



CHAPTER

A

BIODIVERSITY DEVELOPMENT ASSESSMENT REPORT



Biodiversity Development Assessment Report

Exploratory Works Modification 2

Prepared for Snowy Hydro Limited
October 2019

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Biodiversity Development Assessment Report

Exploratory Works Modification 2

Report Number

J17188 RP#70

Client

Snowy Hydro Limited

Date

24 October 2019

Version

v1 Final

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24 October 2019

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Executive Summary

Snowy Hydro Limited (Snowy Hydro) is pursuing the development of the Snowy 2.0 project, which is a pumped hydro-electric storage and generation project within the Kosciuszko National Park (KNP). Snowy 2.0 involves linking Talbingo and Tantangara reservoirs within the existing Snowy Mountains Hydro-electric Scheme (Snowy Scheme) and building an underground power station between the two reservoirs.

Snowy Hydro sought approval to carry out Exploratory Works prior to the commencement of Snowy 2.0 Main Works. The purpose of the Exploratory Works for Snowy 2.0 is primarily to gain a greater understanding of the conditions at the proposed location of the power station, approximately 850 m below ground level. Exploratory Works was subject to a separate approval to Main Works and an Environmental Impact Statement (EIS, Application SSI 18_9208) was prepared for Exploratory Works and lodged with the Department of Planning and Environment (DPE) in July 2018. Exploratory Works for Snowy 2.0 was approved on 7 February 2019.

Since the Exploratory Works EIS was developed, a construction contractor (Future Generation Joint Venture (FGJV)) has been engaged by Snowy Hydro and a period of design development has led to a shift in the location of the power station approximately one kilometre west along the tunnel alignment. The proposed modification reflects project changes and requirements identified by the construction contractor.

Modification 2 comprises of:

- revision of the exploratory tunnelling method from drill and blast to tunnel boring machine (TBM) method;
- road upgrades for transport of TBM equipment and materials required for tunnelling;
- vegetation trimming, and selective tree lopping and removal on Lobs Hole Ravine Road (south) to provide adequate clearance for transport of the maximum TBM load;
- access via Lobs Hole Ravine Road (north) and maintenance to provide improved secondary access and egress to Lobs Hole;
- relocation of Middle Bay Barge ramp;
- revision of the transport strategy to reduce the use of barging;
- increase Lobs Hole accommodation camp from 152 personnel to up to 220. The additional accommodation would be located vertically within the currently proposed footprint;
- ancillary construction areas and activities required for installation of communications infrastructure across Talbingo Reservoir;
- additional diesel storage capacity for TBM until construction power is available;
- TBM power supply prior to Lobs Hole substation commissioning including additional/larger diesel generators; and
- revision of the transport strategy to reduce the use of barging.

This report documents the terrestrial biodiversity assessment methods and results, the initiatives built into the Modification 2 project design to avoid and minimise biodiversity impacts, and the additional mitigation and management measures proposed, including offset requirements, to address any residual impacts not able to be avoided.

Modification 2 is located predominately within the South Eastern Highlands Interim Biogeographic Regionalisation of Australia (IBRA) region and Bondo IBRA subregion, and within the Kosciuszko National Park (KNP). Native vegetation is largely intact, with an 97% native vegetation cover within a 1,500 m buffer of the disturbance boundary, providing a high degree of connectivity to a large and contiguous patch of vegetation.

Significant field surveys have been undertaken within and adjacent to the Modification 2 disturbance area, including initial field assessments, detailed vegetation mapping, vegetation integrity assessment and comprehensive targeted flora and fauna surveys which have exceeded NSW and Commonwealth survey guidelines. The northern section of Lobs Hole Ravine Road has not been subject to detailed targeted surveys as the project boundary was identified out of survey season for many species. This is discussed further in Section 6.3.3.

A key focus of project design has been to avoid and minimise impacts to biodiversity values identified during the field surveys, in recognition of the location of the proposed modification in the KNP. This has included an iterative process to the design, including the following steps:

- identification of biodiversity values through comprehensive, rigorous and thorough biodiversity surveys;
- communication of identified values to the project team, including Snowy Hydro and the design team;
- consultation between the design team and project ecologists on various elements to consider both direct and indirect impacts and work through an iterative design process, with multiple iterations of design elements to achieve best practice outcomes;
- consultation with key government stakeholders, including the Biodiversity Conservation Division (BCD) of the Department of Planning, Industry and Environment (DPIE), NSW National Parks and Wildlife Service (NPWS) and Commonwealth Department of the Environment and Energy (DoEE), including species experts and accountable officers, to seek input and discuss measures proposed to avoid, minimise and mitigate impacts;
- feedback of consultation into the design process; and
- finalisation of measures to avoid, minimise and mitigate impacts.

This has resulted in significant design revisions to avoid impacts, including minimising vegetation clearance along the Lobs Hole Ravine Road and Link Road to avoid impacts to Smoky Mouse habitat. In addition, works have been sited, wherever possible, in disturbed parts of the project area to minimise impacts to biodiversity.

Residual impacts following implementation of all controls include:

- trimming of vegetation to 1.1 m in height across 0.38 ha of native vegetation;
- clearing of 1.62 ha of native vegetation; and
- impacts to 0.99 ha of threatened species habitat for three species credit species.

A total of 36 ecosystem credits and 32 species credits are required to offset impacts arising from Modification 2.

In summary, a significant effort has been undertaken to understand the biodiversity values within the project area and design the project to avoid and minimise impacts to identified values. The proposed modification has been sited, where possible, within disturbed areas as a priority. Where this could not be achieved impacts have been minimised and mitigated through implementation of appropriate controls. Residual impacts will be offset in accordance with the objective and principles outlined in the biodiversity offset framework, and before impacts occur.

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Abbreviations

BAM	Biodiversity Assessment Method
BC Act	NSW <i>Biodiversity Conservation Act 2016</i>
BC Regulation	NSW Biodiversity Conservation Regulation 2017
BDAR	Biodiversity Development Assessment Report
Bionet	BioNet Atlas of NSW Wildlife
Biosecurity Act	NSW <i>Biosecurity Act 2015</i>
BOS	Biodiversity Offsets Scheme
CHM	Canopy Height Model
CSSI	Critical State significant infrastructure
DoEE	Commonwealth Department of Environment and Energy
DFSI	Department of Finance, Services and Innovation
DIWA	Directory of Important Wetlands in Australia
DPE	NSW Department of Planning and Environment
DPI	Department of Primary Industries
DPIE	NSW Department of Planning, Industry and Environment
EIS	Environmental impact statement
EP&A Act	NSW <i>Environmental Planning and Assessment Act 1979</i>
EPBC Act	Commonwealth <i>Environment Protection and Biodiversity Conservation Act 1999</i>
EPIs	Environmental Planning Instruments
FGJV	Future Generation Joint Venture
FM Act	NSW <i>Fisheries Management Act 1994</i>
GDEs	Groundwater Dependent Ecosystems
GPS	Geographic Positioning System
IBRA	Interim Biogeographic Regionalisation of Australia
KFH	Key Fish Habitats
KNP	Kosciusko National Park
LGA	Local Government Area
LiDAR	Light Detection and Ranging
MNES	Matters of National Environmental Significance
NPW Act	NSW <i>National Parks and Wildlife Act 1974</i>
NPWS	New South Wales Parks and Wildlife Service
OEH	Office of Environment and Heritage
PCT	NSW Plant Community Type
PMST	Protected Matters Search Tool
PoM	Plan of Management

RVA	Rapid Vegetation Assessment
SEARs	Secretary's Environmental Assessment Requirements
SEPP	State Environmental Planning Policy
Snowy Hydro	Snowy Hydro Limited
Snowy Scheme	Snowy Mountains Hydro-electric Scheme
SRD SEP	State and Regional Development SEPP
SSI	State Significant Infrastructure
TBM	Tunnel boring machine
TBDC	Threatened Biodiversity Data Collection
TECs	Threatened Ecological Communities
VIS	Vegetation Information System

Part A

Stage 1: Biodiversity Assessment

1 Introduction

1.1 The project

Snowy Hydro Limited (Snowy Hydro) proposes to develop Snowy 2.0, a large-scale pumped hydro-electric storage and generation project which would increase hydro-electric capacity within the existing Snowy Mountains Hydro-electric Scheme (Snowy Scheme). This would be achieved by establishing a new underground hydro-electric power station that would increase the generation capacity of the Snowy Scheme by almost 50%, providing an additional 2,000 megawatts (MW) generating capacity, and providing approximately 350,000 megawatt hours (MWh) of storage available to the National Electricity Market (NEM) at any one time, which is critical to ensuring system security as Australia transitions to a decarbonised NEM. Snowy 2.0 will link the existing Tantangara and Talbingo reservoirs within the Snowy Scheme through a series of underground tunnels and hydro-electric power station.

Snowy 2.0 has been declared to be State significant infrastructure and critical State significant infrastructure (CSSI) by the NSW Minister for Planning under the provisions of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act) and is defined in Clause 9 of Schedule 5 of the *State Environmental Planning Policy (State and Regional Development) 2011* (SRD SEPP). Separate applications and environmental impact statements (EIS) for different phases of Snowy 2.0 are being submitted under Part 5, Division 5.2 of the EP&A Act. The Exploratory Works EIS was approved by the Minister on 7th February 2019.

1.2 Purpose of this report

The Biodiversity Development Assessment Report (BDAR) supports the Assessment Report for Modification 2 to the Exploratory Works approval. It documents the terrestrial biodiversity assessment methods and results, the initiatives built into the project design to avoid and minimise associated impacts to terrestrial biodiversity, and the mitigation and management measures, including offset requirements, proposed to address any unavoidable residual impacts.

The specific objectives of this assessment are to:

- describe the existing biodiversity values and existing environment;
- identify and assess the potential for the presence of biodiversity values, including threatened species and communities, listed under relevant legislation including the NSW *Biodiversity Conservation Act 2017* (BC Act) and Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act);
- identify ecological constraints within, and impacts arising from, the modification;
- provide mitigation measures to reduce the impacts from the proposal on biodiversity wherever possible; and
- where impacts are unavoidable, consider compensatory measures that are appropriate for the modification.

This BDAR has been prepared in accordance with the Biodiversity Assessment Method (BAM, OEH 2017a).

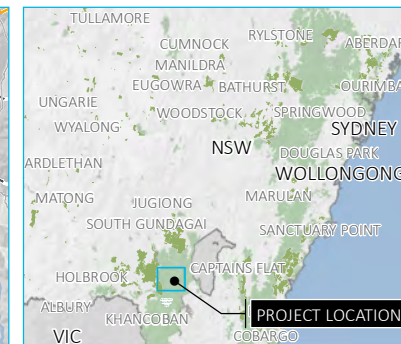
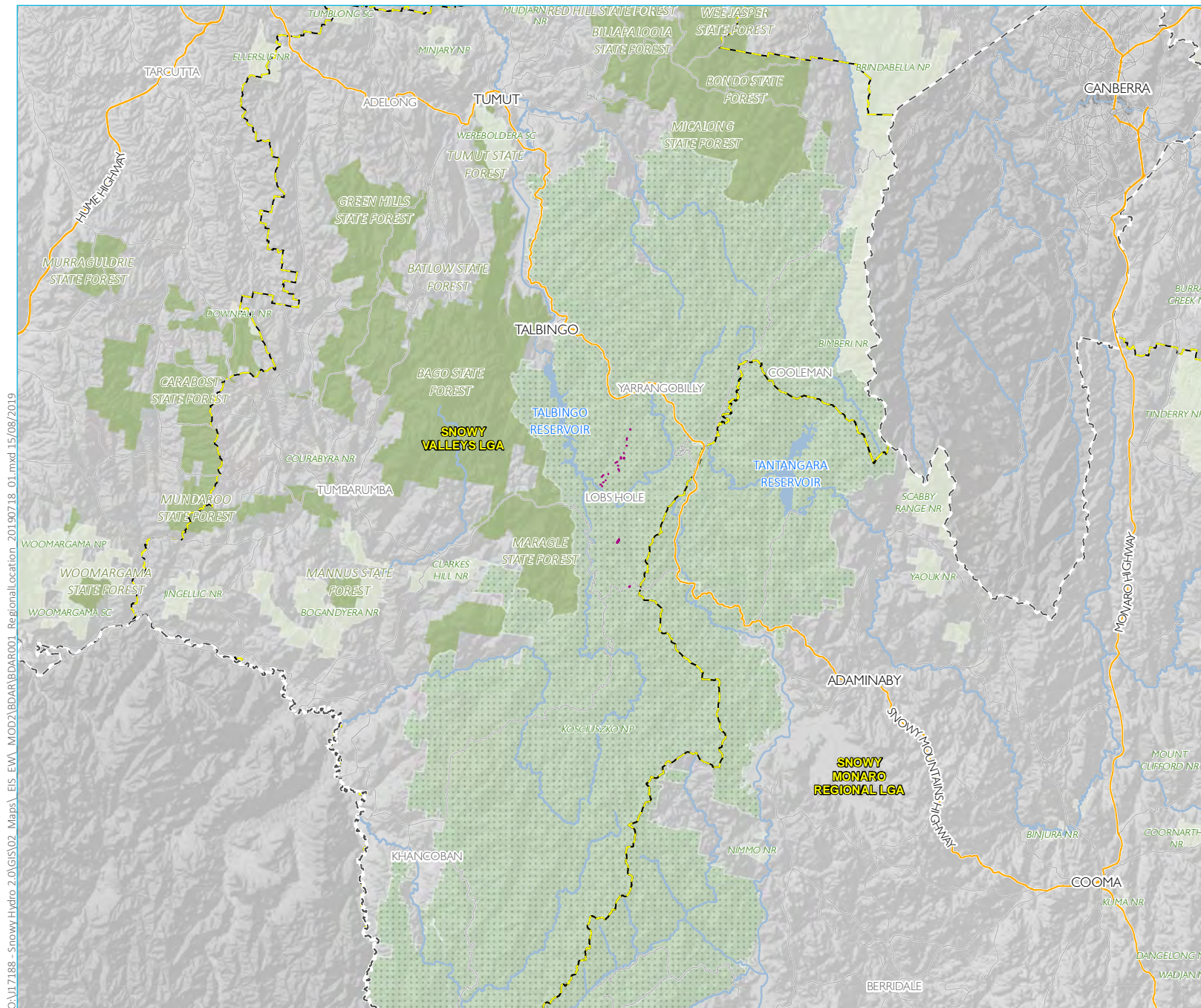
1.3 Location of Modification 2

The disturbance footprint for Modification 2 is located within the Australian Alps, in southern NSW. The regional location of Modification 2 is shown on Figure 1.1, within the Snowy Valleys local government area (LGA) and Kosciuszko National Park (KNP).

The proposed modifications are along Lobs Hole Ravine Road, Link Road and Talbingo Reservoir in Lobs Hole Ravine within the KNP. The project area is shown on Figure 1.2 and comprises the following relevant to this BDAR:

- road upgrades for transport and delivery of TBM equipment and materials required for tunnelling on Link Road;
- minor vegetation trimming, and selective tree lopping/removal on Lobs Hole Ravine Road (South) to provide adequate clearance for transport of the maximum TBM load; and
- improved access and egress to Lobs Hole via Lobs Hole Ravine Road (North).

A full description of the scope of the proposed modification is provided in Section 2.4 and in the Assessment Report.

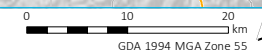


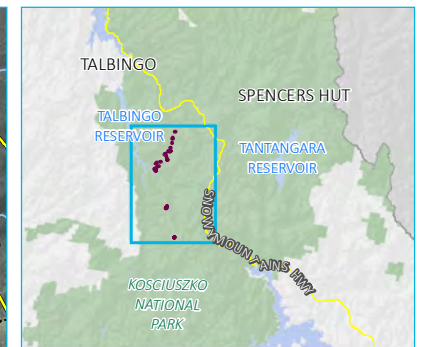
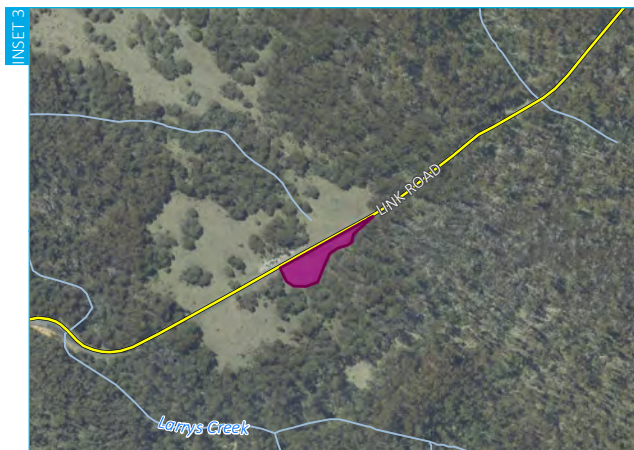
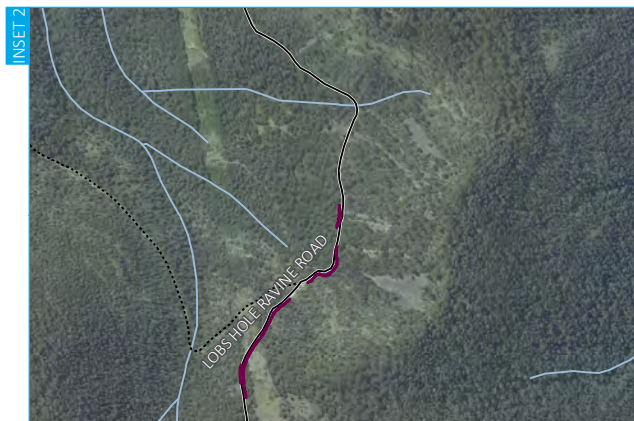
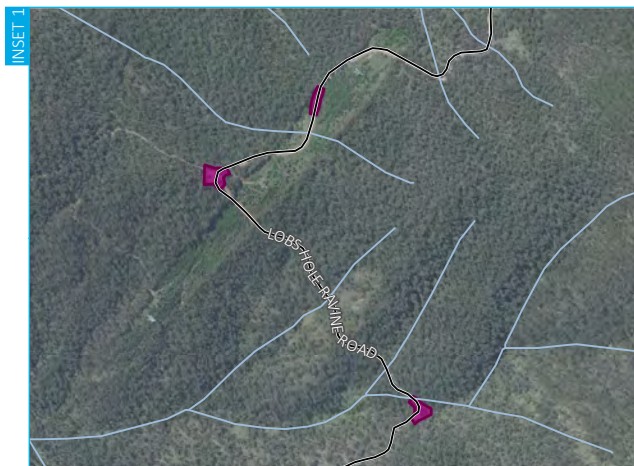
- KEY**
- Exploratory Works MOD 2 disturbance footprint
 - ▬ Local government area boundary
 - ▬ State boundary
 - ▬ Waterbody
 - Kosciuszko National Park
 - NPWS reserve
 - State forest
 - ▬ Main road
 - ▬ Local road
 - ▬ Watercourse

Regional location of Snowy 2.0 and Modification 2

Snowy 2.0
Biodiversity development assessment
Modification 2
Figure 1.1

Source: EMM (2019); Snowy Hydro (2019); SMEC (2017); DFSI (2017); GA (2015); LPMA (2011)





- KEY**
- Exploratory Works MOD 2 disturbance footprint
 - Main road
 - Local road
 - Vehicular track
 - Watercourse / drainage line
 - Waterbody

Modification 2 project area

Snowy 2.0
Biodiversity development assessment
Modification 2
Figure 1.2

Source: EMM (2018); Snowy Hydro (2018); NearMap (2018); PhotoMapping (2018); SMEC (2018); DFSI (2017); GA (2015); LPMA (2011)
O:\J17188 - Snowy Hydro 2.0\GIS\02_Maps\EIS_EW_MOD2\BDAR\BDAR002_ProjectLocation_20190718_01.mxd 15/08/2019

0 1 2 km
GDA 1994 MGA Zone 55



1.4 Project area, survey area, disturbance and avoidance footprint definitions

The Exploratory Works Modification 2 would be undertaken within the project area shown in Figure 1.1.

The disturbance footprint for Modification 2 includes all areas where land could be directly disturbed by the modification and includes all areas subject to clearing and ground disturbance. The project area includes all areas in which Modification 2 will occur, including the clearing area, as well as areas proposed for vegetation trimming along the top of Lobs Hole Ravine Road.

Both desktop assessments and field surveys have been undertaken to assess the biodiversity values at a State and Commonwealth level that occur across the survey area. The survey area includes the disturbance and avoidance footprints for Exploratory Works, including Modification 1 and 2, as show in Figure 1.2 of EMM (2018d), and the disturbance boundary for Modification 2 and adjacent areas, as shown in Figure 1.2 of this assessment.

Surveys have also been undertaken across a broad area as a part of the Main Works project for Snowy 2.0. Where relevant, these surveys are discussed herein.

1.5 Proponent

Snowy Hydro Limited is the proponent for Modification 2. Snowy Hydro is an integrated energy business – generating energy, providing price risk management products for wholesale customers and delivering energy to homes and businesses. Snowy Hydro is the fourth largest energy retailer in the NEM and is Australia’s leading provider of peak, renewable energy.

1.6 Assessment guidelines and requirements

This terrestrial biodiversity assessment has been prepared to support the application for Modification 2. Table 1.1 lists the matters relevant to this assessment and where they are addressed in this report.

Table 1.1 Terrestrial biodiversity related elements of the SEARS and how they have been addressed

Requirement	Section addressed
An assessment of the biodiversity values and the likely biodiversity impacts of the project in accordance with the BC Act, the BAM and documented in a BDAR.	This report.
A strategy to offset any residual impacts of the project focusing on improving the biodiversity and conservation values of the Kosciuszko National Park in the medium to long term.	Section 7.4.
An assessment of the impacts of the project on aquatic ecology, including impacts on key fish habitat and threatened species of fish.	Exploratory Works EIS, Section 6.5.3 (EMM 2018a) Aquatic Ecology Assessment (Cardno 2019)

1.7 Information sources

1.7.1 Other relevant reports

The terrestrial biodiversity assessment has been prepared with reference to other technical reports that were prepared as part of the EIS for Modification 2. The other relevant reports referenced in this terrestrial biodiversity assessment are listed below:

- Cardno 2019, Aquatic ecology assessment.
- EMM 2018a, Environmental Impact Statement: Exploratory Works for Snowy 2.0, Vol 1, prepared for Snowy Hydro Limited.
- EMM 2018b, Response to Submissions: Exploratory Works for Snowy 2.0, prepared for Snowy Hydro Limited.
- EMM 2018c, Geological Sites Report, prepared for Snowy Hydro Limited.
- EMM 2018d, Biodiversity Development Assessment Report, Exploratory Works for Snowy 2.0, prepared for Snowy Hydro Limited.
- EMM 2018e. Snowy 2.0 Exploratory Works EIS. Groundwater Assessment, prepared for Snowy Hydro Limited.
- EMM 2018f. Snowy 2.0 Exploratory Works. EPBC Act Assessment, Matters of National Environmental Significance Report: Species and Communities, prepared for Snowy Hydro Limited.
- EMM 2019a, Modification 1 to Infrastructure Approval SSI 9208 – Snowy 2.0 Exploratory Works, prepared for Snowy Hydro Limited.
- EMM 2019b, Exploratory Works Modification 1 Biodiversity Assessment Development Report for Snowy 2.0, prepared for Snowy Hydro Limited.

1.7.2 Publications and databases

In order to provide context for Modification 2, information about flora and fauna species, populations, communities and habitats from the locality (generally within 10 km of the project area) was obtained from the following databases:

- OEH (2018a) *BioNet Atlas of NSW Wildlife* (Bionet) for previous threatened species records;
- Commonwealth Department of Environment and Energy (DoEE) *Protected Matters Search Tool* (PMST) for Matters of National Environmental Significance (MNES, DoEE 2018a), including threatened species and communities likely to occur within the Modification 2 project area; and
- the *NSW Plant Community Types* (PCTs), as held within the Vegetation Information System (VIS) Classification 2.1 database (OEH 2018b).

1.7.3 Spatial data

Spatial data encompassing the Modification 2 project area, including the disturbance and avoidance footprints, was obtained from Snowy Hydro. Base map data was obtained from Department of Finance, Services and Innovation (DFSI) NSW databases, with cadastral data obtained from DFSI digital cadastral database. Mapping for stream orders was obtained from DPI (2013).

The following spatial datasets were utilised during the development of this report:

- *State Vegetation Type Map: Riverina Region Version v1.2 - VIS_ID 4469* (OEH 2016a);
- *Mitchell Landscapes Version V3.1* (OEH 2016b);
- *Interim Biogeographic Regionalisation of Australia (IBRA) Version 7* (DoEE 2017);
- Directory of important wetlands (DoEE 2018b); and
- NSW Wetlands (OEH 2010).

Mapping undertaken during the site assessment was conducted using a hand-held GPS units, mobile tablet computers running Collector for ArcGIS™ and Survey123 for ArcGIS™ and aerial photo interpretation. Accuracy is subject to accuracy of GPS devices, generally ± 5 m. Mapping has been produced using a Geographic Information System (GIS; ArcGIS 10.5).

1.8 Legislation requirements

The project has been assessed against the key biodiversity legislation and government policy, including:

- EPBC Act;
- BC Act;
- *NSW Environmental Planning and Assessment Act 1979* (EP&A Act);
- *NSW Biosecurity Act 2015* (Biosecurity Act); and
- *NSW National Parks and Wildlife Act 1974* (NPW Act).

These are discussed further in Section 3.

2 Exploratory Works

2.1 Snowy 2.0 Exploratory Works planning approvals

Snowy 2.0 is being developed in stages. The first stage, Snowy 2.0 Exploratory Works (SSI 9208), includes an exploratory tunnel and portal and other exploratory and construction activities primarily in the Lobs Hole area of KNP. Approval for Exploratory Works was granted by the then NSW Minister for Planning on 7 February 2019. Construction works commenced in March 2019. Submission of the application and subsequent approval of Exploratory Works ahead of Main Works was critical as it will obtain detailed geological data about the rock types, conditions, ground temperature and stress conditions to inform the detailed design of the underground power station cavern.

The Exploratory Works were referred to the Commonwealth Minister for the Environment under the EPBC Act (Reference 2018/8217) and were determined on 10 July 2018 not to be a controlled action.

An application to modify the Exploratory Works approval to include additional geotechnical drilling and a construction power connection to the existing TransGrid 330 kV line 2 at Lobs Hole (Modification 1) was submitted to DPIE in June 2019 and publicly exhibited between 26 June and 9 July 2019. A response to submissions report was subsequently submitted to DPIE in September 2019 and a determination for Modification 1 is expected in October 2019.

A second modification to the Exploratory Works (Modification 2) is the subject of this application and involves changing the tunnelling method for the exploratory tunnel from drill and blast to TBM. The proposed modification is described in Chapter 3.

This chapter provides details of the approved Exploratory Works as well as the proposed Modification 1.

2.2 Snowy 2.0 Exploratory Works overview

The Exploratory Works involves the construction of an exploratory tunnel to enable exploratory drilling and provide a greater understanding of the underground conditions, principally at the power station cavern. The EIS also described several supporting elements required to facilitate the construction of the exploratory tunnel.

The approved Exploratory Works project includes:

- an exploratory tunnel about 3.1 km long to the site of the underground power station;
- horizontal and other test drilling, investigations and analysis in situ at the proposed cavern location and associated areas, and around the portal construction pad, access roads and excavated rock management areas all within the disturbance footprint;
- a portal construction pad for the exploratory tunnel. This will provide the entrance structure to the tunnel and an area for infrastructure and equipment needed to support tunnelling activities;
- an accommodation camp for the Exploratory Works construction workforce;
- road works and upgrades to enable access and haulage routes during Exploratory Works. This included upgrades to 26 km of existing roads and creation of about 2 km of new roads;

- barge access infrastructure to enable access and transport by barge on Talbingo Reservoir. This included one new barge ramp at Talbingo Spillway in the northern part of Talbingo Reservoir and one new barge ramp at Middle Bay near Lobs Hole at the southern part of Talbingo Reservoir;
- excavated rock management, including subaqueous placement within Talbingo Reservoir. Up to 750,000 m³ of excavated rock will need to be tested for its geochemical properties (ie whether the rock is reactive or non-reactive) before being managed by a combination of the following options:
 - re-use – suitable material can be used as construction materials for roads or similar. Some materials will be provided to NPWS for use in road maintenance and upgrades in other areas of KNP;
 - on land placement – material will be placed in one of two on land emplacement areas. The eastern emplacement area has been designed to safely treat reactive material with the material to either be emplaced within Talbingo Reservoir as part of the trial or removed from KNP following completion of Exploratory Works. The western emplacement area will be used for temporary storage of materials for re-use during Exploratory Works; and
 - subaqueous placement within Talbingo Reservoir – suitable material will be placed at a suitable location within Talbingo Reservoir, subject to a number of water quality controls and monitoring; and
- services infrastructure such as diesel-generated power, water and communication.

The EIS also detailed that horizontal and other test drilling, investigations and analysis was proposed for the above elements to inform their detailed design.

Exploratory Works commenced in February 2019 and is estimated to take around 34 months to complete.

2.3 Modification 1 overview

In June 2019, Snowy Hydro sought to modify infrastructure consent SSI 9208 pursuant to section 5.25 of the EP&A Act to reflect requirements identified as part of the detailed design undertaken by the construction contractor (FGJV). At the time of the preparation of this report, the Modification 1 application continues to be assessed by DPIE and is expected to be determined in October 2019.

The scope of the Modification 1 includes:

- Borehole drilling and geophysical surveys for further geotechnical investigation of the Snowy 2.0 power station and power waterway at Marica, Talbingo and Tantangara. Geotechnical investigations will involve the following activities:
 - clearing of up to 2.79 hectares (ha) of additional vegetation for access tracks and drilling pads. About 1.33 ha within Smokey Mouse potential habitat;
 - trimming of overhanging dangerous branches on adjacent trees (these trees will not require removal);
 - mulching of trees and vegetation;
 - establishment of an additional 1 km of access tracks (4 m wide), including minor earthworks, placement of geofabric (as required) and import of stabilised material;

- establishment of eight drilling pads and boreholes at top of the cavern area, with an area of 900 m² per pad, including minor earthworks, placement of geofabric (as required) and import of stabilised material (as required);
 - undertaking geophysical surveys near Talbingo and Tantangara reservoirs;
 - establishment of two drilling pads and boreholes at both Talbingo and Tantangara reservoirs with an area of 900 m² per pad, including approximately 400 m of additional access tracks and minor earthworks (as required);
 - establishment of in-reservoir boreholes including one in Talbingo Reservoir and two in Tantangara Reservoir;
 - drilling of additional nested vertical boreholes at each of the drilling pads up to a depth of 1,100 m;
 - conversion of the investigation boreholes into monitoring bores;
 - undertaking geophysical surveys; and
 - rehabilitation of the drilling pads and access tracks following completion of works.
- Ongoing groundwater monitoring using existing boreholes and access tracks within KNP.
 - Ongoing maintenance and rehabilitation of existing access tracks required for groundwater monitoring and geotechnical investigations within KNP.
 - Establishment of a construction power connection to the existing transmission line (Line 2) at Lobs Hole for power supply to the Exploratory Works accommodation camp and construction areas. This will include:
 - Construction of a 330/33 kilovolt (kV) substation, within KNP and adjacent to Line 2, which forms a 330-kV connection between Upper Tumut Switching Station and Yass Substation.
 - Geotechnical investigation works to inform the detailed design of the substation.
 - Replacement of one transmission support structure (Structure 54) within the existing transmission easement. This will involve removal of the existing structure and establishment of one new steel lattice tower, approximately 50 m in height.
 - Short overhead 330 kV transmission line connections (approximately 100 m in length) between the substation and the new Structure 54.
 - 33 kV feeder connection between the substation and the Exploratory Works construction power network. This will be either overhead lines or underground cables.
 - Establishment and upgrade of access tracks and roads to the new substation and transmission line structures.
 - Installation of a fibre optic communication link into the new substation from the approved communication network.
 - Ancillary activities, including brake and winch sites, crane pads, site compounds and equipment laydown areas.

- Minor changes to the project boundary identified through detailed design including:
 - additional disturbance area around Camp Bridge and Wallaces Creek Bridge required for improved constructability of the crossings. Works within these areas will include vegetation clearing, levelling earthwork, erection of falsework, sediment controls, laydown, parking and movement of equipment.
 - additional disturbance area required for the construction power connection to an existing transmission line at Lobs Hole. Works in this area will include establishing a substation, connection infrastructure, access roads and ancillary construction areas.
 - revised road upgrade for Lobs Hole/Ravine Road to improve drainage and safety.
 - minor additions to construction areas for design optimisation.
- Removal of dangerous trees on Lobs Hole Ravine Road. This will involve either complete or partial removal of up to 91 trees that have been identified to pose a safety risk to construction crew and road users on Lobs Hole/Ravine Road and Mine Trail Road.
- Continued use of existing communications towers within KNP that were previously approved by the National Parks and Wildlife Service (NPWS) under a separate review of environmental factors (REF R – Wallaces Creek Geotechnical drilling) environmental impact assessment carried out under the NSW *National Parks and Wildlife Act 1974* (NPW Act) and its regulation for the geotechnical investigation program.
- Increase in peak traffic volumes. Additional vehicles will be required to access the site to facilitate construction of Exploratory Works, however no change in impacts to the road network are expected.
- Four additional laydown areas to improve constructability near Talbingo north. The proposed areas will assist with the installation of communications infrastructure, road works and barge infrastructure works; and
- Two additional geotechnical boreholes are required to facilitate the detailed design of cuttings, bridge foundations, retaining wall foundations, and drainage structures near Nungar Creek.

2.4 Modification 2 overview

The scope of the proposed modification includes:

- revision of the exploratory tunnelling method from drill and blast to predominantly TBM method;
- road upgrades for transport and delivery of TBM equipment and materials required for tunnelling;
- vegetation trimming, and selective tree lopping/removal on Lobs Hole Ravine Road (South) to provide adequate clearance for transport of the maximum TBM load;
- access via Lobs Hole Ravine Road (North) to provide improved secondary access and egress to Lobs Hole;
- relocation of Middle Bay Barge ramp to significantly reduce dredging area required for its establishment;
- increase Lobs Hole accommodation camp from 152 personnel to up to 250 (the additional accommodation would be an additional storey to the existing camp within the currently proposed footprint);

- additional diesel storage capacity for the TBM until construction power (subject to Modification 1) is available;
- additional diesel generators to provide power supply to the TBM prior to Lobs Hole substation commissioning; and
- revision of the transport strategy to reduce the use of barging for delivery of materials to site.

An overview of the proposed modification is provided in Figure 2.1.

2.4.1 Tunnel boring machine method

The proposed tunnelling method approved under the EW EIS included drill and blast method for excavation of the Exploratory Tunnel only. Since the preparation of the EW EIS, Snowy Hydro Limited has engaged FGJV to deliver the EW. The FGJV design and tunnelling method for the exploratory tunnel includes the use of a tunnel boring machine (TBM), which is outside the scope of the original approval. Snowy Hydro Limited seek a revision of the tunnelling method from drill and blast to TBM.

The exploratory tunnel will be excavated using one TBM that will be launched from either the portal construction pad or within the exploratory tunnel. As was the case for the already approved drill and blast method, excavation of the exploratory tunnel will occur 24 hours a day, seven days per week.

It is anticipated that drill and blast methods will be used for the exploratory tunnel until the TBM arrives on-site.

Tunnel boring machines are used to excavate tunnels with a circular cross section. The TBM will be fully equipped to perform the excavation, ventilation, lining, removal of excavated material.

The TBM will be engineered to facilitate dismantling operations. This will avoid the need to excavate a preliminary dismantling chamber and allow the TBM to be retrieved from the executed tunnel.

Systematic surveys will be conducted ahead of the TBM to identify potentially critical areas with poor rock conditions or high fracturing.

The TBM will be equipped with devices to perform the following surveys:

- geophysical Seismic reflection surveys;
- geoelectrical surveys; and
- systematic probing using percussive drilling.

The probing results will also be used to determine the presence of potentially acid forming (PAF) and naturally occurring asbestos (NOA) material.

The TBMs will be equipped with drilling machines to drill drainage holes with PVC pipes to relieve groundwater pressures. If required, pre-excavation grouting will also be used to seal-off groundwater inflow and to improve the stability of the excavation face.

Post-excavation grouting from the segmental lining may also be used to further consolidate the surrounding rock and/or prevent water ingress if required.

Further details, including a diagram of the TBM, have been provided in the main document for Exploratory Works Modification 2.

2.4.2 Road upgrades

Minor road upgrade works are required to enable transport of TBM equipment and materials required for tunnelling. This section provides details of the road works proposed under Modification 2.

i Link Road turnaround

To enable safe transport of the TBM equipment and materials to the construction areas at Lobs Hole a turnaround area will be established on Link Road. This area is located around 600 m west of the Lobs Hole Ravine Road intersection and occupies an area approximately 175 m long adjacent the south side of Link Road. The turnaround area will enable oversize loads to turnaround on the Link Road and approach the Lobs Hole Ravine Road intersection in a west-east direction. The proposed Link Road turnaround will be used a staging point, as well as for storage of equipment and materials and general laydown activities. The area has been sited within an existing cleared area and avoids impacts to surrounding intact areas of vegetation and habitat.

ii Lobs Hole Ravine Road South

Minor upgrade works are required on a couple of sections Lobs Hole Ravine Road (South) to enable the transport of the maximum sized equipment required for the TBM delivery. The maximum width load required for TBM transport has a width of 6.8 m and is a key factor driving the proposed road upgrades (Plate 2.1).

Vegetation trimming and removal is required to provide adequate clearance for the maximum load transport via the upper sections of Lobs Hole Ravine Road (south). As previously described, the largest piece of equipment that requires transport via Lobs Hole Ravine Road measures 6.8 m wide. To safely transport the maximum load a clearance width of 7.4 m is required for the extent of the transport route.

The upper sections of Lobs Hole Ravine Road have high ecological value due to the presence of the critically endangered Smoky Mouse and its habitat. The approved Exploratory Works avoid widening works along this road section as a result. To minimise impacts to potential Smoky Mouse habitat it is proposed to trim vegetation and selectively remove trees, as required, along the upper sections of Lobs Hole Ravine Road. Vegetation removal will occur at a width of 7.4 m and 1.1 m height for the extent of upper Lobs Hole Ravine Road. The majority of this clearance will be achieved within the existing Lobs Hole Ravine Road (south) disturbed area, with minor trimming along the edges of the existing disturbed area. The total area requiring vegetation trimming outside the existing disturbed area for upper Lobs Hole Ravine Road is less than 0.38 ha. The proposed vegetation trimming on upper Lobs Hole Ravine Road is provided in Figure 2.1.

Some minor road widening is also required on the upper sections of Lobs Hole Ravine Road. This is in the sections where the existing road batters are very steep and adequate clearance for the maximum load cannot be achieved through vegetation trimming only. The revised road upgrade includes some areas where additional ground disturbance is required. Rock stabilisation may also be undertaken along the Lobs Hole Ravine Road boundary as required for safety. The sections of Lobs Hole Ravine Road (south) requiring additional widening are provided in Figure 2.1.

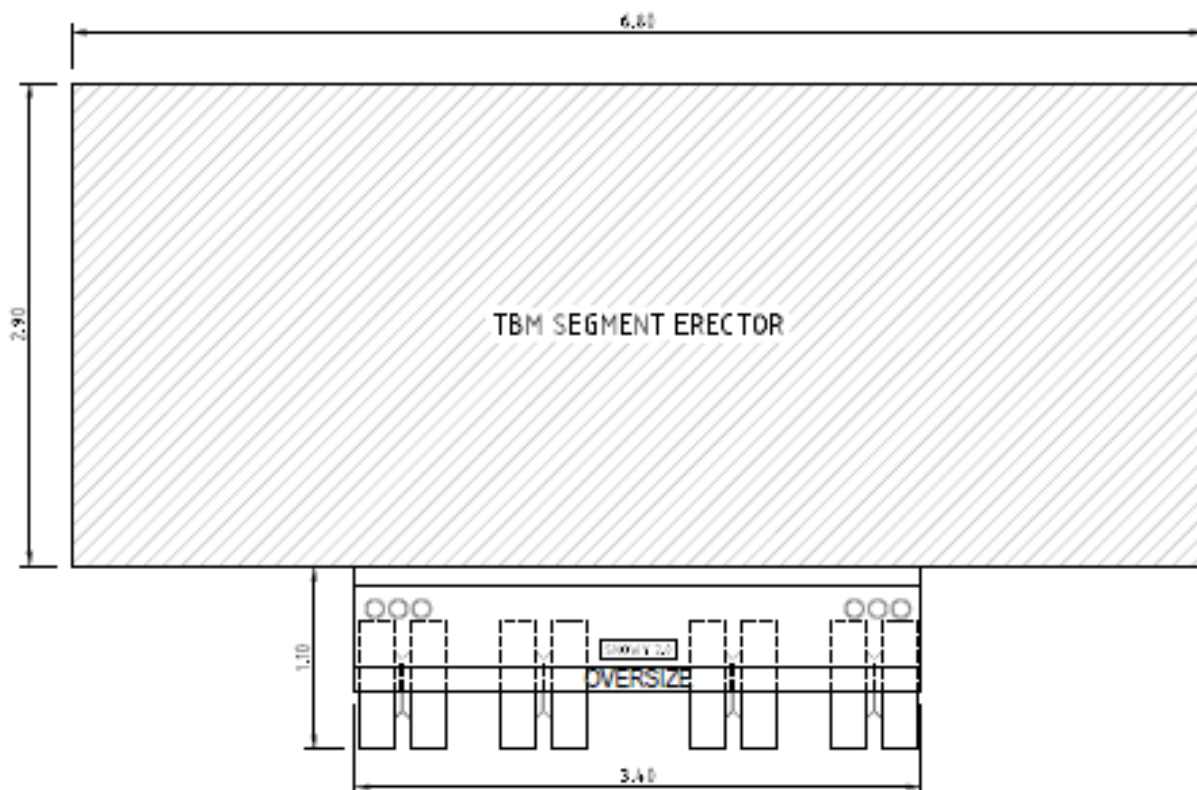


Plate 2.1 TBM load cross section

iii Cooma roundabouts

Upgrade works are required to two roundabouts on Sharp Street Cooma. Upgrades are required to these roundabouts to enable the passage of oversized vehicles to the project area. Several options for the roundabout designs have been developed to maintain consistent size and kerb to match current conditions for large vehicles. Some existing signage may need to be replaced with removable signs to allow them to be taken down for oversized movement. The design for the roundabouts will be finalised and agreed with Snowy Monaro Regional Council prior to construction.

iv Lobs Hole Ravine Road North

Roadworks are proposed to Lobs Hole Ravine Road North to provide an alternate access to Lobs Hole and improve emergency access and egress. It is proposed to use Lobs Hole Ravine Road North as an access route for light vehicles to Lobs Hole. Road works will include road upgrade and widening in several sections suitable for passing bays as well as regular maintenance of the existing roadway. These works are described in the sections below.

To improve the suitability of Lobs Hole Ravine Road North for secondary access, road widening will be undertaken to provide passing bays at regular intervals. There are 20 sections of road widening that will be carried out on sections of the existing road that provide suitable passing opportunities. The works required are provided in Figure 2.1. Road upgrade construction methods within the passing bay sections will be consistent with the road upgrades undertaken for other Exploratory Works access roads.

Regular maintenance will be undertaken within the existing road to maintain suitable access. All maintenance works will be carried out within the existing road and disturbed area. Maintenance works will include:

- restoring road profile (longitudinal, crossfall / crown) and surface as required, ensuring proper runoff;
- clearing and reforming blocked table, mitre or catch drains to ensure proper drainage;
- removing roadside vegetation impeding on driver visibility or passing opportunities within the existing roadway. No vegetation clearing will occur outside the existing disturbed area;
- clearing existing culverts if required;
- installation of temporary erosion / sedimentation controls if required to drains or outfalls; and
- temporary removal and restoration of roll-over / dish drains if required to facilitate long vehicle movements (generally to be restored on the same day).

v Clearing of native vegetation

Clearing will be required to allow for road upgrades subject to this modification. The additional clearing will include approximately 1.62 ha of vegetation to establish road upgrades on Lobs Hole Ravine Road south, Lobs Hole Ravine Road North and Link Road.

The clearing will be undertaken as follows:

- installation of site delineation/webbing, inclusive of sediments control measures along the road;
- pre-clearance vegetation inspections by ecologists;
- removal of the trees and overstorey vegetation with chainsaws and hand tools and stockpiling of vegetation for rehabilitation activities; and
- removal of the remaining ground vegetation and stumps using a forestry mulcher.

2.4.3 Power supply

Additional power supply capacity is required to enable TBM tunnelling for Exploratory Works. The Lobs Hole substation proposed under Modification 1 is scheduled to be online from October 2020 and will provide the power supply required for operation of the TBM. It is currently planned to commence tunnelling with the TBM from May 2020. In the period prior to the Lobs Hole substation commissioning the additional power supply required for TBM tunnelling will be provided by additional diesel generator sets. Diesel generator sets with a total capacity of 20 MVa as well as an additional three 65 kL diesel storage tanks will be installed at the portal construction pad. It is expected that approximately 24,000 L of diesel would be consumed per day while diesel generators provide the TBM power supply.

2.4.4 Transport strategy

A key commitment under the EW EIS was the use of barges for the transportation of machinery, equipment and materials to the work site. Condition 45 of the Minister's approval requires:

The Proponent must maximise the use of barge infrastructure on the Talbingo Reservoir to deliver heavy machinery, construction equipment and materials to the site.

As part of design development, the use of barges for the transport of machinery, equipment and materials was reviewed, and determined to no longer be the preferred option. Modification 2 proposes to revise the transport strategy so that all materials and equipment required for Exploratory Works will be delivered using Lobs Hole Ravine Road South as the primary access road.

The revised transport strategy is not expected to change the traffic volumes required for the Exploratory Works; however, it will have some impact on the transport route of oversize overmass vehicle movements.

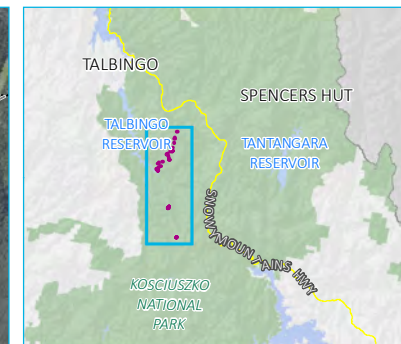
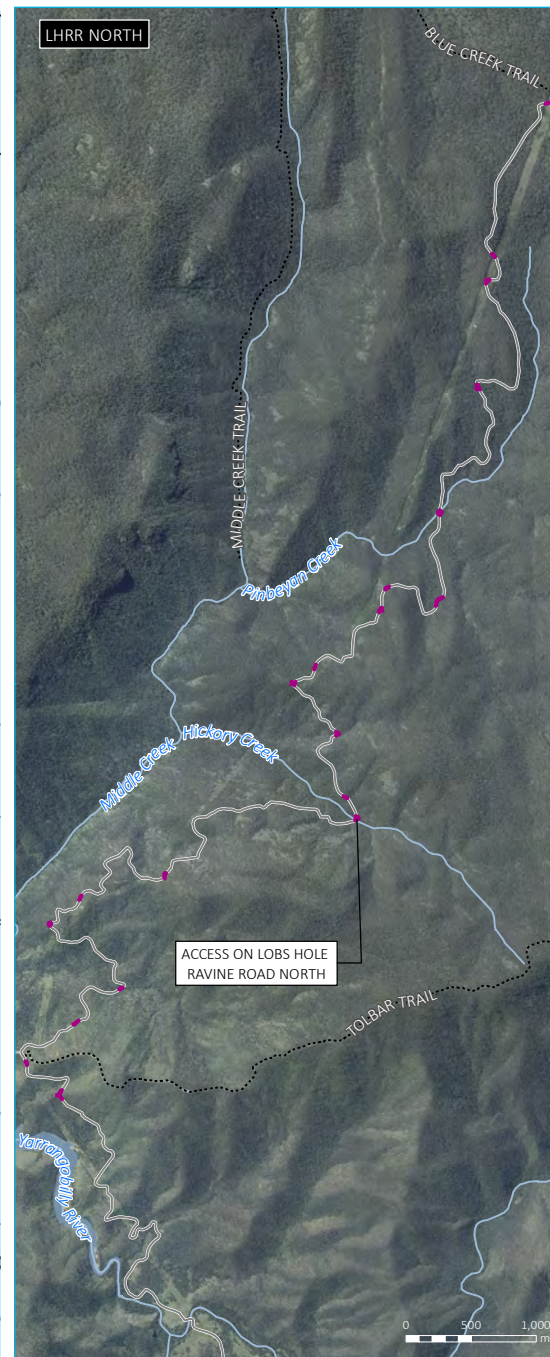
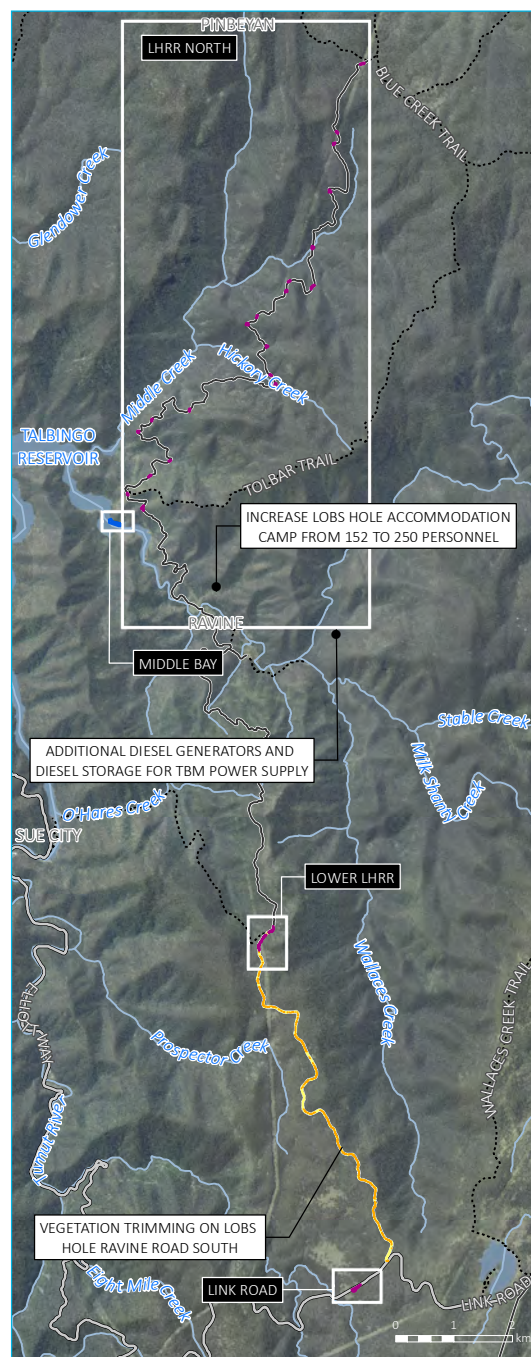
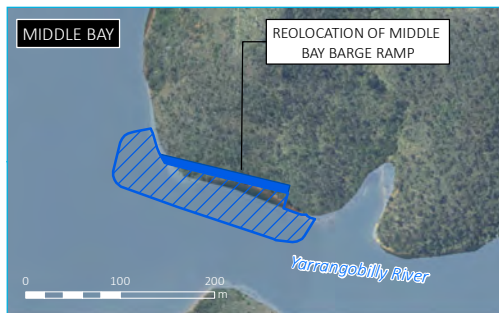
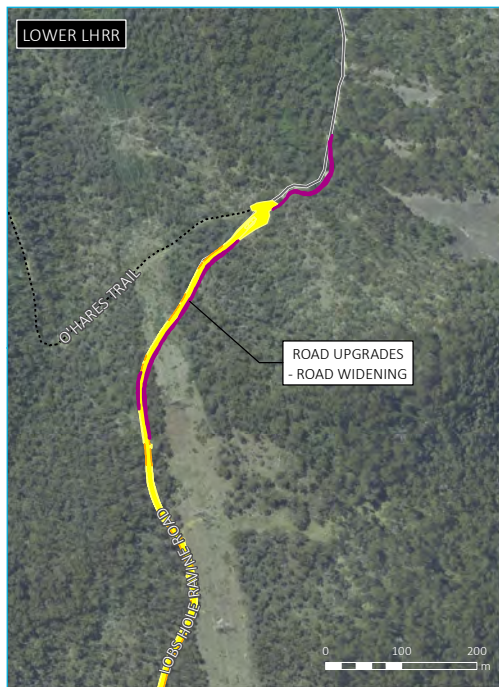
2.4.5 Middle Bay barge ramp

The location of the Middle Bay barge ramp was reviewed and revised as part of detailed design. An alternative location for the Middle Bay barge ramp was identified to the west of the existing barge ramp location. The new barge ramp would be within the disturbance footprint as approved for Exploratory Works and proposed under Modification 1. The Middle Bay barge ramp relocation is provided in Figure 2.1.

A key benefit of the new barge ramp location is that it minimises the requirement for dredging as part of the barge ramp construction. The area within the reservoir where dredging may be required for the revised barge ramp is approximately 0.85 ha, which is significantly reduced compared to the 2.9 ha of dredging required for the previous barge ramp location. The Middle Bay barge ramp would be constructed in the revised location using the methods consistent with what was previously approved.

2.4.6 Accommodation camp

Additional capacity is required at the Lobs Hole accommodation camp. Lobs Hole accommodation camp will increase capacity to provide beds for up to 250 personnel, from the approved camp which would provide for 152 personnel. The additional accommodation would be created through a vertical expansion of the Lobs Hole accommodation camp using modular and stackable accommodation units that will allow the expansion entirely within the existing construction footprint. The additional accommodation capacity is required to house the construction workforce. The expected number of personnel required increased based on the detailed design undertaken by the construction contractor. The additional capacity will also assist in accommodating the construction workforce required for the Lobs Hole substation.



- KEY
- Modification 2 disturbance boundary
 - Middle Bay barge access
 - Disturbance area - barge infrastructure
 - Disturbed area - LHRR south
 - Vegetation trimming - LHRR south
 - Waterbody
 - Watercourse
 - Main road
 - Local road
 - Vehicular track

Modification 2 elements

Snowy 2.0
Biodiversity development assessment
Modification 2
Figure 2.1

Source: EMM (2019); Snowy Hydro (2019); PhotoMapping (2018); SMEC (2018); DFSI (2017); GA (2015); LPMA (2011)

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GDA 1994 MGA Zone 55



3 Legislative context

This chapter provides a brief outline of the key biodiversity legislation and government policy considered in this assessment.

3.1 Commonwealth

3.1.1 Environmental Protection and Biodiversity Conservation Act 1999

The EPBC Act provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities, heritage places and water resources which are defined as MNES under the EPBC Act. These are:

- world heritage properties;
- places listed on the National Heritage Register;
- Ramsar wetlands of international significance;
- threatened flora and fauna species and ecological communities;
- migratory species;
- Commonwealth marine areas;
- the Great Barrier Reef Marine Park;
- nuclear actions (including uranium mining); and
- water resources, in relation to coal seam gas or large coal mining development.

Under the EPBC Act, a person proposing to take an action that may or will have a significant impact on MNES, or the environment generally for “Commonwealth agencies”, is to be referred to DoEE for determination as to whether or not it is a controlled action. If deemed a controlled action the project is assessed under the EPBC Act and a decision made as to whether or not to grant approval.

The Exploratory Works project was referred to the Commonwealth Minister for the Environment in June 2018 (EPBC 2018/8217). The project was deemed not a controlled action in July 2018. Impacts associated with this modification do not modify the conclusions drawn in the original referral and will not result in a significant impact to MNES. Impacts to MNES, including threatened species and communities listed under the EPBC Act, have been assessed in Section 8.

3.2 State

3.2.1 Environmental Planning and Assessment Act 1979

The EP&A Act was enacted to encourage the consideration and management of impacts of proposed development or land-use changes on the environment and the community. The EP&A Act is administered by the DPE.

The EP&A Act provides the overarching structure for planning in NSW; however, is supported by other statutory environmental planning instruments (EPIs) including SEPPs. Snowy Hydro is seeking to modify infrastructure approval SSI 9208 pursuant to section 5.25 of the EP&A Act. EPIs relevant to the natural environment are outlined further below.

i State Environmental Planning Policy (State and Regional Development) 2011

Snowy 2.0 has been declared to be CSSI by the NSW Minister for Planning under the provisions of the EP&A Act 1979 and is defined in clause 9 of Schedule 5 of the SRD SEPP.

ii State Environmental Planning Policy No 44 – Koala Habitat Protection

State Environmental Planning Policy No 44 – Koala Habitat Protection (SEPP 44) aims to encourage the conservation and management of natural vegetation areas that provide habitat for koalas to ensure permanent free-living populations will be maintained over their present range and to reverse the current trend of koala-population decline. It applies to areas of native vegetation greater than 1 ha and in councils listed in Schedule 1 of SEPP 44. The Modification 2 project area is located in the Snowy Valleys Council LGA, which are listed in Schedule 1, therefore Koala habitat has been considered within this assessment.

No Koalas or scats were found in the modification survey area during targeted surveys (see Section 6.3.4iie). The site is therefore not considered core Koala habitat under SEPP 44.

3.2.2 Fisheries Management Act 1994

The FM Act contains provisions for the conservation of fish stocks, key fish habitat, biodiversity, threatened species, populations and ecological communities. It regulates the conservation of fish, vegetation and some aquatic macroinvertebrates and the development and sharing of the fishery resources of NSW for present and future generations. The FM Act lists threatened species, populations and ecological communities, key threatening processes (KTPs) and declared critical habitat. Assessment guidelines to determine whether a significant impact is expected are detailed in section 220ZZ and 220ZZA of the FM Act.

Another objective of the FM Act is to conserve key fish habitats (KFH). These are defined as aquatic habitats that are important to the sustainability of recreational and commercial fishing industries, the maintenance of fish populations generally and the survival and recovery of threatened aquatic species. KFH is defined in sections 3.2.1 and 3.2.2 of the Policy and Guidelines for Fish Conservation and Management (DPI 2013).

The impact of Modification 2 on threatened aquatic species, populations, communities, habitats and KFH have been assessed separately and are presented in the aquatic ecology assessment (Cardno 2019).

