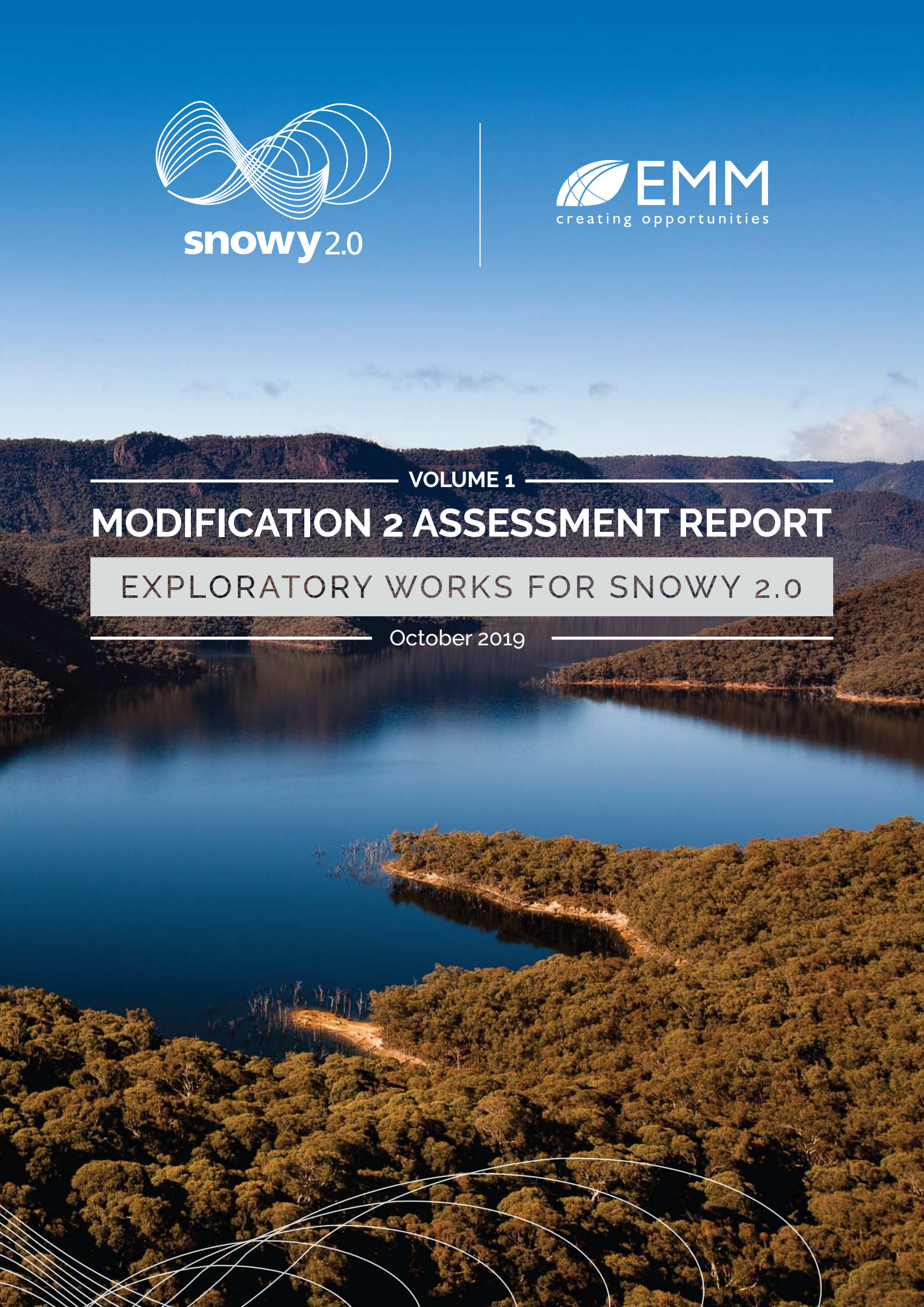

snowy 2.0

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VOLUME 1

MODIFICATION 2 ASSESSMENT REPORT

EXPLORATORY WORKS FOR SNOWY 2.0

October 2019

Snowy 2.0 Exploratory Works

Modification 2 to Infrastructure Approval SSI 9208

Report Number

J17188 RP#1

Client

Snowy Hydro Limited

Date

17 October 2019

Version

v1 Final

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CHAPTER 1

INTRODUCTION

1 Introduction

1.1 Overview of Snowy 2.0

Snowy Hydro Limited (Snowy Hydro) owns and operates the Snowy Mountains Hydro-electric Scheme (Snowy Scheme), a large and complex water storage and diversion scheme in the Australian Alps in southern New South Wales (NSW). In March 2017 Snowy Hydro announced a plan to conduct a Feasibility Study into a possible pumped hydro-electric expansion of the existing Snowy Scheme, called 'Snowy 2.0'. The final investment decision (FID) to proceed with Snowy 2.0 was made by Snowy Hydro's Independent Board of Directors on 12 December 2018 following two years of robust market and economic modelling, extensive due diligence and planning. Shareholder approval was subsequently received from the Australian Government on 26 February 2019.

Snowy 2.0 is the largest committed renewable energy project in Australia and is critical to underpinning system security and reliability as Australia transitions to a decarbonised economy. Snowy 2.0 will increase the pumped hydro-electric capacity of the existing Snowy Scheme by linking Tantangara and Talbingo reservoirs with tunnels and a power station built in between, almost 1 km below the ground.

Snowy 2.0 will increase the generation capacity of the Snowy Scheme by almost 50%, providing an additional 2,000 megawatts (MW) generating capacity, and making approximately 350,000 megawatt hours (MWh) (175 hours of energy storage) available to the National Electricity Market (NEM). When operational, Snowy 2.0 will provide on-demand energy generation and large-scale energy storage; allowing the water to flow from Tantangara Reservoir into Talbingo Reservoir in the generating mode and pumping water out of Talbingo Reservoir (the lower reservoir) to Tantangara Reservoir (the upper reservoir) in the storage mode.

Snowy 2.0 will provide large-scale energy storage and quick-start electricity generation at critical times of peak demand when energy supply is constrained and at times when intermittent renewable energy output is low. Pumping water at times of low electricity demand (ie when there is excess supply) means that Snowy 2.0 will have water ready to use for energy generation at times when consumers need it most. Snowy 2.0 will make efficient use of precious water resources to generate electricity without impacting on downstream water users and environmental flows for the Murray-Darling Basin.

Snowy 2.0 has been declared State significant infrastructure (SSI) and critical State significant infrastructure (CSSI) in accordance with the provisions of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act). The declaration of Snowy 2.0 as a CSSI project acknowledges that the project is critical to the State for environmental, economic or social reasons.

It is noted that due primarily to a lack of information being available about the geological conditions where works are proposed, Snowy 2.0 is being developed in two phases; Exploratory Works and Main Works. Exploratory Works involves a 3.1 kilometre (km) exploratory tunnel and portal and other exploratory and construction activities, primarily in the Lobs Hole area of KNP that is aimed at obtaining the required geological information to adequately inform the detailed design of underground works, including the power station location, as part of Main Works.

Accordingly, Snowy Hydro sought approval to carry out Exploratory Works prior to the commencement of Snowy 2.0 Main Works. 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, Industry and Environment (DPIE), formerly Department of Planning and Environment (DPE), in July 2018. Exploratory Works for Snowy 2.0 were approved on 7 February 2019.

A Referral of a Proposed Action was submitted to the Commonwealth Department of the Environment and Energy (DoEE) for the Exploratory Works on 28 May 2018 (Ref 2018/H217). On 10 July 2018, the Assistant Minister for the Environment determined that Exploratory Works was not a controlled action. Therefore the proposed action does not require any further assessment and approval under the Commonwealth Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act).

Construction of Exploratory Works has now commenced and the Snowy 2.0 Main Works EIS was lodged with DPIE in September 2019 and is on exhibition until 6 November 2019.

An application to modify the Exploratory Works approval (SSI-9208-Mod-1) was submitted to DPIE in June 2019. Modification 1 proposes additional geotechnical investigations, establishment of a substation at Lobs Hole and minor changes to the project boundary. The Modification 1 application is currently being assessed by DPIE.

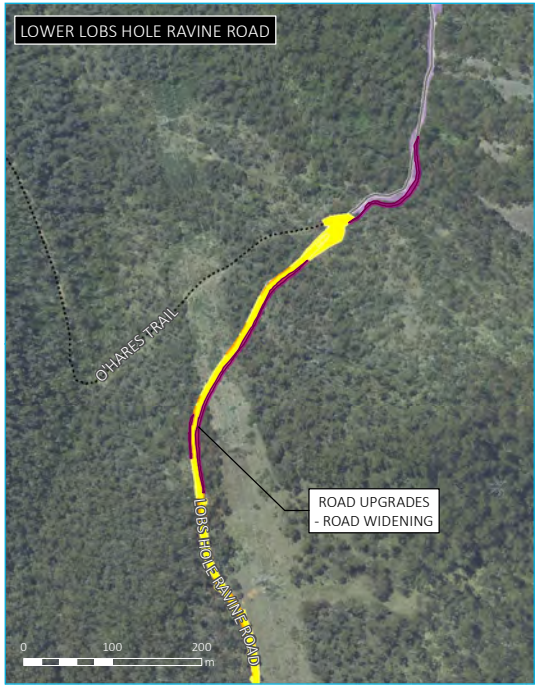
1.2 Overview of modification

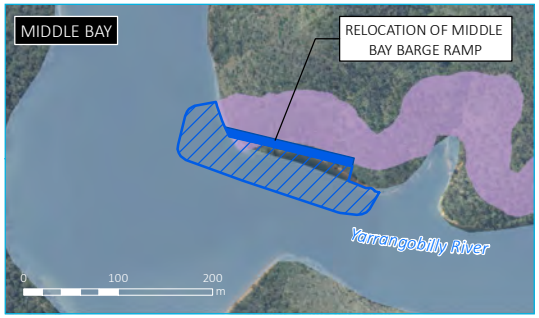
Snowy Hydro is seeking to modify Infrastructure Approval SSI 9208 (Modification 2) pursuant to section 5.25 of the EP&A Act to reflect requirements identified as part of the detailed design undertaken by Future Generation Joint Venture (FGJV).

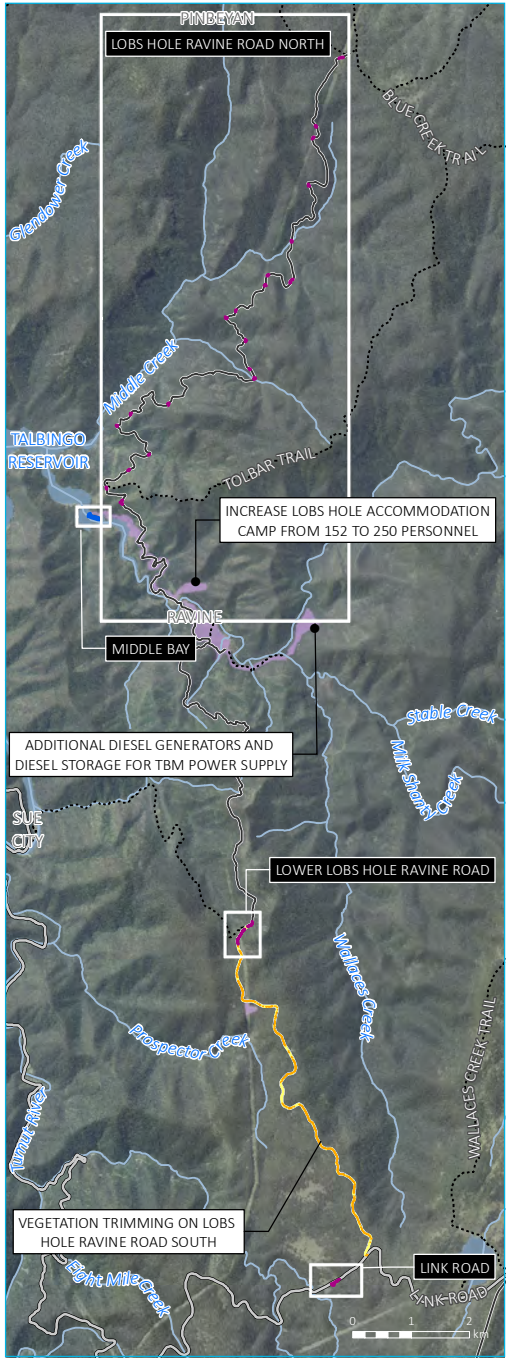
The scope of the proposed modification includes:

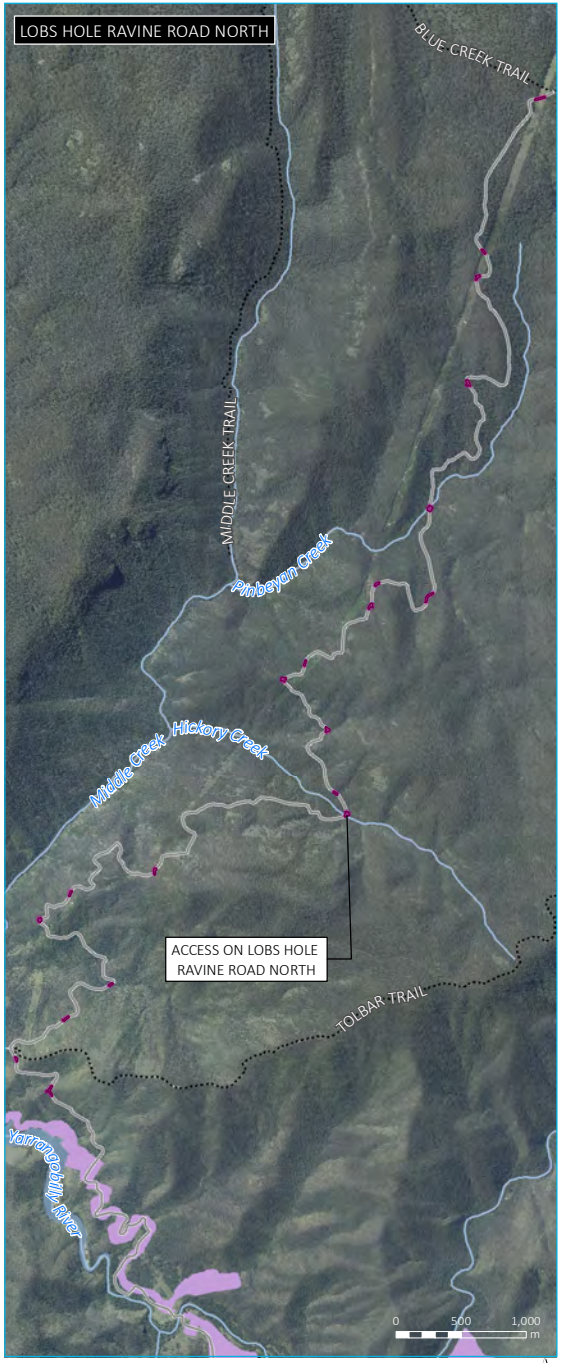
- revision of the exploratory tunnelling method from drill and blast to predominantly tunnel boring machine (TBM) method;
- road upgrades for transport and delivery of TBM equipment and materials required for tunnelling;
- minor vegetation trimming, and selective tree lopping/removal on Lobs Hole Ravine Road (South) to provide adequate clearance for transport of the maximum TBM load;
- improved access and egress to Lobs Hole via Lobs Hole Ravine Road (North);
- relocation of Middle Bay Barge ramp to significantly reduce dredging area required for its establishment;
- increase Lobs Hole accommodation camp capacity 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 the Lobs Hole Substation construction power connection (subject of 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.

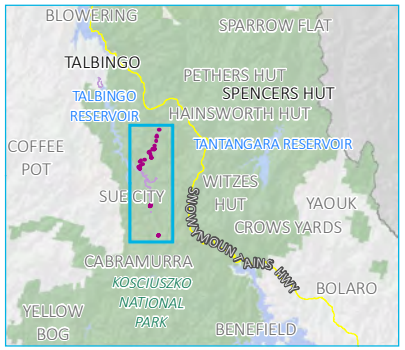
An overview of the Modification 2 elements is provided in Figure 1.1.











KEY

- Exploratory Works MOD 2 disturbance footprint
- Approved disturbance footprint
- Middle Bay barge access
- Disturbance area - barge infrastructure
- Disturbed area - Lobs Hole Ravine Road south
- Vegetation trimming - Lobs Hole Ravine Road south
- Waterbody
- Watercourse
- Main road
- Local road
- Vehicular track

Modification 2 overview

Snowy 2.0
Exploratory works
Modification 2
Figure 1.1

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

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1.3 Need for modification

Since the Exploratory Works EIS was developed, FGJV has been engaged by Snowy Hydro and a period of design development has led to a shift in the tunnelling method and transport strategy. The proposed modification reflects project changes and requirements identified by FGJV.

Modification 2 will enhance the outcomes of Exploratory Works. The proposed modification will contribute to the aims of Exploratory Works by providing the following benefits:

- improve worker safety during construction;
- reduce environmental impact of blasting and dredging;
- improve schedule and increase reliability of tunnelling;
- improve constructability through standardising construction processes and reducing the handling of materials; and
- optimise cost.

The need for the proposed modification is discussed further in Section 4.1.3.

1.4 Location of modification

The proposed modification works occur largely within and adjacent to the Exploratory Works project area in the northern section of the KNP. A new area will be included within the disturbance footprint, which is on Link Road, west of the Lobs Hole Ravine Road intersection which will allow for the manoeuvring of oversize over mass (OSOM) vehicles delivering the TBM to site. Minor road widening will also occur on Lobs Hole Ravine Road North between Lobs Hole and Snowy Mountains Highway to allow for light vehicle egress.

1.5 Purpose of this report

This report provides the environmental assessment for the proposed modification of the Exploratory Works for Snowy 2.0 project (the project), in accordance with section 5.25 of the EP&A Act. This report includes:

- an overview of the approved project;
- a description of the proposed modification to the approved project;
- justification for the proposed modification;
- an assessment of the potential environmental impacts of the proposed modification;
- details of the changes to the conditions of the project approval required by the proposed modification; and
- details of the changes to the approved environmental management measures required by the proposed modification.

CHAPTER 2

EXPLORATORY WORKS

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, a construction power connection to the existing TransGrid 330 kV line 2 at Lobs Hole and a range of more minor matters explained in more detail in Section 2.3 (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 includes, amongst other things, changing the tunnelling method for the exploratory tunnel from drill and blast to predominantly 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 Exploratory Works elements are shown on Figure 2.1.

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 m^3 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;

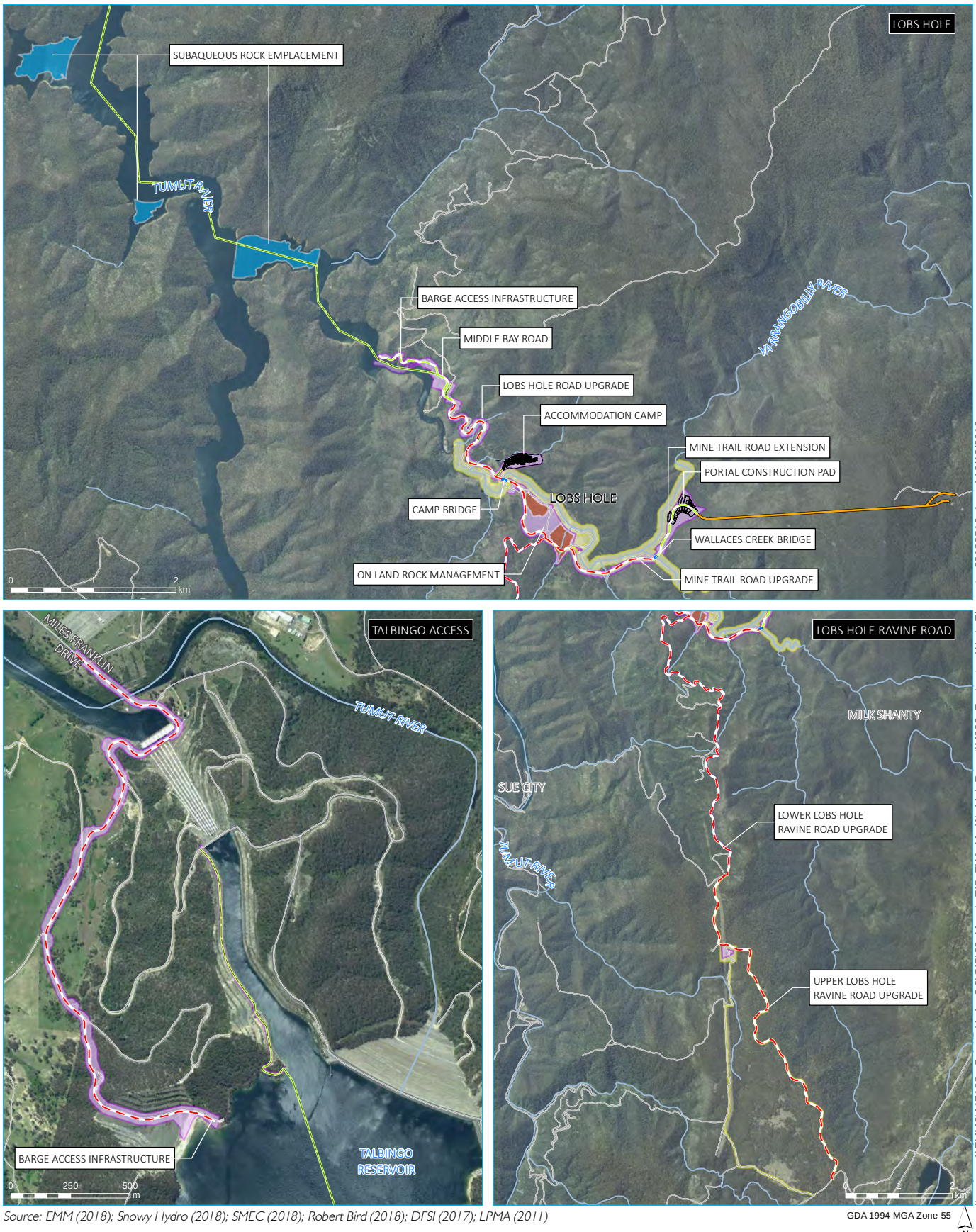
    - on land placement – material will be placed in one of two on land emplacement areas. The eastern emplacement area has been designed to safely treat reactive material with the material to either be emplaced within Talbingo Reservoir as part of the trial or removed from KNP following completion of Exploratory 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.



