SNOWY 2.0

RAVINE ROAD FAUNA UNDERPASS INSTALLATION AND AS-BUILT REPORT

Revision Information					
Revision	Date	Description	Author	Reviewer	Approver
Draft v1.0	03/06/2022	Draft	Jordan Chenery	Chris Buscall	
Final	28/07/2022	Final	Jordan Chenery	Ben Croome	Chris Buscall

Contents

1.0 Introduction

1.1 Purpose

- To provide the relevant background and context of fauna underpass installation.
- Present the information used to plan and construct the fauna underpasses along Ravine Road.
- Outline the ‘lessons learnt’ from this installation and stakeholder engagement process.
- Provide details on the frequency of monitoring and reporting as well future improvements to the current fauna underpass structures.

1.2 Background

As part of the extensive ecological assessments for the Snowy 2.0 project Smoky Mice (*Pseudomys fumeus*) were recorded within habitat along Ravine Road and in the Marica area. This species is listed as ‘Endangered’ under the Environment Planning and Biodiversity Conservation Act 1999 and ‘Critically Endangered’ (E4A) under the *Biodiversity Conservation Act 2016.*

Photograph 1: Ravine Road prior to upgrade work

Smoky Mouse presence is predominantly associated with tall forests dominated by Mountain Gum and Snow Gum, with a moderate to dense shrubby mid-storey, and dense groundcover with abundant subshrubs. Its habitat is located above 1,100m altitude along the upper reaches of Lobs Hole Ravine Road and in the Marica area. As part of the Snowy 2.0

planning approval process, it was committed to carry out an extensive Monitoring Program to ascertain whether the project was having measurable impact on the surrounding environment. As such, the Main Works Biodiversity Management Plan (S2-FGJV-ENV-PLN-0106) Appendix B provides a detailed Biodiversity Monitoring Program which will conduct throughout the construction and post construction phases presence/absence monitoring and habitat characteristic monitoring for Smoky Mouse (*Pseudomys fumeus*).

Furthermore, as part of the planning approval considerations and diligence around any potential impact on Smoky Mice, the Fauna Strike Mitigation Strategy, Appendix G of the Biodiversity Management Plan was produced (S2-FGJV-ENV-PLN-0106). The purpose of this Fauna Strike Mitigation Strategy was to describe how the project will mitigate against fauna mortality caused by vehicles on Ravine Road and Marica Roads. This was prepared to satisfy the requirements of schedule 3, condition 18(c) and 17(e) of the Infrastructure Approval (SSI 9687).

This Fauna Strike Mitigation Strategy provides the following actions that will be implemented by the project to assess and / or mitigate any impact on Smoky Mouse as a result of project traffic:

- Initial fauna strike management - Complete
- Fauna underpass installation - Complete
- Population viability analysis (PVA) - Complete
- Mortality monitoring - Commenced

Section 3.1.2.1 of the Mitigation Plan (S2-FGJV-ENV-PLN-0106 Appendix G) provides specific detail on the fauna underpass design consideration. This includes the following description,

“The underpass design will consist of culverts. The section of Ravine Road along which underpasses will be installed is relatively flat. Installation of large culverts in this area would necessitate large earthworks to enable sufficient drainage through the culverts, as well as works to ensure sufficient cover for animals entering and exiting culverts. Alternative culvert sizes and designs were reviewed. A smaller culvert size is proposed, measuring approximately 300 mm (width) by 225 mm (height).

The underpasses will have rocks and coarse woody debris, preferred by the Smoky Mouse, placed in the base of the culvert in consultation with NPWS and BCD. This combination of culvert size and inclusion of small rocks and woody debris would ensure predators such as Cats and Foxes could not access the underpass and provide refuge habitat for Smoky Mouse. This design also ensures civil works required to place underpasses beneath project roads and at entry and exit points is minimal, ensuring a smaller degree of impact from proposed works.

