wallaby scat, old turkey mound	Nil
	East	2	Spring	25/10/2023	NM/LA	Good	Nil	Nil	26.3	59	10:35	11:05	Lit Fallax, BtP scat, fox scat.	Nil
	West	2	Spring	25/10/2023	NM/LA	Good	Nil	Nil	26.3	59	11:05	11:35	Lace monitor, Lampropholis, Bandicoot scat and digs	Nil
Burkes	East	1	Spring	26/09/2023	AE EL	Good	RL	Nil	23	56	1537	1542	Wallaby scat, lampropholis multiple	Nil
	West	1	Spring	26/09/2023	AE EL	Good	RL	Nil	23	56	1544	1559	Wallaby hm, wallaby scat, lampropholis multiple, btp scat, bandicoot digs	Nil
	East	1	Spring	28/09/2023	AE EL	Mod	Nil	Nil	21	73	1140	1150	Lampropholis multiple, btp scat, bandicoot dig	Scattered clouds
	West	1	Spring	28/09/2023	AE EL	Mod	Nil	Nil	21	73	1124	1139	Lampropholis multiple, btp scat, bandicoot dig, fox scat, land mullet hm, wallaby scat, prob koala scat	Nil
Martells bridge	East	1	Spring	26/09/2023	AE EL	Good	RL	Nil	24	50	1206	1221	Lampropholis multiple, dog print, bandicoot digs, wallaby scat, l.delicata, l.guichenoti	Nil

Location	Side	Obs. No.	Season	Date	Staff	Vis	Wind	Rain	Temp	Humidity	Start	Finish	Species	Comment
	West	1	Spring	26/09/2023	AE EL	Good	RL	Nil	24	50	1147	1202	Bandicoot digs, Lampropholis multiple, l. Fallax hc	Nil
	East	2	Spring	25/10/2023	NM/LA	Good	Nil	Nil	26.3	59	915	945	Nil	Nil
	West	2	Spring	25/10/2023	NM/LA	Good	Nil	Nil	26.3	59	946	1016	Dog scat, fox scat	Nil
Mcgraths	East	1	Spring	26/09/2023	AE EL	Good	RL	Nil	26	43	1504	1514	Lampropholis multiple, wallaby scat	Water almost dried out
	West	1	Spring	26/09/2023	AE EL	Good	RL	Nil	26	43	1516	1531	Water dragon	Nil
	East	2	Spring	28/09/2023	AE EL	Mod	Nil	Nil	21	73	1155	1205	Lampropholis multiple	Scattered clouds
	West	2	Spring	28/09/2023	AE EL	Mod	Nil	Nil	21	73	1205	1220	Lampropholis multiple	Nil

Table B3: Nocturnal spotlight surveys of adjacent habitat during year seven NH2U monitoring, 2023. GHFF = grey-headed flying fox, SuG = sugar glider, Lit. = Litoria, SEBtP = short-eared brushtail possum, FtG = feathertail glider sp., CBtP = common brushtail possum, BtPoss = Brushtail possum species, TF = Tawny Frogmouth, CRTp = common ringtail possum, Pseud. = Pseudophryne species, Lim = Limnodynastes species, Lit = Litoria species, A. brevis = Adelotus brevis, Upe sp. = Uperolia species, ONJ = Owllet-Nightjar.

Location	Side	Season	Obs. No.	Date	Staff	Vis	Wind	Rain	Temp	Humidity	Start	Finish	Species	Comment
Tysons	East	Autumn	1	23/03/2023	LA, EL, AE	Poor	Nil	Heavy showers	21	90	1943	1953	Pr koala	difficult to see - bright eyeshine
	West	Autumn	1	23/03/2023	LA, EL, AE	Poor	Nil	Heavy showers	21	90	1954	2004	Nil	Nil
	East	Autumn	2	4/05/2023	LA	Good	Nil	Nil	16	64	1756	1820	Bandicoot scat	Nil
	West	Autumn	2	4/05/2023	LA	Good	Nil	Nil	16	64	1824	1854	SeBtP	Nil
Access G	East	Autumn	1	3/05/2023	AE/EL	Good	Nil	Nil	16	83	20:14	20:29	L.fallax hc	Nil
	West	Autumn	1	3/05/2023	AE/EL	Good	Nil	Nil	16	83	20:34	20:49	C.signifera, redbacked toadlet, sml snake spp.	Nil
	East	Autumn	2	4/05/2023	LA	Good	Nil	Nil	16	64	1934	2004	C.signifera, rodent scat	Nil
	West	Autumn	2	4/05/2023	LA	Good	Nil	Nil	16	64	1904	1934	SeBtp, c.signifera	Nil
Nth martells	East	Autumn	1	23/03/2023	LA/EL/AE	Fair	Poor	Heavy showers	21	90	2211	2221	P. Coriacea	Nil
	West	Autumn	1	23/03/2023	LA/EL/AE	Fair	Poor	Heavy showers	21	90	2211	2221	P. Coriacea	Nil
	East	Autumn	2	3/05/2023	AE/EL	Good	Nil	Nil	16	83	1856	1911	Owlet nightjar (HC)	Nil
	West	Autumn	2	3/05/2023	AE/EL	Good	Nil	Nil	16	83	19:16	19:31	Nil	Nil
Sth martells	East	Autumn	1	2/05/2023	AE/EL/LA	Good	ML	Nil	14	87	2140	2155	Nil	Nil
	West	Autumn	1	2/05/2023	AE/EL/LA	Good	ML	Nil	14	87	2200	2215	Nil	Nil
	East	Autumn	2	4/05/2023	AE/EL	Good	Nil	Nil	16	64	1914	1929	GHFF (SM)	Nil
	West	Autumn	2	4/05/2023	AE/EL	Good	Nil	Nil	16	64	1934	1949	GHFF (HC)	Nil
Dalhousie	East	Autumn	1	23/03/2023	LA/EL/AE	Fair	Poor	Heavy showers	21	90	2055	2115	P. Coriacea	Nil

Location	Side	Season	Obs. No.	Date	Staff	Vis	Wind	Rain	Temp	Humidity	Start	Finish	Species	Comment
	West	Autumn	1	23/03/2023	LA/EL/AE	Fair	Poor	Heavy showers	21	90	2055	2115	P. Coriacea	Nil
	East	Autumn	2	3/05/2023	AE/EL	Good	Nil	Nil	14	86	2150	2205	Nil	Nil
	West	Autumn	2	3/05/2023	AE/EL	Good	Nil	Nil	14	86	2209	2224	Lizard spp. Egernia spp.	Nil
Burkes	East	Autumn	1	3/05/2023	AE/EL	Good	Nil	Nil	19	61	1745	1800	FtG, BtP spp, FF.	Nil
	West	Autumn	1	3/05/2023	AE/EL	Good	Nil	Nil	19	61	1805	1815	Nil	Nil
	East	Autumn	1	4/05/2023	AE/EL	Good	Nil	Nil	16	64	1748	1803	GHFF	Nil
Martells bridge	West	Autumn	1	4/05/2023	AE/EL	Good	Nil	Nil	16	64	1808	1823	Nil	Nil
	East	Autumn	1	3/05/2023	AE/EL	Good	Nil	Nil	16	84	2106	2120	Nil	Nil
	West	Autumn	1	3/05/2023	AE/EL	Good	Nil	Nil	16	84	2122	2137	Nil	Nil
Mcgraths	East	Autumn	2	4/05/2023	AE/EL	Good	Nil	Nil	16	64	2012	2027	C.signifera, small-eyed snake	Nil
	West	Autumn	2	4/05/2023	AE/EL/LA	Good	Nil	Nil	16	64	2033	2048	Nil	Nil
	East	Autumn	1	3/05/2023	AE/EL	Good	MI	Nil	19	61	1820	1835	Tawny frogmouth	Nil
	West	Autumn	1	3/05/2023	AE/EL	Good	MI	Nil	19	61	1835	1848	SeBtP	Nil
	East	Autumn	2	4/05/2023	AE/EL	Good	Nil	Nil	16	64	1829	1844	Nil	Nil
	West	Autumn	2	4/05/2023	AE/EL	Good	Nil	Nil	16	64	1844	1859	Ringtail possum, SuG, FtG, 2x macropod spp.	Nil
Tysons	East	Spring	1	25/09/2023	AE EL	Good	MI	Nil	15	78	2131	2146	L. fallax hc, I. Peronii hc	Nil
	West	Spring	1	25/09/2023	AE EL	Good	MI	Nil	15	78	2148	2203	L. Fallax hc, frogmouth hc, ghff hc	Nil
	East	Spring	2	27/09/2023	AE EL	Good	Nil	Nil	19	84	2108	2123	L. fallax, I. peronii hc	Veg median obs. Ew dragon, black rat se
Access G	West	Spring	2	27/09/2023	AE EL	Good	Nil	Nil	19	84	2125	2140	Nil	Leaftail gecko in culvert
	East	Spring	1	25/09/2023	AE EL	Good	MI	Nil	15	78	2206	2217	L. fallax hc, I. Peronii hc	Nil
	West	Spring	1	25/09/2023	AE EL	Good	MI	Nil	15	78	2218	2230	Ghff hc, I. fallax hc	Nil
Nth martells	East	Spring	2	27/09/2023	AE EL	Good	Nil	Nil	19	84	2146	2151	Ghff hc, striped marsh frog sm, I. fallax hc, I. peronii hc	Nil
	West	Spring	2	27/09/2023	AE EL	Good	Nil	Nil	19	84	2152	2207	SqG se, bandicoot hc, OnJ hc, I. tyleri hc, macropod spp. hm	Nil
	East	Spring	1	25/09/2023	AE EL	Good	MI	Nil	18	68	1955	2010	Nil	Nil
Sth martells	West	Spring	1	25/09/2023	AE EL	Good	MI	Nil	18	68	2015	2032	Nil	Nil
	East	Spring	2	27/09/2023	AE EL	Good	Nil	Nil	19	84	1947	2002	Striped marsh frog sm	Nil
	West	Spring	2	27/09/2023	AE EL	Good	Nil	Nil	19	84	2005	2020	Owl spp. sm	Nil
	East	Spring	1	25/09/2023	AE EL	Good	MI	Nil	15	78	2052	2107	Se btp se, lit peronii hc	Microbat in culvert
	West	Spring	1	25/09/2023	AE EL	Good	MI	Nil	15	78	2109	2124	Lit fallax hc, lit peronii hc, sebtp se x2, macropod hm	Nil
	East	Spring	2	27/09/2023	AE EL	Good	Nil	Nil	19	84	2034	2049	L. fallax obs.	Nil
	West	Spring	2	27/09/2023	AE EL	Good	Nil	Nil	19	84	2051	2106	A. brevis, I. fallax, I. peronii hc	Nil