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Source: EMM (2018); Snowy Hydro (2018); SMEC (2018); Robert Bird (2018); DFSI (2017); LPMA (2011)

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KEY

- Exploratory tunnel
- Access road upgrade
- Access road extension
- Permanent bridge
- Portal construction pad and accommodation camp conceptual layout
- Communications cable
- Local road or track
- Watercourse
- On land rock management
- Subaqueous excavated rock placement
- Disturbance footprint
- Avoidance footprint

Approved Exploratory Works elements

Snowy 2.0
Exploratory Works EIS
Modification 1
Figure 2.1

snowy 2.0

EMM creating opportunities

2.3 Modification 1

In June 2019, Snowy Hydro applied 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 m^2 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 m^2 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 Approved activities relevant to proposed modification

2.4.1 Construction and disturbance

The disturbance footprint defined for the approved Exploratory Works consists of all areas subject to clearing and ground disturbance. The extent of the disturbance footprint is shown on Figure 2.1 and shows the area required for construction, including the buildings and structures, portal construction pad, road widenings and bridges, laydown areas, and rock emplacement areas.

The Exploratory Works EIS detailed that typical construction activities that may occur within the disturbance footprint included:

- road works including minor surface upgrades of existing tracks (where no widening is needed), and extension or widening of existing tracks and the maintenance of these tracks;
- bridge works including establishing temporary bridges and environmental controls to facilitate permanent bridge construction;
- geophysical and geotechnical investigation such as seismic survey and borehole drilling;
- site establishment at the portal construction pad, accommodation camp and rock emplacement areas including set up of environmental controls, clearing of vegetation, earthworks, installing site drainage and stabilising the site, and installing and commissioning services infrastructure;
- barge access works including excavating and dredging works and installing precast concrete panels and bollards; and
- revegetation, rehabilitation, management and monitoring.

The EIS also detailed that there would be no surface disturbance associated with the exploratory tunnel except at the tunnel portal and that the disturbance footprint therefore excluded the exploratory tunnel alignment.

In addition, Section 3.3 of the EIS detailed that the only built feature on the surface above the exploratory tunnel is an access track established for the previous geotechnical drilling program in the Marica area, above the previous location of the power station.

As discussed in Section 2.2, the construction and disturbance boundary is proposed to be amended under the proposed Modification 1 to the Exploratory Works.

2.4.2 Exploratory tunnel construction

The major stage and primary activity of the approved Exploratory Works is the extraction of rock to create the exploratory tunnel. Works would include the establishment of the portal and associated earthworks and batter protection, the drill and blast operation, rock coring, testing and cavern alignment confirmation to provide the completed exploratory tunnel. Tunnelling would be carried out via traditional methods, drill and blast being the most likely option. The exploratory tunnel would be shotcrete lined. The EIS identified the following steps for construction:

- set out pre-support pattern and next advance blast pattern;

- install tunnel pre-support ahead of advancing tunnel face if required;
- drill next advance blast pattern;
- undertake charging and stemming of blast holes;
- conduct blasting;
- inspect blast area to ensure it is free of undetonated explosives;
- excavate blast spoil and scale the blasted zone;
- undertake geotechnical mapping of the tunnel face;
- set out rock bolt pattern and excavation performance monitoring locations where required;
- install tunnel support typically including rock bolts and steel fibre reinforced shotcrete and supplemented by steel ribs and lagging where required;
- install and monitor tunnel excavation performance monitoring instruments if required; and
- progressively repeat above sequence for the development of the exploratory tunnel.

The following supporting activities and methods would also be implemented during exploratory tunnel construction:

- forced ventilation of the tunnel excavation will commence once the tunnel has extended 20–30 m beyond the portal subject to the performance of the tunnel to self-ventilate;
- tunnel drainage systems will be progressively installed as tunnelling advances. This will typically consist of sumps constructed at 250–500 m intervals with the sumps connected to the tunnel portal and a sump at or near the tunnel face. The sump at the tunnel face will be equipped with a submersible pump and flexible discharge hose to feed tunnel water to the closest sump;
- bench excavation will follow as a complementary sequence 20–50 m behind heading construction following a similar drill and blast sequence;
- in-tunnel services such as water supply, power, lighting, air quality monitoring and communications will be progressively advanced around 20 m behind the tunnel face and away from blasting zone; and
- tunnel invert concreting will follow behind the bench development and may include under slab drainage system installation.

2.4.3 Power and energy

Power supply for the approved Exploratory Works is required at the accommodation camp, the portal construction pad and the Middle Bay barge ramp. Power requirements at these sites would be provided by diesel generator set at the portal construction pad as shown in Figure 2.3 of the EIS. A temporary high voltage/low voltage reticulation network would connect the diesel generators to facilities throughout the project area via buried conduit within the Exploratory Works disturbance footprint. Diesel storage tanks would be at the portal construction pad.

Exploratory Works power supply is approved to be provided by diesel generators at the portal construction pad. The predicted fuel use for the duration of Exploratory Works is approximately 8,690,000 litres (L) of diesel fuel.

As discussed in Section 2.2, construction power supply through the construction of the Lobs Hole substation is to be established under the proposed Modification 1.

i Fuel storage facility

The main fuel storage facility for the approved Exploratory Works would be north-west of the tunnel portal as shown in Figure 2.3 of the EIS. The fuel storage facility would have capacity to store approximately 275,000 L of fuel and have an area of around 122 m^2. Fuel storage facilities would also be provided at ancillary construction areas as described in Section 2.10.6 of the EIS.

2.4.4 Barge access and transport

The approved Exploratory Works EIS proposed barge access infrastructure to enable transport of bulky and heavy equipment and provide alternative access in case of emergency. Heavy equipment for barge transport may include drilling jumbos, haul trucks and large excavators for portal construction and establishment of work sites. Materials including cement, aggregates, sand and steel could also be delivered by barge. The barge access infrastructure includes:

- a new barge ramp near the Talbingo Spillway (Talbingo barge ramp);
- a new barge ramp at Middle Bay (Middle Bay barge ramp);
- occasional use of the existing Talbingo Reservoir boat ramp near the dam wall; and
- dredging to facilitate ramp construction and barge navigation.

i Talbingo and Middle Bay barge ramps

The Talbingo barge ramp is on Snowy Hydro owned land at the north end of Talbingo near the existing Talbingo Spillway and would comprise a barge ramp and adjacent laydown area. The Talbingo barge ramp would be a concrete ramp at a grade of 1:10 (vertical: horizontal) approximately 10 m wide. The reservoir bed 20 m either side of the centreline of the barge ramp would be no higher than the barge ramp surface. The infrastructure for the Talbingo barge ramp is provided in Figure 2.12 of the EIS.

The Middle Bay barge ramp and access makes use of existing access and previously disturbed areas near the existing Middle Bay unformed boat launching area. The Middle Bay barge ramp would take the form of a concrete ramp at a grade of 1:10 and be approximately 15 m wide. The infrastructure proposed for Middle Bay barge ramp is provided in Figure 2.13 of the EIS.

The barge ramps would be constructed from cast in-situ concrete above the reservoir FSL and pre-cast concrete planks or slabs below FSL. The pre-cast planks would be laid on a pre-prepared flexible foundation comprising bedding material screed and compacted at the desired grade. The planks would be connected with stainless steel straps and pins. The barge bow ramp would be lowered onto the concrete barge ramp to enable vehicles, plant and equipment to roll-on and roll-off the barges. The barges would be positioned using tugs and held against the concrete ramp by mooring lines attached to bollards near the crest of the ramp. The mooring lines would be tensioned using a winch to ensure the barges are held securely in place.

ii Middle Bay navigation channel

Dredging is required to establish a navigation channel on the approach to the Middle Bay barge ramp. The minimum channel depth would be 534.7m Australian Height Datum (AHD) for Exploratory Works.

Channel batters formed by dredging would be approximately 1:2. Acceptable dredge batters would be confirmed following review of the geotechnical investigation. The minimum width of the navigation channel would be 50 m. Turning basins would be 100 m. The width of the navigation channel may increase in the vicinity of bends in the channel to accommodate navigation.

The navigation channel alignment would also provide space for a pump intake, on the inside bend of the channel, approximately 80 m downstream from the toe of the ramp.

iii Barge transport

The Exploratory Works EIS stated that barges would be loaded at the Talbingo barge ramp, travel about 18 km along Talbingo Reservoir and be unloaded at the Middle Bay barge ramp before returning to the north. A round trip from Talbingo barge ramp to Middle Bay barge ramp and return would take approximately four hours. Some loads would also be transported in the reverse direction, for example when equipment is no longer required. Barges would be towed by a tug or self-propelled. There would also be the need for smaller, faster maintenance boats. There are expected to be up to 24 barge movements per day transporting equipment and materials between Talbingo barge ramp and Middle Bay barge ramp.

Barges at Middle Bay would also be used for transport and placement of excavated material as part of the sub-aqueous rock placement program (See Section 2.5.4 of the EIS). Barging may occur 24 hours a day but is likely to be used predominantly during daylight hours.

2.4.5 Access road and tracks

In total, 18.5 km of road widening, 7.5 km of road upgrades that do not include widening, 2 km of new roads and two watercourse crossings are approved as part of Exploratory Works. A summary of the access road works required is provided in Table 2.1 below and further described in this section.

Table 2.1 Access road works summary

Roadwork area	Overview
Road upgrades without widening	
Upper Lobs Hole Ravine Road	Minor upgrades to 7.5 km section of existing road. Generally, only single lane access would be provided. No cut and fill earthworks or vegetation clearing would be undertaken
Road upgrades with widening	
Lower Lobs Hole Ravine Road	Upgrades to 6 km section of existing road involving cut and fill earthworks in some sections, with two-way access provided
Lobs Hole Road	Upgrade to 7.3 km section of existing road providing two-way access
Mine Trail Road	Upgrade to 2.2 km section of existing track to two-way access
Spillway Road	Upgrade of a 3 km section of existing road to provide two-way access to the proposed Talbingo barge ramp
New roads	
Mine Trail Road extension	Establishment of a new two-way road providing access to the exploratory tunnel portal
Middle Bay Road	Establishment of a new two-way road to the proposed Middle Bay barge ramp
Watercourse crossings	
Wallaces Creek Bridge	Establishment of a new bridge at Wallaces Creek as part of the Mine Trail Road extension
Camp Bridge	Establishment of a new bridge across Yarrangobilly River as part of Lobs Hole Road upgrade

For public safety reasons, public access to Lobs Hole Ravine Road would be restricted from both the Snowy Mountains Highway (in the north) and Link Road (in the south) for the duration of Exploratory Works.

The EIS detailed a number of different approaches to utilising existing tracks or establishing new access roads within the proposed disturbance footprint, including the following:

i Existing tracks for upgrade without widening

The EIS detailed that where road upgrades are proposed without widening, no works would occur beyond their current boundary, which is defined by the growth of established vegetation at the edge of the track. There will be no vegetation clearing to upgrade these tracks, however in some instances minor trimming of overhanging branches may be required to ensure safety of road users.

Tracks which have erosion features and rutting that prevent safe passing would have all or some of the following minor improvement works: removal of high points, infill of scours, blade levelling and compaction of the surface by rolling.

ii Track widening and construction of new roads

The EIS detailed that where track widening or new roads are established a minimal disturbance footprint approach would be adopted. Before any widening works start, the following sequence of events would be carried out:

- clearing and grubbing works will be undertaken including the removal of high points;
- drainage will be constructed;
- bulk earthworks (ie cut and fill) will be carried out;
- road pavement material will be placed on the roadway;
- road safety furniture and signage will be installed as required; and
- site stabilisation and rehabilitation to happen as soon as practical.

2.4.6 Traffic movements

i Primary transport routes

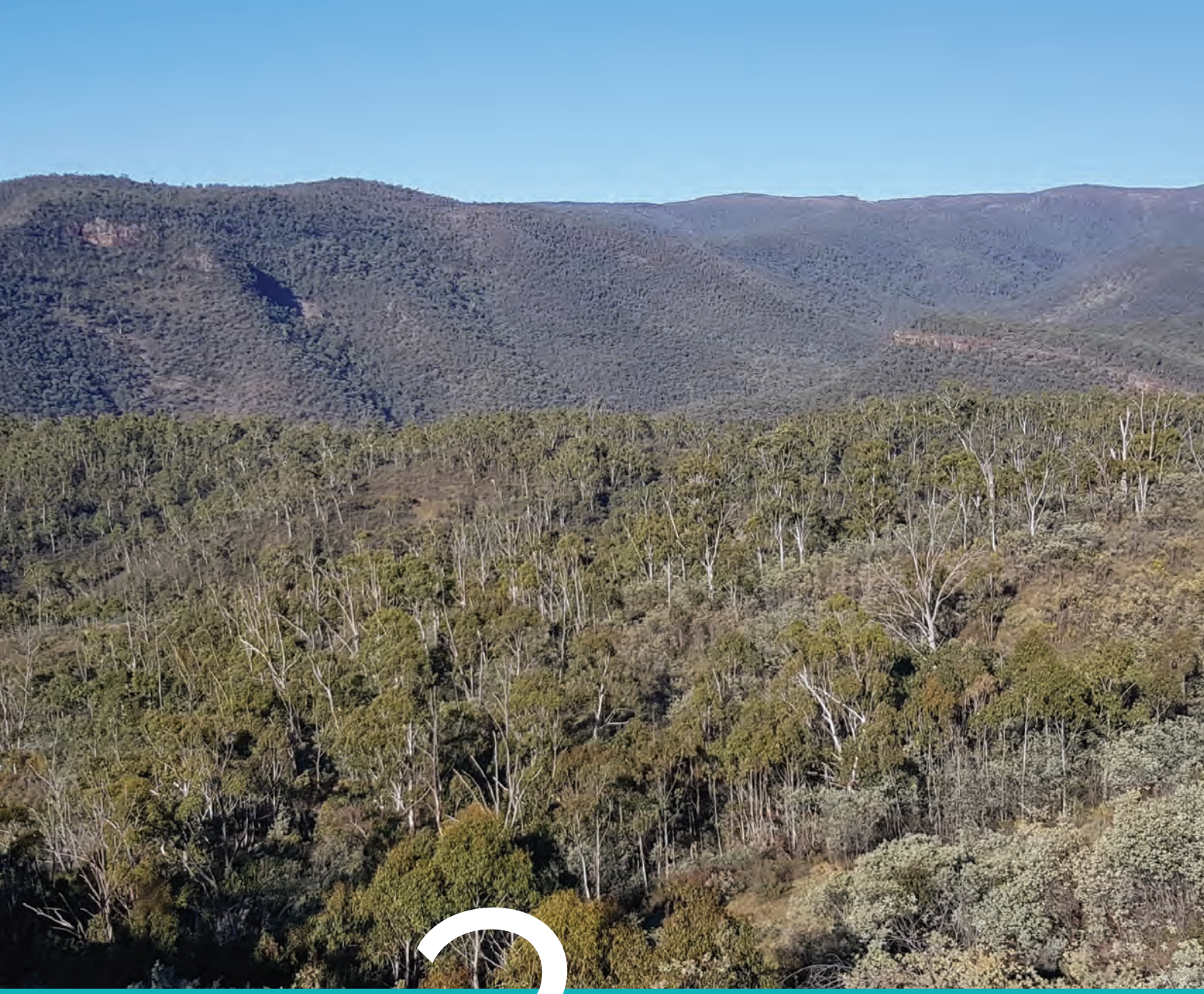
It is expected that the majority of materials and equipment would travel along the Snowy Mountains Highway, Link Road and Lobs Hole Ravine Road, with some travelling via Talbingo to Talbingo Reservoir and transfer via a barge to site. The primary transport routes for construction material deliveries to site are provided in Figure 2.19 of the EIS.

2.4.7 Accommodation camp

The approved accommodation camp would comprise up to 152 single rooms with private ensuites. The accommodation camp layout includes ensuite rooms surrounding central facilities including a kitchen, gym, administration office, laundry, maintenance building, sewage and water treatment plants and parking that will service the Exploratory Works workforce. The conceptual layout of the accommodation camp is shown on Figure 2.4 of the EIS.

The accommodation camp would provide food and beverage services to the Exploratory Works workforce in the dedicated kitchen. Laundry facilities would be provided in the central facilities building. A gym and recreation facility would be provided for use by the workforce during stays at the accommodation camp.

Access to the accommodation camp would be via an access road connecting to the north side of Lobs Hole Road at Lobs Hole. Car and bus parking facilities would be provided for the workforce.



CHAPTER 3

PROPOSED MODIFICATION

3 Proposed modification

3.1 Modification 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;
- improved access and egress to Lobs Hole via Lobs Hole Ravine Road (North);
- relocation of Middle Bay Barge ramp to significantly reduce dredging area required for its establishment;
- increase Lobs Hole accommodation camp capacity 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 the Lob Hole Substation 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 1.1.

3.2 Tunnelling method

The approved tunnelling method is a drill and blast method for excavation of the Exploratory Tunnel only. Since the preparation of the Exploratory Works EIS, Snowy Hydro Limited has engaged FGJV to deliver the Exploratory Works. The FGJV design and tunnelling method for the exploratory tunnel includes the use of a 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 predominantly TBM.

The exploratory tunnel will be predominantly excavated using one TBM that will be launched from either the portal construction pad or within the exploratory tunnel. As is 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.

Drill and blast methods will continue to be implemented as required and will be used for the exploratory tunnel until the TBM arrives on-site.

3.2.1 Tunnel boring machine method

Tunnel boring machines are used to excavate tunnels with a circular cross section. The selection of the TBM is one of the most important technical aspects of the project. The TBM will be fully equipped to perform the excavation, ventilation, lining, and 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 tunnel, thereby reducing the amount of excavated rock material.

Non-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 probe core retrieval ahead of the advancing tunnel face.

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 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.

An example diagram showing a TBM is provided in Figure 3.1 below.