A diagrammatic depiction of the proposed culvert design is shown in Figure 1. Underpass design will involve consideration of ongoing maintenance requirements. The installation of these underpasses provides an opportunity to determine the uptake by fauna and thus the

efficacy to mitigate fauna strike without (or with) guiding fencing. This will be monitored through remote cameras as outlined in Section 4.3".

The proposed culvert concept shown in Figure 1 was developed and adopted with guidance provided by NPWS and BCS from their experience in installing similar underpasses for Mountain Pygmy Possums in KNP.

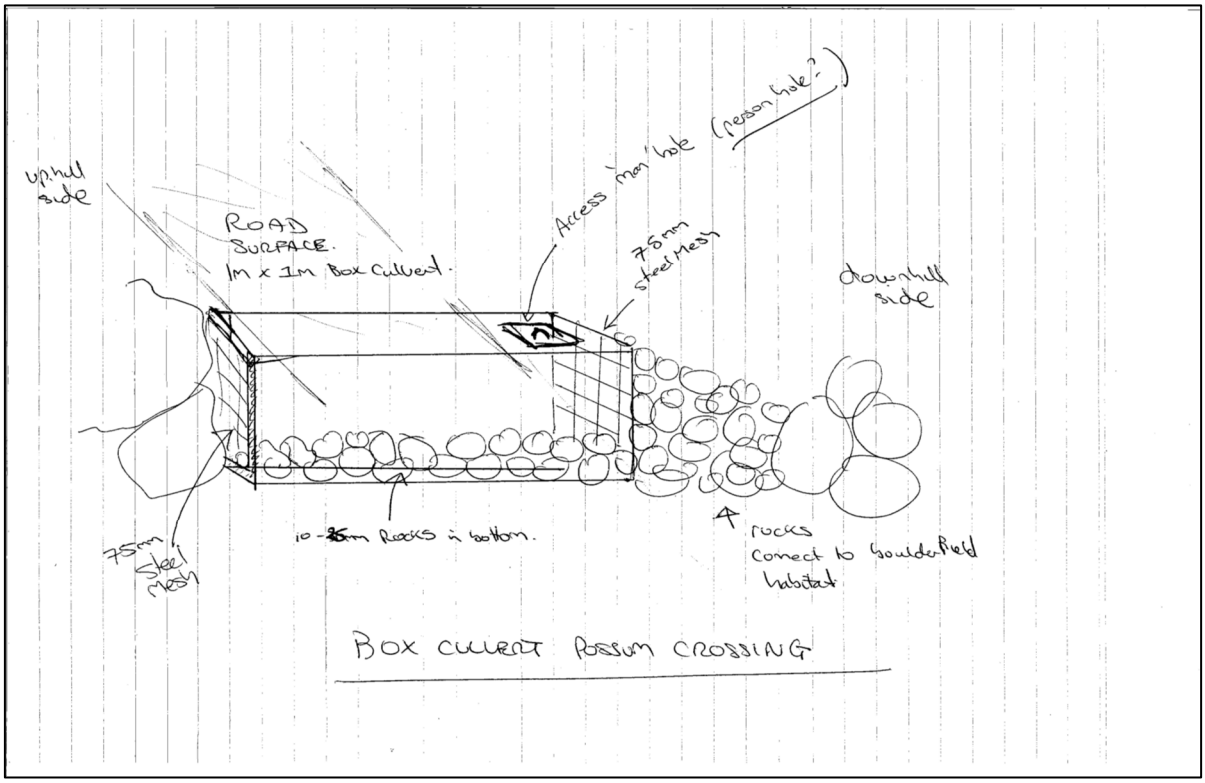


Figure 1: Example underpass sketch provided by NPWS

As part of the Main Works Biodiversity Management plan (Appendix G), 6 locations along Lobs Hole Ravine Road were identified for the construction of fauna underpasses. Each location was selected in accordance with Smoky Mouse survey locations and records derived from the biodiversity surveys undertaken for Snowy 2.0.