Location	Side	Season	Obs. No.	Date	Staff	Vis	Wind	Rain	Temp	Humidity	Start	Finish	Species	Comment
Dalhousie	East	Spring	1	25/09/2023	AE EL	Good	MI	Nil	15	80	2259	2314	Nil	Nil
	West	Spring	1	25/09/2023	AE EL	Good	MI	Nil	15	80	2240	2255	Nil	Nil
	East	Spring	2	27/09/2023	AE EL	Good	Nil	Nil	18	82	2250	2305	L. Fallax hc	Nil
	West	Spring	2	27/09/2023	AE EL	Good	Nil	Nil	18	82	2308	2323	L. Fallax hc, frogmouth obs.	Nil
Burkes	East	Spring	1	25/09/2023	AE EL	Good	MI	Nil	18	68	1822	1837	Cbtp sm, ghff sm	Nil
	West	Spring	1	25/09/2023	AE EL	Good	MI	Nil	18	68	1839	1854	Ringtail possum se, SuG se	Nil
	East	Spring	1	27/09/2023	AE EL	Good	Nil	Nil	20	82	1821	1836	House mouse hm, l. Fallax hc, a. brevis hc	Nil
	West	Spring	1	27/09/2023	AE EL	Good	Nil	Nil	20	82	1840	1855	Small petaurid spp. sm, sebtsp se	Nil
Martells bridge	East	Spring	1	25/09/2023	AE EL	Good	MI	Nil	15	80	2333	2343	Nil	Nil
	West	Spring	1	25/09/2023	AE EL	Good	MI	Nil	15	80	2321	2331	Nil	Nil
	East	Spring	2	27/09/2023	AE EL	Good	Nil	Nil	18	82	2215	2225	l. Fallax, l. Peronii hc, rodent spp. Sm	Nil
	West	Spring	2	27/09/2023	AE EL	Good	Nil	Nil	18	82	2227	2237	L. Fallax hc	Nil
Mcgraths	East	Spring	1	25/09/2023	AE EL	Good	MI	Nil	18	68	1912	1927	SuG hc, litoria fallax hc	Nil
	West	Spring	1	25/09/2023	AE EL	Good	MI	Nil	18	68	1930	1945	SuG hc, litoria fallax hc	Nil
	East	Spring	2	27/09/2023	AE EL	Good	Nil	Nil	20	82	1904	1919	L. fallax, a. brevis, l. tyleri hc	Nil
	West	Spring	2	27/09/2023	AE EL	Good	Nil	Nil	20	82	1920	1936	L. fallax, a. brevis, l. tyleri hc	Nil

Table B4: Underpass camera effort during year seven NH2U monitoring, 2023. A = active, CE = card error, Uk = unknown.

Site	Location	Season	Install	Check	Status	Battery (%)	No. Vids	Date last vid	Retrieve	Status	No.vids	Date last vid (if flat)	Active days	Comments
Burkes	Gound	Autumn	21/03/23	3/05/23	Active	80	83	-	5/06/23	A	38	-	76	Nil
Burkes	Furniture	Autumn	21/03/23	3/05/23	Active	99	CE - 0	-	5/06/23	A	298	-	43	Nil
Mcgraths	North	Autumn	21/03/23	3/05/23	Active	80	971	-	Missing	NA	NA	-	43	Cam missing
Mcgraths	South	Autumn	21/03/23	3/05/23	Flat	0	122	30/03/23	5/06/23	A	35	-	42	Nil
South Martells	Gound	Autumn	21/03/23	4/05/23	Active	90	118	-	5/06/23	A	65	-	76	Nil
South Martells	Furniture	Autumn	21/03/23	4/05/23	Active	99	693	-	5/06/23	A	456	-	76	Nil
North Martells	Gound	Autumn	21/03/23	2/05/23	Active	80	49	-	5/06/23	A	91	-	76	Nil
North Martells	Furniture	Autumn	21/03/23	2/05/23	Active	85	66	-	5/06/23	A	54	-	76	Nil
Tyson's east	Ground	Autumn	21/03/23	2/05/23	Active	90	128	-	5/06/23	A	81	-	76	Nil

Site	Location	Season	Install	Check	Status	Battery (%)	No. Vids	Date last vid	Retrieve	Status	No.vids	Date last vid (if flat)	Active days	Comments
Tyson's east	Furniture	Autumn	21/03/23	2/05/23	Active	80	302	-	5/06/23	A	140	-	76	Nil
Tyson's east	Split ground	Autumn	21/03/23	2/05/23	Active	90	21	12/04/23	5/06/23	A	81	-	56	Nil
Tyson's west	Ground	Autumn	21/03/23	2/05/23	Active	90	107	-	5/06/23	A	209	-	76	Nil
Tyson's west	Furniture	Autumn	21/03/23	2/05/23	Active	90	390	-	5/06/23	A	388	-	76	Nil
Tyson's west	Split ground	Autumn	21/03/23	2/05/23	Flat	0	CE - 0	-	5/06/23	A	CE	-	0	No data camera fault.
Access G	Ground	Autumn	21/03/23	2/05/23	Active	90	72	-	5/06/23	A	55	-	76	Nil
Access G	Furniture	Autumn	21/03/23	2/05/23	Active	90	0	-	5/06/23	A	CE	-	0	No data camera fault.
Access G	Split ground	Autumn	21/03/23	2/05/23	Active	10	109	-	5/06/23	A	73	-	76	Nil
Dalhousie east	Ground	Autumn	21/03/23	2/05/23	Active	90	116	-	5/06/23	A	166	-	76	Nil
Dalhousie east	Furniture	Autumn	21/03/23	2/05/23	Active	90	79	-	5/06/23	A	64	-	76	Nil
Dalhousie West	Ground	Autumn	21/03/23	2/05/23	Active	90	60	-	5/06/23	A	45	-	76	Nil
Dalhousie West	Furniture	Autumn	21/03/23	2/05/23	Active	91	57	-	5/06/23	A	46	-	76	Nil
Martell's bridge	Ground	Autumn	21/03/23	2/05/23	Flat	0	794	8/04/23	5/06/23	A	768	-	52	Nil
Martell's Bridge	Ground	Autumn	21/03/23	3/05/23	Cam flooded	Nr	685	15/04/23	5/06/23	A	286	-	58	Nil
Burkes	Ground	Spring	26/09/23	25/10/23	A	95	34	-	22/11/23	Flat	50	22/11/23	57	Nil
Burkes	Furniture	Spring	26/09/23	26/10/23	A	64	900	-	22/11/23	40%	122	-	57	Nil
Mcgrath's	North	Spring	26/09/23	25/10/23	A	95	265	-	22/11/23	66%	55	-	57	Nil
Mcgrath's	South	Spring	26/09/23	25/10/23	A	95	604	-	22/11/23	66%	0	Check	29	Camera not armed correctly
South Martell's	Ground	Spring	26/09/23	25/10/23	A	95	146	-	22/11/23	70%	82	-	57	Nil
South Martell's	Furniture	Spring	26/09/23	25/10/23	A	84	5	25/10/23	22/11/23	90%	108	-	57	Nil
North Martell's	Ground	Spring	26/09/23	25/10/23	A	95	58	-	22/11/23	90%	54	-	57	Nil
North Martell's	Furniture	Spring	26/09/23	25/10/23	F	0	1	25/10/23	22/11/23	90%	CE	Check	0	No data camera fault.
Tyson's east	Ground	Spring	27/09/23	25/10/23	A	95	71	25/10/23	22/11/23	90%	136	-	56	Nil

Site	Location	Season	Install	Check	Status	Battery (%)	No. Vids	Date last vid	Retrieve	Status	No.vids	Date last vid (if flat)	Active days	Comments
Tysons east	Furniture	Spring	27/09/23	25/10/23	A	95	88	-	22/11/23	80%	83	-	56	Nil
Tysons east	Split ground	Spring	27/09/23	25/10/23	A	95	139	-	22/11/23	90%	194	-	56	Nil
Tysons west	Ground	Spring	27/09/23	25/10/23	A	95	109	-	22/11/23	90%	98	-	56	Nil
Tysons west	Furniture	Spring	27/09/23	25/10/23	A	95	177	-	22/11/23	90%	58	-	56	Nil
Tysons west	Split ground	Spring	27/09/23	25/10/23	A	95	87	-	22/11/23	90%	102	-	56	Nil
Access G	Ground	Spring	27/09/23	25/10/23	A	95	38	-	22/11/23	90%	47	-	56	Nil
Access G	Furniture	Spring	27/09/23	25/10/23	A	95	75	-	22/11/23	90%	101	-	56	Nil
Access G	Split ground	Spring	27/09/23	25/10/23	A	95	135	-	22/11/23	90%	121	-	56	Nil
Dalhousie east	Gound	Spring	26/09/23	25/10/23	A	95	92	-	24/11/23	90%	139	-	59	Nil
Dalhousie east	Furniture	Spring	26/09/23	26/10/23	A	66	48	-	24/11/23	80%	773	-	59	Nil
Dalhousie West	Gound	Spring	26/09/23	25/10/23	A	95	88	-	24/11/23	70%	85	-	59	Nil
Dalhousie West	Furniture	Spring	26/09/23	26/10/23	A	75	268	-	24/11/23	Flat	88	24/11/23	59	must have died on retrieve
Martells bridge south	Ground	Spring	26/09/23	25/10/23	A	95	511	-	22/11/23	90%	739	-	57	Nil
Martells Bridge north	Ground	Spring	26/09/23	25/10/23	A	95	373	-	22/11/23	90%	848	-	57	Nil

Table B5: Underpass sand pad track data during year seven NH2U monitoring, 2023. Prob = probably, poss = possible, Lit = Litoria, Btposs = brushtail possum, unid = unidentified, E = east, W = west.

Site	Cell	Date	Check no.	Tracks (no. of/direction of travel)	Pad condition	Comments
Tysons	NE	2/05/2023	Install	N/A		2 bags each (8 bags)
		3/05/2023	1	Nil	Good	Nil
		4/05/2023	2	Nil	Good	Nil
		5/05/2023	3	Rodent spp 2e1w	Good	Nil
		6/05/2023	4	Nil	Good	Nil
	SE	2/05/2023	Install	N/A		Nil
		3/05/2023	1	Nil	Good	Nil
		4/05/2023	2	Nil	Good	Nil
		5/05/2023	3	Rodent spp 1e1w	Good	Nil

Site	Cell	Date	Check no.	Tracks (no. of/direction of travel)	Pad condition	Comments
		6/05/2023	4	Rodent spp 1e	Good	Nil
	NW	2/05/2023	Install	N/A		Nil
		3/05/2023	1	Rattus spp 2e, antechinus 1w	Good	Nil
		4/05/2023	2	Rodent spp 1e	Good	Nil
		5/05/2023	3	Nil	Good	Nil
		6/05/2023	4	Rodent spp 1e1w	Good	Nil
	SW	2/05/2023	Install	N/A		Nil
		3/05/2023	1	Nil	Water through middle	Nil
		4/05/2023	2	Rodent spp 1w	Water through middle	Nil
		5/05/2023	3	Nil	Water through middle	Nil
	6/05/2023	4	Nil	Water through middle	Nil	
Access G	N	2/05/2023	Install	N/A		2 bags each (4 bags)
		3/05/2023	1	Dog 1w	Good	Nil
		4/05/2023	2	Rodent 1w	Good	Nil
		5/05/2023	3	Water rat 2e2w	Good	Nil
		6/05/2023	4	Water rat 1e, eastern water dragon 1e	Good	Nil
	S	2/05/2023	Install	N/A		Nil
		3/05/2023	1	Nil	Water through middle	Nil
		4/05/2023	2	Small lizard 1e1w	Water through middle	Nil
		5/05/2023	3	Water rat 1e	Water through middle	Nil
	6/05/2023	4	Nil	Water through middle	Nil	
Nth Martells	Single	2/05/2023	Install	N/A		2 bags
		3/05/2023	1	Rodent spp. 1e 1w	Water through middle	Nil
		4/05/2023	2	Nil	Water through middle	Nil
		5/05/2023	3	Nil	Water through middle	Nil
		6/05/2023	4	Nil	Water through middle	Nil
Sth Martells	Single	2/05/2023	Install	N/A		2 bags
		3/05/2023	1	Rodent spp. incomplete	Good	Nil
		4/05/2023	2	Nil	Good	Nil
		5/05/2023	3	Nil	Good	Nil
		6/05/2023	4	Nil	Good	Nil
Dalhousie	E	2/05/2023	Install	N/A		2 bags each (4 bags)
		3/05/2023	1	Nil	Water through middle	Nil
		4/05/2023	2	House mouse 1e1w, rodent spp. 1w	Water through middle	Nil
		5/05/2023	3	Nil	Water through middle	Nil
		6/05/2023	4	Rodent spp. 2e3w	Water through middle	Nil