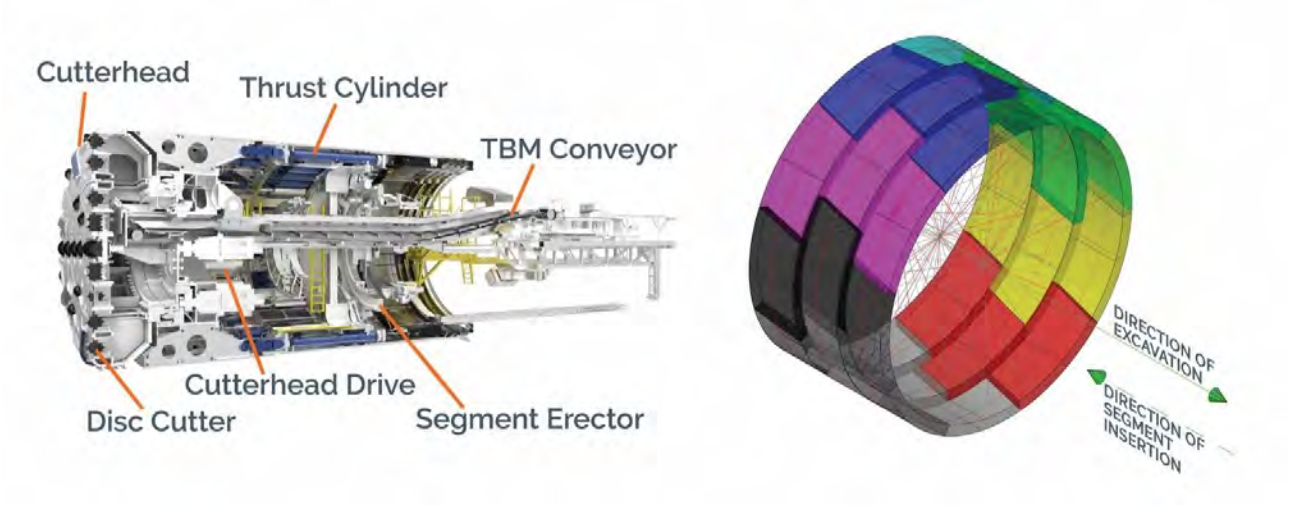


Figure 3.1 Example Tunnel Boring Machine (TBM)

3.2.2 Exploratory tunnel

Detailed design and geotechnical investigations have optimised the preferred location of the power station cavern and thereby reduced the length of the exploratory tunnel. The exploratory tunnel has reduced in length from 3.1 km to 2.5 km. A minor variation of an additional approximately 500 m may be required if the exploratory drilling indicates poor ground conditions in the nominated cavern location. The revised exploratory tunnel location is shown in Figure 3.2. The internal diameter of the TBM exploratory tunnel will be approximately 9.9 m. A TBM launching chamber may also be established within the exploratory tunnel with dimensions of approximately 13.9 m by 13.3 m. The proposed changes to the exploratory tunnel represent a significant project improvement through design optimisation. The project optimisation through detailed design is expected to reduce the exploratory tunnel length by approximately 600 m and reduce the volume of excavated material by 65,000 m^3.

3.3 Road upgrades

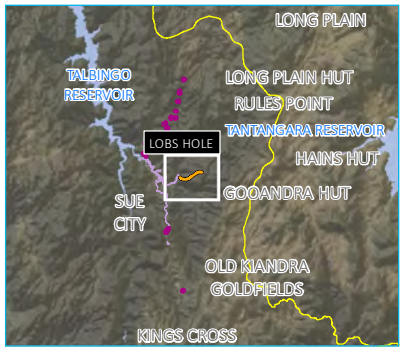
Minor road upgrade works are required to enable transport of TBM equipment and materials required for tunnelling. The road upgrades have been designed to avoid and minimise impacts to native vegetation and threatened species. The proposed road upgrades also avoid impacting any areas of geodiversity significance including the boulder streams, karst and fossil features on Lobs Hole Ravine Road. This section provides details of the road works proposed under Modification 2.

3.3.1 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 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 facilitate set down and turn-back of oversize and overmass (OSOM) deliveries. This facility would minimise the OSOM delivery duration along Link Road and Snowy Mountains Highway and enable oversize loads to safely turnaround off of Link Road and approach the Lobs Hole Ravine Road intersection in a west – east direction. Suitable traffic controls will be implemented for vehicles entering and exiting the turnaround area. The proposed Link Road turnaround will be used as 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 tree cover. The Link Road turnaround area is provided in Figure 3.3.

3.3.2 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 is 6.8 m and is a key factor driving the proposed road upgrades.



KEY

- Exploratory Works MOD 2 disturbance footprint
- Approved disturbance footprint
- Indicative exploratory tunnel
- Approved portal construction pad conceptual layout
- Approved access road upgrade
- Approved access road extension
- Contour (10m)
- Contour (100m)
- Local road
- Vehicular track
- Watercourse / drainage line

Indicative exploratory tunnel

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

0 250 500 m

GDA 1994 MGA Zone 55

N

Snowy 2.0
Exploratory Works
Modification 2
Figure 3.2

snowy 2.0

EMM creating opportunities

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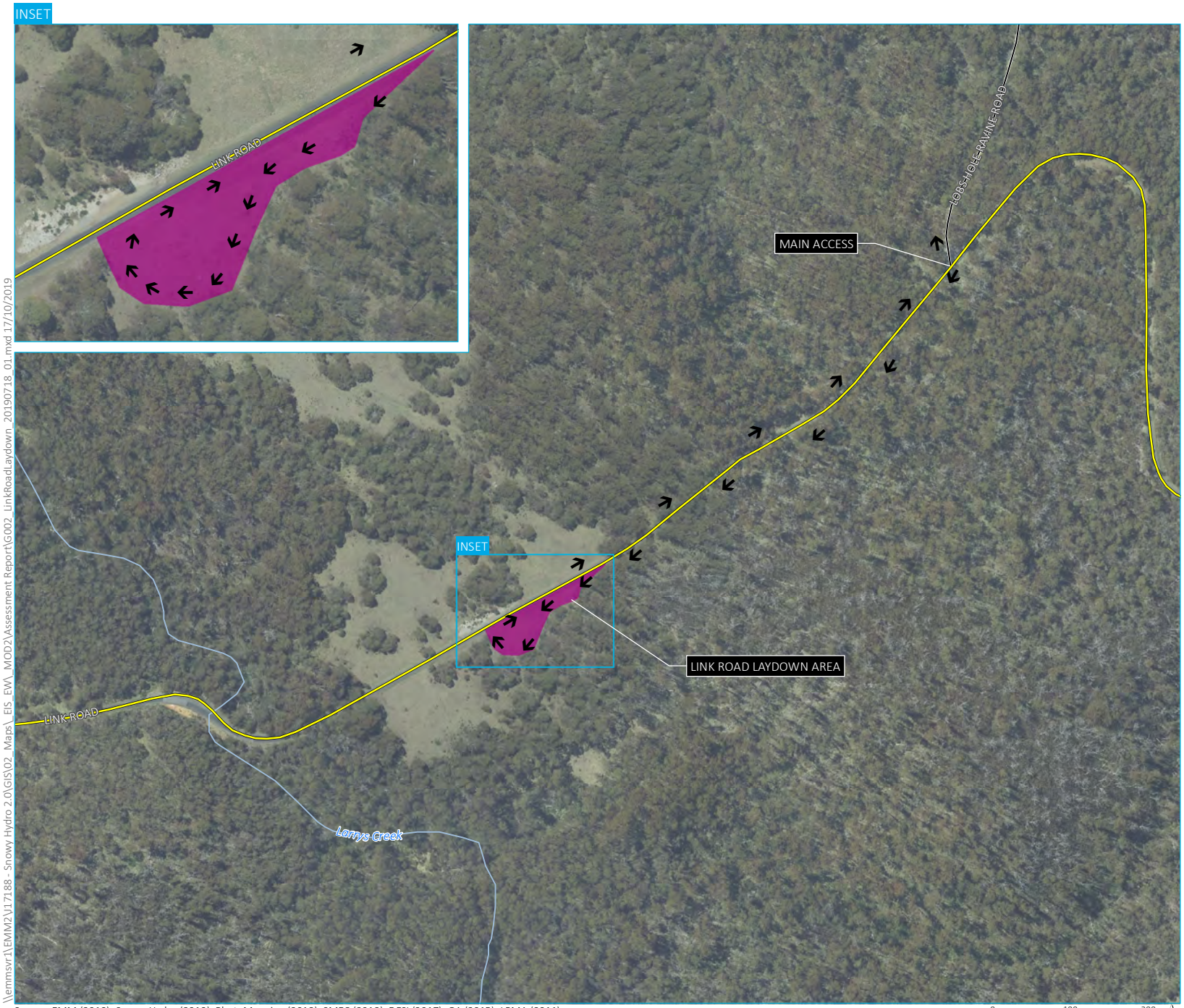

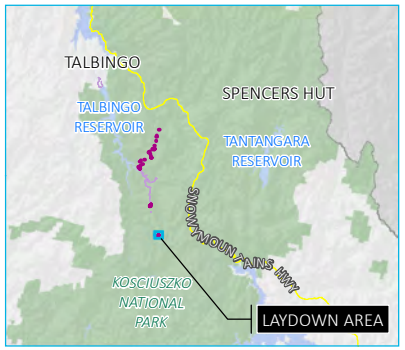

KEY

- Direction of OSOM transport
- Exploratory Works MOD 2 disturbance footprint
- Approved disturbance footprint
- Main road
- Local road
- Watercourse / drainage line

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

0 100 200 m

GDA 1994 MGA Zone 55

N

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Link Road laydown area

Snowy 2.0
Exploratory Works
Modification 2
Figure 3.3

snowy 2.0

EMM creating opportunities

i Vegetation trimming and removal

Vegetation trimming and removal is required to provide adequate clearance for the maximum load transport via some of 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. A diagram showing indicative dimensions of the maximum oversize load is provided in Figure 3.4 below. To safely transport the maximum load a clearance width of 7.4 m is required for the extent of the transport route. The proposed vegetation trimming on upper Lobs Hole Ravine Road is provided in Figure 3.5.

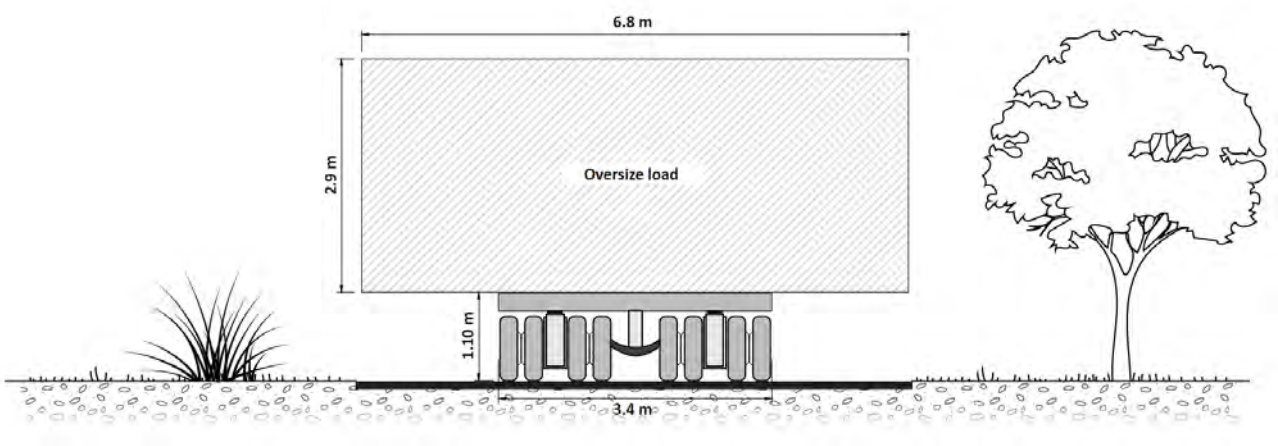
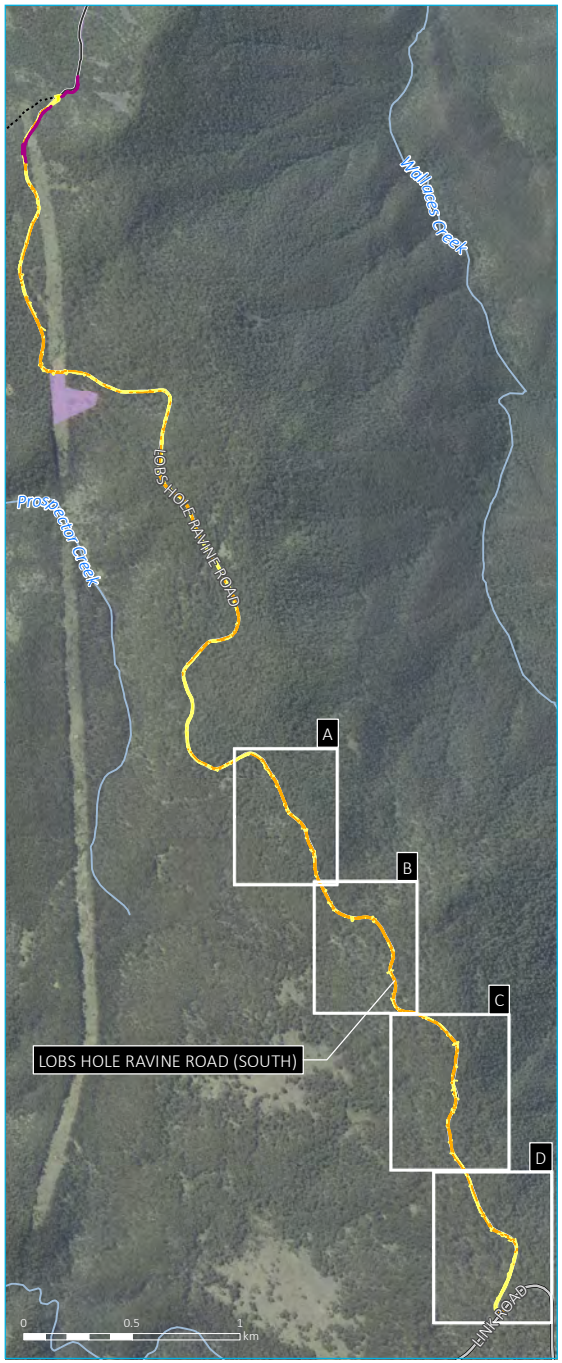


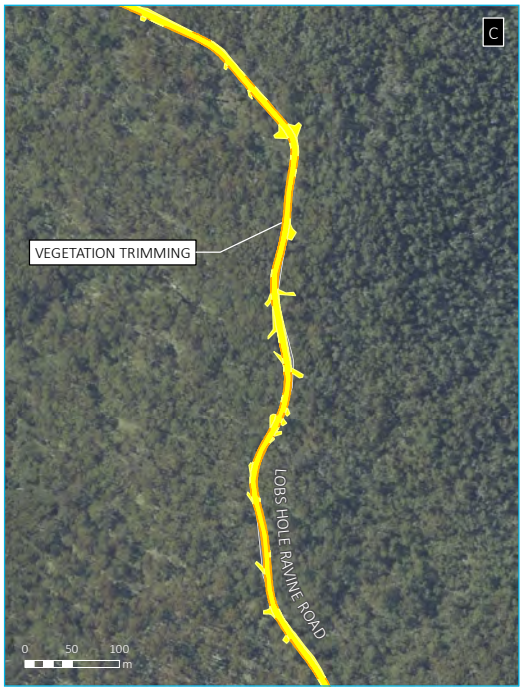
Figure 3.4 Cross-section of maximum load required for Modification 2

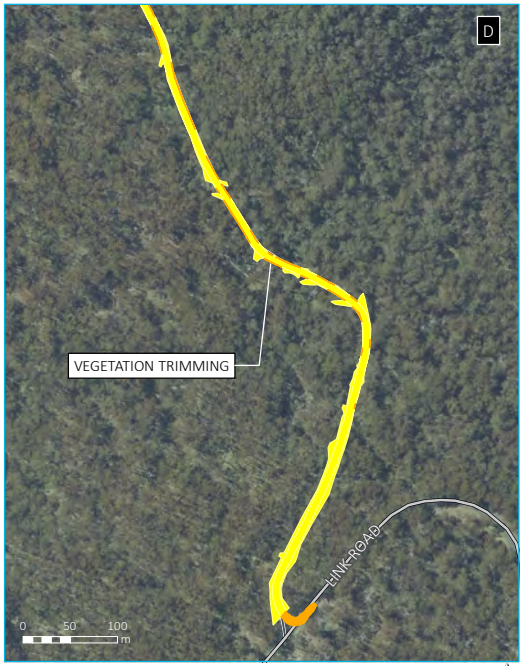
The upper sections of Lobs Hole Ravine Road have high ecological value due to the presence of the critically endangered Smoky Mouse and its habitat. The approved Exploratory Works avoid widening works along this road section as a result. To minimise impacts to potential Smoky Mouse habitat it is proposed to trim vegetation and selectively remove trees as required along some sections of 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. Most of this clearance will be achieved within the existing Lobs Hole Ravine Road (South) 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 approximately 0.4 ha. The area of potential Smoky Mouse habitat that will be affected by proposed vegetation trimming is less than 0.01 ha.

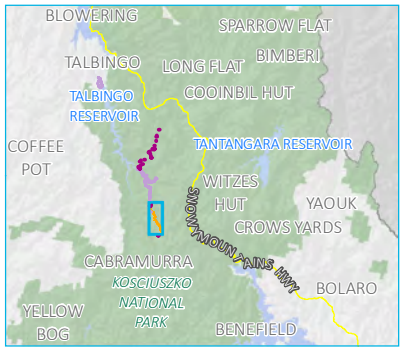
i Minor widening

Some minor road widening is also required on the upper sections of Lobs Hole Ravine Road 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 would have a footprint of approximately 0.1 ha and includes some areas where additional ground disturbance is required. Rock stabilisation may also be undertaken along the Lobs Hole Ravine Road disturbance boundary as required for safety. The sections of Lobs Hole Ravine Road (South) requiring additional widening are provided in Figure 3.6.









KEY

- Exploratory Works MOD 2 disturbance footprint
- Approved distrubance footprint
- Disturbed area - Lobs Hole Ravine Road south
- Vegetation trimming - Lobs Hole Ravine Road south
- Watercourse
- Main road
- Local road
- Vehicular track

Vegetation trimming on upper Lobs Hole Ravine Road

Snowy 2.0
Exploratory works
Modification 2
Figure 3.5

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

GDA 1994 MGA Zone 55

N

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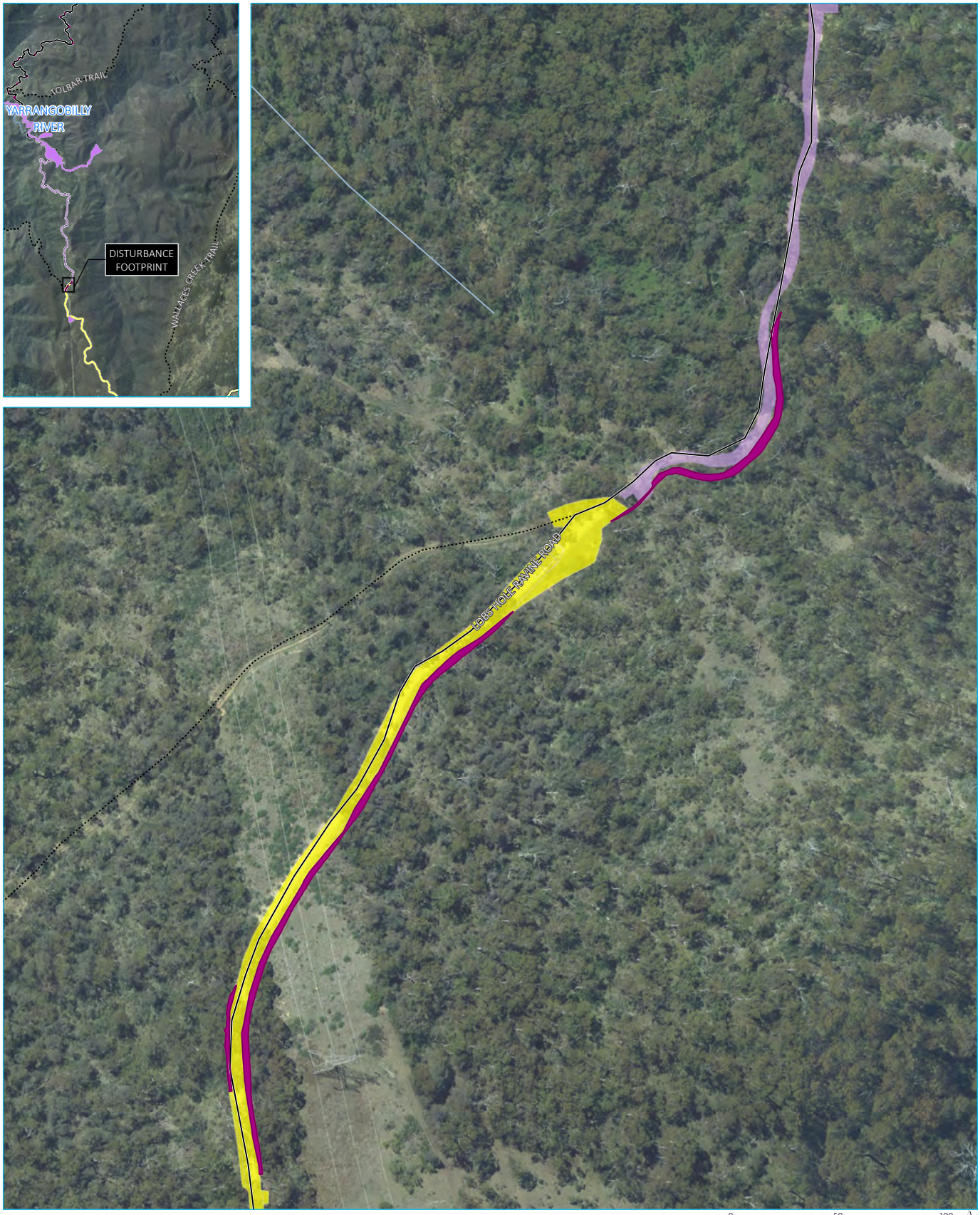

Source: EMM (2019); Snowy Hydro (2019); PhotoMapping (2018); SMEC (2019); DFSI (2017); GA (2015); LPMA (2011)

0 50 100 m
GDA 1994 MGA Zone 55
N

KEY

- Exploratory Works MOD 2 disturbance footprint
- Approved disturbance footprint
- Disturbed area - Lobs Hole Ravine Road south
- Local road
- Vehicular track
- Watercourse/drainage line

Lobs Hole Ravine Road (South) roadworks

Snowy 2.0
Exploratory Works
Modification 2
Figure 3.6

snowy 2.0

EMM creating opportunities

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3.3.3 Cooma roundabouts

Upgrade works are required to two roundabouts on Sharp Street, Cooma. The roundabouts to be upgraded are shown in Figure 3.7. Upgrades are required to these roundabouts to enable the passage of oversize 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. Concept designs for the proposed roundabouts are provided in Appendix B. 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.