Photograph 2: Scoping suitable locations for underpasses

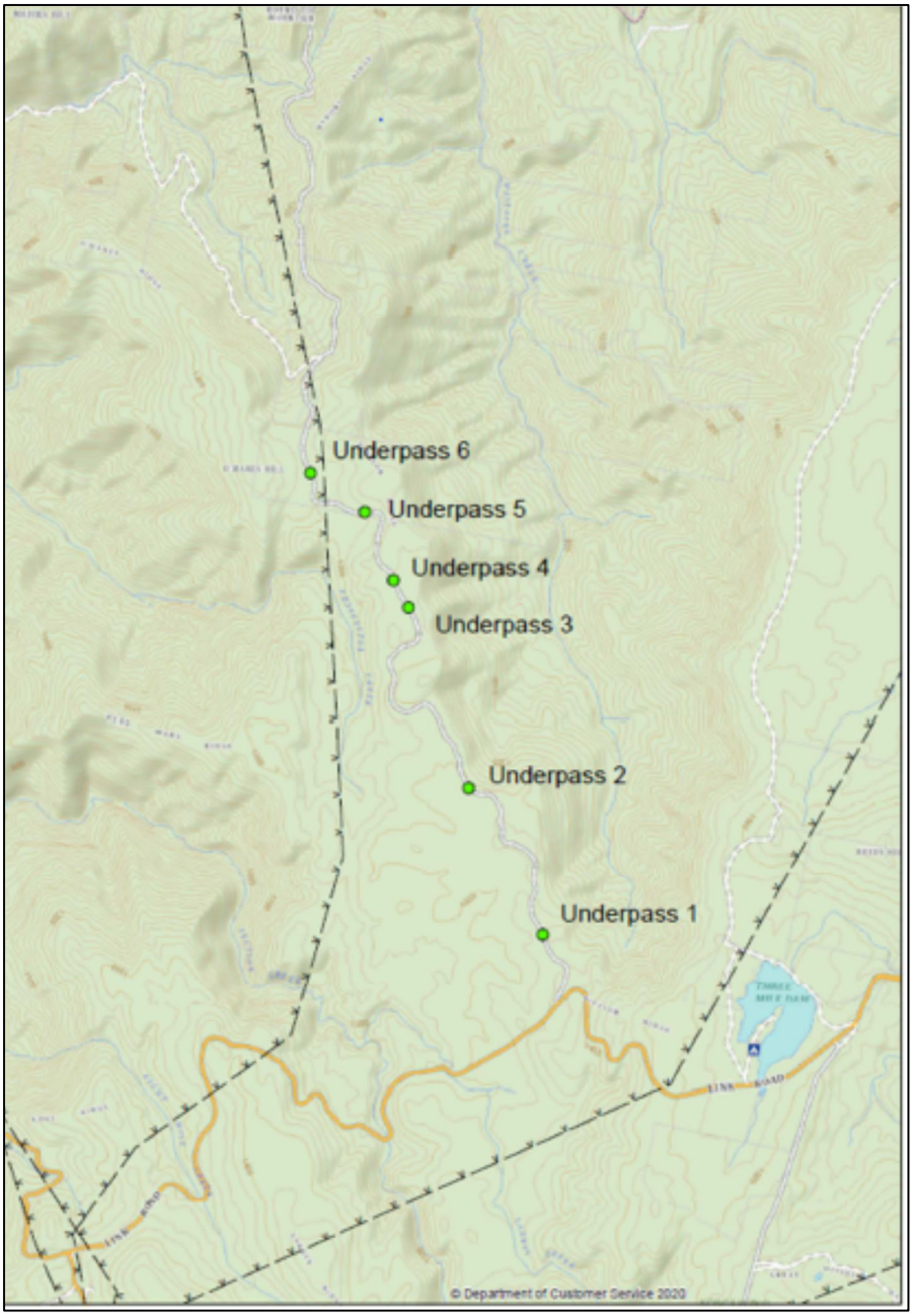


Figure 2: Fauna underpass locations detailed in the Snowy 2.0 Biodiversity Management Plan