3.2.3 Biodiversity Conservation Act 2016

The BC Act details mechanisms for the conservation of biodiversity in NSW through the protection of threatened flora and fauna species, populations and ecological communities. The BC Act, together with the NSW Biodiversity Conservation Regulation 2017 (BC Regulation), established the Biodiversity Offsets Scheme (BOS).

The BOS includes establishment of the Biodiversity Assessment Method (BAM, OEH 2017a) for use by accredited persons in biodiversity assessment under the scheme. The purpose of the BAM is to assess the impact of actions on threatened species and threatened ecological communities (TECs) and their habitats, and determine offset requirements.

The BAM sets out the requirements for a repeatable and transparent assessment of terrestrial biodiversity values in order to:

- identify the biodiversity values on land subject to proposed development area;
- determine the residual impacts of a proposed development following all measures to avoid, minimise and mitigate impacts; and
- quantify and describe the biodiversity credits required to offset the residual impacts of proposed development on biodiversity values.

For CSSI projects use of the BAM is mandatory. The biodiversity assessment for Modification 2 has been undertaken in accordance with the requirements of the BAM, as set out in this BDAR.

3.2.4 Biosecurity Act 2015

The NSW *Biosecurity Act 2015* has superseded the *Noxious Weeds Act 1993*, which has now been repealed.

The primary objective of the Biosecurity Act is to provide a framework for the prevention, elimination and minimisation of biosecurity risks posed by biosecurity matter, dealing with biosecurity matter, carriers and potential carriers, and other activities that involve biosecurity matter, carriers or potential carriers.

The Biosecurity Act stipulates management arrangements for weed biosecurity risks in NSW, with the aim to prevent, eliminate and minimise risks. Management arrangements include:

- any land managers and users of land have a responsibility for managing weed biosecurity risks that they know about or could reasonably be expected to know about;
- applies to all land within NSW and all waters within the limits of the State; and
- local strategic weed management plans will provide guidance on the outcomes expected to discharge duty for the weeds in that plan.

The Riverina Regional Strategic Weed Management Plan 2017 - 2022 (RLLS 2017) outlines how government, industry, and the community will share responsibility and work together to identify, minimise, respond to and manage weeds within the Riverina Region, which includes the Modification 2 project area. The plan also supports regional implementation of the Biosecurity Act.

3.2.5 National Parks and Wildlife Act 1979

Under the NPW Act, the Director General of NPWS is responsible for the care, control and management of all national parks and various other categories of protected area. The primary responsibilities of NPWS under this legislation are the protection and maintenance of natural and cultural values, and the fostering of public appreciation, understanding and enjoyment of those values.

The KNP Plan of Management (PoM, DEC 2006a) details management objectives for such features within the park such as native plants and animals, soils, karst, rivers, lakes etc. Management objectives follow those specified within the NPW Act. Relevant management objectives include:

- native plant species and communities are maintained and/or rehabilitated and include a representative range of successional stages and age classes;
- viable populations of all native animal species that currently occur in the park are maintained or restored;
- the diversity of native species found in the park is maximised at a regional scale; and

- research informs the management of the native animals of the park.

The requirements of the NPW Act and the KNP PoM have been considered in this report.

4 Landscape features

The identification of landscape features within the Modification 2 project area was determined using Section 4 of the BAM (OEH 2017a), as summarised within this chapter.

4.1 Landscape features

4.1.1 Bioregions and landscapes

The Modification 2 project area occurs across two IBRA regions and subregions (Figure 4.1):

- South Eastern Highlands IBRA region and Bondo IBRA subregion; and
- Australian Alps IBRA region and Snowy Mountains IBRA subregion.

As the majority of the Modification 2 project area is located in the South Eastern Highlands IBRA region and Bondo IBRA subregion these were the region and subregion used in this assessment.

The Modification 2 project area occurs across six NSW Landscapes (formerly Mitchell Landscapes, Figure 4.1):

- Cabramurra - Kiandra Basalt Caps and Sands;
- Cootamundra - Tumut Serpentinite and Ultramafics;
- Kings Cross Montane;
- Pinbeyan - Ravine Ranges;
- Tantangara High Plains and Peaks; and
- Tooma Granite Ranges.

The majority of the project area is located in the Pinbeyan - Ravine Ranges NSW Landscape, therefore this was the landscape used in this assessment.

4.1.2 Watercourses and wetlands

The Modification 2 project area is located within the Murrumbidgee catchment in the Australian Alps, south-eastern NSW. The Murrumbidgee catchment covers 84,000 square kilometres of southern NSW. It is bordered by the Great Dividing Range to the east, the Lachlan Catchment to the north and the Murray Catchment to the south (NOW 2011).

The Modification 2 intersects the southern end of Talbingo Reservoir, within Lobs Hole. The reservoir was constructed between 1968 and 1971 as a part of the Snowy Scheme. It has a surface area of 1,940 ha and has a capacity of 921,000 ML when full. The reservoir supplies water to the Tumut 3 power station. The edges of the reservoir are located largely within the KNP, except for the northern section adjacent to the dam wall. The edges are largely vegetated, including intact native vegetation. Numerous stags are located within the reservoir, resulting from the inundation of forests when the dam was completed. Talbingo Reservoir is mapped in the NSW Wetlands spatial dataset (OEH 2010).

No Directory of Important Wetlands in Australia (DIWA) wetlands or Ramsar wetlands are located within or immediately adjacent to the Modification 2 project area.

Wetlands, watercourses and associated buffers are shown in Figure 4.2.

4.1.3 Connectivity

The Modification 2 project area is located within KNP, which is largely vegetated across its 673,543 ha extent, with intact remnant vegetation extending into a further 1.6 M ha across the Australian Alps. The extent of vegetation across the KNP provides a high degree of connectivity.

The various watercourses provide suitable connectivity for aquatic and semi-aquatic species (such as fish and amphibians) and species which use linear features (such as birds and bats) to navigate. The wooded area supports connective feature for terrestrials and arboreal mammals, birds, reptiles etc. The areas within Lobs Hole containing open grassland, paddock trees are considered less suitable for the movement of mammals that require vegetation cover to avoid predation.

4.1.4 Areas of geological significance and soil hazard features

Several areas of geological significance are located within the Modification 2 project area. A summary is provided in EMM (2018c), with further details in the Exploratory Works Geological Sites Report (EMM 2018c).

4.1.5 Areas of outstanding biodiversity value

There are no areas of outstanding biodiversity value within a 1,500m buffer of the Modification 2 project area.

4.2 Assessment of site context

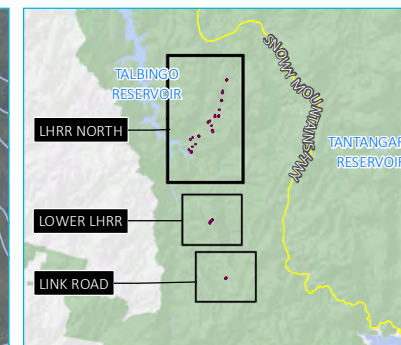
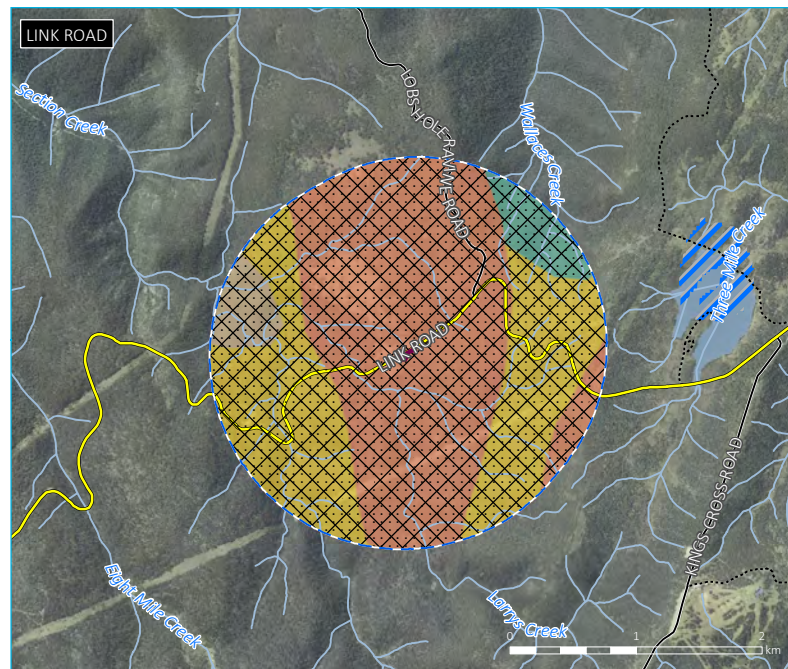
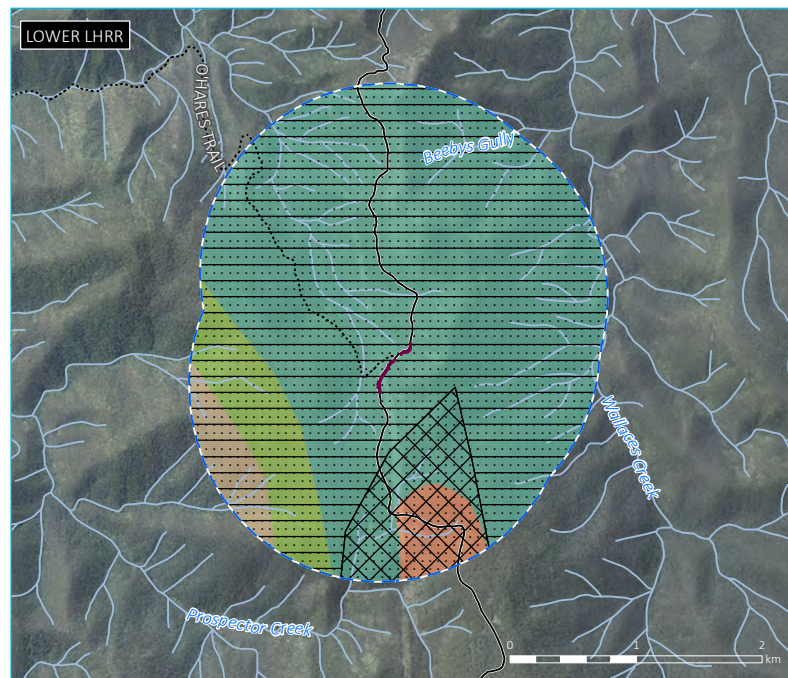
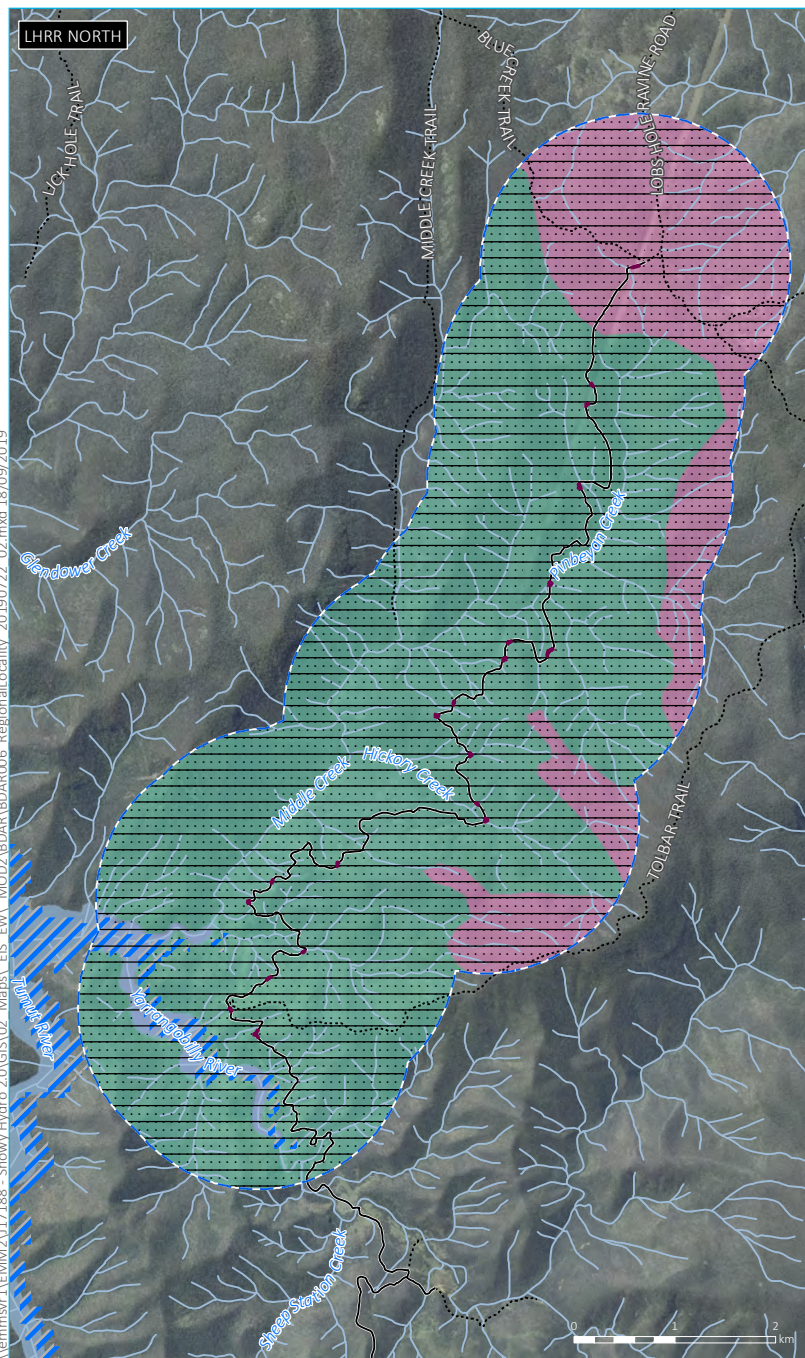
The site context has been assessed in accordance with Section 4.3 of the BAM (OEH 2017a) for site-based developments.

Mapping of vegetation within a 1,500 m buffer of the Modification 2 project area was undertaken using aerial mapping interpretation and spatial data from the State Vegetation Type Map: Riverina Region Version v1.2 - VIS_ID 4469 (OEH 2016a). This mapping was modified using the vegetation extent as mapped by EMM (see Section 5). Thirty-six PCTs were mapped within the 1500 m buffer (Figure 4.1).

A conservative approach was undertaken to include all areas of native vegetation, including the mapped candidate native grassland (as verified) that are likely to be derived from the mapped woodland communities. This approach allowed a greater list of threatened species to be filtered in for later assessment of habitat suitability for Modification 2.

Approximately 5,200 ha of native vegetation was mapped within the 5,375 ha buffer area. Native vegetation cover within the buffer area is approximately 97%.

\\lemmsvr1\EMM2\U17188 - Snowy Hydro 2.0\GIS\02 Maps\ EIS EWI MOD2\BDAR\BDAR006 Regional\Locality 2019\0722_02.mxd 18/09/2019



- KEY**
- Watercourse
 - Main road
 - Local road
 - Vehicular track
 - Modification 2 disturbance footprint
 - 1500 m buffer
 - NSW wetlands (OEH, 2009)
 - Native vegetation
 - IBRA 7 (region - sub region)
 - Australian Alps - Australian Alps
 - South Eastern Highlands - Bondo
 - Mitchell Landscapes
 - Cabramurra - Kiandra Basalt Caps and Sands
 - Cootamundra - Tumut Serpentine and Ultramafics
 - Kings Cross Montane
 - Pinbeyn - Ravine Ranges
 - Tantangara High Plains and Peaks
 - Tooma Granite Ranges
 - Water

Regional locality

Snowy 2.0
Biodiversity development assessment
Modification 2
Figure 4.1

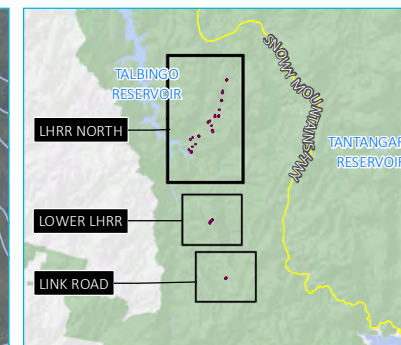
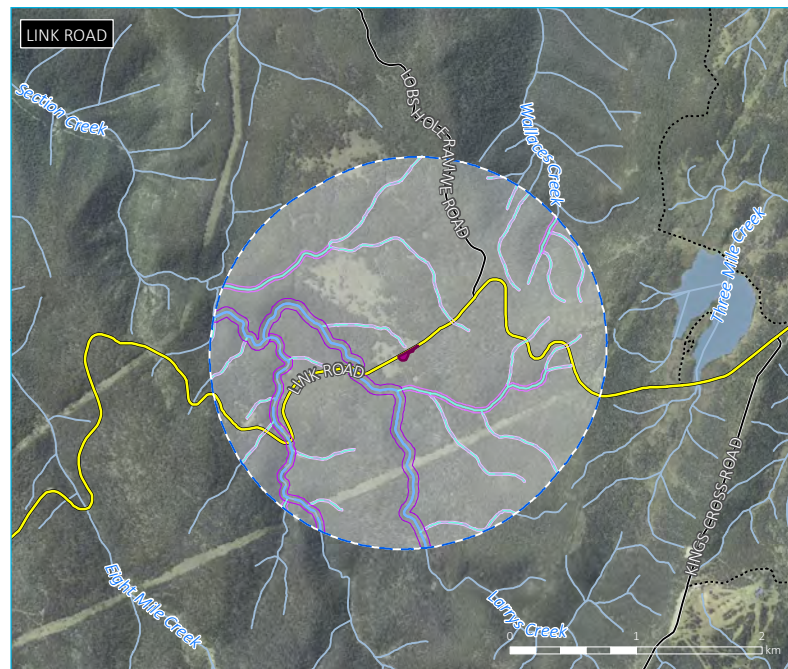
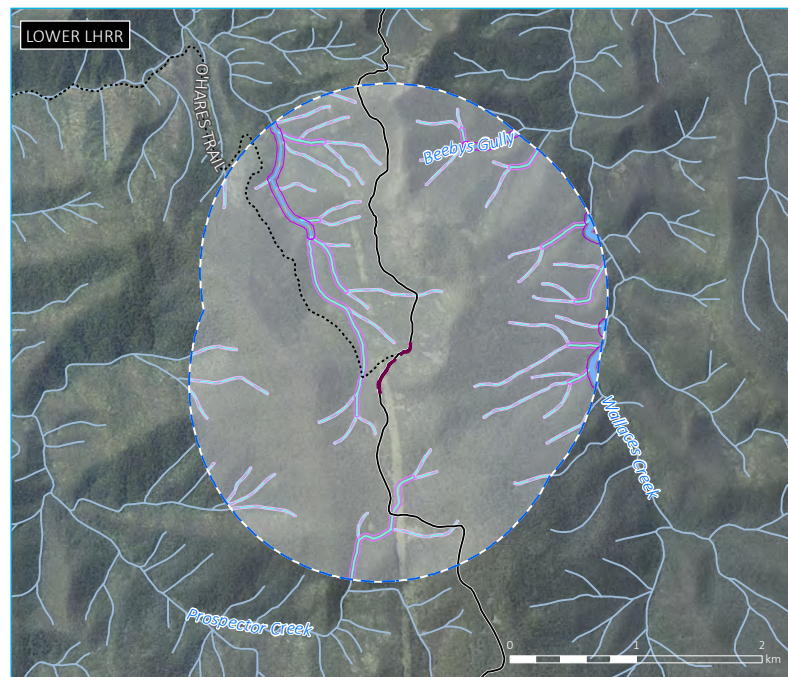
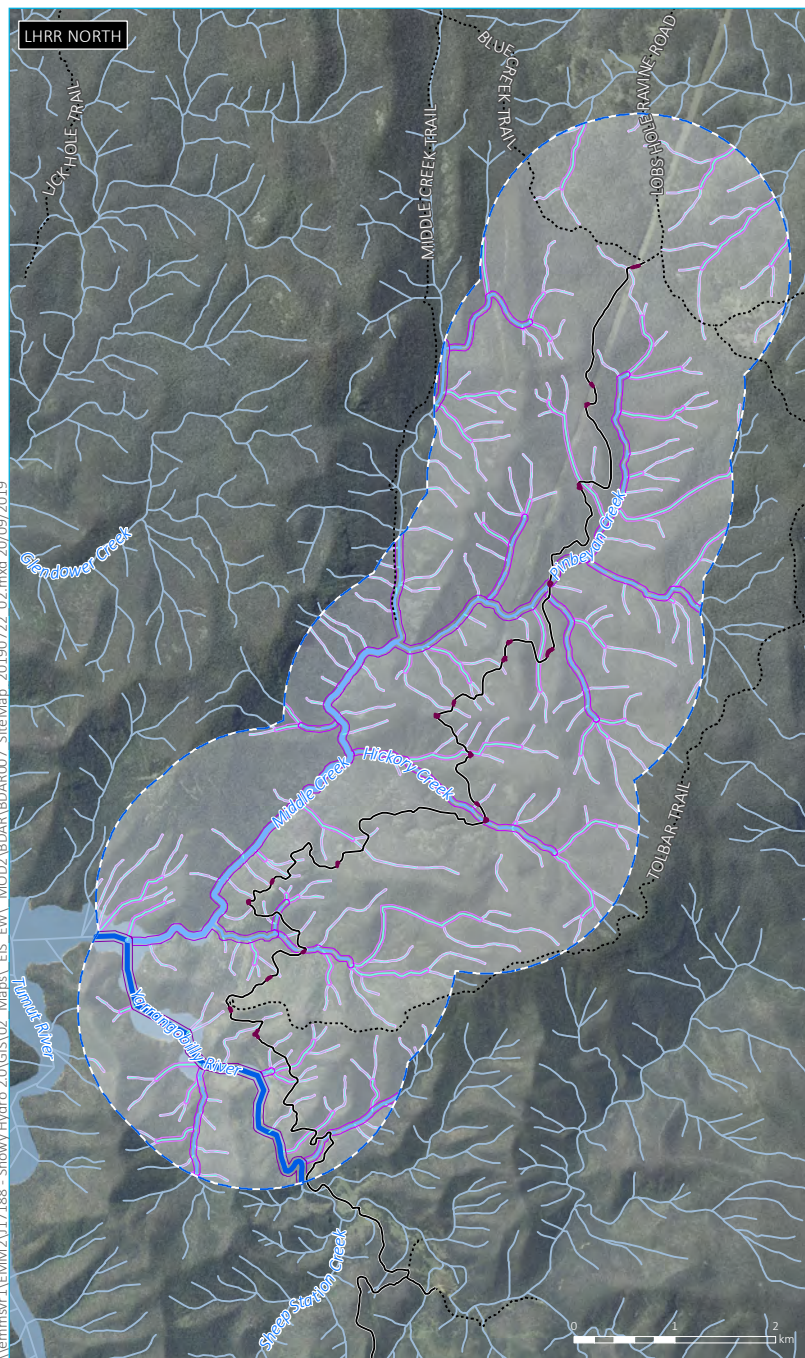


Source: EMM (2019); Snowy Hydro (2019); PhotoMapping (2018); SMEC (2018); DFSI (2017); GA (2015); LPMA (2011); DPI (2013); OEH (2017); DPE (2018)

GDA 1994 MGA Zone 55



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- KEY**
- Watercourse
 - Main road
 - Local road
 - Vehicular track
 - Modification 2 disturbance footprint
 - 1500 m buffer
 - Riparian buffer
 - 10 m
 - 20 m
 - 30 m
 - 40 m
 - 50 m
 - Strahler stream order
 - 1st order
 - 2nd order
 - 3rd order
 - 4th order
 - 5th order
 - 7th order

Site map

Snowy 2.0
Biodiversity development assessment
Modification 2
Figure 4.2

Source: EMM (2019); Snowy Hydro (2019); PhotoMapping (2018); SMEC (2018); DFSI (2017); GA (2015); LPMA (2011); DPI (2013); OEH (2017); DPE (2018)

GDA 1994 MGA Zone 55



5 Native vegetation

The extent of native vegetation within the Modification 2 project area was determined using Section 5 of the BAM (OEH 2017a), as summarised within this chapter.

5.1 Background review

A review of regional native vegetation mapping (OEH 2016a) was undertaken to inform the site survey. The presence of these PCTs was assessed and confirmed in line with the methods outlined below.

5.2 Methods

The following sections outline the methods employed to map vegetation, and to assess the vegetation integrity of native vegetation within the survey area.

5.2.1 Detailed vegetation mapping and habitat assessment

A preliminary assessment of the survey area was undertaken between August 2017 and October 2017. Additional mapping was undertaken in February and March 2018 due to the inclusion of additional survey areas. This preliminary assessment included detailed vegetation mapping and habitat assessments. Revision of this preliminary vegetation mapping was undertaken in November and December 2018, and June 2019, in response to additional plots being undertaken and review of the PCTs across the Snowy 2.0 survey area.

To map vegetation, the survey area was traversed on foot and by vehicle, with vegetation mapped and aligned with NSW PCTs. PCTs were stratified into vegetation zones based on broad condition state using the definitions in Table 5.1.

Table 5.1 Definitions used in delineation of vegetation zones

Condition class	Description
High	Largely intact with all stratum present and minimal disturbance
Medium	Some elements or stratum missing or immature, but minimal disturbance
Poor	Tree stratum present, but understorey vegetation degraded due to weeds or other major disturbance.
Derived grassland	Trees stratum missing, with sparse shrub layer. Native vegetation restricted to groundcover.
Other	Regeneration is occurring due to previous human impacts, such as clearing or fire, but minimal to moderate disturbance to other stratum.
Low	Tree stratum and shrub stratum missing. Predominantly exotic groundcover.

Where there was some uncertainty about correct PCT alignment, or to justify PCT alignment, a series of rapid vegetation assessments (RVAs) were undertaken, with the three dominant species in the overstorey, midstorey and groundcover recorded.

Vegetation was mapped in the field using GPS-enabled tablet computers using Collector for ArcGIS™. Field data was then aligned with a canopy height model (CHM) developed using Light Detection and Ranging (LiDAR) data in a GIS.

5.2.2 Vegetation integrity assessment

Following the stratification of vegetation zones within the survey area, native vegetation integrity was assessed using data obtained via a series of plots, as per the methodology outlines in Section 5 of the BAM (OEH 2017a). Plot data was collected from the survey area between November 2017 and June 2019. At each plot location the following was undertaken:

- one 20x20 m plot from assessment of composition and structure; and
- one 20 x 50 m plots for assessment of function, including a series of five 1 x 1 m plots to assess average leaf litter cover.

The assessment of composition and structure, based on a 20 x 20 m plot, recorded species name, stratum, growth form, cover and abundance rating for each species present within the plot. Cover (foliage cover) was estimated for all species rooted in or overhanging the plot, and recorded using decimals (if less than 1%, rounded to whole number (1-5%) or estimated to the nearest 5% (5- 100%). Abundance was counted (up to 20) and estimated above 20, and recorded using the following intervals: 1, 2, 3, 4, 5, 10, 20, 50, 100, 500, 1,000, 1,500, 2,000 etc.

The assessment of function recorded the number of large trees, the presence of tree stem size class, tree regeneration, number of trees with hollows and length of fallen logs, as well as leaf litter cover within the 20 x 50 m plot and five 1 x 1 m subplots. The minimum number of plots and transects per vegetation zone was determined using Table 4 of the BAM (OEH 2017a). Datasheets are provided in Appendix A while compiled plot data is provided in Appendix B.

As a result of recent design change being provided outside of the survey seasons, some vegetation integrity plots were not within the disturbance footprint. Vegetation integrity plots within the broader survey area were chosen for the Modification 2 assessment. All plots used are part of the vegetation zones being impacted and are considered representative of the vegetation zones within the Modification 2 footprint.

5.3 Results

5.3.1 Vegetation description

The Modification 2 project area is located across two main areas; Lobs Hole Ravine Road and Link Road.

Vegetation in the lower section of Lobs Hole at Talbingo Reservoir consists of dry sclerophyll forests and grassy woodlands. Native vegetation, which includes fauna habitats, have been modified by past disturbances associated with land clearing, livestock grazing and weed invasion. Native vegetation has re-established itself throughout Lobs Hole; however, Blackberry, a weed of national significance, has established itself to the point of infestation within the area, particularly in gullies.

Vegetation along the northern (upper) sections of Lobs Hole Ravine Road north consists of tall sclerophyll forests and grassy woodlands. These areas are generally intact with minimal disturbance. Northern sections of Lobs Hole Ravine Road, close to the Snowy Mountains Highway, have been subject to past fires; as a result, shrub layers are sparsely within this area. Vegetation within powerline easements consist of derived grassland, with a higher number of exotics compared to adjacent vegetation.

Vegetation along Link Road, west of Lobs Hole Ravine Road, mainly consists of wet sclerophyll forests and grassy woodlands. Small patches have been modified by past disturbances and consist of derived grasslands.

5.3.2 Plant community types

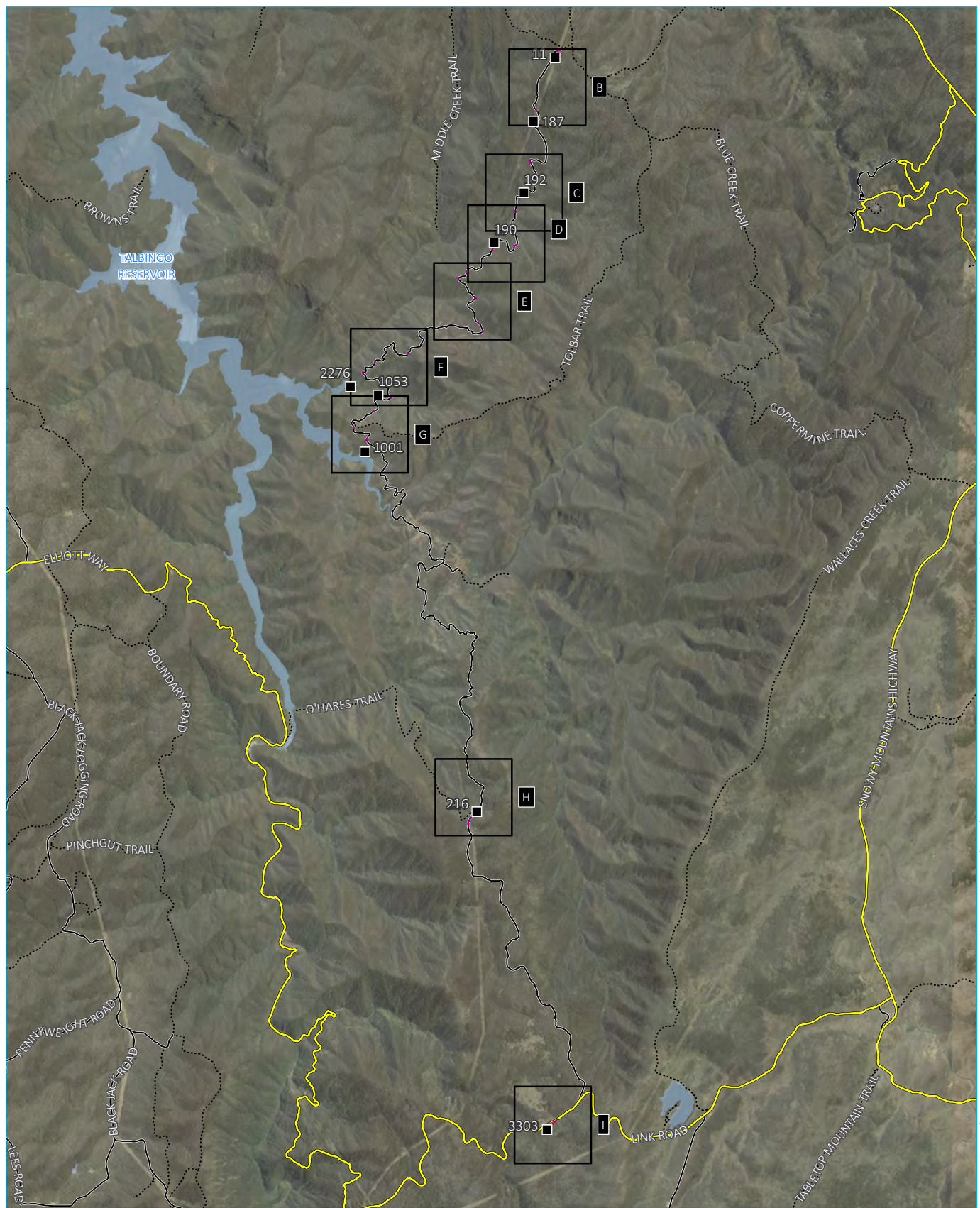
Site investigations, including determination of vegetation communities using the methods described in Section 5.2.1, identified the presence of six PCTs within the Modification 2 disturbance footprint (Figure 5.1). The PCT, vegetation formation and vegetation class (Keith 2004) are described within Table 5.2.

Table 5.2 Plant community types mapping within the Modification 2 disturbance footprint

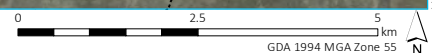
Plant community type	Vegetation formation	Vegetation class	Area (ha)
PCT 296 – Brittle Gum – Peppermint open forest of the Woomargama to Tumut region, NSW South Western Slopes Bioregion	Dry Sclerophyll Forest (Shrubby sub-formation)	Southern Tableland Dry Sclerophyll Forests	0.56
PCT 300 – Ribbon Gum - Narrow-leaved (Robertsons) Peppermint montane fern - grass tall open forest on deep clay loam soils in the upper NSW South Western Slopes Bioregion and western Kosciuszko escarpment	Wet Sclerophyll Forests (Grassy sub-formation)	Southern Tableland Wet Sclerophyll Forests	0.28
PCT 729 - Broad-leaved Peppermint - Candlebark shrubby open forest of montane areas, southern South Eastern Highlands Bioregion and South East Corner Bioregion	Dry Sclerophyll Forests (Shrubby sub-formation)	Southern Tableland Dry Sclerophyll Forests	0.13
PCT 953 – Mountain Gum - Snow Gum - Broad-leaved Peppermint shrubby open forest of montane ranges, South Eastern Highlands Bioregion and Australian Alps Bioregion	Dry Sclerophyll Forests (Shrubby sub-formation)	Southern Tableland Dry Sclerophyll Forests	0.13
PCT 1191 – Snow Gum - Candle Bark woodland on broad valley flats of the tablelands and slopes, South Eastern Highlands Bioregion	Grassy Woodlands	Subalpine Woodlands	0.07
PCT 1196 - Snow Gum - Mountain Gum shrubby open forest of montane areas, South Eastern Highlands Bioregion and Australian Alps Bioregion	Grassy Woodlands	Subalpine Woodlands	0.45
TOTAL			1.62

Overall, 1.62 ha of native vegetation was mapped across six PCTs within the disturbance footprint. These PCTs are described in further detail within the following section.

A further 0.38 ha of native vegetation will be subject to minor trimming and tree lopping/removal. As vegetation trimming along Lobs Hole Ravine Road North will not result in any notable impacts to native vegetation or threatened species habitat, impacts will be short-term and vegetation will be able to naturally regenerate no offsets have been determined for this component of the project.



Source: EMM (2019); Snowy Hydro (2019); PhotoMapping (2018); SMEC (2019); DFIG (2017); GA (2015); LPMA (2011)



KEY

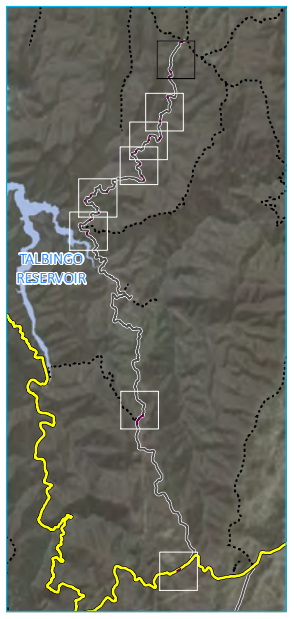
- Plot location
- ▭ Modification 2 disturbance footprint
- ▭ Page index
- Waterbody
- Main road
- Local road
- Vehicular track

Plant Community Type and vegetation zone mapping within the Modification 2 project area, including plots locations - Overview

Snowy 2.0
Biodiversity development assessment
Modification 2
5.1 a



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Source: EMM (2019); Snowy Hydro (2019); PhotoMapping (2018); SMEC (2019); DFSI (2017); GA (2015); LPMA (2011)

KEY

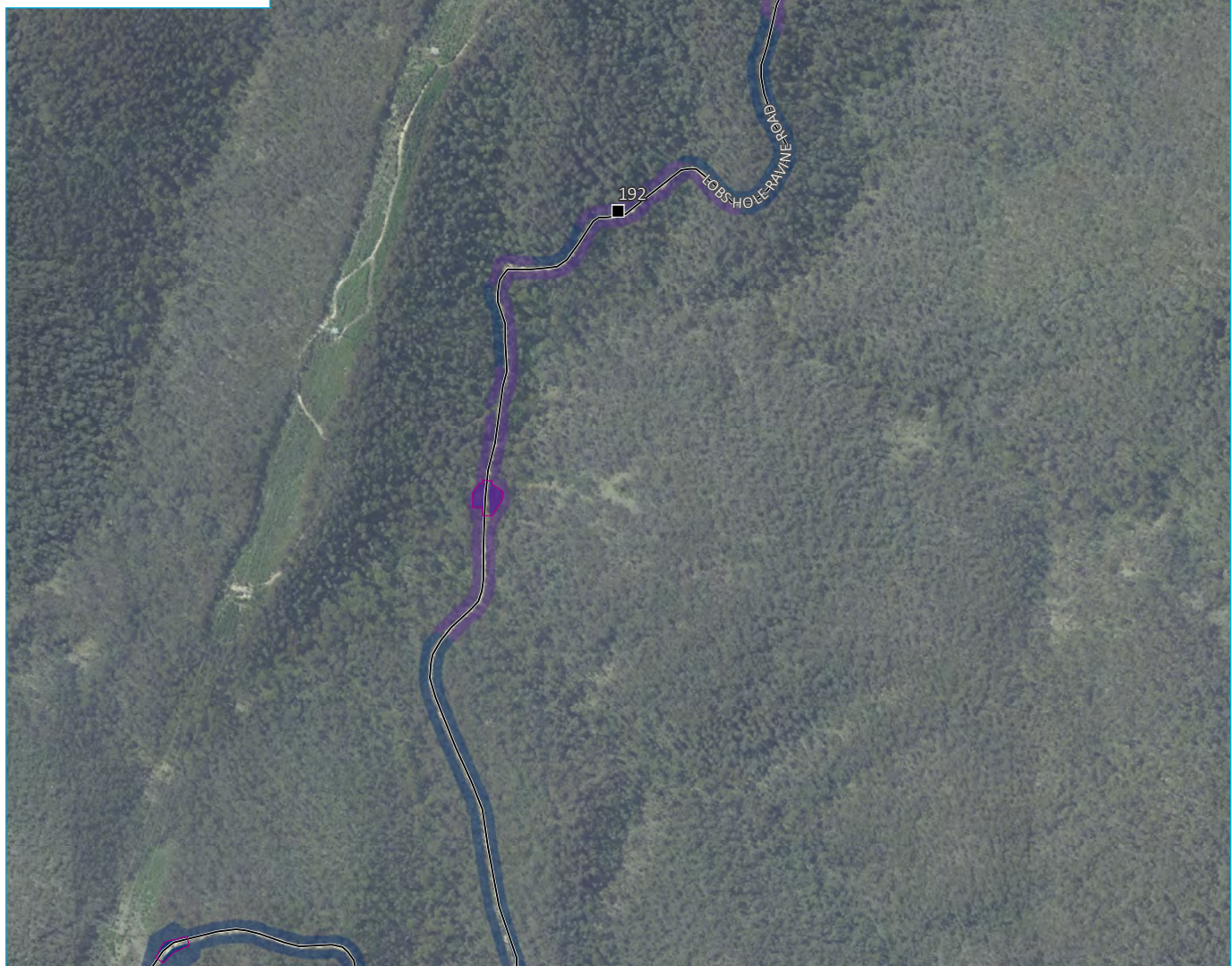
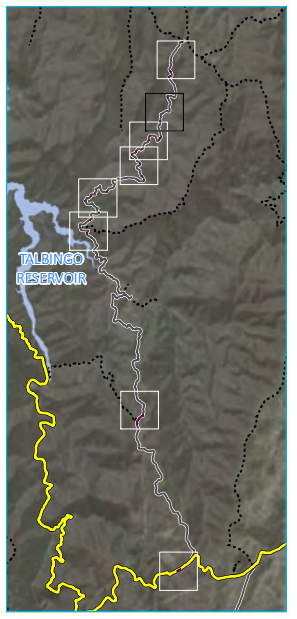
- Plot location
- Local road
- Vehicular track
- Modification 2 disturbance footprint
- PCT 296
 - High
 - Derived grassland
- PCT 952
 - Other
- PCT 953
 - High
 - Derived grassland

Plant Community Type and vegetation zone mapping within the Modification 2 project area, including plots locations

Snowy 2.0
Biodiversity development assessment
Modification 2
5.1 b



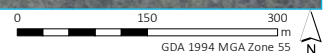
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Source: EMM (2019); Snowy Hydro (2019); PhotoMapping (2018); SMEC (2019); DFSI (2017); GA (2015); LPMA (2011)

KEY

- Plot location
- Local road
- Modification 2 disturbance footprint
- PCT 296
- High
- PCT 300
- Medium

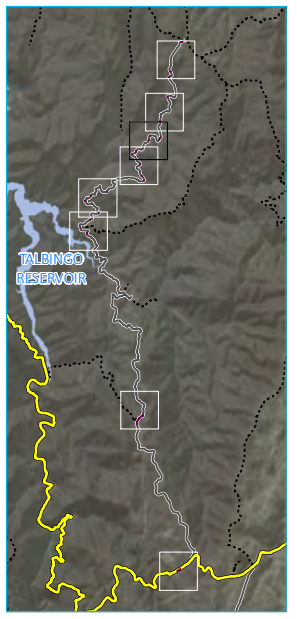


Plant Community Type and vegetation
zone mapping within the Modification 2
project area, including plots locations

Snowy 2.0
Biodiversity development assessment
Modification 2
5.1 c



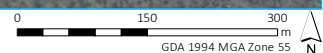
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Source: EMM (2019); Snowy Hydro (2019); PhotoMapping (2018); SMEC (2019); DFSI (2017); GA (2015); LPMA (2011)

KEY

- Plot location
- Local road
- Modification 2 disturbance footprint
- PCT 296
- High
- Derived grassland
- PCT 300
- Medium

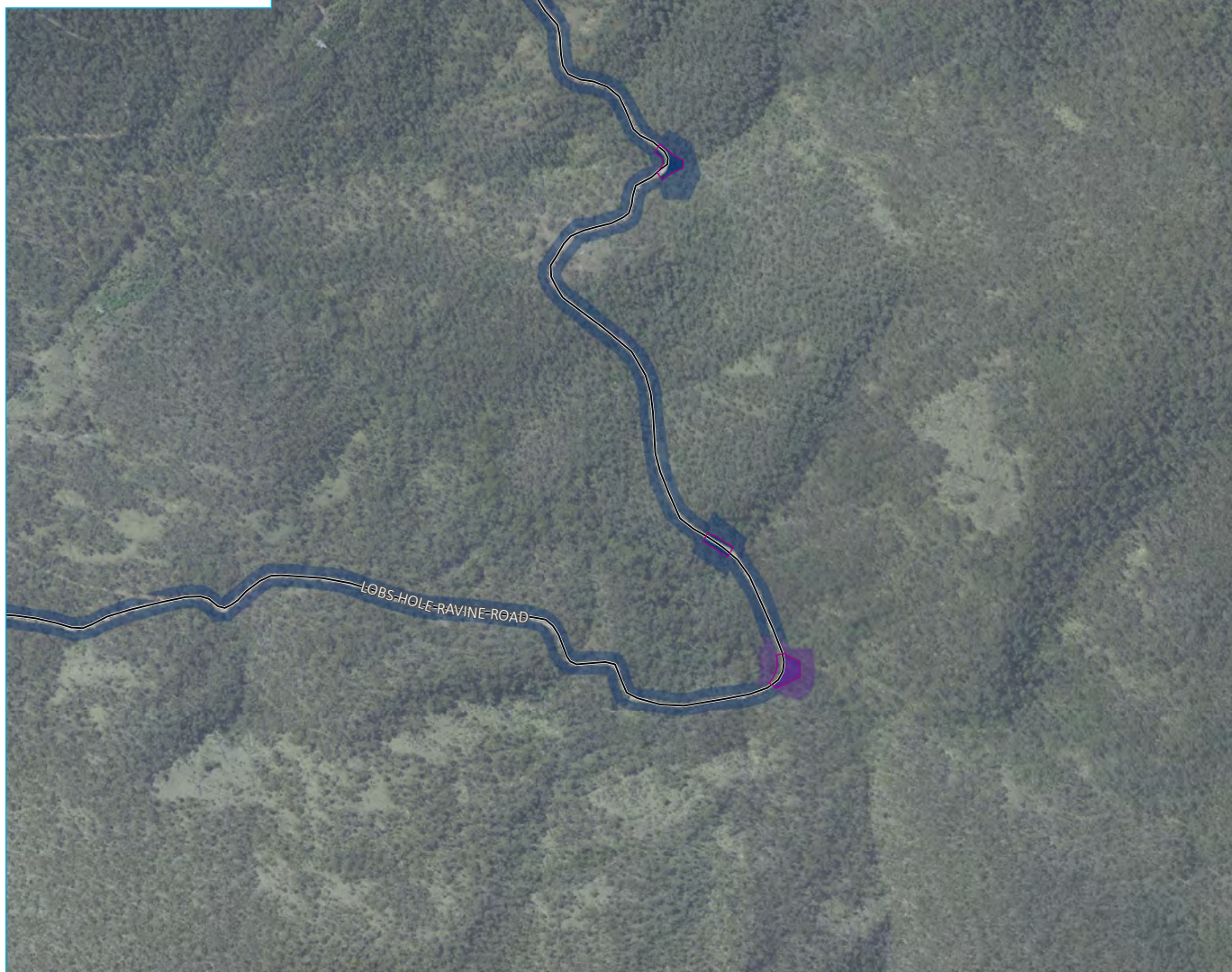
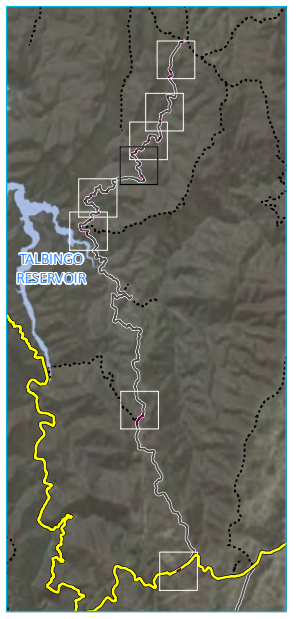


Plant Community Type and vegetation
zone mapping within the Modification 2
project area, including plots locations

Snowy 2.0
Biodiversity development assessment
Modification 2
5.1 d



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Source: EMM (2019); Snowy Hydro (2019); PhotoMapping (2018); SMEC (2019); DFSI (2017); GA (2015); LPMA (2011)

KEY

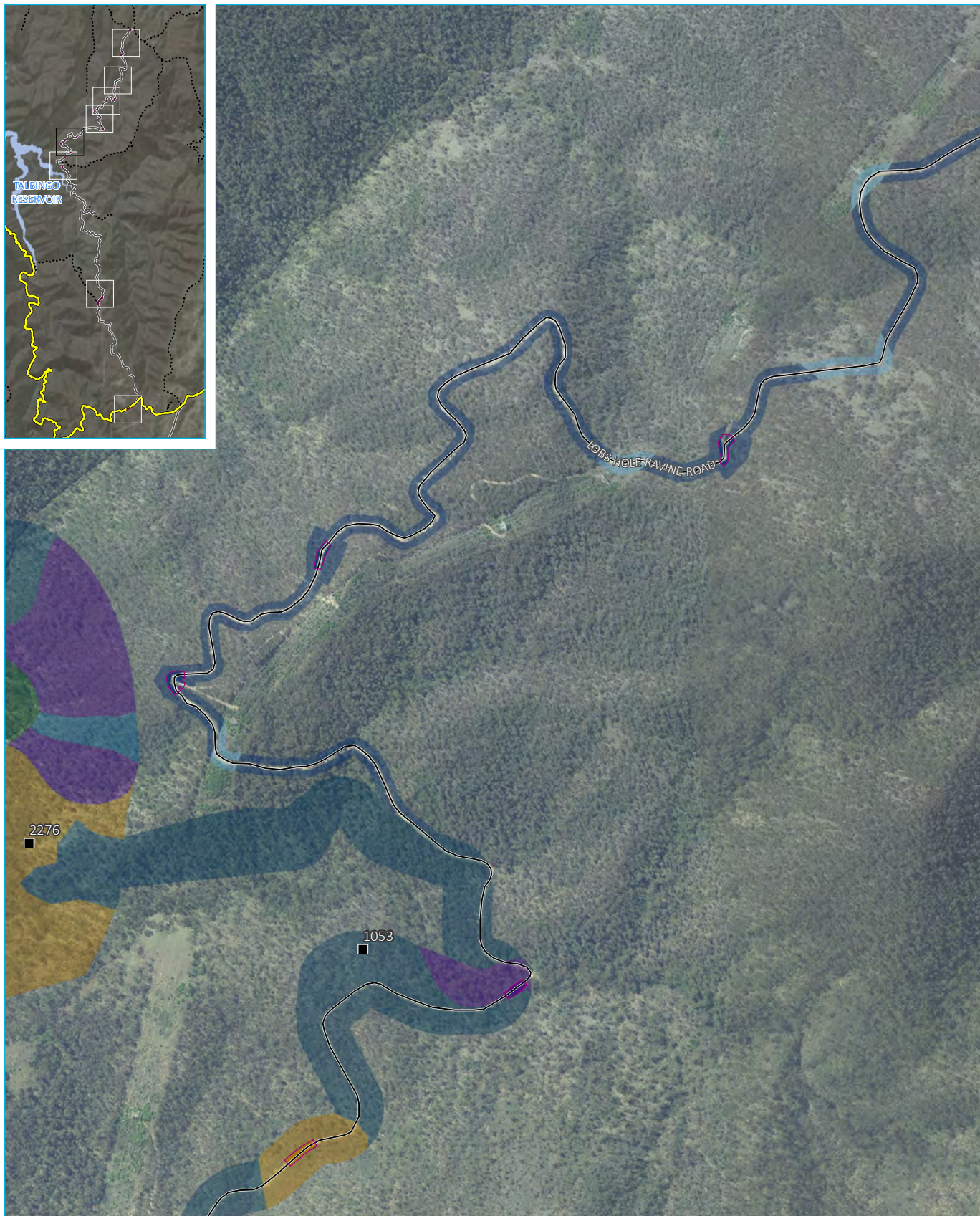
- Local road
- Modification 2 disturbance footprint
- PCT 296
- High
- Derived grassland
- PCT 300
- Medium

Plant Community Type and vegetation zone mapping within the Modification 2 project area, including plots locations

Snowy 2.0
Biodiversity development assessment
Modification 2
5.1 e



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Source: EMM (2019); Snowy Hydro (2019); PhotoMapping (2018); SMEC (2019); DFSI (2017); GA (2015); LPMA (2011)

KEY

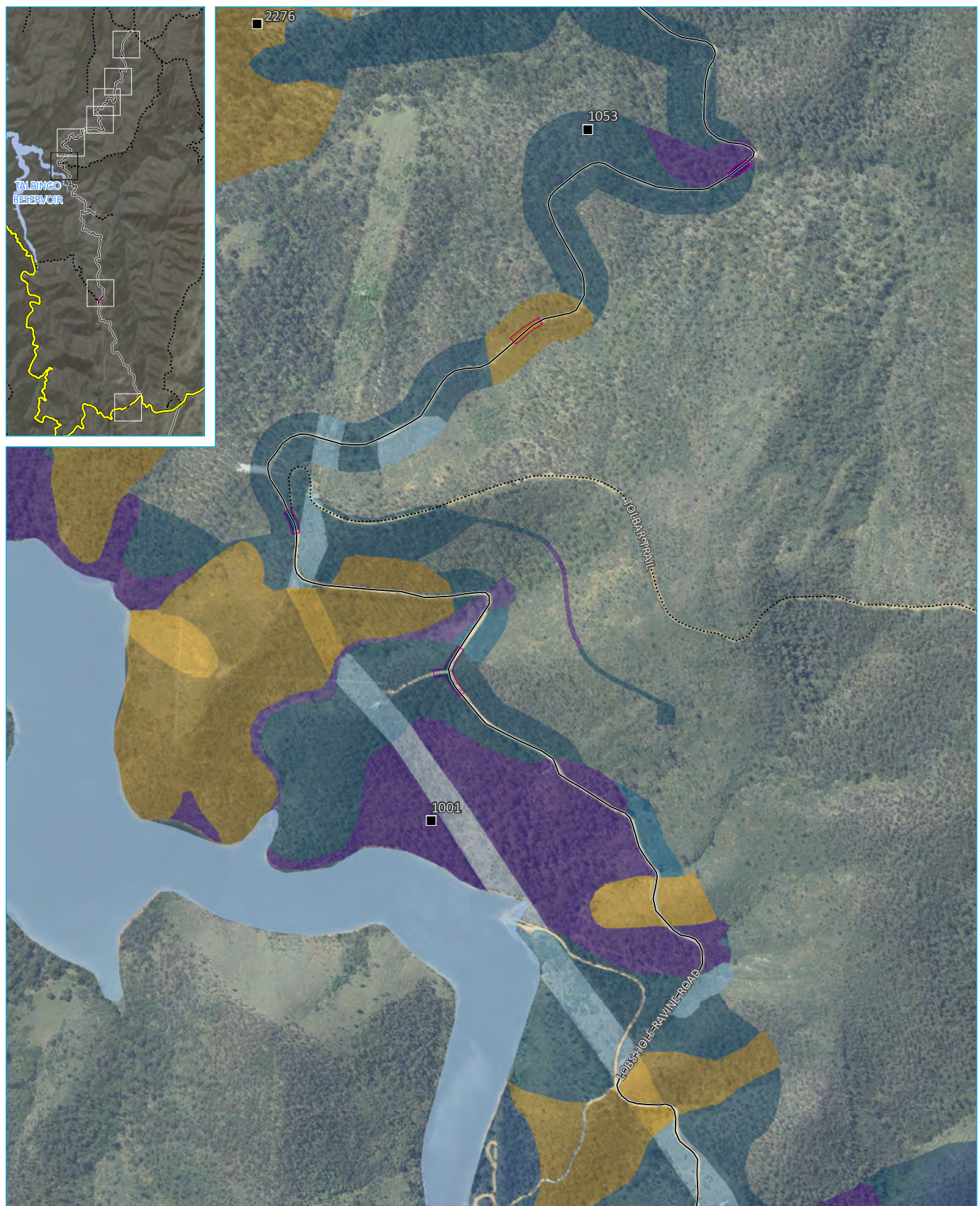
- Plot location
- Local road
- Modification 2 disturbance footprint
- PCT 299
 - High
- PCT 296
 - High
- Derived grassland
- PCT 300
 - High
- PCT 729
 - High
 - Medium
- PCT 1191
 - High

Plant Community Type and vegetation zone mapping within the Modification 2 project area, including plots locations

Snowy 2.0
Biodiversity development assessment
Modification 2
5.1 f



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Source: EMM (2019); Snowy Hydro (2019); PhotoMapping (2018); SMEC (2019); DFSI (2017); GA (2015); LPMA (2011)

KEY

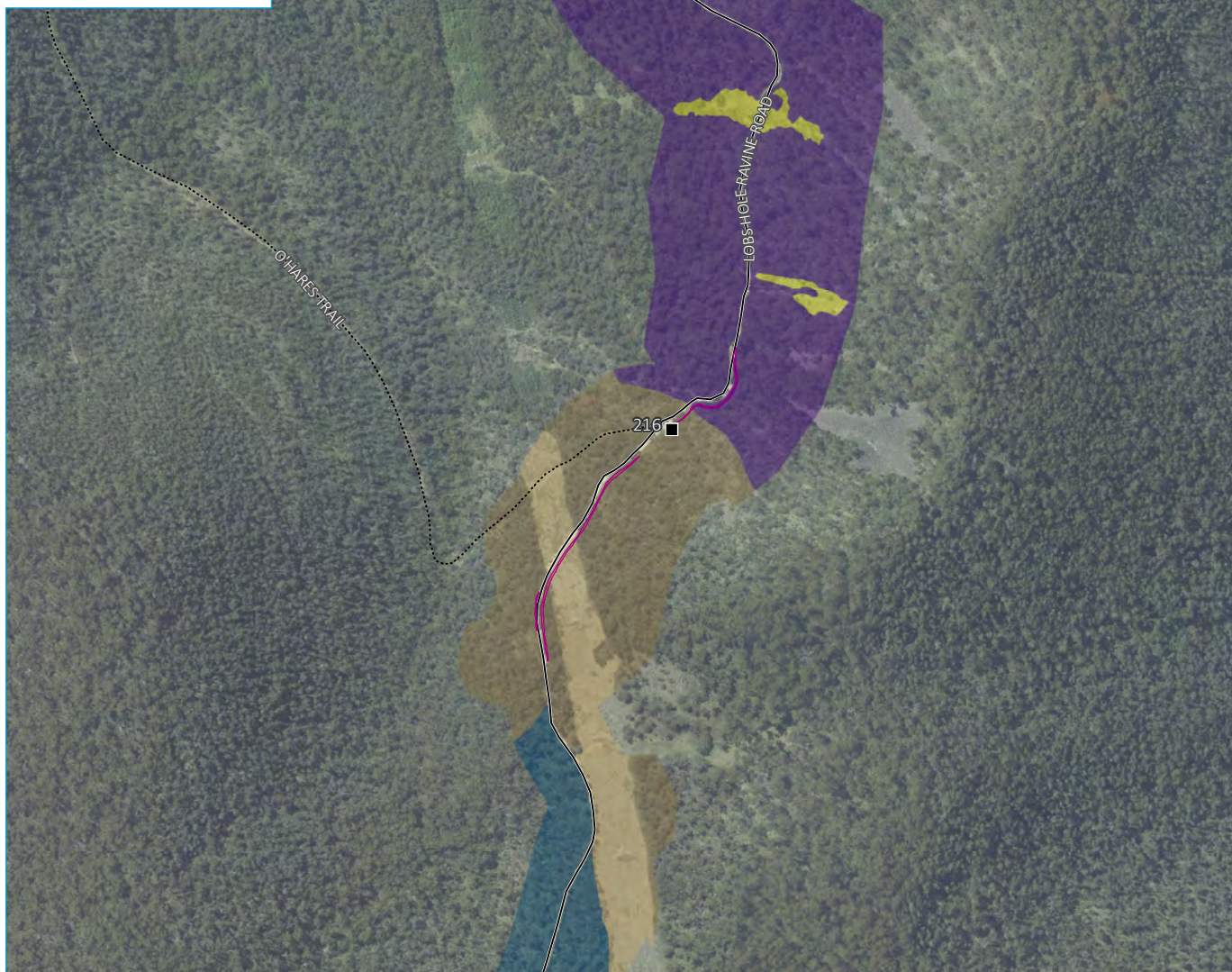
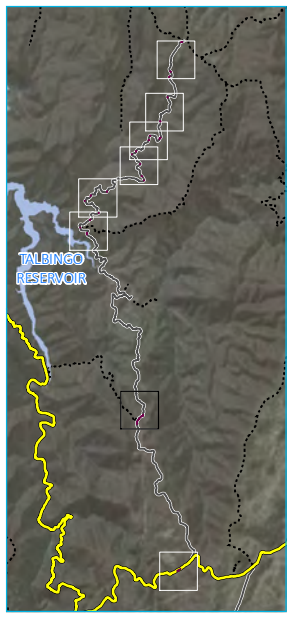
- Plot location
- Local road
- Vehicular track
- Modification 2 disturbance footprint
- Waterbody
- PCT 296
 - High
 - Medium
- PCT 300
 - High
 - Medium
- Medium
- Derived grassland
- PCT 311
 - High
 - Medium
- PCT 729
 - High
 - Medium
 - Derived grassland
- PCT 1191
 - High
 - Medium
 - Derived grassland

Plant Community Type and vegetation zone mapping within the Modification 2 project area, including plots locations

Snowy 2.0
Biodiversity development assessment
Modification 2
5.1 g



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Source: EMM (2019); Snowy Hydro (2019); PhotoMapping (2018); SMEC (2019); DFIGI (2017); GA (2015); LPMA (2011)

KEY

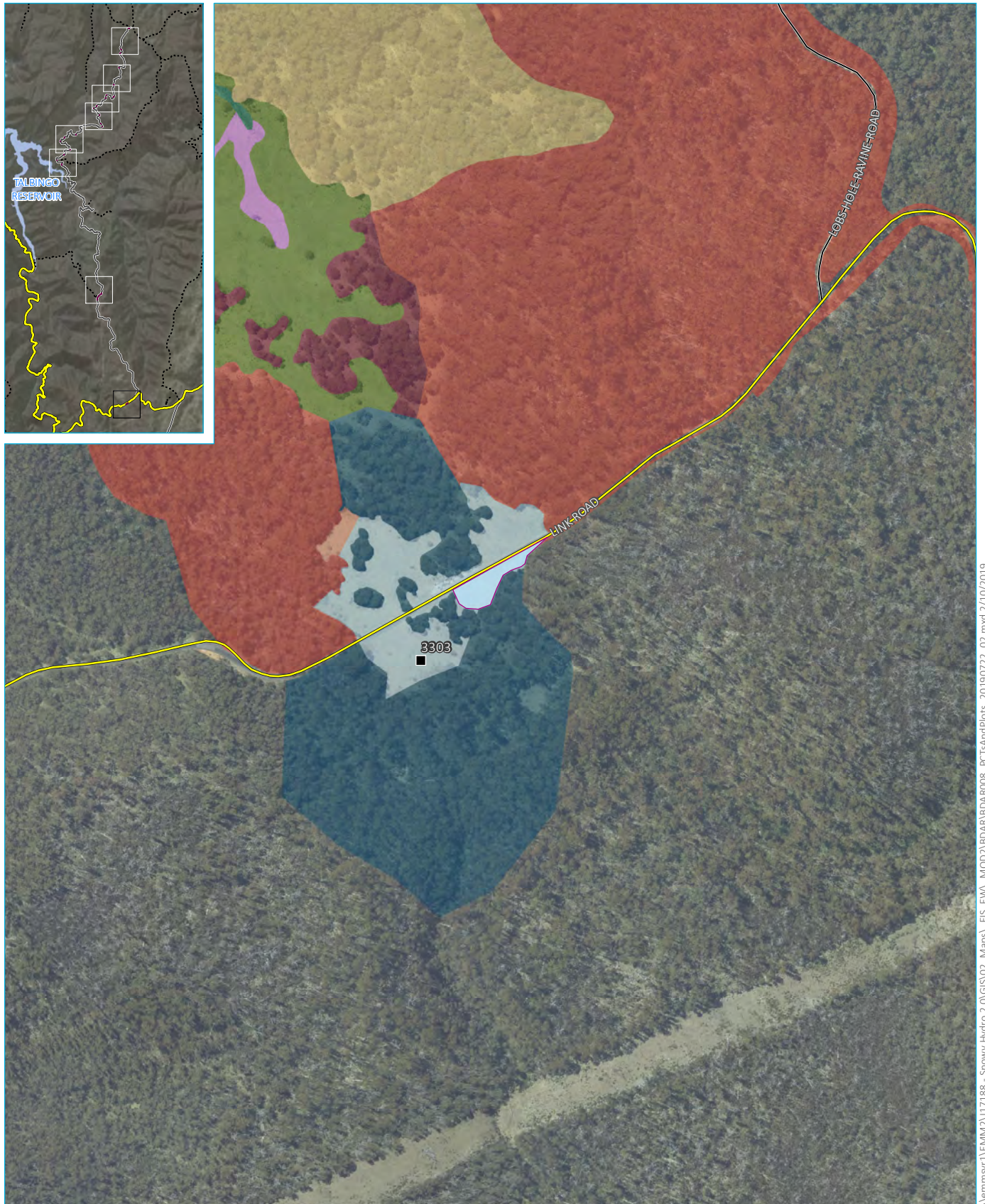
- Plot location
- Local road
- Vehicular track
- Modification 2 disturbance footprint
- PCT 300
- High
- PCT 643
- Low
- PCT 729
- High
- PCT 953
- High
- Derived grassland
- PCT 1196
- High
- Derived grassland

Plant Community Type and vegetation zone mapping within the Modification 2 project area, including plots locations

Snowy 2.0
Biodiversity development assessment
Modification 2
5.1 h



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Source: EMM (2019); Snowy Hydro (2019); PhotoMapping (2018); SMEC (2019); DFSI (2017); GA (2015); LPMA (2011)

KEY

■ Plot location	PCT 638	PCT 1224
— Main road	High	High
— Local road	Derived grassland	PCT 1196
□ Modification 2 disturbance footprint	PCT 639	High
PCT 303	High	Derived grassland
High	PCT 644	
Other	High	
PCT 637	PCT 1225	
High	Other	

Plant Community Type and vegetation zone mapping within the Modification 2 project area, including plots locations

Snowy 2.0
Biodiversity development assessment
Modification 2
5.1 i



5.3.3 Vegetation zones

Each of the six PCTs identified within the Modification 2 disturbance footprint were stratified into vegetation zones based on broad condition state, as per the method outlined in Section 5.2.1, and allocated a condition class as per the descriptions in Table 5.1. This process identified 11 vegetation zones within the modified project area, as outlined in Table 5.3.