Site	Cell	Date	Check no.	Tracks (no. of/direction of travel)	Pad condition	Comments
	W	2/05/2023	Install	N/A		Nil
		3/05/2023	1	Rodent spp. 1e 1w rattus, antechinus 2w	Good	Nil
		4/05/2023	2	Rodent spp. 1e1w	Good	Nil
		5/05/2023	3	Nil	Good	Nil
		6/05/2023	4	House mouse 1e?, possible antechinus 1w	Good	Nil
Burkes	Single	2/05/2023	Install	N/A		3 bags
		3/05/2023	1	Wallaby spp. 1 e 1w	Good	Nil
		4/05/2023	2	Rodent spp. 2e, wallaby 1e	Good	Nil
		5/05/2023	3	Nil	Good	Nil
		6/05/2023	4	Water rat? 1e1w	Good	Nil
Martels bridge	N	2/05/2023		Not installed. Missing		Nil
	S	2/05/2023	Install	N/A		Old sandpad smoothed out
		3/05/2023	1	Nil	Good	Nil
		4/05/2023	2	Nil	Good	Nil
		5/05/2023	3	Nil	Good	Nil
		6/05/2023	4	Nil	Good	Nil
Mcgrath	S		No install	Inundated	Inundated	2 bags each (6)
Tysons	NE	30/10/2023	Install	N/A		2 bags each (8 bags)
		31/10/2023	1	Water dragon 1e2w, rodent 1e	Good	Nil
		1/11/2023	2	Lace monitor? 1w, rodent numerous	Good	Nil
		2/11/2023	3	Water dragon and lace monitor 1e1w	Good	Nil
		3/11/2023	4	Rodent meandering	Good	Nil
	SE	30/10/2023	Install	N/A		Nil
		31/10/2023	1	1 e water dragon, rodent 2e2w	Good	Nil
		1/11/2023	2	Rodent 1e	Good	Nil
		2/11/2023	3	Water dragon 1w2e, Btp 1e1w	Good	Nil
		3/11/2023	4	Water dragon 1e, rodent meandering	Good	Nil
	NW	30/10/2023	Install	N/A		Nil
		31/10/2023	1	Snake spp. 1 w rodent 1e1w	Good	Nil
		1/11/2023	2	Lace monitor 1w rodent meandering	Good	Nil
		2/11/2023	3	BtP 1e1w, rodent meandering	Good	Nil
		3/11/2023	4	Btp 1e1w water dragon?1e1w	Good	Nil
	SW	30/10/2023	Install	N/A		Nil
		31/10/2023	1	Btp 1e1w	Good	Nil
		1/11/2023	2	Rodent meandering, Lace monitor 1w	Good	Nil

Site	Cell	Date	Check no.	Tracks (no. of/direction of travel)	Pad condition	Comments
		2/11/2023	3	Rodent 1e1w, Btp2w, water dragon 1e1w	Good	Nil
		3/11/2023	4	Nil	Good	Nil
Access G	N	30/10/2023	Install	N/A		2 bags each (4 bags)
		31/10/2023	1	Water dragon 1e1w	Good	Nil
		1/11/2023	2	Nil	Good	Nil
		2/11/2023	3	Nil	Good	Nil
		3/11/2023	4	Lace monitor 1e, rodent 1e1w	Good	Nil
	S	30/10/2023	Install	N/A		Nil
		31/10/2023	1	Nil	Good	Nil
		1/11/2023	2	Water dragon 2e	Good	Nil
		2/11/2023	3	Rodent 2e2w (meandering), antechinus 2e1w	Good	Nil
		3/11/2023	4	Lace monitor? 1w	Good	Nil
Nth Martells	Single	30/10/2023	Install	N/A		2 bags
		31/10/2023	1	1e1w BtP	Good	Nil
		1/11/2023	2	Rodent 2e1w, Btp 1e	Good	Nil
		2/11/2023	3	1e Frog spp, Rodent 1 e1w	Good	Nil
		3/11/2023	4	1e1w BtP	Good	Nil
Sth Martells	Single	30/10/2023	Install	N/A		2 bags
		31/10/2023	1	Rodent 3e1w	Good	Nil
		1/11/2023	2	Rodent 1e	Good	Nil
		2/11/2023	3	Rodent 1e1w	Good	Nil
		3/11/2023	4	Rodent 2e2w (meandering)	Good	Nil
Dalhousie	E	30/10/2023	Install	N/A		2 bags each (4 bags)
		31/10/2023	1	Antechinus 1e1w, rodent 1 west	Good	Nil
		1/11/2023	2	Lace monitor 1w, rodent 1e1w	Good	Nil
		2/11/2023	3	Water dragon 1e1w, lace monitor 1e	Good	Nil
		3/11/2023	4	Rodent 1e1w, Btp2w, water dragon 1e1w	Good	Nil
	W	30/10/2023	Install	N/A		Nil
		31/10/2023	1	Antechinus 2e1w	Good	Nil
		1/11/2023	2	Lace monitor 1w, rodent meandering	Good	Nil
		2/11/2023	3	Rodent meandering	Good	Nil
		3/11/2023	4	Antechinus 1e, lace monitor 1e, Btp 1, rodent 1w	Good	Nil
Burkes	Single	30/10/2023	Install	N/A		3 bags
		31/10/2023	1	Nil	Good	Nil
		1/11/2023	2	Lace monitor 1e	Good	Nil
		2/11/2023	3	Rodent 1e1w	Good	Nil

Site	Cell	Date	Check no.	Tracks (no. of/direction of travel)	Pad condition	Comments
Martels bridge		3/11/2023	4	Nil	Good	Nil
	N			Not installed.		
	S	30/10/2023	Install	N/A		Nil
		31/10/2023	1	Dog 1e, fox 1e	Good	Nil
		1/11/2023	2	Nil	Good	Nil
		2/11/2023	3	Cat? 1e1w	Good	Nil
	3/11/2023	4	Large bird 1e	Good	Nil	
Mcgrath	S			Inundated		

Table B6: Underpass tracks/scats data during year seven NH2U monitoring, 2023.

Site	Cell	Check no.	Season	Date	Scats	Tracks	Comments
Tysons	NE	1	Autumn	21/03/2023	Rodent spp., small lizard spp.	Nil	Nil
		2	Autumn	2/05/2023	Rodent spp.	Nil	Nil
		3	Autumn	5/06/2023	Antechinus spp., rodent spp	Fox, rodent spp., water rat	Nil
	SE	1	Autumn	21/03/2023	Rodent spp., bandicoot spp.	Nil	Nil
		2	Autumn	2/05/2023	Rodent spp.	Nil	Nil
		3	Autumn	5/06/2023	Antechinus spp., rodent spp.	Water rat, rodent spp., bandicoot spp.	Nil
	NW	1	Autumn	21/03/2023	Rodent on rail	Nil	Nil
		2	Autumn	2/05/2023	Bandicoot spp.	Nil	Nil
		3	Autumn	5/06/2023	Antechinus spp., rodent spp.	Nil	Nil
SW	1	Autumn	21/03/2023	Nil	Nil	Nil	
	2	Autumn	2/05/2023	Rodent spp.	Nil	Nil	
	3	Autumn	5/06/2023	Nil	Nil	Nil	
Access G	N	1	Autumn	20/03/2023	Fox, medium lizard, microbat spp. swallow	Nil	Nil
		2	Autumn	2/05/2023	Rodent spp., small lizard spp., microbat spp.	Nil	Nil
		3	Autumn	5/06/2023	Nil	Nil	Nil
	S	1	Autumn	20/03/2023	Rodent spp.	Nil	Nil
		2	Autumn	2/05/2023	Rodent spp., microbat spp.	Nil	Nil
		3	Autumn	5/06/2023	Nil	Nil	Nil
Nth Martells	Single cell	1	Autumn	21/03/2023	Wallaby, bird spp.	Nil	Nil
		2	Autumn	2/05/2023	Rodent spp.	Nil	Nil
		3	Autumn	5/06/2023	Nil	Nil	Nil
Sth Martells	Single cell	1	Autumn	21/03/2023	Nil	Nil	Nil

Site	Cell	Check no.	Season	Date	Scats	Tracks	Comments
		2	Autumn	3/05/2023	Btp spp., rodent spp., microbat	Nil	Nil
		3	Autumn	5/06/2023	Microbat, rodent spp. and Btp spp.	Nil	Nil
Dalhousie	E	1	Autumn	21/03/2023	Antechinus spp. on rail, rodent spp. on rail	Nil	Nil
		2	Autumn	2/05/2023	Rodent spp., amphibian	Nil	Nil
		3	Autumn	5/06/2023	Antechinus spp.	Nil	Nil
	W	1	Autumn	21/03/2023	Nil	Nil	Nil
		2	Autumn	2/05/2023	Small reptile	Nil	Nil
		3	Autumn	5/06/2023	Antechinus spp.	Nil	Nil
Burkes	Single cell	1	Autumn	20/03/2023	Swallow	Lace monitor, red-necked wallaby	Nil
		2	Autumn	3/05/2023	Rodent spp.	Nil	Nil
		3	Autumn	5/06/2023	Rodent spp.	Rodent tracks - water rat?	Nil
Martells bridge	Bridge	1	Autumn	20/03/2023	Medium lizard, wallaby spp.	Nil	Nil
		2	Autumn	2/05/2023	Small reptile, wallaby spp.	Nil	Nil
		3	Autumn	5/06/2023	Small reptile	Nil	Nil
Mcgraths	S	1	Autumn	NS	NS	NS	Inundated
		2	Autumn	NS	NS	NS	Inundated
		3	Autumn	NS	NS	NS	Inundated
Tyson's	NE	1	Spring	25/09/2023	Btp, rodent spp., antechinus spp., fox	Nil	Nil
		2	Spring	25/10/2023	Rodent, bandicoot, antechinus	Medium lizard	Nil
		3	Spring	22/11/2023	Rodent, bandicoot	Rodent, btp, large lizard	Nil
	SE	1	Spring	25/09/2023	Bandicoot, antechinus, rodent	Antechinus, rodent	Nil
		2	Spring	25/10/2023	Rodent	Bandicoot, medium reptile	Nil
		3	Spring	22/11/2023	Rodent	Med lizard, rodent	Nil
	NW	1	Spring	25/09/2023	Antechinus spp.	Nil	Nil
		2	Spring	25/10/2023	Rodent, antechinus	Nil	Nil
		3	Spring	22/11/2023	Sml reptile, rodent, antechinus	Btp, rodent, lizard medium	Nil
	SW	1	Spring	25/09/2023	Rodent	Nil	Nil
		2	Spring	25/10/2023	Nil	Nil	Nil
		3	Spring	22/11/2023	Btp, rodent	Btp, rodent, lizard sp	Nil
Access G	N	1	Spring	25/09/2023	Rodent	Reptile, rodent	Nil
		2	Spring	25/10/2023	Rodent	Water dragon	Nil
		3	Spring	22/11/2023	Rodent, bird	Nil	Nil
	S	1	Spring	25/09/2023	Rodent, bird	Reptile	Nil
		2	Spring	25/10/2023	Reptile	Water dragon	Nil
		3	Spring	22/11/2023	Rodent	Nil	Nil