Underpass Structure #	Easting	Northing	Ravine Road Chainage (approx.)
1	628866.6387	6029065.893	1400
2	628222.054	6029839.826	2550
3	627802.2456	6031204.241	4500
4	627640.4039	6031513.062	4850
5	627370.914	6032089.821	5650
6	626915.0129	6032440.269	6350

Figure 3: Location of underpasses on Ravine Road

2.0 Installation of Trial Underpass

In November 2020 a ‘trial’ fauna underpass was installed underneath Ravine Road near the top of Prospectors Creek. This underpass was installed specifically to test the proposed design and construction method and gauge feedback from BCD and NPWS prior to installation of the remaining five underpasses.

Photographs 3 and 4 show the culverts being placed underneath the road surface. Culverts were laid down with rock and woody debris placed into the culverts prior to sealing.

Photograph 3 - Installation of trial underpass

Photograph 4 - Material inside trial underpass

The trial underpass culverts sat underneath the road surface and provided access beneath the road and in principle achieved the objectives in the Fauna Strike However, it was identified that additional protection / cover at the underpass entry and exit points should be installed to provide cover from predators.

Photograph 5 - showing smaller culvert and 'ramp' over

Following the initial review and installation of the trial underpass a site inspection was held with key personnel from NPWS and BCD in January 2021. The feedback provided included the following which were incorporated into the final design:

- The trial underpass installed is too narrow in width/ height dimensions for focal length of monitoring cameras and long-term maintenance
- Need to install rocks / debris at both underpass entrances and steel mesh at tunnel entrances to protect from predators. No flammable debris to be placed within the culvert
- Need to lower or reduce the ramp over underpasses for long-term traffic/ road operation
- Need to install headwalls to prevent movement of road / shoulder material into the underpass entrance