Table 5.3 Vegetation zones mapped within the Modification 2 disturbance footprint

Plant community type	Condition	Area (ha)
PCT 296 – Brittle Gum – Peppermint open forest of the Woomargama to Tumut region, NSW South Western Slopes Bioregion	Derived grassland	0.10
PCT 296 – Brittle Gum – Peppermint open forest of the Woomargama to Tumut region, NSW South Western Slopes Bioregion	High	0.46
PCT 300 – Ribbon Gum - Narrow-leaved (Robertsons) Peppermint montane fern - grass tall open forest on deep clay loam soils in the upper NSW South Western Slopes Bioregion and western Kosciuszko escarpment	Medium	0.20
PCT 300 – Ribbon Gum - Narrow-leaved (Robertsons) Peppermint montane fern - grass tall open forest on deep clay loam soils in the upper NSW South Western Slopes Bioregion and western Kosciuszko escarpment	High	0.08
PCT 729 - Broad-leaved Peppermint - Candlebark shrubby open forest of montane areas, southern South Eastern Highlands Bioregion and South East Corner Bioregion	Derived grassland	<0.01
PCT 729 - Broad-leaved Peppermint - Candlebark shrubby open forest of montane areas, southern South Eastern Highlands Bioregion and South East Corner Bioregion	Medium	<0.01
PCT 729 - Broad-leaved Peppermint - Candlebark shrubby open forest of montane areas, southern South Eastern Highlands Bioregion and South East Corner Bioregion	High	0.13
PCT 953 – Mountain Gum - Snow Gum - Broad-leaved Peppermint shrubby open forest of montane ranges, South Eastern Highlands Bioregion and Australian Alps Bioregion	Derived grassland	0.07
PCT 953 – Mountain Gum - Snow Gum - Broad-leaved Peppermint shrubby open forest of montane ranges, South Eastern Highlands Bioregion and Australian Alps Bioregion	High	0.06
PCT 1191 – Snow Gum - Candle Bark woodland on broad valley flats of the tablelands and slopes, South Eastern Highlands Bioregion	High	0.07
PCT 1196 - Snow Gum - Mountain Gum shrubby open forest of montane areas, South Eastern Highlands Bioregion and Australian Alps Bioregion	Derived grassland	0.45
TOTAL		1.62

Notes: Vegetation zones with an area less than 0.01 ha were not inputted into the BAM calculator.

Descriptions of each PCT are provided in the following tables. PCTs and vegetation zones are mapped in Figure 5.1.

Table 5.4 PCT 296 – Brittle Gum – peppermint open forest of the Woomargama to Tumut region, NSW South Western Slopes Bioregion

PCT 296 - Brittle Gum – peppermint open forest of the Woomargama to Tumut region, NSW South Western Slopes Bioregion	
PCT ID	296
Common name	Brittle Gum – peppermint open forest of the Woomargama to Tumut region, NSW South Western Slopes Bioregion
Condition class	Three vegetation zones were mapped within the project area: <ul style="list-style-type: none"> • Derived grassland • High
Extent within Modification 2	Derived grassland: 0.10 ha High: 0.46 ha
Description	This PCT occurs on steep hillslopes and mountain landforms along the northern sections of Lobs Hole Ravine Road. The canopy consists of Brittle gum (<i>Eucalyptus mannifera</i> subsp. <i>mannifera</i>), Broad-leaved Peppermint (<i>Eucalyptus dives</i>) and Red Stringybark (<i>Eucalyptus macrorhyncha</i>). Narrow-leaved (Robertson’s) Peppermint (<i>Eucalyptus robertsonii</i> subsp. <i>robertsonii</i>) was recorded scattered throughout. The midstorey varies between a fairly sparse to dense cover comprising of Silver Wattle (<i>Acacia dealbata</i>), Native Blackthorn (<i>Bursaria spinosa</i>), Common Fringe-myrtle (<i>Calytrix tetragona</i>), Hoary guinea flower (<i>Hibbertia obtusifolia</i>), Mountain Banksia (<i>Banksia canei</i>) and <i>Cassinia longifolia</i> . The groundcover consists of a variety of native grasses, forbs, rushes and sedges. Grasses including Tussock (<i>Poa labillardierei</i>), Snowgrass (<i>Poa sieberiana</i> var. <i>sieberiana</i>), Silvertop Wallaby Grass (<i>Rytidosperma pallidum</i>) and <i>Poa sieberiana</i> var. <i>cyanophylla</i> . While native forbs comprise of Raspwort (<i>Gonocarpus teucroides</i>), Grass Trigger plant (<i>Stylidium graminifolium</i>), Small St John’s Wort (<i>Hypericum gramineum</i>) and Hairy Apple Berry (<i>Billardiera scandens</i>). Rushes and sedges include Wattle Mat-rush (<i>Lomandra filiformis</i> subsp. <i>filiformis</i>) and Fluke Bogrush (<i>Schoenus apogon</i>). Exotic species recorded within this vegetation type include St John’s Wort (<i>Hypericum perforatum</i>), Blackberry (<i>Rubus fruticosus</i> sp. agg), Sweet Briar (<i>Rosa rubiginosa</i>) and Common Centaury (<i>Centaureum erythraea</i>).
Survey effort	Derived grassland: one plot (187) High: one plot (190)
Condition description	This PCT occurs in two condition states within the project area extending along the northern sections of Lobs Hole Ravine Road. The majority of this PCT in the project area is in high condition consisting of relatively intact vegetation with high native cover, multiple vegetation strata, and low exotic cover. Cleared grassland areas derived from this PCT were mapped as derived grassland. These areas consist of derived grassland underneath managed powerline easements.
Characteristic species used for identification of PCT	Canopy species associated with this PCT were recorded within this community, these include Brittle Gum, Broad-leaved Peppermint, Red Stringybark and Robertson’s Peppermint. Aligning midstorey species include Silver Wattle and Hoary guinea flower. Understorey species that align with this PCT include Wattle Mat-rush, Small St John’s Wort, Grass Trigger plant and Raspwort.
Justification of evidence used to identify the PCT	PCT 296 occurs within the NSW South Western Slopes, South Eastern Highlands and Australian Alps, in which the project area is located. The landscape position described within the VIS states the PCT occurs at altitudes over 500 m on steep hillslopes or mountain landform patterns; this community has been recorded within these landforms. Characteristic species recorded within this community align with the VIS.
Status	Commonwealth EPBC Act: not listed NSW BC Act: not listed
Estimate of percent cleared value of PCT	40%

Table 5.4 PCT 296 – Brittle Gum – peppermint open forest of the Woomargama to Tumut region, NSW South Western Slopes Bioregion

PCT 296 - Brittle Gum – peppermint open forest of the Woomargama to Tumut region, NSW South Western Slopes Bioregion



Photograph 5.1 Brittle Gum – peppermint open forest of the Woomargama to Tumut region, NSW South Western Slopes Bioregion – Plot 190

Table 5.5 PCT 300 – Ribbon Gum – Narrow-leaved (Robertsons) Peppermint montane fern – grass tall open forest on deep clay loam soils in the upper NSW South Western Slopes Bioregion and Kosciuszko escarpment description

PCT 300 – Ribbon Gum – Narrow-leaved (Robertsons) Peppermint montane fern – grass tall open forest on deep clay loam soils in the upper NSW South Western Slopes Bioregion and Kosciuszko escarpment

PCT ID	300
Common name	Ribbon Gum – Narrow-leaved (Robertsons) Peppermint montane fern – grass tall open forest on deep clay loam soils in the upper NSW South Western Slopes Bioregion and Kosciuszko escarpment
Condition class	Two vegetation zones were mapped within the project area: <ul style="list-style-type: none"> • Medium • High
Extent within Modification 2	Medium: 0.20 ha High: 0.08 ha
Description	This PCT occurs on sheltered hillslopes across the project area; this PCT is known to occur along Lobs Hole Ravine Road. The canopy is composed of Ribbon Gum (<i>Eucalyptus viminalis</i>) and Narrow-leaved Peppermint. The midstorey comprises of Silver wattle, Handsome Flat Pea (<i>Platylobium formosum</i>), Wedge-leaved Wattle (<i>Acacia pravissima</i>), Narrow Leaf Hop Bush (<i>Dodonaea viscosa</i> subsp. <i>angustissima</i>), Bulbine Lily (<i>Bulbine bulbosa</i>), <i>Cassinia longifolia</i> and River Lomatia (<i>Lomatia myricoides</i>). Ground cover includes a number of native grasses, rushes and forbs. Grasses recorded include Slender Wallaby Grass (<i>Rytidosperma penicillatum</i>), <i>Dichelachne rara</i> , Longhair Plume Grass (<i>Dichelachne crinita</i>), Tussock, and Speargrass (<i>Austrostipa scabra</i>). Native forbs include Bidgee-widgee (<i>Acaena novae-zelandiae</i>), Tall Bluebell (<i>Wahlenbergia stricta</i> subsp. <i>stricta</i>), Small St John's Wort, Variable Glycine (<i>Glycine tabacina</i>), Prickly Woodruff (<i>Asperula scoparia</i>) and Native violet (<i>Viola betonicifolia</i>). The exotic species Delicate Hairgrass (<i>Aira elegantissima</i>), Common Centaury, St John's Wort and Blackberry were recorded within the community.
Survey effort	Medium: one plot (192) High: one plot (1001)
Condition description	This PCT occurs in high and medium condition states throughout the project area where it primarily occurs on steep slopes. These areas consist of relatively intact vegetation with high native cover and relatively low exotic cover. Areas mapped as medium condition include higher exotic species.
Characteristic species used for identification of PCT	Canopy species associated with this PCT were recorded within this community, these include Ribbon Gum and Narrow-leaved Peppermint. Aligning midstorey species include Silver Wattle, Handsome Flat Pea, Wedge-leaved Wattle and River Lomatia. Understorey species aligning with the VIS include Bidgee-widgee, Small St John's Wort, Variable Glycine, Prickly Woodruff and Native Violet.
Justification of evidence used to identify the PCT	PCT 300 occurs within the South Eastern Highlands, NSW South Western Slopes and Australian Alps IBRA regions, in which the project area is located. The landscape position described within the VIS states the PCT occurs on sheltered hillslopes in a mountain landform pattern; this community has been recorded within these landforms. Characteristic species recorded within this community align with the VIS.
Status	Commonwealth EPBC Act: not listed NSW BC Act: not listed
Estimate of percent cleared value of PCT	20%

Table 5.5 **PCT 300 – Ribbon Gum – Narrow-leaved (Robertsons) Peppermint montane fern – grass tall open forest on deep clay loam soils in the upper NSW South Western Slopes Bioregion and Kosciuszko escarpment description**

PCT 300 –Ribbon Gum – Narrow-leaved (Robertsons) Peppermint montane fern – grass tall open forest on deep clay loam soils in the upper NSW South Western Slopes Bioregion and Kosciuszko escarpment



Photograph 5.2 **Ribbon Gum – Narrow-leaved (Robertsons) Peppermint montane fern – grass tall open forest on deep clay loam soils in the upper NSW South Western Slopes Bioregion and Kosciuszko escarpment – Plot 3300**

Table 5.6 PCT 729 – Broad-leaved Peppermint - Candlebark shrubby open forest of montane areas, southern South Eastern Highlands Bioregion and South East Corner Bioregion description

PCT 729 – Broad-leaved Peppermint - Candlebark shrubby open forest of montane areas, southern South Eastern Highlands Bioregion and South East Corner Bioregion

PCT ID	729
Common name	Broad-leaved Peppermint - Candlebark shrubby open forest of montane areas, southern South Eastern Highlands Bioregion and South East Corner Bioregion
Condition class	<p>Three vegetation zones were mapped within the project area:</p> <ul style="list-style-type: none"> • Derived grassland • Medium • High <p>The vegetation zones assigned a condition code of Derived grassland and Medium were not inputted into the calculator as the area of these vegetation zone is less than 0.01 ha.</p>
Extent within Modification 2	High: 0.13 ha
Description	<p>This PCT occurs along Lobs Hole Ravine Road on adjacent foothills of Talbingo Reservoir. The canopy is composed of Candlebark (<i>Eucalyptus rubida</i>), Broad-leaved Peppermint and Robertson's Peppermint. The midstorey comprises of Common Fringe-myrtle, Hoary guinea, Mountain Banksia, Native Blackthorn, <i>Cassinia longifolia</i>, Dwarf Cherry (<i>Exocarpus stricta</i>), Wedge-leaved Wattle, Silver wattle, Daphne Heath (<i>Brachyloma daphnoides</i>), Pink Beard Heath (<i>Leucopogon ericoides</i>) and Showy Parrot Pea (<i>Dillwynia sericea</i>). Ground cover comprising of native forbs, sedges, rushes and grasses. Native grasses include Kangaroo Grass, Snowgrass, and <i>Dichelachne rara</i>. Native forbs, rushes and sedges recorded include Scaly Buttons (<i>Leptorhynchus squamatus</i>), Raspwort, Poverty Raspwort (<i>Gonocarpus tetragynus</i>), Stinking Pennywort (<i>Hydrocotyle laxiflora</i>), Bears-ear (<i>Cymbonotus lawsonianus</i>), <i>Oxalis perennans</i>, Rough Bedstraw (<i>Galium gaudichaudii</i>), Tall Bluebell, Creeping Cudweed (<i>Euchiton japonicas</i>), Honeypots (<i>Acrotriche serrulata</i>), Small St Johns Wort, Wattle Mat-rush, Mat-rush (<i>Lomandra confertifolia</i>) and <i>Juncus usitatus</i>. A number of exotic species were recorded including Delicate Hairgrass, Common Centaury, St John's Wort, Catsear, Sweet Briar and Haresfoot Clover (<i>Trifolium arvense</i>).</p>
Survey effort	High: one plot (1053)
Condition description	This PCT occurs in a high condition state along Lobs Hole Ravine Road, adjacent to Talbingo Reservoir. Vegetation consists of relatively intact vegetation with high native cover and relatively low exotic cover.
Characteristic species used for identification of PCT	Canopy species associated with this PCT were recorded within this community, these include Candlebark, Broad-leaved Peppermint and Robertson's Peppermint. Aligning midstorey species include Daphne Heath, <i>Cassinia longifolia</i> and Silver Wattle. Snowgrass and <i>Dichelachne rara</i> align with this PCTs groundcover species.
Justification of evidence used to identify the PCT	PCT 729 occurs within the South Eastern Highlands and Australian Alps IBRA regions, in which the project area is located. The landscape position described within the VIS states the PCT occurs on exposed dry slopes and foothills at intermediate altitudes; this community has been recorded within these landforms. Characteristic species recorded within this community align with the VIS.
Status	<p>Commonwealth EPBC Act: not listed</p> <p>NSW BC Act: not listed</p>
Estimate of percent cleared value of PCT	35%

Table 5.6 **PCT 729 – Broad-leaved Peppermint - Candlebark shrubby open forest of montane areas, southern South Eastern Highlands Bioregion and South East Corner Bioregion description**

PCT 729 – Broad-leaved Peppermint - Candlebark shrubby open forest of montane areas, southern South Eastern Highlands Bioregion and South East Corner Bioregion



Photograph 5.3 **Broad-leaved Peppermint - Candlebark shrubby open forest of montane areas, southern South Eastern Highlands Bioregion and South East Corner Bioregion – Plot 1053**

Table 5.7 PCT 953 – Mountain Gum - Snow Gum - Broad-leaved Peppermint shrubby open forest of montane ranges, South Eastern Highlands Bioregion and Australian Alps Bioregion description

PCT 953 – Mountain Gum - Snow Gum - Broad-leaved Peppermint shrubby open forest of montane ranges, South Eastern Highlands Bioregion and Australian Alps Bioregion

PCT ID	953
Common name	Mountain Gum - Snow Gum - Broad-leaved Peppermint shrubby open forest of montane ranges, South Eastern Highlands Bioregion and Australian Alps Bioregion
Condition class	Two vegetation zones were mapped within the project area: <ul style="list-style-type: none"> • Derived grassland • High
Extent within Modification 2	Derived grassland: 0.07 ha High: 0.06 ha
Description	This PCT occurs in montane areas along Lobs Hole Ravine Road. The canopy is composed of Mountain Gum (<i>Eucalyptus dalrympleana</i>), Snow Gum and Broad-leaved Peppermint with occasional Robertson's peppermint. The midstorey mainly consists of Silver Wattle, Red-leaved Wattle (<i>Acacia rubida</i>), Daphne Heath, <i>Cassinia longifolia</i> , <i>Cassinia uncata</i> , <i>Daviesia latifolia</i> , Dwarf Cherry, Pink-tip Daisy-bush (<i>Olearia erubescens</i>), Common Shaggy Pea (<i>Oxylobium ellipticum</i>), <i>Daviesia mimosoides</i> subsp. <i>mimosoides</i> and Handsome Flat Pea. Ground cover comprises of native forbs, rushes, grasses and ferns. Native forbs include Prickly Woodruff, <i>Glycine clandestina</i> , <i>Senecio gunnii</i> , Creamy Candles (<i>Stackhousia monogyna</i>), Grass Trigger-plant and Native Violet. Other ground stratum species include Spiny-head Mat-rush (<i>Lomandra longifolia</i>), Mountain Geebung (<i>Persoonia chamaepitys</i>) and Common Bracken (<i>Pteridium esculentum</i>).
Survey effort	Derived grassland: one plot (11) High: one plot (216)
Condition description	This PCT occurs in two condition states within the project area – derived grassland and high. Areas mapped as high condition state along Lobs Hole Ravine Road consist of relatively intact vegetation with high native cover and relatively low exotic cover. Areas mapped as derived grassland are located underneath managed powerline easements adjacent to Lobs Hole Ravine Road north. These cleared grassland areas are derived from this PCT and contain a high native component.
Characteristic species used for identification of PCT	Canopy species associated with this PCT were recorded within this community, these include Mountain Gum, Snowy Gum and Broad-leaved Peppermint. Aligning midstorey species include <i>Cassinia longifolia</i> , Silver Wattle, Red-leaved Wattle, <i>Daviesia mimosoides</i> subsp. <i>mimosoides</i> , Common Shaggy Pea and Pink-tip Daisy-bush. <i>Glycine clandestina</i> , <i>Senecio gunnii</i> , Creamy Candles, Prickly Woodruff and Native Violet align with this PCTs groundcover species.
Justification of evidence used to identify the PCT	PCT 953 occurs within the South Eastern Highlands and Australian Alps IBRA regions, in which the project area is located. The landscape position described within the VIS states the PCT occurs in montane areas within the Kosciuszko area; this community has been recorded within these landforms. Characteristic species recorded within this community align with the VIS.
Status	Commonwealth EPBC Act: not listed NSW BC Act: not listed Justification: The VIS states the PCT likely relates to the TEC Tableland Basalt Forest in the Sydney Basin and South Eastern Highlands Bioregions EEC. The project area is outside the known distribution. This community lacks suitable grassy understorey and does not occur on basalt, therefore it is not considered to align with this TEC.
Estimate of percent cleared value of PCT	5%

Table 5.7 PCT 953 – Mountain Gum - Snow Gum - Broad-leaved Peppermint shrubby open forest of montane ranges, South Eastern Highlands Bioregion and Australian Alps Bioregion description

PCT 953 – Mountain Gum - Snow Gum - Broad-leaved Peppermint shrubby open forest of montane ranges, South Eastern Highlands Bioregion and Australian Alps Bioregion



Photograph 5.4 Mountain Gum - Snow Gum - Broad-leaved Peppermint shrubby open forest of montane ranges, South Eastern Highlands Bioregion and Australian Alps Bioregion – Plot 216

Table 5.8 PCT 1191 – Snow Gum - Candle Bark woodland on broad valley flats of the tablelands and slopes, South Eastern Highlands Bioregion description

PCT 1191 – Snow Gum - Candle Bark woodland on broad valley flats of the tablelands and slopes, South Eastern Highlands Bioregion

PCT ID	1191
Common name	Snow Gum - Candle Bark woodland on broad valley flats of the tablelands and slopes, South Eastern Highlands Bioregion
Condition class	A single vegetation zone was mapped within the project area: <ul style="list-style-type: none"> • High
Extent within Modification 2	High: 0.07 ha
Description	This PCT occurs on footslopes along Lobs Hole Road, north of Talbingo Reservoir. The canopy is composed of Snow Gum, Candlebark and Black Sally (<i>Eucalyptus stellulata</i>). The midstorey consists of Blackwood, Silver Wattle, Native Blackthorn, Dwarf Cherry, Mountain Banksia, Hoary Guinea Flower and Narrow Leaf Hop Bush. Ground cover predominantly consists of native grasses and forbs. Native grasses include Kangaroo Grass, Bog Snowgrass (<i>Poa costiniana</i>), Tall sedge (<i>Carex appressa</i>), Wattle Mat-rush, Spiny-headed Mat-rush (<i>Lomandra longifolia</i>), and Many-flowered Mat-rush (<i>Lomandra multiflora</i>). Forb species within this community include Poverty Raspwort, Stinking Pennywort, Kidney Weed (<i>Dichondra repens</i>), Small St John's Wort, Sheep's Burr (<i>Acaena echinate</i>), Austral Bugle (<i>Ajuga australis</i>), Prickly Starwort and Native Violet. Several exotic species were recorded including Sweet Briar, Blackberry, St Johns Wort, Sheep Sorrel (<i>Acetosella vulgaris</i>) and Catsear (<i>Hypochaeris radicata</i>).
Survey effort	High: one plot (2276)
Condition description	This PCT occurs in a single condition state of high, consisting of relatively intact vegetation with high native cover, multiple vegetation strata, and low exotic cover.
Characteristic species used for identification of PCT	Canopy species associated with this PCT were recorded within this community, these include Snow Gum, Candlebark and Black Sally. Blackwood and Silver Wattle align with this PCTs midstorey species. Aligning groundcover species include Poverty Raspwort, Stinking Pennywort and Kangaroo Grass.
Justification of evidence used to identify the PCT	PCT 1191 occurs within the South Eastern Highlands, NSW South Western Slopes and Australian Alps, in which the project is located. The landscape position described within the VIS states the PCT occurs on frost-hollow flats and footslopes in undulating tableland areas between 600 and 1,000 m altitude. This community has been recorded within these landforms. Characteristic species recorded within this community align with the VIS.
Status	Commonwealth EPBC Act: not listed NSW BC Act: not listed Justification: The VIS states the PCT likely relates to the TEC Monaro Tableland Cool Temperate Grassy Woodland in the South Eastern Highlands Bioregion. This PCT is not considered to align with the above TEC being dominated by Candlebark and Mountain Gum (not Snow Gum) and lacking suitable grassy understorey.
Estimate of percent cleared value of PCT	95%

Table 5.8 **PCT 1191 – Snow Gum - Candle Bark woodland on broad valley flats of the tablelands and slopes, South Eastern Highlands Bioregion description**

PCT 1191 – Snow Gum - Candle Bark woodland on broad valley flats of the tablelands and slopes, South Eastern Highlands Bioregion



Photograph 5.5 **Snow Gum - Candle Bark woodland on broad valley flats of the tablelands and slopes, South Eastern Highlands Bioregion – Plot 184**

Table 5.9 PCT 1196 – Snow Gum – Mountain Gum shrubby open forest of montane areas, South Eastern Highlands Bioregion and Australian Alps Bioregion

PCT 1196 – Snow Gum - Mountain Gum shrubby open forest of montane areas, South Eastern Highlands Bioregion and Australian Alps Bioregion

PCT ID	1196
Common name	Snow Gum - Mountain Gum shrubby open forest of montane areas, South Eastern Highlands Bioregion and Australian Alps Bioregion
Condition class	A single vegetation zones was mapped within the project area: <ul style="list-style-type: none"> Derived grassland
Extent within Modification 2	Derived grassland: 0.45 ha
Description	This PCT on montane to sub-alpine ridges and slopes along Lobs Hole Ravine Road and Link Road. The canopy is composed of Snow Gum, Mountain Gum and Robertson's Peppermint. This community consists of a diverse midstorey consisting of <i>Daviesia ulicifolia</i> , <i>Daviesia mimosoides</i> subsp. <i>mimosoides</i> , <i>Platylobium formosum</i> subsp. <i>formosum</i> , Dolly Bush (<i>Cassinia aculeata</i>), Mountain Hickory (<i>Acacia obliquinervia</i>), Slender Rice-flower (<i>Pimelea linifolia</i> var. <i>linifolia</i>), Creamy Candles, River Lomatia, Coffee Berry (<i>Coprosma hirtella</i>), Dwarf Cherry, Leaf Bossiaea (<i>Bossiaea foliosa</i>) an Blackwood. Groundcover consisted of native forbs, sedges, rushes and grasses. Native grasses include Snowgrass, <i>Poa induta</i> and Tussock. Native forbs, rushes and sedges recorded include Native Violet, Prickly Starwort, Variable Glycine, Native Geranium, Small Poranthera (<i>Poranthera microphylla</i>), Trailing Speedwell (<i>Veronica plebeia</i>), Spiny-headed Mat-rush, Common Woodruff (<i>Asperula conferta</i>), Grass Trigger plant, <i>Acaena agnipila</i> , Bulbine Lily, Swamp Dock (<i>Rumex brownii</i>), <i>Senecio gunnii</i> , Alpine Shaggy Pea (<i>Podolobium alpestre</i>), Mountain Caladenia (<i>Caladenia alpine</i>), Common Buttercup (<i>Ranunculus lappaceus</i>), Slender Woodrush (<i>Luzula atrata</i>), Old Man's Beard (<i>Clematis aristata</i>), <i>Lomandra filiformis</i> subsp. <i>coriacea</i> , <i>Brachyscome spathulata</i> and Bidgee-widgee. Exotic species such as Catsear, White Clover (<i>Trifolium repens</i>) and Blackberry were recorded within the community.
Survey effort	Derived grassland: one plot (3303)
Condition description	This PCT occurs within a single condition state of derived grassland. Cleared grassland areas along Link Road and Lobs Hole Ravine Road with a higher native component were mapped as derived grasslands.
Characteristic species used for identification of PCT	Canopy species associated with this PCT were recorded within this community, these include Snow Gum, Mountain Gum and Robertson's Peppermint. Aligning midstorey species include <i>Daviesia ulicifolia</i> , <i>Daviesia mimosoides</i> subsp. <i>mimosoides</i> , <i>Platylobium formosum</i> subsp. <i>formosum</i> and Coffee Berry. Aligning understorey species include Snowgrass, Prickly Starwort, Bidgee-widgee, <i>Senecio gunnii</i> , Small Poranthera, Spiny-headed Mat-rush, Native Violet and <i>Brachyscome spathulata</i> .
Justification of evidence used to identify the PCT	PCT 1196 occurs within the South Eastern Highlands, NSW South Western Slopes and Australian Alps IBRA regions, in which the project area is located. The landscape position described within the VIS states the PCT occurs on montane to sub-alpine slopes and ridges; this community has been recorded within these landforms. Characteristic species recorded within this community align with the VIS.
Status	Commonwealth EPBC Act: not listed NSW BC Act: not listed Justification: This VIS states that this PCT forms part of the Tablelands Basalt Forest in the Sydney Basin and South Eastern Highlands Bioregions EEC. Due to the lack of grassy understory throughout these woodlands it is not considered to align with the TEC above.

Table 5.9 PCT 1196 – Snow Gum – Mountain Gum shrubby open forest of montane areas, South Eastern Highlands Bioregion and Australian Alps Bioregion

PCT 1196 – Snow Gum - Mountain Gum shrubby open forest of montane areas, South Eastern Highlands Bioregion and Australian Alps Bioregion

Estimate of percent cleared 5%
value of PCT



Photograph 5.6 Snow Gum - Mountain Gum shrubby open forest of montane areas, South Eastern Highlands Bioregion and Australian Alps Bioregion – Plot 3303

5.3.4 Assessment of patch size

For each vegetation zone within the Modification 2 disturbance footprint, patch size was assessed using a select process in ArcGIS, using existing vegetation mapping (OEH 2016a) and aerial imagery. All intact native vegetation separated by a distance of less than 100m (woody vegetation ecosystems) or 30 m (non-woody vegetation ecosystems) was mapped sequentially.

This process showed that vegetation within the modification project area forms part of large patches of connecting vegetation throughout KNP, with patch sizes of greater than 100 ha. This patch size was used in the calculator.

5.3.5 Vegetation integrity score

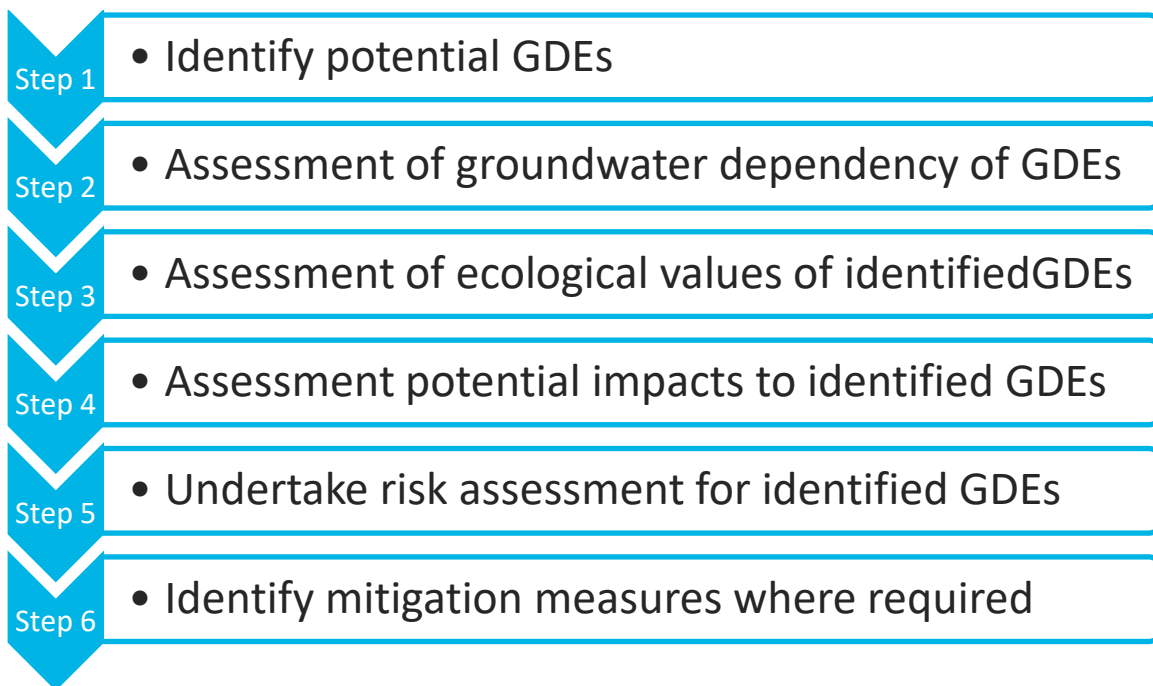
The vegetation integrity score for each vegetation zone is provided in Table 5.10.

Table 5.10 Vegetation integrity scores for all vegetation zones mapped within the Modification 2 disturbance footprint

Plant community type	Condition	Vegetation integrity score
PCT 296 – Brittle Gum – Peppermint open forest of the Woomargama to Tumut region, NSW South Western Slopes Bioregion	Derived grassland	41.2
PCT 296 – Brittle Gum – Peppermint open forest of the Woomargama to Tumut region, NSW South Western Slopes Bioregion	High	55.3
PCT 300 – Ribbon Gum - Narrow-leaved (Robertsons) Peppermint montane fern - grass tall open forest on deep clay loam soils in the upper NSW South Western Slopes Bioregion and western Kosciuszko escarpment	Medium	56
PCT 300 – Ribbon Gum - Narrow-leaved (Robertsons) Peppermint montane fern - grass tall open forest on deep clay loam soils in the upper NSW South Western Slopes Bioregion and western Kosciuszko escarpment	High	56.8
PCT 729 - Broad-leaved Peppermint - Candlebark shrubby open forest of montane areas, southern South Eastern Highlands Bioregion and South East Corner Bioregion	High	71.9
PCT 953 – Mountain Gum - Snow Gum - Broad-leaved Peppermint shrubby open forest of montane ranges, South Eastern Highlands Bioregion and Australian Alps Bioregion	Derived grassland	36.7
PCT 953 – Mountain Gum - Snow Gum - Broad-leaved Peppermint shrubby open forest of montane ranges, South Eastern Highlands Bioregion and Australian Alps Bioregion	High	79
PCT 1191 – Snow Gum - Candle Bark woodland on broad valley flats of the tablelands and slopes, South Eastern Highlands Bioregion	High	85.3
PCT 1196 - Snow Gum - Mountain Gum shrubby open forest of montane areas, South Eastern Highlands Bioregion and Australian Alps Bioregion	Derived grassland	41.1

5.4 Groundwater dependent ecosystems

A groundwater dependent ecosystem (GDE) risk assessment has been completed in accordance with the NSW Government *Risk Assessment Guidelines for Groundwater Dependent Ecosystems* (Serov et al. 2012). This assessment follows the process detailed below:



5.4.1 Identification of potential GDEs

Ecosystems that could rely on either the surface or subsurface expression of groundwater within or surrounding the Modification 2 project area are those associated with:

- creeks where deep groundwater is discharging and provides baseflow;
- shallow (perched) groundwater systems;
- terrestrial vegetation overlying shallow groundwater (within the vegetation's root zone).

These ecosystems have been classified into three categories according to their dependence on groundwater:

- non-dependent;
- facultative:
 - opportunistic;
 - proportional;
 - highly dependent; and
- entirely dependent/obligate.

Considerations in evaluating PCTs and their potential dependency on groundwater included:

- the physiology of plant species that occur in that community and their likely dependence on water availability;
- the PCTs location in the landscape; and

- if the rooting depth of vegetation would be able to take up groundwater based on likely depth of the aquifer and soil characteristics.

Access to the groundwater is dependent on a number of factors with the core factor being the depth to the water table. As terrestrial vegetation communities are composed of a range of vegetation types with a range of rooting depths and strategies there is a relationship between groundwater depth and the types and composition of the vegetation that is able to access it (Serov P 2013).

i Potential GDEs

A list of potential GDEs is provided in Table 5.11.

Table 5.11 **Terrestrial GDE assessment**

Plant community type	Area (ha) in disturbance footprint	Assigned category of groundwater dependency	Justification
PCT 296 – Brittle Gum – Peppermint open forest of the Woomargama to Tumut region, NSW South Western Slopes Bioregion	0.56	Facultative – proportional	This PCT occurs on mid to lower slopes, including in some areas where groundwater is less than 5 m deep. This community does not occur in areas where groundwater flows are likely to be concentrated, such as riparian areas or gullies. A conservative assessment has been undertaken and it is assumed that this PCT has a facultative reliance on groundwater, with some dependence on groundwater inflows to maintain structure and function.
PCT 300 – Ribbon Gum - Narrow-leaved (Robertsons) Peppermint montane fern - grass tall open forest on deep clay loam soils in the upper NSW South Western Slopes Bioregion and western Kosciuszko escarpment	0.33	Non-dependent	This community does not occur in areas of shallow groundwater.
PCT 729 – Broad-leaved Peppermint - Candlebark shrubby open forest of montane areas, southern South Eastern Highlands Bioregion and South East Corner Bioregion	0.12	Non-dependent	This community does not occur in areas of shallow groundwater.
PCT 953 – Mountain Gum - Snow Gum - Broad-leaved Peppermint shrubby open forest of montane ranges, South Eastern Highlands Bioregion and Australian Alps Bioregion	0.12	Non-dependent	This community does not occur in areas of shallow groundwater.
PCT 1191 – Snow Gum - Candle Bark woodland on broad valley flats of the tablelands and slopes, South Eastern Highlands Bioregion	0.12	Non-dependent	This community does not occur in areas of shallow groundwater.
PCT 1196 – Snow Gum - Mountain Gum shrubby open forest of montane areas, South Eastern Highlands Bioregion and Australian Alps Bioregion	0.46	Non-dependent	This community does not occur in areas of shallow groundwater.

5.4.2 Final risk assessment for identified GDEs

A detailed assessment of potential groundwater impacts is provided in EMM (2018e). In line with this assessment, the GDEs present in the project area and the impacts arising from the project, the overall risk assessment, prepared in accordance with Serov et al. (2012), GDEs are considered as having high ecological value/low risk of impact (category A).

The mitigation measures required by Serov et al. (2012) for this risk level include:

- protection measures for aquifer and GDEs;
- continue protection measures for aquifers and GDEs;
- undertake baseline risk monitoring;
- undertake periodic monitoring and assessment; and
- continue monitoring as a part of adaptive management.

Management and monitoring of groundwater is outlined in EMM (2018e).

6 Threatened species

6.1 Fauna habitat assessment

A fauna habitat assessment is provided in EMM (2018b). Fauna habitat within the Modification 2 project area is largely consistent with this assessment, except for areas along Link Road and northern sections of Lobs Hole Ravine Road.

The top of Lobs Hole Ravine Road, near the Snowy Mountains Highway, consists of grassy woodlands, dominated by Black Sallee, Mountain Gum and Narrow-leaved Peppermint. These areas lack large logs and woody debris as a result of historical fire. Vegetation rapidly changes along Lobs Hole Ravine Road (north) as a result of undulating altitudes and creek lines. Sections within Lobs Hole Ravine Road (north) are widely similar to those at the southern end of the road. Consisting of wet and dry sclerophyll forest, varying within gullies and drainage lines. These areas have a significant amount of leaf litter and large trees containing hollows. Large logs were predominant within gullies dominated by Ribbon Gum.

Cleared vegetation along Link Road and under powerline easements along Lobs Hole Ravine Road lack structural elements and habitat features. These areas provide minimal habitat for fauna species. Adjacent vegetation to the cleared areas consists of grassy woodlands with large logs and coarse woody debris.

6.2 Ecosystem credit species assessment

Ecosystem credits species are threatened species that can be reliably predicted to use an area of land based on habitat surrogates. For the purposes of the BAM (OEH 2017a), ecosystem credit species are deemed to be offset through the habitat surrogates (PCTs) in which they occur.

A list of ecosystem credit species predicted to occur within the Modification 2 project area, based on the PCTs present and generated by the calculator associated within the BAM (OEH 2017a) is provided in Table 6.1. The potential for these species to occur within the Modification 2 disturbance footprint was assessed in accordance with Section 6.2 of the BAM (OEH 2017a).

Table 6.1 **Assessment of ecosystem credit species within the Modification 2 disturbance footprint**

Scientific name	Common name	Justification for exclusion
<i>Anthochaera phrygia</i>	Regent Honeyeater (Foraging)	Not excluded.
<i>Artamus cyanopterus cyanopterus</i>	Dusky Woodswallow	Excluded from cleared vegetation zones (condition class Derived grassland).
<i>Callocephalon fimbriatum</i>	Gang-gang Cockatoo (Foraging)	Excluded from cleared vegetation zones (condition class Derived grassland).
<i>Calyptorhynchus lathami</i>	Glossy Black-Cockatoo (Foraging)	Not excluded.
<i>Chthonicola sagittata</i>	Speckled Warbler	Not excluded.
<i>Circus assimilis</i>	Spotted Harrier	Not excluded.
<i>Climacteris picumnus victoriae</i>	Brown Treecreeper (eastern subspecies)	Excluded from cleared vegetation zones (condition class Derived grassland).
<i>Daphoenositta chrysoptera</i>	Varied Sittella	Excluded from cleared vegetation zones (condition class Derived grassland).
<i>Dasyurus maculatus</i>	Spotted-tailed Quoll	Not excluded.
<i>Falsistrellus tasmaniensis</i>	Eastern False Pipistrelle	Excluded from cleared vegetation zones (condition class Derived grassland).
<i>Haliaeetus leucogaster</i>	White-bellied Sea-Eagle (Foraging)	The White-bellied Sea-eagle feeds on fish and freshwater turtles, but also waterbirds, reptiles, mammals and carrion, using a perch near water. Species excluded from all PCTs not associated with the Yarrangobilly River or Talbingo Reservoir (all PCTs except PCTs 296, 300 and 1191) and from cleared vegetation zones (condition class Derived grassland).
<i>Hieraaetus morphnoides</i>	Little Eagle (Foraging)	Not excluded.
<i>Lophoictinia isura</i>	Square-tailed Kite (Foraging)	Not excluded.
<i>Melanodryas cucullata cucullata</i>	Hooded Robin (south-eastern form)	Not excluded.
<i>Miniopterus schreibersii oceanensis</i>	Eastern Bentwing-bat (Foraging)	Excluded from cleared vegetation zones (condition class Derived grassland).
<i>Neophema pulchella</i>	Turquoise Parrot	Not excluded.
<i>Ninox connivens</i>	Barking Owl (Foraging)	Not excluded.
<i>Ninox strenua</i>	Powerful Owl (Foraging)	Excluded from cleared vegetation zones (condition class Derived grassland).

Table 6.1 Assessment of ecosystem credit species within the Modification 2 disturbance footprint

Scientific name	Common name	Justification for exclusion
<i>Pachycephala olivacea</i>	Olive Whistler	Not excluded.
<i>Petaurus australis</i>	Yellow-bellied Glider	Excluded from cleared vegetation zones (condition class Derived grassland) due to lack of hollow bearing trees.
<i>Petroica boodang</i>	Scarlet Robin	Not excluded.
<i>Petroica phoenicea</i>	Flame Robin	Not excluded.
<i>Phascolarctos cinereus</i>	Koala (Foraging)	Excluded from all PCTs as the species is rare in KNP and no evidence was observed during targeted surveys.
<i>Stagonopleura guttata</i>	Diamond Firetail	Not excluded.
<i>Suta flagellum</i>	Little Whip Snake	Not excluded.
<i>Tyto novaehollandiae</i>	Masked Owl (Foraging)	Excluded from cleared vegetation zones (condition class Derived grassland).
<i>Varanus rosenbergi</i>	Rosenberg's Goanna	Not excluded.

6.3 Species credit species assessment

6.3.1 Habitat constraints assessment (Step 2)

Species credit species are threatened species that cannot be reliably predicted to use an area of land based on habitat surrogates. For the purposes of the BAM (OEH 2017a), species credit species require detailed assessment and, if present, additional offsets to ecosystem credits. An assessment of habitat constraints for threatened species was undertaken in accordance with Step 2 of Section 6.4 of the BAM (OEH 2017a). For those threatened species predicted to occur, for which habitat constraints are listed, an assessment was undertaken of the presence of the habitat features within the Modification 2 disturbance footprint.

The species generated by the calculator with habitat constraints, as well as the results of the habitat constraints assessment, are shown in Table 6.2.

Table 6.2 **Assessment of habitat and geographic constraint features within the Modification 2 project area**

Scientific name	Common name	Feature	Sensitivity to gain class	Habitat/geographic constraint present in development site	Justification
<i>Litoria spenceri</i>	Spotted Tree Frog	<ul style="list-style-type: none"> Waterbodies River environments with rocky habitat or with 500 m of rocky river 	Very high	Yes	The development site intersects Talbingo Reservoir.
<i>Myotis macropus</i>	Southern Myotis	<ul style="list-style-type: none"> Hollow bearing trees Within 200 m of riparian zone Bridges, caves or artificial structures within 200 m of riparian zone 	High	Yes	The development site contains hollow bearing trees with parts of the project area located within 200 m of a riparian zone.
<i>Phascogale tapoatafa</i>	Brush-tailed Phascogale	<ul style="list-style-type: none"> Hollow bearing trees 	High	Yes	The development site contains hollow bearing trees.
<i>Pomaderris cotoneaster</i>	Cotoneaster Pomaderris	<ul style="list-style-type: none"> South of northern Kosciuszko National Park boundary 	High	Yes	The development site is located to the south of the northern boundary of KNP.
<i>Pseudophryne pengilleyi</i>	Northern Corroboree Frog	<ul style="list-style-type: none"> Above 700 m above sea level (ASL) 	Very high	Yes	The majority of the modification is located above 700 m ASL.
<i>Thesium australe</i>	Austral Toadflax	<ul style="list-style-type: none"> Kosciuszko National Park 	Moderate	Yes	The development site is located within KNP.

Using the process outlined in Step 2 of Section 6.4 of the BAM (OEH 2017a) no species were excluded based on habitat and geographic features.

The Spotted Tree Frog, Leafy Anchor Plant, Southern Myotis, Brush-tailed Phascogale, Cotoneaster Pomaderris, Northern Corroboree Frog and Austral Toadflax have not been excluded on the basis of the identified habitat constraints. Further consideration is given to these species in Section 6.3.2.

6.3.2 Identifying candidate species credit species for further assessment (Step 3)

To develop a list of species credit species for further assessment, an assessment was undertaken in accordance with Step 3 of Section 6.4 of the BAM (OEH 2017a), as shown in Table 6.3.