Site	Cell	Check no.	Season	Date	Scats	Tracks	Comments
Nth Martells	Single cell	1	Spring	26/09/2023	Bird, fox	Btp, reptile spp.	Nil
		2	Spring	25/10/2023	Nil	Water dragon, rodent	Nil
		3	Spring	22/11/2023	Bird	Nil	Nil
Sth Martells	Single cell	1	Spring	26/09/2023	Microbat, fox, btp	Nil	Nil
		2	Spring	25/10/2023	Microbat, bandicoot, btp	Nil	Nil
		3	Spring	22/11/2023	Rodent, btp, microbat	Nil	Nil
Dalhousie	E	1	Spring	26/09/2023	Possum, rodent	Nil	Carpet python culvert apron
		2	Spring	25/10/2023	Rodent	Nil	Nil
		3	Spring	22/11/2023	Nil	Nil	Nil
	W	1	Spring	26/09/2023	Rodent, fox	Nil	Nil
		2	Spring	25/10/2023	Antechinus, microbat	Nil	Nil
		3	Spring	22/11/2023	Nil	Nil	Nil
Burkes	Single cell	1	Spring	26/09/2023	Btp, rodent	Rodent spp., fox, bandicoot spp.	Nil
		2	Spring	25/09/2023	BTP, bandicoot	Water dragon, rodent, bandicoot	Nil
		3	Spring	22/11/2023	Btp, rodent	Rodent, cat, btp, bandicoot	Nil
Martells bridge	Bridge	1	Spring	26/09/2023	Rodent, bandicoot, small reptile, microbat	Dog	Nil
		2	Spring	25/10/2023	Fox, dog	Nil	Nil
		3	Spring	22/11/2023	Reptile	Large reptile	Nil
Mcgraths	S	1	Spring	No search	No search	No search	inundated
		2	Spring	25/10/2023	Rodent	Nil	Nil
		3	Spring	22/11/2023	Wallaby	Nil	Nil

Table B7: Frog survey data during year seven NH2U monitoring, 2023. Lit = Litoria spp., C. = Crinia spp., Pseud. = Pseudophryne spp., Lim. = Limnodynastes spp., M. fasciolatus = Mixophyes fasciolatus, HC= Heard call, SE= Saw eyeshine, SM= Saw movement.

Location	Obs .No	Date	Staff	Visibilit y	Wind	Rain	Air Temp	Humidity	Start	Finish	Species UP	Species ad hab	Comment
Tyson's	1	23/03/2023	LA, EL, AE	Poor	Nil	Heavy showers	21	90	1943	1948	Nil	Nil	Prob koala in ad hab east side
	2	4/05/2023	LA	Good	Nil	Nil	16	64	1820	1824	Nil	Nil	Nil
Access G	1	23/03/2023	LA, EL, AE	Poor	Nil	Heavy showers	21	90	2009	2014	Nil	L.fallax hc	Nil
	2	3/05/2023	EL, AE	Good	Nil	Nil	16	84	2029	2034	Nil	Nil	Nil
	3	4/05/2023	LA	Good	Nil	Nil	16	64	1933	1937	Nil	C.signifera, redbacked toadlet hc	Nil
Nth Martells	1	23/03/2023	LA, EL, AE	Poor	Nil	Heavy showers	21	90	2212	2220	Nil	P. Coriacea (hc)	Nil

Location	Obs .No	Date	Staff	Visibility	Wind	Rain	Air Temp	Humidity	Start	Finish	Species UP	Species ad hab	Comment
	2	3/05/2023	EL, AE	Good	Nil	Nil	16	83	1911	1916	Nil	Nil	Nil
Sth martells	1	23/03/2023	LA, EL, AE	Poor	Nil	Heavy showers	21	90	2235	2245	Nil	Nil	Nil
	2	2/05/2023	EL, AE	Good	Nil	Nil	16	83	2155	2200	Nil	Nil	Nil
	3	4/05/2023	EL, AE	Good	Nil	Nil	16	64	1929	1933	Nil	Nil	Nil
Dalhousie	1	23/03/2023	LA, EL, AE	Poor	Nil	Heavy showers	21	90	2050	2055	Nil	P. Coriacea (hc)	Nil
	2	3/05/2023	EL, AE	Good	Nil	Nil	14	86	2205	2209	Nil	Nil	Nil
Burkes	1	23/03/2023	LA, EL, AE	Poor	Nil	Heavy showers	21	90	2015	2021	Nil	Nil	Nil
	2	3/05/2023	EL, AE	Good	Nil	Nil	19	61	1800	1805	Nil	Nil	Nil
	3	4/05/2023	EL, AE	Good	Nil	Nil	16	64	1804	1808	Nil	Nil	Nil
Martells bridge	1	23/03/2023	LA, EL, AE	Poor	Nil	Heavy showers	21	90	2027	2032	Nil	Nil	Nil
	2	3/05/2023	EL, AE	Good	Nil	Nil	16	84	2120	2125	Nil	Nil	Nil
	3	4/05/2023	LA, EL, AE	Good	Nil	Nil	16	64	20:27	2033	Nil	C.signifera (hc)	Nil
Mcgraths	1	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	Inundated 1m water
	2	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	Inundated 1m water
	3	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	Inundated 1m water
	4	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	Inundated 1m water
Tysons	1	25/09/2023	AE EL	Good	Lm	Nil	15	78	2146	2149	Nil	L. fallax hc, I. Peronii hc	Nil
	2	27/09/2023	AE EL	Good	Nil	Nil	19	82	2123	2125	Nil	L. fallax hc, I. Peronii hc	Nil
	3	25/10/2023	LA/NM	Good	Nil	Nil	23.4	76	1915	1920	Nil	L.dentata, L.fallax (HC)	Nil
	4	26/10/2023	LA/NM	Poor	RL	Heavy showers	16.5	94	2007	2017	Nil	L. dentata, Lit. Peronii (HC)	Nil
	5	1/11/2023	AE/LA	Good	19.3	Light showers	19.3	82	1931	1941	Nil	Lit peronii, L. Fallax, P. coriacea (all HC)	Male koala heard calling 100m west of culvert
Access G	1	25/09/2023	AE EL	Good	MI	Nil	15	78	2217	2219	Nil	L. fallax hc, I. Peronii hc	Nil
	2	27/09/2023	AE EL	Good	Nil	Nil	18	82	2151	2153	Nil	Striped marsh frog sm, I. fallax hc, I. peronii hc, I. tyleri hc	Nil
	3	25/10/2023	LA/NM	Good	Nil	Nil	23.4	76	1915	1920	Nil	L.fallax (HC)	Nil

Location	Obs .No	Date	Staff	Visibilit y	Wind	Rain	Air Temp	Humidity	Start	Finish	Species UP	Species ad hab	Comment
	4	26/10/2023	LA/NM	Poor	RL	Heavy showers	16.5	94	2022	2032	Nil	Lim. Peronii (SM)	Nil
	5	1/11/2023	AE/LA	Good	19.3	Light showers	19.3	82	1948	1958	Nil	L. Fallax, L. Tylerii	Nil
Martells bridge	1	25/09/2023	AE EL	Good	Lm	Nil	15	80	2331	2334	Nil	Nil	Nil
	2	27/09/2023	AE EL	Good	Nil	Nil	18	82	2225	2227	Nil	I. Fallax, I. Peronii hc	Nil
	3	25/10/2023	LA/NM	Good	Nil	Nil	23.4	76	1952	2002	Nil	Lit fallax	Nil
	4	26/10/2023	LA/NM	Poor	RL	Heavy showers	16.5	94	2041	2051	Nil	Nil	Nil
	5	1/11/2023	AE/LA	Good	19.3	Light showers	19.3	82	2007	2017	Nil	L. Fallax	Nil
Dalhousie	1	25/09/2023	AE EL	Good	Lm	Nil	15	80	2255	2258	Nil	Nil	Nil
	2	27/09/2023	AE EL	Good	Nil	Nil	18	82	2305	2308	Nil	L. Fallax hc	Nil
	3	25/10/2023	LA/NM	Good	Nil	Nil	23.4	76	2015	2025	Nil	L.fallax	Nil
	4	26/10/2023	LA/NM	Poor	RL	Heavy showers	16.5	94	2059	2109	Nil	L. dentata, Lit. Peronii (HC)	Nil
	5	1/11/2023	AE/LA	Good	19.3	Light showers	19.3	82	2028	2038	Nil	L. Fallax, L. Dentata	Nil
Mcgraths	1	NS	NS		NS	NS	NS	NS	NS	NS	NS	NS	Inundated
	2	NS	NS		NS	NS	NS	NS	NS	NS	NS	NS	Inundated
	3	25/10/2023	LA/NM	Good	Nil	Nil	23.4	76	1915	1920	Nil	Nil	Nil
	4	26/10/2023	LA/NM	Poor	RL	Heavy showers	16.5	94	1911	1921	Nil	Nil	Nil
	5	1/11/2023	AE/LA	Good	19.3	Light showers	19.3	82	2043	2053	Nil	A. Brevis, L. Fallax	Inundated
Burkes	1	25/09/2023	AE EL	Good	Lm	Nil	18	68	1837	1839	Nil	Nil	Hc in adhab spot
	2	27/09/2023	AE EL	Good	Nil	Nil	20	82	1836	1840	Nil	L. Fallax hc, a. brevis hc	Nil
	3	25/10/2023	LA/NM	Good	Nil	Nil	23.4	76	2044	2054	Nil	Nil	Nil
	4	26/10/2023	LA/NM	Poor	RL	Heavy showers	16.5	94	1900	1910	Nil	Lit fallax	Nil
	5	1/11/2023	AE/LA	Good	19.3	Light showers	19.3	82	2111	2121	Nil	L. Fallax, C. Signifera, A. brevis	Nil
Sth martells	1	25/09/2023	AE EL	Good	Lm	Nil	15	78	2107	2109	Nil	L. peronii hc, L. fallax hc	Nil
	2	27/09/2023	AE EL	Good	Nil	Nil	19	82	2049	2051	Nil	A. brevis (hc), I. fallax (obs.), I. peronii (hc)	Nil

Location	Obs .No	Date	Staff	Visibilit y	Wind	Rain	Air Temp	Humidity	Start	Finish	Species UP	Species ad hab	Comment
	3	25/10/2023	LA/NM	Good	Nil	Nil	23.4	76	2105	2115	M.fasciolatus (SE)	A.brevis, M.fasciolatus, Lit. Peronii, L.fallax	Photo on Nirvarnas Phone M. Fasciolatus
	4	26/10/2023	LA/NM	Poor	RL	Heavy showers	16.5	94	1933	1943	Nil	A. brevis, Lit. Peronii, P. Coreacea	Nil
	5	1/11/2023	AE/LA	Good	19.3	Light showers	19.3	82	2127	2137	Nil	Nil	Nil
Nth Martells	1	25/09/2023	AE EL	Good	Lm	Nil	18	68	2011	2014	Nil	Nil	Nil
	2	27/09/2023	AE EL	Good	Nil	Nil	19	82	2002	2005	Nil	Striped marsh frog sm	Nil
	3	25/10/2023	LA/NM	Good	Nil	Nil	23.4	76	2126	2136	Nil	Nil	Nil
	4	26/10/2023	LA/NM	Poor	RL	Heavy showers	16.5	94	1947	1957	Lim. Peronii culvert apron	Lim. Peronii (SM), Lit fallax (HC)	Nil
	5	1/11/2023	AE/LA	Good	19.3	Light showers	19.3	82	2139	2139	Nil	L. Fallax	Nil

Table B8: Underpass hair funnel data during year seven monitoring at NH2U, 2023.