Photograph 6 - Site inspection with BCD and NPWS representatives

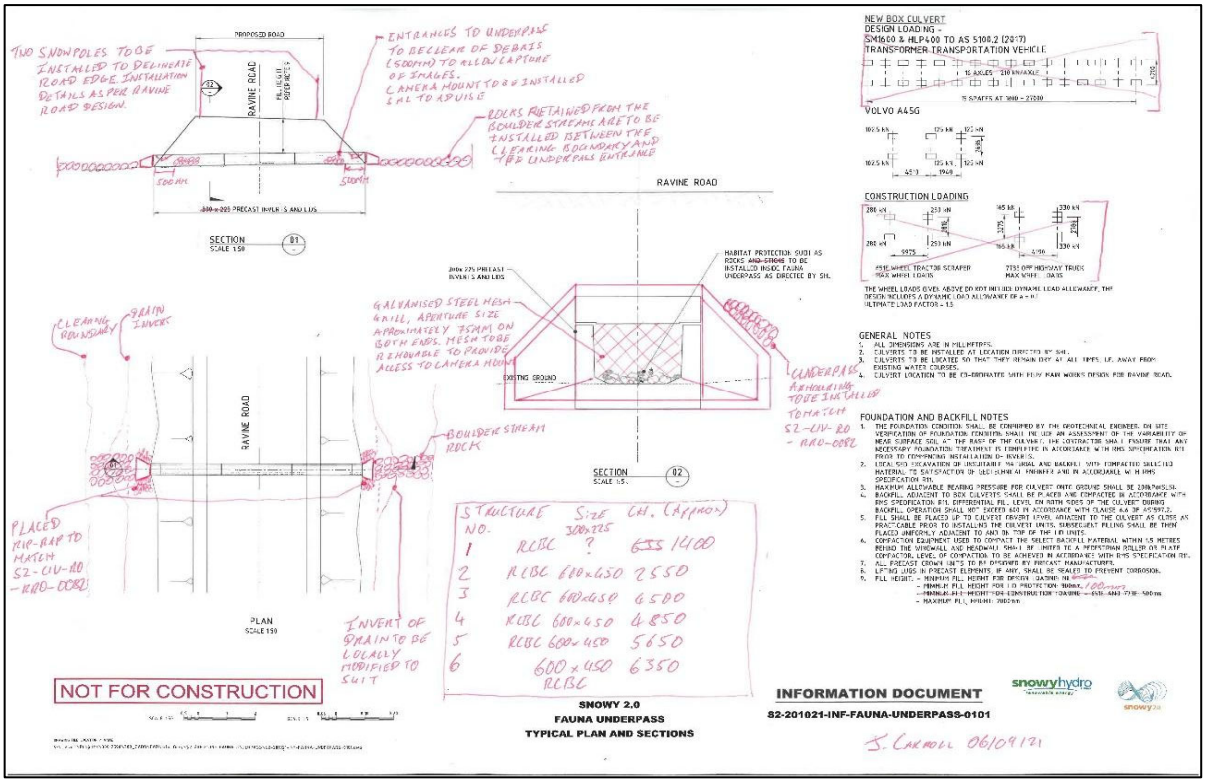


Figure 4: Marked up 'red line' drawing illustrating the changes made post installation and feedback received regarding the trial underpass

3.0 Fauna Underpass Design Details

Final as-built underpass designs have been provided in Appendix A

3.1 Design vehicle

All fauna underpasses on Ravine Road were designed to consider fully loaded Volvo 45Gs. The main works contractor and logistics subcontractor will need to analyse the suitability of the road (specifically the fauna underpasses) once the final vehicle and mass is confirmed.

It is anticipated that the combined weight of the transport vehicle and transformer will not exceed that of a fully loaded Volvo 45G which is 71,000kg.

Figure 5: Volvo 45G articulated dump truck

3.2 Road geometry and cover

Initially the underpasses were set too high resulting in vertical road geometry that created a 'speed hump' effect. To address this issue cover was removed rather than lowering the as-built underpasses as it was determined that if they were lowered then the risk of water and silt transferring into the culverts would be increased. While some drainage is expected through the underpasses, major transfer of water is not desired due to the associated maintenance with higher flows and the build-up of sediment.

Photograph 7 - Final Ravine Road alignment above underpass

3.3 Culvert type/size

The fauna underpasses are all type Rocla Concrete Box Culverts (RCBC - reinforced concrete box culverts) with dimensions of 2.4m long x 600mm wide x 450mm high.

Figure 6: An example of the RCBC installed

3.4 Access mesh

Galvanised mesh will be installed at all underpass entrances along Ravine Road. The mesh is required to be fixed in place so that larger feral predators cannot access the underpasses. However, the mesh must also be readily removable to install and service the monitoring cameras. 500mm of space is to be left at the entrance of each underpass to allow the camera to capture images of fauna (Photograph 12). Roughly 50% of the underpass needs to be filled with boulder rock. The aperture of the mesh is approximately 75mm on both ends.

3.5 Roadside drains and transitions

The inverts of the roadside drains were locally modified to allow flow to redirect from the highpoint at the fauna underpass and back towards the installed drainage culverts. Underpass side slopes adjacent to headwalls are protected with riprap. Minor earthworks were completed and oversized boulder rock from nearby landscape was imported to allow a transition area from underpass back into existing timbered areas.

Photograph 8: Boulder rock transitioning into the surrounding vegetation

3.6 Headwalls

Headwalls have been installed in order to funnel fauna into the structure and protect the road base around the structure. The fauna underpasses are installed at the high part of the road minimising the amount of water shedding from the road. It is recommended that two snow poles are installed to delineate the road edge and the presence of the underpass.