Table 6.3 Species credit species and status and habitat suitability assessment

Scientific name	Common name	Candidate species	Justification
Flora			
<i>Caladenia montana</i>	-	No	<p>Terrestrial orchid restricted to high montane areas 700-1,000 m ASL. The species grows in well-drained loam on slopes and ridges of montane forest among an understorey of shrubs. The species occurs mainly in the east alps section of the Alpine National Park in Victoria. It may occur in southern Kosciuszko National Park adjacent to Victoria.</p> <p>The species is unlikely to occur based on geographic distribution and the project area does not contain suitable habitat.</p>
<i>Euphrasia scabra</i>	Rough Eyebright	No	<p>Rough Eyebright occurs in or at the margins of swampy grassland or in sphagnum bogs, often in wet, peaty soil. The species appears to be self-fertilising but seed production is variable, perhaps depending on season. There are three known populations in NSW: Bondi State Forest, South East Forests National Park and near Nunnock Swamp.</p> <p>The project area does not contain suitable habitat for this species; therefore, it is unlikely to occur.</p>
<i>Pomaderris cotoneaster</i>	Cotoneaster Pomaderris	Yes	<p>Cotoneaster Pomaderris has a very disjunct distribution, being known from the Nungatta area, northern KNP (near Tumut). Cotoneaster Pomaderris has been recorded in a range of habitats in predominantly forested country. The habitats include forest with deep, friable soil, amongst rock beside a creek, on rocky forested slopes and in steep gullies between sandstone cliffs.</p> <p>The survey area contains forest and rocky forested slopes that are considered suitable habitat to support this species based on the limited understanding of the species ecology.</p>
<i>Pterostylis alpina</i>	-	Yes	<p>The greenhood orchid grows in moist forests on foothills and ranges, extending to montane areas in NSW. The species is known to occur in the Southern Tablelands south from Bondo State Forest. It is often found on sheltered slopes near streams in rich loam.</p> <p>The project area contains suitable moist slopes near streams.</p>
<i>Thesium australe</i>	Austral Toadflax	Yes	<p>Austral Toadflax occurs in grassland on coastal headlands or grassland and grassy woodland away from the coast, often in association with Kangaroo Grass and often in wet areas. This species is a root parasite that takes water and some nutrients from other plants, especially Kangaroo Grass. This species is found in very small populations scattered across eastern NSW, along the coast, and from the Northern to Southern Tablelands region.</p> <p>Most PCTs within the project area are unlikely to support this species, as they are shrubby and lack moist areas. Suitable damp, grassy woodland habitat likely to be restricted to damp areas of PCT 1196 within the project area.</p>

Table 6.3 Species credit species and status and habitat suitability assessment

Scientific name	Common name	Candidate species	Justification
Fauna			
<i>Anthochaera phrygia</i>	Regent Honeyeater (Breeding)	No	<p>The Regent Honeyeater mainly inhabits temperate woodlands and open forests of the inland slopes of south-east Australia. The species particularly favours Box-Ironbark woodland, and riparian forests of River Sheoak. Woodlands with significantly large numbers of mature trees with high canopy cover and abundance of mistletoe are favoured.</p> <p>The project area does not support suitable breeding habitat for this species and is not located within mapped important areas.</p>
<i>Callocephalon fimbriatum</i>	Gang-gang Cockatoo (Breeding)	Yes	<p>In spring and summer, generally found in tall mountain forests and woodlands, particularly in heavily timbered and mature wet sclerophyll forests. Nests are located in hollows that are 10 cm in diameter or larger and at least 9 m above the ground in eucalypts.</p> <p>The project area contains suitable breeding habitat to support this species.</p>
<i>Calyptorhynchus lathamii</i>	Glossy Black-Cockatoo (Breeding)	No	<p>The Glossy Black-cockatoo inhabits coastal woodlands and drier forest areas, open inland woodlands, or timbered watercourses where its main food source, the casuarina (she-oak) is common. The species prefers to nest in hollows of large, old eucalypt trees, alive or dead, typically around 3 to 30 metres above the ground. The current known distribution within NSW covers areas from the coast to the tablelands, and as far west as the Riverina and Pilliga Scrub.</p> <p>The project area does not support suitable breeding habitat with dominant She-oak (<i>Allocasuarina</i> spp.). The species is not known to occur within the project area.</p>
<i>Cercartetus nanus</i>	Eastern Pygmy-possum	Yes	<p>The Eastern Pygmy-possum is found in a broad range of habitats from rainforest through sclerophyll forest and woodland to heath, but in most areas woodlands and heath appear to be preferred. Feeds largely on nectar and pollen collect from banksias, eucalypts and bottlebrushes. Also feeds on insects throughout the year. This feed source may be more important in habitats where flowers are less abundant such as wet forests. Shelters in tree hollows, rotten stumps, holes in the ground, abandoned bird-nests, Ringtail Possum (<i>Pseudocheirus peregrinus</i>) dreys or thickets of vegetation (eg grass-tree skirts). Nest-building appears to be restricted to breeding females. Tree hollows are favoured but spherical nests have been found under the bark of eucalypts and in shredded bark in tree forks.</p> <p>The project area supports suitable habitat for this species.</p>

Table 6.3 Species credit species and status and habitat suitability assessment

Scientific name	Common name	Candidate species	Justification
<i>Haliaeetus leucogaster</i>	White-bellied Sea-Eagle (Breeding)	No	<p>Habitats are characterised by the presence of large areas of open water including larger rivers, swamps, lakes, and the sea. Breeding habitat consists of mature tall open forest, open forest, tall woodland, and swamp sclerophyll forest close to foraging habitat. Nest trees are typically large emergent eucalypts and often have emergent dead branches or large dead trees nearby which are used as 'guard roosts'. Nests are large structures built from sticks and lined with leaves or grass.</p> <p>No nests suitable for the species were observed during the habitat assessment. Breeding habitat unlikely to occur within the project area.</p>
<i>Hieraaetus morphnoides</i>	Little Eagle (Breeding)	No	<p>The Little Eagle occupies open eucalypt forest, woodland or open woodland. Sheoak or Acacia woodlands and riparian woodlands of interior NSW are also used. The species nests in tall living trees within a remnant patch, where pairs build a large stick nest in winter.</p> <p>No nests suitable for the species were observed during the habitat assessment. Breeding habitat is unlikely to occur within the project area.</p>
<i>Litoria booroolongensis</i>	Booroolong Frog	No	<p>The Booroolong Frog is associated with permanent streams in a variety of vegetation types. Primary habitat requirements are extensive rock bank structures along permanent rivers with the key feature of these rock structures being rock crevices in relatively shallow, slow to medium-flowing sections of stream.</p> <p>The project area does not contain suitable habitat for this species, lacking streams and permanent watercourses.</p>
<i>Litoria spenceri</i>	Spotted Tree Frog	No	<p>The Spotted Tree Frog is extremely rare and occurs in scattered, geographically isolated populations. Historically it was known from two streams in southern NSW on the north-west side of the Great Dividing Range; however both populations appeared to have become locally extinct. One population has been re-established via a reintroduction program. It occurs among boulders or debris along naturally vegetated, rocky fast flowing upland streams and rivers.</p> <p>Due to extremely limited population distribution in NSW and lack of suitable waterbodies within the project area, this species is considered unlikely to occur.</p>
<i>Litoria verreauxii alpina</i>	Alpine Tree Frog	No	<p>The Alpine Tree Frog occurs in the south-eastern NSW and Victorian high country (alpine and sub-alpine zones) generally above 1,100 m ASL. Most locations are within the KNP and some are close to alpine resorts. Found in a wide variety of habitats including woodland, heath, grassland and herb fields. Breed in natural and artificial wetlands including ponds, bogs, fens, streamside pools, stock dams and drainage channels that are still or slow flowing.</p> <p>The project area does not contain suitable habitat for this species, lacking bogs and fens or slow flowing channels.</p>

Table 6.3 Species credit species and status and habitat suitability assessment

Scientific name	Common name	Candidate species	Justification
<i>Lophoictinia isura</i>	Square-tailed Kite (Breeding)	No	<p>The Square-tailed Kite is found in a variety of timbered habitats including dry woodlands and open forests. The species shows a particular preference for timbered watercourses, where nests are constructed in a fork or on large, horizontal limbs.</p> <p>No nests suitable for the species were observed during the habitat assessment. Breeding habitat is unlikely to occur within the project area.</p>
<i>Miniopterus schreibersii oceanensis</i>	Eastern Bentwing-bat (Breeding)	No	<p>Caves are the primary roosting habitat, but also use derelict mines, storm-water tunnels, buildings and other man-made structures. Maternity caves have very specific temperature and humidity regimes, and are known from a limited number of sites across the species range.</p> <p>The project area contains no suitable roosting structures for this species. This species is unlikely to roost within the project area.</p>
<i>Myotis macropus</i>	Southern Myotis	No	<p>This species roost in groups close to water in caves, mine shafts, hollow-bearing trees, storm water channels, building, under bridges and in dense foliage. The Southern Myotis relies on waterways with pools of 3 m wide or greater for foraging, breeding and roosting.</p> <p>The disturbance area does not contain suitable habitat for the species within 200m of permanent waterbodies, as defined in OEH (2018c).</p>
<i>Ninox connivens</i>	Barking Owl (Breeding)	Yes	<p>Inhabits woodland and open forest, including fragmented remnants and partly cleared farmland. It is flexible in its habitat use, and hunting can extend in to closed forest and more open areas. Roost in shaded portions of tree canopies, including tall midstorey trees with dense foliage such as Acacia and Casuarina species. It typically breeds in hollows of large eucalypts or paperbarks, usually near watercourses or wetlands. Nest-hollow entrances are 2-35 m above the ground with a diameter of 20-46 cm and depth of 20-300 cm. During nesting season, the male perches in a nearby tree overlooking the hollow entrance.</p> <p>The project area contains suitable habitat. Suitable nesting habitat is limited to areas of mature trees located adjacent to Talbingo Reservoir.</p>
<i>Ninox strenua</i>	Powerful Owl (Breeding)	No	<p>The Powerful Owl inhabits a range of vegetation types, from woodland and open sclerophyll forest to tall open wet forest and rainforest, requiring large tracts of forest or woodland habitat. The species nests in large tree hollows (at least 0.5 m deep), in large eucalypts (diameter at breast height of 80-240 cm) that are at least 150 years old. Nest in unburnt gullies and lower slopes within 100 m of streams.</p> <p>The disturbance area lacks suitable nesting habitat within 100 m of streams.</p>

Table 6.3 Species credit species and status and habitat suitability assessment

Scientific name	Common name	Candidate species	Justification
<i>Petaurus norfolcensis</i>	Squirrel Glider	Yes	<p>The Squirrel Glider inhabits mature or old growth Box, Box-Ironbark woodlands and River Red Gum forest west of the Great Dividing Range and Blackbutt-Bloodwood forest with heath understorey in coastal areas. The species prefers mixed species stands with a shrub or Acacia mid-storey. The species relies on large old trees with hollows for breeding and nesting; however, trees need to be less than 50 m apart.</p> <p>Suitable feed and nesting trees are limited to the habitat west of Wallaces creek within the project area.</p>
<i>Petroica rodinogaster</i>	Pink Robin	Yes	<p>Inhabits rainforest and tall, open eucalypt forest, particularly in densely vegetated gullies. Like most Robins, requires perching habitat from which it can predate insects and spiders, but does spend significant time on the ground.</p> <p>Potential for the species to occur within the modification project area.</p>
<i>Phascogale tapoatafa</i>	Brush-tailed Phascogale	Yes	<p>The Brush-tailed Phascogale prefers dry sclerophyll open forest with sparse groundcover of herbs, grasses, shrubs or leaf litter. The species also inhabits heath, swamps, rainforest and wet sclerophyll forest. Nests and shelters in tree hollows with entrances 2.5 - 4 cm wide. Known to use many different hollows over a short time span.</p> <p>The species is scarce in the KNP, with a single record. Potential suitable habitat occurs within the project area and therefore the species will be retained as a candidate species.</p>
<i>Phascolarctos cinereus</i>	Koala (Breeding)	Yes	<p>Koalas live in eucalypt woodlands and forests. Home range size varies according to quality of habitat, ranging from less than two to several hundred hectares. The trees within the project area provide foraging or sheltering resources for Koala. Ribbon Gum, identified as a Koala feed tree, is present within the project area.</p> <p>Recent Koala records are scarce in KNP; however, as suitable habitat exists, the species is retained as a candidate species.</p>
<i>Pseudomys fumeus</i>	Smoky Mouse	Yes	<p>The precise habitat requirements of the Smoky Mouse are not clear. A wide range of vegetation communities are occupied, from damp coastal heath in East Gippsland, to sub-alpine heath. A characteristic of Smoky Mouse localities, except those in wet gullies, is a floristically diverse midstorey with members of the plant families Epacridaceae, Fabaceae and Mimosaceae well represented. Ground cover is also likely to be critical and can be in the form of dense low vegetation, such as occurs in heaths, or grass tussocks, rocks and logs in more open habitats. Soil conditions also need to be conducive to burrowing and growth of hypogeal fungi, a major component of the diet (Menkhurst and Broome 2008a, 2008b).</p> <p>Suitable habitat for the Smoky Mouse is located in the higher regions of the project area above 1,100 m.</p>

Table 6.3 **Species credit species and status and habitat suitability assessment**

Scientific name	Common name	Candidate species	Justification
<i>Pseudophryne pengilleyi</i>	Northern Corroboree Frog	No	<p>The Northern Corroboree Frog occurs in forests, sub-alpine woodlands and tall heath in the Fiery Range from the Snowy Mountains Highway to Wee Jasper. Populations also occur in the pine plantations near Tumut. Summer breeding habitat includes pools and seepages in sphagnum bogs, wet heath, wet tussock grasslands and herbfields in low-lying depressions. Outside the breeding season adults move away from the bogs into the surrounding heath, woodland and forest to overwinter under litter, logs and dense groundcover.</p> <p>The area of the project area above 700 m ASL does not provide suitable habitat for this species, either within or in proximity to the project area.</p>
<i>Tyto novaehollandiae</i>	Masked Owl (Breeding)	Yes	<p>The Masked Owl lives in dry eucalypt forests and woodlands from sea level to 1,100 m. The species requires old hollow-bearing eucalypts greater than 90 cm diameter at breast height, with hollows greater than 40 cm wide, greater than 100 cm deep and at least 3 m above the ground, for breeding. Will breed in a variety of topographic positions.</p> <p>The project area contains suitable nesting habitat along the top of Lobs Hole Ravine Road, where suitable sized hollows are present.</p>

This assessment identified the following species as candidate species requiring further assessment:

- three threatened flora species:
 - Austral Toadflax;
 - Cotoneaster Pomaderris;
 - *Pterostylis alpina*;
- four threatened bird species:
 - Gang-gang Cockatoo;
 - Pink Robin;
 - Barking Owl;
 - Masked Owl;
- five threatened mammal species:
 - Brush-tailed Phascogale;
 - Eastern Pygmy-possum;
 - Smoky Mouse;
 - Koala; and
 - Squirrel Glider.

The following additional species were included as candidate species for the purposes of the EPBC Act assessment process (EMM 2018f):

- two threatened flora species:
 - Curtis' Colobanth (*Colobanthus curtisiae*);
 - Blue-tongued Greenhood (*Pterostylis oreophila*);
- two threatened fauna species:
 - Greater Glider (*Petauroides volans*);
 - Spotted-tailed Quoll;
- two migratory bird species:
 - Rufous Fantail; and
 - Satin Flycatcher.

Targeted surveys were undertaken, and the presence or absence of these species in the modification survey area determined, in accordance with Section 6.4 of the BAM (OEH 2017a). Survey methods and outcomes are discussed further below.

6.3.3 Targeted survey methods

Extensive targeted flora and fauna surveys have been undertaken for the Snowy 2.0 project, including along the southern section of Lobs Hole Ravine Road and in Lobs Hole. Please refer to EMM (2018d and 2019b) for detailed survey methods and survey effort completed within these areas. Given the nature and extent of these surveys in relation to the disturbance footprint for Modification 2, repetition of this survey effort is not included in this report.

The northern section of Lobs Hole Ravine Road has not been subject to detailed targeted surveys as the project boundary was identified out of the appropriate survey season for many species. It is considered that the extensive surveys undertaken within the locality for Snowy 2.0 are sufficient to characterise the likely impacts arising from Modification 2 in this area. Where required, additional pre-clearance surveys will be completed within this area prior to any construction work being undertaken. The results of these additional surveys, as well as any additional offsets required, will be addressed within the response to submissions.

6.3.4 Targeted survey results

Candidate species credit species have been discussed below; addressing records of threatened flora and fauna, and identification of species polygons. As per the BAM (OEH 2017a), a species polygon must be mapped to include suitable habitat features or habitat components associated with the species within the development footprint. Species polygons have been created for relevant species within the development site as per the TBDC. For species without relevant guidelines, species polygons have been established based on requirements of similar species.

i Threatened flora survey results

No threatened flora species were recorded during targeted surveys within the Modification 2 survey area. All candidate threatened flora species are considered to have a low likelihood of occurrence with the disturbance footprint following targeted surveys.

ii Threatened fauna survey results

Ten threatened fauna species have been recorded within or adjacent to the Modification 2 project area (Figure 6.1):

- Seven threatened bird species:
 - Dusky Woodswallow (ecosystem credit species);
 - Flame Robin (ecosystem credit species)
 - Gang-gang Cockatoo;
 - Masked Owl (ecosystem credit species);
 - Olive Whistler (ecosystem credit species);
 - Pink Robin

- White-bellied Sea-eagle (ecosystem credit species);
- Three threatened mammal species:
 - Eastern Bentwing-bat (ecosystem credit species);
 - Eastern Pygmy-possum; and
 - Smoky Mouse.

Threatened fauna survey results are outlined for each survey group in the section below. Ecosystem credit species are not discussed further in this section, as they are not candidate threatened species credit species.

a Diurnal birds

One target species, the Gang-gang Cockatoo, was recorded within and adjacent to the project area and is considered to be impacted by Modification 2 (Figure 6.2). The Pink Robin was recorded adjacent to the project area, however, is not considered to occur within the Modification 2 disturbance footprint. Therefore, it is considered a low likelihood of occurring in the disturbance footprint. No other diurnal bird candidate species credit species were recorded and are considered a low likelihood of occurring in the disturbance footprint.

Gang-gang Cockatoo

The Gang-gang Cockatoo was found to be common throughout the Modification 2 project area, with the species observed foraging at numerous locations (Figure 6.2). The species was observed to be most common in sub-alpine woodlands (such as the top of Lobs Hole Ravine Road) and riparian areas at lower elevations. Targeted nest searches were undertaken along the top of Lobs Hole and areas adjacent to Talbingo Reservoir. The Gang-gang Cockatoo was not observed nesting but was observed investigation hollows on four occasions, one of which was recorded adjacent to, but not within, the Modification 2 disturbance boundary along Lobs Hole Ravine Road.

The Gang-gang Cockatoo nests in the trunks, limbs or dead spouts of tall living trees, in tall, mature sclerophyll forests, often near water (NSWSC 2005, 2008). Nests are located in hollows that are 10 cm in diameter or larger and at least 9 m above the ground in eucalypts (OEH 2018b). Suitable hollows are most common in the areas where the species was observed to be most common, along the upper reaches of Lobs Hole Ravine Road, in PCT 1196 - Snow Gum - Mountain Gum shrubby open forest of montane areas.

The threatened biodiversity data collection (TBDC) does not specify how the species polygon for the Gang-gang Cockatoo should be defined. However, as no breeding hollows were recorded within the disturbance boundary a species polygon for the Gang-gang Cockatoo has not been identified, and offsets are not required.



Photograph 6.1 **Gang-gang Cockatoo**

b **Nocturnal birds**

One target species, the Masked Owl, was recorded foraging within and adjacent to the Modification 2 disturbance footprint (Figure 6.3). The Barking Owl is considered a low likelihood of occurring within the disturbance footprint. The Barking Owl is considered scarce at higher elevations of the tablelands (NPWS 2003) and the species is known to respond strongly to call playback. Given the failure to record this species during targeted surveys it is considered unlikely to occur.

Masked Owl

The Masked Owl was recorded at two locations within and adjacent to the Modification 2 disturbance footprint during targeted surveys; on the Yarrangobilly River in Lobs Hole and in the upper sections of Lobs Hole Ravine Road, near the intersection with Link Road (Figure 6.3). Both records were from the species being “called in” as a result of call playback.

The Masked Owl nests in large (greater than 90 cm diameter at breast height), old, hollow eucalypts. Nesting hollows are greater than 40 cm wide and 100 cm deep. Unlike other forest owls, there is no relationship with distance to watercourses and the species will breed in a variety of topographic positions (DEC 2006b). Suitable sized trees and hollows are restricted to the two areas where the species was observed; the upper sections of Lobs Hole Ravine Road in areas of PCT 1196 - Snow Gum - Mountain Gum shrubby open forest of montane areas, South Eastern Highlands Bioregion and Australian Alps Bioregion. However, no nesting birds were identified during surveys.

As per the TBDC, the species polygon should be established by providing a circular buffer of 100m around the nest tree. As no nesting birds were observed a species polygon for the Masked Owl has not been identified, and offsets are not required.



Photograph 6.2 **Masked Owl**

c **Small terrestrial mammals**

Two target species, the Eastern Pygmy-possum and Smoky Mouse, were recorded within or adjacent to the Modification 2 disturbance footprint.

Eastern Pygmy-possum

The Eastern Pygmy-possum was recorded adjacent to the project area, within the upper reaches of Lobs Hole Ravine Road (Figure 6.4). Following extensive surveys completed for the broader Snowy 2.0 project area, the Eastern Pygmy-possum was recorded in the following PCTs:

- PCT 296 – Brittle Gum – Peppermint open forest of the Woomargama to Tumut region, NSW South Western Slopes Bioregion;
- PCT 300 – Ribbon Gum - Narrow-leaved (Robertsons) Peppermint montane fern - grass tall open forest on deep clay loam soils in the upper NSW South Western Slopes Bioregion and western Kosciuszko escarpment;
- PCT 729 - Broad-leaved Peppermint - Candlebark shrubby open forest of montane areas, southern South Eastern Highlands Bioregion and South East Corner Bioregion;

- PCT 953 - Mountain Gum - Snow Gum - Broad-leaved Peppermint shrubby open forest of montane ranges, South Eastern Highlands Bioregion and Australian Alps Bioregion; and
- PCT 1196 - Snow Gum - Mountain Gum shrubby open forest of montane areas, South Eastern Highlands Bioregion and Australian Alps Bioregion.

The Eastern Pygmy-possum can be found in a broad range of habitats from rainforest through sclerophyll forest and woodland to heath, but in most areas woodlands and heath appear to be preferred. The species feeds largely on nectar and pollen collected from banksias, eucalypts and bottlebrushes and there is a strong association with Banksias (Tulloch and Dickman 2006) and a dense, flowering understorey (Harris et al. 2014, Law et al. 2017).

On this basis, the PCTs listed above were used to develop the species polygon on the basis of suitably dense understorey habitat with flowering Banksia (Figure 6.4). PCTs in Low or Derived grassland condition classes were excluded as they do not provide a sufficiently dense understorey selected by the species.



Photograph 6.3 Eastern Pygmy-possum (image courtesy of Lachlan Hall)

Smoky Mouse

Extensive targeted surveys for the Smoky Mouse have been undertaken, with the species identified at 70 locations across the survey area (16 by terrestrial trapping, 53 by remote camera and one incidental record, Figure 6.4).

The species distribution within the survey area is predominantly associated with a single vegetation community (PCT 1196 - Snow Gum - Mountain Gum shrubby open forest of montane areas, South Eastern Highlands Bioregion and Australian Alps Bioregion) along the upper reaches of Lobs Hole Ravine Road, above 1,100 m. In this area vegetation consists of tall forests dominated by Mountain Gum and Snow Gum, with a moderate to dense shrubby midstorey dominated by shrubs from the plant family Fabaceae (with some Epacridaceae and Mimosaceae), and dense groundcover with abundant sub-shrubs, logs and leaf litter. At around 1,100 m, vegetation transitions to drier communities dominated by Peppermint, Brittle Gum and Candlebark with a moderate to sparse midstorey and sparse grassy groundcover. Soils also become much rockier and may be less suitable for burrowing.

A conservative assessment of habitat has been undertaken, with all vegetation not in Derived Grassland condition classes above 1,100 m altitude identified as potential habitat. Only PCT 953 - Mountain Gum - Snow Gum - Broad-leaved Peppermint shrubby open forest of montane ranges, South Eastern Highlands Bioregion and Australian Alps Bioregion was recorded within the disturbance boundary.

This data was used to determine species polygons for this species (Figure 6.4).



Photograph 6.4 **Smoky Mouse**

d Large terrestrial mammals

No Spotted-tailed Quolls were recorded during targeted surveys within the Modification 2 disturbance footprint. However, an incidental record of Quoll scat was recorded off Wallaces Creek Firetrail, approximately 9 km from the project area.

The Spotted-tailed Quoll is known to have home ranges of several hundred to several thousand hectares and occurs at low densities (DELWP 2016, DEWHA 2009, DSE 2011). The species is primarily forest-dependent, and occupies a wide range of habitat types, including rainforest, wet and dry sclerophyll forest, coastal heathland, scrub and dunes, woodland, heathy woodland, swamp forest, mangroves, on beaches and sometimes in grassland or pastoral areas adjacent to forested areas. Given this, the species has potential to occupy the Modification 2 disturbance footprint at low densities, with large areas of suitable habitat present throughout the locality; the species is likely to be wide ranging. All areas of the survey area are deemed to provide suitable habitat, with suitable denning sites focused on boulderfields on Lobs Hole Ravine Road, and areas with a high density of hollow logs in sub-alpine areas at the top of Lobs Hole Ravine Road and along the Yarrangobilly River.

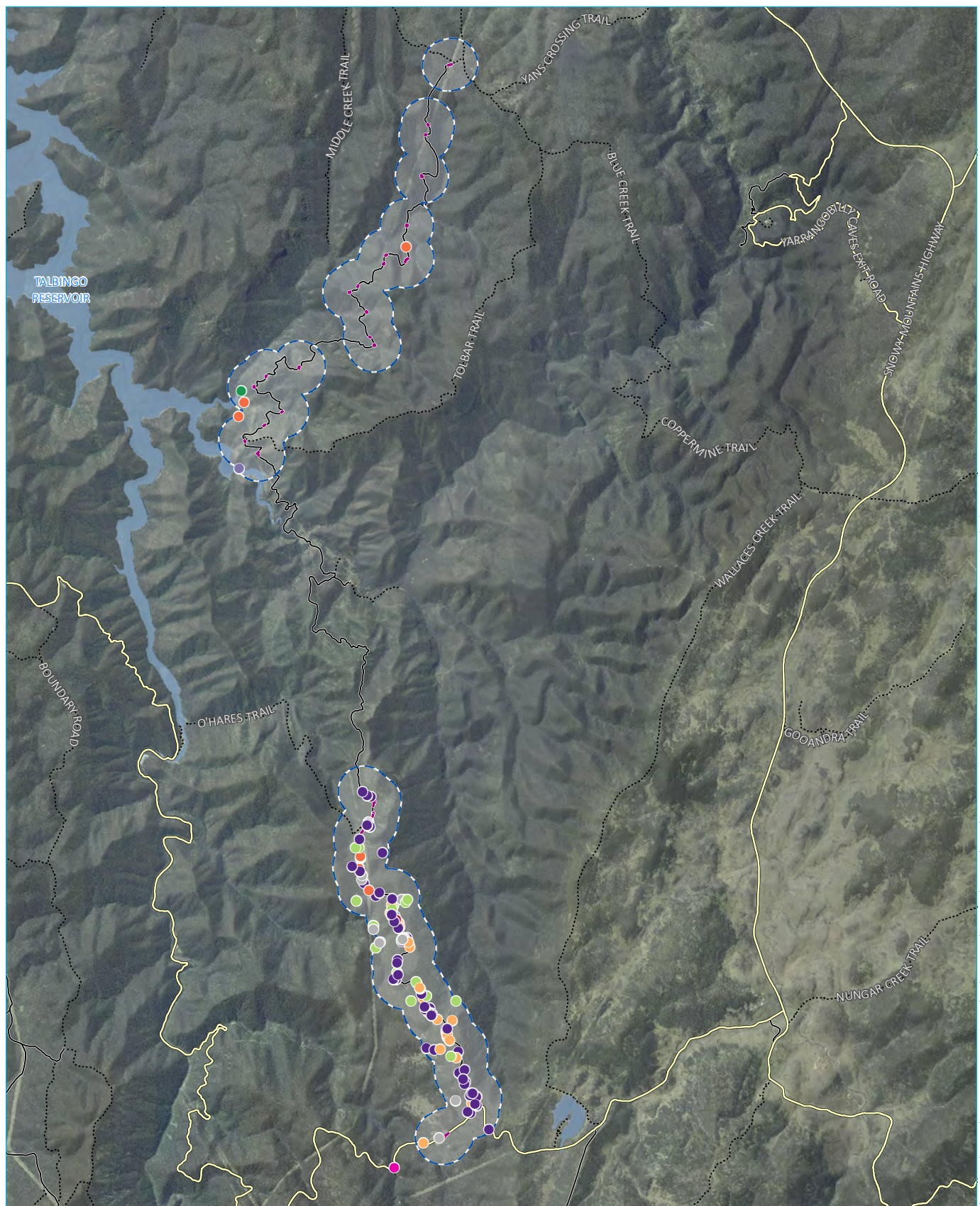
However, as the species is an ecosystem credit species for the purposes of the BAM a species polygon has not been developed.

e Arboreal mammals

No arboreal mammals were recorded during targeted surveys.

Although there is some potential for these species to occur at low densities and/or utilise habitats within the project area on occasion the species are not considered present for the purposes of this assessment. Habitat for the Greater Glider, which coincides with Smoky Mouse habitat, will not be significantly impacted (see Section 7).

The Koala is rare in the KNP, with a single record over 10 km of the project area and a recent record in November 2016 from near Blowering Dam, east of Tumut (ABC News 2018). There is insufficient evidence to undertake a Koala habitat assessment in accordance with the Koala habitat assessment tool outlined in DoE (2014). Therefore, RGB SAT surveys, spotlighting and Songmeter surveys were undertaken. The Koala was not observed during these surveys and is considered unlikely to occur for the purposes of this assessment.



Source: EMM (2019); Snowy Hydro (2019); PhotoMapping (2018); SMEC (2019); DFSI (2017); GA (2015); LPMA (2011)

KEY

- Main road
- Local road
- Vehicular track
- Waterbody
- 500 m buffer
- Modification 2 disturbance footprint

Threatened species

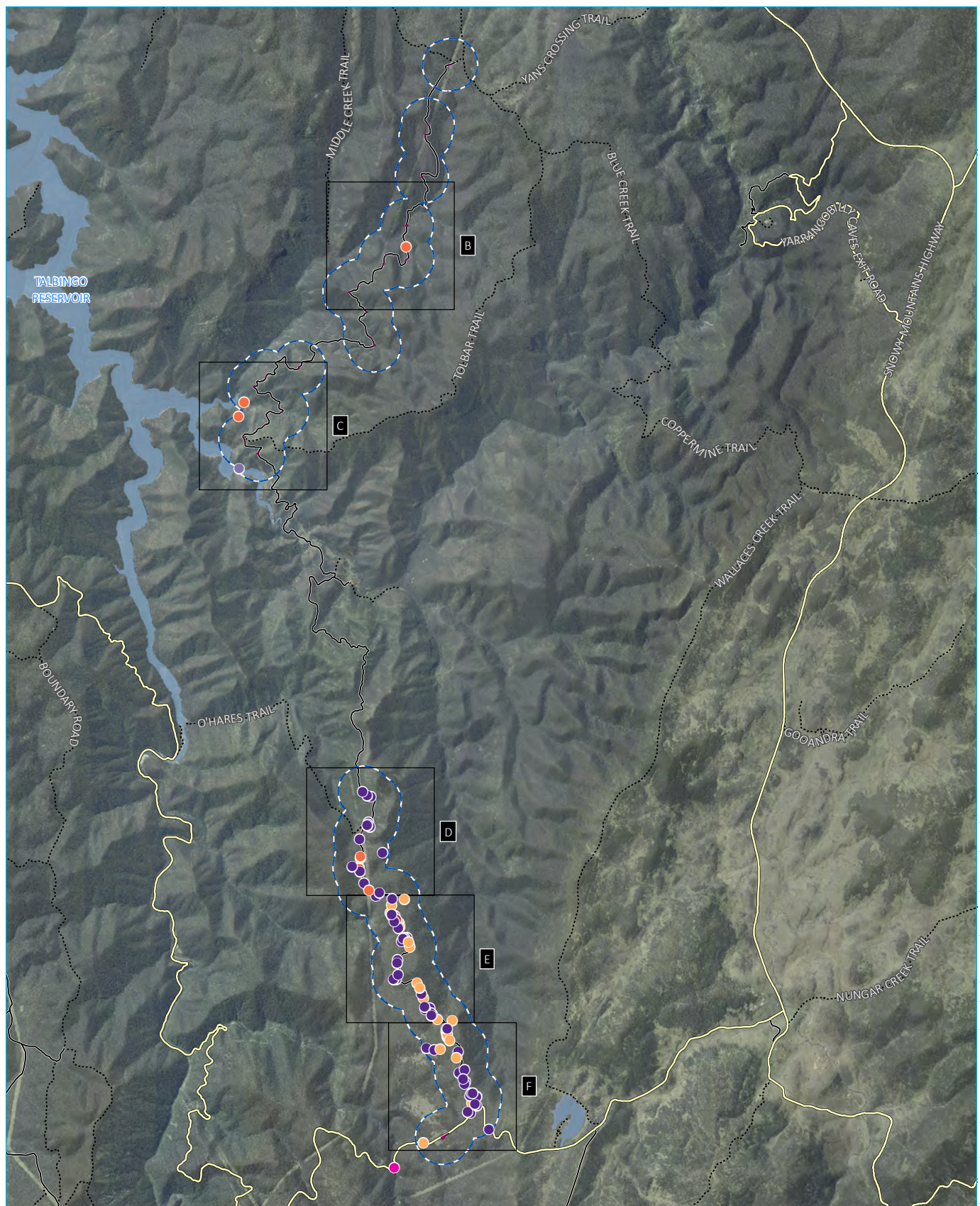
- Smoky Mouse
- Eastern Bentwing-bat
- Eastern Pygmy-possum
- Flame Robin

- Dusky Woodswallow
- Olive Whistler
- Gang-gang Cockatoo
- White-bellied Sea-Eagle
- Masked Owl
- Pink Robin

Threatened species overview

Snowy 2.0
Biodiversity development assessment
Modification 2
6.1





Source: EMM (2019); Snowy Hydro (2019); PhotoMapping (2018); SMEC (2019); DFSI (2017); GA (2015); LPMA (2011)

KEY

- Main road
- Local road
- Vehicular track
- Waterbody
- 500 m buffer
- Grid index

Threatened species

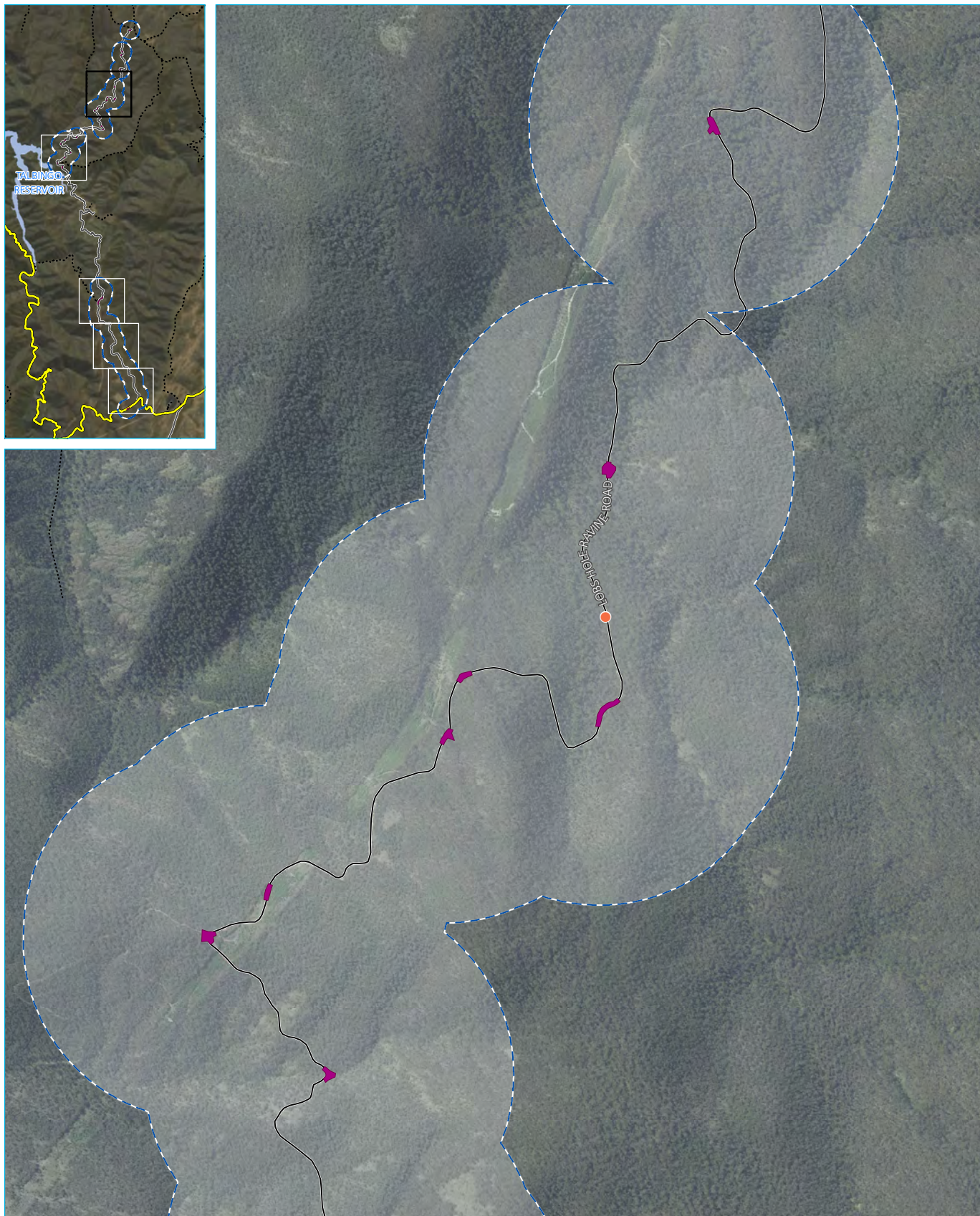
- Flame Robin
- Dusky Woodswallow
- Olive Whistler
- Gang-gang Cockatoo
- White-bellied Sea-Eagle
- Pink Robin

- Modification 2 disturbance footprint
- Disturbed area - LHR south
- Vegetation trimming - LHR south

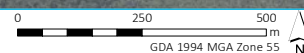
Diurnal bird survey results

Snowy 2.0
Biodiversity development assessment
Modification 2
6.2 a





Source: EMM (2019); Snowy Hydro (2019); PhotoMapping (2018); SMEC (2019); DFSI (2017); GA (2015); LPMA (2011)



KEY

- Local road
- Vehicular track
- 500 m buffer
- Modification 2 disturbance footprint

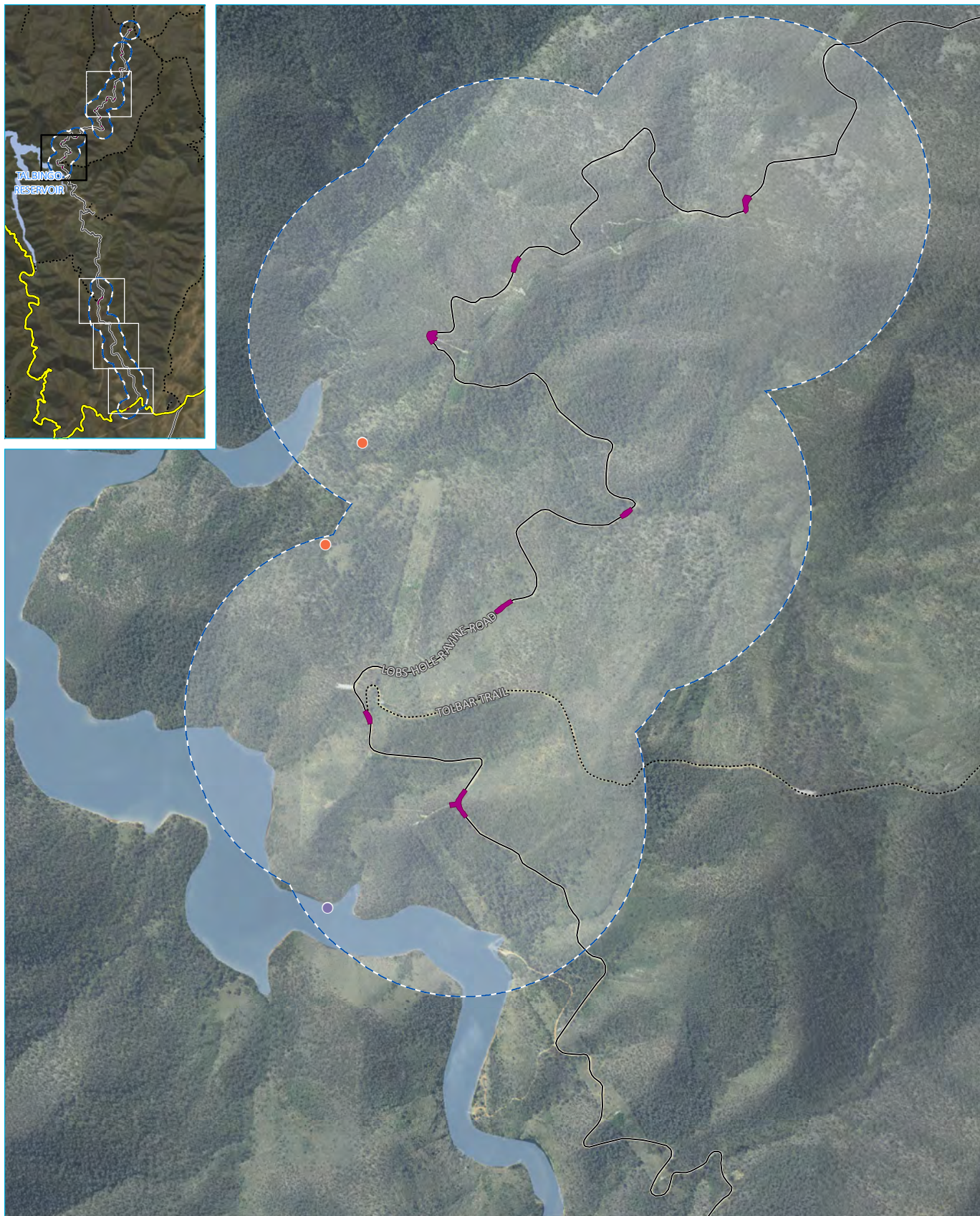
- Threatened species
- Dusky Woodswallow

Diurnal bird survey results

Snowy 2.0
Biodiversity development assessment
Modification 2
6.2 b



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Source: EMM (2019); Snowy Hydro (2019); PhotoMapping (2018); SMEC (2019); DFSI (2017); GA (2015); LPMA (2011)

KEY

- Local road
- Vehicular track
- Waterbody
- 500 m buffer
- Modification 2 disturbance footprint

Threatened species

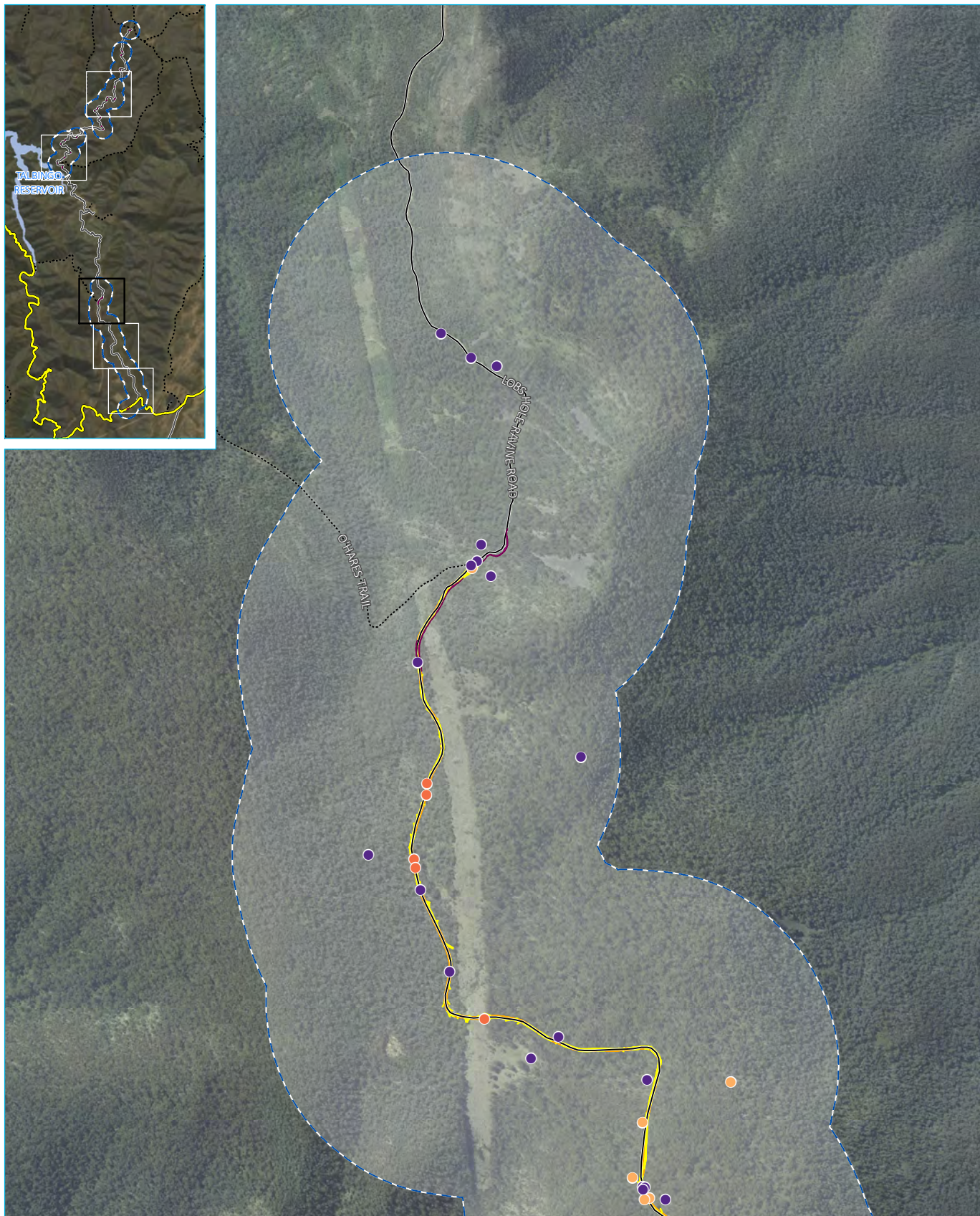
- Orange dot: Dusky Woodswallow
- Purple dot: White-bellied Sea-Eagle

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GDA 1994 MGA Zone 55

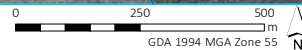
Diurnal bird survey results

Snowy 2.0
Biodiversity development assessment
Modification 2
6.2 c





Source: EMM (2019); Snowy Hydro (2019); PhotoMapping (2018); SMEC (2019); DFSI (2017); GA (2015); LPMA (2011)



KEY

- Local road
- Vehicular track
- 500 m buffer
- Modification 2 disturbance footprint
- Disturbed area - LHRR south
- Vegetation trimming - LHRR south

Threatened species

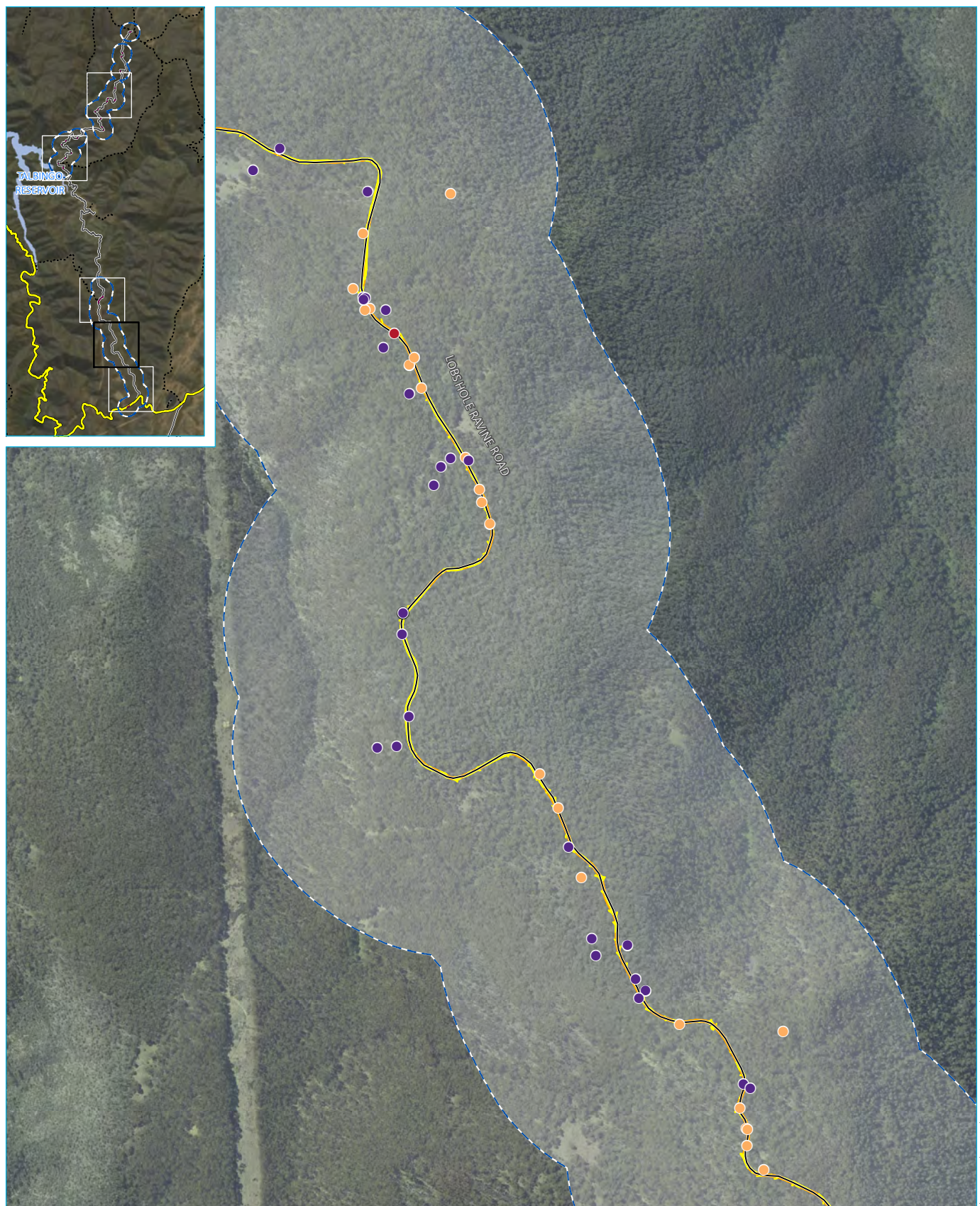
- Flame Robin
- Dusky Woodswallow
- Olive Whistler
- Gang-gang Cockatoo

Diurnal bird survey results

Snowy 2.0
Biodiversity development assessment
Modification 2
6.2 d



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Source: EMM (2019); Snowy Hydro (2019); PhotoMapping (2018); SMEC (2019); DFSI (2017); GA (2015); LPMA (2011)

KEY

- Local road
- 500 m buffer
- Disturbed area - LHRR south
- Vegetation trimming - LHRR south

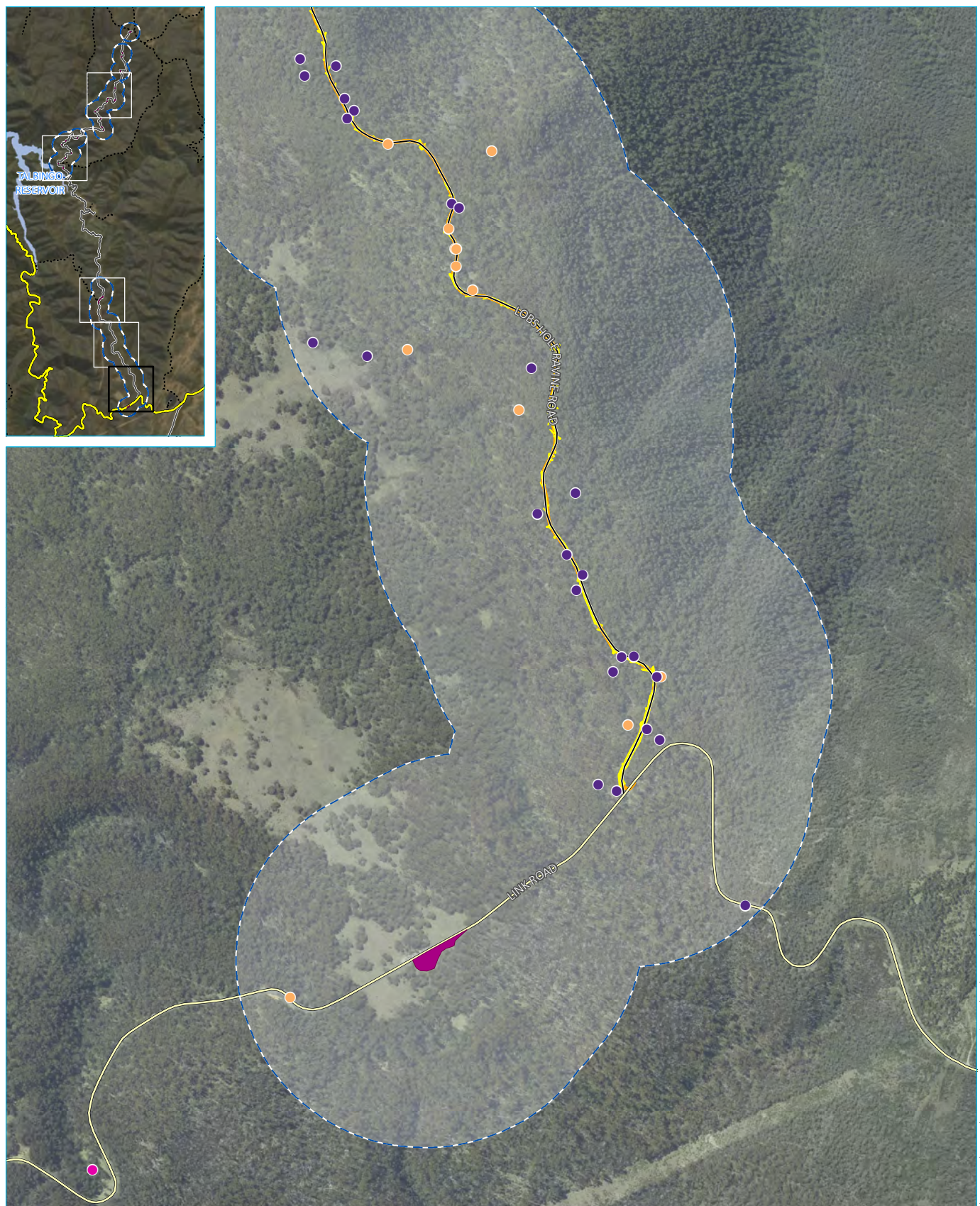
Threatened species

- Flame Robin
- Dusky Woodswallow
- Olive Whistler
- Gang-gang Cockatoo
- Gang-gang cockatoo breeding hollow

Diurnal bird survey results

Snowy 2.0
Biodiversity development assessment
Modification 2
6.2 e





Source: EMM (2019); Snowy Hydro (2019); PhotoMapping (2018); SMEC (2019); DFSI (2017); GA (2015); LPMA (2011)

KEY

- Main road
- Local road
- 500 m buffer
- Modification 2 disturbance footprint
- Disturbed area - LHRR south
- Vegetation trimming - LHRR south

Threatened species

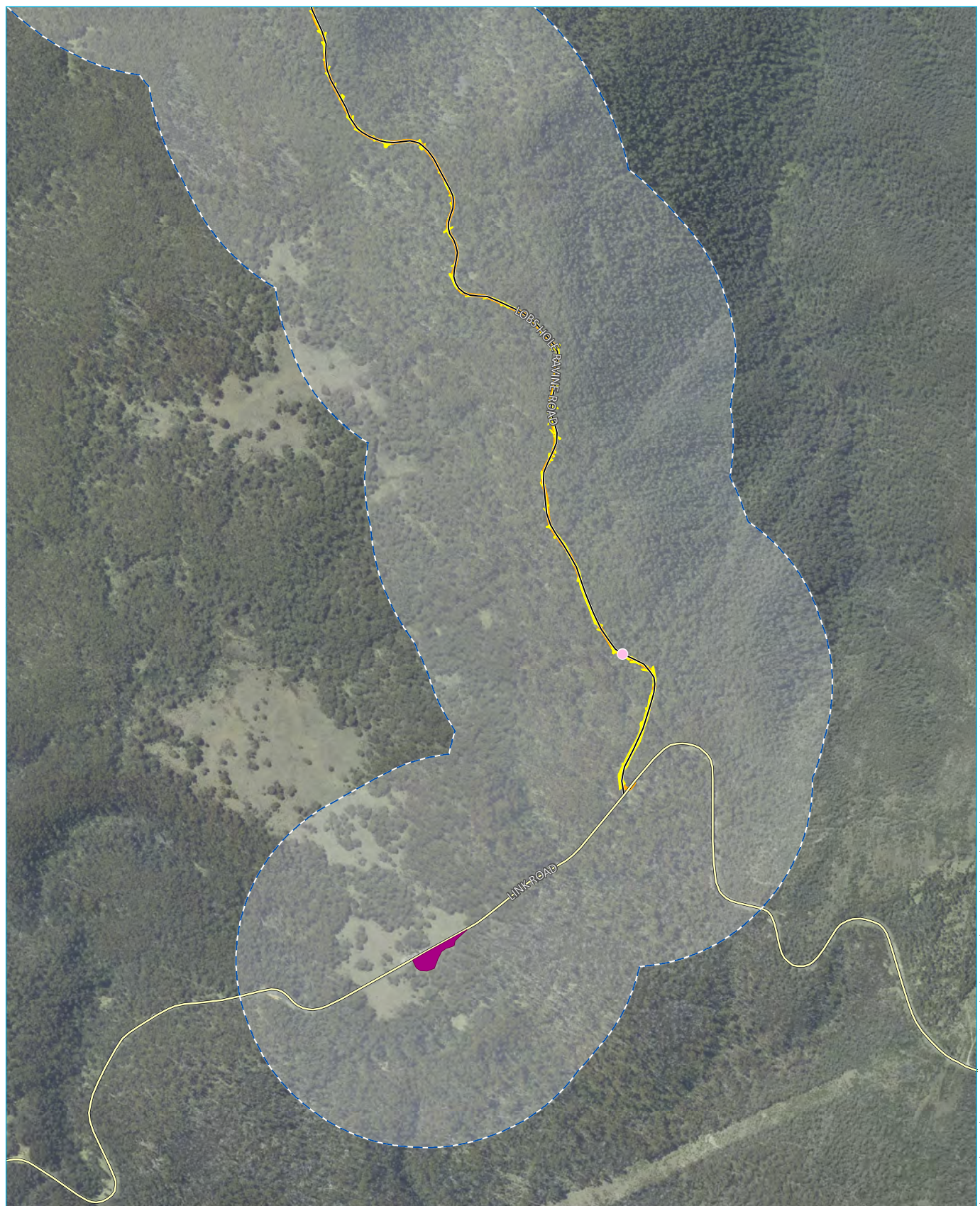
- Flame Robin
- Gang-gang Cockatoo
- Pink Robin

Diurnal bird survey results

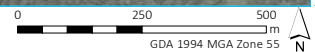
Snowy 2.0
Biodiversity development assessment
Modification 2
6.2 f



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Source: EMM (2019); Snowy Hydro (2019); PhotoMapping (2018); SMEC (2019); DFSI (2017); GA (2015); LPMA (2011)



KEY

- Main road
- Local road
- 500 m buffer
- Modification 2 disturbance footprint
- Disturbed area - LHRR south
- Vegetation trimming - LHRR south

Threatened species

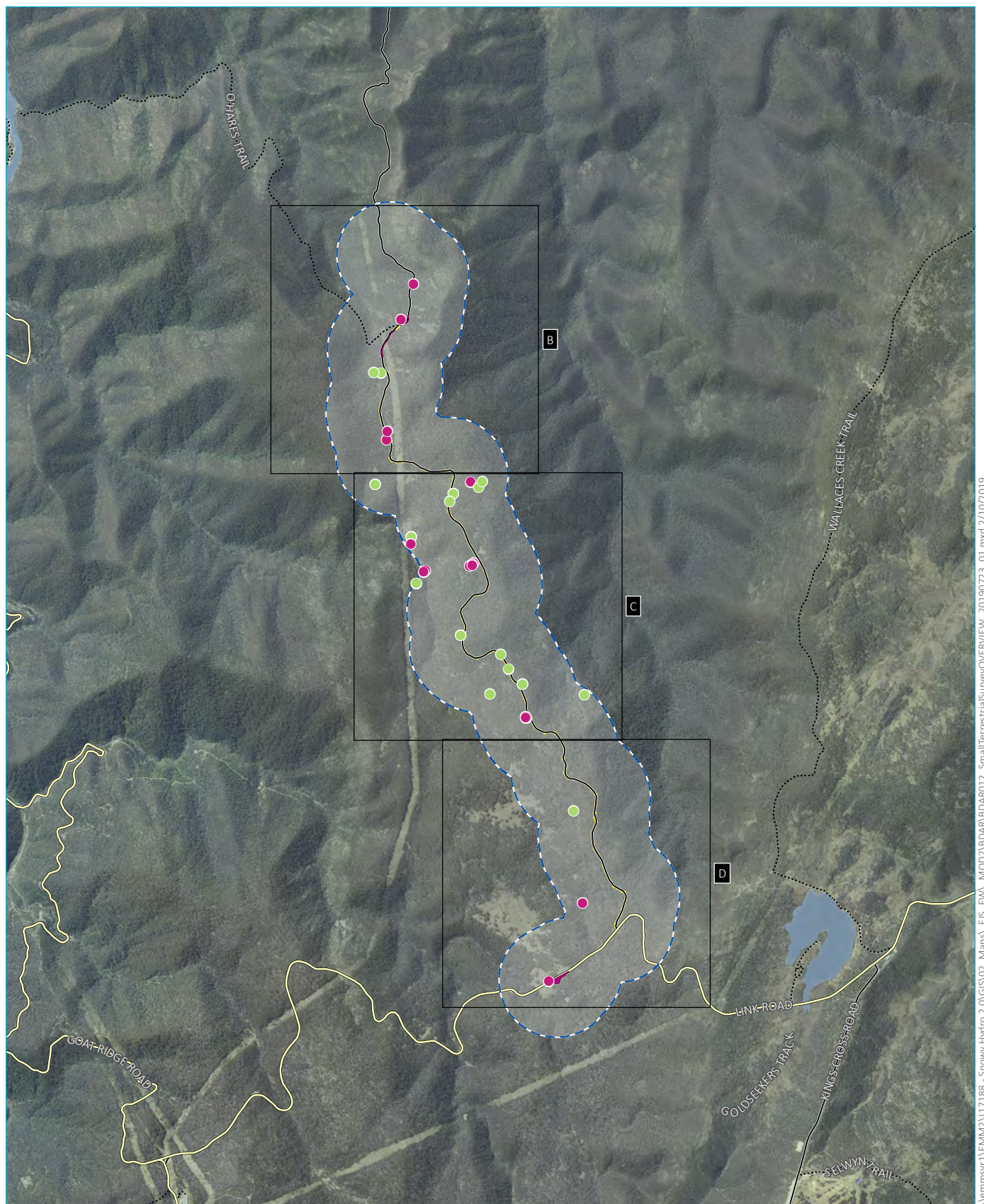
- Masked Owl

Nocturnal bird survey results

Snowy 2.0
Biodiversity development assessment
Modification 2
6.3



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Source: EMM (2019); Snowy Hydro (2019); PhotoMapping (2018); SMEC (2019); DFSI (2017); GA (2015); LPMA (2011)