Funnel ID	Season	Install Date	Collect date	Active days	Species #1	Species #2
Dalhousie E G	Autumn	2/05/2023	5/06/2023	34	Isoodon macrourus/Peremales nasuta	Nil
Dalhousie E FF	Autumn	2/05/2023	5/06/2023	34	Nil	Nil
Dalhousie W G	Autumn	2/05/2023	5/06/2023	34	Nil	Nil
Dalhousie W FF	Autumn	2/05/2023	5/06/2023	34	Mus musculus	Nil
South Martells FF	Autumn	2/05/2023	5/06/2023	34	Mus musculus	Rattus rattus
South Martells G	Autumn	2/05/2023	5/06/2023	34	Mus musculus	Trichosurus sp.
Burke's Gr	Autumn	2/05/2023	5/06/2023	34	Mus musculus	Trichosurus vulpecula
Burke's FF	Autumn	2/05/2023	5/06/2023	34	Mus musculus	Trichosurus vulpecula
North Martells G	Autumn	2/05/2023	5/06/2023	34	Mus musculus	Nil
North Martells FF	Autumn	2/05/2023	5/06/2023	34	Mus musculus	Nil
Tyson's WG	Autumn	2/05/2023	5/06/2023	34	Antechinus sp.	Nil
Tyson's W FF	Autumn	2/05/2023	5/06/2023	34	Nil	Nil
Tyson's E G	Autumn	2/05/2023	5/06/2023	34	Mus musculus	Nil
Tyson's E FF	Autumn	2/05/2023	5/06/2023	34	Antechinus stuartii	Nil
Access G Gr	Autumn	2/05/2023	5/06/2023	34	Mus musculus,	Rattus fuscipes (probable)
Access G FF	Autumn	2/05/2023	5/06/2023	34	Mus musculus	Nil
Martells Bridge E	Autumn	2/05/2023	5/06/2023	34	Mus musculus	Nil
Martells Bridge S	Autumn	2/05/2023	5/06/2023	34	Mus musculus	Nil
Dalhousie EE Gr	Spring	26/10/2023	22/11/2023	27	Nil	Nil

Funnel ID	Season	Install Date	Collect date	Active days	Species #1	Species #2
Dalhousie WW FF	Spring	26/10/2023	22/11/2023	27	Nil	Nil
South Martells FF	Spring	26/10/2023	22/11/2023	27	Rattus rattus	Nil
South Martells W	Spring	26/10/2023	22/11/2023	27	Rattus rattus	Nil
Burke's FF	Spring	26/10/2023	22/11/2023	27	Trichosurus vulpecula	Nil
Burke's Gr	Spring	26/10/2023	22/11/2023	27	Nil	Nil
North Martells FF	Spring	26/10/2023	22/11/2023	27	Nil	Nil
North Martells W	Spring	26/10/2023	22/11/2023	27	Nil	Nil
Tyson's W G	Spring	26/10/2023	22/11/2023	27	Nil	Nil
Tyson's E FF	Spring	26/10/2023	22/11/2023	27	Nil	Nil
Access G N	Spring	26/10/2023	22/11/2023	27	Nil	Nil
Access G E	Spring	26/10/2023	22/11/2023	27	Nil	Nil
Martells Bridge N	Spring	26/10/2023	22/11/2023	27	Mus musculus	Nil
Martells Bridge S	Spring	26/10/2023	22/11/2023	27	Wallabia bicolor(probable)	Nil

Table B9: Exclusion fence camera effort during year seven monitoring at NH2U, 2023.

Site	Easting	Northing	Season	Install date	Date retrieved	Status	No. vids	Date last vid	Days Active	Comments
Dalhousie NW	499667	6621992	Autumn	6/05/2023	5/06/2023	Flat	0	-	0	CE
Dalhousie SW	499678	6621921	Autumn	6/05/2023	5/06/2023	Flat	24	15/05/2023	9	Nil
Dalhousie NE	499741	6622021	Autumn	6/05/2023	5/06/2023	Active	19	-	30	Nil
Dalhousie SE	499776	6621970	Autumn	6/05/2023	5/06/2023	Active	725	-	30	Nil
South Martells NW	498535	6622868	Autumn	4/05/2023	5/06/2023	Active	0	-	32	Nil
South Martells SW	498544	6622855	Autumn	4/05/2023	5/06/2023	Active	0	-	32	Nil
South Martells NE	498595	6622902	Autumn	4/05/2023	5/06/2023	Flat	1	-	0	Wrong SD card Likely no data recorded.
South Martells SE	498601	6622894	Autumn	4/05/2023	5/06/2023	Flat	3	7/05/2023	3	Nil
Burkes NW	500278	6616806	Autumn	Not installed	Not installed			-		Not installed
Burkes SW	500267	6616778	Autumn	Not installed	Not installed			-		Not installed
Burkes NE	500351	6616837	Autumn	4/05/2023	5/06/2023	Active	56	-	32	ID49: area outside culvert cleared, rd can see cams
Burkes SE	500337	6616740	Autumn	4/05/2023	5/06/2023	Flat	526	13/05/2023	9	ID65: area outside culvert clared...
North Martells NW	498309	6623380	Autumn	Not installed	Not installed			-		Not installed need saw
North Martells SW	498324	6623341	Autumn	4/05/2023	5/06/2023	Active	15	-	32	ID74
North Martells NE	498378	6623430	Autumn	4/05/2023	5/06/2023	Active	18	-	32	ID193
North Martells SE	498374	6623404	Autumn	4/05/2023	5/06/2023	Active	0?	-	32	ID192
Tyson's NW	498685	6627459	Autumn	6/05/2023	5/06/2023	Active	22	-	30	Nil
Tyson's SW	498629	6627430	Autumn	6/05/2023	5/06/2023	Active	0	-	30	Nil
Tyson's NE	498718	6627410	Autumn	6/05/2023	5/06/2023	Active	27	-	30	Nil

Site	Easting	Northing	Season	Install date	Date retrieved	Status	No. vids	Date last vid	Days Active	Comments
Tyson's SE	498697	6627318	Autumn	6/05/2023	5/06/2023	Flat	3	10/05/2023	4	Nil
Access G NW	497927	6626258	Autumn	6/05/2023	5/06/2023	Flat	0	-	0	Nil
Access G SW	497900	6626205	Autumn	6/05/2023	5/06/2023	Active	51	-	30	Nil
Access G NE	497983	6626218	Autumn	6/05/2023	5/06/2023	Active	CE	-	30	Nil
Access G SE	497962	6626183	Autumn	6/05/2023	5/06/2023	Flat	0	-	30	Nil
Martells bridge NW	498843	6622557	Autumn	4/05/2023	5/06/2023	Active	21	-	32	Nil
Martells bridge SW	498895	6622517	Autumn	4/05/2023	5/06/2023	Flat	0	-	0	Nil
Martells bridge NE	498880	6622611	Autumn	4/05/2023	5/06/2023	Flat	18	2/06/2023	29	Nil
Martells bridge SE	498923	6622580	Autumn	4/05/2023	5/06/2023	Flat	0	-	0	Nil
Dalhousie NW	499667	6621992	Spring	26/10/2023	22/11/2023	Flat	0	ND	27	Nil
Dalhousie SW	499678	6621921	Spring	26/10/2023	22/11/2023	Flat	47	3/11/2023	8	Nil
Dalhousie NE	499741	6622021	Spring	26/10/2023	22/11/2023	100%	1697	7/11/2023	12	Nil
Dalhousie SE	499776	6621970	Spring	26/10/2023	22/11/2023	Flat	18	30/10/2023	4	Nil
South Martells NW	498535	6622868	Spring	26/10/2023	22/11/2023	33%	4	Nil	27	Nil
South Martells SW	498544	6622855	Spring	26/10/2023	22/11/2023	66%	2	Nil	27	Nil
South Martells NE	498595	6622902	Spring	26/10/2023	22/11/2023	70%	15	Nil	27	Nil
South Martells SE	498601	6622894	Spring	26/10/2023	22/11/2023	Flat	3	28/10/2023	Nil	Cam still attached to fence. Sd retrieved
Burkes NW	500278	6616806	Spring	NA	NA	NA	NA	NA	NA	NA
Burkes SW	500267	6616778	Spring	NA	NA	NA	NA	NA	NA	NA
Burkes NE	500351	6616837	Spring	26/10/2023	22/11/2023	Flat	?	ND	Nil	Took bracket, screw stuck
Burkes SE	500337	6616740	Spring	26/10/2023	22/11/2023	Flat	?	ND	Nil	Card error
North Martells NW	498309	6623380	Spring	30/10/2023	22/11/2023	25%	11	Nil	27	Not installed need saw
North Martells SW	498324	6623341	Spring	30/10/2023	22/11/2023	58%	65	Nil	27	Nil
North Martells NE	498378	6623430	Spring	30/10/2023	22/11/2023	6%	352	Nil	27	Nil
North Martells SE	498374	6623404	Spring	30/10/2023	22/11/2023	40%	791	Nil	27	Nil
Tyson's NW	498685	6627459	Spring	26/10/2023	22/11/2023	Flat	14	30/10/2023	4	Nil
Tyson's SW	498629	6627430	Spring	26/10/2023	22/11/2023	Flat	35	30/10/2023	4	Nil
Tyson's NE	498718	6627410	Spring	26/10/2023	22/11/2023	Flat	1	29/10/2023	3	Water in cam on sd in retrieval
Tyson's SE	498697	6627318	Spring	26/10/2023	22/11/2023	Flat	2	27/10/2023	1	Nil
Access G NW	497927	6626258	Spring	26/10/2023	22/11/2023	Flat	3	30/10/2023	4	Nil
Access G SW	497900	6626205	Spring	26/10/2023	22/11/2023	Flat	1	27/10/2023	1	Nil
Access G NE	497983	6626218	Spring	26/10/2023	22/11/2023	50%	29	Nil	27	Nil
Access G SE	497962	6626183	Spring	26/10/2023	22/11/2023	Flat	23	9/11/2023	14	Nil
Martells bridge NW	498843	6622557	Spring	30/10/2023	22/11/2023	Flat	1118	ND	5	Date wrong on cam 1/1/09-5/1/09. 5 days active.
Martells bridge SW	498895	6622517	Spring	30/10/2023	22/11/2023	Flat	0	ND	Nil	no images
Martells bridge NE	498880	6622611	Spring	30/10/2023	22/11/2023	Flat	8	1/11/2023	2	Nil

Site	Easting	Northing	Season	Install date	Date retrieved	Status	No. vids	Date last vid	Days Active	Comments
Martells bridge SE	498923	6622580	Spring	30/10/2023	22/11/2023	Flat	739	Nil	27	Nil

Table B10: Road-kill survey data recorded during year seven monitoring at NH2U, 2023.