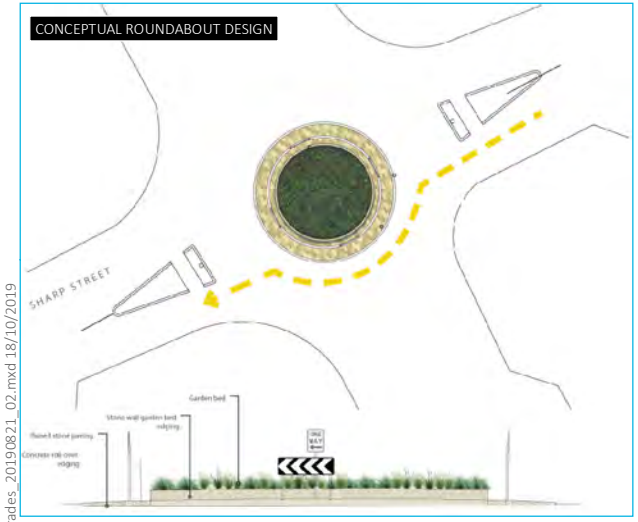
It should be noted that, although the Cooma roundabouts are spatially remote from the principal Exploratory Works project site, the CSSI declaration for the Snowy 2.0 project applies to development for the purposes of the Snowy 2.0 project on any land within the Snowy Monaro Regional local government area (refer to clause 9(2)(c) of Schedule 5 to *State Environmental Planning Policy (State and Regional Development) 2011*). Section 4.2.5 provides further details in relation to the declaration of the project as CSSI.

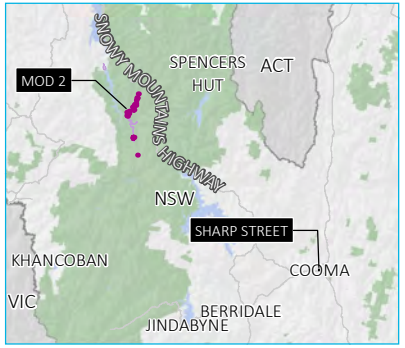
3.3.4 Lobs Hole Ravine Road (North)

Roadworks are proposed to Lobs Hole Ravine Road (North) to provide improved access and egress to Lobs Hole, including improved emergency access and egress. 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. An assessment of traffic and transport impacts from the proposed modification is provided in Section Figure 3.8.

i Road widening

To improve the suitability of Lobs Hole Ravine Road (North) for 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 3.8. Road upgrade construction methods within the passing bay sections will be consistent with the road upgrades undertaken for other Exploratory Works access roads.





KEY

- Exploratory Works MOD 2 disturbance footprint
- Approved disturbance footprint
- Main road
- Local road
- Watercourse / drainage line

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

0 50 100 m

GDA 1994 MGA Zone 55

N

Cooma roundabout upgrades

Snowy 2.0
Exploratory Works
Modification 2
Figure 3.7

snowy 2.0

EMM creating opportunities

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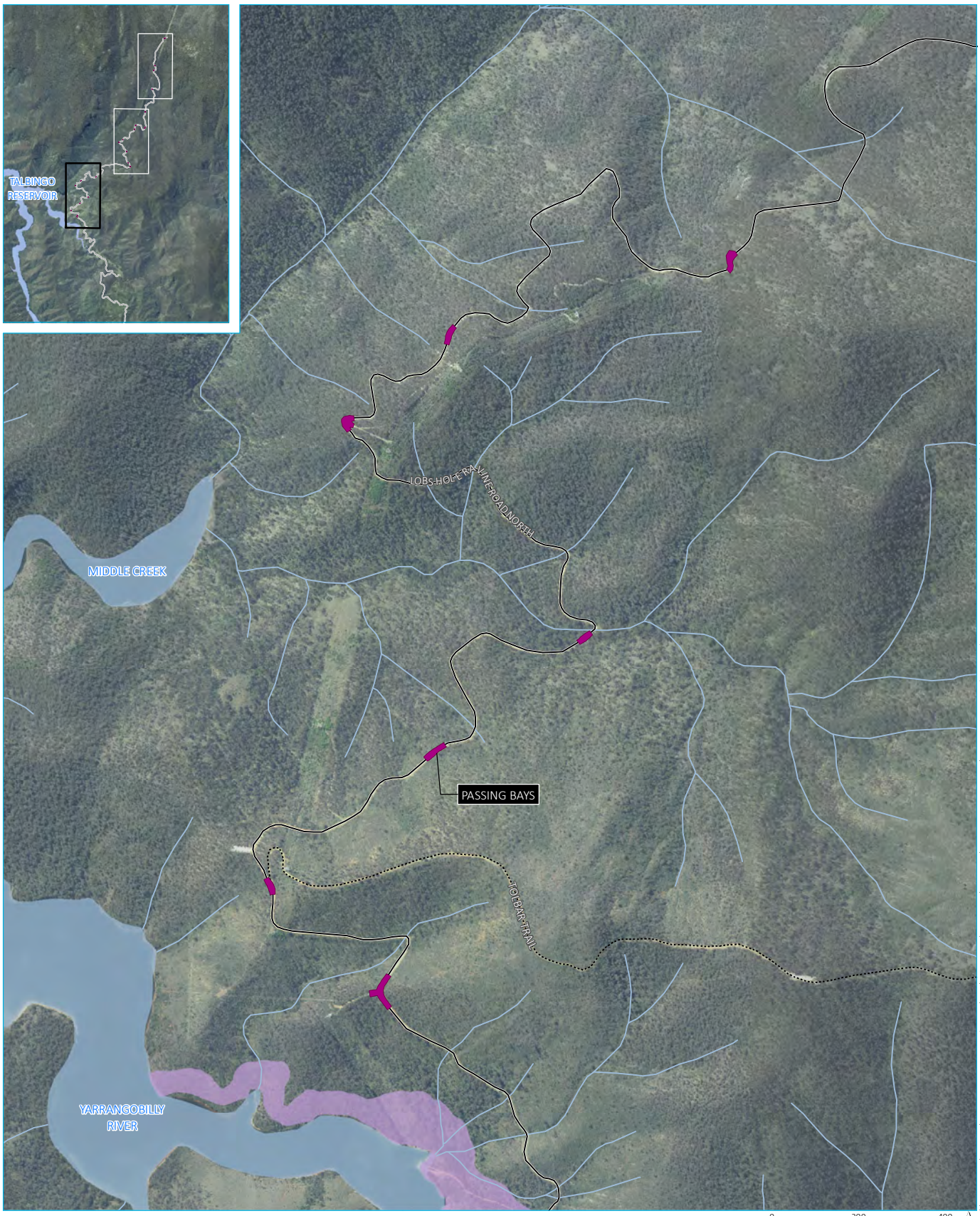

Source: EMM (2019); Snowy Hydro (2019); PhotoMapping (2018); SMEC (2019); DFSI (2017); GA (2015); LPMA (2011)

0 200 400 m
GDA 1994 MGA Zone 55
N

KEY

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

Lobs Hole Ravine Road (North) access and upgrade

Snowy 2.0
Exploratory Works
Modification 2
Figure 3.8 a

snowy 2.0

EMM
creating opportunities

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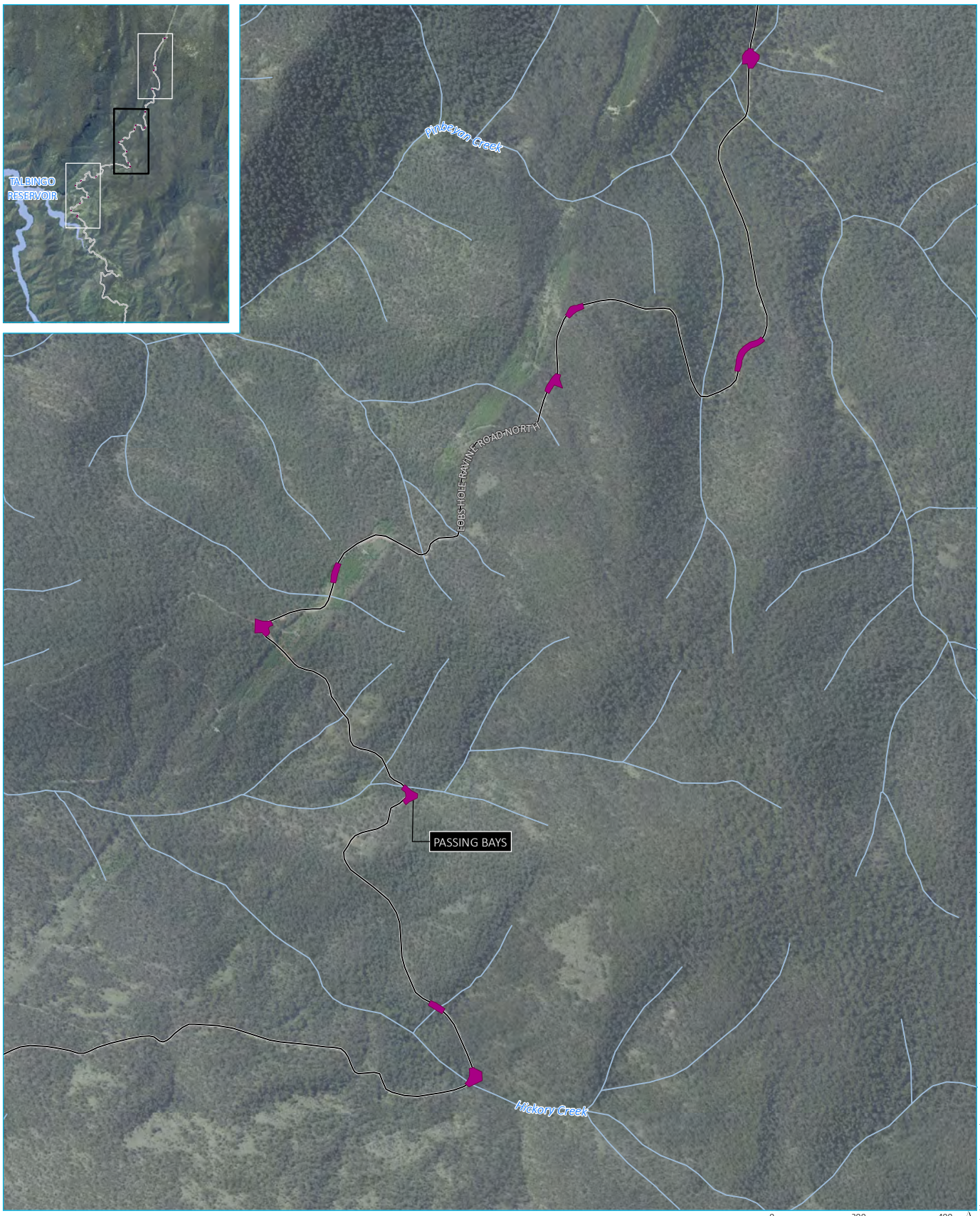

Source: EMM (2019); Snowy Hydro (2019); PhotoMapping (2018); SMEC (2019); DFSI (2017); GA (2015); LPMA (2011)

0 200 400 m
GDA 1994 MGA Zone 55
N

KEY

- Exploratory Works MOD 2 disturbance footprint
- Local road
- Vehicular track
- Watercourse/drainage line

Lobs Hole Ravine Road
(North) access and upgrade

Snowy 2.0
Exploratory Works
Modification 2
Figure 3.8 b

snowy 2.0

EMM
creating opportunities

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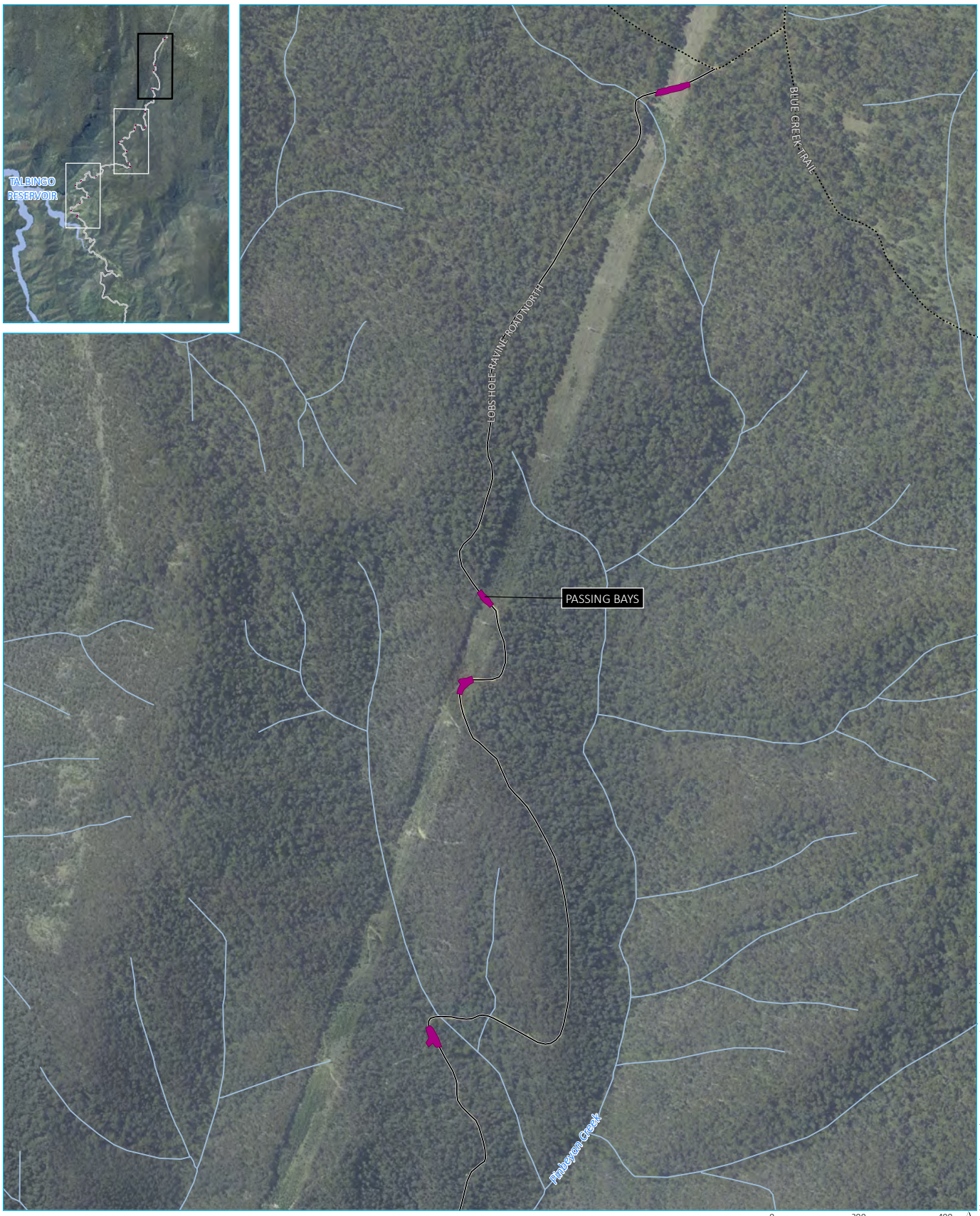

Source: EMM (2019); Snowy Hydro (2019); PhotoMapping (2018); SMEC (2019); DFSI (2017); GA (2015); LPMA (2011)

0 200 400 m
GDA 1994 MGA Zone 55
N

KEY

- Exploratory Works MOD 2 disturbance footprint
- Local road
- Vehicular track
- Watercourse/drainage line

Lobs Hole Ravine Road (North) access and upgrade

Snowy 2.0
Exploratory Works
Modification 2
Figure 3.8 c

snowy 2.0

EMM creating opportunities

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ii Road maintenance

Periodic maintenance will be undertaken to Lobs Hole Ravine Road (North) 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).

iii Safety

Minor works to improve safety will be carried out as required. This will include:

- placement of temporary barriers (concrete or steel), anchored into the ground within the existing disturbed area where the down slope is steep and requires a safety control to be in place to ensure safe movement of light vehicles;
- appropriate signage and traffic management;
- installation or replacement of guideposts;
- removing vegetation that has fallen on (or is otherwise obstructing) the roadway; and
- removal of dangerous trees.

3.3.5 Clearing

Clearing will be required to allow for road upgrades the subject to this modification. The additional clearing will include approximately 0.07 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:

- pre-clearance vegetation inspections by ecologists;
- installation of site delineation/webbing, inclusive of sediments control measures along the road;
- removal of the trees and upper story 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.

3.4 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 approximately 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 August 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.

3.5 Transport strategy

A commitment under the Exploratory Works EIS was the use of barges for the transportation of machinery, equipment and materials to the work site. Schedule 3, 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 OSOM vehicle movements. An assessment of traffic and transport impacts from the proposed modification is provided in Section 6.5.

It is proposed that condition 45 of the Minister's approval be removed.

3.5.1 Talbingo recreational area

As part of the Exploratory Works EIS assessment, the Talbingo recreational area was proposed to mitigate impacts on recreational users of Talbingo Reservoir from barge use and construction activities at the Talbingo Spillway. It is now proposed to remove the requirement to establish the Talbingo recreational area as part of the Exploratory Works. As the proposed transport strategy no longer requires regular transport of materials and equipment via barge from Talbingo Spillway it is expected that impacts to recreational users will be significantly reduced. The Talbingo Spillway barge ramp may be used temporarily during the installation of the communications cable, however, this is expected to be a short-term impact only.

As impacts of barge use on recreational users of Talbingo Reservoir will be significantly reduced the proposed recreational area is no longer considered to be a necessary condition of approval. Schedule 3, condition 4 of the Minister's approval requires:

> Prior to installing the approved barge infrastructure at the northern end of the Talbingo Reservoir, unless the Planning Secretary agrees otherwise, the Proponent must develop a detailed plan for the new recreational area at the Talbingo Boat Ramp in consultation with Snowy Valleys Council and the NPWS, and to the satisfaction of the Planning Secretary. In preparing this plan, the Proponent must consider the feasibility and merits of incorporating a small area of the Kosciuszko National Park into the plan to enhance the new recreational area. The plan must include:
>
> (a) the detailed layout of the new recreational area;

(b) a program to construct the new recreational area and minimise any disruption associated with the closure of the existing recreational area;

(c) an assessment of any additional impacts associated with the plan; and

(d) a program to keep the local community informed of any:

- closures to the boat ramp;
- closures to the existing swimming area; and
- restrictions to waterway access on the Talbingo Reservoir.

Modification 2 proposes to remove this condition of approval as changes to the project transport strategy are expected to negate impacts to recreational users of Talbingo Reservoir.