Photograph 9: Installed headwall and rip rap

3.7 Fauna cameras

Based on the culvert size and camera focal length, the following equipment was procured to monitor the six underpasses:

- 10 x Reconyx HP2w HyperFire 2 with a custom focal length of 525mm
- 10 x Reconyx HP2w HyperFire 2 with a custom focal length of 375mm
- 20 x HyperFire 2 Series Security Enclosure for mounting onto the roof of the culverts

Figure 7: Reconyx camera unit

Photograph 10: Example of image quality

4.0 Monitoring and Reporting

4.1 Frequency of monitoring and reporting

Fauna underpasses along Lobs Hole Ravine Road are to be routinely monitored for the presence of Smoky Mice. Monitoring rounds will involve the collection and download of SD cards from each fauna camera. To ensure that no gaps exist in the data set, the SD cards will need to be downloaded once a month (every four weeks). However, the frequency of monitoring may be increased if the SD cards continue to present as 'full' during collection. As per BMP Appendix G:

Cameras should be set up facing downwards at a height appropriate to capture the width of the underpass entry/exit. Cameras will be set to take 10 photos per trigger with a one second interval between images, and a quiet period of 30 second between triggers. Cameras will be set on all six underpasses and set to record continuously.

Using this approach, the usage of underpasses by the Smoky Mouse will be determined. A successful movement will be determined through an animal being detected on both cameras at around the same time period.

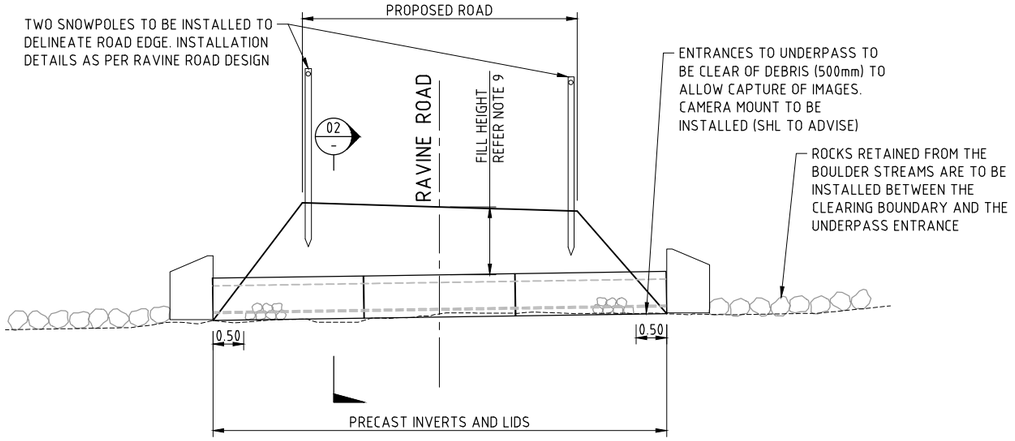
The images collected from the fauna cameras will be utilised in a quarterly monitoring report, developed in consultation with a suitably qualified ecologist. Items discussed within the report will include, but will not be limited to: species identification, localised observations and the uptake by fauna. As stated above, this will be produced every quarter to determine '*the efficacy to mitigate fauna strike without (or with) guarding fencing'*.

Photograph 11: Fauna camera featured above containing the SD card

5.0 Future Actions

Action #	Description	Timing
1	*Installation of fauna crossing signs* A set of fauna crossing signs will be installed at each monitoring location along Ravine Road. The signs will mark each underpass location for those undertaking monitoring or maintenance activities.	01/10/2022
2	*Installation of galvanised mesh* Galvanised mesh is to be positioned at the entrance of each fauna underpass culvert.	01/10/2022
3	*Commence monthly monitoring program* This will include monthly downloading of images from each camera and review by a qualified ecologist with a monthly activity report with any recommendations or improvements	01/07/2022
4	External reporting to update stakeholders Development of external report to be provided to external stakeholders as to the effectiveness of the underpasses and activity findings.	01/12/2022