KEY

- Main road
- Local road
- Vehicular track
- TerrestrialGridIndex_20190723
- Waterbody
- 500 m buffer
- Modification 2 disturbance footprint
- Disturbed area - LHRR south
- Vegetation trimming - LHRR south

Threatened species

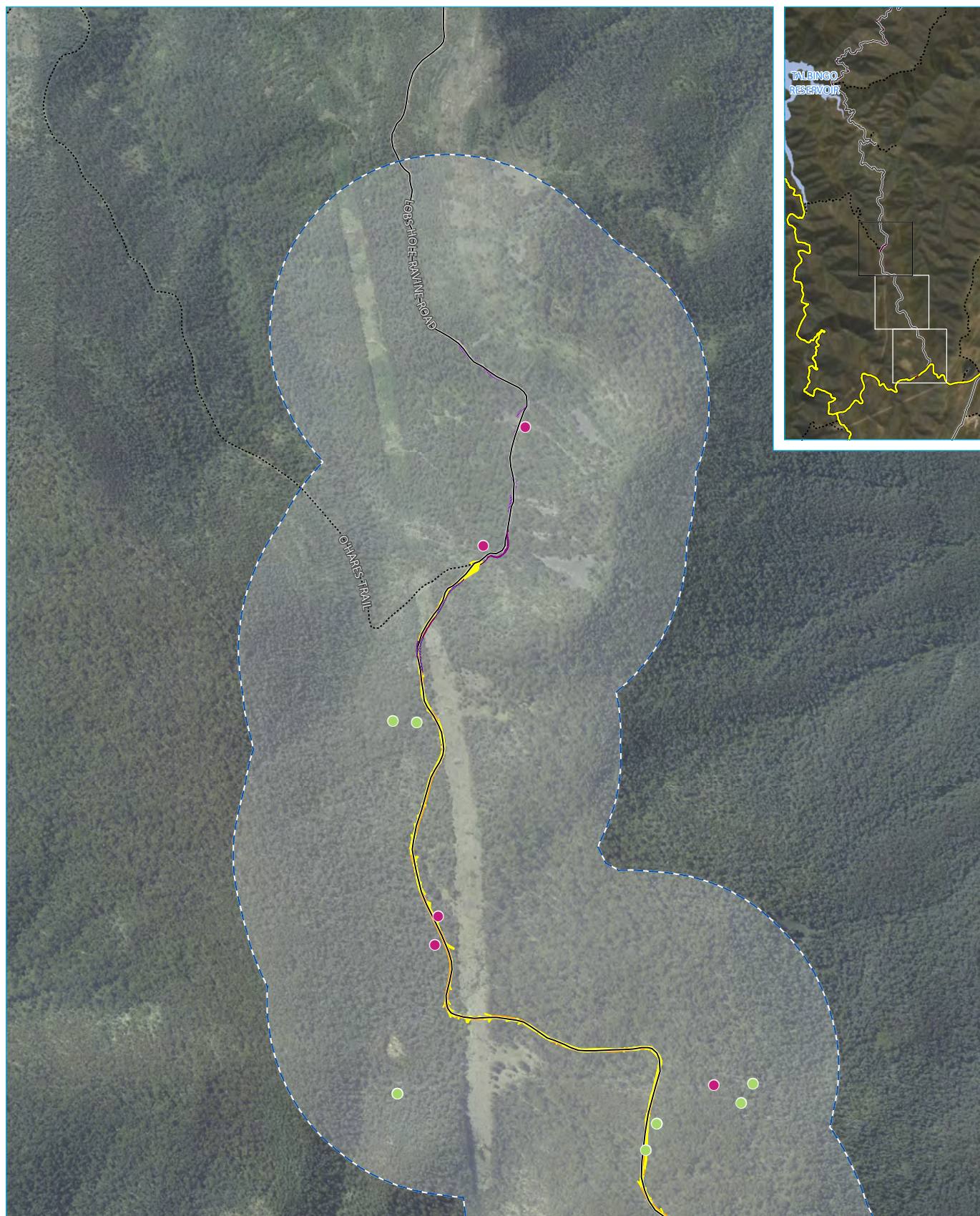
- Eastern Pygmy-possum
- Smoky Mouse

Small terrestrial mammal survey results - overview

Snowy 2.0
Biodiversity development assessment
Modification 2
6.4 a



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Source: EMM (2019); Snowy Hydro (2019); PhotoMapping (2018); SMEC (2019); DFSI (2017); GA (2015); LPMA (2011)

KEY

- Local road
- Vehicular track
- 500 m buffer
- Modification 2 disturbance footprint
- Disturbed area - LHRR south
- Vegetation trimming - LHRR south

- Smoky Mouse species polygon
- Eastern pygmy possum species polygon
- Threatened species
- Eastern Pygmy-possum
- Smoky Mouse

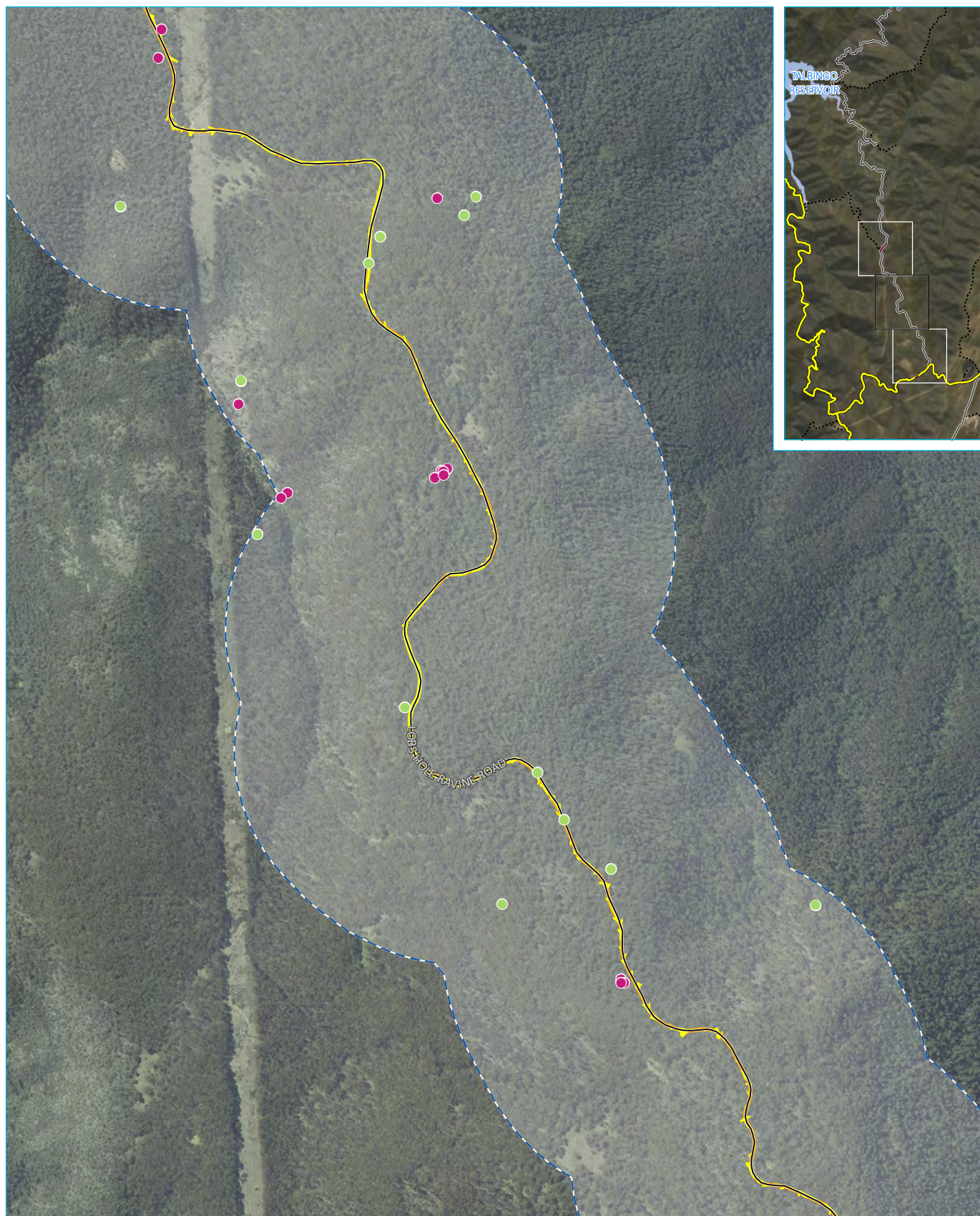
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Small terrestrial mammal survey results

Snowy 2.0
Biodiversity development assessment
Modification 2
6.4 b



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Source: EMM (2019); Snowy Hydro (2019); PhotoMapping (2018); SMEC (2019); DFSI (2017); GA (2015); LPMA (2011)

KEY

— Local road

500 m buffer

Disturbed area - LHRR south

Vegetation trimming - LHRR south

Threatened species

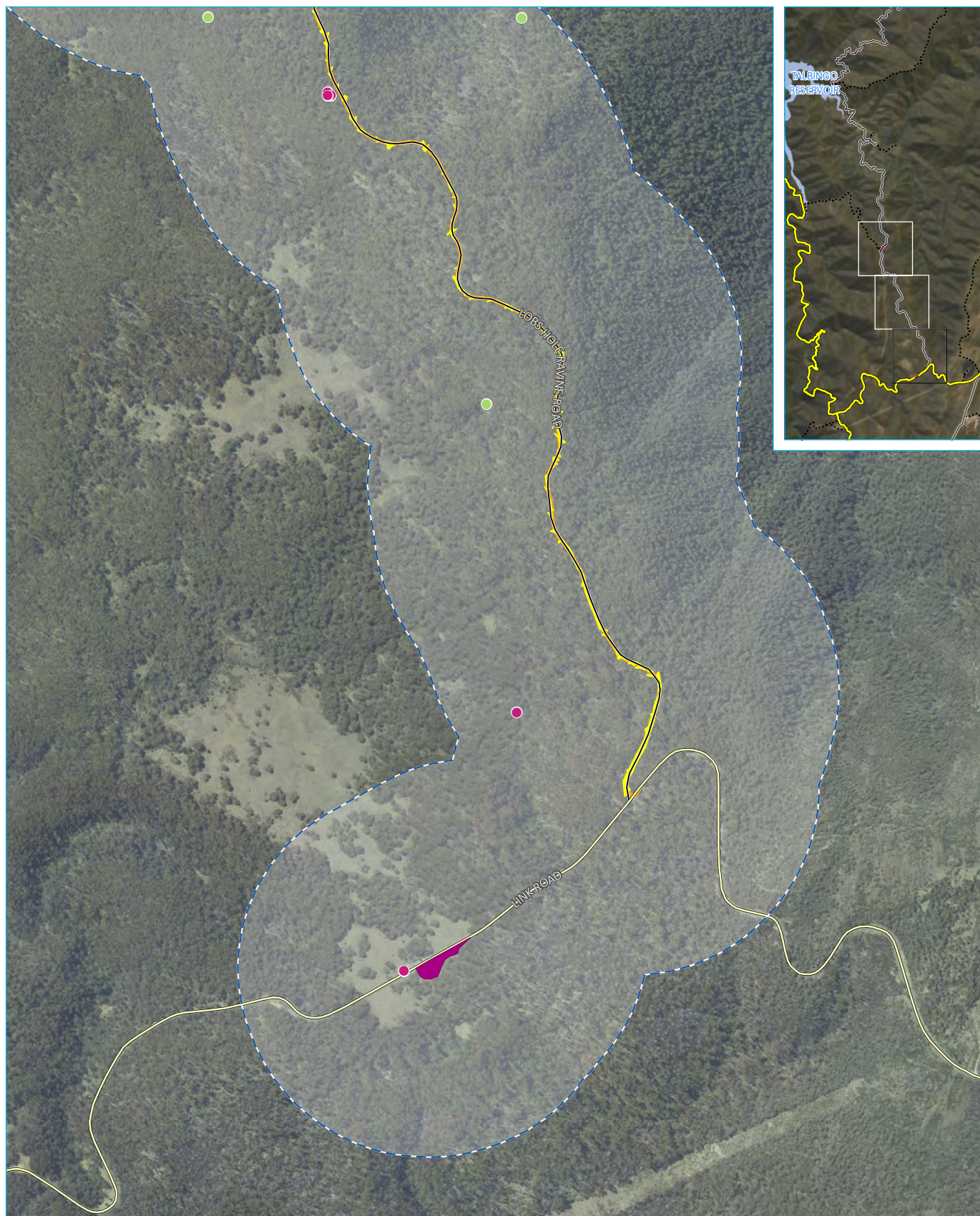
● Eastern Pygmy-possum

● Smoky Mouse

Small terrestrial mammal survey results

Snowy 2.0
Biodiversity development assessment
Modification 2
6.4 c





Source: EMM (2019); Snowy Hydro (2019); PhotoMapping (2018); SMEC (2019); DFSI (2017); GA (2015); LPMA (2011)

KEY

- Main road
- Local road
- 500 m buffer
- Modification 2 disturbance footprint
- Disturbed area - LHRR south
- Vegetation trimming - LHRR south
- Threatened species
 - Eastern Pygmy-possum
 - Smoky Mouse

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GDA 1994 MGA Zone 55

Small terrestrial mammal
survey results

Snowy 2.0
Biodiversity development assessment
Modification 2
6.4 d



6.3.5 Species credit species

A list of candidate species credit species predicted to occur within Modification 2, along with an assessment of whether the survey area provides suitable habitat, whether the species was recorded during targeted surveys and whether the species will be impacted by the modification is provided within

Based on targeted surveys, the following species will be impacted:

- Eastern Pygmy-possum – 0.93 ha; and
- Smoky Mouse – 0.06 ha.

These species will require offsets in accordance with the BAM (OEH 2017a). Species polygons across the survey area are shown in Figure 6.4.

Table 6.4 Species credit species, habitat suitability and targeted survey results

Scientific name	Common name	Biodiversity risk weighting	Habitat present within the disturbance footprint	Recorded during field surveys	Impacted by development	Justification
Flora						
<i>Pomaderris cotoneaster</i>	Cotoneaster Pomaderris	2.00	Yes. Predominantly riparian zones.	No	No	Not recorded during targeted surveys.
<i>Thesium australe</i>	Austral Toadflax	1.50	Yes. Upper sections of Lobs Hole Ravine Road in damp sections of PCT 1196.	No	No	Not recorded during targeted surveys.
Fauna						
<i>Callocephalon fimbriatum</i>	Gang-gang Cockatoo (Breeding)	2.00	Yes. Breeding habitat largely restricted to areas with suitably sized hollows in PCT 1196 along the upper section of Lobs Hole Ravine Road. Species forages more broadly across the survey area.	Yes	No	No breeding hollows were recorded within the disturbance footprint.
<i>Cercartetus nanus</i>	Eastern Pygmy-possum	2.00	Yes. Species occurs in a broad range of habitats within the survey area, usually associated with a dense midstorey and/or feed species such as Banksias.	Yes	Yes	PCTs 296, 300, 729, 953 and 1196 have been considered suitable habitat on the basis of suitably dense understorey habitat with flowering Banksias. PCTs in Derived Grassland condition classes were excluded as they do not provide a sufficiently dense understorey selected by the species.
<i>Ninox connivens</i>	Barking Owl (Breeding)	2.00	Yes. Suitable nesting habitat is limited to areas of mature trees adjacent to Talbingo Reservoir.	No	No	The Barking Owl is considered scarce at higher elevations of the tablelands (NPWS 2003). Given the species is known to respond strongly to call playback but was not recorded during targeted surveys it is considered unlikely to occur.

Table 6.4 Species credit species, habitat suitability and targeted survey results

Scientific name	Common name	Biodiversity risk weighting	Habitat present within the disturbance footprint	Recorded during field surveys	Impacted by development	Justification
<i>Petaurus norfolcensis</i>	Squirrel Glider	2.00	Yes. Suitable feed and nesting trees are limited to the habitat along the upper sections of Lobs Hole Ravine Road.	No	No	Not recorded during targeted surveys.
<i>Petroica rodinogaster</i>	Pink Robin	2.00	Yes. Tall, open eucalypt forest, particularly in densely vegetated gullies largely on upper sections of Lobs Hole Ravine Road and along the Yarrangobilly River.	No	No	Species was recorded adjacent to the disturbance boundary, along Link Road. The species was not recorded during targeted surveys within the project area and is not considered to be impacted by the development.
<i>Phascogale tapoatafa</i>	Brush-tailed Phascogale	2.00	Yes.	No	No	Not recorded during targeted surveys.
<i>Phascolarctos cinereus</i>	Koala (Breeding)	2.00	Yes. Scarce in the KNP, but potential to occur in Eucalypt forest and woodland below 800 m elevation.	No	No	Not recorded during targeted surveys.
<i>Pseudomys fumeus</i>	Smoky Mouse	3.00	Yes. Tall forests dominated by Mountain Gum and Snow Gum, with a moderate to dense shrubby midstorey dominated by shrubs from the plant family <i>Fabaceae</i> (with some <i>Epacridaceae</i> and <i>Mimosaceae</i>), and dense groundcover with abundant sub-shrubs, logs and leaf litter.	Yes	Yes	Species was recorded within PCTs 729, 953 and 1196 above 1,000m altitude, not within Derived Grassland condition classes.

Table 6.4 Species credit species, habitat suitability and targeted survey results

Scientific name	Common name	Biodiversity risk weighting	Habitat present within the disturbance footprint	Recorded during field surveys	Impacted by development	Justification
<i>Tyto novaehollandiae</i>	Masked Owl (Breeding)	2.00	Yes. Breeding habitat containing suitable hollows limited to PCT 1196 along Lobs Hole Ravine Road.	Yes	No	Species was recorded within the disturbance boundary as a result of call playback. However, no nesting hollows were identified during surveys, therefore no breeding species will be impacted by development.

Part B

Stage 2: Impact Assessment

7 Impact assessment (biodiversity values)

This chapter identifies the potential impacts of Exploratory Works, including Modification 2, on the biodiversity values identified above. Measures taken to date to avoid and minimise impacts are summarised and recommendations to assist in the design and development that further avoids, minimises and mitigates impacts are provided below.

7.1 Potential direct, indirect and prescribed impacts

The potential impacts arising from Modification 2 will remain consistent with those outlined in the Exploratory Works BDAR (EMM 2018d) and the Exploratory Works Modification 1 BDAR (EMM 2019b). These impacts are not discussed in detail in this report. Please refer to EMM (2018d) and EMM (2019b) for detailed information on potential direct, indirect and prescribed impacts.

The main direct impacts of Modification 2 will be associated with clearing of native vegetation communities and loss of species habitat.

7.2 Measures to avoid, minimise and mitigate impacts

Snowy Hydro, in consultation with EMM and the design team (SMEC) and construction contractor (Future Generation Joint Venture, FGJV) have undertaken significant steps to avoid, minimise and mitigate impacts.

A key focus of project design for Modification 2 has been to avoid and minimise impacts to biodiversity values identified during the field surveys. In recognition of the location of the Exploratory Works in the KNP, and associated biodiversity and other values of the Park, the project has undergone significant steps to avoid, minimise and mitigate impacts. The process below has been followed to ensure impacts are avoided and minimised to the greatest extent possible, within the design and other limitations of Modification 2:

- identification of biodiversity values through comprehensive, rigorous and thorough biodiversity surveys;
- communication of identified values to the project team, including Snowy Hydro and the design team;
- consultation between the design team and project ecologists on various elements to consider both direct and indirect impacts and work through an iterative design process, with multiple iterations of design elements to achieve best practice outcomes;
- consultation with key government stakeholders, including the BCD at DPIE, NPWS and DoEE, including species experts and accountable officers, to seek input and discuss measures proposed to avoid, minimise and mitigate impacts;
- feedback of consultation into the design process; and
- finalisation of measures to avoid, minimise and mitigate impacts.

Measures undertaken to avoid, minimise and mitigate impacts that have arisen during the process outlined above are discussed below for each project element.

7.2.1 Tunnel boring machine method

The proposed method for the exploratory tunnelling will be to revise from drill and blast method to TBM. The TBM method will not have any additional impacts to terrestrial ecology with the main impact occurring underground.

7.2.2 Road upgrades

Road upgrades are required for the transportation of the TBM equipment and materials. Upgrades to accommodate the TBM will be completed along Link Road and Lobs Hole Ravine Road South. During detailed design of road upgrades minor revisions to the road have occurred to avoid and minimise impacts on threatened species, including the Gang-gang Cockatoo and Smoky Mouse.

Particular consideration was undertaken during the design of the Link Road turnaround to avoid any impact to Smoky Mouse habitat. The disturbance footprint has been restricted to partially cleared area, avoiding direct impact on hollow bearing trees and preferred habitat for the Smoky Mouse. The removal of vegetation along Lobs Hole Ravine Road South has largely been restricted to trimming to avoid direct impacts to Smoky Mouse habitat. However, some areas will result in the total removal of vegetation. These areas will be offset accordance with the biodiversity offset framework, as outlined in EMM (2018d).

Road widening and maintenance along Lobs Hole Ravine Road North are required to provide an alternate access to Lobs Hole and improve emergency access. Road works will include road upgrades and widening to include passing bay sections. Regular road maintenance will be undertaken to maintain suitable access. Review of road design identified the potential Smoky Mouse habitat. Passing bays within these areas were relocated under powerline easements and within areas of Derived Grassland to avoid potential Smoky Mouse habitat.

Vegetation clearing works will be undertaken in accordance with the Exploratory Works Biodiversity Management Plan (EMM 2019a), including staged clearing – see EMM (2019a) for further detail. Further targeted surveys will be undertaken in areas not surveyed, with additional offset requirements calculated should threatened species be recorded.

7.2.3 Power supply

Additional power supply is required for the TBM for the Exploratory Works. Diesel generators have been designed to sit within the portal construction pad, approved within the Exploratory Works. This addition to the Exploratory Works will not result in any additional impacts to terrestrial ecology.

7.2.4 Transport strategy

A key design change within Modification 2 includes the transport of all machinery, equipment and materials through Lobs Hole Ravine Road. The revised transport strategy is not expected to change traffic volumes required for the Exploratory Works. Mitigation measures outlined in the BMP (EMM 2019a) will continue to be implemented to reduce the potential of vehicle strike on Smoky Mouse.

7.2.5 Middle Bay barge ramp

The location of the Middle Bay barge ramp is proposed to move the west of the existing barge ramp location. Through detailed design the barge ramp will be within the approved disturbance footprint for the Exploratory Works, therefore no additional impacts will occur on aquatic EPBC listed species such as the Macquarie Perch and Trout Cod. Adjacent areas of vegetation used in association with the barge ramp have previously been approved within the Exploratory Works EIS (EMM 2018a). A key benefit of the new barge ramp location is that the dredging requirement will be minimised as part of the construction design.

7.2.6 Accommodation camp

Additional accommodation will be required to accommodate up to 250 personnel. The accommodation units have been designed to minimise additional disturbance through a vertical expansion of the camp using stackable units. This design process has avoided any additional removal of vegetation and the disturbance of adjacent vegetation. The increase in personnel within the accommodation camp will not result in any additional impacts to terrestrial ecology, as previously assessed within the Exploratory Works (EMM 2018d). Mitigations and controls to reduce any minor indirect impacts including changes to runoff and increase in the activity of predators will continue to be implemented (EMM 2018d). The rehabilitation strategy implemented within the Exploratory Works will additionally be continued post construction period (EMM 2018d).

7.3 Impact summary

7.3.1 Summary of measures to avoid, minimise and mitigate impacts

A summary of impacts arising from Modification 2, and measures to avoid, minimised and mitigate impacts, is provided in Table 7.2.

Table 7.1 **Summary of impacts, and measures to avoid, minimise and mitigate these impacts**

Project element	Impact	Impact avoidance	Impact minimisation	Impact mitigation
Road upgrades – Link Road turnaround	<p><i>Removal of native vegetation and threatened species habitat.</i></p> <p>Type: direct impact.</p> <p>Frequency: once, during construction.</p> <p>Intensity: up to 0.45 ha of native vegetation removal.</p> <p>Duration: initial stages of construction.</p> <p>Consequence: potential impacts to native vegetation and fauna habitat.</p>	<ul style="list-style-type: none"> • Restriction of native vegetation removal to Derived Grassland, avoiding potential Smoky Mouse habitat. 	<ul style="list-style-type: none"> • Restriction of native vegetation removal to the minimal amount required for the TBM load to turn around. 	<ul style="list-style-type: none"> • Pre-clearing process.
	<p><i>Introduction of weeds and pathogens into the works area.</i></p> <p>Type: indirect impact.</p> <p>Frequency: potential for daily impacts.</p> <p>Intensity: unknown.</p> <p>Duration: ongoing through construction phase.</p> <p>Consequence: potential to impact on threatened species, resulting in decline in habitat quality.</p>	<ul style="list-style-type: none"> • Not required. 	<ul style="list-style-type: none"> • Construction of wash-down stations at a suitable location. • Washdown required for weeds as well as <i>P.cimmamomi</i>. 	<ul style="list-style-type: none"> • Implementation of a weed and pathogen monitoring program.
Road upgrades – Lobs Hole Ravine Road (south)	<p><i>Trimming of native vegetation, and selective tree lopping and removal.</i></p> <p>Type: indirect impact.</p> <p>Frequency: once, during construction.</p> <p>Intensity: native vegetation above 1.1 m from the ground across 0.38 ha.</p> <p>Duration: initial stages of construction.</p> <p>Consequence: potential impacts to native vegetation and fauna habitat.</p>	<ul style="list-style-type: none"> • Retention of trees wherever possible. 	<ul style="list-style-type: none"> • Restriction of native vegetation trimming to above 1.1 m in height; avoiding direct impacts to Smoky Mouse habitat. • Using the existing track and restricting the removal of vegetation to areas where the track is not wide enough. 	<ul style="list-style-type: none"> • Tree lopping to be undertaken with pre-clearance and clearing procedures. • Hollow bearing limbs and sections of trunk to be retained in adjacent areas as habitat.

Table 7.1 Summary of impacts, and measures to avoid, minimise and mitigate these impacts

Project element	Impact	Impact avoidance	Impact minimisation	Impact mitigation
	<p><i>Removal of vegetation and threatened species habitat.</i></p> <p>Type: direct impact.</p> <p>Frequency: once, during construction.</p> <p>Intensity: up to 0.10 ha of native vegetation removal.</p> <p>Duration: initial stages of construction.</p> <p>Consequence: potential impacts to native vegetation and fauna habitat, including 0.06 ha of Smoky Mouse habitat and 0.93 ha of Eastern Pygmy -possum habitat.</p>	<ul style="list-style-type: none"> • Not required. 	<ul style="list-style-type: none"> • Using the existing track and restriction of the removal of vegetation to areas where the track is not wide enough. 	<ul style="list-style-type: none"> • Pre-clearing process. • Smoky Mouse monitoring program.
	<p><i>Introduction of weeds and pathogens into the works area.</i></p> <p>Type: indirect impact.</p> <p>Frequency: potential for daily impacts.</p> <p>Intensity: unknown.</p> <p>Duration: ongoing through construction phase.</p> <p>Consequence: potential to impact on threatened species, resulting in decline in habitat quality.</p>	<ul style="list-style-type: none"> • Not required 	<ul style="list-style-type: none"> • Washdown required for weeds as well as <i>P.cimmamomi</i>. • Wash-down of all vehicles will be completed prior to movement from Link Road to Lobs Hole Ravine and vice versa. 	<ul style="list-style-type: none"> • Implementation of a weed and pathogen monitoring program. • Implementation of a weed control program if weeds are identified along road verges.

Table 7.1 Summary of impacts, and measures to avoid, minimise and mitigate these impacts

Project element	Impact	Impact avoidance	Impact minimisation	Impact mitigation
Road upgrades – Lobs Hole Ravine Road (north)	<p><i>Removal of vegetation and threatened species habitat.</i></p> <p>Type: direct impact.</p> <p>Frequency: once, during construction.</p> <p>Intensity: up to 1.07 ha of native vegetation removal.</p> <p>Duration: initial stages of construction.</p> <p>Consequence: potential impacts to native vegetation and fauna habitat, including 0.84 ha of Eastern Pygmy-possum habitat.</p>	<ul style="list-style-type: none"> Turning bays within Smoky Mouse habitat were moved to Derived Grassland areas. 	<ul style="list-style-type: none"> Using the existing track and restriction of the removal of vegetation to necessary turning bays. 	<ul style="list-style-type: none"> Pre-clearing process including searches for threatened flora species and breeding hollows.
	<p><i>Introduction of weeds and pathogens into the works area.</i></p> <p>Type: indirect impact.</p> <p>Frequency: potential for daily impacts.</p> <p>Intensity: unknown.</p> <p>Duration: ongoing through construction phase.</p> <p>Consequence: potential to impact on threatened species, resulting in decline in habitat quality.</p>	<ul style="list-style-type: none"> Not required 	<ul style="list-style-type: none"> Construction of wash-down stations at a suitable location. Wash-down of all vehicles will be completed prior to movement from Snowy Mountains Highway to Lobs Hole Ravine and vice versa. 	<ul style="list-style-type: none"> Implementation of a weed and pathogen monitoring program. Implementation of a weed control program if weeds are identified along road verges.

7.3.2 Serious and irreversibly impacts (SAIL)

The Smoky Mouse is identified as a candidate species for serious and irreversible impacts (SAIL). The SAIL threshold for Smoky Mouse is identified as the Threatened Biodiversity Data Collection (TBDC) as “mapped important areas”. Given the population that has been identified regionally (see below) this area would be considered important to the conservation of the species.

Impacts to 0.06 ha of Smoky Mouse habitat will result from the Exploratory Works Modification 2 and is identified as SAIL. Significant design works have been undertaken to avoid impacts to Smoky Mouse habitat, as outlined in Section 7.2 and summarised in Table 7.2. This work has been undertaken in consultation with key staff from BCD of DPIE, NPWS and DoEE.

The size of the local population of Smoky Mouse is unknown. The species was recorded at 11 locations along the upper section of Lobs Hole Ravine Road to around 1, 100 m elevation in 2017/18. Regional surveys undertaken in 2018/19 across 66 sites have recorded the Smoky Mouse at 40 locations. These surveys have demonstrated that the population found within Modification 2 is part of an extensive population in this southern section of KNP, ranging from Coppermine Firetrail in the north, to Wallace’s Creek Firetrail in the east, Link Road in the south and close to the Tumut River in the west. The species is likely to have a sporadic but extensive distribution within this area.

Given the controls put in place it is expected that the impacts to Smoky Mouse will be minimal. The Exploratory Works project, including the original approval plus Modification 1 and 2, will result in a cumulative impact to 1.86 ha of habitat. Controls put in place to avoid, minimise and mitigate indirect impacts from fauna vehicle strike, weeds and pathogens are expected to ensure negligible impacts to key habitat required for the species lifecycle, including breeding habitat, foraging and dispersal. No fragmentation will occur.

The relationship of this population to other populations is unknown. The nearest live records to survey area are from an artificial boulderfield constructed on an old rock stockpile at Happy Jacks dating to 2015.

The species is also well-represented as subfossil remains in the pellets at roost sites of the Sooty Owl (*Tyto tenebricosa*) at Yarrangobilly Caves (Ford 1998), and three Smoky Mouse were found deceased at Yarrangobilly Caves, suspected cat kills. Several recent remains (estimated between one and three years old) have also been identified amongst hundreds of small mammals remains at Sooty Owl roosts currently in use in this cave system (R. Bilney, Forestry Corporation, pers comm. March 2018, cited in Schulz (2018). This suggest a population occurs within the foraging range of the Sooty Owl (200-1000 ha, DEC 2006b). However, recent surveys in this area have failed to re-locate the species (Schulz and Broome 2018). If this species is extent in this area, there is potential that the regional population outlined above.

7.3.3 Impacts requiring offsets

This section provides an assessment of the impacts requiring offsetting in accordance with Section 10 of the BAM (OEH 2017a).

i Impacts on native vegetation

Impacts to native vegetation requiring offsets include:

- direct impacts on 0.56 ha of PCT 296 – Brittle Gum – Peppermint open forest of the Woomargama to Tumut region, NSW South Western Slopes Bioregion;
- direct impacts on 0.28 ha of PCT 300 – Ribbon Gum - Narrow-leaved (Robertsons) Peppermint montane fern - grass tall open forest on deep clay loam soils in the upper NSW South Western Slopes Bioregion and western Kosciuszko escarpment;

- direct impacts on 0.13 ha of PCT 729 – Broad-leaved Peppermint - Candlebark shrubby open forest of montane areas, southern South Eastern Highlands Bioregion and South East Corner Bioregion;
- direct impacts on 0.13 ha of PCT 953 – Mountain Gum - Snow Gum - Broad-leaved Peppermint shrubby open forest of montane ranges, South Eastern Highlands Bioregion and Australian Alps Bioregion;
- direct impacts on 0.07 ha of PCT 1191 – Snow Gum - Candle Bark woodland on broad valley flats of the tablelands and slopes, South Eastern Highlands Bioregion; and
- direct impacts on 0.45 ha of PCT 1196 – Snow Gum - Mountain Gum shrubby open forest of montane areas, South Eastern Highlands Bioregion and Australian Alps Bioregion.

A summary of ecosystem credits required for all vegetation zones, including changes in vegetation integrity score, are provided in Table 7.2. A total of 36 ecosystem credits are required to offsets the residual impacts of the Exploratory Works Modification 2. A credit report is provided in Appendix C.

Table 7.2 Summary of ecosystem credits required for impacts to all vegetation zones for the Modification 2

Vegetation zone number	PCT	Vegetation zone name	Area (ha)	Vegetation integrity score	Future vegetation integrity score	Change in vegetation integrity score	Credits required
1	PCT 296 – Brittle Gum – Peppermint open forest of the Woomargama to Tumut region, NSW South Western Slopes Bioregion	296_DNG	0.10	41.2	0	-41.2	2
2	PCT 296 – Brittle Gum – Peppermint open forest of the Woomargama to Tumut region, NSW South Western Slopes Bioregion	296_High	0.46	55.3	0	-55.3	10
3	PCT 300 – Ribbon Gum - Narrow-leaved (Robertsons) Peppermint montane fern - grass tall open forest on deep clay loam soils in the upper NSW South Western Slopes Bioregion and western Kosciuszko escarpment	300_Medium	0.20	56	0	-56	4
4	PCT 300 – Ribbon Gum - Narrow-leaved (Robertsons) Peppermint montane fern - grass tall open forest on deep clay loam soils in the upper NSW South Western Slopes Bioregion and western Kosciuszko escarpment	300_High	0.08	56.8	0	-56.8	2
5	PCT 729 - Broad-leaved Peppermint - Candlebark shrubby open forest of montane areas, southern South Eastern Highlands Bioregion and South East Corner Bioregion	729_High	0.13	71.9	0	-71.9	4
6	PCT 953 – Mountain Gum - Snow Gum - Broad-leaved Peppermint shrubby open forest of montane ranges, South Eastern Highlands Bioregion and Australian Alps Bioregion	953_DNG	0.07	36.7	0	-36.7	1
7	PCT 953 – Mountain Gum - Snow Gum - Broad-leaved Peppermint shrubby open forest of montane ranges, South Eastern Highlands Bioregion and Australian Alps Bioregion	953_High	0.06	79	0	-79	2
8	PCT 1191 – Snow Gum - Candle Bark woodland on broad valley flats of the tablelands and slopes, South Eastern Highlands Bioregion	1191_High	0.07	85.3	0	-85.3	4
9	PCT 1196 - Snow Gum - Mountain Gum shrubby open forest of montane areas, South Eastern Highlands Bioregion and Australian Alps Bioregion	1196_DNG	0.45	41.1	0	-41.1	7
TOTAL			1.62				36

Offsets will be provided in accordance with the biodiversity offset framework outlined in Section 7.4.

ii [Impacts on threatened species](#)

Impacts to threatened species habitat requiring offsets include:

- direct impacts on 0.93 ha of habitat for the Eastern Pygmy-possum; and
- direct impacts on 0.06 ha of habitat for the Smoky Mouse.

A summary of the species credits required for all vegetation zones occupied by the threatened species, including changes in vegetation integrity score, are provided in Table 7.3. A total of 32 species credits are required to offset the residual impacts of Modification 2. A credit report is provided in Appendix C.

Offsets will be provided in accordance with the biodiversity offset framework outlined in Section 7.4.

Table 7.3 **Summary of threatened species credit required for Modification 2**

Species	Vegetation zone name	Area (ha)/individual (HL)	Habitat condition	Future habitat condition	Loss of habitat condition	Candidate SAIL	Species credits
Eastern Pygmy-possum	296_High	0.46	55.3	0	-55.3	No	13
Eastern Pygmy-possum	300_High	0.08	56.8	0	-56.8	No	2
Eastern Pygmy-possum	300_Medium	0.2	56	0	-56	No	6
Eastern Pygmy-possum	729_High	0.13	71.9	0	-71.9	No	5
Eastern Pygmy-possum	953_High	0.06	79	0	-79	No	2
Smoky Mouse	953_High	0.06	79	0	-79	Yes	4
TOTAL		0.99					32

7.3.4 Impacts not requiring offsets

Additional areas not requiring assessment in accordance with Section 10.4 of the BAM (OEH 2017a) include:

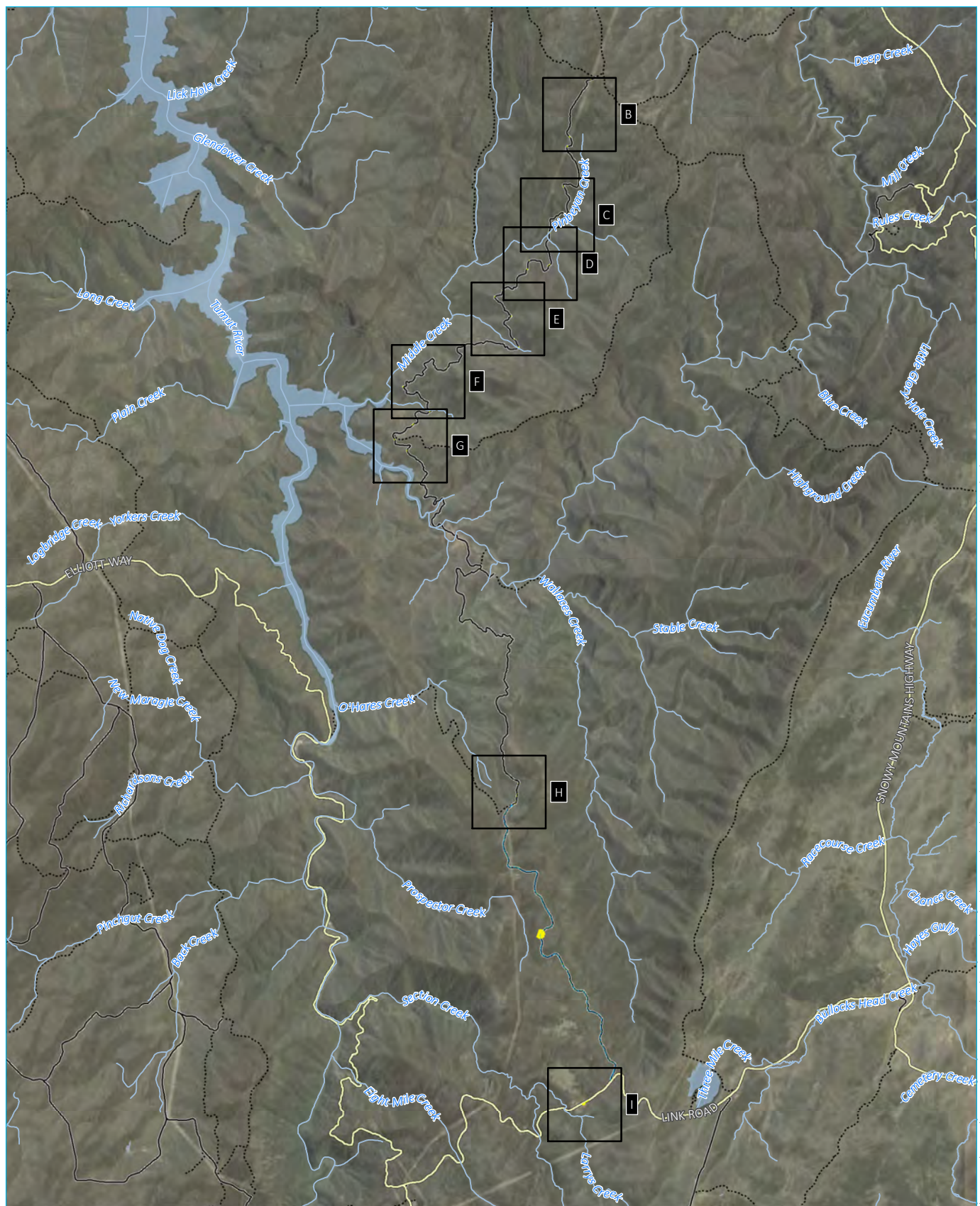
- trimming of native vegetation to 1.1m;
- existing roads;
- cleared and highly disturbed land; and
- watercourses.

As vegetation trimming along Lobs Hole Ravine Road North will not result in any notable impacts to native vegetation or threatened species habitat, impacts will be short-term and vegetation will be able to naturally regenerate no offsets have been determined for this component of the project.

7.4 Biodiversity offset framework

Significant and extensive consultation has been undertaken with NPWS, BCD of DPIE and DoEE regarding the biodiversity offset for Snowy 2.0, including for this Exploratory Works modification. Throughout this consultation process, the objective of the offset framework has been to ensure any offsets achieve best value for the management of biodiversity values in KNP from offset payments from Snowy 2.0.

The offsets delivered for this Exploratory Works Modification 2 will be consistent with those delivered for Exploratory Works, with Snowy Hydro to make payment to NPWS, in line with the Exploratory Works biodiversity offset strategy (EMM 2018g), for in-Park conservation measures to be implemented.



Source: EMM (2019); Snowy Hydro (2019); PhotoMapping (2018); SMEC (2019); DFSI (2017); GA (2015); LPMA (2011)

KEY

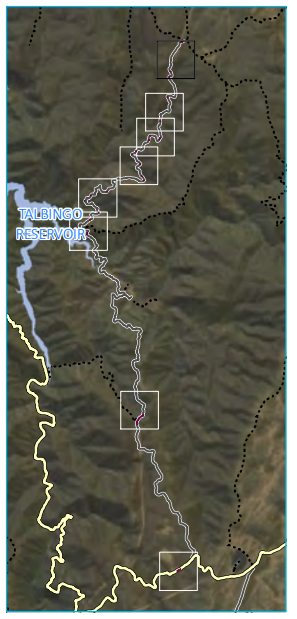
- Main road
- Local road
- Vehicular track
- Waterbody
- Watercourse/drainage line
- Serious and irreversible impacts
- Impacts requiring offsets
- Impacts not requiring offsets
- Areas not requiring assessment

Serious and irreversible impacts, impacts requiring offsets, impacts not requiring offsets and areas not requiring assessment - Overview

Snowy 2.0
Biodiversity development assessment
Modification 2
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Source: EMM (2019); Snowy Hydro (2019); PhotoMapping (2018); SMEC (2019); DFSI (2017); GA (2015); LPMA (2011)

KEY

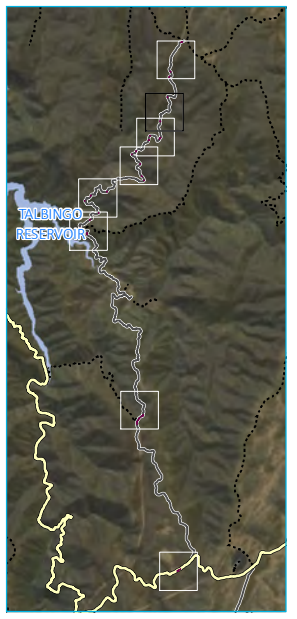
- Local road
- Vehicular track
- Impacts requiring offsets

Serious and irreversible impacts, impacts requiring offsets, impacts not requiring offsets and areas not requiring assessment

Snowy 2.0
Biodiversity development assessment
Modification 2
7.1 b



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Source: EMM (2019); Snowy Hydro (2019); PhotoMapping (2018); SMEC (2019); DFSI (2017); GA (2015); LPMA (2011)

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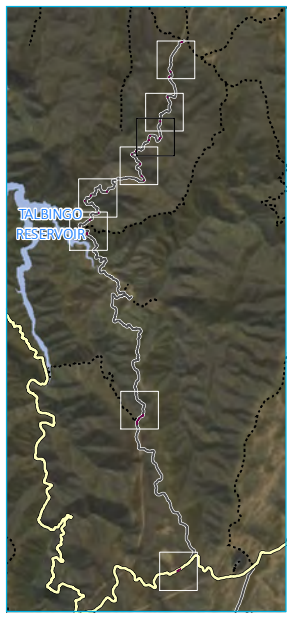
- Local road
- Impacts requiring offsets

Serious and irreversible impacts, impacts requiring offsets, impacts not requiring offsets and areas not requiring assessment

Snowy 2.0
Biodiversity development assessment
Modification 2
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Source: EMM (2019); Snowy Hydro (2019); PhotoMapping (2018); SMEC (2019); DFSI (2017); GA (2015); LPMA (2011)

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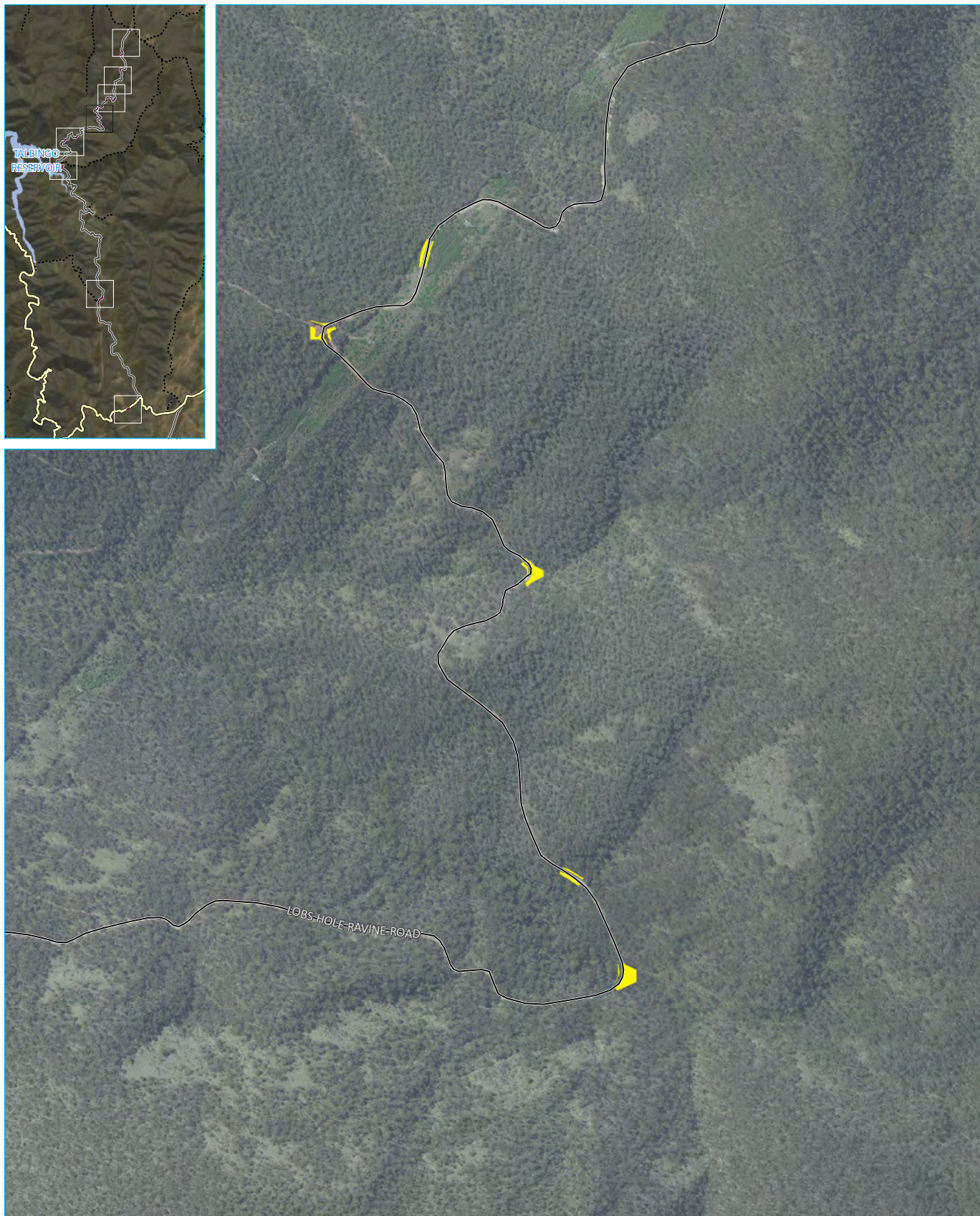
- Local road
- Impacts requiring offsets

Serious and irreversible impacts, impacts requiring offsets, impacts not requiring offsets and areas not requiring assessment

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Biodiversity development assessment
Modification 2
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Source: EMM (2019); Snowy Hydro (2019); PhotoMapping (2018); SMEC (2019); DFSI (2017); GA (2015); LPMA (2011)

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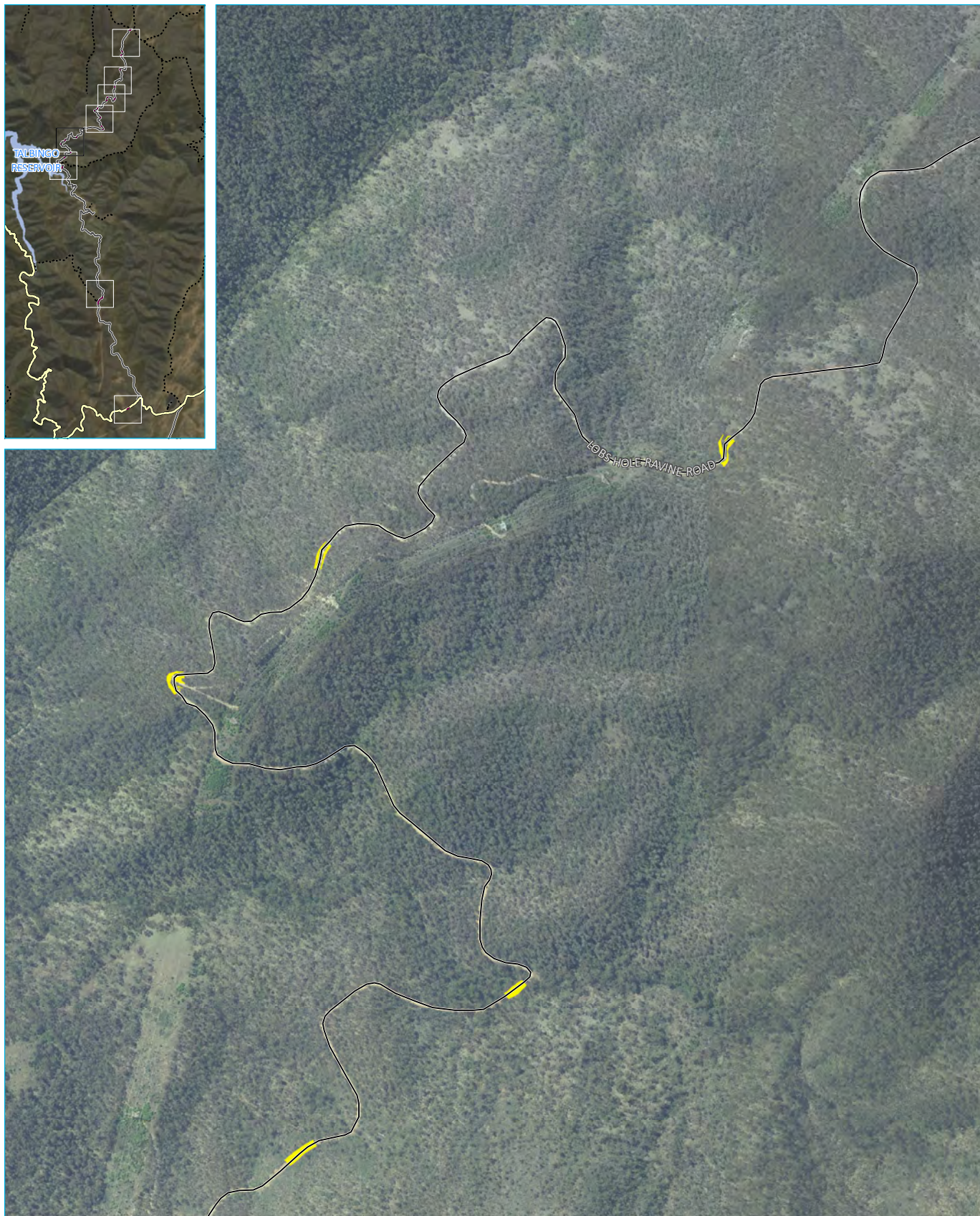
- Local road
- Impacts requiring offsets

Serious and irreversible impacts, impacts requiring offsets, impacts not requiring offsets and areas not requiring assessment

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Biodiversity development assessment
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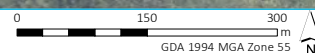
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Source: EMM (2019); Snowy Hydro (2019); PhotoMapping (2018); SMEC (2019); DFSI (2017); GA (2015); LPMA (2011)

KEY

- Local road
- Impacts requiring offsets

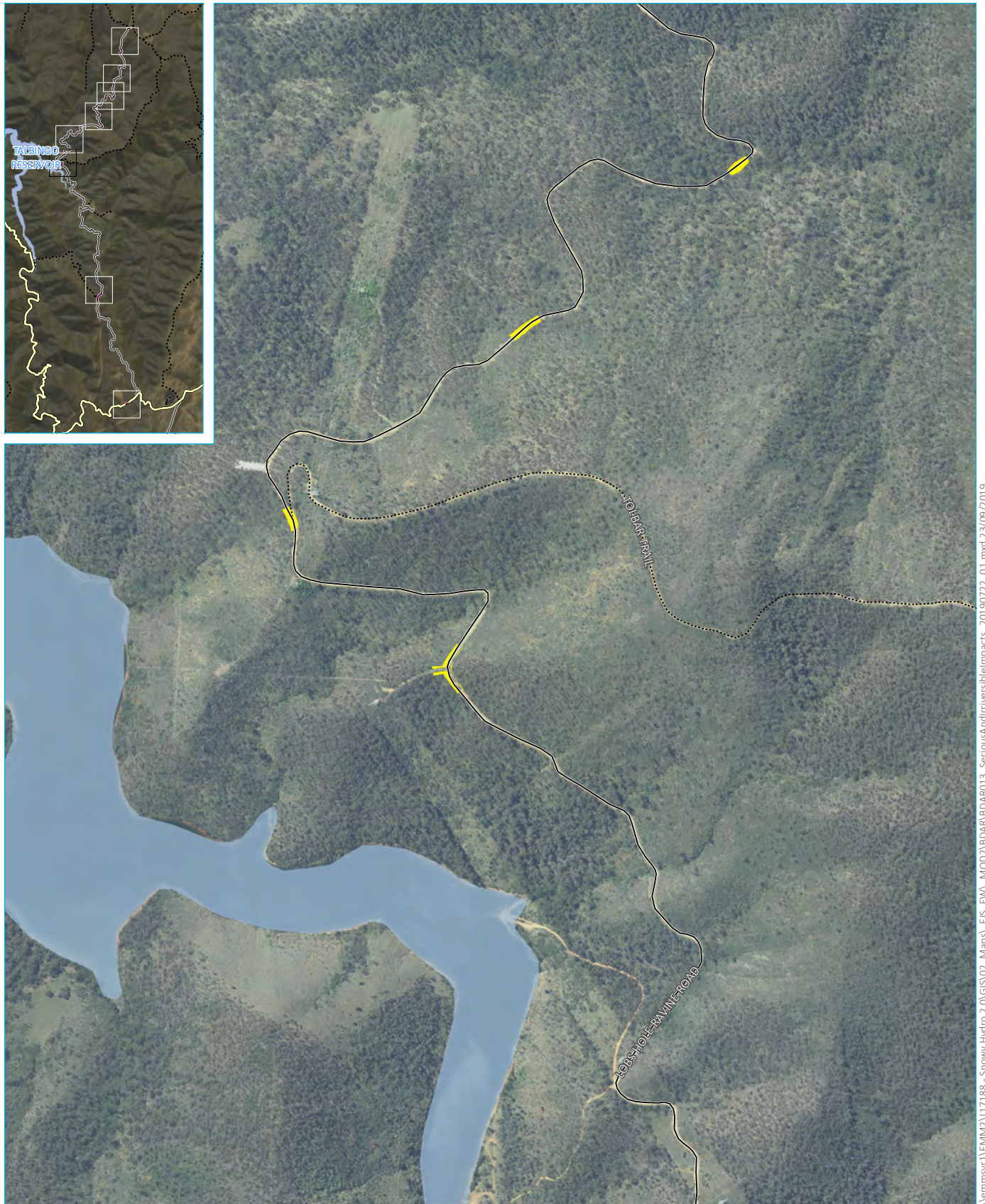


Serious and irreversible impacts, impacts requiring offsets, impacts not requiring offsets and areas not requiring assessment

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Biodiversity development assessment
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Source: EMM (2019); Snowy Hydro (2019); PhotoMapping (2018); SMEC (2019); DFSI (2017); GA (2015); LPMA (2011)

KEY

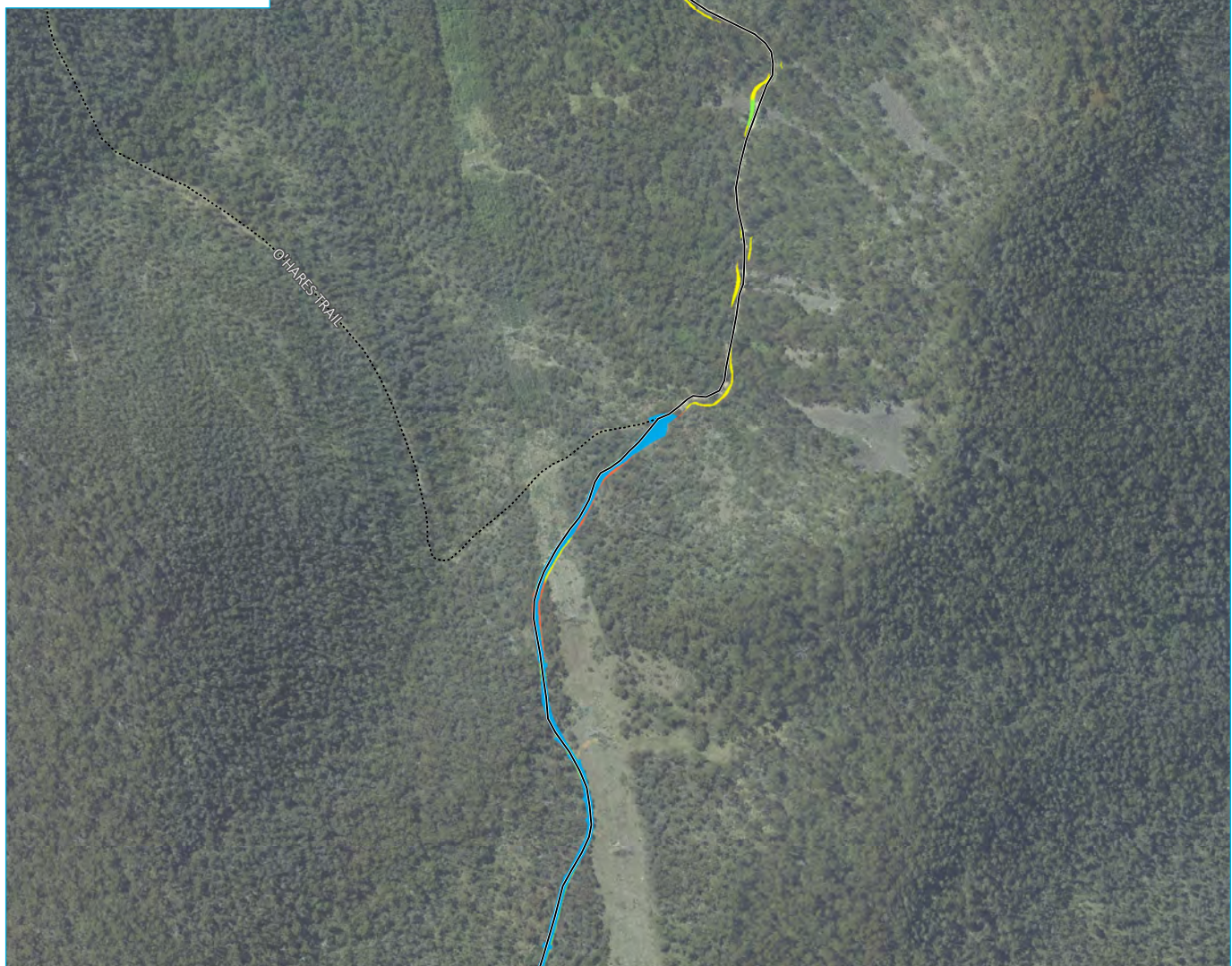
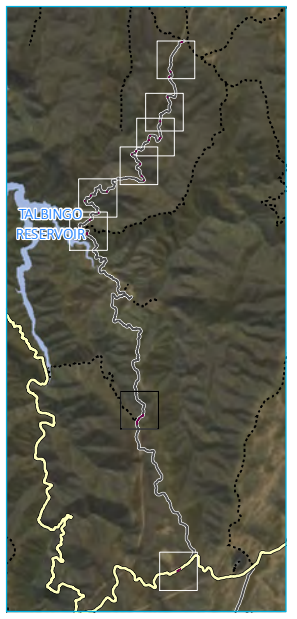
- Local road
- Vehicular track
- Waterbody
- Impacts requiring offsets

Serious and irreversible impacts, impacts requiring offsets, impacts not requiring offsets and areas not requiring assessment

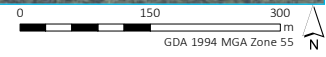
Snowy 2.0
Biodiversity development assessment
Modification 2
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Source: EMM (2019); Snowy Hydro (2019); PhotoMapping (2018); SMEC (2019); DFSI (2017); GA (2015); LPMA (2011)



KEY

- Local road
- Vehicular track
- Orange box: Serious and irreversible impacts
- Yellow box: Impacts requiring offsets
- Green box: Impacts not requiring offsets
- Blue box: Areas not requiring assessment

Serious and irreversible impacts, impacts requiring offsets, impacts not requiring offsets and areas not requiring assessment

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Biodiversity development assessment
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7.1 h



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Source: EMM (2019); Snowy Hydro (2019); PhotoMapping (2018); SMEC (2019); DFSI (2017); GA (2015); LPMA (2011)

KEY

- Main road
- Local road
- Impacts requiring offsets
- Impacts not requiring offsets
- Areas not requiring assessment

Serious and irreversible impacts, impacts requiring offsets, impacts not requiring offsets and areas not requiring assessment

Snowy 2.0
Biodiversity development assessment
Modification 2
7.1 i



8 Assessment of biodiversity legislation

8.1 Environment Protection and Biodiversity Conservation Act

This section provides an assessment of the project's impacts specific to species and communities listed under the EPBC Act.