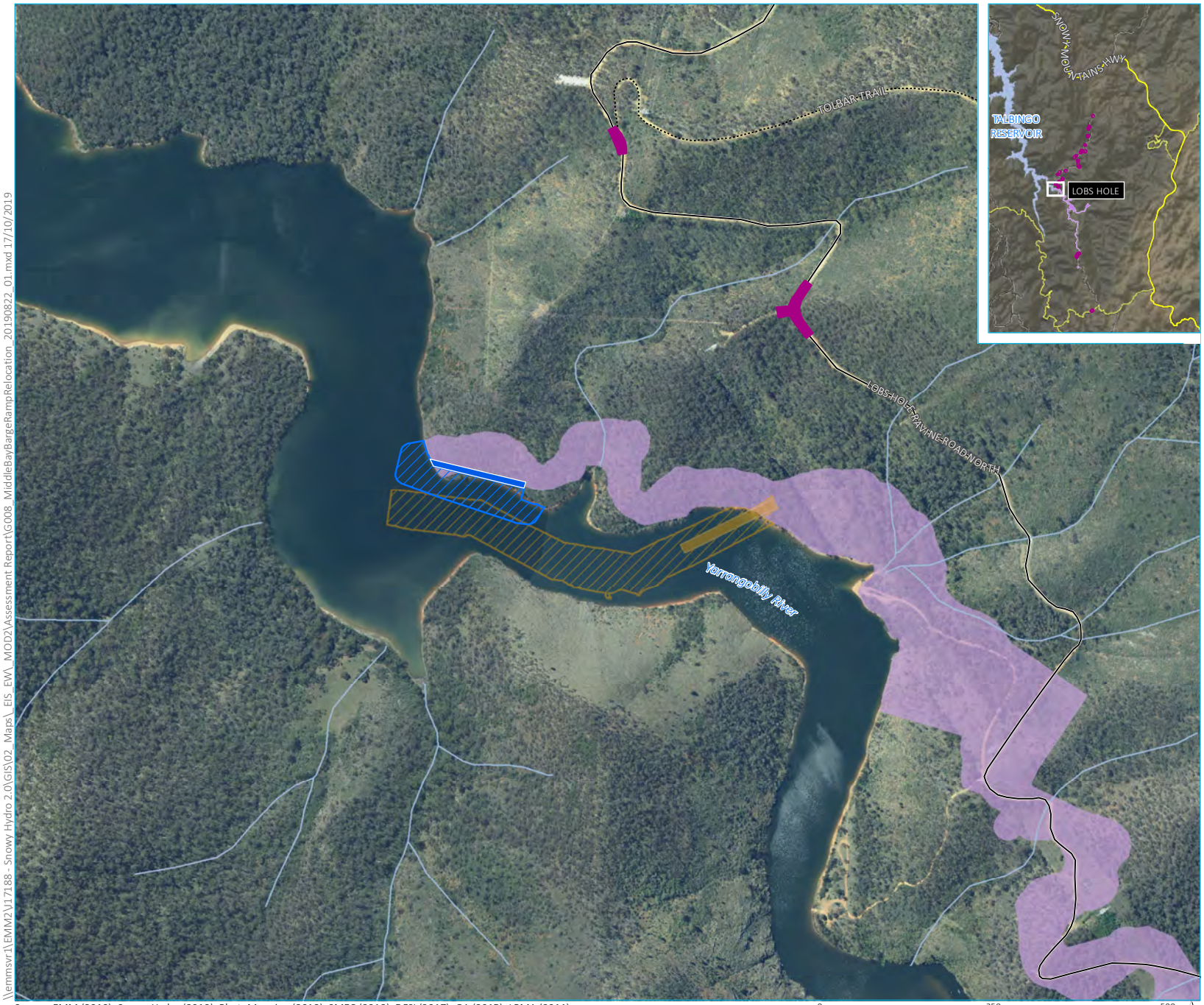
3.6 Middle Bay barge ramp

The location of the Middle Bay barge ramp was reviewed and revised as part of further refinement to the construction methodology. An alternative location for the Middle Bay barge ramp was identified to the west of the approved 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 3.9.

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 methods consistent with what was previously approved.

3.7 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 an additional storey to 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 refinements made to the construction methodology and schedule undertaken by FGJV.



KEY

- Exploratory Works MOD 2 disturbance footprint
- Approved disturbance footprint
- Proposed barge ramp relocation
- Proposed disturbance area - barge infrastructure
- Exploratory Works EIS barge ramp
- Exploratoy Works disturbance area - barge access
- Local road
- Vehicular track
- Watercourse / drainage line

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

0 250 500 m

GDA 1994 MGA Zone 55

N

\\emmsvr1\EMM2\J17188 - Snowy Hydro 2.0\GIS\02_Maps_EIS_EW_MOD2\Assessment Report\G008_MiddleBayBargeRampRelocation_20190822_01.mxd 17/10/2019

Middle Bay barge ramp relocation

Snowy 2.0
Exploratory Works
Modification 2
Figure 3.9

snowy 2.0

EMM creating opportunities

CHAPTER 4

STRATEGIC AND STATUTORY CONTEXT

4 Strategic and statutory context

4.1 Strategic context and justification

4.1.1 Snowy 2.0 strategic context

The strategic context of Snowy 2.0 relates to its critical significance for the NEM, key State and Commonwealth government plans and policies, and economic, social and environmental trends driving a paradigm shift in the energy market.

During the Feasibility Study for Snowy 2.0 and in the lead up to its final investment decision (FID), Marsden Jacob Associates (MJA) carried out independent market modelling to understand upcoming trends and the future NEM in which Snowy 2.0 will operate. The findings of these studies confirm the strategic justification and need for Snowy 2.0 to provide large-scale storage that facilitates firming and reliability to the NEM, as the NEM decarbonises over the next few decades. While the MJA modelling in the lead up to FID in late 2018 is still very relevant and underpins the strong economic case for the project since this time, the energy market has evolved and changed much more quickly than originally anticipated even just a year ago.

The likelihood of coal-fired generators closing earlier than previously anticipated is increasing (Aurora Energy Research 2019) and concurrently, the rapid uptake of intermittent renewables due to favourable economics is changing the energy market landscape. For example, investment in large-scale renewable energy projects doubled in 2018 compared to a previous record-breaking 2017, increasing from $10 billion to $20 billion (Clean Energy Council 2019). NSW is likely to have one of the greatest requirements for energy replacement and capacity, as several coal-fired power plants are confirmed to be retired within the next decade. As the likelihood of new coal-fired power stations is considered to be low, much of the replacement of coal-powered generation will be from renewable sources and to a lesser extent gas.

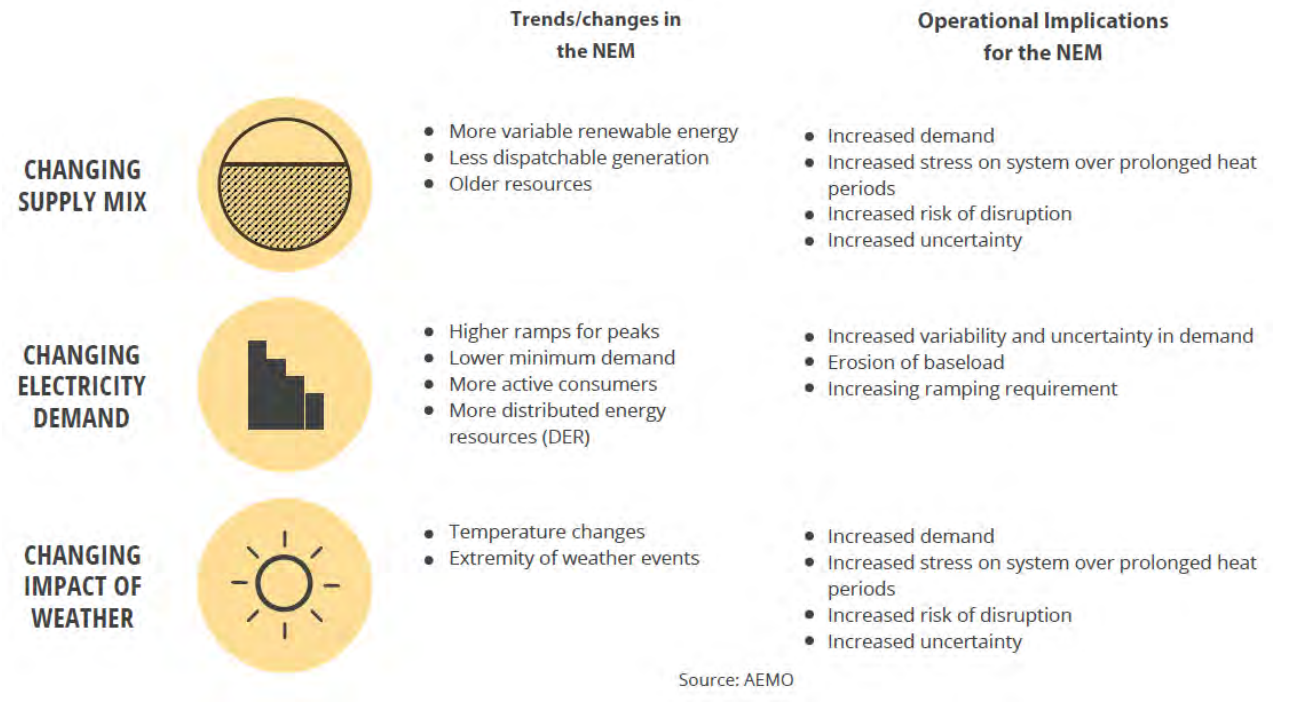


Figure 4.1 Key system changes in the NEM

In recognition of the need to manage the transition and future energy mix in the NEM, Snowy 2.0 was declared CSSI by the former NSW Minister for Planning under the NSW EP&A Act in March 2018. It was declared as critical for the energy security and reliability needs of NSW. At the time of the declaration the Minister stated that Snowy 2.0 was "essential for the future security of our energy system, the economy and the environment." The declaration signifies the critical role that Snowy 2.0, together with the upgrades to the NSW transmission network, will play in providing reliable on-demand energy and large-scale storage to NSW as it transitions to a low emissions economy. Snowy 2.0 is the largest committed renewable energy project in Australia. By expanding the current Snowy Scheme's renewable energy capacity by almost 50%, the NEM will be served with an additional 2,000 MW generating capacity.

In terms of the future energy market, the key benefits of Snowy 2.0 are summarised as follows:

- Snowy 2.0 provides low emission on-demand energy and will underpin the continued decarbonisation of the economy;
- Snowy 2.0 provides deep storages to allow more flexibility to respond to seasonal variability when compared to other VRE and batteries;
- Snowy 2.0, being a closed system, can move water between reservoirs and not rely on natural inflows that may vary seasonally, offering valuable seasonal storage and insurance against drought risk. This is because Snowy 2.0's pumping capabilities work in a 'closed' system - water is recycled between the two dams so the same water can be used to generate power more than once, making the most of available water;
- Snowy 2.0 will have the capability to run for over seven days continuously before it needs to be 'recharged'. By comparison, small and large-scale batteries have limited storage (typically one to four hours);
- Snowy 2.0 will improve the overall efficiency of the NEM by absorbing and storing excess energy from the system at times of excess demand (through pumping) and generate at the critical times of peak times; and
- Snowy 2.0 has a 100-year design life and will generate power for the generations to come.

The net result of Snowy 2.0 being developed is improved market efficiency, more reliable market operation, the provision of large-scale energy storage, encouragement of more variable renewable energy generation to enter the NEM and lower emissions at the lowest cost.

4.1.2 Need for Exploratory Works

As previously described, the purpose of the Exploratory Works was to gain a greater understanding of the underground geological conditions for underground works, principally for the proposed location of the new power station (EMM 2018a). Exploratory Works will involve construction of an exploratory tunnel to enable exploratory drilling and provide a greater understanding of the underground conditions at the Snowy 2.0 power station cavern. The Exploratory Works were designed to confirm and build on the geological data already collected and confirm the orientation of the cavern and its construction method almost 850 m below ground level. The Exploratory Works are needed to ensure the detailed design and construction of Snowy 2.0 meets high standards for quality, safety, efficiency and the environment to meet the objectives of providing timely security and reliability to the NEM.

Figure 4.2 Key benefits of Snowy 2.0 in the NEM

4.1.3 Need for modification

Modification 2 will enhance the outcomes of Exploratory Works. The proposed modification will contribute to the aims of Exploratory Works by providing the following benefits:

- improve worker safety during construction through use of TBM method with concrete segment tunnel lining, reduction in blasting activities, improvements in road safety and removal of barge transportation;
- reduce environmental impact of blasting and aquatic environment disturbance through significant reduction in dredging footprint;
- improve schedule and increase reliability through use of the more efficient TBM excavation method;
- improve constructability through standardising construction processes and reduce the handling of materials; and
- optimise cost.

The need for the proposed modification is discussed further in this section.

i Tunnelling method

The proposed tunnelling method approved under the Exploratory Works EIS included a drill and blast method for excavation of the exploratory tunnel only. The FGJV design and tunnelling method for the exploratory tunnel includes the use of a TBM, which is outside the scope of the original approval. The key benefit of the change to tunnelling methods is that TBM tunnelling will reach the power station cavern location in a shorter time than what would be achieved using drill and blast methods. This will provide advanced geotechnical information needed for the design of critical elements of Snowy 2.0. The following sections provide a detailed description of benefits provided by the proposed change in tunnelling methods.

a Schedule

Improvement in schedule is one of the main benefits of TBM excavation relative to drill and blast. TBM could provide a proportional benefit on excavation advance rate of at least 5:1 when compared to drill and blast. Using a TBM will allow the tunnel to be completed several months ahead of the reference drill and blast construction timetable. This allows for earlier completion of the Exploratory Works to allow for more detailed investigation of geological and geotechnical conditions at depth for the design and orientation of the cavern.

TBM tunnelling additionally offers a higher reliability on schedule as compared to drill and blast, in particular when variable ground conditions are encountered.

b Safety

Excavation using TBM methods generally demonstrate better performance compared to drill and blast tunnelling construction methods. Moreover, the proposed TBM installs concrete lining concurrently with excavation which provides workers with protection against falling rocks, reduces the need for working at heights and removes the need for manual labour to install final tunnel lining. TBM methods perform better in terms of safety risks when they encounter unforeseen geological conditions and as a result facilitate a more controlled environment for tunnelling personnel.

c Environmental impacts

The use of TBM reduces the amount of blasting that is required, and the associated noise and vibration, and dust impacts generated during blasting. Additionally, the spoil material generated by the TBM is generally cleaner than the material produced by drill and blast which can be impacted by the inclusion of additional undesirable materials such as stemming material and detonation cords.

d Constructability

Constructability is improved since the activities are performed in a more controlled environment and the construction process is much more standardised. The use of TBM creates positive benefits to constructability by minimising the hazardous material management.

Should the Main Works project not proceed following the undertaking of Exploratory Works, the TBM and associated plant and equipment would be removed from the site, and the site rehabilitated.

ii Transport strategy

A commitment under the Exploratory Works 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 a part of design development, the FGJV reviewed the proposed use of barges for the transport of machinery, equipment and materials, and concluded that it was no longer the preferred option, noting the following.

a Logistics

The majority of construction materials required for Exploratory Works, in particular pre-cast tunnel segments, will now be sourced from locations East of the project area. The additional environmental, social and traffic impacts described below, associated with the use of Talbingo for transport is prohibitive given the origin of the materials.

b Cost

The cost of establishing and operating barge transport as the main method for delivering heavy machinery, construction equipment and materials to site outweighs the benefits it would provide to the Exploratory Works. Given the limited scope of the Exploratory Works, the capital investment required to establish marine infrastructure that is only required for use over a relatively short amount of time is not effective. The use of barging is not a fundamental requirement for the delivery of the Exploratory Works.

c Constructability

The use of barges would increase the handling of material and equipment substantially, requiring road transport at both the Talbingo end and also when it arrived in the KNP. The handling of materials and equipment over the water introduces risks to both environment and the safety of personnel, which although manageable, adds additional risk to an already complex activity. Furthermore, transport on water would also introduce the potential for delays in the event of adverse weather with the potential for high swell, dangerous winds and low visibility.

d Safety

Removal of the requirement to maximise use of barges results in an improvement to safety due to minimised interference between marine transport movements and recreational reservoir users. Additionally, this reduces the amount of on-water activities and the associated risks to construction personnel and the environment that arise from working over water.

e Environmental impacts

Reducing barge operations minimises traffic and amenity impacts on the locality of Talbingo from truck movements through Talbingo township and minimises impacts to recreational access from construction activities that would be associated with the construction and operation of any permanent barge loading and unloading facilities at the northern end of Talbingo Reservoir.

Additionally, the proposed change minimises impact on the aquatic environment by minimising dredging required and disturbance to accumulated sediments on the reservoir bed.

4.2 Statutory context

This section provides a summary of legislation relevant to the Modification 2 application. A detailed assessment of the legislative framework for the Exploratory Works was provided in the Exploratory Works EIS (EMM 2018a).

4.2.1 Introduction

Snowy Hydro is a company incorporated under the Commonwealth Corporations Act 2001, with an independent board of directors and shareholders. Snowy Hydro is fully owned by the Australian Government.

The existing Snowy Scheme has a unique approval mechanism where it is able to operate within land that is reserved as a national park under NSW legislation. The components of the existing Snowy Scheme within the KNP operate under the Snowy Park Lease from the NSW Minister for the Environment. Snowy Hydro also operates the Snowy Scheme under a stringent water licence administered by DPIE Water that allows for water collection, storage, diversion and release in order to generate electricity.

On 26 October 2017, Snowy Hydro requested that the NSW Minister for Planning declare Snowy 2.0 to be CSSI to which Part 5, Division 5.2 of the EP&A Act applies. On 7 March 2018 the NSW Minister for Planning declared Snowy 2.0 to be CSSI with the declaration coming into effect on 9 March 2018. Exploratory Works, as a component of Snowy 2.0, may be carried out without development consent under Part 4 of the EP&A Act and is declared to be CSSI for the purposes of the EP&A Act. The Exploratory Works was approved by the Minister for Planning on 7 February 2019 pursuant to section 5.19 of the EP&A Act.

4.2.2 Kosciuszko National Park

The existing Snowy Scheme and assets have long been part of the KNP landscape and are a key feature in park recreation and visitation. The KNP is reserved as a national park under Part 4, Division 3 of the NPW Act. NSW national parks are the responsibility of the NPWS which is a part of DPIE.

KNP contains unique sub-alpine values and declared wilderness areas and is listed on the Australian National Heritage List. All activities on reserved land must be consistent with the objects and purpose of the NPW Act.

All activities within KNP must be consistent with the KNP PoM, prepared in accordance with Part 5 of the NPW Act. Various references are made to the existence and continued operation of the Snowy Scheme throughout the KNP PoM, including within park zoning provisions and Chapter 12. The PoM also incorporates the Snowy Management Plan to more specifically deal with the operations of the existing Snowy Scheme within KNP.

As such, should approval be granted for the proposed modification, the Snowy Management Plan will be reviewed and updated to incorporate management obligations with respect to the Snowy 2.0 project in accordance with the timetable imposed by the SHC Amendment Act.

4.2.3 Snowy Hydro

The former Commonwealth Snowy Mountains Hydro-electric Authority was corporatised under the NSW SHC Act (and corresponding legislation passed in Victoria and by the Commonwealth) as Snowy Hydro Limited on 28 June 2002. Snowy Hydro is now fully owned by the Commonwealth following the acquisition of all remaining shares by the Commonwealth from the States of NSW and Victoria in July 2018.

In addition to providing for the corporatisation of Snowy Hydro Limited, the SHC Act implemented a range of measures to transition the operations of the Snowy Scheme as regulated under NSW environmental laws and other regulatory requirements for the first time. As part of this transition Snowy Hydro was entitled to be granted the Snowy Water Licence and the Snowy Park Lease to enable the continued operation of the existing Snowy Scheme and in addition its operations were recognised as having the necessary approvals and consent for the purposes of the EP&A Act and as authorised under the NSW *National Parks and Wildlife Act 1974* (NPW Act).

i Snowy Park Lease

Part 6, section 37(2) of the SHC Act entitled Snowy Hydro to the grant of a lease, licence, easement or right of way over KNP, for the purposes of the existing Snowy Scheme. The Snowy Park Lease was granted to Snowy Hydro by the former NSW Minister for Environment in 2002 and has a term of 75 years. The lease covers land where infrastructure associated with the existing Snowy Scheme has been constructed. Section 41(5) of the SHC Act provides that development that is for a purpose for which a lease has been granted under Part 6 of the Act, is taken to be authorised under the NPW Act.

ii Amending legislation to authorise Snowy 2.0

The NSW *Snowy Hydro Corporatisation Amendment (Snowy 2.0) Act 2018* (the SHC Amendment Act) was passed by the NSW Parliament in November 2018. The SHC Amendment Act authorised further leases and other tenures to be granted over the KNP to facilitate the construction and ongoing operation of Snowy 2.0 including the supporting electricity transmission upgrades.

Section 37A(2) of the SHC Act entitles Snowy Hydro to the grant of a lease, licence, easement or right of way over the KNP, for the purposes of and in connection with, Snowy 2.0 and confers similar entitlements for the transmission assets. Snowy Hydro entered into an Agreement for Lease (AFL) with the NSW Minister for the Environment on 18 December 2018 in respect of Snowy 2.0. Subject to the terms of the AFL, Snowy Hydro (and its contractors) will be granted rights to access the areas required for construction under Works Access Licences and Construction Leases. On practical completion of construction of Snowy 2.0, Snowy Hydro will be granted an Operational Lease to allow the ongoing operation of Snowy 2.0. This operational lease will expire at the same time as the Snowy Park Lease issued in 2002. Snowy Hydro must satisfy a number of conditions precedent before it will be granted rights to access and use KNP, including that Snowy 2.0 must obtain CSSI approval.