Appendix A - As-Built Fauna Underpass Design



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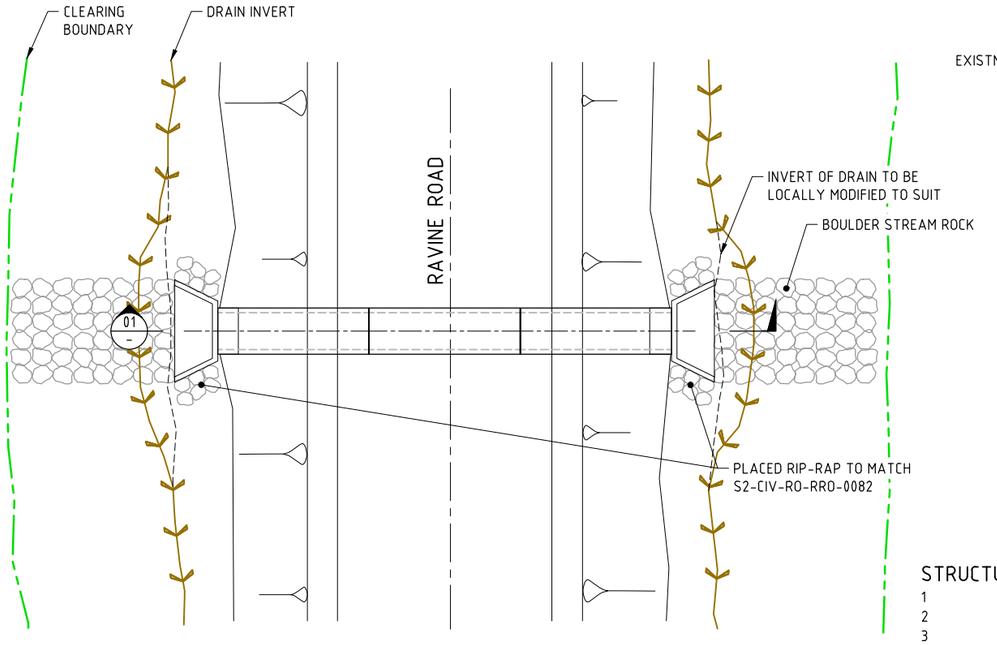

PLAN
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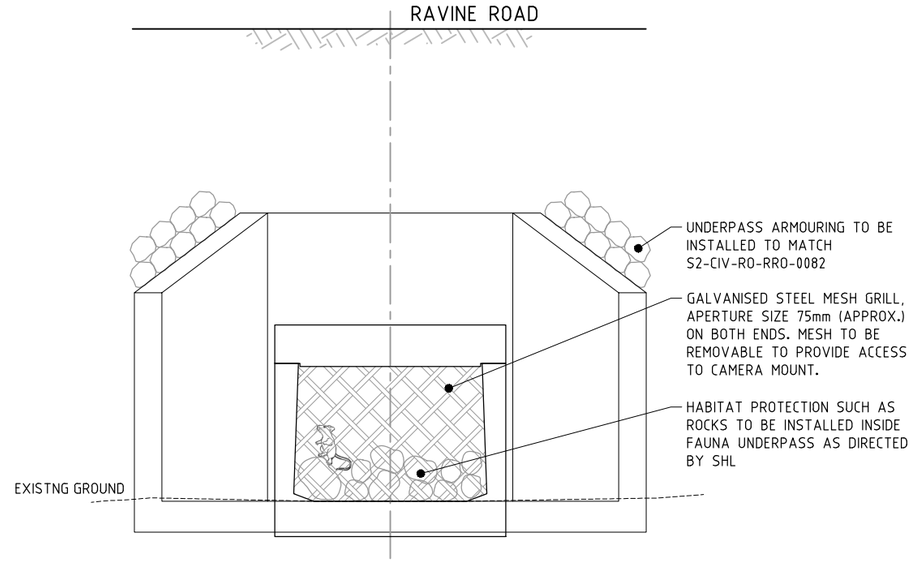
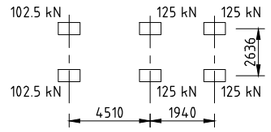


SECTION 02
SCALE 1:10

STRUCTURE No.	SIZE	CH (APPROX.)
1	RCBC	1400
2	RCBC 600x450	2550
3	RCBC 600x450	4500
4	RCBC 600x450	4850
5	RCBC 600x450	5650
6	RCBC 600x450	6350