Species	Season	Time	Easting	Northing
Bandicoot spp.	Autumn	2023-04-25T22:17:29Z	497481	6611892
Bird spp.	Autumn	2023-05-01T22:30:54Z	497502	6612072
Snake spp.	Autumn	2023-04-25T22:16:21Z	497804	6613427
Medium mammal spp.	Autumn	2023-04-25T22:50:09Z	498069	6613738
Bandicoot spp.	Autumn	2023-05-01T22:18:32Z	498867	6614520
Long nosed bandicoot	Autumn	2023-04-25T22:15:15Z	498871	6614528
Bandicoot spp.	Autumn	2023-05-01T22:18:03Z	499184	6615302
Chelidae spp.	Autumn	2023-04-25T22:51:57Z	499496	6615662
Medium mammal spp.	Autumn	2023-04-25T22:14:26Z	499566	6615687
Fox	Autumn	2023-05-01T22:33:36Z	499704	6615854
Wallaby spp.	Autumn	2023-05-01T22:14:52Z	500418	6620658
Reptile spp.	Autumn	2023-04-25T22:57:41Z	498566	6622853
Bandicoot spp.	Autumn	2023-05-01T22:11:08Z	498083	6626446
Bandicoot spp.	Autumn	2023-04-25T22:05:40Z	498096	6626475
Bird spp.	Autumn	2023-04-25T22:03:56Z	499632	6626477
Bandicoot spp.	Autumn	2023-3-22T22:11:05Z	498098	6626477
Bandicoot spp.	Autumn	2023-3-22T22:11:05Z	499482	6622220
Rodent spp.	Autumn	2023-3-22T22:11:05Z	500359	6620959
Wallaby spp.	Autumn	2023-3-22T22:11:05Z	499410	6615539
Small bird spp.	Autumn	2023-3-22T22:11:05Z	498731	6614301
Brush-tail possum	Autumn	2023-3-22T22:11:05Z	500430	6619181
Bird spp.	Autumn	2023-3-22T22:11:05Z	500416	6620477
Bandicoot spp.	Autumn	2023-3-22T22:11:05Z	498018	6624158
Wallaby spp.	Autumn	2023-3-22T22:11:05Z	497853	6624572
Small bird spp.	Autumn	2023-3-22T22:11:05Z	497715	6625317
Swamp wallaby	Autumn	2023-3-22T22:11:05Z	500223	6630232
Bandicoot	Spring	2023-11-02T22:41:41Z	497919	6626142
Small bird	Spring	2023-11-02T23:00:24Z	499793	6621942

Species	Season	Time	Easting	Northing
Medium mammal	Spring	2023-11-02T23:30:41Z	500434	6617840
Medium bird	Spring	2023-11-02T23:39:29Z	500267	6616752
Tyto sp.	Spring	2023-11-02T23:39:42Z	500339	6616895
Bird sp	Spring	2023-11-03T00:14:52Z	497712	6625363
Brush-tail possum spp.	Spring	2023-11-03T00:16:24Z	498764	6627555
Bird sp	Spring	2023-11-03T00:18:09Z	500155	6629628
Medium mammal	Spring	2023-11-02T22:40:13Z	498056	6626408

Table B11: Site habitat assessment. Eucs = eucalypts, MoF = moist open forest, DoF = dry open forest, McF = moist closed forest.

Site	Side	Hab class	Dominant canopy spp.	Dominant sub canopy spp.	Dominant Ground cover
McGraths	East	MOF	Flooded Gum, blackbutt, Pink Bloodwood, brushbox, Tallowwood	Vine spp, Rainforest spp, Bangalow palms, cheese tree	Gahnia spp, Cordyline spp, blady grass, Lantana, leaf litter
	West		Pints radiata, blackbutt, Rainforest spp,	Vine spp, Rainforest spp, camphor laurel	Agricultural grasses, Lantana, bracken, pine needles
Burke's	East	MOF/DOF	Blackbutt, Tallowwood, swamp Mahogany	Bamboo, emergent eucs, acacia spp, casuarina spp, cheese tree	Blady grass, lantana, scetaria, cordyline spp
	West	DOF	Tallowwood, blackbutt, Flooded Gum, Grey Ironbark	Emergent eucs, acacia spp, casuarina spp, vine spp	Cordyline, blady grass
South Martell's	East	MOF	Blackbutt, Flooded Gum, grey ironbark	Vine spp, emergent eucs, acacia spp, some Rainforest spp, casuarina spp	Cordyline, gahnia, blady grass, vine spp
	West	MOF	Flooded Gum, Grey Ironbark, small fruited grey gum	Vine spp, emergent eucs, acacia spp, some Rainforest spp, casuarina spp	Cordyline, vine spp
Tyson's	West	MOF	Swamp Mahogany, melaleuca quin,	Melaleuca spp, emergent eucs, acacia spp, cheese story	Cordyline, blady grass, gahnia
	East	MCF/MOF	Flooded Gum, Grey Ironbark, turpentine,	Casuarina spp, emergent eucs, vine spp	Cordyline, gahnia, leaf litter
Access G	West	MCF	Grey Ironbark, brushbox, small fruited grey gum,	Bangalow palms, Rainforest spp, vine spp	Cordyline spp, emergent Rainforest spp,
	East	MCF	Grey Ironbark, flooded Gum,	Melaleuca spp, emergent eucs, casuarina spp	Cordyline spp, gahnia, leaf palms
Dalhousie	West	DOF	Blackbutt, pink Bloodwood, Flooded Gum, turpentine	Casuarina spp, emergent eucs, vine spp, Rainforest spp	Various grasses, blady grass, leaf litter
	East	MOF	Blackbutt, pink Bloodwood, Flooded Gum, turpentine	Casuarina spp, emergent eucs, vine spp, Rainforest spp	Various grasses, blady grass, gahnia spp, Cordyline spp, leaf litter, Acacia spp.
North Martell's	West	MOF/DOF	Blackbutt, Red Mahogany	Melaleuca spp, emergent eucs, acacia spp	Cordyline, gahnia, small shrubs
	East	MOF/DOF	Blackbutt, Red Mahogany	Melaleuca spp, emergent eucs, acacia spp	Cordyline, gahnia, small shrubs

Martell's bridge	East	MOF	flooded gum. ironbark, pink blood wood	Calisatomen spp., melaleuca spp., rainforest spp. Acacia app.	Cordyline, lantana, gahnia
	West	MOF	Pink Bloodwood, ironbark, turpentine	emergent rainforest spp, Casuarina spp., Acacia spp	blady grass, leaf litter

Table B12: Summary of underpass image review data recorded by species/fauna groups during year seven monitoring at NH2U, 2023.

Season	Site	Cell	Cam	Species	Complete	Incomplete	East	West	NDM	Comments
Autumn	Access G		Furniture	Nil	0	0	0	0		Microbats present
Autumn	Access G		Ground	Black rat	5	0	5	0		
Autumn	Access G		Ground	Long-nosed bandicoot	6	0	5	1		
Autumn	Access G		Ground	Eastern water dragon	1	0	0	1		
Autumn	Access G		Ground	Rodent spp.	6	0	6	0		
Autumn	Access G		Ground	Water rat	6	1	5	1		
Autumn	Access G		Ground	Cat	1	0	0	1		
Autumn	Access G		Ground	Bandicoot spp.	3	0	3	0		
Autumn	Access G		Ground	Cormorant spp.	1	0	0	1		
Autumn	Access G		Split ground	Rodent spp.	11	2	8	3		Microbats present
Autumn	Access G		Split ground	Water rat	20	1	17	3		
Autumn	Access G		Split ground	Black rat	7	0	4	3		
Autumn	Access G		Split ground	Eastern water dragon	4	0	3	1		
Autumn	Access G		Split ground	House Mouse	1	0	0	1		
Autumn	Access G		Split ground	Cat	3	0	1	2		
Autumn	Access G		Split ground	Cormorant spp.	3	0	1	2		
Autumn	Access G		Split ground	Brush-tail possum spp.	1	0	1	0		
Autumn	Access G		Split ground	Long-nosed bandicoot	0	1	0	0		
Autumn	Access G		Split ground	Bandicoot spp.	1	0	1	0		
Autumn	Access G		Split ground	Fox	1	0	0	1		
Autumn	Access G		Split ground	Melomys	1	0	1	0		
Autumn	Burke's		Furniture	Antechinus spp.	3	1	0	3		
Autumn	Burke's		Furniture	Common brushtail possum	7	2	3	4		
Autumn	Burke's		Furniture	Rodent spp.	2	1	0	2		
Autumn	Burke's		Ground	House Mouse	2	0	1	1		
Autumn	Burke's		Ground	Long-nosed bandicoot	6	1	6	0		
Autumn	Burke's		Ground	Bandicoot spp.	1	0	1	0		
Autumn	Burke's		Ground	Black rat	6	2	4	2		
Autumn	Burke's		Ground	Fox	3	0	3	0		

Season	Site	Cell	Cam	Species	Complete	Incomplete	East	West	NDM	Comments
Autumn	Burke's		Ground	Rodent spp.	10	0	8	2		
Autumn	Burke's		Ground	Water rat	4	1	4	0		
Autumn	Burke's		Ground	Dog	1	0	1	0		
Autumn	Burke's		Ground	Swamp wallaby	1	0	0	1		
Autumn	Burke's		Ground	Bush rat	2	0	1	1		
Autumn	Dalhousie	East	Furniture	Eastern water dragon	1	0	1	0		Dirt bike riders using culvert
Autumn	Dalhousie	East	Furniture	Short-eared brushtail possum	10	0	4	6		Microbats present
Autumn	Dalhousie	East	Furniture	Antechinus spp.	1	0	1	0		
Autumn	Dalhousie	East	Furniture	Common brushtail possum	3	0	1	2		
Autumn	Dalhousie	East	Furniture	Rodent spp.	1	0	0	1		
Autumn	Dalhousie	East	Ground	Black rat	15	6	13	2		Microbats present
Autumn	Dalhousie	East	Ground	Water rat	18	2	8	10		
Autumn	Dalhousie	East	Ground	Fox	1	0	0	1		
Autumn	Dalhousie	East	Ground	Rodent spp.	18	10	12	6		
Autumn	Dalhousie	East	Ground	Cat	1	0	1	0		
Autumn	Dalhousie	East	Ground	House mouse	2	0	1	1		
Autumn	Dalhousie	East	Ground	Short-beaked echidna	1	1	1	0		
Autumn	Dalhousie	East	Ground	Antechinus spp.	3	1	1	2		
Autumn	Dalhousie	East	Ground	Bandicoot spp.	1	0	1	0		
Autumn	Dalhousie	East	Ground	Australian white ibis	3	4	2	1		
Autumn	Dalhousie	West	Furniture	Egernia spp.	6	0	0	6		
Autumn	Dalhousie	West	Furniture	Lace monitor	1	0	0	1		
Autumn	Dalhousie	West	Ground	Eastern water dragon	2	0	2	0		
Autumn	Dalhousie	West	Ground	Black rat	7	0	5	2		
Autumn	Dalhousie	West	Ground	Fox	0	1	0	0		
Autumn	Dalhousie	West	Ground	Water rat	4	0	3	1		
Autumn	Dalhousie	West	Ground	Rodent spp.	2	1	2	0		
Autumn	Dalhousie	West	Ground	Short-beaked echidna	1	0	0	1		
Autumn	Dalhousie	West	Ground	Australian white ibis	0	1	0	0		
Autumn	Martell's Bridge	North	North	Dog	18	1	7	11		Pair travelling together (image 50), pack (3) image 190
Autumn	Martell's Bridge	North	North	Fox	1	0	1	0		Dirt bike riders using culvert, lots of false triggers
Autumn	Martell's Bridge	South	South	Fox	3	0	0	3		100's false trigger from grass
Autumn	Martell's Bridge	South	South	Dog	6	0	4	2		
Autumn	Martell's Bridge	South	South	Swamp wallaby	3	0	2	1		
Autumn	McGraths	North	North	Eastern yellow robin	0	1	0	0		See images
Autumn	McGraths	North	North	Red-browed finch	0	1	0	0		