8.1.1 Threatened ecological communities

Three threatened ecological communities were predicted to occur in the region by the PMST search (Appendix D). Recorded PCTs were compared to the three listed ecological communities predicted to occur, and an assessment of likelihood was completed (Table E.1) This assessment concluded that no threatened ecological communities were recorded or considered to occur within the project area.

8.1.2 Threatened species

Thirty-three species were predicted to occur in the region by the PMST search (Appendix D). Table E.2 provides an assessment of likelihood of flora species and Table E.3 provides an assessment of likelihood for fauna species utilising habitat within the project area. Four species listed as threatened under the EPBC Act were recorded and/or considered likely to occur and utilise habitat on-site. These include:

- Smoky Mouse;
- Spotted-tailed Quoll;
- Macquarie Perch; and
- Trout Cod.

An assessment of significance was completed for each of these species (Appendix F). These assessments concluded that a significant impact was unlikely to result from cumulative impacts associated with Exploratory Works, including Modification 2.

8.1.3 Migratory species

Eleven migratory species listed under the EPBC Act were predicted to occur in the region by the PMST search (Appendix D). An assessment of likelihood was completed (Table E.4), concluding no migratory species were recorded or considered likely to occur within the project area.

9 Conclusion

Significant field surveys have been undertaken across the Modification 2 survey area, including initial field assessments, detailed vegetation mapping, vegetation integrity assessments and comprehensive targeted flora and fauna surveys which have exceeded NSW and Commonwealth survey guidelines. These surveys have been undertaken to understand the biodiversity values within the survey area, allowing consideration of these values during design.

Native vegetation within Modification 2 reflects past land use. Historical use of Lobs Hole for the movement of stock, as a settlement and copper mining to 1917 and more contemporarily for recreation, have resulted in some clearing and disturbance of vegetation in the area, particularly adjacent to Lobs Hole. In these areas, native vegetation and fauna habitats have been modified by past disturbances associated with land clearing, livestock grazing and weed invasion. Elsewhere, vegetation remains largely intact with minimal disturbance. Vegetation mapping identified six PCTs within the Modification 2 disturbance footprint; these PCTs were stratified into 11 vegetation zones on the basis of broad condition state. Three vegetation zones show significant levels of disturbance, while a further three show some degree of impact. Vegetation integrity scores reflect this condition, with scores varying between 36.7 and 85.3.

Threatened species surveys identified 10 threatened fauna species recorded within and adjacent to the Modification 2 disturbance footprint; six ecosystem credit species and four species credit species. A significant result was the identification of a population of the critically endangered Smoky Mouse within areas west of Wallaces Creek Fire Trail. This species is known from a limited number of extant sites in NSW. The Masked Owl was recorded foraging alongs Lobs Hole Ravine Road and at Lobs Hole but was not recorded breeding. Breeding habitat for the Gang-gang Cockatoo was identified along Lobs Hole Ravine Road, adjacent to (but not within) the disturbance footprint. The Eastern Pygmy-possum was recorded at numerous locations within Lobs Hole.

A key focus of project design has been to avoid and minimise impacts to biodiversity values identified during the field surveys, in recognition of the location of Modification 2 in the KNP. This has resulted in significant design revisions to avoid and minimise direct impacts. Significant controls have been put in place to avoid, minimise and mitigate indirect impacts. Residual impacts following implementation of all controls include:

- clearing of 1.62 ha of native vegetation; and
- impacts to 0.99 ha of threatened species habitat for two species credit species.

In summary, a significant effort has been undertaken to understand the biodiversity values Modification 2 and design the project to avoid and minimise impacts to identified values. Modification 2 has been sited, where possible, within disturbed areas as a priority. Where this could not be achieved impacts have been minimised and mitigated through implementation of appropriate controls. Residual impacts will be offset in accordance with the objective and principles outlined in the biodiversity offset framework.

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Appendix A

Vegetation integrity assessment – datasheets

BAM Site – Field Survey Form

Plot ID:	11	Date:	19-12-17	Survey Name:	Lobs Hole Ravine Access Road	Recorders:	AM, SD
Zone:	55	Easting:	628566.026	Plot dimensions:	20m x 50m	Midline bearing:	180
Datum:	GDA94	Northing:	6048199.292	IBRA region:	South Eastern Highlands (Bondo)	Zone ID:	
Plant Community Type:	953: Mountain Gum - Snow Gum - Broad-leaved Peppermint shrubby open forest of montane ranges, South Eastern Highlands Bioregion and Australian Alps Bioregion				Confidence:	Medium	Photo #:
Vegetation Class:	Southern Tableland Dry Sclerophyll Forests				EEC:	No	Confidence:
							Low

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	2
	Shrubs:	9
	Grasses etc.:	8
	Forbs:	15
	Ferns:	0
	Other:	0
Sum of Cover of native vascular plants by growth form group	Trees:	0.3
	Shrubs:	3.1
	Grasses etc.:	81.4
	Forbs:	4.4
	Ferns:	0
	Other:	0
High Threat Weed cover:		7.1

BAM Attribute (1000 m2 plot) DBH			
DBH	Stem count (euc)	Stem count (non-euc)	Stems with Hollows
80 + cm:	0	0	0
50 – 79 cm:	0	0	0
30 – 49 cm:	0	0	0
20 – 29 cm:	0	0	0
10 – 19 cm:	0	0	0
5 – 9 cm:	0	0	0
< 5 cm:	0	0	0
Length of logs (m) (≥10 cm diameter, >50 cm in length)	27		

Counts apply when the number of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For a multi-stemmed tree, only the largest living stem is included in the count/estimate. Tree stems must be living. For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)					Bare ground cover (%)					Cryptogam cover (%)					Rock cover (%)				
Subplot score (% in each):	60	60	30	50	50	20	1	0	15	10	0	0	0	0	3	0	0	0	5	2
Average of the 5 subplots:	50					9.2					0.6					1.4				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type		Lf Element (A)	Hillslope	Lf Pattern (A)	Low hills	Microrelief	
		Lf Element (B)		Lf Pattern (B)			
Lithology (A)	Metamorphic rock (unidentified)	Soil Surface Texture	Clay loam	Soil Colour	Light brown	Soil Depth	Medium
Lithology (B)							
Slope	3	Aspect	South-east	Site Drainage		Distance to nearest water & type	

Plot Disturbance	Severity code	Age code	Observational evidence
Clearing (inc. logging):		greater than 10yo	Derived grassland from clearing for powerline easement
Cultivation (inc. pasture):			No evidence
Soil erosion:			No evidence
Firewood / CWD removal:			No evidence
Grazing (identify native/stock):	Light		No evidence of livestock or feral animals
Fire damage:			No evidence
Storm damage:			No evidence
Weediness:	Moderate		Exotic forbs
Other:			

Severity: 0=no evidence, 1=light, 2=moderate, 3=severe

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if "top 3"; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ..., 100% (foliage cover)
 Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
 Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Survey Name:	Lobs Hole Ravine Access Road					
	Date:	19-12-17	Plot ID:	11	Recorders:	AM, SD

GF Code	Top 3 native species in each growth form group: Full species name mandatory All other native and exotic species: Full species name where practicable	Cover	Abund	Voucher	N, E or HTE	Stratum
	<i>Hypericum perforatum</i>	7	300		HTE	
Forb (FG)	<i>Veronica derwentiana</i> subsp. <i>derwentiana</i>	0.3	2		N	
Grass & grasslike	<i>Themeda triandra</i>	50	1000		N	
Grass & grasslike	<i>Lomandra bracteata</i>	0.5	30		N	
Grass & grasslike	<i>Poa sieberiana</i>	30	1000		N	
Shrub (SG)	<i>Leptospermum myrtifolium</i>	0.3	5		N	
	<i>Taraxacum officinale</i>	0.2	50		E	
Forb (FG)	<i>Dichondra repens</i>	2	500		N	
	<i>Acetosella vulgaris</i>	0.1	30		HTE	
Forb (FG)	<i>Geranium solanderi</i>	0.3	50		N	
Forb (FG)	<i>Dianella revoluta</i>	0.5	20		N	
Shrub (SG)	<i>Daviesia latifolia</i>	1	30		N	
Shrub (SG)	<i>Pimelea pauciflora</i>	0.2	20		N	
	<i>Centaureum erythraea</i>	0.1	30		E	
Shrub (SG)	<i>Rubus parvifolius</i>	0.3	5		N	
Forb (FG)	<i>Stellaria pungens</i>	0.2	20		N	
Grass & grasslike	<i>Poa helmsii</i>	0.2	5		N	
Shrub (SG)	<i>Epacris breviflora</i>	0.2	5		N	
	<i>Holcus lanatus</i>	0.2	10		E	
	<i>Hypochaeris radicata</i>	0.2	40		E	
Tree (TG)	<i>Eucalyptus dalrympleana</i>	0.1	1		N	
Shrub (SG)	<i>Hakea microcarpa</i>	0.1	1		N	
Forb (FG)	<i>Cymbonotus lawsonianus</i>	0.1	3		N	
Forb (FG)	<i>Erigeron bellidioides</i>	0.1	3		N	
	<i>Verbascum virgatum</i>	0.1	5		E	
Forb (FG)	<i>Veronica calycina</i>	0.1	10		N	
Forb (FG)	<i>Oxalis perennans</i>	0.1	5		N	
Shrub (SG)	<i>Cassinia ochracea</i>	0.8	5		N	
Tree (TG)	<i>Eucalyptus pauciflora</i>	0.2	5		N	
Forb (FG)	<i>Euchiton japonicus</i>	0.2	50		N	
Shrub (SG)	<i>Bossiaea foliosa</i>	0.1	1		N	
Forb (FG)	<i>Hypericum gramineum</i>	0.1	20		N	
Grass & grasslike	<i>Rytidosperma penicillatum</i>	0.3	80		N	
Forb (FG)	<i>Microtis unifolia</i>	0.1	10		N	
Forb (FG)	<i>Gonocarpus tetragynus</i>	0.1	10		N	
Shrub (SG)	<i>Hibbertia obtusifolia</i>	0.1	5		N	
Forb (FG)	<i>Ranunculus lappaceus</i>	0.1	5		N	
Forb (FG)	<i>Dipodium</i> spp.	0.1	1		N	
Grass & grasslike	<i>Lomandra filiformis</i> subsp. <i>filiformis</i>	0.1	5		N	
Grass & grasslike	<i>Anthosachne scabra</i>	0.2	20		N	
Grass & grasslike	<i>Lachnagrostis filiformis</i>	0.1	1		N	

BAM Site – Field Survey Form

Plot ID:	187	Date:	08-01-18	Survey Name:	Lobbs Hole Ravine Road north	Recorders:	SD	
Zone:	55	Easting:	628142.3788	Plot dimensions:	20m x 50m	Midline bearing:	90	
Datum:	GDA94	Northing:	6046952.08	IBRA region:	South Eastern Highlands (Bondo)	Zone ID:		
Plant Community Type:	296: Brittle Gum - peppermint open forest of the Woomargama to Tumut region, NSW South Western Slopes Bioregion				Confidence:	Medium	Photo #:	
Vegetation Class:	Southern Tableland Dry Sclerophyll Forests				EEC:	No	Confidence:	High

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	3
	Shrubs:	10
	Grasses etc.:	6
	Forbs:	6
	Ferns:	1
	Other:	1
Sum of Cover of native vascular plants by growth form group	Trees:	2
	Shrubs:	10.8
	Grasses etc.:	7.2
	Forbs:	3.8
	Ferns:	60
	Other:	0.5
High Threat Weed cover:		1.1

BAM Attribute (1000 m2 plot) DBH			
DBH	Stem count (euc)	Stem count (non-euc)	Stems with Hollows
80 + cm:	0	0	0
50 – 79 cm:	0	0	0
30 – 49 cm:	0	0	0
20 – 29 cm:	0	0	0
10 – 19 cm:	0	0	0
5 – 9 cm:	0	0	0
< 5 cm:	0	0	0
Length of logs (m) (≥10 cm diameter, >50 cm in length)	84		

Counts apply when the number of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For a multi-stemmed tree, only the largest living stem is included in the count/estimate. Tree stems must be living. For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)					Bare ground cover (%)					Cryptogam cover (%)					Rock cover (%)				
Subplot score (% in each):	60	98	100	40	90	20	5	5	60	5	0	20	10	70	40	0	0	0	0	0
Average of the 5 subplots:	77.6					19					28					0				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type		Lf Element (A)	Hillslope	Lf Pattern (A)	Hills	Microrelief	
		Lf Element (B)		Lf Pattern (B)			
Lithology (A)	Sedimentary rock (unidentified)	Soil Surface Texture	Clay	Soil Colour	Brown	Soil Depth	Medium
Lithology (B)							
Slope	17	Aspect	East	Site Drainage	Medium	Distance to nearest water & type	

Plot Disturbance	Severity code	Age code	Observational evidence
Clearing (inc. logging):	Severe	greater than 10yo	Poweline easement
Cultivation (inc. pasture):			
Soil erosion:	Moderate	greater than 10yo	Powerline clearing
Firewood / CWD removal:			
Grazing (identify native/stock):			
Fire damage:			
Storm damage:			
Weediness:	Light	3 to 10 yo	
Other:			

Severity: 0=no evidence, 1=light, 2=moderate, 3=severe

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
 Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
 Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Survey Name:	Lobbs Hole Ravine Road north					
	Date:	08-01-18	Plot ID:	187	Recorders:	SD

GF Code	Top 3 native species in each growth form group: Full species name mandatory All other native and exotic species: Full species name where practicable	Cover	Abund	Voucher	N, E or HTE	Stratum
Fern (EG)	<i>Pteridium esculentum</i>	60	1000		N	
Shrub (SG)	<i>Cassinia ochracea</i>	1	20		N	
Forb (FG)	<i>Asperula scoparia</i>	1	100		N	
Grass & grasslike	<i>Lomandra longifolia</i>	2	80		N	
Tree (TG)	<i>Acacia dealbata</i>	1	10		N	
Shrub (SG)	<i>Platylobium montanum</i>	0.7	40		N	
Shrub (SG)	<i>Daviesia latifolia</i>	1	30		N	
Forb (FG)	<i>Gonocarpus tetragynus</i>	0.5	40		N	
Other (OG)	<i>Cassytha glabella</i>	0.5	20		N	
	<i>Hypericum perforatum</i>	1	200		HTE	
Shrub (SG)	<i>Pimelea linifolia</i>	3	200		N	
Shrub (SG)	<i>Leucopogon fletcheri</i> subsp. <i>brevisepalus</i>	3	200		N	
Grass & grasslike	<i>Deyeuxia quadriseta</i>	0.5	50		N	
Forb (FG)	<i>Stylidium graminifolium</i>	1	200		N	
Grass & grasslike	<i>Poa sieberiana</i> var. <i>sieberiana</i>	3	300		N	
Shrub (SG)	<i>Hibbertia obtusifolia</i>	0.5	30		N	
Tree (TG)	<i>Eucalyptus dalrympleana</i>	0.5	2		N	
Tree (TG)	<i>Eucalyptus mannifera</i> subsp. <i>mannifera</i>	0.5	2		N	
Shrub (SG)	<i>Persoonia chamaepeuce</i>	0.2	5		N	
Forb (FG)	<i>Stellaria pungens</i>	1	100		N	
Shrub (SG)	<i>Tetradlea bauerifolia</i>	1	50		N	
Shrub (SG)	<i>Baekkea utilis</i>	0.1	10		N	
	<i>Centaurium erythraea</i>	0.3	30		E	
	<i>Taraxacum officinale</i>	0.5	50		E	
	<i>Hypochaeris glabra</i>	0.3	30		E	
Grass & grasslike	<i>Anthosachne scabra</i>	0.5	50		N	
Forb (FG)	<i>Scleranthus fasciculatus</i>	0.2	10		N	
Grass & grasslike	<i>Poa sieberiana</i> var. <i>cyanophylla</i>	0.7	50		N	
	<i>Aira elegantissima</i>	0.2	20		E	
	<i>Holcus lanatus</i>	0.2	20		E	
Shrub (SG)	<i>Lomatia myricoides</i>	0.3	2		N	
	<i>Agrostis capillaris</i>	0.1	5		HTE	
Grass & grasslike	<i>Aristida ramosa</i>	0.5	30		N	
Forb (FG)	<i>Microtis unifolia</i>	0.1	1		N	

BAM Site – Field Survey Form

Plot ID:	190	Date:	09-01-18	Survey Name:	Lobs Hole Ravine Road north	Recorders:	SD	
Zone:	55	Easting:	627370.4074	Plot dimensions:	20m x 50m	Midline bearing:	300	
Datum:	GDA94	Northing:	6044577.778	IBRA region:	South Eastern Highlands (Bondo)	Zone ID:		
Plant Community Type:	296: Brittle Gum - peppermint open forest of the Woomargama to Tumut region, NSW South Western Slopes Bioregion				Confidence:	High	Photo #:	
Vegetation Class:	Southern Tableland Dry Sclerophyll Forests				EEC:	No	Confidence:	High

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	3
	Shrubs:	11
	Grasses etc.:	5
	Forbs:	6
	Ferns:	1
	Other:	2
Sum of Cover of native vascular plants by growth form group	Trees:	20
	Shrubs:	29.3
	Grasses etc.:	2.5
	Forbs:	0.9
	Ferns:	0.1
	Other:	0.6
High Threat Weed cover:		0

BAM Attribute (1000 m2 plot) DBH			
DBH	Stem count (euc)	Stem count (non-euc)	Stems with Hollows
80 + cm:	0	0	0
50 – 79 cm:	1	0	2
30 – 49 cm:	0	0	0
20 – 29 cm:	0	0	0
10 – 19 cm:	0	0	0
5 – 9 cm:	0	0	0
< 5 cm:	0	0	0
Length of logs (m) (≥10 cm diameter, >50 cm in length)	200		

Counts apply when the number of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For a multi-stemmed tree, only the largest living stem is included in the count/estimate. Tree stems must be living. For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)					Bare ground cover (%)					Cryptogam cover (%)					Rock cover (%)				
Subplot score (% in each):	90	80	80	95	95	0	2	5	5	0	10	10	30	30	15	15	1	10	1	10
Average of the 5 subplots:	88					2.4					19					7.4				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type		Lf Element (A)	Hillslope	Lf Pattern (A)	Mountains	Microrelief	
		Lf Element (B)		Lf Pattern (B)			
Lithology (A)	Sedimentary rock (unidentified)	Soil Surface Texture	Sandy loam	Soil Colour	Brown	Soil Depth	Shallow
Lithology (B)							
Slope	30	Aspect	North-west	Site Drainage	Good	Distance to nearest water & type	

Plot Disturbance	Severity code	Age code	Observational evidence
Clearing (inc. logging):	Moderate	greater than 10yo	
Cultivation (inc. pasture):			
Soil erosion:	Moderate	greater than 10yo	
Firewood / CWD removal:			
Grazing (identify native/stock):			
Fire damage:	Light	3 to 10 yo	
Storm damage:			
Weediness:			
Other:			

Severity: 0=no evidence, 1=light, 2=moderate, 3=severe

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
 Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
 Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Survey Name:	Lobs Hole Ravine Road north					
	Date:	09-01-18	Plot ID:	190	Recorders:	SD

GF Code	Top 3 native species in each growth form group: Full species name mandatory All other native and exotic species: Full species name where practicable	Cover	Abund	Voucher	N, E or HTE	Stratum
Tree (TG)	<i>Eucalyptus mannifera</i> subsp. <i>mannifera</i>	7	5		N	
Tree (TG)	<i>Eucalyptus dives</i>	3	5		N	
Tree (TG)	<i>Eucalyptus macrorhyncha</i>	10	10		N	
Shrub (SG)	<i>Acacia obliquinervia</i>	10	100		N	
Shrub (SG)	<i>Dillwynia phyllioides</i>	15	200		N	
Other (OG)	<i>Cassytha glabella</i>	0.5	20		N	
Shrub (SG)	<i>Brachyloma daphnoides</i>	1	30		N	
Forb (FG)	<i>Dianella revoluta</i>	0.1	10		N	
Forb (FG)	<i>Poranthera</i> spp.	0.2	30		N	
Forb (FG)	<i>Gonocarpus tetragynus</i>	0.2	30		N	
Forb (FG)	<i>Asperula</i> spp.	0.2	30		N	
Grass & grasslike	<i>Lomandra bracteata</i>	0.1	20		N	
Shrub (SG)	<i>Cassinia longifolia</i>	0.7	20		N	
Shrub (SG)	<i>Hibbertia obtusifolia</i>	0.5	20		N	
Forb (FG)	<i>Senecio quadridentatus</i>	0.1	1		N	
Grass & grasslike	<i>Rytidosperma pallidum</i>	2	100		N	
Shrub (SG)	<i>Tetradlea bauerifolia</i>	1	200		N	
Shrub (SG)	<i>Persoonia chamaepeuce</i>	0.2	30		N	
Other (OG)	<i>Hardenbergia violacea</i>	0.1	10		N	
Shrub (SG)	<i>Exocarpos strictus</i>	0.1	2		N	
Shrub (SG)	<i>Banksia canei</i>	0.5	2		N	
Grass & grasslike	<i>Poa</i> spp.	0.2	20		N	
Grass & grasslike	<i>Austrostipa scabra</i>	0.1	10		N	
Shrub (SG)	<i>Pimelea linifolia</i>	0.1	10		N	
Shrub (SG)	<i>Leucopogon fletcheri</i> subsp. <i>brevisepalus</i>	0.2	10		N	
Grass & grasslike	<i>Lomandra filiformis</i> subsp. <i>filiformis</i>	0.1	5		N	
Forb (FG)	<i>Stylidium graminifolium</i>	0.1	5		N	
Fern (EG)	<i>Asplenium flabellifolium</i>	0.1	5		N	

BAM Site – Field Survey Form

Plot ID:	192	Date:	09-01-18	Survey Name:	Lobbs Hole Ravine Road north	Recorders:	SD	
Zone:	55	Easting:	627958.7871	Plot dimensions:	20m x 50m	Midline bearing:	160	
Datum:	GDA94	Northing:	6045556.519	IBRA region:	South Eastern Highlands (Bondo)	Zone ID:		
Plant Community Type:	300: Ribbon Gum - Narrow-leaved (Robertsons) Peppermint montane fern - grass tall open forest on deep clay loam soils in the upper NSW South Western Slopes Bioregion and western Kosciuszko escarpment				Confidence:	High	Photo #:	
Vegetation Class:	Southern Tableland Wet Sclerophyll Forests				EEC:	No	Confidence:	High

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	3
	Shrubs:	13
	Grasses etc.:	5
	Forbs:	12
	Ferns:	0
	Other:	3
Sum of Cover of native vascular plants by growth form group	Trees:	25.5
	Shrubs:	38.8
	Grasses etc.:	16.5
	Forbs:	2.4
	Ferns:	0
	Other:	0.4
High Threat Weed cover:		0

BAM Attribute (1000 m2 plot) DBH			
DBH	Stem count (euc)	Stem count (non-euc)	Stems with Hollows
80 + cm:	1	0	0
50 – 79 cm:	3	0	5
30 – 49 cm:	0	0	0
20 – 29 cm:	0	0	0
10 – 19 cm:	0	0	0
5 – 9 cm:	0	0	0
< 5 cm:	0	0	0
Length of logs (m) (≥10 cm diameter, >50 cm in length)	30		

Counts apply when the number of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For a multi-stemmed tree, only the largest living stem is included in the count/estimate. Tree stems must be living. For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)					Bare ground cover (%)					Cryptogam cover (%)					Rock cover (%)				
Subplot score (% in each):	100	100	60	80	95	0	0	50	25	1	10	10	20	15	20	0	0	0	95	0
Average of the 5 subplots:	87					15.2					15					19				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type		Lf Element (A)	Hillslope	Lf Pattern (A)	Mountains	Microrelief	
		Lf Element (B)		Lf Pattern (B)			
Lithology (A)	Sedimentary rock (unidentified)	Soil Surface Texture	Clay	Soil Colour	Brown	Soil Depth	Medium
Lithology (B)							
Slope	30	Aspect	South-east	Site Drainage	Medium	Distance to nearest water & type	

Plot Disturbance	Severity code	Age code	Observational evidence
Clearing (inc. logging):	Moderate	greater than 10yo	
Cultivation (inc. pasture):			
Soil erosion:	Light	greater than 10yo	
Firewood / CWD removal:			
Grazing (identify native/stock):			
Fire damage:	Light	3 to 10 yo	
Storm damage:			
Weediness:			
Other:			

Severity: 0=no evidence, 1=light, 2=moderate, 3=severe

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF -- circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
 Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
 Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Survey Name:	Lobbs Hole Ravine Road north					
	Date:	09-01-18	Plot ID:	192	Recorders:	SD

GF Code	Top 3 native species in each growth form group: Full species name mandatory All other native and exotic species: Full species name where practicable	Cover	Abund	Voucher	N, E or HTE	Stratum
Tree (TG)	<i>Eucalyptus robertsonii</i>	20	10		N	
Tree (TG)	<i>Eucalyptus mannifera</i> subsp. <i>mannifera</i>	5	5		N	
Shrub (SG)	<i>Daviesia latifolia</i>	20	500		N	
Shrub (SG)	<i>Grevillea rosmarinifolia</i>	2	50		N	
Shrub (SG)	<i>Leucopogon fletcheri</i> subsp. <i>brevisepalus</i>	5	200		N	
Shrub (SG)	<i>Cassinia aculeata</i>	5	10		N	
Shrub (SG)	<i>Platylobium montanum</i>	2	100		N	
Tree (TG)	<i>Acacia melanoxylon</i>	0.5	5		N	
Shrub (SG)	<i>Olearia phlogopappa</i>	0.8	30		N	
Grass & grasslike	<i>Lomandra filiformis</i> subsp. <i>coriacea</i>	0.3	20		N	
Shrub (SG)	<i>Persoonia chamaepeuce</i>	2	80		N	
Forb (FG)	<i>Asperula scoparia</i>	0.5	50		N	
Grass & grasslike	<i>Poa sieberiana</i> var. <i>sieberiana</i>	5	500		N	
Forb (FG)	<i>Geranium solanderi</i>	0.1	10		N	
Grass & grasslike	<i>Lomandra filiformis</i> subsp. <i>filiformis</i>	0.2	30		N	
Grass & grasslike	<i>Poa sieberiana</i> var. <i>cyanophylla</i>	10	1000		N	
Forb (FG)	<i>Podolepis jaceoides</i>	0.3	100		N	
Forb (FG)	<i>Gonocarpus tetragynus</i>	0.2	40		N	
Forb (FG)	<i>Stackhousia monogyna</i>	0.1	1		N	
Forb (FG)	<i>Stellaria pungens</i>	0.2	20		N	
Shrub (SG)	<i>Banksia canei</i>	0.5	8		N	
Forb (FG)	<i>Ranunculus lappaceus</i>	0.2	20		N	
Shrub (SG)	<i>Acacia pravissima</i>	0.1	5		N	
	<i>Centaurium erythraea</i>	0.1	10		E	
Forb (FG)	<i>Galium binifolium</i>	0.2	30		N	
Forb (FG)	<i>Poranthera microphylla</i>	0.2	30		N	
Other (OG)	<i>Clematis aristata</i>	0.1	10		N	
Other (OG)	<i>Glycine tabacina</i>	0.2	30		N	
Shrub (SG)	<i>Coprosma quadrifida</i>	0.1	1		N	
Other (OG)	<i>Glycine microphylla</i>	0.1	10		N	
Forb (FG)	<i>Veronica derwentiana</i> subsp. <i>derwentiana</i>	0.2	5		N	
Shrub (SG)	<i>Exocarpos strictus</i>	0.2	1		N	
Grass & grasslike	<i>Lomandra longifolia</i>	1	20		N	
Shrub (SG)	<i>Cassinia longifolia</i>	1	20		N	
Shrub (SG)	<i>Coprosma hirtella</i>	0.1	1		N	
Forb (FG)	<i>Viola betonicifolia</i>	0.1	20		N	
Forb (FG)	<i>Viola hederacea</i>	0.1	1		N	

BAM Site – Field Survey Form

Plot ID:	216	Date:	12-12-17	Survey Name:	Access Roads	Recorders:	SD, EL
Zone:	55	Easting:	627032.6318	Plot dimensions:	20m x 50m	Midline bearing:	211
Datum:	GDA94	Northing:	6033444.058	IBRA region:	South Eastern Highlands (Bondo)	Zone ID:	
Plant Community Type:	953: Mountain Gum - Snow Gum - Broad-leaved Peppermint shrubby open forest of montane ranges, South Eastern Highlands Bioregion and Australian Alps Bioregion				Confidence:		Photo #:
Vegetation Class:	Southern Tableland Dry Sclerophyll Forests				EEC:		Confidence:

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	6
	Shrubs:	7
	Grasses etc.:	5
	Forbs:	18
	Ferns:	0
	Other:	2
Sum of Cover of native vascular plants by growth form group	Trees:	22.3
	Shrubs:	6.9
	Grasses etc.:	72.3
	Forbs:	4
	Ferns:	0
	Other:	0.3
High Threat Weed cover:		0.2

BAM Attribute (1000 m2 plot) DBH			
DBH	Stem count (euc)	Stem count (non-euc)	Stems with Hollows
80 + cm:	1	0	1
50 – 79 cm:	3	0	3
30 – 49 cm:	1	0	0
20 – 29 cm:	1	0	0
10 – 19 cm:	1	0	0
5 – 9 cm:	1	0	0
< 5 cm:	1	0	0
Length of logs (m) (≥10 cm diameter, >50 cm in length)	43		

Counts apply when the number of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For a multi-stemmed tree, only the largest living stem is included in the count/estimate. Tree stems must be living. For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)					Bare ground cover (%)					Cryptogam cover (%)					Rock cover (%)				
Subplot score (% in each):	10	45	25	50	10	2	20	0	20	5	0	0	0	0	0	0	4	0	4	0
Average of the 5 subplots:	28					9.4					0					1.6				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type		Lf Element (A)	Hillslope	Lf Pattern (A)	Mountains	Microrelief	
		Lf Element (B)		Lf Pattern (B)			
Lithology (A)	Metamorphic rock (unidentified)	Soil Surface Texture	Clay loam	Soil Colour	Brown	Soil Depth	Shallow
Lithology (B)							
Slope	28	Aspect	NW	Site Drainage	Good	Distance to nearest water & type	

Plot Disturbance	Severity code	Age code	Observational evidence
Clearing (inc. logging):	Moderate	greater than 10yo	
Cultivation (inc. pasture):			No evidence
Soil erosion:	Light		Associated with access track adjacent
Firewood / CWD removal:			No evidence
Grazing (identify native/stock):	Light	greater than 10yo	Native and exotic herbivores
Fire damage:	Light	greater than 10yo	
Storm damage:			No evidence
Weediness:	Light	less than 3yo	Forbs
Other:			

Severity: 0=no evidence, 1=light, 2=moderate, 3=severe

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if "top 3"; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
 Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
 Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Survey Name:	Access Roads						
		Date:	12-12-17	Plot ID:	216	Recorders:	SD, EL

GF Code	Top 3 native species in each growth form group: Full species name mandatory All other native and exotic species: Full species name where practicable	Cover	Abund	Voucher	N, E or HTE	Stratum
Tree (TG)	<i>Eucalyptus pauciflora</i>	10	10		N	
Tree (TG)	<i>Eucalyptus rubida</i> x <i>dalrympleana</i>	5	5		N	
Tree (TG)	<i>Eucalyptus dalrympleana</i>	2	1		N	
Tree (TG)	<i>Acacia melanoxylon</i>	5	40		N	
Shrub (SG)	<i>Cassinia longifolia</i>	5	60		N	
Shrub (SG)	<i>Mirbelia platylobioides</i>	0.3	30		N	
Forb (FG)	<i>Plantago gaudichaudii</i>	0.7	200		N	
Grass & grasslike	<i>Poa sieberiana</i>	70	1000		N	
	<i>Crepis capillaris</i>	0.1	20		E	
Forb (FG)	<i>Gonocarpus teucrioides</i>	0.5	80		N	
Forb (FG)	<i>Cullen microcephalum</i>	0.3	30		N	
Forb (FG)	<i>Stackhousia monogyna</i>	0.1	20		N	
Shrub (SG)	<i>Exocarpos strictus</i>	1	20		N	
Other (OG)	<i>Desmodium varians</i>	0.2	40		N	
Forb (FG)	<i>Hydrocotyle laxiflora</i>	0.3	100		N	
	<i>Trifolium arvense</i>	0.1	20		E	
Forb (FG)	<i>Wahlenbergia gloriosa</i>	0.1	20		N	
Tree (TG)	<i>Acacia dealbata</i> subsp. <i>subalpina</i>	0.2	3		N	
Forb (FG)	<i>Asperula conferta</i>	0.5	100		N	
Grass & grasslike	<i>Carex breviculmis</i>	0.1	20		N	
Grass & grasslike	<i>Themeda triandra</i>	2	100		N	
Forb (FG)	<i>Lotus australis</i>	0.4	30		N	
Forb (FG)	<i>Chrysocephalum semipapposum</i>	0.2	20		N	
Forb (FG)	<i>Senecio quadridentatus</i>	0.1	10		N	
	<i>Centaurium erythraea</i>	0.1	5		E	
Tree (TG)	<i>Eucalyptus robertsonii</i>	0.1	10		N	
Forb (FG)	<i>Chrysocephalum apiculatum</i>	0.1	5		N	
Forb (FG)	<i>Viola betonicifolia</i>	0.1	10		N	
	<i>Hypericum perforatum</i>	0.2	50		HTE	
Forb (FG)	<i>Rumex brownii</i>	0.1	1		N	
Forb (FG)	<i>Cymbonotus lawsonianus</i>	0.1	10		N	
Forb (FG)	<i>Galium gaudichaudii</i>	0.1	10		N	
Grass & grasslike	<i>Lomandra micrantha</i> subsp. <i>tuberculata</i>	0.1	10		N	
Forb (FG)	<i>Podolepis</i> spp.	0.1	1		N	
Shrub (SG)	<i>Leucopogon fletcheri</i> subsp. <i>brevisepalus</i>	0.2	1		N	
Other (OG)	<i>Glycine tabacina</i>	0.1	10		N	
Forb (FG)	<i>Hypericum gramineum</i>	0.1	20		N	
Grass & grasslike	<i>Dichelachne</i> spp.	0.1	10		N	
Shrub (SG)	<i>Cassinia aculeata</i>	0.1	2		N	
Shrub (SG)	<i>Coprosma hirtella</i>	0.1	1		N	
Shrub (SG)	<i>Mirbelia oxyllobioides</i>	0.2	1		N	
Forb (FG)	<i>Leptorhynchus squamatus</i>	0.1	30		N	

BAM Site – Field Survey Form

Plot ID:	1001	Date:	16-03-18	Survey Name:	X1	Recorders:	JA, ACM	
Zone:	55	Easting:	624845.63	Plot dimensions:	20m x 20m	Midline bearing:	120	
Datum:	GDA94	Northing:	6040478.855	IBRA region:	South Eastern Highlands (Bondo)	Zone ID:		
Plant Community Type:	300: Ribbon Gum - Narrow-leaved (Robertsons) Peppermint montane fern - grass tall open forest on deep clay loam soils in the upper NSW South Western Slopes Bioregion and western Kosciuszko escarpment				Confidence:		Photo #:	
Vegetation Class:	Southern Tableland Wet Sclerophyll Forests				EEC:	No	Confidence:	

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	2
	Shrubs:	7
	Grasses etc.:	6
	Forbs:	7
	Ferns:	0
	Other:	1
Sum of Cover of native vascular plants by growth form group	Trees:	40
	Shrubs:	75.6
	Grasses etc.:	5.5
	Forbs:	0.7
	Ferns:	0
	Other:	0.1
High Threat Weed cover:		32.1

BAM Attribute (1000 m2 plot) DBH			
DBH	Stem count (euc)	Stem count (non-euc)	Stems with Hollows
80 + cm:	1	0	0
50 – 79 cm:	4	0	3
30 – 49 cm:	7	0	0
20 – 29 cm:	4	0	0
10 – 19 cm:	15	0	0
5 – 9 cm:	10	0	0
< 5 cm:	16	0	0
Length of logs (m) (≥10 cm diameter, >50 cm in length)	51		

Counts apply when the number of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For a multi-stemmed tree, only the largest living stem is included in the count/estimate. Tree stems must be living. For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)					Bare ground cover (%)					Cryptogam cover (%)					Rock cover (%)				
Subplot score (% in each):	95	100	90	100	100	5	0	10	0	0	15	0	0	5	40	0	0	0	0	0
Average of the 5 subplots:	97					3					12					0				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type		Lf Element (A)	Hillslope	Lf Pattern (A)	Low hills	Microrelief	
		Lf Element (B)		Lf Pattern (B)			
Lithology (A)	Alluvial loams and clays	Soil Surface Texture	Gravelly clay covered with litter	Soil Colour	Brown	Soil Depth	Shallow
Lithology (B)							
Slope	Slight slope down along midline	Aspect	120°SE	Site Drainage		Distance to nearest water & type	approx 30m

Plot Disturbance	Severity code	Age code	Observational evidence
Clearing (inc. logging):			
Cultivation (inc. pasture):			
Soil erosion:			
Firewood / CWD removal:			
Grazing (identify native/stock):			
Fire damage:			
Storm damage:			
Weediness:	Severe	greater than 10yo	
Other:			

Severity: 0=no evidence, 1=light, 2=moderate, 3=severe

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
 Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
 Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Survey Name:	X1						
		Date:	16-03-18	Plot ID:	1001	Recorders:	JA, ACM

GF Code	Top 3 native species in each growth form group: Full species name mandatory All other native and exotic species: Full species name where practicable	Cover	Abund	Voucher	N, E or HTE	Stratum
Tree (TG)	<i>Eucalyptus viminalis</i>	15	5		N	
Tree (TG)	<i>Eucalyptus dives</i>	25	12		N	
Shrub (SG)	<i>Acacia pravissima</i>	70	400		N	
Shrub (SG)	<i>Cassinia longifolia</i>	5	5		N	
Shrub (SG)	<i>Exocarpos strictus</i>	0.2	5		N	
	<i>Rubus fruticosus</i> sp. agg.	30	10		HTE	
	<i>Rosa rubiginosa</i>	0.1	5		HTE	
	<i>Hypericum perforatum</i>	2	50		HTE	
Grass & grasslike	<i>Poa sieberiana</i>	5	100		N	
Grass & grasslike	<i>Lomandra multiflora</i> subsp. <i>Multiflora</i>	0.1	5		N	
Grass & grasslike	<i>Lomandra</i> spp.	0.1	2		N	
Forb (FG)	<i>Stellaria pungens</i>	0.1	30		N	
Other (OG)	<i>Glycine clandestina</i>	0.1	2		N	
Forb (FG)	<i>Asperula conferta</i>	0.1	40		N	
Forb (FG)	<i>Gonocarpus tetragynus</i>	0.1	30		N	
Shrub (SG)	<i>Mirbelia oxylobioides</i>	0.1	12		N	
Forb (FG)	<i>Acaena novae-zelandiae</i>	0.1	5		N	
Grass & grasslike	<i>Rytidosperma penicillatum</i>	0.1	10		N	
	<i>Centaurium erythraea</i>	0.1	5		E	
Shrub (SG)	<i>Hibbertia obtusifolia</i>	0.1	2		N	
Shrub (SG)	<i>Leucopogon fletcheri</i> subsp. <i>brevisepalus</i>	0.1	2		N	
Grass & grasslike	<i>Carex inomitata</i>	0.1	3		N	
Grass & grasslike	<i>Carex breviculmis</i>	0.1	20		N	
Forb (FG)	<i>Acaena ovina</i>	0.1	5		N	
Shrub (SG)	<i>Acrotriche serrulata</i>	0.1	1		N	
Forb (FG)	<i>Stackhousia</i> spp.	0.1	3		N	
Forb (FG)	<i>Lagenophora stipitata</i>	0.1	4		N	

BAM Site – Field Survey Form

Plot ID:	1053	Date:	07-02-18	Survey Name:	Access Roads - PLOT 184A	Recorders:	AM, DK	
Zone:	55	Easting:	625099.684	Plot dimensions:	20m x 50m	Midline bearing:	260	
Datum:	GDA94	Northing:	6041600.275	IBRA region:	South Eastern Highlands (Bondo)	Zone ID:		
Plant Community Type:	729: Broad-leaved Peppermint - Candlebark shrubby open forest of montane areas, southern South Eastern Highlands Bioregion and South East Corner Bioregion				Confidence:	Medium	Photo #:	
Vegetation Class:	Southern Tableland Dry Sclerophyll Forests				EEC:	No	Confidence:	Medium

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	3
	Shrubs:	15
	Grasses etc.:	5
	Forbs:	11
	Ferns:	0
	Other:	1
Sum of Cover of native vascular plants by growth form group	Trees:	35
	Shrubs:	24.4
	Grasses etc.:	3.7
	Forbs:	2.2
	Ferns:	0
	Other:	0.1
High Threat Weed cover:		0.1

BAM Attribute (1000 m2 plot) DBH			
DBH	Stem count (euc)	Stem count (non-euc)	Stems with Hollows
80 + cm:	0	0	0
50 – 79 cm:	1	0	0
30 – 49 cm:	1	0	0
20 – 29 cm:	1	0	0
10 – 19 cm:	1	0	0
5 – 9 cm:	1	0	0
< 5 cm:	1	0	0
Length of logs (m) (≥10 cm diameter, >50 cm in length)	43		

Counts apply when the number of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For a multi-stemmed tree, only the largest living stem is included in the count/estimate. Tree stems must be living. For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)					Bare ground cover (%)					Cryptogam cover (%)					Rock cover (%)				
Subplot score (% in each):	90	90	60	45	75	5	5	20	40	5	0	1	10	0	0	0	0	0	0	3
Average of the 5 subplots:	72					15					2.2					0.6				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type		Lf Element (A)	Hillslope	Lf Pattern (A)	Mountains	Microrelief	
		Lf Element (B)		Lf Pattern (B)			
Lithology (A)		Soil Surface Texture	Loam	Soil Colour	Brown	Soil Depth	
Lithology (B)							
Slope	5-10	Aspect	0	Site Drainage		Distance to nearest water & type	

Plot Disturbance	Severity code	Age code	Observational evidence
Clearing (inc. logging):	Moderate	greater than 10yo	
Cultivation (inc. pasture):			No evidence
Soil erosion:			No evidence
Firewood / CWD removal:			No evidence
Grazing (identify native/stock):	Light		Macropods
Fire damage:	Light	greater than 10yo	
Storm damage:			No evidence
Weediness:	Light		Exotic forbs
Other:			

Severity: 0=no evidence, 1=light, 2=moderate, 3=severe

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
 Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
 Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Survey Name:	Access Roads - PLOT 184A					
	Date:	07-02-18	Plot ID:	1053	Recorders:	AM, DK

GF Code	Top 3 native species in each growth form group: Full species name mandatory All other native and exotic species: Full species name where practicable	Cover	Abund	Voucher	N, E or HTE	Stratum
Tree (TG)	<i>Eucalyptus dives</i>	5	4		N	
Tree (TG)	<i>Eucalyptus macrorhyncha</i>	25	30		N	
Tree (TG)	<i>Eucalyptus rubida</i>	5	7		N	
Shrub (SG)	<i>Cassinia longifolia</i>	5	20		N	
Shrub (SG)	<i>Banksia canei</i>	1	2		N	
Shrub (SG)	<i>Acacia pravissima</i>	0.5	2		N	
Shrub (SG)	<i>Pultenaea subspicata</i>	3	20		N	
Shrub (SG)	<i>Cryptandra amara</i>	3	40		N	
Shrub (SG)	<i>Dillwynia rudis</i>	0.5	5		N	
Grass & grasslike	<i>Dichelachne rara</i>	1	200		N	
Forb (FG)	<i>Chrysocephalum semipapposum</i>	1	50		N	
Forb (FG)	<i>Stylidium graminifolium</i>	0.1	30		N	
Forb (FG)	<i>Hypericum gramineum</i>	0.2	50		N	
	<i>Trifolium arvense</i>	0.1	100		E	
	<i>Centaurium erythraea</i>	0.1	20		E	
Grass & grasslike	<i>Rytidosperma penicillatum</i>	2	200		N	
Shrub (SG)	<i>Brachyloma daphnoides</i>	4	40		N	
Forb (FG)	<i>Euchiton japonicus</i>	0.1	30		N	
Shrub (SG)	<i>Dodonaea viscosa</i> subsp. <i>angustissima</i>	2	10		N	
Grass & grasslike	<i>Poa sieberiana</i> var. <i>sieberiana</i>	0.5	20		N	
Grass & grasslike	<i>Lomandra filiformis</i> subsp. <i>coriacea</i>	0.1	20		N	
Shrub (SG)	<i>Hibbertia obtusifolia</i>	0.2	2		N	
Shrub (SG)	<i>Bursaria spinosa</i>	1	5		N	
Shrub (SG)	<i>Acacia siculiformis</i>	1	10		N	
	<i>Hypericum perforatum</i>	0.1	5		HTE	
Other (OG)	<i>Glycine clandestina</i>	0.1	5		N	
Shrub (SG)	<i>Dillwynia phyllicoides</i>	2	10		N	
Shrub (SG)	<i>Indigofera australis</i>	0.1	3		N	
Forb (FG)	<i>Hovea heterophylla</i>	0.1	2		N	
Forb (FG)	<i>Gonocarpus tetragynus</i>	0.2	50		N	
Shrub (SG)	<i>Grevillea arenaria</i> subsp. <i>canescens</i>	0.1	3		N	
Forb (FG)	<i>Wahlenbergia stricta</i> subsp. <i>stricta</i>	0.1	10		N	
Forb (FG)	<i>Hydrocotyle sibthorpioides</i>	0.1	2		N	
Forb (FG)	<i>Galium gaudichaudii</i> subsp. <i>gaudichaudii</i>	0.1	5		N	
Forb (FG)	<i>Pimelea curviflora</i> var. <i>sericea</i>	0.1	3		N	
Forb (FG)	<i>Poranthera microphylla</i>	0.1	20		N	
Shrub (SG)	<i>Leucopogon attenuatus</i>	1	10		N	
Grass & grasslike	<i>Dichelachne sieberiana</i>	0.1	10		N	

BAM Site – Field Survey Form

Plot ID:	2276	Date:	14-04-19	Survey Name:	2276	Recorders:	MP, CE
Zone:	55	Easting:	624563.6143	Plot dimensions:	20m x 50m	Midline bearing:	154
Datum:	GDA94	Northing:	6041770.869	IBRA region:	South Eastern Highlands (Bondo)	Zone ID:	
Plant Community Type:	1191: Snow Gum - Candle Bark woodland on broad valley flats of the tablelands and slopes, South Eastern Highlands Bioregion				Confidence:	High	Photo #:
Vegetation Class:	Subalpine Woodlands				EEC:	No	Confidence:
						High	

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	5
	Shrubs:	12
	Grasses etc.:	8
	Forbs:	14
	Ferns:	0
	Other:	1
Sum of Cover of native vascular plants by growth form group	Trees:	15.9
	Shrubs:	46.6
	Grasses etc.:	61.2
	Forbs:	1.7
	Ferns:	0
	Other:	0.2
High Threat Weed cover:		6.3

BAM Attribute (1000 m2 plot) DBH			
DBH	Stem count (euc)	Stem count (non-euc)	Stems with Hollows
80 + cm:	0	0	0
50 – 79 cm:	2	0	0
30 – 49 cm:	3	0	0
20 – 29 cm:	1	0	0
10 – 19 cm:	1	0	0
5 – 9 cm:	1	0	0
< 5 cm:	1	0	0
Length of logs (m) (≥10 cm diameter, >50 cm in length)	33		

Counts apply when the number of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For a multi-stemmed tree, only the largest living stem is included in the count/estimate. Tree stems must be living. For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)					Bare ground cover (%)					Cryptogam cover (%)					Rock cover (%)				
Subplot score (% in each):	20	70	50	60	45	50	0	0	0	0	0	0	3	2	0	10	0	15	0	0
Average of the 5 subplots:	49					10					1					5				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type		Lf Element (A)	Hillslope	Lf Pattern (A)	Hills	Microrelief	
		Lf Element (B)		Lf Pattern (B)			
Lithology (A)	Quartz and stone	Soil Surface Texture	Loamy	Soil Colour	Browm	Soil Depth	Moderate
Lithology (B)							
Slope		Aspect	SW	Site Drainage	Good	Distance to nearest water & type	50m

Plot Disturbance	Severity code	Age code	Observational evidence
Clearing (inc. logging):			
Cultivation (inc. pasture):			
Soil erosion:			
Firewood / CWD removal:			
Grazing (identify native/stock):			
Fire damage:			
Storm damage:			
Weediness:	Moderate	less than 3yo	Rubus fruticosus agg
Other:			

Severity: 0=no evidence, 1=light, 2=moderate, 3=severe

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
 Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
 Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Survey Name:	25-03-06 0:00						
		Date:	14-04-19	Plot ID:	2276	Recorders:	MP, CE

GF Code	Top 3 native species in each growth form group: Full species name mandatory All other native and exotic species: Full species name where practicable	Cover	Abund	Voucher	N, E or HTE	Stratum
Grass & grasslike	<i>Themeda triandra</i>	55	500	No	N	
Shrub (SG)	<i>Bursaria spinosa</i>	20	100	No	N	
Shrub (SG)	<i>Exocarpos strictus</i>	1	20	No	N	
	<i>Potentilla recta</i>	0.6	50	No	E	
	<i>Hypericum perforatum</i>	1	100	No	HTE	
Grass & grasslike	<i>Poa costiniana</i>	5	100	No	N	
Shrub (SG)	<i>Banksia canei</i>	3	10	No	N	
Tree (TG)	<i>Eucalyptus rubida</i>	2	2	No	N	
Tree (TG)	<i>Eucalyptus stellulata</i>	5	3	No	N	
	<i>Rosa rubiginosa</i>	0.1	3	No	HTE	
	<i>Rubus fruticosus</i> sp. agg.	5	20	No	HTE	
Tree (TG)	<i>Acacia melanoxylon</i>	1.5	3	No	N	
	<i>Centaurium</i> spp.	0.1	60	No	E	
Grass & grasslike	<i>Rytidosperma</i> spp.	0.1	10	No	N	
Forb (FG)	<i>Geranium</i> spp.	0.1	10	No	N	
Other (OG)	<i>Glycine clandestina</i>	0.2	15	No	N	
Grass & grasslike	<i>Lomandra filiformis</i>	0.6	20	No	N	
	<i>Paspalum dilatatum</i>	0.1	10	No	HTE	
Forb (FG)	<i>Dichondra repens</i>	0.2	100	No	N	
Forb (FG)	<i>Gonocarpus tetragynus</i>	0.1	60	No	N	
Tree (TG)	<i>Eucalyptus dives</i>	0.4	1	No	N	
	<i>Acetosella vulgaris</i>	0.1	12	No	HTE	
Shrub (SG)	<i>Pimelea linifolia</i>	1	100	No	N	
Shrub (SG)	<i>Leucopogon ericoides</i>	0.4	20	No	N	
Forb (FG)	<i>Hypericum gramineum</i>	0.1	4	No	N	
	<i>Conyza</i> spp.	0.1	4	No	E	
Shrub (SG)	<i>Leucopogon virgatus</i>	0.8	20	No	N	
Shrub (SG)	<i>Dodonaea viscosa</i> subsp. <i>Angustissima</i>	3	30	No	N	
Shrub (SG)	<i>Mirbelia oxylobioides</i>	15	25	No	N	
Forb (FG)	<i>Dianella</i> spp.	0.2	15	No	N	
Forb (FG)	<i>Viola betonicifolia</i>	0.1	4	No	N	
Forb (FG)	<i>Ajuga australis</i>	0.1	4	No	N	
Forb (FG)	<i>Asperula conferta</i>	0.1	50	No	N	
	<i>Hypochaeris radicata</i>	0.1	8	No	E	
Grass & grasslike	<i>Dichelachne rara</i>	0.1	10	No	N	
Forb (FG)	<i>Oxalis perennans</i>	0.1	4	No	N	
Forb (FG)	<i>Hovea heterophylla</i>	0.1	6	No	N	
Shrub (SG)	<i>Pimelea curviflora</i>	0.2	20	No	N	
Grass & grasslike	<i>Luzula</i> spp.	0.1	8	No	N	
Shrub (SG)	<i>Brachyloma daphnoides</i>	2	40	No	N	
Shrub (SG)	<i>Hibbertia obtusifolia</i>	0.1	4	No	N	
Forb (FG)	<i>Hydrocotyle laxiflora</i>	0.1	10	No	N	
Tree (TG)	<i>Eucalyptus dalrympleana</i>	7	11	No	N	
Grass & grasslike	<i>Lomandra multiflora</i> subsp. <i>Multiflora</i>	0.1	1	No	N	
Shrub (SG)	<i>Acrotriche serrulata</i>	0.1	2	No	N	
Forb (FG)	<i>Cymbonotus</i> spp.	0.1	4	No	N	
Forb (FG)	<i>Acaena</i> spp.	0.2	10	No	N	

Grass & grasslike	<i>Poa helmsii</i>	0.2	4	No	N	
	<i>Verbascum virgatum</i>	0.1	4	No	E	
Forb (FG)	<i>Plantago spp.</i>	0.1	6	No	N	

BAM Site – Field Survey Form

Plot ID:	3303	Date:	25-06-19	Survey Name:	LINK RD	Recorders:	MP DK
Zone:	55	Easting:	628407.8108	Plot dimensions:	20m x 50m	Midline bearing:	228
Datum:	GDA94	Northing:	6027219.862	IBRA region:	Australian Alps (Snowy Mountains)	Zone ID:	
Plant Community Type:	1196: Snow Gum - Mountain Gum shrubby open forest of montane areas, South Eastern Highlands Bioregion and Australian Alps Bioregion				Confidence:	High	Photo #:
Vegetation Class:	Subalpine Woodlands				EEC:	No	Confidence:
						High	

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	0
	Shrubs:	5
	Grasses etc.:	7
	Forbs:	15
	Ferns:	0
	Other:	0
Sum of Cover of native vascular plants by growth form group	Trees:	0
	Shrubs:	2.1
	Grasses etc.:	81.3
	Forbs:	9.9
	Ferns:	0
	Other:	0
High Threat Weed cover:		0.1

BAM Attribute (1000 m2 plot) DBH			
DBH	Stem count (euc)	Stem count (non-euc)	Stems with Hollows
80 + cm:	0	0	0
50 – 79 cm:	0	0	0
30 – 49 cm:	0	0	0
20 – 29 cm:	0	0	0
10 – 19 cm:	0	0	0
5 – 9 cm:	0	0	0
< 5 cm:	0	0	0
Length of logs (m) (≥10 cm diameter, >50 cm in length)	0		

Counts apply when the number of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For a multi-stemmed tree, only the largest living stem is included in the count/estimate. Tree stems must be living. For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)					Bare ground cover (%)					Cryptogam cover (%)					Rock cover (%)				
Subplot score (% in each):	95	75	70	50	50	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Average of the 5 subplots:	68					0.2					0					0				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type		Lf Element (A)	Hillslope	Lf Pattern (A)		Microrelief	
		Lf Element (B)		Lf Pattern (B)			
Lithology (A)		Soil Surface Texture		Soil Colour		Soil Depth	
Lithology (B)							
Slope	1	Aspect	W	Site Drainage	Moderate	Distance to nearest water & type	

Plot Disturbance	Severity code	Age code	Observational evidence
Clearing (inc. logging):	Severe	greater than 10yo	Cleared during powerlines being built. Prob a laydown
Cultivation (inc. pasture):			
Soil erosion:			
Firewood / CWD removal:			
Grazing (identify native/stock):	Light		Macropod
Fire damage:			
Storm damage:			
Weediness:	Moderate		Some exotic grasses. Close to a road
Other:			

Severity: 0=no evidence, 1=light, 2=moderate, 3=severe

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
 Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
 Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Survey Name:	LINK RD					
			Date:	25-06-19	Plot ID:	3303
			Recorders:		MP DK	

GF Code	Top 3 native species in each growth form group: Full species name mandatory All other native and exotic species: Full species name where practicable	Cover	Abund	Voucher	N, E or HTE	Stratum
Grass & grasslike	<i>Poa helmsii</i>	5	50		N	
Grass & grasslike	<i>Poa spp.</i>	25	500		N	
Shrub (SG)	<i>Bossiaea foliosa</i>	0.1	2		N	
Shrub (SG)	<i>Hakea microcarpa</i>	0.4	2		N	
Shrub (SG)	<i>Pimelea linifolia</i>	1	60		N	
Forb (FG)	<i>Scleranthus biflorus</i>	2	1000		N	
Forb (FG)	<i>Epilobium spp.</i>	1	2000		N	
Grass & grasslike	<i>Carex spp.</i>	1	900		N	
	<i>Hypochaeris radicata</i>	1	250		E	
Forb (FG)	<i>Geranium spp.</i>	0.2	80		N	
Grass & grasslike	<i>Rytidosperma pilosum</i>	50	2000		N	
Forb (FG)	<i>Stellaria pungens</i>	0.1	10		N	
Forb (FG)	<i>Pratia spp.</i>	0.2	100		N	
Forb (FG)	<i>Oreomyrrhis spp.</i>	0.2	100		N	
	<i>Acetosella vulgaris</i>	0.1	50		HTE	
Forb (FG)	<i>Acaena spp.</i>	0.2	60		N	
Forb (FG)	<i>Ranunculus spp.</i>	0.1	10		N	
Forb (FG)	<i>Ajuga australis</i>	0.3	25		N	
Forb (FG)	<i>Acaena novae-zelandiae</i>	0.1	10		N	
	<i>Trifolium repens</i>	0.1	4		E	
Shrub (SG)	<i>Podolobium alpestre</i>	0.4	8		N	
	<i>Conyza spp.</i>	0.1	1		E	
Forb (FG)	<i>Cardamine spp.</i>	0.1	40		N	
Forb (FG)	<i>Euchiton spp.</i>	0.3	1000		N	
Grass & grasslike	<i>Lomandra spp.</i>	0.1	30		N	
Forb (FG)	<i>Asperula scoparia</i>	0.1	15		N	
Forb (FG)	<i>Asteraceae indeterminate</i>	1	150		N	
	<i>Poaceae indeterminate</i>	3	250		E	
Forb (FG)	<i>Oreomyrrhis argentea</i>	4	300		N	
Grass & grasslike	<i>Luzula spp.</i>	0.1	10		N	
Shrub (SG)	<i>Acrothamnus hookeri</i>	0.2	4		N	
Grass & grasslike	<i>Carex inversa</i>	0.1	4		N	

Appendix B

Vegetation integrity assessment – plot data

Table B.1 Vegetation integrity plot data

plot	zone	easting	northing	bearing	compTree	compShrub	compGrass	compForbs	compFerns	compOther	strucTree	strucShrub	strucGrass	strucForbs	strucFerns	strucOther	funLargeTrees	funHollowtrees	funLitterCover	funLenFallenLogs	funTreeStem5to9	funTreeStem10to19	funTreeStem20to29	funTreeStem30to49	funTreeStem50to79	funTreeRegen	funHighThreatExotic
187	55	628142	6046952	90	3	10	6	6	1	1	2.0	10.8	7.2	3.8	60.0	0.5	0	0	77.6	84.0	0	0	0	0	0	0	1.1
190	55	627370	6044578	300	3	11	5	6	1	2	20.0	29.3	2.5	0.9	0.1	0.6	1	2	88.0	200.0	0	0	0	0	1	0	0.0
192	55	627959	6045557	160	3	13	5	12	0	3	25.5	38.8	16.5	2.4	0.0	0.4	1	5	87.0	30.0	0	0	0	0	1	0	0.0
1001	55	624846	6040479	120	2	7	6	7	0	1	40.0	75.6	5.5	0.7	0.0	0.1	1	3	97.0	51.0	1	1	1	1	1	1	32.1
1053	55	625100	6041600	260	3	15	5	11	0	1	35.0	24.4	3.7	2.2	0.0	0.1	1	0	72.0	43.0	1	1	1	1	1	1	0.1
11	55	628566	6048199	180	2	9	8	15	0	0	0.3	3.1	81.4	4.4	0.0	0.0	0	0	50.0	27.0	0	0	0	0	0	0	7.1
216	55	627033	6033444	211	6	7	5	18	0	2	22.3	6.9	72.3	4.0	0.0	0.3	4	4	28.0	43.0	1	1	1	1	1	1	0.2
2276	55	624564	6041771	154	5	12	8	14	0	1	15.9	46.6	61.2	1.7	0.0	0.2	2	0	49.0	33.0	1	1	1	1	1	1	6.3
3303	55	628408	6027220	228	0	5	7	15	0	0	0.0	2.1	81.3	9.9	0.0	0.0	0	0	68.0	0.0	0	0	0	0	0	0	0.1

Appendix C

Credit Report

BAM Credit Summary Report

Proposal Details

Assessment Id	Proposal Name	BAM data last updated *
00016724/BAAS17037/19/00016725	Snowy Hydro - EW Modification 2	17/10/2019
Assessor Name	Report Created	BAM Data version *
	23/10/2019	16
Assessor Number	BAM Case Status	Date Finalised
	Open	To be finalised
Assessment Revision	Assessment Type	
1	Major Projects	

* Disclaimer: BAM data last updated may indicate either complete or partial update of the BAM calculator database. BAM calculator database may not be completely aligned with Bionet.