Section 38(1) of the SHC Act, provides that a plan of management may deal with the activities of Snowy Hydro within the KNP and impose obligations on the company to comply with the plan of management. This compliance obligation is supported by Part 4 of the *NSW National Parks and Wildlife Regulation 2009* (NPW Regulation).The SHC Amendment Act also provided for a transitional period for the KNP PoM and the Snowy Management Plans to be revised to reflect Snowy 2.0. Clause 7 of Schedule 4 to the SHC Act provides a period of three years from when first planning approval is granted for any part of the Snowy 2.0 project, for the KNP PoM to be amended for the purposes of including the Snowy 2.0 project. A further period until 1 January 2024 is then allowed for the Snowy Management Plan to be updated. During that transitional period, section 81(4) of the NPW Act does not operate to prohibit operations being undertaken in relation to the Snowy 2.0 project that are not in accordance with those plans.

iii Snowy Water Licence

The Snowy Water Licence is a special purpose statutory approval issued under Part 5 of the SHC Act. It embodies the operating and accounting principles of the Snowy Scheme. The Snowy Water Licence confers several rights and obligations on Snowy Hydro for the collection of all water from the rivers, streams and lakes within the Snowy Water Catchment. Snowy Hydro has the right to divert, store and use that water to generate electricity and for purposes that are incidental or related to the generation of electricity, and the obligation to release that water from storage.

iv Deemed planning approvals for existing Snowy scheme

Part 7 of the SHC Act approved the existing Snowy Scheme development as at the date of corporatisation (28 June 2002) under former Parts 4 and 5 of the EP&A Act. Section 41(2) of the SHC Act provides:

> A determining authority is not required to comply with Part 5 of the EPA Act for the purposes of granting an initial approval. However, the determining authority is, for the purposes of any Act or law, taken to have complied with Part 5 of the EPA Act in granting the initial approval (but only to the extent that the determining authority would but for this Act have been required to comply with that Part).

Section 41(3) of the SHC Act provides:

> For the purposes of the application of any Act or law to an activity that is part of the existing Scheme development but that is not the subject of an approval granted by a determining authority or of a development consent, the activity is taken to have been commenced and previously carried out in accordance with Part 5 of the EPA Act.

Section 41(4) of the SHC Act further provides:

> This subsection applies to any development that is part of the existing Scheme development and that, on the corporatisation date, cannot be carried out without development consent. On that date, the Snowy Hydro Company is taken to have been granted that development consent in accordance with Part 4 of the EPA Act by the relevant consent authority under that Part.

These deemed arrangements applied to the existing scheme as at the date of corporatisation. Any proposed changes since that time have been developed in accordance with applicable legislation.

4.2.4 Commonwealth approvals

An approval under the EPBC Act is required for Exploratory Works if:

- it will have or is likely to have a significant impact on matters of national environmental significance (MNES); or
- it will have or is likely to have a significant impact on the environment inside or outside the Australian jurisdiction.
- If an activity or action requires approval under the EPBC Act, it is deemed to be a 'controlled action' and requires approval from the Commonwealth Minister for the Environment or the Minister's delegate. To determine whether a proposed action will or is likely to be a controlled action, a Referral of Proposed Action is submitted to DoEE for assessment.

A Referral of the Exploratory Works was submitted to DoEE on 28 May 2018 (Ref 2018/H217) and publicly notified from 2 June 2018 to 20 June 2018. A decision on the referral was made by the Assistant Minister for the Environment on 10 July 2018 which stated that Exploratory Works is not a controlled action, meaning that it does not require further assessment and approval under the EPBC Act before it can proceed. The Assistant Minister also declared under section 28(4) of the EPBC Act that Exploratory Works are a class of actions to which section 28 of the EPBC Act (a prohibition against Commonwealth Agencies taking actions that significantly impact the environment) will not apply. This is because the Minister declared that, in taking the action, Snowy Hydro will have to comply with NSW legislation (ie EP&A Act) that provides for comprehensive assessment and management of Exploratory Works impacts, and which has the object of protecting the environment.

An assessment of impacts to MNES from Modification 2 is provided in Section 6.1 and Section 6.2 of this report. Consultation with DoEE was also undertaken as discussed in Section 5. Based on the assessment of impacts and consultation, Modification 2 is not expected to have significant impacts on MNES or the environment generally and therefore has not been referred to DoEE under the EPBC Act and will continue to be treated as not a controlled action.

4.2.5 NSW planning framework

The EP&A Act and NSW *Environmental Planning and Assessment Regulation 2000* (EP&A Regulation) form the statutory framework for planning approval and environmental assessment in NSW. This legislation is supported by environmental planning instruments (EPIs) including State environmental planning policies (SEPPs) and local environmental plans (LEPs).

i Critical State Significant Infrastructure

Section 5.12 of the EP&A Act provides for the declaration of State significant infrastructure (SSI), and Section 5.13 enables the Minister for Planning to declare SSI to be CSSI if 'it is of a category that, in the opinion of the Minister, is essential for the State for economic, environmental or social reasons'.

On 7 March 2018 the NSW Minister for Planning declared Snowy 2.0 to be SSI and CSSI. The declaration came into effect on 9 March 2018 and is reflected in clause 9 of Schedule 5 to the *State Environmental Planning Policy (State and Regional Development*) *2011* (SRD SEPP).

Snowy 2.0 is development of the kind specified in clause 9(3) of Schedule 5 to the SRD SEPP and, accordingly, may be carried out without development consent under Part 4 of the Act and is declared to be SSI and CSSI. As such, the project requires assessment and approval under Division 5.2 of the EP&A Act.

ii Approval pathway

Snowy Hydro is seeking to modify infrastructure approval SSI 9208 pursuant to section 5.25 of the EP&A Act, which includes the following relevant provisions:

5.25 Modification of Minister's approval

(1) In this section:

Minister's approval *means an approval to carry out State significant infrastructure under this Division, and includes an approval granted on the determination of a staged infrastructure application.*

Modification *of an approval means changing the terms of the approval, including revoking or varying a condition of the approval or imposing an additional condition on the approval.*

(2) The proponent may request the Minister to modify the Minister's approval for State significant infrastructure. The Minister's approval for a modification is not required if the infrastructure as modified will be consistent with the existing approval under this Division.

(3) The request for the Minister's approval is to be lodged with the Planning Secretary. The Planning Secretary may notify the proponent of environmental assessment requirements with respect to the proposed modification that the proponent must comply with before the matter will be considered by the Minister.

(4) The Minister may modify the approval (with or without conditions) or disapprove of the modification.

Snowy Hydro met with DPIE on 15 October 2019 to notify the Department of its intention to lodge an application for a modification to the Exploratory Works approval and proposed assessment methodologies for the likely key environmental impacts. This report is intended to accompany the application for Modification 2 and provides an environmental impact assessment of the proposed works.

ii Other state approvals and licences

Table 4.1 summarises Snowy Hydro's consideration of Modification 2 against all other NSW regulatory requirements (outside of the EP&A Act). Although EPIs do not apply to SSI or CSSI due to the effect of section 5.22(2) of the EP&A Act, consideration of the instruments that would have applied to the Exploratory Works project area is also provided. The requirements of the Biodiversity Conservation Act 2016 are addressed in Chapter 6.

Table 4.1 Consideration of other regulatory requirements

Approvals not required under section 5.23		
A permit under section 201, 205 or 219 of the NSW *Fisheries Management Act 1994* (FM Act)	Relevant but not required	A permit under section 201, 205 or 219 of the NSW *Fisheries Management Act 1994* (FM Act)
An approval under Part 4 or an excavation permit under section 139 of the NSW *Heritage Act 1977*	Relevant but not required	An approval under Part 4 or an excavation permit under section 139 of the NSW *Heritage Act 1977*
An Aboriginal heritage impact permit under section 90 of the NSW *National Parks and Wildlife Act 1974*	Relevant but not required	An Aboriginal heritage impact permit under section 90 of the NSW *National Parks and Wildlife Act 1974*
A bushfire safety authority under section 100B of the NSW *Rural Fires Act 1997*	Relevant but not required	A bushfire safety authority under section 100B of the NSW *Rural Fires Act 1997*
A water use approval under section 89, a water management work approval under section 90 or an activity approval (other than a groundwater interference approval) under section 91 of the NSW *Water Management Act 2000*	Relevant but not required	A water use approval under section 89, a water management work approval under section 90 or an activity approval (other than a groundwater interference approval) under section 91 of the NSW *Water Management Act 2000*
Approvals required to be issued consistently under section 5.24		
An aquaculture permit under section 114 of the NSW *Fisheries Management Act 1994*	No	The project does not involve aquaculture.
Approval under section 15 of the NSW *Mine Subsidence Compensation Act 1961*	No	The project is not within a mine subsidence district.
A mining lease under the NSW *Mining Act 1992*	No	The project does not involve mining.
A production lease under the NSW *Petroleum (Onshore) Act 1991*	No	The project does not involve petroleum production.
An environment protection licence (EPL) under Chapter 3 of the NSW *Protection of the Environment Operations Act 1997*	Yes	EPL 21266 was issued by the EPA on 9 May 2019 and will apply or be expanded as necessary for the applicable scheduled activities the subject of this modification application. Under section 5.24(1) of the EP&A Act, an EPL cannot be refused if it is necessary for carrying out approved SSI and is to be substantially consistent with the EP&A Act approval.
A consent under section 138 of the NSW *Roads Act 1993*	Yes	The project involves interaction and works within public road reserves.
A licence under the NSW *Pipelines Act 1967*	No	The project does not involve the construction and operation of water pipelines.

CHAPTER 5

ENGAGEMENT

5 Engagement

This chapter provides an overview of the engagement activities carried out before and during the preparation of the proposed modification.

5.1 Introduction

Stakeholder engagement commenced on the broader Snowy 2.0 before Exploratory Works was being scoped. Stakeholder engagement has been led by Snowy Hydro with the support of FGJV, EMM and technical specialists where required.

5.2 Framework

Snowy Hydro has adopted a proactive and flexible end-to-end stakeholder engagement strategy for Snowy 2.0, which will be applicable to all phases of Snowy 2.0, including Exploratory Works. It aims to meet all objectives and the demands of a diverse range of stakeholders with changing needs. The framework is based on the International Association for Public Participation (IAP2) *Public Participation Spectrum, 2014* (the Spectrum). The key phases and how they have been implemented for Snowy 2.0 and Exploratory Works to date are summarised below:

- identify - identification of stakeholders and impacts;
- design and prepare - definition of desired level of engagement (to inform, consult, involve, or collaborate), and the development of corresponding stakeholder engagement tools and methods;
- engage - commence stakeholder engagement in line with the level identified in the previous phase, and implement relevant methods;
- provide feedback - create mechanisms for timely two-way feedback on stakeholder needs and concerns; and
- review - implement a continuous improvement loop to assess the adequacy and effectiveness of engagement, and where required, change the nature of engagement.

The framework will be applied throughout the lifespan of Snowy 2.0, with the ability to adapt if/when Snowy 2.0 progresses (including Exploratory Works) and as/when stakeholder requirements change, while remaining consistent with the overarching objectives.

The following sections in this chapter summarise engagement undertaken for Modification 2.

5.3 Engagement with stakeholders

The stakeholder engagement for Modification 2 has focused on consultation with key agency stakeholders.

5.4 Government agency engagement

The details of stakeholder engagement undertaken with key government agencies are provided in the following sections.

5.4.1 NSW Department of Planning, Industry and Environment

A meeting was held with NSW DPIE on 21 August 2019 to provide a project update on modifications to the Exploratory Works. The scope, timing and approach to assessment of Modification 2 was discussed.

A letter was subsequently prepared and issued to DPIE in October 2019 which provided a summary of the scope, consultation and technical assessments proposed for Modification 2.

5.4.2 NSW DPIE National Parks and Wildlife Service

A meeting was held with NPWS on 22 July 2019 to provide a briefing on Modification 2. The following key matters for consideration in Modification 2 were raised in the meeting and during the meeting:

- quantification of vegetation clearance; and
- detailed assessment of any impacts to geodiversity features.

5.4.3 NSW DPIE Biodiversity and Conservation

Consultation with DPIE Biodiversity and Conservation (formerly OEH) has been ongoing throughout the design of Snowy 2.0 and the development of the EIS for the Exploratory Works and Main Works.

Snowy Hydro issued a letter to DPIE Biodiversity and Conservation on 3 October 2019 that provided information on the scope and proposed assessment methodology of Modification 2. Consultation for Modification 2 will continue with DPIE Fisheries throughout the exhibition period.

5.4.4 NSW DPIE – Fisheries

Snowy Hydro issued a letter to DPIE Fisheries on 3 October 2019 that provided information on the scope and proposed assessment methodology of Modification 2. Consultation for Modification 2 will continue with DPIE Fisheries throughout the exhibition period.

5.4.5 NSW DPIE (Crown Lands & Water Division)

Snowy Hydro issued a letter to Department of Industry (Crown Lands & Water Division) on 3 October 2019 that provided information on the scope and proposed assessment methodology of Modification 2. Consultation for Modification 2 will continue with Department of Industry (Crown Lands & Water Division) throughout the exhibition period.

5.4.6 NSW Environment Protection Authority

Snowy Hydro issued a letter to EPA on 3 October 2019 that provided information on the scope and proposed assessment methodology of Modification 2. Consultation for Modification 2 will continue with EPA throughout the exhibition period.

5.4.7 Commonwealth Department of Environment and Energy

Snowy Hydro issued a letter to DEE on 3 October 2019 that provided information on the scope and proposed assessment methodology of Modification 2. Consultation for Modification 2 will continue with DEE throughout the exhibition period.

5.4.8 NSW Roads and Maritime Services

Snowy Hydro issued a letter to RMS on 3 October 2019 that provided information on the scope and proposed assessment methodology of Modification 2. Consultation for Modification 2 will continue with RMS throughout the exhibition period.

5.4.9 Snowy Monaro Regional Council

Snowy Hydro issued a letter to SMRC on 3 October 2019 that provided information on the scope and proposed assessment methodology of Modification 2. Consultation for Modification 2 will continue with SMRC throughout the exhibition period.

5.4.10 Snowy Valleys Council

Snowy Hydro issued a letter to SVC on 3 October 2019 that provided information on the scope and proposed assessment methodology of Modification 2. Consultation for Modification 2 will continue with SVC throughout the exhibition period.

CHAPTER 6

ENVIRONMENTAL IMPACT ASSESSMENT

6 Environmental impact assessment

6.1 Terrestrial ecology

The assessment of terrestrial ecology impacts for the proposed modification was undertaken by EMM. A Biodiversity Development Assessment Report (BDAR) was prepared and is provided in Appendix A.

The primary focus of this assessment process has been the avoidance and minimisation of impacts through iterative design. The involvement of project ecologists has been a key part of the design process, providing information on biodiversity as potential impacts were identified, and working with the design team to avoid and minimise impacts, where possible

The NSW *Biodiversity Conservation Act 2016* (BC Act) is the legislation responsible for the conservation of biodiversity in NSW. The BC Act, together with the NSW Biodiversity Conservation Regulation 2017, established the Biodiversity Offsets Scheme (BOS), which in turn established the biodiversity assessment method (BAM, OEH 2017). The biodiversity surveys, analysis and assessment for Exploratory Works have been undertaken in line with the requirements of the BAM.

6.1.1 Existing environment

The Modification 2 project area occurs across two Interim Biogeographic Regionalisation for Australia (IBRA) regions and subregions. These are:

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

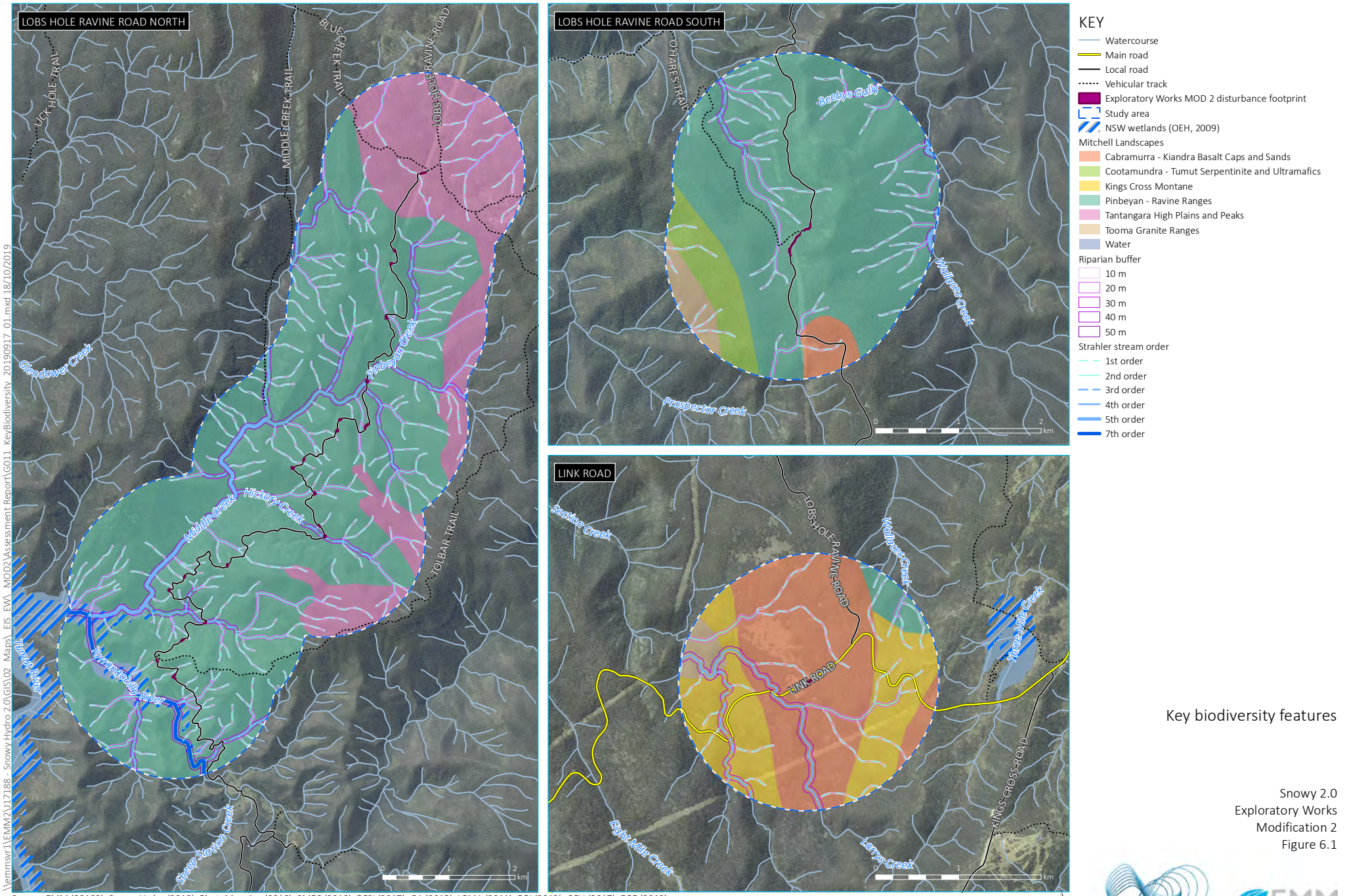
The proposed modification also occurs across three NSW Landscapes: Pinbeyan – Ravine Ranges; Tantangara High Plains and Peaks; and Cabramurra – Kiandra Basalt Caps and Sands. Key biodiversity features of the project area are shown in Figure 6.1.

i Vegetation overview

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 disturbance 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 Lobs Hole Ravine Road (North) within the northern sections 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 sparse within this area. Areas adjacent to the powerline easement are in good condition with relatively low exotic species. Vegetation below powerline easements consist of derived grassland, with a higher number of exotic species 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 disturbance and consist of derived grasslands.



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Source: EMM (20189); Snowy Hydro (2019); PhotoMapping (2018); SMEC (2018); DFSI (2017); GA (2015); LPMA (2011); DPI (2013); OEH (2017); DPE (2018)

GDA 1994 MGA Zone 55

N

Key biodiversity features

Snowy 2.0
Exploratory Works
Modification 2
Figure 6.1

snowy 2.0

EMM
creating opportunities

ii Plant community types

Plant community types (PCTs) are a NSW classification system used to identify plant communities. Vegetation mapping identified six PCTs within the proposed modification disturbance footprint (see Table 6.1). These six PCTs include 11 vegetation zones. Of these zones, four are mapped as low condition and seven mapped as moderate/good.

Table 6.1 Plant Community Types mapped within the Modification 2 disturbance footprint

Plant community type	Vegetation formation	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)	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)	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)	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)	0.13
PCT 1191 – Snow Gum - Candle Bark woodland on broad valley flats of the tablelands and slopes, South Eastern Highlands Bioregion	Grassy 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	0.45
TOTAL		**1.62**

iii Threatened ecological communities

The six PCTs listed in Table 6.1 have been reviewed against threatened ecological communities (TECs) listed under Commonwealth and NSW legislation. Three TECs were identified through geographic and habitat constraints as having potential to occur. However, following detailed desk and field studies, it was determined that none of these TECs occur in the Modification 2 disturbance footprint.

iv Groundwater dependent ecosystems

One PCT was identified as a groundwater dependent ecosystem (GDE): PCT 296 – Brittle Gum – Peppermint open forest of the Woomargama to Tumut region, NSW South Western Slopes Bioregion. PCT 296 is found on mid to lower slopes including areas where groundwater is less than 5 m and was assigned facultative as a conservative approach.

v Threatened species

a Threatened flora

Three species of threatened flora were identified as species candidate species, following a habitat suitability assessment. Two species were considered to have potential to occur and identified as candidate species. No threatened flora species were recorded during targeted surveys within the Modification 2 disturbance footprint. All candidate threatened flora species are considered to have a low likelihood of occurrence within the disturbance footprint following targeted surveys. An overview of threatened flora and fauna survey results is provided in Figure 6.1.