Season	Site	Cell	Cam	Species	Complete	Incomplete	East	West	NDM	Comments
Autumn	McGraths	South	South	Nil	0	0	0	0		
Autumn	North Martell's		Furniture	Lace monitor	1	0	1	0		Microbats present
Autumn	North Martell's		Ground	Fox	1	0	1	0		Microbats present
Autumn	North Martell's		Ground	Water rat	12	0	12	0		
Autumn	North Martell's		Ground	Rodent spp.	9	1	8	1		
Autumn	North Martell's		Ground	Black rat	3	2	1	2		
Autumn	North Martell's		Ground	Australian white ibis	3	0	2	1		
Autumn	North Martell's		Ground	Stork spp.	2	0	2	0		
Autumn	North Martell's		Ground	Dog	2	0	2	0		
Autumn	South Martell's		Furniture	Short-eared brushtail possum	26	20	13	13		
Autumn	South Martell's		Furniture	Bush rat	0	2	0	0		
Autumn	South Martell's		Furniture	Antechinus spp.	0	1	0	0		
Autumn	South Martell's		Furniture	Common brushtail possum	20	11	6	14		
Autumn	South Martell's		Furniture	Brushtail possum spp.	5	0	5	0		
Autumn	South Martell's		Ground	Fox	13	0	13	0		Microbats present
Autumn	South Martell's		Ground	Black rat	25	6	13	12		
Autumn	South Martell's		Ground	Long-nosed bandicoot	8	1	7	1		
Autumn	South Martell's		Ground	Water rat	1	0	0	1		
Autumn	South Martell's		Ground	Short-eared brushtail possum	4	1	3	1		
Autumn	South Martell's		Ground	Short-beaked echidna	4	0	2	2		
Autumn	South Martell's		Ground	Rodent spp.	9	1	8	1		
Autumn	South Martell's		Ground	Cormorant spp.	1	0	1	0		
Autumn	South Martell's		Ground	Bandicoot spp.	5	0	5	0		
Autumn	South Martell's		Ground	Antechinus spp.	1	0	1	0		
Autumn	South Martell's		Ground	Bird spp.	1	0	0	1		
Autumn	Tyson's	East	Furniture	Short-eared brushtail possum	52	3	22	30		Microbats present
Autumn	Tyson's	East	Furniture	Rodent spp.	15	2	7	8		
Autumn	Tyson's	East	Furniture	Black rat	13	9	11	2		
Autumn	Tyson's	East	Furniture	Eastern water dragon	2	1	2	0		
Autumn	Tyson's	East	Furniture	Lace monitor	1	0	0	1		
Autumn	Tyson's	East	Furniture	Antechinus spp.	41	3	35	6		
Autumn	Tyson's	East	Furniture	Brushtail possum spp.	3	0	1	2		
Autumn	Tyson's	East	Furniture	Common brushtail possum	5	0	2	3		
Autumn	Tyson's	East	Furniture	Bird spp.	1	0	1	0		
Autumn	Tyson's	East	Furniture	Azure kingfisher	3	0	0	3		
Autumn	Tyson's	East	Ground	Black rat	22	4	20	2		

Season	Site	Cell	Cam	Species	Complete	Incomplete	East	West	NDM	Comments
Autumn	Tyson's	East	Ground	Eastern water dragon	9	3	8	1		
Autumn	Tyson's	East	Ground	Water rat	7	2	5	2		
Autumn	Tyson's	East	Ground	Short-eared brushtail possum	1	0	1	0		
Autumn	Tyson's	East	Ground	Rodent spp.	7	2	7	0		
Autumn	Tyson's	East	Ground	Common brushtail possum	2	1	2	0		
Autumn	Tyson's	East	Ground	Lace monitor	4	0	3	1		
Autumn	Tyson's	East	Ground	Short-beaked echidna	1	0	0	1		
Autumn	Tyson's	East	Ground	Fox	1	1	1	0		
Autumn	Tyson's	East	Ground	Antechinus spp.	7	3	5	2		
Autumn	Tyson's	East	Ground	House mouse	1	0	1	0		
Autumn	Tyson's	East	Ground	Brushtail possum spp.	3	0	3	0		
Autumn	Tyson's	East	Ground	Duck spp.	3	0	3	0		
Autumn	Tyson's	East	Split ground	Black rat	7	0	3	4		
Autumn	Tyson's	East	Split ground	Water rat	1	0	0	1		
Autumn	Tyson's	West	Furniture	Rodent spp.	2	1	2	0		
Autumn	Tyson's	West	Furniture	Brushtail possum spp.	14	1	9	5		
Autumn	Tyson's	West	Furniture	Short-eared brushtail possum	4	1	3	1		
Autumn	Tyson's	West	Furniture	Black Rat	13	4	10	3		
Autumn	Tyson's	West	Furniture	Egernia spp.	1	0	1	0		
Autumn	Tyson's	West	Furniture	Small unknown mammal	1	0	1	0		Image 65, 71
Autumn	Tyson's	West	Furniture	Rodent spp.	3	0	1	2		
Autumn	Tyson's	West	Furniture	Bird spp.	0	4	0	0		
Autumn	Tyson's	West	Furniture	Antechinus spp.	21	24	12	9		
Autumn	Tyson's	West	Furniture	Common brushtail possum	1	0	0	1		
Autumn	Tyson's	West	Ground	Black rat	57	11	25	32		
Autumn	Tyson's	West	Ground	Water rat	5	2	3	2		
Autumn	Tyson's	West	Ground	Rodent spp.	6	0	6	0		
Autumn	Tyson's	West	Ground	Brushtail possum spp.	16	0	1	15		
Autumn	Tyson's	West	Ground	Short-eared brushtail possum	1	0	1	0		
Autumn	Tyson's	West	Ground	Antechinus spp.	16	1	9	7		
Autumn	Tyson's	West	Ground	Fox	2	1	2	0		
Autumn	Tyson's	West	Split ground	Nil	0	0	0	0		
Spring	Access G		Furniture	Lace monitor	9	5	4			microbats
Spring	Access G		Furniture	Antechinus spp.	55	46	9	3		
Spring	Access G		Furniture	Short-eared brushtail possum	45	27	18			

Season	Site	Cell	Cam	Species	Complete	Incomplete	East	West	NDM	Comments
Spring	Access G		Furniture	Eastern water dragon	1	1				
Spring	Access G		Ground	Eastern water dragon	13	8	5			microbats
Spring	Access G		Ground	Short-eared brushtail possum	1	1				
Spring	Access G		Ground	Lace monitor	11	6	5			
Spring	Access G		Ground	Antechinus spp.	1		1			
Spring	Access G		Ground	Koala	2	1	1			10/10/23 5:04 image 22 (west), 14/10/23 17:22 image 30 (east)
Spring	Access G		Ground	Black rat	6	4	2			
Spring	Access G		Ground	Water rat	2	1	1			
Spring	Access G		Ground	Koala						18/11/23 image 37
Spring	Access G		Split ground	Eastern water dragon	18	15	3			
Spring	Access G		Split ground	Lace monitor	11	7	4			
Spring	Access G		Split ground	Antechinus spp.	4	3	1			
Spring	Access G		Split ground	Koala	1	1				10/10/23 5:10 image 57
Spring	Access G		Split ground	Bandicoot spp.	2	2				
Spring	Access G		Split ground	Long-nosed bandicoot	3	3				
Spring	Access G		Split ground	Black rat	1	1				
Spring	Access G		Split ground	Dog	0			1		
Spring	Burke's		Furniture	Short-eared brushtail possum	1	17	26	3		
Spring	Burke's		Ground	Bush rat	3	2	1			
Spring	Burke's		Ground	Black rat	11	7	4	2		
Spring	Burke's		Ground	Long-nosed bandicoot	7	7				
Spring	Burke's		Ground	Bandicoot spp.	1	1				
Spring	Burke's		Ground	Short-eared brushtail possum	3	2	1			
Spring	Dalhousie	East	Furniture	Trichosurus spp.	2	1	1			
Spring	Dalhousie	East	Furniture	Antechinus spp.	4	3	1	4		
Spring	Dalhousie	East	Furniture	Short-eared brushtail possum	26	14	12	2		
Spring	Dalhousie	East	Furniture	Black rat	0			1		
Spring	Dalhousie	East	Ground	Black rat	36	23	13	10		
Spring	Dalhousie	East	Ground	Eastern water dragon	6	5	1			
Spring	Dalhousie	East	Ground	Short-beaked echidna	3	3				
Spring	Dalhousie	East	Ground	Short-eared brushtail possum	4	2	2			
Spring	Dalhousie	East	Ground	Antechinus spp.	1		1			
Spring	Dalhousie	East	Ground	Rodent spp.	2	1	1			
Spring	Dalhousie	East	Ground	Lace monitor	16	8	8			
Spring	Dalhousie	East	Ground	Trichosurus spp.	4	1	3			
Spring	Dalhousie	East	Ground	Water rat	2	2				

Season	Site	Cell	Cam	Species	Complete	Incomplete	East	West	NDM	Comments
Spring	Dalhousie	East	Ground	Dog	5	3	2			
Spring	Dalhousie	East	Ground	Lizard spp.	1	1				
Spring	Dalhousie	West	Furniture	Lace monitor	18	11	7			
Spring	Dalhousie	West	Furniture	Antechinus spp.	2	2				
Spring	Dalhousie	West	Ground	Black rat	21	16	5	2		
Spring	Dalhousie	West	Ground	Bandicoot spp.	0			1		
Spring	Dalhousie	West	Ground	Rodent spp.	1		1			
Spring	Dalhousie	West	Ground	Egernia richardi	2	1	1			
Spring	Dalhousie	West	Ground	Eastern water dragon	5	5				
Spring	Dalhousie	West	Ground	Antechinus spp.	2	2				
Spring	Martell's Bridge	North	North	Nil	0					
Spring	Martell's Bridge	South	South	Swamp wallaby	1		1			
Spring	McGraths	North	North	Black rat	3	2	1	7		
Spring	McGraths	North	North	Bush rat	0			6		
Spring	McGraths	North	North	Red-bellied black snake	2	1	1			
Spring	McGraths	North	North	Lace monitor	2	1	1	1		
Spring	McGraths	North	North	Python	1	1				
Spring	McGraths	North	North	Short-beaked echidna	1	1		1		
Spring	McGraths	North	North	Short-eared brushtail possum	3	2	1			
Spring	McGraths	North	North	Water rat	1		1			
Spring	McGraths	North	North	Long-nosed bandicoot	0			1		
Spring	McGraths	South	South	Nil	0					
Spring	North Martell's		Furniture	Nil	0					
Spring	North Martell's		Ground	Snake spp.	2		2			microbats
Spring	North Martell's		Ground	Lace monitor	6	3	3			
Spring	North Martell's		Ground	Fox	3	2	1			
Spring	North Martell's		Ground	Short-eared brushtail possum	3	2	1	1		
Spring	North Martell's		Ground	Eastern water dragon	1	1		1		
Spring	North Martell's		Ground	Water rat	4	2	2			
Spring	North Martell's		Ground	Lace monitor	5	3	2	2		
Spring	North Martell's		Ground	Black rat	4	2	2			
Spring	North Martell's		Ground	Rodent spp.	1	1				
Spring	North Martell's		Ground	Dog	3	2	1	1		
Spring	North Martell's		Ground	Long-nosed bandicoot	1	1				
Spring	South Martell's		Furniture	Black rat	19	12	7	4		
Spring	South Martell's		Furniture	Short-eared brushtail possum	32	17	15	5		