Ecosystem credits for plant communities types (PCT), ecological communities & threatened species habitat

Zone	Vegetation zone name	Vegetation integrity loss / gain	Area (ha)	Constant	Species sensitivity to gain class (for BRW)	Biodiversity risk weighting	Potential SAIL	Ecosystem credits
Brittle Gum - peppermint open forest of the Woomargama to Tumut region, NSW South Western Slopes Bioregion								
1	296_DNG	41.2	0.1	0.25	High Sensitivity to Potential Gain	1.50		2
2	296_High	55.3	0.5	0.25	High Sensitivity to Potential Gain	1.50		10

BAM Credit Summary Report

						Subtotal	12
Broad-leaved Peppermint - Candlebark shrubby open forest of montane areas, southern South Eastern Highlands Bioregion and South East Corner Bioregion							
5	729_High	71.9	0.1	0.25	High Sensitivity to Potential Gain	1.50	4
						Subtotal	4
Mountain Gum - Snow Gum - Broad-leaved Peppermint shrubby open forest of montane ranges, South Eastern Highlands Bioregion and Australian Alps Bioregion							
6	953_DNG	36.7	0.1	0.25	High Sensitivity to Potential Gain	1.50	1
7	953_High	79.0	0.1	0.25	High Sensitivity to Potential Gain	1.50	2
						Subtotal	3
Ribbon Gum - Narrow-leaved (Robertsons) Peppermint montane fern - grass tall open forest on deep clay loam soils in the upper NSW South Western Slopes Bioregion and western Kosciuszko escarpment							
3	300_Medium	56.0	0.2	0.25	High Sensitivity to Potential Gain	1.50	4
4	300_High	56.8	0.1	0.25	High Sensitivity to Potential Gain	1.50	2
						Subtotal	6
Snow Gum - Candle Bark woodland on broad valley flats of the tablelands and slopes, South Eastern Highlands Bioregion							
8	1191_High	85.3	0.1	0.25	High Sensitivity to Potential Gain	2.50	4
						Subtotal	4
Snow Gum - Mountain Gum shrubby open forest of montane areas, South Eastern Highlands Bioregion and Australian Alps Bioregion							
9	1196_DNG	41.1	0.5	0.25	High Sensitivity to Potential Gain	1.50	7
						Subtotal	7
						Total	36

Species credits for threatened species

Vegetation zone name	Habitat condition (HC)	Area (ha) / individual (HL)	Constant	Biodiversity risk weighting	Potential SAIL	Species credits
<i>Cercartetus nanus / Eastern Pygmy-possum (Fauna)</i>						
296_High	55.3	0.46	0.25	2	False	13
300_Medium	56.0	0.2	0.25	2	False	6
953_High	79.0	0.06	0.25	2	False	2
729_High	71.9	0.13	0.25	2	False	5
300_High	56.8	0.08	0.25	2	False	2
					Subtotal	28
<i>Pseudomys fumeus / Smoky Mouse (Fauna)</i>						
953_High	79.0	0.06	0.25	3	True	4
					Subtotal	4

Appendix D

MNES Protected Matters Search



EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about [Environment Assessments](#) and the EPBC Act including significance guidelines, forms and application process details.

Report created: 02/10/19 12:47:01

[Summary](#)

[Details](#)

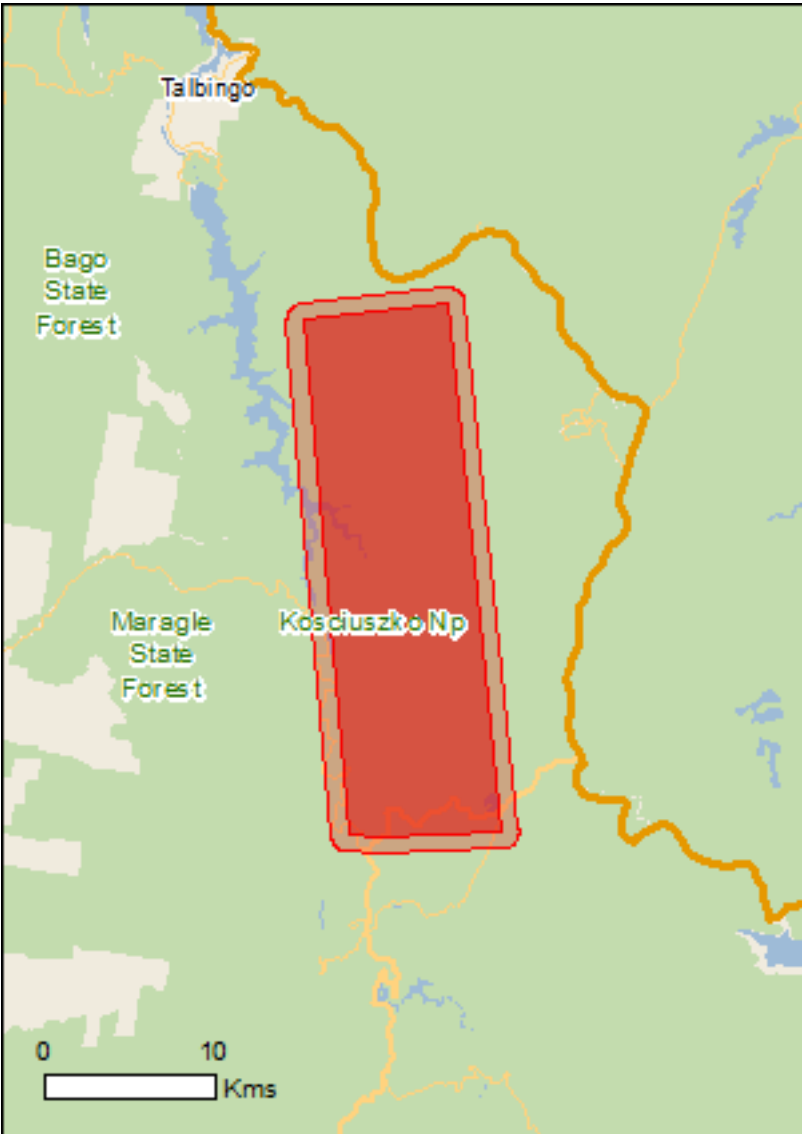
[Matters of NES](#)

[Other Matters Protected by the EPBC Act](#)

[Extra Information](#)

[Caveat](#)

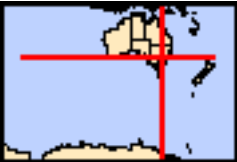
[Acknowledgements](#)



This map may contain data which are ©Commonwealth of Australia (Geoscience Australia), ©PSMA 2010

[Coordinates](#)

[Buffer: 1.0Km](#)



Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the [Administrative Guidelines on Significance](#).

World Heritage Properties:	None
National Heritage Places:	2
Wetlands of International Importance:	4
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	3
Listed Threatened Species:	33
Listed Migratory Species:	11

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at <http://www.environment.gov.au/heritage>

A [permit](#) may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	16
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	1
Regional Forest Agreements:	1
Invasive Species:	31
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

National Heritage Properties		[Resource Information]
Name	State	Status
Natural		
Australian Alps National Parks and Reserves	NSW	Listed place
Historic		
Snowy Mountains Scheme	NSW	Listed place

Wetlands of International Importance (Ramsar)		[Resource Information]
Name	Proximity	
Banrock station wetland complex	700 - 800km upstream	
Hattah-kulkyne lakes	500 - 600km upstream	
Riverland	600 - 700km upstream	
The coorong, and lakes alexandrina and albert wetland	700 - 800km upstream	

Listed Threatened Ecological Communities [Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Name	Status	Type of Presence
Alpine Sphagnum Bogs and Associated Fens	Endangered	Community known to occur within area
Natural Temperate Grassland of the South Eastern Highlands	Critically Endangered	Community likely to occur within area
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	Critically Endangered	Community may occur within area

Listed Threatened Species [Resource Information]

Name	Status	Type of Presence
Birds		
Anthochaera phrygia Regent Honeyeater [82338]	Critically Endangered	Foraging, feeding or related behaviour may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Grantiella picta Painted Honeyeater [470]	Vulnerable	Species or species habitat likely to occur within area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Rostratula australis Australian Painted-snipe, Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area
Fish		
Maccullochella macquariensis Trout Cod [26171]	Endangered	Species or species habitat may occur within

Name	Status	Type of Presence
		area
Maccullochella peelii Murray Cod [66633]	Vulnerable	Species or species habitat may occur within area
Macquaria australasica Macquarie Perch [66632]	Endangered	Translocated population known to occur within area
Frogs		
Litoria booroolongensis Booroolong Frog [1844]	Endangered	Species or species habitat likely to occur within area
Litoria raniformis Growling Grass Frog, Southern Bell Frog, Green and Golden Frog, Warty Swamp Frog [1828]	Vulnerable	Species or species habitat may occur within area
Litoria spenceri Spotted Tree Frog [25959]	Endangered	Species or species habitat may occur within area
Litoria verreauxii alpina Alpine Tree Frog, Verreaux's Alpine Tree Frog [66669]	Vulnerable	Species or species habitat known to occur within area
Pseudophryne corroboree Southern Corroboree Frog [1915]	Critically Endangered	Species or species habitat may occur within area
Mammals		
Burramys parvus Mountain Pygmy-possum [267]	Endangered	Species or species habitat may occur within area
Dasyurus maculatus maculatus (SE mainland population) Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (southeastern mainland population) [75184]	Endangered	Species or species habitat likely to occur within area
Mastacomys fuscus mordicus Broad-toothed Rat (mainland), Tooarrana [87617]	Vulnerable	Species or species habitat likely to occur within area
Petauroides volans Greater Glider [254]	Vulnerable	Species or species habitat may occur within area
Phascolarctos cinereus (combined populations of Qld, NSW and the ACT) Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory) [85104]	Vulnerable	Species or species habitat may occur within area
Pseudomys fumeus Smoky Mouse, Konoom [88]	Endangered	Species or species habitat likely to occur within area
Pteropus poliocephalus Grey-headed Flying-fox [186]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Plants		
Calotis glandulosa Mauve Burr-daisy [7842]	Vulnerable	Species or species habitat may occur within area
Colobanthus curtisiae Curtis' Colobanth [23961]	Vulnerable	Species or species habitat likely to occur within area
Glycine latrobeana Clover Glycine, Purple Clover [13910]	Vulnerable	Species or species habitat may occur within area

Name	Status	Type of Presence
Leucochrysum albicans var. tricolor Hoary Sunray, Grassland Paper-daisy [56204]	Endangered	Species or species habitat may occur within area
Prasophyllum bagoense Bago Leek-orchid [84276]	Critically Endangered	Species or species habitat known to occur within area
Prasophyllum innubum Brandy Marys Leek-orchid [83603]	Critically Endangered	Species or species habitat known to occur within area
Pterostylis oreophila Blue-tongued Orchid, Kiandra Greenhood [22903]	Critically Endangered	Species or species habitat known to occur within area
Rutidosia leiolepis Monaro Golden Daisy [21490]	Vulnerable	Species or species habitat likely to occur within area
Thesium australe Austral Toadflax, Toadflax [15202]	Vulnerable	Species or species habitat known to occur within area
Xerochrysum palustre Swamp Everlasting, Swamp Paper Daisy [76215]	Vulnerable	Species or species habitat likely to occur within area

Reptiles		
Aprasia parapulchella Pink-tailed Worm-lizard, Pink-tailed Legless Lizard [1665]	Vulnerable	Species or species habitat may occur within area
Cyclodomorphus praealtus Alpine She-oak Skink [64721]	Endangered	Species or species habitat may occur within area

Listed Migratory Species

[[Resource Information](#)]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area

Migratory Terrestrial Species		
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat known to occur within area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat known to occur within area

Migratory Wetlands Species		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Listed Marine Species	[Resource Information]	
* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.		
Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba Great Egret, White Egret [59541]		Species or species habitat likely to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area

Name	Threatened	Type of Presence
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat known to occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat may occur within area

Extra Information

State and Territory Reserves	[Resource Information]
Name	State
Kosciuszko	NSW

Regional Forest Agreements	[Resource Information]
Note that all areas with completed RFAs have been included.	
Name	State
Southern RFA	New South Wales

Invasive Species	[Resource Information]
Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.	

Name	Status	Type of Presence
Birds		
Acridotheres tristis Common Myna, Indian Myna [387]		Species or species habitat likely to occur within area
Alauda arvensis Skylark [656]		Species or species habitat likely to occur within area
Anas platyrhynchos Mallard [974]		Species or species habitat likely to occur within area
Carduelis carduelis European Goldfinch [403]		Species or species habitat likely to occur within area
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Passer domesticus House Sparrow [405]		Species or species habitat likely to occur within area
Passer montanus Eurasian Tree Sparrow [406]		Species or species habitat likely to occur

Name	Status	Type of Presence
		within area
Streptopelia chinensis Spotted Turtle-Dove [780]		Species or species habitat likely to occur within area
Sturnus vulgaris Common Starling [389]		Species or species habitat likely to occur within area
Turdus merula Common Blackbird, Eurasian Blackbird [596]		Species or species habitat likely to occur within area
Mammals		
Bos taurus Domestic Cattle [16]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Equus caballus Horse [5]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Feral deer Feral deer species in Australia [85733]		Species or species habitat likely to occur within area
Lepus capensis Brown Hare [127]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
Sus scrofa Pig [6]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Asparagus asparagoides Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473]		Species or species habitat likely to occur within area
Cytisus scoparius Broom, English Broom, Scotch Broom, Common Broom, Scottish Broom, Spanish Broom [5934]		Species or species habitat likely to occur within area
Genista sp. X Genista monspessulana Broom [67538]		Species or species habitat may occur within area
Nassella neesiana Chilean Needle grass [67699]		Species or species

Name	Status	Type of Presence
		habitat likely to occur within area
Nassella trichotoma Serrated Tussock, Yass River Tussock, Yass Tussock, Nassella Tussock (NZ) [18884]		Species or species habitat likely to occur within area
Pinus radiata Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780]		Species or species habitat may occur within area
Rubus fruticosus aggregate Blackberry, European Blackberry [68406]		Species or species habitat likely to occur within area
Salix spp. except S.babylonica, S.x calodendron & S.x reichardtii Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow [68497]		Species or species habitat likely to occur within area
Senecio madagascariensis Fireweed, Madagascar Ragwort, Madagascar Groundsel [2624]		Species or species habitat likely to occur within area
Ulex europaeus Gorse, Furze [7693]		Species or species habitat likely to occur within area

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

-35.899596 148.391063,-35.89904 148.375271,-35.680702 148.351925,-35.674009 148.427456,-35.897928 148.455608,-35.899596 148.391063

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

- [Office of Environment and Heritage, New South Wales](#)
- [Department of Environment and Primary Industries, Victoria](#)
- [Department of Primary Industries, Parks, Water and Environment, Tasmania](#)
- [Department of Environment, Water and Natural Resources, South Australia](#)
- [Department of Land and Resource Management, Northern Territory](#)
- [Department of Environmental and Heritage Protection, Queensland](#)
- [Department of Parks and Wildlife, Western Australia](#)
- [Environment and Planning Directorate, ACT](#)
- [Birdlife Australia](#)
- [Australian Bird and Bat Banding Scheme](#)
- [Australian National Wildlife Collection](#)
- Natural history museums of Australia
- [Museum Victoria](#)
- [Australian Museum](#)
- [South Australian Museum](#)
- [Queensland Museum](#)
- [Online Zoological Collections of Australian Museums](#)
- [Queensland Herbarium](#)
- [National Herbarium of NSW](#)
- [Royal Botanic Gardens and National Herbarium of Victoria](#)
- [Tasmanian Herbarium](#)
- [State Herbarium of South Australia](#)
- [Northern Territory Herbarium](#)
- [Western Australian Herbarium](#)
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- [Australian Government, Department of Defence](#)
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- [Australian Tropical Herbarium, Cairns](#)
- [eBird Australia](#)
- [Australian Government – Australian Antarctic Data Centre](#)
- [Museum and Art Gallery of the Northern Territory](#)
- [Australian Government National Environmental Science Program](#)
- [Australian Institute of Marine Science](#)
- [Reef Life Survey Australia](#)
- [American Museum of Natural History](#)
- [Queen Victoria Museum and Art Gallery, Inveresk, Tasmania](#)
- [Tasmanian Museum and Art Gallery, Hobart, Tasmania](#)
- Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the [Contact Us](#) page.

Appendix E

EPBC Act protected matters likelihood of occurrence assessment

E.1 Likelihood of occurrence assessment – threatened ecological communities

Table E.1 Likelihood of occurrence assessment – threatened ecological communities

Threatened Ecological Community	EPBC Act	BC Act	Likelihood of occurrence	Justification
Alpine Sphagnum Bogs and Associated Fens	EN	E1	Negligible	<p>Alpine Sphagnum Bogs and Associated Fens community is found in permanently wet areas, such as along streams, drainage lines, valley edges and valley floors in alpine, sub-alpine and montane areas, on general to moderate slopes. The characteristic floristics, of which Sphagnum is a major component, are maintained by summer groundwater seepage.</p> <p>Desktop assessment did not identify any communities within the project area that are associated with this TEC. The community was not identified during detailed vegetation mapping.</p>
Natural Temperate Grassland of the South Eastern Highlands	CE	-	Negligible	<p>Natural Temperate Grasslands of the South Eastern Highlands occurs at elevations of 250-1200 m, on a wide range of topographic positions and on soils derived from a variety of substrates. It occurs as a naturally treeless or sparsely treed community.</p> <p>The project area does not support naturally treeless areas of grassland. All grassland communities are derived due to clearing.</p>
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	CE	E4A	Negligible	<p>White Box-Yellow Box-Blakely's Red Gum Grassy Woodlands occurs from Queensland to South Australia, with the predicted distribution of the community including the northern end of the project area at Talbingo. The community occurs as a grassy woodland or derived grassland community dominated by White Box (<i>Eucalyptus albens</i>), Yellow Box (<i>E.melliodora</i>) or Blakely's Red Gum (<i>E.blakelyi</i>) in the east of the community's range, or Grey Box (<i>E.microcarpa</i> or <i>E. moluccana</i>) in the Nandewar bioregion.</p> <p>The community was not identified during detailed vegetation mapping.</p>

Notes: 1. EPB Act status: CE- critically endangered, EN – endangered, VU – vulnerable
2. BC Act status: E4A – critically endangered, E1 – endangered, E2 – endangered population, V - vulnerable

E.2 Likelihood of occurrence assessment – threatened flora

Table E.2 Likelihood of occurrence assessment – threatened flora

Scientific name	Common name	EPBC Act	BC Act	Likelihood of occurrence	Justification
<i>Calotis glandulosa</i>	Mauve Burr-daisy	VU	V	Low	<p>The Mauve Burr-daisy is a sprawling, branches herb occurring in montane and subalpine grasslands in the Australian Alps. It is mostly found in subalpine grassland (dominated by <i>Poa spp.</i>) and montane or natural temperate grassland dominated by Kangaroo Grass and Snow Gum Woodlands within the Monaro area. The species is common on roadsides as it known to colonise on bare patches.</p> <p>The species has not been recorded within 10 km of the project area.</p> <p>The project area does not support suitable grassland habitat.</p>
<i>Colobanthus curtisiae</i>	Curtis' Colobanth	VU	-	Low	<p>Curtis' Colobanth, is a glabrous tufted perennial herb to 40 mm high, forming small clumps from laterally branching short stems. The species is known to occur in a wide variety of vegetation communities, including lowland <i>Poa</i> and <i>Themeda</i> grasslands, to grassy and shrubby woodland/forests and rockplates. It occurs on gentle slopes with elevations of between 160 m to 1300 m. The species is most commonly found on soils derived from sandstone as well as clay loams derived from dolerite and basalt.</p> <p>The species has not been recorded within 10 km of the project area.</p> <p>Given the limited understanding of the species' ecology, Curtis' Colobanth was considered a candidate species requiring further consideration. The species was considered to have potential to occur on gently sloping areas with basalt derived soils in the upper reaches of Lobs Hole Ravine Road.</p> <p>This species was not recorded during targeted surveys.</p>

Table E.2 **Likelihood of occurrence assessment – threatened flora**

Scientific name	Common name	EPBC Act	BC Act	Likelihood of occurrence	Justification
<i>Glycine latrobeana</i>	Clover Glycine	V	E4A	Negligible	<p>Clover Glycine is a decumbent to ascending herb growing to only a few centimetres high. Leaves are trifoliate, providing the name. The species is endemic to south-eastern Australia, where it is widely distributed from Port Pirie in South Australia, through much of Victoria to near Hobart in Tasmania. There are historical records of the species from Delegate and near Tom Groggin; however, subsequent searches have failed to locate these plants. In 2011 a population of Clover Glycine was located at Kellys Plain in Kosciuszko National Park. The species is recorded from grassland and grassy woodland, with the species restricted to a ~ 3 ha area in NSW.</p> <p>The species has not been recorded within 10 km of the project area.</p> <p>The project area does not support suitable habitat.</p>
<i>Leucochrysum albicans</i> var. <i>tricolor</i>	Hoary Sunray	EN	-	Negligible	<p>The Hoary Sunray is a small, perennial paper daisy endemic to south-eastern Australia, where it occurs in NSW, the ACT Victoria and Tasmania. In NSW the species occurs in an area roughly bounded by Albury, Bega and Goulburn, occupying grasslands, grassy areas in woodlands and dry open forests, and modified habitats, on a variety of soil types.</p> <p>The species has not been recorded within 10 km of the project area.</p> <p>The project area is outside the known distribution of the species and does not support suitable grassland or open grassy woodland habitats.</p>
<i>Prasophyllum bagoense</i>	Bago Leek-orchid	CE	E4A	Negligible	<p>The Bago Leek-orchid is a slender, tuberous, terrestrial orchid growing singly or in loose groups. The species is known from a single population at McPhersons Plain, east of Tumbarumba in the Southern Tablelands of New South Wales. The species' habitat is a sub-alpine treeless plain at an elevation of approximately 1200 m where it grows in wet sedgeland, tall wet heathland, open heathland extending onto adjacent eucalypt woodland. The species grows in moist to wet shallow clay loam. The underlying basalt geology may be an important feature.</p> <p>There are six records of this species within 10 km of the project area, all to the west of the survey area.</p> <p>The project area does not support suitable treeless plain habitat.</p>

Table E.2 **Likelihood of occurrence assessment – threatened flora**

Scientific name	Common name	EPBC Act	BC Act	Likelihood of occurrence	Justification
<i>Prasophyllum innubum</i>	Brandy Marys Leek-orchid	CE	E4A	Negligible	<p>Brandy Mary's Leek-orchid is a terrestrial herb growing singly or in loose groups, with an erect leaf 25–50 cm long and with 6–20 small brownish-purple flowers with white or pinkish labellums. The species is restricted to a 45 km² area east of Tumbarumba in the Southern Tablelands in Bago State Forest and adjacent private land. It grows beside small streams and peatland Sphagnum hummocks, in adjacent grassy flats and also extending into open woodland at around 1,200 m elevation. The underlying basalt geology may be an important feature.</p> <p>There are two records of the species within 10 km of the project area.</p> <p>The project area does not support suitable natural grassy flats or peatlands.</p>
<i>Pterostylis oreophila</i>	Blue-tongued Orchid	CE	E4A	Low	<p>The Blue-tongued Greenhood is a terrestrial orchid growing to 200 mm tall, with dark green, fleshy, flat leaves. The solitary flowers are erect, light green and white. The recurved labellum is a distinctive bluish or blue-green (aqua) colour. The species occurs at 20 locations in four distinct geographic locations including the Kiandra and Bago areas of NSW. The species grows beside small montane and subalpine streams under tall dense thickets of Mountain Tea Tree (<i>Leptospermum grandiflorum</i>), in black oozing mud or less commonly in peaty soils and sphagnum mounds.</p> <p>There are three records of the species within 10 km of the project area.</p> <p>Marginal habitat was conservatively assumed to occur in the project area, in the south of the project area along Lobs Hole Ravine Road. The species was not recorded during targeted surveys.</p>
<i>Rutidosia leiolepis</i>	Monaro Golden Daisy	VU	V	Negligible	<p>The Monaro Golden Daisy, is a low, tufted perennial with dark green leaves, with a woolly under surface, to about 10 cm. The solitary, slightly domed flower-heads are about 15 mm across, and occur on erect woolly stems to about 25 cm tall. The species is known from 21 locations in Kosciuszko National Park on high (sub-alpine) treeless plains, mainly above an altitude of 1,200 m.</p> <p>The species has not been recorded within 10 km of the project area.</p> <p>The project area does not support suitable treeless plains grassland habitat.</p>

Table E.2 **Likelihood of occurrence assessment – threatened flora**

Scientific name	Common name	EPBC Act	BC Act	Likelihood of occurrence	Justification
<i>Thesium australe</i>	Austral Toadflax	VU	V	Low	<p>Austral Toadflax is a hairless, yellow-green perennial herb with slender wiry stems to 40 cm high and tiny white flowers. The species occurs in NSW, the ACT, Queensland and Victoria and has a sporadic and widespread distribution within this range. The species occurs in grassland on coastal headlands or grassland and grassy woodland away from the coast, and is often found in association with Kangaroo Grass (<i>Themeda australis</i>).</p> <p>There are 18 records of the species within 10 km of the project area.</p> <p>The species was considered to have potential to occur within the project area, particularly in discrete locations where Kangaroo Grass was prevalent. The species was not recorded during targeted surveys.</p>
<i>Xerochrysum palustre</i>	Swamp Everlasting	VU	-	Negligible	<p>The Swamp Everlasting is a small erect herb, endemic to south-eastern Australia with a distribution spanning south-eastern NSW through Victoria to north-eastern Tasmania. It is found growing at elevations of up to 1,300 m. The species grows in wetlands including sedge swamps and shallow freshwater marshes, often on heavy black clay soils.</p> <p>The species has not been recorded within 10 km of the project area.</p> <p>The project area does not support suitable wetland habitat.</p>

Notes: 1. EPB Act status: CE- critically endangered, EN – endangered, VU – vulnerable
2. BC Act status: E4A – critically endangered, E1 – endangered, E2 – endangered population, V - vulnerable

E.3 Likelihood of occurrence assessment – threatened fauna

Table E.3 Likelihood of occurrence assessment – threatened fauna

Scientific name	Common name	EPBC Act	BC Act	Likelihood of occurrence	Justification
Birds					
<i>Anthochaera phrygia</i>	Regent Honeyeater	CE	E4A	Negligible	<p>The Regent Honeyeater is a striking, predominantly black and yellow bird. Its head and neck are black, with warty pink or yellow skin around the eyes. Endemic to mainland south-eastern Australia, the species has a patchy distribution from south-east Queensland, through NSW and the ACT into central Victoria. Records are widely distributed across this range, but the species is only found regularly at a few localities in NSW and Victoria. Most records of regent honeyeaters come from box-ironbark eucalypt associations, where the species seems to prefer more fertile sites with higher soil water content. Other forest types regularly utilised by the Regent Honeyeater include wet lowland coastal forest dominated by Swamp Mahogany (<i>Eucalyptus robusta</i>), Spotted Gum-Ironbark associations and riverine woodlands.</p> <p>The species has not been recorded within 10 km of the project area.</p> <p>The project area does not support key habitat or feed tree species. The species has been recorded in the Southeast Highlands bioregion, but most records are located north east of the survey area on more fertile plains.</p>
<i>Calidris ferruginea</i>	Curlew Sandpiper	CE, Mi, M	E1	Negligible	<p>The Curlew Sandpiper is a small, slim sandpiper. Inland, the species mainly occur around ephemeral and permanent lakes, dams, waterholes and bore drains, usually with bare edges of mud or sand. They forage at the edges of shallow pools and drains of intertidal mudflats and sandy shores.</p> <p>The species has not been recorded within 10 km of the project area.</p> <p>The project area does not provide suitable waterbodies with muddy or sandy edges.</p>

Table E.3 **Likelihood of occurrence assessment – threatened fauna**

Scientific name	Common name	EPBC Act	BC Act	Likelihood of occurrence	Justification
<i>Grantiella picta</i>	Painted Honeyeater	VU	V	Negligible	<p>The Painted Honeyeater has black upperparts, white underparts, black spots on its flanks and yellow edges to the flight and tail feathers. The bill is a deep pink and the eye red. The species is sparsely distributed from south-eastern Australia to north-western Queensland and eastern Northern Territory, with inland slopes of the Great Dividing Range seeing greatest concentrations and almost all records of breeding. The species has a specialist diet mainly consisting of mistletoe fruits, but also includes nectar. The species inhabits mistletoes in a variety of vegetation types, including eucalypt forests/woodlands, riparian woodlands, box-ironbark-yellow gum woodlands, acacia-dominated woodlands, paperbarks, casuarinas, callitris, and trees on farmland or gardens.</p> <p>The species has not been recorded within 10 km of the project area and the species has not been recorded from similar montane or sub-alpine habitats in the region.</p> <p>The project area is outside the known distribution of the species and does not support suitable habitat providing abundant Mistletoes.</p>
<i>Hirundapus caudacutus</i>	White-throated Needletail	VU	-	Low	<p>An aerial species found in feeding concentrations over cities, hilltops and timbered ranges. Breeds in Asia. White-throated Needletails almost always forage aerially, at heights up to 'cloud level'</p> <p>There are eight records of the species within 10 km of the project area.</p> <p>The project area is not considered support any roosting habitat.</p>
<i>Numenius madagascariensis</i>	Eastern Curlew	CE, Mi, M		Negligible	<p>The Eastern Curlew is the largest migratory shorebird in the world, migrating to Australia during the northern hemisphere winter. In Australia, the species has a primarily coastal distribution, inhabiting sheltered coasts, especially estuaries, bays, harbours, inlets and coastal lagoons, with large intertidal mudflats or sandflats, often with beds of seagrass.</p> <p>The species has not been recorded within 10 km of the project area.</p> <p>The project area does not provide suitable intertidal habitat.</p>
<i>Rostratula australis</i>	Australian Painted Snipe	EN, M	E1	Negligible	<p>The Australian Painted Snipe is a stocky wading bird, endemic to Australia and has been recorded at wetlands in all states and territories. The species inhabits shallow ephemeral and permanent freshwater (occasionally brackish) wetlands.</p> <p>The species has not been recorded within 10 km of the project area.</p> <p>The project area does not provide suitable wetland habitat for this species.</p>

Table E.3 **Likelihood of occurrence assessment – threatened fauna**

Scientific name	Common name	EPBC Act	BC Act	Likelihood of occurrence	Justification
Small terrestrial mammals					
<i>Burramys parvus</i>	Mountain Pygmy-possum	EN	E1	Low	<p>The Mountain Pygmy-possum is the largest of the five species of Pygmy-possum with a head-body length of 10–11 cm, a tail length of 13–15 cm and adults weigh 35–80 g. The species is endemic to alpine, sub-alpine and montane areas of mainland south-eastern Australia, occurring in three separate regions: Kosciuszko National Park in NSW, and Mt Buller and Mt Bogong-Mt Higginbotham in Victoria. The species' ecology is linked to the highly seasonal environment. It occupies mostly boulderfields and rock screes, around or above the upper limits of the tree-line, associated with shrubby heath vegetation. Boulderfields with good rock structure and long snow duration provide a favourable microclimate. Proximity to permanent water has been found to be a key driver of suitable habitat. There are 73 records of the species within 10 km of the project area; all are from the Happy Jacks spoil site, 6 km south of the project area.</p> <p>Boulderfields in the survey area, along Lobs Hole Ravine Road, have been previously surveyed for the species by OEH. These sites are not located close to permanent water, and thought to be unsuitable for the species.</p> <p>This species was not recorded during surveys.</p>
<i>Mastacomys fuscus</i>	Broad-toothed Rat	VU	V, E2	Low	<p>The Broad-toothed Rat is a native rodent with a broad face, short tail and stocky body. It has fine, dense fur which is brown tinged with rufous above, merging to a paler grey underneath. The fur may have a green tinge due to the presence of algae. The species has a highly fragmented distribution, with scattered records across the Great Dividing Range from near Warburton in Victoria to the Brindabella Range in the ACT and up into the Barrington Tops in NSW, with at least one poorly-known subpopulation in coastal areas of far East Gippsland and south-eastern NSW. In alpine and sub-alpine areas the species inhabits alpine and subalpine heathlands, grassland adjacent to boulder outcrops, swamps, sedgelands and occasionally forests with grassy understories.</p> <p>There are 53 records of the species within 10 km of the project area; none of which are within Lobs Hole.</p> <p>The project area does not support suitable heathlands or grasslands for this species.</p>

Table E.3 **Likelihood of occurrence assessment – threatened fauna**

Scientific name	Common name	EPBC Act	BC Act	Likelihood of occurrence	Justification
<i>Pseudomys fumeus</i>	Smoky Mouse	EN	E4A	Recorded	<p>The Smoky Mouse is a small native rodent endemic to mainland south-eastern Australia, where it occurs in Victoria, NSW and the ACT. The species has a relatively wide but disjunct distribution within this broad range; populations are small and fragmented. The precise habitat requirements of the Smoky Mouse are not clear. A wide range of vegetation communities are occupied, from damp coastal heath in East Gippsland, to sub-alpine heath. However, in the South Eastern Highland most records are from ridgeline dry heathy open-forest.</p> <p>There is a single historical record of the species from near Yarrangobilly Caves, recorded from a Quoll scat. Bones of the Smoky Mouse have also been recorded in owl pellets during the excavation of a number of caves in the Lobs Hole Ravine area (to the south-west of the project area) and around Yarrangobilly Caves.</p> <p>The species was recorded at 59 locations within and adjacent to Modification 2, above 1,100 m ASL. Sub-alpine woodlands above 1,100 m are deemed suitable habitat.</p>
Large terrestrial mammals					
<i>Dasyurus maculatus</i>	Spotted-tailed Quoll	EN	V	Moderate	<p>The Spotted-tailed Quoll is one of Australia’s largest extant marsupial carnivores, and has a distinctive spotted appearance. The species is primarily forest-dependent , and occupies a wide range of habitat types, including rainforest, wet and dry sclerophyll forest, coastal heathland, scrub and dunes, woodland, heathy woodland, swamp forest, mangroves, on beaches and sometimes in grassland or pastoral areas adjacent to forested areas. The species has home ranges of several hundred to several thousand hectares in size and will use multiple dens. moving between den sites every 1-4 days. The species occurs at low densities.</p> <p>There are four records of the species within 10 km of the project area, to the west and north.</p> <p>The species has potential to occupy the project area at low densities, with large areas of suitable habitat present. In the project area, the species is likely to be wide ranging, making detection challenging. All areas are deemed to provide suitable habitat, with suitable denning sites focused on boulderfields, and areas with a high density of hollow logs.</p> <p>One scat record was recorded near Wallaces Creek Fire Trail, however the species was not detected during targeted surveys.</p>

Table E.3 **Likelihood of occurrence assessment – threatened fauna**

Scientific name	Common name	EPBC Act	BC Act	Likelihood of occurrence	Justification
Arboreal mammals					
<i>Petauroides volans</i>	Greater Glider	VU	E2	Low	<p>The Greater Glider is the largest gliding possum in Australia. The species is distributed across eastern Australia, occurring from the Windsor Tableland in north Queensland through to central Victoria (Wombat State Forest), with an elevational range from sea level to 1200 m above sea level. The species is restricted to eucalypt forests and woodlands, typically found in highest abundance in taller, montane, moist eucalypt forests with relatively old trees and abundant hollows. The species distribution may be patchy even in suitable habitat.</p> <p>There are three records of the species within 10 km of the project area.</p> <p>Suitable, taller, montane, moist eucalypt forests with old trees and abundant hollows is found along the upper sections of Lobs Hole Ravine Road and along the Yarrangobilly River. Suitable habitat on Lobs Hole Ravine Road is located above 1200 m. The species was not recorded during targeted surveys.</p>
<i>Phascolarctos cinereus</i>	Koala	VU	V, E2	Low	<p>The Koala is a tree-dwelling, medium-sized marsupial, distributed from Cairns to South Australia, however, the listed population does not include Victoria or South Australia. Koalas inhabit a range of temperate, sub-tropical and tropical forest, woodland and semi-arid communities dominated by species from the genus <i>Eucalyptus</i>. The distribution of Koalas is also affected by altitude, with the species limited to below 800 m ASL.</p> <p>The species has not been recorded within 10 km of the project area.</p> <p>Although the species is considered rare in Kosciuszko National Park, a precautionary approach to the species occupancy was undertaken, with suitable Eucalypt forest and woodland below 800 m elevation deemed to provide suitable habitat. The species was not recorded during targeted surveys.</p>

Table E.3 **Likelihood of occurrence assessment – threatened fauna**

Scientific name	Common name	EPBC Act	BC Act	Likelihood of occurrence	Justification
Bats					
<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox	VU	V	Low	<p>The Grey-headed Flying-fox is a large, endemic megachiropteran bat occurring in south-eastern Australia. The species distribution extends from Bundaberg in Queensland to Melbourne in Victoria, and from the coast inland to the western slopes of NNSW. There are some contemporary records from South Australia. The Grey-headed Flying-fox feeds on nectar and pollen from flowers of canopy trees and fleshy fruits from rainforest trees and vines, with regional preferences shown.</p> <p>The species has not been recorded within 10 km of the project area.</p> <p>The project area is outside the known distribution of the species, with records to the north and west of the project area considered areas of unusual occupation or vagrant records in the species' recovery plan (DECCW 2009). The species may occur as a vagrant within the project area on occasion.</p>
Amphibians					
<i>Litoria booroolongensis</i>	Booroolong Frog	EN	E1	Negligible	<p>The Booroolong Frog is a medium size, stream dwelling frog. It is nocturnal but can be seen during day on rocks in or near the water. The species is restricted to NSW and north-eastern Victoria, predominantly along western-flowing streams of the Great Dividing Range between 200 and 1,300 m above sea level. The Booroolong Frog is associated with permanent streams in a variety of vegetation types. Primary habitat requirements are extensive rock bank structures along permanent rivers with the key feature of these rock structures being rock crevices in relatively shallow, slow to medium-flowing sections of stream. By day frogs shelter under rocks or amongst vegetation near the ground along the edge of the stream. Breeding is known to occur in spring and early summer, from October to early January. Egg deposition sites are typically in shallow, slow-flowing sections of stream or isolated rock pools along stream margins. Tadpoles take 2-4 months to develop, metamorphosing in late summer to early autumn.</p> <p>There are five records within 10 km of the project area, from the Yarrangobilly River and Jounama Creek catchments.</p> <p>The Booroolong Frog was recorded adjacent to the project area within the Yarrangobilly River. The project area does not contain any suitable waterbodies to support this species.</p>

Table E.3 **Likelihood of occurrence assessment – threatened fauna**

Scientific name	Common name	EPBC Act	BC Act	Likelihood of occurrence	Justification
<i>Litoria raniformis</i>	Southern Bell Frog	VU	E1	Negligible	<p>The Growling Grass Frog is a large frog, with females exceeding 100 mm in length. The species is endemic to south-eastern Australia. In NSW the species occurs from Bombala in the far south-eastern corner of the state, through the Southern Tablelands, and along the Murrumbidgee and Murray Rivers. The Growling Grass Frog inhabits a wide range of still waterbodies, including lagoons, swamps, lakes, ponds, farm dams, irrigation channels and quarries and may occupy slow-flowing sections of streams and rivers.</p> <p>The species has not been recorded within 10 km of the project area.</p> <p>The project area is outside the known distribution of the species, and does not support suitable still waterbodies or slow-flowing stream habitat.</p>
<i>Litoria spenceri</i>	Spotted Tree Frog	EN	E4A	Negligible	<p>The Spotted Tree Frog is extremely rare and occurs in scattered, geographically isolated populations. It occurs among boulders or debris along naturally vegetated, rocky fast flowing upland streams and rivers. It is known from two streams in southern NSW on the north-west side of the Great Dividing Range. In summer, during the breeding season, adults bask on large in-stream boulders while juveniles occupy shingle banks. In winter animals are thought to hibernate in vegetation outside of the mainstream environment.</p> <p>The species has not been recorded within 10 km of the project area.</p> <p>Due to extremely limited population distribution in NSW this species is considered unlikely to occur within the project area.</p>
<i>Litoria verreauxii alpina</i>	Alpine Tree Frog	VU	E1	Negligible	<p>The Alpine Tree Frog is a relatively small Hylid frog, growing to approximately 3 cm in length. The species occurs in the alpine and sub-alpine zones of south-eastern NSW and Victoria, generally higher than 1100 metres above sea level and is the only frog species known to occur above the winter snowline on the Australian mainland. The Alpine Tree Frog breeds in natural and artificial wetlands including ponds, bogs, fens, streamside pools, stock dams and drainage channels that are slow flowing or still. Non-breeding habitat and overwintering refuges are poorly known but are likely to include flat rocks, fallen logs, leaf litter and other ground debris.</p> <p>There are 10 records of the species within 10 km of the project area, all to the east.</p> <p>The project area does not support suitable habitat for this species.</p>

Table E.3 **Likelihood of occurrence assessment – threatened fauna**

Scientific name	Common name	EPBC Act	BC Act	Likelihood of occurrence	Justification
<i>Pseudophryne corroboree</i>	Southern Corroboree Frog	CE	E4A	Negligible	<p>The Southern Corroboree Frog and Northern Corroboree are distinctive and easily recognised because of their striking dorsal colour patterns consisting of bright yellow or green longitudinal stripes alternating with black stripes. The two frog species have a limited geographic distribution. The Southern Corroboree Frog now occurs in a small number of remnant populations along the north-western edge of its former range (within Kosciuszko National Park, from Smiggin Holes in the south, and northwards to the Maragle Range. The species breeds in pools and seepages in sphagnum bogs, wet tussock grasslands, fens and wet heath. They also forage and shelter in montane forest, sub-alpine woodland and tall heath adjacent to the breeding areas. The Southern Corroboree Frog is highly restricted to areas above 1,300 m ASL. There are three records of the species within 10 km of the project area, all to the south.</p> <p>The project area is outside the restricted distribution of this species.</p>
Reptiles					
<i>Aprasia parapulchella</i>	Pink-tailed Worm-lizard	VU	V	Negligible	<p>The Pink-tailed Worm-lizard a small, legless and very slender lizard that lives underground. Colouration is predominantly grey-brown to pale grey, with a slightly darker head and nape and a paler underside. The end part of the tail is pinkish to reddish-brown. The species occurs in NSW, Victoria and the ACT where it is widely but patchily distributed along the foothills of the western slopes of the Great Dividing Range between Bendigo in Victoria and Gunnedah in NSW. Habitat includes primary and secondary grassland, grassy woodland and woodland communities, and the species usually inhabits sloping sites that contain rocky outcrops or scattered, partially buried rocks. Habitat tends to be well-drained mid-slope or ridge-top sites with loosely embedded rocks on soil substrate with ant galleries present.</p> <p>The species has not been recorded within 10 km of the project area.</p> <p>The project area is outside the known distribution of the species and does not support grassy or grassy woodland habitat with scattered or partially buried rock.</p>

Table E.3 **Likelihood of occurrence assessment – threatened fauna**

Scientific name	Common name	EPBC Act	BC Act	Likelihood of occurrence	Justification
<i>Cyclodomorphus praealtus</i>	Alpine She-oak Skink	EN	E1	Low	<p>The Alpine She-oak Skink is a medium-sized member of the lizard family Scincidae. The species has a restricted distribution, known from eight broad locations above 1,500 m in the Australian Alps from Omeo Plain in the south, to Kiandra in the north. It occupies alpine grasslands, alpine heathland, alpine grassy heathland and grassy areas with a very sparse cover of Snow Gums.</p> <p>There is one record of the species within 10 km of the project area. The species was found to be moderately abundant in sub-alpine grasslands during targeted surveys for the broader Snowy 2.0 project.</p> <p>The project area does not support suitable grassland habitat for this species.</p>
Fish		EPBC Act	FM Act		
<i>Maccullochella macquariensis</i>	Trout Cod	EN	E	Moderate	<p>Trout Cod were described originally from the Macquarie River, but there is now only one self-sustaining population of Trout Cod remaining in the wild in the Murray River between Yarrawonga and Barmah.</p> <p>No waterways within the survey area are identified by DPI (2016a) as supporting the species, although the survey area lies within the natural distribution of this species.</p> <p>Although the only self-sustaining population occurs in the Murray River, this species has recently been stocked in Talbingo Reservoir. Its predicted distribution also includes the project area.</p> <p>The Trout Cod may occur in Talbingo Reservoir.</p>
<i>Maccullochella peelii</i>	Murray Cod	VU		Low	<p>The Murray Cod was formerly widespread and abundant in the lower and mid-altitude reaches of the Murray-Darling Basin but now has a patchy distribution and abundance across its historic range. The species has been found in diverse habitats including flowing and standing waters, small, clear, rocky streams on the inland slopes and uplands of the Great Dividing Range, large, turbid, meandering slow-flowing rivers, creeks, anabranches, and lakes and larger billabongs of the inland plains of the Murray Darling Basin.</p> <p>No waterways within the survey area are identified by DPI (2016a) as supporting the species.</p> <p>The project area is outside the natural distribution of the species, and no stocking of Talbingo Reservoir has occurred.</p>

Table E.3 **Likelihood of occurrence assessment – threatened fauna**

Scientific name	Common name	EPBC Act	BC Act	Likelihood of occurrence	Justification
<i>Macquaria australasica</i>	Macquarie Perch	EN	E	Moderate	<p>The Macquarie Perch is found in the Murray-Darling Basin, particularly the upstream reaches of the Lachlan, Murrumbidgee and Murray rivers, and parts of south-eastern coastal NSW. The draft National Recovery Plan for Macquarie Perch identifies four self-sustaining populations; none are within the project area. Macquarie Perch prefer clear water and deep, rocky holes with extensive cover in the form of aquatic vegetation, large boulders, debris and overhanging banks. They spawn in spring or summer and lay their eggs over stones and gravel in shallow, fast-flowing upland streams or flowing parts of rivers. Macquarie Perch inhabiting impoundments would likely undertake upstream spawning migration in October to mid-January after which adults usually move from the streams to the lake. Migration may not be necessary in stream dwelling fish.</p> <p>The Tumut River is identified as habitat for this species (DPI 2016a).</p> <p>A stocked population may occur in Talbingo Reservoir within the project area.</p>

Notes: 1. EPBC Act status: CE- critically endangered, EN – endangered, VU – vulnerable, Mi – migratory, M – marine
2. BC Act status: E4A – critically endangered, E1 – endangered, E2 – endangered population, V – vulnerable
3. FM Act status: E – Endangered

E.4 Likelihood of occurrence assessment – migratory species

Table E.4 Likelihood of occurrence assessment – migratory species

Scientific name	Common name	EPBC Act	BC Act	Likelihood of occurrence	Justification
Migratory Marine Birds					
<i>Apus pacificus</i>	Fork-tailed Swift	Mi		Negligible	<p>Almost exclusively aerial (foraging). The Fork-tailed Swift breeds in Asia but migrates to Australia from September to April. Individuals or flocks can be observed hawking for insects at varying heights from only a few metres from the ground and up to 300 metres high.</p> <p>The species has not been recorded within 10 km of the project area.</p> <p>The project area and does not support suitable habitat.</p>
Migratory Terrestrial Species					
<i>Hirundapus caudacutus</i>	White-throated Needletail	Mi		Low	<p>An aerial species found in feeding concentrations over cities, hilltops and timbered ranges. Breeds in Asia. White-throated Needletails almost always forage aerially, at heights up to 'cloud level'.</p> <p>There are eight records of the White-throated Needletail within 10 km of the project area.</p> <p>The project area is not considered support any roosting habitat.</p>
<i>Motacilla flava</i>	Yellow Wagtail	Mi		Negligible	<p>Regular spring-summer visitor in north of Australia, rare vagrant or occasional visitor farther south. Found in marshes, damp paddocks, airfields, cultivated fields, lawns and estuaries.</p> <p>The species has not been recorded within 10 km of the project area.</p> <p>The project area is outside the known distribution of the species, and does not support suitable habitat.</p>
<i>Myiagra cyanoleuca</i>	Satin Flycatcher	Mi		Low	<p>The Satin Flycatcher inhabits heavily vegetated gullies in eucalypt-dominated forests and taller woodlands, and on migration, occur in coastal forests, woodlands, mangroves and drier woodlands and open forests. The species can occur at elevations of up to 1,400 m ASL. The Satin Flycatcher breeds in heavily vegetated gullies.</p> <p>There are 30 records of the species within 10 km of the project area.</p> <p>The project area lacks suitable heavily vegetated gullies.</p>

Table E.4 **Likelihood of occurrence assessment – migratory species**

Scientific name	Common name	EPBC Act	BC Act	Likelihood of occurrence	Justification
<i>Rhipidura rufifrons</i>	Rufous Fantail	Mi, M		Low	<p>Migratory species that prefers dense, moist undergrowth of tropical rainforests and scrubs. The species mainly inhabits wet sclerophyll forests often in gullies dominated by eucalypts such as Tallow-wood (<i>Eucalyptus microcorys</i>), Mountain Grey Gum (<i>E. cypellocarpa</i>), Narrow-leaved Peppermint (<i>E. radiata</i>), Mountain Ash (<i>E. regnans</i>), Alpine Ash (<i>E. delegatensis</i>), Blackbutt (<i>E. pilularis</i>). During migration it can stray into gardens and more open areas.</p> <p>There are seven records of the species within 10 km of the project area.</p> <p>The project area lacks suitable heavily vegetated gullies.</p>
Migratory Wetlands Species					
<i>Actitis hypoleucos</i>	Common Sandpiper	Mi, M		Negligible	<p>Inhabits a wide range of coastal and inland wetlands, often with muddy or rocky margins. Also known to occur at estuaries, billabongs, dams, pools and lakes, often associated with mangroves.</p> <p>The species has not been recorded within 10 km of the project area.</p> <p>The project area does not support suitable wetland habitat.</p>
<i>Calidris acuminata</i>	Sharp-tailed Sandpiper	Mi, M		Negligible	<p>The Sharp-tailed Sandpiper forages at the edge of water within wetlands or intertidal mudflats, either on bare wet mud, sand or shallow water. They will also foraging among inundated vegetation of saltmarsh, grass or sedges. Roosting occurs at the edges of wetlands, on wet open mud or sand or in sparse vegetation.</p> <p>The species has not been recorded within 10 km of the project area.</p> <p>The project area does not support suitable wetland habitat.</p>
<i>Calidris ferruginea</i>	Curlew Sandpiper	CE, Mi, M	E1	Negligible	<p>Inhabits sheltered intertidal mudflats. Also non-tidal swamps, lagoons and lakes near the coast. Infrequently recorded inland.</p> <p>The species has not been recorded within 10 km of the project area.</p> <p>The project area does not provide suitable waterbodies with muddy or sandy edges.</p>