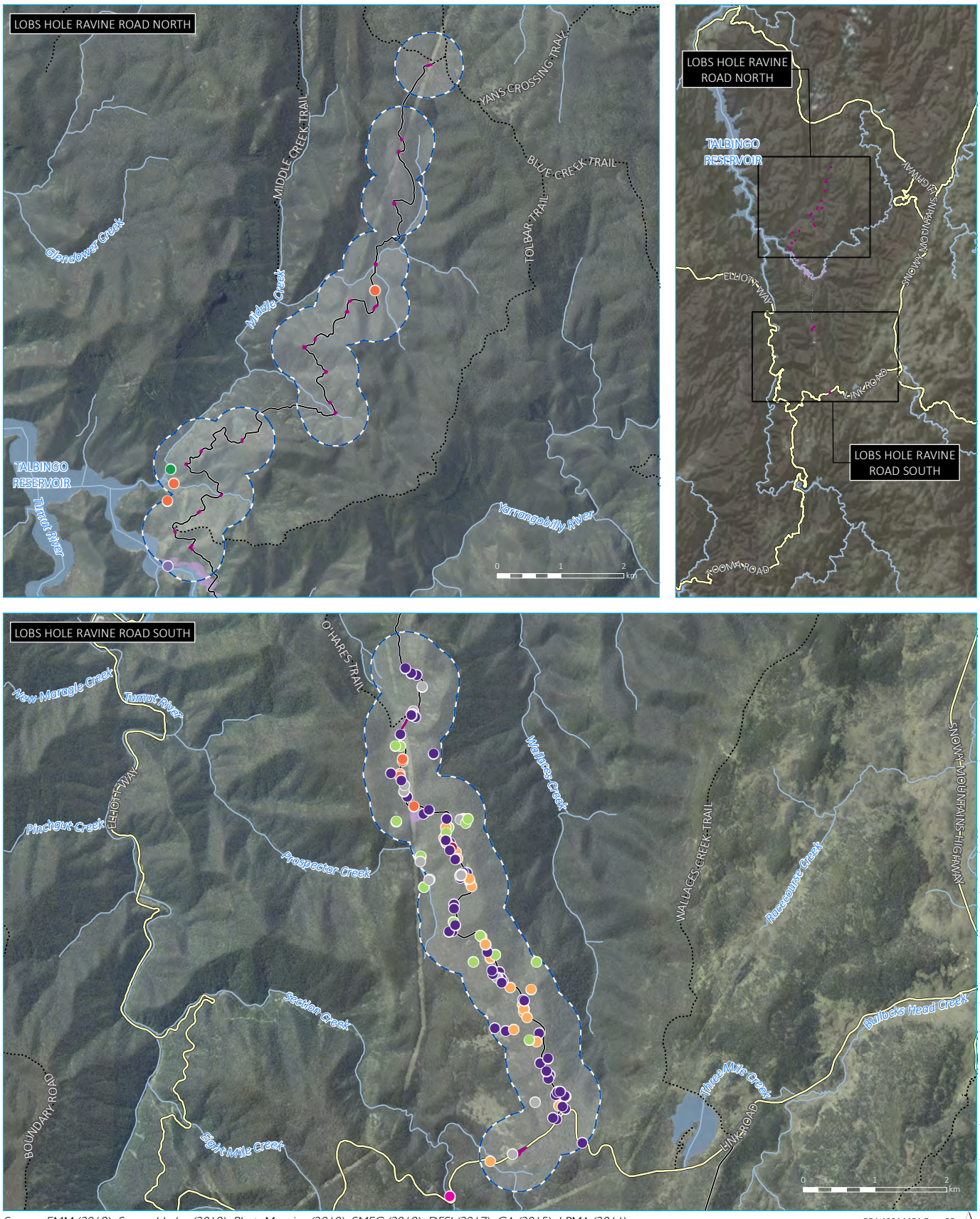
b Threatened fauna

Twenty-one fauna species were identified as candidate species, with nine species identified as candidate species after completing a habitat suitability assessment. A further six additional species were included as candidate species for the purposes of the EPBC Act assessment.

Ten threatened fauna species were recorded during targeted surveys within or adjacent to the Modification 2 disturbance footprint. These species are identified in Table 6.2. An overview of threatened flora and fauna survey results is provided in Figure 6.2.

Table 6.2 Threatened terrestrial fauna recorded during targeted surveys

Common names	Scientific name	Conservation status in NSW (BC Act)	Commonwealth conservation status (EPBC Act)
Birds			
Dusky Woodswallow	*Artamus cyanopterus*	Vulnerable	Not listed
Flame Robin	*Petroica phoenicea*	Vulnerable	Not listed
Gang-gang Cockatoo	*Callocephalon fimbriatum*	Vulnerable	Not listed
Masked Owl	*Tyto novaehollandiae*	Vulnerable	Not listed
Olive Whistler	*Pachycephala olivacea*	Vulnerable	Not listed
Pink Robin	*Petroica rodinogaster*	Vulnerable	Not listed
White bellied Sea-eagle	*Haliaeetus leucogaster*	Vulnerable	Not listed
Mammals			
Eastern Bentwing-bat	*Miniopterus schreibersii oceanensis*	Vulnerable	Not listed
Eastern Pygmy-possum	*Cercartetus nanus*	Vulnerable	Not listed
Smoky Mouse	*Pseudomys fumeus*	Critically endangered	Endangered



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

GDA 1994 MGA Zone 55

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KEY

- Local road
- Vehicular track
- Watercourse/drainage line
- Waterbody
- Exploratory Works MOD 2 disturbance footprint
- Approved disturbance footprint
- Study area

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
Exploratory Works
Modification 2
Figure 6.2

snowy 2.0

EMM creating opportunities

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6.1.2 Impact assessment

i Avoidance and minimisation of 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:

- 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 OEH, NPWS and DEE, 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.

Threatened species and their habitat were key drivers for changes made to design, including Smoky Mouse. The emphasis placed on the Smoky Mouse during design is because of its confirmed presence, critically endangered conservation status, specific and limited habitat range, and susceptibility to impacts.

The following measures to avoid and minimise impacts have been implemented during the design process.

a Tunnel boring machine method

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

b Road upgrades

During detailed design of road upgrades minor revisions to the road have occurred to avoid significant impact 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 vegetation zones of Derived Grassland, avoiding direct impact on hollow bearing trees and preferred Smoky Mouse habitat.

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 these areas determined that some of the passing bays were able to be moved out of Smoky Mouse habitat and under powerline easements and areas of Derived Grassland condition class.

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 removal of all vegetation. These areas will be offset accordance with the biodiversity offset framework, as outlined in EMM (2018d).

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.

c 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. Adjacent areas of vegetation used in association with the barge ramp have previously been approved within the Exploratory Works EIS (EMM 2018a).

d 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. The rehabilitation strategy implemented for the Exploratory Works will also be applied to the proposed Modification 2 works.

e 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.

f Transport strategy

A key design change within Modification 2 includes the transport of all machinery, equipment and materials through Lobs Hole Ravine Road. This change will have no impact on terrestrial ecology.

ii Residual impacts

Residual impacts following implementation of the avoidance and minimisation measures include:

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

Biodiversity offset credits have been calculated for Modification 2. A total of 36 ecosystem credits and 32 species credits are required to offset the residual biodiversity impacts of Modification 2.

6.1.3 Mitigation and management

The existing mitigation measures implemented for the Exploratory Works are expected to be adequate to manage residual impacts to biodiversity from the proposed modification. No additional management and mitigation measures are proposed.

6.2 Aquatic ecology

6.2.1 Description of impacting processes

Within Talbingo Reservoir, the Middle Bay barge ramp for Modification 2 will be approximately 300 m west of the approved location. The relocation of the Middle Bay barge ramp is considered to be a minimal change in proposed activities and overall reduction in aquatic ecology impacts. The main differences between the Exploratory Works and Modification 2 design and location will be a significantly smaller dredge footprint (approximately 0.8 ha compared to 2.9 ha), but a greater extent of shoreline and riparian habitat loss due to the alignment of the Modification 2 design with the existing shoreline. This will result in 216 m of linear shoreline affected compared to approximately 40 m. The total volume of material requiring excavation for the Modification 2 works will be equal to or less than for the approved Exploratory Works design. The toe of the Modification 2 barge ramp would be at 532.0 m AHD to allow for operation at minimum operating level (MOL) while providing 2.3 m of clearance for a laden barge plus under keel clearance. Dredging would be carried out either using a cutter suction / trailer hopper dredger and / or may involve using an excavator from either a barge or from the shore above the water level. Dredge spoil from Modification 2 barge ramp construction will be placed within the designated subaqueous spoil placement area at Ravine Bay/Middle Bay.

The proposed timeframe for construction works is approximately three months and is expected to take place during the first half of 2020. It is otherwise assumed that the construction methodology will be similar to that proposed for Exploratory Works and involve:

- geophysical and geotechnical investigation of the barge access area to inform detailed design;
- site establishment and excavation of barge access area;
- installation of precast concrete panels at the ramp location;
- installation of bollards for mooring lines;
- removal of trees and debris to establish a navigation channel allowing barge access; and
- minor dredging to allow barge access at the reservoir MOL.

Construction of the Modification 2 barge ramp will result in similar impacting processes and effects to that expected for the Exploratory Works barge ramp. This would include:

- direct - removal/modification of habitat and associated biota within the barge ramp construction footprint;
- direct – hydraulic entrainment of fish and mobile invertebrates within the dredge area;
- indirect – changes to water quality;
- indirect – noise related impacts; and
- indirect – spread of aquatic weeds and pests.

Similar control measures to those outlined for the Exploratory Works will be used to minimise the extent of habitat loss/ modification and to minimise the effects of suspended sediments. Where feasible, shoreline habitat would be restored and rehabilitated following the completion of works to ensure minimal loss of fish habitat. Residual loss of soft sediment, shoreline habitat and associated biota would, however, be expected and is discussed in further detail

below. All dredging works would be closely monitored and carried out according to the Dredge Management Plan. Other relevant management plans would include:

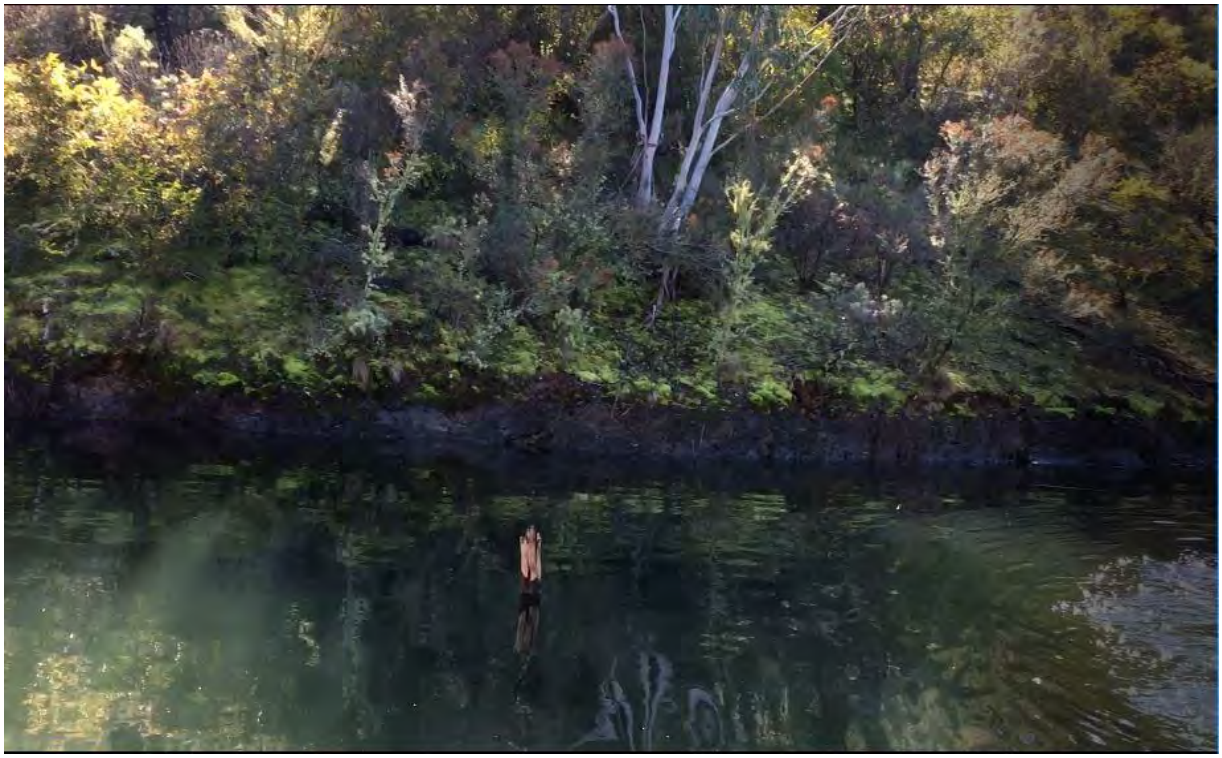
- Surface Water Management Plan;
- Erosion and Sediment Control Plan; and
- Aquatic Habitat Management Plan.

6.2.2 Impacts on aquatic habitats and biota

i Removal / modification of habitat and associated biota within the barge ramp construction footprint

The shoreline and riparian habitat at the original boat ramp location for Exploratory Works was surveyed by boat as part of the Exploratory Works baseline surveys. This area consisted primarily of un-vegetated bare rock and unconsolidated material on the banks, with an understorey of scrub and mature eucalypt woodland higher up on the banks. Submerged trees, wood debris and the pest water weed *Elodea canadensis* was present along many sections of the Middle Bay shoreline. Following a further shoreline inspection on 30 July 2019, the area of shoreline specific to the Modification 2 barge ramp was similar in nature to the original site with steep, often vertical banks, consisting of unconsolidated rock, occasional boulders and soft sediments with patches of *Juncus* sp. and other grasses immediately above the water line. The shoreline was notably eroded and slumping in sections along the extent of the Modification 2 footprint where there was a greater proportion of soft sediment. One to two feet of exposed rock was visible between the water line and vegetated bank (Photograph 6.1 and Photograph 6.2).

Photograph 6.1 Representative riparian habitat within eastern portion of footprint



Photograph 6.2 Representative riparian habitat within western portion of footprint

The area of shoreline lost / disturbed due to the Modification 2 boat ramp would, however, extend for up to 216 m as opposed to 40 m. This alone would be a substantial loss of shoreline habitat within Middle Bay, but would not be considered unique or significant habitat at the scale of the broader reservoir. This area of shoreline could, however, provide habitat for Murray crayfish and is discussed further in Section 6.6.1 iii.

The reservoir bed at the Modification 2 boat ramp location is expected to be similar to that elsewhere in Middle Bay and consist of un-vegetated soft sediment, although the exact nature of the substratum will require verification following site specific geotechnical surveys.

Submerged trees and macrophytes (likely to be predominantly *E. canadensis*) are also a feature of the reservoir bed. Construction of the boat ramp will result in the loss / modification of approximately 0.8 ha of reservoir bed which is a substantially smaller footprint than was proposed for the Exploratory Works barge ramp design. The area of soft sediment, submerged timber and any associated macrophytes lost will therefore be much less than for the original design and unlikely to have a significant effect within the reservoir and minimal effect within Middle Bay. A proportion of the shoreline habitat is also likely within the existing operational range and therefore may be subject to periodic inundation and loss under the current operating licence. As described in the Snowy 2.0 Exploratory Works Aquatic Ecology Assessment (Cardno 2018), any areas of soft sediment habitat disturbed due to dredging are likely to be recolonised by invertebrates following the completion of the construction works. Where possible, areas of disturbed shoreline habitat outside of the operating water levels would be rehabilitated with native riparian vegetation.

ii Hydraulic entrainment within the dredge area

Hydraulic entrainment, through the direct uptake of aquatic organisms by the suction field generated at the draghead or cutterhead during dredging operations may result in the localised by-catch of fish eggs, larvae, mobile juveniles and adults (Wenger, et al., 2017). Based on fish populations known to occur within Talbingo Reservoir, receptors potentially affected could include several threatened species, non-threatened native species and non-native species (including some pest species). Those that occur in high abundances and would be most likely to be affected include brown and rainbow trout and redfin perch. The Murray crayfish (listed as vulnerable under the FM Act) and common yabbies are also likely to occur. Most adult fish are likely to be deterred by vessel noise and quickly move out of danger, although it is unknown whether freshwater crayfish would be at risk of direct entrainment. To minimise the risk to Murray crayfish, prior to site establishment and clearance of submerged timber, targeted surveys would be undertaken to collect and relocate any Murray crayfish potentially in the area. This process would be outlined in the Aquatic Habitat Management Plan.

Because of the relatively short-term (three months) and small scale of the proposed dredging works, the consequence of any dredging related mortality of fish, eggs and larvae would be minor. Furthermore, as the scale of dredging works for Modification 2 will be substantially less than that proposed for the Exploratory Works barge ramp design, risks associated with entrainment will also be much less.

iii Changes to water quality

Modification 2 boat ramp construction and dredging has potential to impact on water quality via increasing the levels of suspended fine sediments and turbidity and potentially via the release and mobilisation of contaminants into the water column. The operation of work barges and heavy plant also presents the risk of fuels, oils and grease entering the reservoir via spills, leakages or poor maintenance. These potential impacts are consistent with the approved Exploratory Works and suitable mitigation and management form part of the existing approved project.

Silt curtains would be deployed around the barge ramp construction and dredging areas to contain the spread of suspended fine sediments, therefore effects of suspended sediments and associated turbidity are not expected to extend substantially beyond the localised dredge areas. Fish and mobile macroinvertebrates trapped within silt curtains could be subject to varying levels of physiological stress and potentially mortality e.g. Wenger et al. (2017). Pre-clearance surveys would, however, be undertaken to minimise the risk to Murray crayfish, occurring within the dredge area prior to dredging. However, some native fish (and potentially some Murray crayfish that were not trapped and relocated) within the silt curtains are likely to be subjected to sub-lethal effects or mortality as a result of high concentrations of suspended sediments and turbidity.

Samples collected from within Middle Bay are found to have elevated concentrations of lead, nickel and zinc when compared against the National Assessment Guidelines for Dredging (2009) screening levels (Royal Haskoning DHV, 2018). Accordingly contaminants may be mobilised, but restricted to within silt curtains where they would settle out onto the reservoir bed. All dredging works would be carried out according to the Dredge Management Plan and Surface Water Management Plans. These include provisions to monitor water quality and ensure that unacceptable levels of turbidity, suspended sediments and /or contaminants i.e. which could pose a threat to aquatic biota will not be reached.

Notwithstanding this, as the Modification 2 dredge area for the Middle Bay barge ramp is substantially smaller than that of the Exploratory Works design, the overall impacts to water quality will be far less given that a smaller area of fine sediment will be disturbed. Upon the completion of dredging works, it is expected that assemblages within the affected areas would recover rapidly from the temporary disturbance.

iv Noise related impacts

There is a risk of acoustic disturbance (noise and vibration) to aquatic biota associated with increased work vessel traffic and use of dredge equipment. Mobile fauna such as fish are likely to temporarily move outside the range of any acoustic disturbance but would return thereafter. Long-term effects on aquatic fauna are therefore not expected. Geotechnical investigations using vibrocores or seismic air guns have potential to cause short-term but intense noise and vibration potentially resulting in physiological damage to aquatic biota (Cardno 2018). Given that the extent of the footprint for the Modification 2 barge ramp is substantially smaller than the Exploratory Works design, fewer cores and / or seismic shots will be required and the duration will be shorter. The risk of any substantial harm and potential mortality of fish and invertebrates is therefore expected to be less than the approved project.

v Spread of aquatic weeds and pests

Heavy plant, vehicles and barges operating in and around waterways during construction of roads, utilities and infrastructure have potential to act as vectors for a range of aquatic weeds and pest fish if not properly managed. Elodea (*Elodea canadensis*), occurs throughout Talbingo Reservoir including around Middle Bay and the Yarrangobilly River. Stringent measures will therefore be adopted to ensure that all vehicles, barges and plant operating in and around Middle Bay during barge ramp construction are thoroughly washed down, dried and inspected when moving between catchments. It will be ensured that work barges and boats flush engines and trailers, and visible debris and biological material is removed. These procedures would be communicated to all vessel operators and outlined within the Dredge Management Plan and Aquatic Habitat Management Plan. The risks associated with transfer of aquatic weeds and pests would not be any different for the Modification 2 barge ramp compared with the original design as the consequences would not change.