VOLVO A45G



THE WHEEL LOADS GIVEN ABOVE DO NOT INCLUDE DYNAMIC LOAD ALLOWANCE, THE DESIGN INCLUDES A DYNAMIC LOAD ALLOWANCE OF a = 0.1
ULTIMATE LOAD FACTOR = 1.5

GENERAL NOTES

1. ALL DIMENSIONS ARE IN MILLIMETRES.
2. CULVERTS TO BE INSTALLED AT LOCATION DIRECTED BY SHL.
3. CULVERTS TO BE LOCATED SO THAT THEY REMAIN DRY AT ALL TIMES, I.E. AWAY FROM EXISTING WATER COURSES.
4. CULVERT LOCATION TO BE CO-ORDINATED WITH FGJV MAIN WORKS DESIGN FOR RAVINE ROAD.

FOUNDATION AND BACKFILL NOTES

1. THE FOUNDATION CONDITION SHALL BE CONFIRMED BY THE GEOTECHNICAL ENGINEER. ON SITE VERIFICATION OF FOUNDATION CONDITION SHALL INCLUDE AN ASSESSMENT OF THE VARIABILITY OF NEAR SURFACE SOIL AT THE BASE OF THE CULVERT. THE CONTRACTOR SHALL ENSURE THAT ANY NECESSARY FOUNDATION TREATMENT IS COMPLETED IN ACCORDANCE WITH RMS SPECIFICATION R11 PRIOR TO COMMENCING INSTALLATION OF INVERTS.
2. LOCALISED EXCAVATION OF UNSUITABLE MATERIAL AND BACKFILL WITH COMPACTED SELECTED MATERIAL TO SATISFACTION OF GEOTECHNICAL ENGINEER AND IN ACCORDANCE WITH RMS SPECIFICATION R11.
3. MAXIMUM ALLOWABLE BEARING PRESSURE FOR CULVERT ONTO GROUND SHALL BE 200kPa(SLS).
4. BACKFILL ADJACENT TO BOX CULVERTS SHALL BE PLACED AND COMPACTED IN ACCORDANCE WITH RMS SPECIFICATION R11. DIFFERENTIAL FILL LEVEL ON BOTH SIDES OF THE CULVERT DURING BACKFILL OPERATION SHALL NOT EXCEED 600 IN ACCORDANCE WITH CLAUSE 6.6 OF AS1597.2.
5. FILL SHALL BE PLACED UP TO CULVERT OBVERT LEVEL ADJACENT TO THE CULVERT AS CLOSE AS PRACTICABLE PRIOR TO INSTALLING THE CULVERT UNITS. SUBSEQUENT FILLING SHALL BE THEN PLACED UNIFORMLY ADJACENT TO AND ON TOP OF THE LID UNITS.
6. COMPACTION EQUIPMENT USED TO COMPACT THE SELECT BACKFILL MATERIAL WITHIN 1.5 METRES BEHIND THE WINGWALL AND HEADWALL SHALL BE LIMITED TO A PEDESTRIAN ROLLER OR PLATE COMPACTOR. LEVEL OF COMPACTION TO BE ACHIEVED IN ACCORDANCE WITH RMS SPECIFICATION R11.
7. ALL PRECAST CROWN UNITS TO BE DESIGNED BY PRECAST MANUFACTURER.
8. LIFTING LUGS IN PRECAST ELEMENTS, IF ANY, SHALL BE SEALED TO PREVENT CORROSION.
9. FILL HEIGHT: - MINIMUM FILL HEIGHT FOR DESIGN LOADING: NIL
   - MINIMUM FILL HEIGHT FOR LID PROTECTION: 100mm
   - MAXIMUM FILL HEIGHT: 2000mm

NOT FOR CONSTRUCTION

SCALE 1:50 0.5 0 1 2
SCALE 1:10 0.1 0 0.1 0.2 0.3 0.4 0.5

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SNOWY 2.0
FAUNA UNDERPASS
TYPICAL PLAN AND SECTIONS

INFORMATION DOCUMENT

S2-CIV-RO-RRO-IFD-220603-S101

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