Table E.4 **Likelihood of occurrence assessment – migratory species**

Scientific name	Common name	EPBC Act	BC Act	Likelihood of occurrence	Justification
<i>Calidris melanotos</i>	Pectoral Sandpiper	Mi, M		Negligible	<p>Scarce, but regular visitor, usually recorded in summer from November to March. Widespread but scattered records in Australia. Usually found in fresh to saline wetlands, floodplains, swamps, estuaries and lagoons, sometimes with emergent or fringing vegetation such as grass.</p> <p>The species has not been recorded within 10 km of the project area.</p> <p>The project area is outside the known distribution of the species, and does not support suitable wetlands habitat.</p>
<i>Gallinago hardwickii</i>	Latham's Snipe	Mi, M		Low	<p>Typically found on wet soft ground or shallow water with good cover of tussocks. Often found in wet paddocks, seepage areas below dams.</p> <p>There are five records of the species within 10 km of the project area.</p> <p>The project area does not contain any suitable wet grassy habitat.</p>
<i>Numenius madagascariensis</i>	Eastern Curlew	CE, Mi		Negligible	<p>Occurs in sheltered coasts, especially estuaries, embayments, harbours, inlets and coastal lagoons with large intertidal mudflats or sandflats often with beds of seagrass.</p> <p>The species has not been recorded within 10 km of the project area.</p> <p>The project area does not provide suitable intertidal habitat.</p>
<p>Notes: 1. EPBC Act status: CE- critically endangered, EN – endangered, VU – vulnerable, Mi – migratory, M – marine</p> <p> 2. BC Act status: E4A – critically endangered, E1 – endangered, E2 – endangered population, V – vulnerable</p>					

Appendix F

EPBC Act significant impact criteria assessments

F.1 Significant impact criteria assessment for Smoky Mouse

Table F.1 Significant impact criteria assessment for Smoky Mouse

Species profile	<p>Smoky Mouse (<i>Pseudomys fumeus</i>)</p> <p>Status: Endangered (EPBC Act), Critically Endangered (BC Act)</p> <p>Distribution: The Smoky Mouse is endemic to mainland south-eastern Australia, where it occurs in Victoria, New South Wales and the Australian Capital Territory. The species has a relatively wide but disjunct distribution, populations are small and fragmented, and there appear to have been local extinctions in several areas. It occurs in four IBRA regions (South East Highlands, South East Corner, Australian Alps and Victorian Midlands). Capture sites range from near sea level to at least 1,800 m altitude (Menkhorst and Broome 2008a, 2008b). KNP has a known population of Smoky Mouse, with records from Yarrangobilly to the north-east and Happy Jacks to the south.</p> <p>Within this range, populations are fragmented and generally low in number, but can fluctuate in size. There is also evidence of apparent local extinctions. While records in new areas are still being obtained, the apparent instability of Smoky Mouse populations is of concern (Menkhorst and Broome 2008a, 2008b).</p> <p>Biology: The Smoky Mouse is similar in size to a small rat, with a head and body length averaging about 90 mm and a tail averaging 140 mm (OEH 2018c). The Smoky Mouse is primarily herbivorous but also consumes invertebrates, with diet varying seasonally according to food availability and energetic demands. At the summit of Mt William, Cockburn (1981a) found that the fruiting bodies of underground fungi predominated in the diet in winter and early spring, with a small proportion of seeds and soil invertebrates. There was a sudden switch to flowers, seeds and Bogong Moths <i>Agrostis infusa</i> in late spring–early summer, while seeds predominated through summer and autumn (Menkhorst and Broome 2008a, 2008b).</p> <p>Males have been surveyed as transient moving between sub-populations in search of mates (Ford et al. 2003). Long-term survival of the population may therefore be contingent on recruitment and immigration between habitat patches, and the regional dynamics of resource availability (Harrison 1994).</p> <p>A characteristic of Smoky Mouse colonies is their ephemeral nature, both spatially and temporally. There are numerous examples of unsuccessful attempts to locate the species at sites where it had been found only a few months previously (eg. Lawrence 1986; Lintermans 1988; Ford et al. 2003; DECC, FNSW unpublished data). This may be due to shifts in home range following fluctuations in resource availability due to climatic fluctuations, or to differences in trappability, or, in the longer-term, to vegetation succession.</p> <p>Breeding: Smoky Mice occurs in small discrete colonies based around patches of dense heath. They sheltered in small groups, sometimes comprising a male and up to five breeding females, in a large, complex burrow system that can be up to 10 m² and more than 25m in length, with multiple nesting chambers (Ford et al. 2003; Woods & Ford 2000; Ford in prep.). Breeding occurred from September–April, and 1–2 litters, each of 3–4 young, were produced after a gestation period of about 30 days (Menkhorst and Broome 2008a, 2008b).</p> <p>Habitat Requirements: The precise habitat requirements of the Smoky Mouse are not clear. A wide range of vegetation communities are occupied, from damp coastal heath in East Gippsland, to sub-alpine heath. A characteristic of Smoky Mouse localities, except those in wet gullies, is a floristically diverse shrub layer with members of the plant families Epacridaceae, Fabaceae and Mimosaceae well represented (Menkhorst and Broome 2008a, 2008b).</p> <p>Habitat types the Smoky Mouse has been recorded in include coastal heath to dry ridgeline forest, sub-alpine heath and, occasionally, wetter gullies (Menkhorst and Seebeck 1981). Ground cover is also likely to be critical and can be in the form of dense low vegetation, such as occurs in heaths, or grass tussocks, rocks and logs in more open habitats. Soil conditions also need to be conducive to burrowing and growth of hypogeal fungi, a major component of the diet (Menkhorst and Broome 2008a, 2008b).</p> <p>Threats: predation by introduced carnivores, habitat changes due to altered fire regimes and dieback caused by the Cinnamon Fungus <i>Phytophthora cinnamomi</i>, and loss, modification and fragmentation of habitat due to road construction and intensive timber harvesting (Menkhorst and Broome 2008a, 2008b).</p>
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Table F.1 **Significant impact criteria assessment for Smoky Mouse**

Criteria	Discussion
Lead to a long-term decrease in size of a population	<p>Initial surveys undertaken in 2017/18 identified a Smoky Mouse population occurring in the southern portion of the Exploratory Works survey area along the upper sections of Lobs Hole Ravine Road, with the species recorded at 12 locations. Regional surveys undertaken in 2018/19 have identified the species across a broad area above 1,100 m, from Coppermine Firetrail in the north, Wallaces Creek Firetrail in the east, Link Road in the south and the Elliott Way in the west. The species is now known from 70 locations (16 by terrestrial trapping, 53 by remote cameras and one incidental record, Figure 6.4. This population is considered significant, being one of the largest known populations of the species.</p> <p>Original surveys found the species to be solely associated with PCT 1196 - Snow Gum - Mountain Gum shrubby open forest of montane areas, South Eastern Highlands Bioregion and Australian Alps Bioregion. Subsequent surveys have identified the species as being associated with three additional PCTs; PCT 729 – Broad-leaved Peppermint - Candlebark shrubby open forest of montane areas, southern South Eastern Highlands Bioregion and South East Corner Bioregion, and PCT 953 - Mountain Gum - Snow Gum - Broad-leaved Peppermint shrubby open forest of montane ranges, South Eastern Highlands Bioregion and Australian Alps Bioregion. The species was found above 1,100m ASL, although it is noted that regional surveys did not include locations below this elevation. However, surveys for Snowy 2.0 have included locations below this elevation. Despite this, associations with elevation remain unclear.</p> <p>All records are all along the upper sections of a north-south ridge. Vegetation consist of tall forests dominated by Mountain Gum and Snow Gum, with some other associated species. There is generally a moderate to dense shrubby midstorey with varying abundance of shrubs from the plant family <i>Fabaceae</i> (with some <i>Epacridaceae</i> and <i>Mimosaceae</i>), and dense groundcover with abundant sub-shrubs, logs and leaf litter. This type of microhabitat is believed to be preferred by the species to take refuge from predators.</p> <p>Modification 2 will result in clearing of 0.06 ha of Smoky Mouse habitat, resulting in a cumulative impact of 1.83 ha for the Exploratory Works (including Modification 1 and 2). The size of the local population is unknown; however, given the extent of species recorded during regional surveys, and the extent of associated habitat in the region, this impact is likely to represent a very small portion of the available habitat for this population.</p> <p>Indirect impacts also have potential to occur as a result of Modification 2 including an increase in feral animal predation and weed invasion as a result of increased disturbances. The feral cat and European fox are recognised threats to Smoky Mouse. The Biodiversity Management Plan (EMM 2019a) includes a feral animal monitoring and control program to be implemented during construction and operational phases of the project. Introduction of weeds and pathogens will be managed through implementation of strict wash down procedures and monitoring, as per the approved BMP (EMM 2019a).</p> <p>Exploratory Works, including Modification 2, will result in a net loss of 1.83 ha of habitat for Smoky Mouse. This represents a small percentage of the available habitat for the species in the region. Mitigation measures will be implemented in accordance with the approved BMP (EMM 2019a) to reduce potential impacts from vehicle strike and feral animal predation. It is not expected the Exploratory Works, including Modification 2, will decrease the size of an important population of the species.</p>

Table F.1 Significant impact criteria assessment for Smoky Mouse

Reduce the area of occupancy for the species	<p>The Smoky Mouse has been recorded across the region, over an estimated 6,000 to 7,000 ha. Within these areas, the species has been recorded across seven PCTs:</p> <ul style="list-style-type: none"> • PCT 300 –Ribbon Gum - Narrow-leaved (Robertsons) Peppermint montane fern - grass tall open forest on deep clay loam soils in the upper NSW South Western Slopes Bioregion and western Kosciuszko escarpment; • PCT 638 –Alpine Ash - Mountain Gum moist shrubby tall open forest of montane areas, southern South Eastern Highlands Bioregion and Australian Alps Bioregion; • PCT 643 – Alpine shrubland on scree, blockstreams and rocky sites of high altitude areas of Kosciuszko National Park, Australian Alps Bioregion; • PCT 644 –Alpine Snow Gum - Snow Gum shrubby woodland at intermediate altitudes in northern Kosciuszko NP, South Eastern Highlands Bioregion and Australian Alps Bioregion; • PCT 729 – Broad-leaved Peppermint - Candlebark shrubby open forest of montane areas, southern South Eastern Highlands Bioregion and South East Corner Bioregion; • PCT 953 - Mountain Gum - Snow Gum - Broad-leaved Peppermint shrubby open forest of montane ranges, South Eastern Highlands Bioregion and Australian Alps Bioregion; and • PCT 1196 - Snow Gum - Mountain Gum shrubby open forest of montane areas, South Eastern Highlands Bioregion and Australian Alps Bioregion. <p>The cumulative impact of 1.83 ha represents less than 1% of the available habitat in the region. Therefore, it is not expected that the Exploratory Works, including Modification 2, will result in a significant loss of habitat for significantly reduce the area of occupancy for Smoky Mouse.</p>
Fragment an existing population into two or more populations	<p>The Smoky Mouse population has been recorded across a broad area within the region, over an estimated 6,000 to 7,000 ha.</p> <p>To ensure there is no additional fragmentation of Smoky Mouse habitats or populations, vegetation along the top of Lobs Hole Ravine Road will be cleared above 1.1 m height. Removal of vegetation along the northern section of Lobs Hole Ravine Road has been restricted to non-Smoky Mouse habitat. Mitigation measure to avoid and reduce vehicles strike on Smoky Mouse will be implemented to ensure their safe movement across the road including avoiding and minimising vehicle movements at night and reducing speed limits.</p> <p>Therefore, it is not anticipated Exploratory Works, including Modification 2, will fragment a population.</p>
Adversely affect habitat critical to survival of a species	<p>Primary habitat for the Smoky Mouse is located on upper ridgelines and slopes above 1,100 m within PCT 729 – Broad-leaved Peppermint - Candlebark shrubby open forest of montane areas, southern South Eastern Highlands Bioregion and South East Corner Bioregion, PCT 953 – Mountain Gum - Snow Gum - Broad-leaved Peppermint shrubby open forest of montane ranges, South Eastern Highlands Bioregion and Australian Alps Bioregion and PCT 1196 – Snow Gum - Mountain Gum shrubby open forest of montane areas, South Eastern Highlands Bioregion and Australian Alps Bioregion.</p> <p>To ensure no loss of Smoky Mouse habitat occurs vegetation along the upper section of Lobs Hole Ravine Road will be removed above 1.1 m height, retaining shrub and ground cover for the species. Vegetation clearing along the northern section of Lobs Hole Ravine Road will avoid Smoky Mouse habitat. Modification 2 will result in the removal of 0.06 ha of Smoky Mouse habitat.</p> <p>There is potential for the proposed Exploratory Works to have adverse indirect impacts on Smoky Mouse habitat through reduction in habitat quality. This may be due to increase in weed abundance or introduction of pathogens such as <i>P. cinnomomi</i>. Mitigation measures outlined in the BMP (EMM 2019a) will be implemented to reduce these indirect impacts and maintain habitat quality including weed control, strict hygiene protocols for vehicles and machinery to minimise weeds being introduced and spread. Additionally, monitoring of the Smoky Mouse population along Lobs Hole Road will be undertaken.</p> <p>Therefore, it is not anticipated that Exploratory Works, including Modification 2, will adversely affect critical habitat.</p>

Table F.1 Significant impact criteria assessment for Smoky Mouse

Disrupt breeding cycle of a population	<p>Smoky Mouse occur in small discrete colonies based around patches of dense heath. They shelter in small groups, sometimes comprising a male and up to five breeding females, in a large, complex burrow system that can be up to 10 m² and more than 25m in length, with multiple nesting chambers (Ford et al. 2003; Woods & Ford 2000; Ford in prep.). Breeding occurs from September–April (Menkhorst, P. and Broome, L. 2006). Given the observed presence of males and females, the survey area is likely to support a breeding population of the Smoky Mouse.</p> <p>Increased levels of noise from additional vehicles and trucks, or drilling rigs, is not expected to impact on Smoky Mouse breeding given the extent of available habitat. Mitigation measures have been put in place to ensure vehicle movements at night will be limited to emergency vehicles movements only on Lobs Hole Ravine Road. No lighting is proposed along the existing Lobs Hole Ravine Road.</p> <p>Overall, the Exploratory Works, including Modification 2, is not expected to disrupt the breeding cycle of Smoky Mouse.</p>
Modify, destroy, remove, isolate or degrade habitat to the extent that the species is likely to decline	<p>Modification 2 will remove 0.06 ha of Smoky Mouse habitat, resulting in a cumulative impact of 1.83 ha for Exploratory Works. These areas to be removed are fragmented across the project boundary and are not likely to significantly impact on the species by fragmenting their population.</p> <p>Vegetation along the top of Lobs Hole Ravine Road will be modified as are result of removal of vegetation above 1.1 m. This will potentially impact canopy cover for the species; however, shrub and ground cover, including fallen timber and logs ,will be retained.</p> <p>There is also potential for Modification 2 to reduce the quality of habitat, as a result of increased weed abundance or introduction of pathogens. A number of mitigation measures, outlined in the BMP (EMM 2019a) will be implemented to ensure habitat quality is maintained including hygiene protocols to prevent introduction of weeds, the spread of weeds or the spread of pathogens.</p> <p>Based on the mitigation measures and the restriction of removal of vegetation to the boulder fields along Lobs Hole Ravine Road, it is not expected Modification 2 will result in a significant loss of habitat availability or habitat quality.</p>
Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat	<p>The Exploratory Works, including Modification 2, has the potential to result in the introduction and spread of weed species, and increase in abundance of feral animals (including feral cats, foxes and feral pigs).</p> <p>As a part of the BMP (EMM 2019a) a detailed weed survey has been completed within the Exploratory Works impact area and adjacent habitats. Weed inspections and control in and adjacent to works areas have commenced, with baseline data collected. These surveys and inspections will be undertaken throughout the construction and operation period to control weeds and prevent them spreading to adjacent bushland. Hygiene protocols will also be put in place to ensure weeds are not brought in with vehicles, machinery etc.</p> <p>A feral animal monitoring and control program has also commenced as a part of the BMP (EMM 2019a). This program will continue to be implemented during the construction and operational phases to minimise impacts of feral animals on wildlife. A focus within Smoky Mouse habitat will be feral Cats and Foxes as they are known to predate on the species.</p> <p>These measures will be extended to additional areas included in Modification 2.</p> <p>Based on the proposed mitigation measures it is not expected that Exploratory Works, including Modification 2, will result in an increase of invasive species.</p>

Table F.1 Significant impact criteria assessment for Smoky Mouse

Introduce disease that may cause the species to decline	<p>A recognised threat to Smoky Mouse is dieback of susceptible heath species caused by <i>Phytophthora cinnamomi</i>. The fungus is a soil-borne water mould that produces an infection which causes a condition in plants called "root rot" or "dieback". It is a threat in some areas due to the substantial habitat changes that result in infected patches of vegetation.</p> <p>By bringing in vehicles, machinery and people there is potential they may carry soil which contains the mould. Mitigation measures outlined in the BMP (EMM 2019a) include strict hygiene protocols to disinfect footwear, machinery and vehicles before entering the KNP and works areas. Monitoring will occur during construction and operational phases to assess for the presence of the <i>P.cinnamomi</i> in susceptible vegetation communities. No introduction of soil is proposed to minimise any chances of introducing diseases.</p> <p>These measures will be extended to additional areas included in Modification 2.</p> <p>Based on the mitigation measures outlined above, it is not expected that Exploratory Works, including Modification 2, will result in introduction of any disease that will cause the species to decline.</p>
Interfere with the recovery of the species	<p>Exploratory Works, including Modification 2, is not expected to interfere with the recovery of the Smoky Mouse. A population has been recorded in the project area, and habitats are in good condition. A cumulative amount of 1.86 ha of Smoky Mouse habitat will be removed from Exploratory Works, including Modification 2. The extent of the regional population is in the order of 6,000 ha to 7,000 ha of available habitat.</p> <p>There is potential for impacts to Smoky Mouse populations from vehicle strike. Modification 2 will result in a TBM vehicle using Lobs Hole Ravine Road and Link Road, therefore increasing the risk of vehicle strike causing Smoky Mouse population decline. Impacts from vehicle strike are more likely to occur at night as the species is nocturnal and during breeding season when males are more transitory. Proposed mitigation measures to address vehicle strike including limiting vehicle movements on Lobs Hole Ravine Road to daytime only.</p> <p>Indirect impacts also have potential to occur as a result of Exploratory Works, including Modification 2, due to an increase in feral animal predation. As a result of increased disturbances in local area there is potential for feral animal numbers to increase. The feral Cat and European Fox are recognised threats to Smoky Mouse. Therefore a feral animal monitoring and control program is outlined in the BMP (EMM 2019a) and is currently being implemented during construction and operational phases of the project. This BMP will be extended to include additional areas outlined in this Modification.</p> <p>Modification 2 is not expected to interfere with the recovery of the species, as impacts to habitat for the regional population of the species are negligible. Comprehensive mitigation measures, as detailed above, will also be implemented through the BMP (EMM 2019a) to ensure indirect impacts are managed.</p>
Conclusion	<p>The project will not have a significant impact on the Smoky Mouse population as:</p> <ul style="list-style-type: none"> • impacts will result to less than 1% of the estimated 6,000 to 7,000 ha of habitat for the local population; • the proposed works will not result in the fragmentation of existing populations; • vehicle and truck movements will be minimised at night or be speed restricted to reduce the likelihood of Smoky Mouse being impacted by vehicle strike; • no lighting will be placed on the access road to avoid any impacts on Smoky Mouse breeding and foraging behaviour; • strict hygiene controls will be put in place to prevent weeds or pathogens entering the site; • feral animal control will be implemented to reduce predation on Smoky Mouse; and • the monitoring plan will be extended to additional areas within Modification 2.

F.2 Significant impact criteria assessment for Spotted-tailed Quoll

Table F.2 Significant impact criteria assessment – Spotted-tailed Quoll

Species profile	<p>Spotted-tailed Quoll (<i>Dasyurus maculatus</i>)</p> <p>Status: Endangered (EPBC Act), Vulnerable (BC Act)</p> <p>Distribution: The Spotted-tailed Quoll's distribution has reduced significantly since European settlement. The species is now found in eastern NSW, eastern Victoria, south-east and north-east Queensland, and Tasmania. DELWP (2016) identifies the Spotted-tail Quoll population in KNP as an important population as the area is a stronghold for the species and important for research.</p> <p>Biology: The Spotted-tailed Quoll is one of Australia's largest extant marsupial carnivores, and has a distinctive spotted appearance. It's larger size and spotted tail distinguish it from other quoll species. Males can grow to 1.3 m in length, whilst females are generally smaller growing to about 85 cm in length. The average lifespan is relative short, estimating between three to five years (DELWP 2016). The carnivorous species hunts on the ground and in trees, consuming a variety of prey including gliders, possums, small wallabies, rats, birds, rabbits, reptiles and invertebrates (OEH 2017c).</p> <p>Breeding: Breeding does not always occur in successive years, however most females produce a litter annually. The average litter size is five young with both sexes maturing at about one year of age (OEH 2017c).</p> <p>Habitat requirements: The species is primarily forest-dependent, and occupies a wide range of habitat types, including rainforest, wet and dry sclerophyll forest, coastal heathland, scrub and dunes, woodland, heathy woodland, swamp forest, mangroves, on beaches and sometimes in grassland or pastoral areas adjacent to forested areas. Individuals use hollow-bearing trees, fallen logs, small caves, rocky outcrops and cliff faces as den sites. The species has home ranges of several hundred to several thousand hectares in size and will use multiple dens, moving between den sites every 1-4 days. The species occurs at low densities (DELWP 2016, DEWHA 2009, DSE 2011).</p> <p>Threats: The major threatening processes associated with the Spotted-tailed Quoll includes habitat loss and modification, fragmentation, timber harvesting, poison baiting, competition and predation from introduced predators including feral cats, foxes and dogs, deliberating killing by landholders, road mortality, bushfires, poisoning by Cane Toads and climate change.</p>
Criteria	Discussion
Lead to a long-term decrease in size of a population	<p>Modification 2 will result in clearing of 1.62 ha of Spotted-tailed Quoll habitat. The majority of these areas are already disturbed due to past land use and human activity, with impacts focused on these disturbed areas (rather than high quality areas). Large areas of suitable habitat will remain in the locality.</p> <p>Indirect impacts also have potential to occur as a result of Modification 2 including an increase in feral animal predation as a result of increased disturbances. The feral cat and dog, and European fox are recognised threats to Spotted-tailed Quoll. The BMP (EMM 2019a) includes a feral animal monitoring and control program to be implemented during construction and operational phases of the project. No additional light or noise impacts will result from Modification 2.</p> <p>Given the extent of habitat remaining in the locality, and limitation of Modification 2 to adjacent areas of Lobs Hole Ravine Road and Link Road, it is unlikely the Project will lead to a long-term decrease in the size of an important population.</p>

Table F.2 Significant impact criteria assessment – Spotted-tailed Quoll

Reduce the area of occupancy for the species	<p>The Exploratory Works Modification 2 will result in clearing of 1.62 ha of Spotted-tailed Quoll habitat. The majority of these areas have been subject to previous disturbance due to past land use and human activity.</p> <p>The Spotted-tailed Quoll has large home ranges of several hundred to several thousand hectares in size in which the species occurs at low densities (DELWP 2016b, DEWHA 2009, DSE 2011). In the locality, the species is likely to be wide ranging, with the Exploratory Works area forming a small part of a much larger home range.</p> <p>The Modification 2 will result in the loss 1.62 ha of habitat for this species. However, given the large home range of this species and the extensive areas of habitat for the important population spread across KNP, the impact arising from the modification will not result in a detectable decrease in the area of occupancy for the important population.</p>
Fragment an existing population into two or more populations	<p>Modification 2 will be undertaken in a disturbed environment, subject to past clearing due to mining and other land uses. Construction activities have been sited, as far as possible, in these disturbed areas to limit impacts to native vegetation and fauna habitat. Large areas of suitable habitat will remain in the locality.</p> <p>The Modification 2 will not result in any fragmentation of habitat.</p>
Adversely affect habitat critical to survival of a species	<p>Habitat critical to the survival of the Spotted-tailed Quoll is identified as “large patches of forest with adequate denning resources and relatively high densities of medium-sized mammalian prey” (DELWP 2016). The vegetation in the locality would meet this criterion; however, such habitat is limited within the survey area, with suitable denning sites focused on boulderfields on Lobs Hole Ravine Road, and areas with a high density of hollow logs in sub-alpine areas along Lobs Hole Ravine Road.</p> <p>The Modification 2 will result in the removal of 1.62 ha of habitat, with large patches of connecting vegetation provided adjacent. Therefore it is not considered the Modification 2 will not adversely affect habitat critical to the survival of the species.</p>
Disrupt breeding cycle of a population	<p>The Spotted-tailed Quoll has a low overall reproductive output, with some females breeding only once or twice during their lives. Den sites include rock crevices, hollow logs, tree hollows, caves and boulder tumbles, and are critical to breeding success (DELWP 2016). Male biased dispersal is likewise critical to the species, to ensure sufficient gene flow between sub-populations.</p> <p>No den sites were identified within the survey area, therefore Modification 2 is not likely to disrupt the breeding cycle of the Spotted-tailed Quoll population.</p>
Modify, destroy, remove, isolate or degrade habitat to the extent that the species is likely to decline	<p>The project will result in direct impacts to habitat for the Spotted-tailed Quoll, with 1.62 ha of habitat to be directly impacted. Indirect impacts may occur due to weed invasion or spread of pathogens. Controls have been implemented to minimise these impacts. The project design incorporated identified biodiversity values, with clearing focused on areas of lower quality/disturbed habitat.</p> <p>There is potential for Modification 2 to reduce the quality of habitat, as a result of increase weed abundance or introduction of pathogens. A number of mitigation measures, outlined in the BMP (EMM 2019a) will be implemented to ensure habitat quality is maintained including hygiene protocols to prevent introduction of weeds, the spread of weeds or the spread of pathogens.</p> <p>Given the above mitigation measures and restriction of removal of vegetation to existing disturbed areas, it is not considered Modification 2 will not result in a decrease in the availability or quality of habitat for the Spotted-tailed Quoll.</p>

Table F.2 **Significant impact criteria assessment – Spotted-tailed Quoll**

Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat	<p>The Exploratory Works, including Modification 2, has the potential to result in the introduction and spread of weed species, and increase in abundance of feral animals (including feral cats, foxes and feral pigs).</p> <p>As a part of the BMP (EMM 2019a) a detailed weed survey has been completed within the Exploratory Works impact area and adjacent habitats. Weed inspections and control in and adjacent to works areas have commenced, with baseline data collected. These surveys and inspections will be undertaken throughout the construction and operation period to control weeds and prevent them spreading to adjacent bushland. Hygiene protocols will also be put in place to ensure weeds are not brought in with vehicles, machinery etc.</p> <p>A feral animal monitoring and control program has also commenced as a part of the BMP (EMM 2019a). This program will continue to be implemented during the construction and operational phases to minimise impacts of feral animals on wildlife.</p> <p>These measures will be extended to additional areas included in Modification 2.</p> <p>Based on the proposed mitigation measures it is not expected that Exploratory Works, including Modification 2, will result in an increase of invasive species.</p>
Introduce disease that may cause the species to decline	<p>Whilst disease is not recognised as a threat to the Spotted-tailed Quoll, introduction of <i>P. cinnamomi</i> could result in "dieback" and impacts to forest habitat.</p> <p>Mitigation measures including strict hygiene protocols to disinfect footwear, machinery and vehicles before entering the KNP and works areas are outlined within the BMP (EMM 2019a). Monitoring will occur during construction and operational phases to assess for the presence of the <i>P.cinnamomi</i> in susceptible vegetation communities.</p> <p>No introduction of soil is proposed to minimise any chances of introducing diseases.</p>
Interfere with the recovery of the species	<p>Exploratory Works, including Modification 2, is not expected to interfere with the recovery of the Spotted-tailed Quoll. Modification 2 has the potential to indirect impact the Spotted-tailed Quoll through the introduction of feral animals. Therefore, a feral animal monitoring and control program has been implemented during construction and operational phases of the project, and is outlined in the BMP (EMM 2019a). This BMP will be extended to include additional areas outlined in this Modification.</p> <p>The Project is not expected to interfere with the recovery of the species, as impacts to habitat for the population are restricted to roadside. Comprehensive mitigation measures, as detailed above, will also be implemented through the BMP (EMM 2019a) to ensure indirect impacts are managed.</p>
Conclusion	<p>The project will not have a significant impact on the Spotted-tailed Quoll as:</p> <ul style="list-style-type: none"> • direct impacts are focused on areas of poor-quality habitat, with 1.62 ha of degraded habitat proposed to be cleared, compared to millions of ha of high-quality habitat in the locality; • no impacts to key breeding habitat will result; and • potential impacts arising from increased feral animal activity, weeds and pathogens will be managed through implementation of feral animal control programs, as well as strict hygiene protocols and weed management programs.

F.3 Significant impact criteria assessment for Macquarie Perch

Table F.3 Macquarie Perch

Species profile	<p>Macquarie Perch (<i>Macquaria australasica</i>)</p> <p>Status: Endangered (EPBC & FM Act)</p> <p>Distribution: Populations within the Murray-Darling Basin and eastern drainage catchments are often small and geographically isolated. The Macquarie Perch is now absent from much of its former range, including all major river systems in the south-eastern part of the Murray-Darling Basin in New South Wales (DoEE 2018c).</p> <p>Biology: The Macquarie Perch is an elongated, oval-shaped fish with black to silver or bluish grey colouring. It can grow up to 55 cm long and weigh up to 3.5 kg (DPI 2016b). The species is fast growing and matures early. Adult fish feed on aquatic insects, larvae, crustaceans and molluscs.</p> <p>Breeding: Macquarie Perch spawn from October to December at sites located downstream of pools. Eggs then float downstream and lodge within gravel and cobble. Eggs will hatch after 10-11 days of water temperatures between 15-17°C (DoE 2013). Females produce around 50,000 – 100,000 eggs (DPI 2016b).</p> <p>Habitat Requirements: The species is found in both river and lake habitats; especially the upper reaches of rivers and their tributaries (DPI 2016b).</p> <p>Threats: The main threats associated with the Macquarie Perch include:</p> <ul style="list-style-type: none"> • changes in water quality, associated with human activities; • modification of natural river flows and temperatures; • competition and predation by exotic fish species; • the viral disease Epizootic Haematopoietic Necrosis (EHN), carried by the introduced species Redfin Perch; and • pollution from domestic, agricultural and industrial sources.
Criteria	Discussion
Lead to a long-term decrease in size of a population	<p>Modification 2 will include the change in design of the Middle Bay barge ramp. Initially the Exploratory Works identified 2.89 ha of dredging will occur for the ramp. The new design in the modification will require a decrease in dredge footprint to 0.85 ha. This will reduce the potential impacts on the Macquarie Perch.</p> <p>As per EMM (2018f) the Macquarie Perch is considered to have a moderate potential of occurrence in Talbingo Reservoir. It is unlikely that the modification will result in significant impact to the Macquarie Perch. The modified barge ramp will not result in any additional or exasperate any existing effects which may lead to a long-term decrease in the population of the Macquarie Perch.</p>
Reduce the area of occupancy of the species	<p>As described in EMM (2018f), potential impacts to the Macquarie Perch due to Modification 2 are likely to be small-scale and temporary and would not result in reduction the area of occupancy of this species. Macquarie Perch habitat (woody debris, rocks and boulders) is abundant throughout the reservoir and there would be negligible reduction to this habitat due to Modification 2. The temporary crossing would not represent a complete or permanent obstruction to fish passage. The permanent crossing would also not obstruct passage and there would be no associated reduction in habitat available to this species.</p>
Fragment an existing population into two or more populations	<p>The Middle Bay barge ramp is unlikely to fragment the population of Macquarie Perch within Talbingo Reservoir.</p>
Adversely affect habitat critical to the survival of a species	<p>As discussed in EMM (2018f), potential impacts to Macquarie Perch due to the Modification 2 are likely to be small-scale and temporary and would not affect habitat critical to the survival of a species.</p>
Disrupt the breeding cycle of a population	<p>The Macquarie Perch is known to reproduced between October to January; undertaking upstream migrations as part of their reproduction. As discussed in EMM (2018f), the temporary structure of the Middle Bay barge ramp will not cause a permanent obstruction to fish passage and will not be developed during October to January.</p>

Table F.3 **Macquarie Perch**

Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	As described in EMM (2018f), potential impacts to the Macquarie Perch due to the Modification 2 are likely to be small-scale and temporary and would not significantly affect its forage, resting or spawning habitat to the extent that the species is likely to decline.
Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat	Invasive species that may predate on the Macquarie Perch include Redfin Perch (<i>Perca fluviatilis</i>), Rainbow Trout (<i>Oncorhynchus mykiss</i>), Brown Trout (<i>Salmo trutta</i>), Wild Goldfish (<i>Carassius auratus</i>), Eastern Gambusia (<i>Gambusia holbrooki</i>) and Carp (<i>Cyprinus carpio</i>). Some of these invasive species were identified within Talbingo Reservoir during aquatic ecology surveys (EMM 2018f). Although Modification 2 has the potential to introduce new species, it is unlikely to result in any further additional associated impact to the Macquarie Perch.
Introduce disease that may cause the species to decline	Invasive species listed above have the potential to carry disease or parasites that could affect the Macquarie Perch. However, most if not all of these diseases are already present in Talbingo Reservoir, therefore Modification 2 is unlikely to introduce any of these diseases.
Interfere with the recovery of the species	As per EMM (2018f), the potential impacts associated with Modification 2 are likely to be small-scale and temporary. Therefore, they are unlikely to result in any long-term effect on the Macquarie Perch or its habitat, and the proposed works are not expected to interfere with the recovery of the species.
Conclusion	<p>The project will not have a significant impact on the Macquarie Perch as:</p> <ul style="list-style-type: none"> • direct dredging impacts to aquatic habitat will be reduced from 2.89 ha to 0.85 ha; • no additional impacts will occur from Modification 2 as previously discussed in EMM (2018f); and • there would be no permanent or complete barrier to the species that has the potential for long term effects.

F.4 Significant impact criteria assessment for Trout Cod

Table F.4 Trout Cod

Species profile	<p>Trout Cod (<i>Maccullochella macquariensis</i>)</p> <p>Status: Endangered (EPBC & FM Act)</p> <p>Distribution: The Trout Cod is known</p> <p>Biology: Trout Cod is a large freshwater fish which can grow up to 85 cm in length, and weight up to 16 kg. Its colour varies between olive to blue-grey (DPI 2017).</p> <p>Breeding: The Trout Cod spawns during spring and early summer, with females producing between 1,200 to 11,000 adhesive eggs. Eggs are deposited on hard surfaces near the stream bottom and are guarded by the male (DPI 2017). Larvae hatch after 5 to 10 days after fertilisation at temperatures of around 20°C (DPI 2006).</p> <p>Habitat Requirements: The species is known to occupy areas with large amounts of in-stream woody debris or 'snags', providing complex habitats for the species life cycle (DPI 2017).</p> <p>Threats: The main threats associated with Trout Cod include:</p> <ul style="list-style-type: none"> • reduction/modification of natural flows and temperature; • barriers of waterways such as dams, weirs and causeways; • removal of riparian vegetation; • habitat degradation as a result of agriculture, sedimentation from land clearing and removal of snags; • over-harvesting by recreational and commercial fishers; • competition from invasive species; and • disease.
Criteria	Discussion
Lead to a long-term decrease in size of a population	<p>Modification 2 will include the change in design of the Middle Bay barge ramp. The updated design has resulted in the reduction of dredging from 2.89 ha to 0.85 ha. This will reduce the potential impacts on the Trout Cod.</p> <p>As per EMM (2018f), the Trout Cod is considered to have a moderate potential of occurrence in Talbingo Reservoir. It is unlikely that the modification will result in significant impact to the Trout Cod. The modified barge ramp will not result in any additional or exasperate any existing effects which may lead to a long-term decrease in the population of the Trout Cod.</p>
Reduce the area of occupancy of the species	<p>As described in EMM (2018f), potential impacts to the Trout Cod due to Modification 2 are likely to be small scale and temporary and would not result in the reduction the area of occupancy of this species. The temporary crossing would not represent a complete or permanent obstruction to fish passage, nor does Trout Cod undertake migration as part of reproduction. The permanent crossing would also not obstruct passage and there would be no associated reduction in habitat available to this species. In any case, any Trout Cod within the reservoir are unlikely to be an important population necessary for the long-term survival and recovery of this species.</p>
Fragment an existing population into two or more populations	<p>The Middle Bay barge ramp is unlikely to fragment the population of Trout Cod within Talbingo Reservoir.</p>
Adversely affect habitat critical to the survival of a species	<p>As described in EMM (2018f), potential impacts to Trout Cod due to the Modification 2 are likely to be small-scale and temporary and would not affect the habitat critical to the survival of a species.</p>
Disrupt the breeding cycle of a population	<p>The Trout Cod spawns annually during late October to early November. As discussed in EMM (2018f), the temporary structure of the Middle Bay barge ramp will not cause a permanent obstruction to fish passage and will not be developed during October to November.</p>

Table F.4 Trout Cod

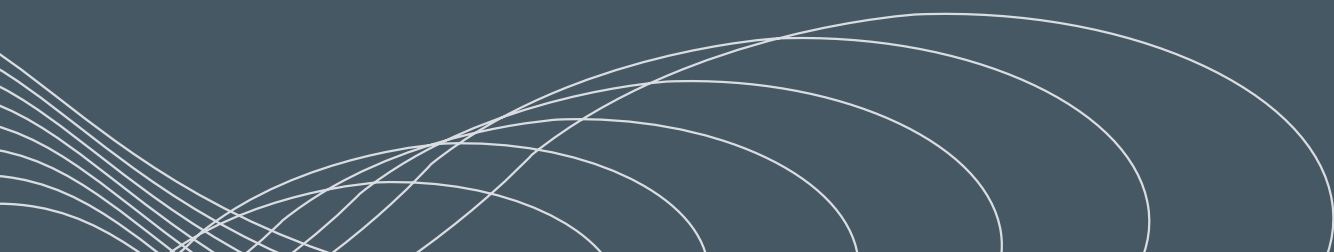
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	As described in EMM (2018f), potential impacts to the Trout Cod due to the Modification 2 are likely to be small-scale and temporary and would not significantly affect its forage, resting or spawning habitat to the extent that the species is likely to decline.
Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat	Invasive species that may predate on the Trout Cod include Redfin Perch, Rainbow Trout, Brown Trout, Wild Goldfish, Eastern Gambusia and Carp. Some of these invasive species were identified within Talbingo Reservoir during aquatic ecology surveys (EMM 2018f). Although Modification 2 has the potential to introduce new species, it is unlikely to result in any further additional associated impact to the Trout Cod.
Introduce disease that may cause the species to decline	Invasive species listed above have the potential to carry disease or parasites that could affect the Trout Cod. However, most if not all of these diseases are already present in Talbingo Reservoir, therefore Modification 2 is unlikely to introduce any of these diseases.
Interfere with the recovery of the species	As per EMM (2018f), the potential impacts associated with Modification 2 are likely to be small-scale and temporary. Therefore, they are unlikely to result in any long-term effect on the Trout Cod or its habitat, and the proposed works are not expected to interfere with the recovery of this species.
Conclusion	<p>The project will not have a significant impact on the Trout Cod as:</p> <ul style="list-style-type: none"> • direct dredging impacts to aquatic habitat will be reduced from 2.89 ha to 0.85 ha; • no additional impacts will occur from Modification 2 as previously discussed in EMM (2018f); and • there would be no permanent or complete barrier to the species that has the potential for long term effects.



CHAPTER

B

COOMA ROUNDABOUT CONCEPT DESIGNS





Vale Street roundabout



Bombala Street roundabout

Oversized vehicle passage through Sharp Street

- Expectation is 15-20 maximum oversized movements to occur over the life of the project and a coordinated traffic management plan will be required for each movement
- Options developed to allow Oversized vehicle movement to pass over roundabout
- Existing roundabout size and kerb to remain matching current conditions for large vehicles
- Some existing signage may need to be replaced with removable signs to allow them to be taken down for oversized movement



Existing conditions

Sharp Street, Cooma

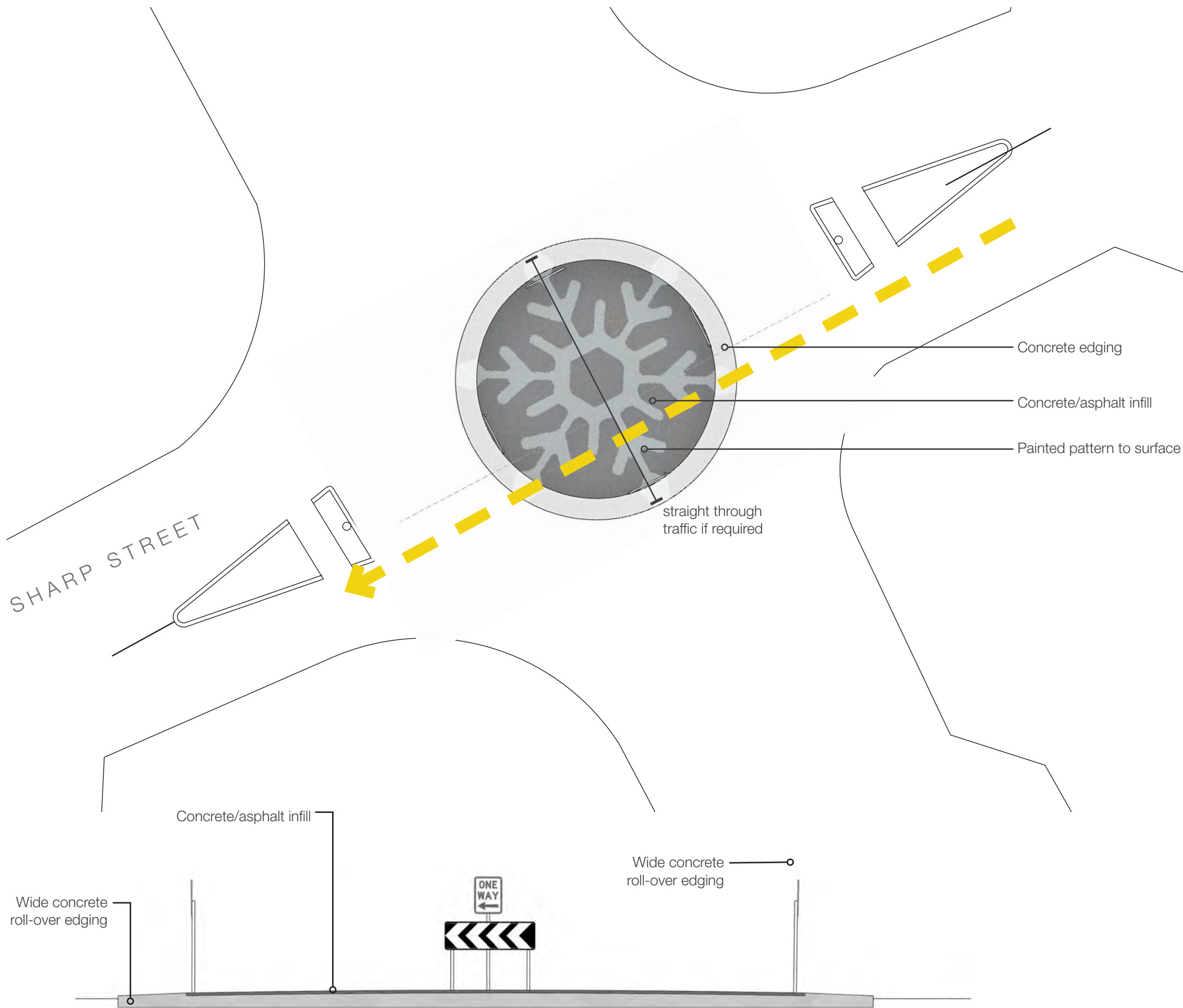
Date Issued: 28.05.2019 | Revision: 1
SMEC Project Reference: Snowy2.0 | Drawing: LC-01
Drawn by: N. Lamb



Urban Design
Landscape Architecture
Town Planning



Member of the Surlana Jurong Group



Concept 01 section (NTS)

Concept 01: Patterned concrete

Sharp Street, Cooma

Date Issued: 28.05.2019 | Revision: 1
SMEC Project Reference: Snowy2.0 | Drawing: LC-01
Drawn by: N. Lamb

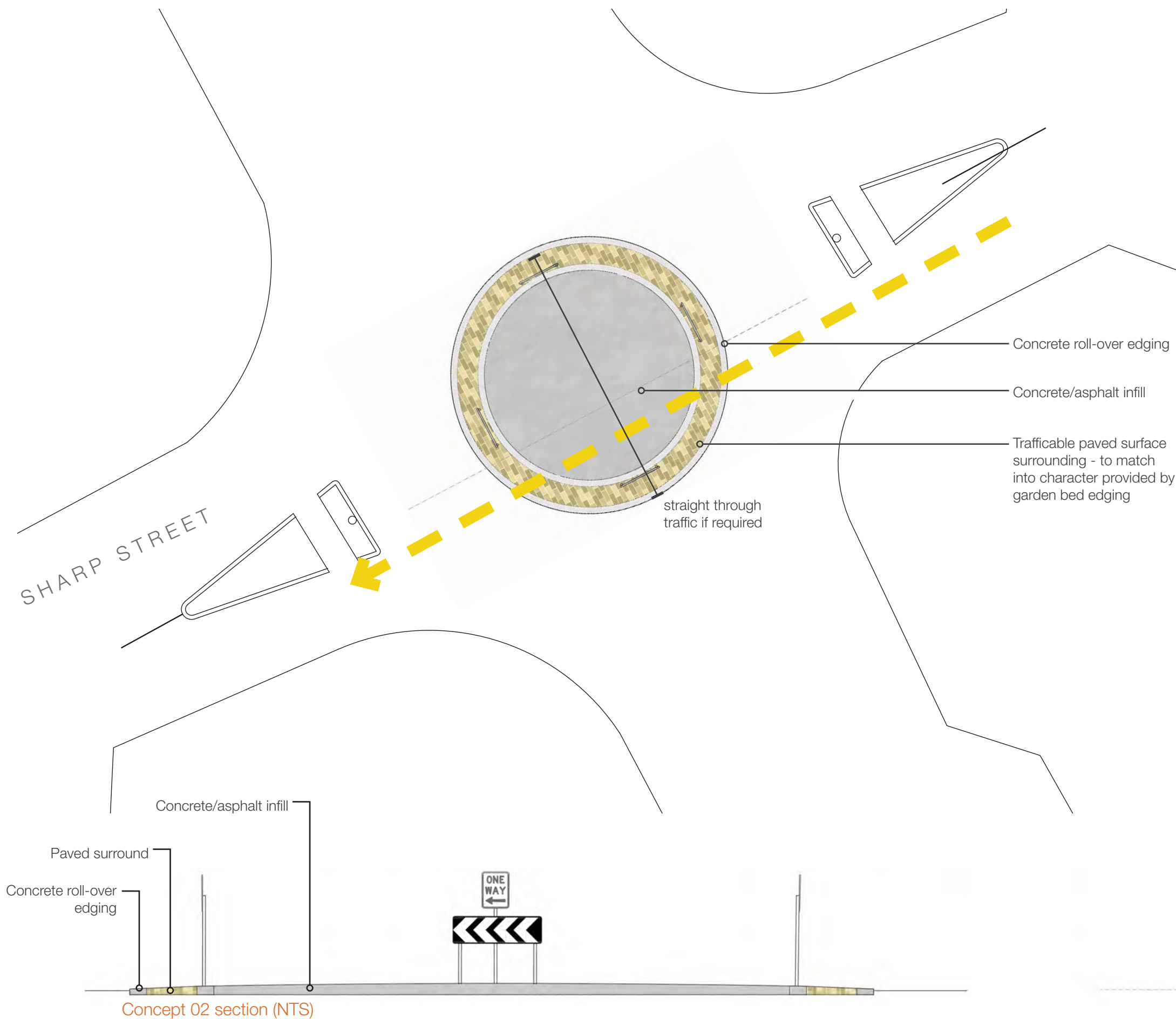


CONCEPT 01 KEY IDEAS

- Option developed to allow Oversized vehicle movement to pass over roundabout and utilise hardstand area as shown
- Retain definition of roundabout to match existing size and conditions for vehicle movements
- Existing roundabout size and kerb to remain matching current conditions for large vehicles
- Some existing signage may need to be replaced with removable signs to allow them to be taken down for oversized movement
- Provide patterning to create interest

Precedent image: patterned concrete roundabout





CONCEPT 02 KEY IDEAS

- Option developed to allow Oversized vehicle movement to pass over roundabout and utilise hardstand area as shown
- Retain definition of roundabout to match existing size and conditions for vehicle movements
- Existing roundabout size and kerb to remain matching current conditions for large vehicles
- Some existing signage may need to be replaced with removable signs to allow them to be taken down for oversized movement
- Provide rollover stone paving to match into existing heritage character provided in corner garden beds
- Centre of roundabout concrete/asphalt for oversized vehicles

Precedent image: paved surround roundabout (without raised garden bed)

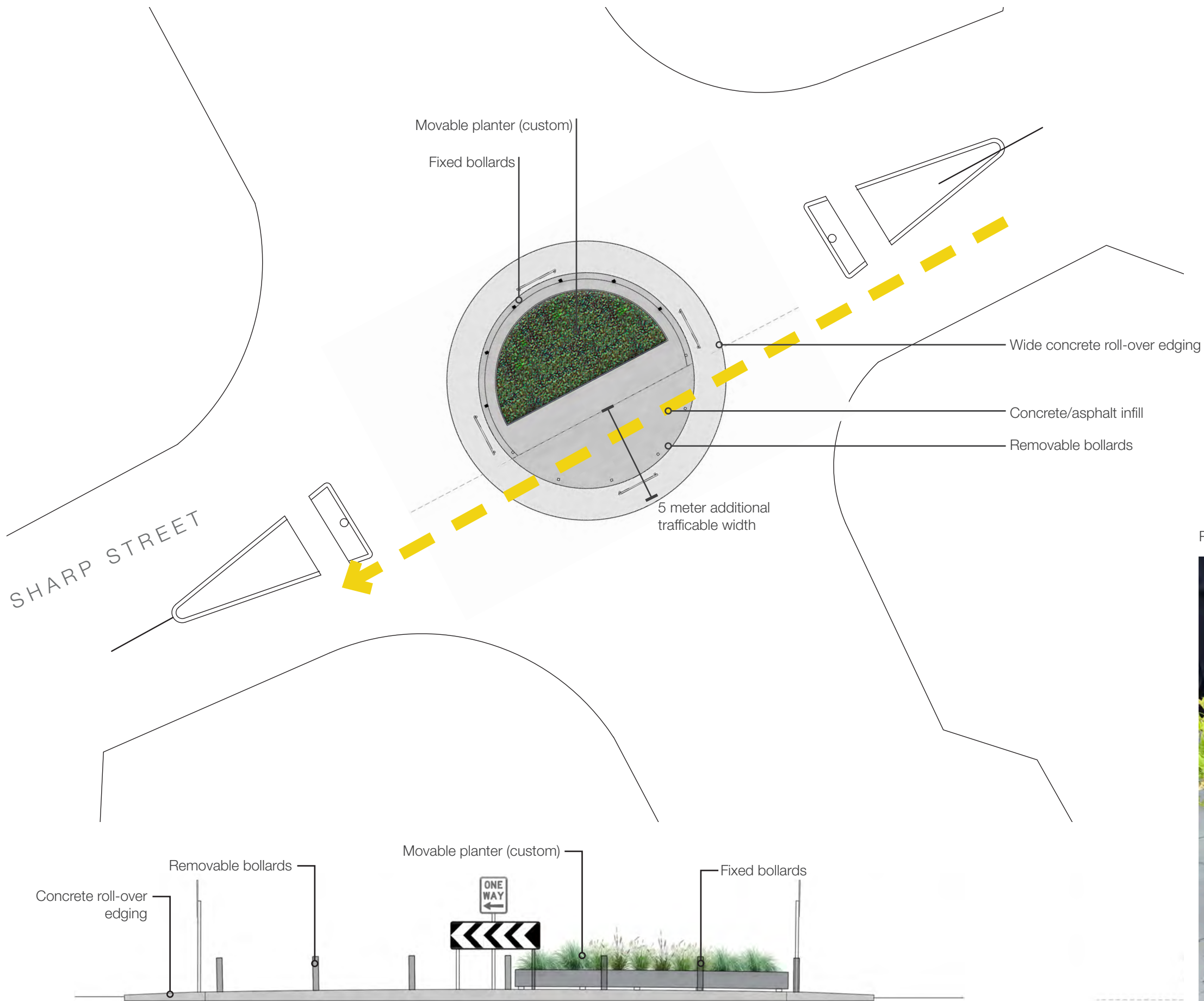


Concept 02: Paved edge

Sharp Street, Cooma

Date Issued: 28.05.2019 | Revision: 1
SMEC Project Reference: Snowy2.0 | Drawing: LC-01
Drawn by: N. Lamb





CONCEPT 03 KEY IDEAS

- Option developed to allow Oversized vehicle movement to pass over roundabout and utilise hardstand area as shown
- Retain definition of roundabout to match existing size and conditions for vehicle movements
- Existing roundabout size and kerb to remain matching current conditions for large vehicles
- Some existing signage may need to be replaced with removable signs to allow them to be taken down for oversized movement
- Install custom movable planter (by fork-lift) to provide greenery to intersection
- Install bollards to protect planter and consider removable bollards to allow Oversized vehicles

Precedent image: removable planters



Concept 03: Removable planter and bollards

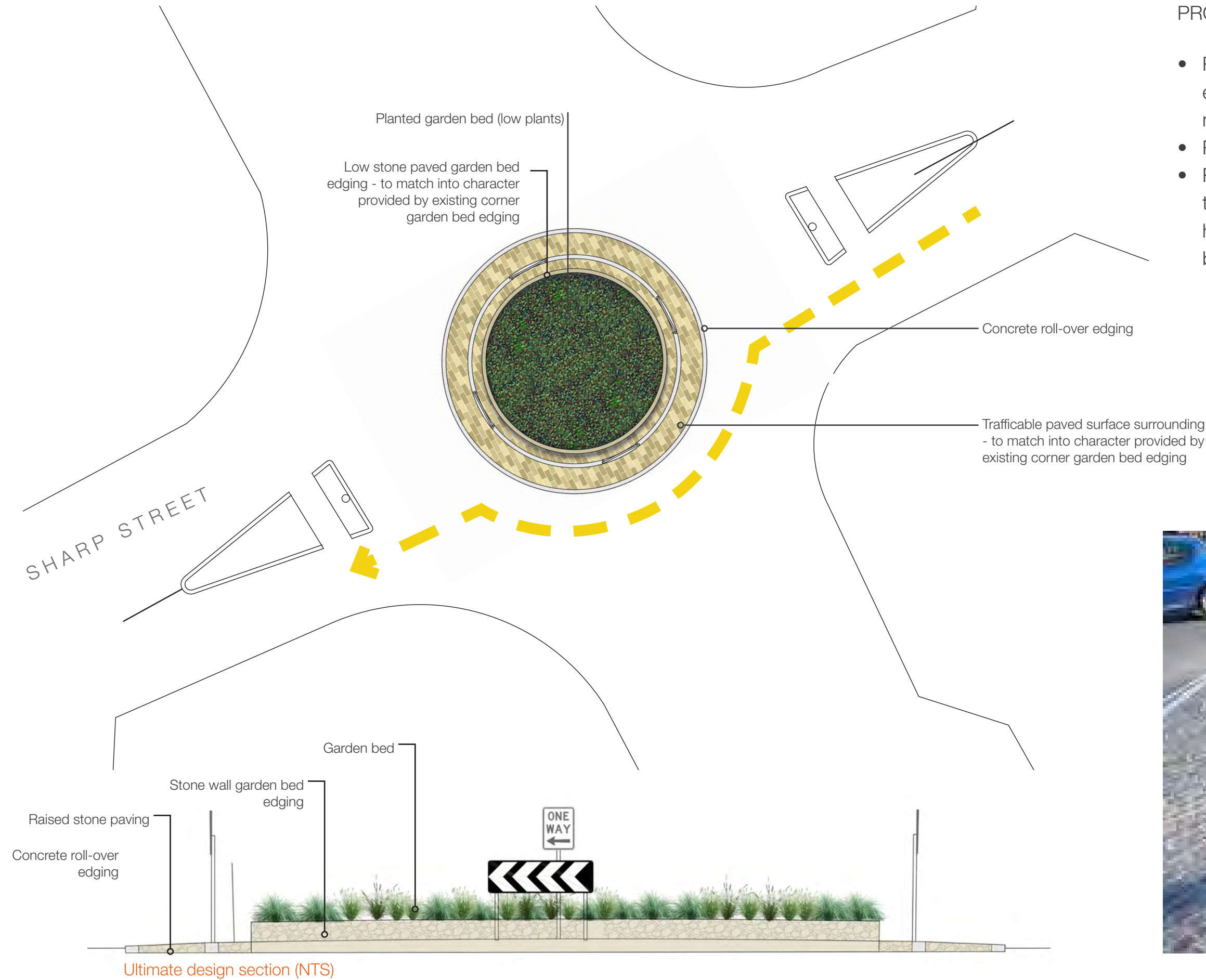
Sharp Street, Cooma

Date Issued: 28.05.2019 | Revision: 1
SMEC Project Reference: Snowy2.0 | Drawing: LC-01
Drawn by: N. Lamb



PROPOSED ULTIMATE DESIGN

- Retain definition of roundabout to match existing size and conditions for vehicle movements
- Rollover stone pavement
- Raised stone garden bed edging and planting to centre of roundabout, to match into existing heritage character provided in corner garden beds



Ultimate design

Sharp Street, Cooma

Date Issued: 28.05.2019| Revision: 1
SMEC Project Reference: Snowy2.0 | Drawing: LC-01
Drawn by: N. Lamb





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