Season	Site	Cell	Cam	Species	Complete	Incomplete	East	West	NDM	Comments
Spring	South Martell's		Furniture	Rodent spp.	8	6	2	1		
Spring	South Martell's		Furniture	Egernia richardi	2	1	1			
Spring	South Martell's		Furniture	Antechinus spp.	2	2				
Spring	South Martell's		Furniture	Lace monitor	10	3	7	3		
Spring	South Martell's		Furniture	Bandicoot spp.	1	1				
Spring	South Martell's		Furniture	Long-nosed bandicoot	3	3				
Spring	South Martell's		Furniture	Fox	2	2				
Spring	South Martell's		Furniture	Dog	2	2				
Spring	South Martell's		Ground	Lace monitor	7	2	5			
Spring	South Martell's		Ground	Eastern water dragon	2	2				
Spring	South Martell's		Ground	Fox	5	5				
Spring	South Martell's		Ground	Black rat	10	4	6		1	
Spring	South Martell's		Ground	Microbat sp.	0			1		
Spring	South Martell's		Ground	Long-nosed bandicoot	23	15	8	7		
Spring	South Martell's		Ground	Short-eared brushtail possum	1	1		1		
Spring	South Martell's		Ground	Rodent spp.	1	1				
Spring	Tyson's	East	Furniture	Lace monitor	3	1	2			
Spring	Tyson's	East	Furniture	Black rat	21	8	13	6		
Spring	Tyson's	East	Furniture	Egernia richardi	2	2				
Spring	Tyson's	East	Furniture	Trichosurus spp.	5	1	4			
Spring	Tyson's	East	Furniture	Medium mammal spp.	2	2				vid 73 & 76
Spring	Tyson's	East	Furniture	Rodent spp.	3	3				
Spring	Tyson's	East	Furniture	Bush rat	5	3	2			
Spring	Tyson's	East	Furniture	Koala	1		1			11/11/2023 23:25
Spring	Tyson's	East	Ground	Black rat	52	34	18	7		
Spring	Tyson's	East	Ground	Snake spp.	1		1			
Spring	Tyson's	East	Ground	Short-beaked echidna	4	1	3			
Spring	Tyson's	East	Ground	Lace monitor	34	14	20			
Spring	Tyson's	East	Ground	Eastern water dragon	11	9	2			
Spring	Tyson's	East	Ground	Water rat	5	4	1			
Spring	Tyson's	East	Ground	Rodent spp.	3	3				
Spring	Tyson's	East	Ground	Common brushtail possum	2	2				
Spring	Tyson's	East	Split ground	Rodent spp.	7	4	3	2		
Spring	Tyson's	East	Split ground	Black rat	38	16	22	12		
Spring	Tyson's	East	Split ground	Eastern water dragon	33	21	12	2		
Spring	Tyson's	East	Split ground	Lace monitor	8	3	5	1		

Season	Site	Cell	Cam	Species	Complete	Incomplete	East	West	NDM	Comments
Spring	Tyson's	East	Split ground	Swamp wallaby	0			4		
Spring	Tyson's	East	Split ground	Water rat	11	10	1	1		
Spring	Tyson's	East	Split ground	Bush rat	4	2	2			
Spring	Tyson's	East	Split ground	Lace monitor	5	3	2			
Spring	Tyson's	East	Split ground	Short-eared brushtail possum	1		1			
Spring	Tyson's	East	Split ground	Common brushtail possum	1		1			
Spring	Tyson's	West	Furniture	Black rat	6	4	2	1		
Spring	Tyson's	West	Furniture	Antechinus spp.	3	2	1	1		
Spring	Tyson's	West	Furniture	Egernia richardi	15	12	3			
Spring	Tyson's	West	Furniture	Short-eared brushtail possum	7	5	2			
Spring	Tyson's	West	Furniture	Lace monitor	2	2				
Spring	Tyson's	West	Furniture	Eastern water dragon	1		1			
Spring	Tyson's	West	Ground	Water rat	8	7	1			
Spring	Tyson's	West	Ground	Black rat	16	9	7	3		
Spring	Tyson's	West	Ground	Antechinus spp.	1		1			
Spring	Tyson's	West	Ground	Lace monitor	33	14	19			
Spring	Tyson's	West	Ground	Eastern water dragon	6	5	1	1		
Spring	Tyson's	West	Ground	Short-eared brushtail possum	14	9	5			
Spring	Tyson's	West	Ground	Rodent spp.	3	3				
Spring	Tyson's	West	Ground	Bandicoot spp.	2	2				
Spring	Tyson's	West	Ground	Swamp wallaby	1	1				
Spring	Tyson's	West	Ground	Short-beaked echidna	4	2	2			
Spring	Tyson's	West	Ground	Macropod spp.	1	1				
Spring	Tyson's	West	Ground	Koala	1		1			11/11/2023 23:29
Spring	Tyson's	West	Split ground	Water rat	5	4	1	1		
Spring	Tyson's	West	Split ground	Black rat	5	2	3	3		
Spring	Tyson's	West	Split ground	Lace monitor	26	13	13			
Spring	Tyson's	West	Split ground	Short-beaked echidna	6	2	4	1		
Spring	Tyson's	West	Split ground	Short-eared brushtail possum	2	1	1			
Spring	Tyson's	West	Split ground	Eastern water dragon	5	2	3			
Spring	Tyson's	West	Split ground	Antechinus spp.	0			1		
Spring	Tyson's	West	Split ground	Red-bellied black snake	2	1	1			
Spring	Tyson's	West	Split ground	Swamp wallaby	1	1				
Spring	Tyson's	West	Split ground	Bush rat	0			1		

Table B13: Presence/absence of fauna detected in the adjacent habitat during year seven monitoring at NH2U, 2023. c=camera monitoring, DS = diurnal searches and NS = Nocturnal searches.

Species	Tyson's			Access G			Martell's N			Martell's S			Dalhousie			Burkes			Martell's B			McGrath's			
	C	DS	NS	C	DS	NS	C	DS	NS	C	DS	NS	C	DS	NS	C	DS	NS	C	DS	NS	C	DS	NS	
Mammals																									
Short-beaked echidna				1						1			1												1
<i>Antechinus</i> spp.					1		1				1					1									
Sugar glider																		1							1
Squirrel glider						1																			
Feathertail glider																		1							1
Long-nosed bandicoot				1			1			1			1			1								1	
Northern brown bandicoot				1			1						1			1			1						
Bandicoot spp.		1	1		1	1		1			1			1			1		1	1			1		
Koala						1												1							
Common ringtail possum																		1							1
Short-eared brushtail possum	1		1	1		1				1		1	1			1		1	1			1		1	1
Common brushtail possum																		1							
Trichosurus spp. (brushtail possum)	1	1									1			1			1	1							
Red-necked Wallaby																	1			1					
Swamp wallaby				1	1								1			1			1				1		
Wallaby spp.		1			1	1		1				1	1			1	1			1			1		
Macropod spp.																									1
Eastern grey kangaroo					1																				
Water rat														1											
Bush rat				1			1							1			1								
House mouse ¹																		1							
Black rat ¹				1						1						1			1			1			
Rodent spp.				1			1			1				1			1			1			1		
Dog ¹				1			1												1	1		1			
Red fox ¹					1			1			1			1		1	1			1					
Rusa Deer ¹	1																								
Cat ¹										1															
Reptiles																									
Lace monitor	1			1			1			1			1	1		1			1			1			
Land mullet				1													1								
Eastern water dragon							1																1		
Garden sun-skink																				1					
Grass skink																				1					

Species	Tyson's			Access G			Martell's N			Martell's S			Dalhousie			Burkes			Martell's B			McGrath's			
	C	DS	NS	C	DS	NS	C	DS	NS	C	DS	NS	C	DS	NS	C	DS	NS	C	DS	NS	C	DS	NS	
Lampropholis spp.		1			1		1	1			1			1			1						1		
Small eyed snake																								1	
Yellow-faced whipsnake																						1			
Small snake spp.						1																			
Frogs																									
Eastern dwarf tree frog		1	1			1		1			1	1		1	1			1		1	1				1
Common eastern froglet					1	1		1																1	
Striped marsh frog						1						1													
Peron's tree frog			1			1						1												1	
Red-backed toadlet					1	1									1										
Tusked frog												1													1
Tyler's tree frog						1																			1
Total spp. or group/survey	4	5	5	11	9	11	9	6	2	7	7	5	10	7	2	12	7	9	9	8	4	9	3	8	
Total spp. or group/survey	10			25			16			16			16			24			18			19			

Table B14: Exclusion fence image review data during year seven monitoring at NH2U, 2023. TB = Towards Bush, TR = Towards Road, TU- Towards Underpass, AFU = Away from Underpass, NDM = No Directional Movement.

Season	Site	Species	Sum of TB	Sum of TF	Sum of TU	Sum of AFU	Sum of NDM
Autumn	Access G	Rodent spp.	1	2	-	2	-
Autumn	Access G	Swamp wallaby	-	-	1	2	-
Autumn	Access G	Bush rat	1	-	-	2	-
Autumn	Access G	Long-nosed bandicoot	-	-	3	2	-
Autumn	Access G	Short-eared brushtail possum	-	-	-	1	-
Autumn	Access G	Northern-brown bandicoot	-	-	2	-	-
Autumn	Access G	Black rat	-	3	-	-	-
Autumn	Burkes	Fox	-	-	-	1	-
Autumn	Burkes	Swamp wallaby	-	-	-	1	-
Autumn	Burkes	Rodent spp.	-	1	-	-	-
Autumn	Dalhousie	Bush rat	1	-	-	1	-
Autumn	Dalhousie	Black rat	-	-	-	1	-
Autumn	Dalhousie	Long-nosed bandicoot	-	-	-	1	-
Autumn	Dalhousie	Snake spp.	-	1	-	-	-
Autumn	Dalhousie	Rodent spp.	3	2	1	-	-
Autumn	Dalhousie	House mouse	-	-	1	-	-
Autumn	Martells Bridge	Dog	-	-	-	5	-

Season	Site	Species	Sum of TB	Sum of TF	Sum of TU	Sum of AFU	Sum of NDM
Autumn	Martells Bridge	Rodent spp.	-	-	-	2	-
Autumn	Martells Bridge	Swamp wallaby	-	-	-	1	-
Autumn	Martells Bridge	Bush rat	-	-	-	1	-
Autumn	North Martell's	Swamp wallaby	-	-	-	1	-
Autumn	North Martell's	Rodent spp.	-	3	-	1	-
Autumn	North Martell's	Bandicoot spp.	-	-	1	-	-
Autumn	South Martell's	Trichosurus spp.	-	-	-	-	-
Autumn	Tysons	Fox	-	-	-	2	-
Autumn	Tysons	Swamp wallaby	2	-	-	1	1
Autumn	Tysons	Rodent spp.	1	2	1	-	-
Autumn	Tysons	Bandicoot spp.	-	1	3	-	-
Spring	Access G	Swamp wallaby	-	-	1	2	2
Spring	Access G	Long-nosed bandicoot	1	-	-	2	-
Spring	Access G	Bandicoot spp.	-	-	2	-	-
Spring	Access G	Bush rat	1	-	-	-	-
Spring	Access G	Short-eared brushtail possum	-	-	1	-	-
Spring	Burkes	Swamp wallaby	-	-	-	1	-
Spring	Burkes	Fox	-	-	-	1	-
Spring	Burkes	Rattus sp.	-	1	-	-	-
Spring	Dalhousie	Dog	-	-	-	1	-
Spring	Dalhousie	Rodent spp.	-	-	-	-	-
Spring	Dalhousie	Scrub turkey	-	-	2	-	-
Spring	Martells Bridge	Black rat	-	2	-	-	-
Spring	North Martell's	Dog	2	-	-	5	1
Spring	North Martell's	Short-eared brushtail possum	-	-	7	1	1
Spring	North Martell's	Scrub turkey	-	-	1	-	-
Spring	North Martell's	Rattus sp.	-	-	-	-	1
Spring	South Martell's	Scrub turkey	-	-	2	1	-
Spring	South Martell's	Swamp wallaby	1	-	-	-	-
Spring	South Martell's	Black rat	-	3	-	-	-
Spring	South Martell's	Dog	-	-	-	-	1
Spring	Tysons	Black rat	-	1	-	-	-