6.2.3 Impacts on KFH, threatened species and EECs

Talbingo Reservoir is mapped as KFH in the Tumut LGA and Snowy River. As Talbingo Reservoir is known to contain habitat for a threatened species (ie Murray crayfish), it would be considered a Type 1 (highly sensitive) KFH as per Fairful and Witheridge (2013). No EECs have been identified to occur within Talbingo Reservoir.

There would be disturbance and permanent loss to KFH due to construction of the barge ramp and associated dredging, particularly wood debris that would be removed during dredging. However, the overall footprint of disturbance for the Modification 2 barge ramp would be a much smaller proportion than that affected by the approved Exploratory Works barge ramp design and a substantially smaller area of reservoir bed would be affected. Similar areas of submerged aquatic vegetation are present throughout Talbingo Reservoir, therefore the loss / modification of areas within the dredge footprint would be unlikely to significantly affect fish or invertebrates as they would seek similar habitat elsewhere. Wooded debris that is cleared prior to works would be moved to another location within the reservoir and potentially used for post-construction rehabilitation where feasible. The procedure for removal and rehabilitation would be outlined within the Dredge Management Plan and Aquatic Habitat Management Plans. No long-term significant impact on KFH would therefore be expected as a result of the Modification 2 barge ramp construction.

Threatened and protected species that are known or likely to occur within Middle Bay and the proposed barge ramp construction areas at Talbingo Reservoir include:

- Murray crayfish (*Euastacus armatus*) – listed as vulnerable under the FM Act;
- Trout cod (*Maccullochella macquariensis*) - endangered under the FM Act and EPBC Act;
- Macquarie perch (*Macquaria australasica*) - endangered under the FM Act and EPBC Act; and

- Murray cod (*Maccullochella peelii*) – vulnerable under the EPBC Act.

A self-sustaining and broadly distributed population of Murray crayfish, occurs within Talbingo Reservoir (Zukowski and Whiterod 2019 – In Draft). Latest surveys (carried out in June 2019) found three individual Murray crayfish at depths between 3.2 m and 7.0 m in and around Middle Bay including the vicinity of the proposed barge ramp. As Murray crayfish have relatively small home ranges and low dispersal abilities (NSW DPI 2019) they would be vulnerable to both direct impacts of habitat removal and entrainment into the drag head as well as indirect impacts to water quality and acoustic disturbance. In particular, Murray crayfish are considered to be intolerant to low levels of dissolved oxygen and in extreme cases, this has led to local population depletion (NSW DPI 2019). Prior to any dredging or excavation activities, targeted surveys would therefore be carried out in and around the proposed dredging and excavation areas to collect Murray crayfish potentially occurring there. Any individuals collected would be translocated to a pre-determined location elsewhere within the reservoir where there is alternative suitable and undisturbed habitat. This would be implemented as outlined in the Aquatic Habitat Management Plan. With this considered, the impact of the proposed Modification 2 barge ramp construction and dredging alone would be unlikely to affect the viability of the Talbingo Reservoir population of Murray crayfish. A procedure will also be outlined within the Aquatic Habitat Management Plan to manage any threatened species findings.

Other threatened species potentially occurring in Talbingo Reservoir include Macquarie perch (*Macquaria australasica*), Trout cod (*Maccullochella macquariensis*) and Murray cod (*Maccullochella peelii*). Results of desktop reviews and recent surveys suggest that the likelihood of any of these occurring in Talbingo Reservoir is very low. Furthermore, the risk of these highly mobile individuals of either species occurring within the very small footprint of the dredge area and being contained within the silt curtains at the time of barge ramp construction would be extremely low and highly unlikely to affect the viability of a local population. As the relocation of the barge ramp will result in a reduction of the dredging footprint, impacts to threatened species are expected to be reduced compared to the approved project.

6.2.4 Key threatening processes

Key threatening processes associated with the Modification 2 barge ramp will be consistent with those predicted for the approved project. Construction of the Modification 2 barge ramp and dredging would have potential to facilitate the following KTPs within Talbingo Reservoir in relation to aquatic ecology:

- degradation of native riparian vegetation along NSW water courses (FM Act);
- removal of large woody debris from New South Wales rivers and streams (FM Act); and
- loss and degradation or native plant and animal habitat by invasion of escaped garden plants, including aquatic plants (EPBC Act).

6.2.5 Mitigation and management

The project's existing management measures are expected to be sufficient to adequately manage predicted impacts to aquatic ecology. No additional controls are required due to the minimal change in proposed activities and overall reduction in aquatic ecology impacts. The mitigation and management controls listed below are consistent with those identified in the Exploratory Works Aquatic Ecology Assessment:

- appropriate methods e.g. silt curtains (or otherwise) would be deployed to minimise the spread of turbid water/suspended solids beyond the footprint of the barge ramp construction and dredge footprint;
- water quality monitoring will be undertaken in accordance with a monitoring plan developed in consultation with regulators.

- prior to construction works, all wooded debris would be cleared from the reservoir bed and littoral shore of the dredge footprint and relocated to a suitable site elsewhere within the reservoir. The specific method and sites where wooded debris is to be translocated would be predetermined and outlined within the Aquatic Habitat Management Plan;

- prior to any disturbance of the shoreline, dredging or barge construction works, surveys would be undertaken to capture Murray crayfish and relocate them to a pre-identified suitable habitat elsewhere in Talbingo Reservoir. The method and process for Murray crayfish capture and translocation would be outlined in the Aquatic Habitat Management Plan. If any threatened species is unexpectedly encountered during construction activities, an unexpected threatened species finds procedure will be followed;

- all vehicles and plant operating in and around watercourses would be washed down, dried and inspected when moving between catchments to minimise the risk of spreading pest macrophytes or fish eggs. All personnel working within the waters should be instructed how to identify potential pests;

- prior to commencement of seismic surveys, smaller releases of compressed air will be undertaken just below the surface. These are expected to discourage more mobile fish away from the area before greater magnitude and potentially more harmful releases of compressed air take place; and

- during seismic surveys, operators should be vigilant to potential harm to fish and invertebrates. If any harmed or dead biota are observed during works then this would result in the scaling back of works (e.g. magnitude, frequency and/or duration of releases).

The following mitigation and management controls have been identified as specific to the Modification 2 barge ramp construction:

- all barge construction and dredging works would be closely monitored and carried out according to the Dredge Management Plan, Surface Water Management Plan and Aquatic Habitat Management Plan;

- appropriate methods and pre-dredge testing would be implemented to ensure that aquatic biota are not exposed to potentially harmful contaminants mobilised within the water column; and

- removal and subsequent disposal of aquatic macrophytes would be undertaken according to the Dredge Management Plan and / or Waste Management Plan.

6.3 Heritage

6.3.1 Introduction

The objectives of the Aboriginal and historical assessment for the proposed modification were to:

- identify Aboriginal and historic cultural heritage values relevant to the proposed modification area;

- assess the significance of any Aboriginal and historic cultural heritage values identified through the investigations and through community consultation;

- assess the impact of the modification on any identified Aboriginal and historical cultural heritage values; and

- if applicable, propose appropriate management measures for potentially impacted Aboriginal and historical cultural heritage values in response to their assessed significance.

6.3.2 Background

This assessment is based on the extensive Aboriginal and historic heritage investigations completed by NSW Archaeology Pty Ltd (NSW Archaeology) for the Exploratory Works (see Appendices O and P, of the Exploratory Works EIS respectively – NSW Archaeology 2018a and 2018b) and for the Snowy 2.0 Main Works (see Appendices P.1 and P.2 of the Main Works EIS respectively – NSW Archaeology 2019a and 2019b). The following provides an overview of the level of investigation already completed to inform the assessments for the proposed modification.

i Overview of Exploratory Works assessments

The Exploratory Works Aboriginal Cultural Heritage Assessment Report (ACHAR) was conducted in line with the OEH (2011b) *Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW and Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales* (NSW DECCW 2010a). A process of Aboriginal community consultation has and continues to be undertaken in line with the OEH *Aboriginal cultural heritage consultation requirements for proponents 2010* (NSW DECCW 2010b).

The Exploratory Works Historic Cultural Heritage Assessment Report (HCHAR) was undertaken in line with the principles of the Australia ICOMOS Burra Charter (Australia ICOMOS 2013a) and its relevant Practice Notes (Australia ICOMOS 2013b, 2013c, 2017). It also complies with the *Historical Archaeology Code of Practice* (Heritage Council of NSW 2006) and the *NSW Heritage Manual* (1996) and its various updates and other guidelines published by the NSW Heritage Office (2001, 2009).

The ACHA and HCHAR were supported by:

- a series of heritage register searches undertaken for the area in and around the Exploratory Works. Searches included relevant statutory and non-statutory heritage lists and databases at local, state and national levels including the NSW OEH Aboriginal Heritage Management Information System (AHIMS), Australian Heritage Database, NSW State Heritage Inventory, NSW OEH Historic Heritage Information Management System (HHIMS), National Trust Register, Kosciuszko Huts Association and other KNP heritage listings;

- regular and ongoing consultation with the Aboriginal community including the nine Registered Aboriginal Parties RAPs for the project, the relevant Local Aboriginal Land Councils and the Northern and Southern Kosciuszko National Park Aboriginal Community Memorandum of Understanding Groups, and a descendant of one of the first European settlers at Lobs Hole;

- review of the relevant anthropological, historical and archaeological literature. For Aboriginal heritage surveys, the results of the AHIMS searches and findings of previous archaeological assessments undertaken for the region were used to develop a predictive model of site type and distributions for the Exploratory Works project area.

ii Overview of modification assessments

The Aboriginal and historic heritage investigations for the Main Works EIS (NSW Archaeology 2019a and 2019b) has continued using the methods employed for the Exploratory Works. This has involved ongoing community consultation, extensive survey and Aboriginal heritage archaeological test excavation.

Notably, parts of the Modification 2 footprint have been surveyed and assessed for their archaeological potential, based on the predictive model and implications of test excavation, as part of the heritage assessments for the Exploratory Works (refer to survey units RSU21) and Main Works EIS's (refer to survey units RSU32 and RSU33).

Snowy 2.0 Registered Aboriginal Parties (RAPs) have been involved in assessing all areas of the proposed Modification for its Aboriginal socio-cultural and archaeological heritage values through involvement in the Exploratory Works and Main Works ACHAs. No cultural information specific to the areas of the proposed modification has been identified by RAPs.

RAPs will be provided with a copy of this assessment and any feedback affecting the management of Aboriginal objects will be resolved in an updated Exploratory Works project Aboriginal cultural heritage management plan.

6.3.3 Existing environment

i Aboriginal cultural heritage context

a Summary of previous investigations

The Snowy Mountains is country to several groups. Many Aboriginal people have cultural and spiritual associations that have long histories embodied in objects, which can be seen on the ground and also intangible values related to the past and current concerns and aspirations (NSW DEC 2006).

Archaeological investigations of the region date back to the 1970s which focused on seasonal Aboriginal occupation of the highlands influenced by weather and access to resources (eg Flood 1973; 1980; Chapman 1977; Navin 1991).

Recent archaeological research has confirmed an Aboriginal presence in the Snowy Mountains since the early Holocene (from around 9,000 years ago) (Aplin et al. 2010, Theden-Ringl 2016). Overall, the distribution of Aboriginal sites identified through AHIMS results along with survey and test excavation by NSW Archaeology indicates that both wide river corridors and major ridgelines were used as access routes through the ranges. Within the dissected ridge and valley topography, proximity to soaks and springs close to ridgetop locations appears to be important site location criteria. Recent research indicates that Aboriginal people occupied the full ranges of topographies in the upland regions and were not tethered to riparian zones or otherwise sheltered from the prevailing weather (NSW Archaeology 2018a).

Lower elevations, such as Lobs Hole to the west (below 600 m AHD), are likely to have provided respite throughout the year from the weather of the surrounding high country. Lobs Hole is also likely to have provided a relative abundance and diversity of flora and fauna, in addition to a reliable source of potable water and firewood.

Most recently NSW Archaeology has completed a significant amount of archaeological survey and test excavation as part of ACHARs for the Snowy 2.0 Exploratory Works and Main Works projects (NSW Archaeology 2018a; 2019a – in preparation). The geographic extent of the proposed modification extends beyond the survey and test excavations areas documented in the Exploratory Works ACHAR which focussed on Ravine, Lobs Hole Ravine Road and Talbingo (NSW Archaeology 2018a).

b AHIMS search results

The Aboriginal sites presented on Figure 6.3 represent those registered on the Aboriginal Heritage Information Management System (AHIMS) register as of 3 April 2019. The AHIMS search results are up to date with the sites recorded by NSW Archaeology for the Exploratory Works and Main Works ACHARs, including associated assessments for geotechnical investigations. These AHIMS sites have been considered in the impact assessment for Aboriginal cultural heritage in this report.

ii Historic heritage context

There are no heritage items within the project area listed on the World Heritage List, Commonwealth Heritage List, State Heritage Register, or local government heritage schedules.

The proposed modification area is within the EPBC Act-listed national heritage places of Australian Alps National Parks and Reserves and Snowy Scheme. No impacts to national heritage are expected as a result of the proposed works. Additionally, mapping for the Kosciuszko Huts Association (KHA) was reviewed against the proposed modification area and no sites will be affected by the proposed modification. Section6.3.4iii further discusses impacts to MNES.

The alpine region and high country have a rich history from the early explorer-settlers in the 1820s, the establishment of pastoralism and summer grazing in the 1830s, the gold rush at Kiandra in 1859-60, early scientific exploration in the latter part of the nineteenth century, and the construction of the Snowy Scheme, development of scientific research, and promotion of tourism and recreation in the twentieth century. During the construction of the Snowy Scheme, Lobs Hole was well used with a major surveying camp set up and as a recreational destination for workers.

The Lobs Hole area has been used since the early 1800s for the movement of stock, prospecting, grazing, settlement, refuge from the winters of Kiandra, gardening and agriculture, copper mining (from the 1860s to about 1917) and recreation. At the height of its mining activity, the area and its settlement; known as Ravine; included homes, a hotel and other structures. The Washington Hotel, in the north-west of Lobs Hole near the Yarrangobilly River, likely represented a social hub for the settlement. Its remains are the only structural remains left above ground at Lobs Hole. Figure 6.3 presents the historical sites within the area surrounding the modification footprint.

NSW Archaeology has completed historical research and extensive survey for historical heritage items as part of the Snowy 2.0 Exploratory Works and Main Works projects (NSW Archaeology 2018b; 2019b – in preparation).

6.3.4 Impact assessment

i Potential sources of impact

The project design and construction elements are described in Chapter 3. Elements of the proposed modification will involve the following ground disturbance activities relevant to the heritage assessment:

- road upgrades including road easement widening and maintenance for access via Lobs Hole Ravine Road (North) to provide improved secondary access and egress to Lobs Hole; and
- the laydown area near the intersection of Link road and Ravine Road.

When machinery is used to dig, grade, bulldoze, scrape, plough or drill the ground, the accompanying disturbance to the ground surface is often significant, and consequently, there would be high likelihood for any Aboriginal objects or historical items which may be present to be harmed. The following section (ii) identifies potential impacts to Aboriginal and historic heritage sites resulting from the proposed works and discusses mitigation and management of those impacts.

The other activity considered for impacts to heritage items includes the 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. Vegetation removal has potential to removal Aboriginal modified trees; however, none have been identified in this area.

The proposed ancillary construction areas and activities required for installation of communications infrastructure across Talbingo Reservoir are within modified terrain from previous construction and does not have potential to impact heritage items.

ii Aboriginal and historic heritage impacts and management

Table 6.3 presents the impact assessment and management measures for Aboriginal cultural heritage values and historical heritage values relevant to the proposed modification. Table 6.3 refers to the survey units shown in Figure 6.3,and relevant heritage items within, that required consideration as the result of the proposed modification footprint. In keeping with the Exploratory Works ACHAR (NSW Archaeology 2018a), the impact assessment and associated management measures have been presented according to survey units rather than individual sites.

The location of one proposed passing bay has changed since the archaeological survey was completed. As a result, survey unit LHRR SU1 was surveyed approximately 550 m south of the currently proposed passing bay on Lobs Hole Ravine Road (North).

The unsurveyed passing bay is within a cleared electricity transmission line (ETL) easement and on the same amorphous undulating plateau crest landform surveyed for LHRR SU1. Similar to LHRR SU1, the unsurveyed area is predicted to have negligible archaeological potential and therefore impacts to Aboriginal objects is considered highly unlikely.

No Aboriginal objects or historical heritage items are likely to be impacted by the proposed modification.

Table 6.3 Aboriginal and historic heritage impact assessment and management measures

Survey unit	Survey results relevant to proposed modification	Significance	Level of impact for survey unit	Changes to management or additional management required	AHIMS sites to be impacted	Historic sites to be impacted
Link Road survey units						
LRd SU1	Grassy frost hollow landform. Relatively low effective survey coverage due to consistent vegetation cover and leaf litter. No Aboriginal objects recorded. Subsurface artefact incidence predicted to be negligible	Low	Partial: disturbance footprint has been reduced since survey.	None	None	None
Lobs Hole Ravine Road survey units						
LHRR SU1	Amorphous undulating plateau crest landform. Low effective survey coverage due to consistent grass cover. Generally high previous mechanical disturbance off existing road. No Aboriginal objects recorded. Subsurface artefact incidence predicted to be very low to negligible *Note that is survey unit does not cover the northern-most passing bay footprint of the proposed modification but is representative of its archaeological potential.	Low	Total	None	None	None
LHRR SU2	Steep simple slope landform (northeast facing) under transmission line. Regularly cleared. Low effective survey coverage due to consistent vegetation cover. No Aboriginal objects recorded. Subsurface artefact incidence predicted to be negligible	Low	Total	None	None	None

Table 6.3 Aboriginal and historic heritage impact assessment and management measures

Survey unit	Survey results relevant to proposed modification	Significance	Level of impact for survey unit	Changes to management or additional management required	AHIMS sites to be impacted	Historic sites to be impacted
LHRR SU3	Moderate gradient simple slope/wide drainage depression landform (southeast facing) under transmission line. Regularly cleared. Low effective survey coverage due to consistent vegetation cover. No Aboriginal objects recorded. Subsurface artefact incidence predicted to be negligible.	Low	Total	None	None	None
LHRR SU4	Steep simple slope landform (east facing). Low effective survey coverage due to consistent vegetation cover and thick leaf litter. No Aboriginal objects recorded. Subsurface artefact incidence predicted to be negligible	Low	Total	None	None	None
LHRR SU5	Pinbeyan Creek drainage depression flowing southwest. Low effective survey coverage due to consistent vegetation cover and thick leaf litter. High previous disturbance due to road and bridge works. No Aboriginal objects recorded. Subsurface artefact incidence predicted to be negligible	Low	Total	None	None	None
LHRR SU6	Moderate gradient simple slope/crest landform (northwest facing). Low effective survey coverage due to consistent vegetation cover and thick leaf litter. No Aboriginal objects recorded. Subsurface artefact incidence predicted to be negligible	Low	Total	None	None	None
LHRR SU7	Steep gradient simple slope/crest landform (northwest facing). Low effective survey coverage due to consistent vegetation cover and thick leaf litter. No Aboriginal objects recorded. Subsurface artefact incidence predicted to be negligible	Low	Total	None	None	None
LHRR SU8	Moderate gradient simple slope landform (southeast facing). Low effective survey coverage due to consistent vegetation cover and thick leaf litter. No Aboriginal objects recorded. Subsurface artefact incidence predicted to be negligible	Low	Total	None	None	None
LHRR SU9	Moderate gradient simple slope landform (west facing) under transmission line. Regularly cleared. Low effective survey coverage due to consistent vegetation cover. No Aboriginal objects recorded. Subsurface artefact incidence predicted to be negligible	Low	Total	None	None	None

Table 6.3 Aboriginal and historic heritage impact assessment and management measures

Survey unit	Survey results relevant to proposed modification	Significance	Level of impact for survey unit	Changes to management or additional management required	AHIMS sites to be impacted	Historic sites to be impacted
LHRR SU10	Narrow gently undulating crest slope landform (west facing). Used for stockpiling/quarrying material. Low effective survey coverage due to significant mechanical disturbance. No Aboriginal objects recorded. Subsurface artefact incidence predicted to be negligible	Low	Total	None	None	None
LHRR SU11	Drainage depression flowing west. Low effective survey coverage due to consistent vegetation. High previous disturbance due to road, off road pullover and bridge works. No Aboriginal objects recorded. Subsurface artefact incidence predicted to be negligible	Low	Total	None	None	None
LHRR SU12	Drainage depression flowing southwest. Low effective survey coverage due to consistent vegetation. High previous disturbance due to road and bridge works. No Aboriginal objects recorded. Subsurface artefact incidence predicted to be negligible	Low	Total	None	None	None
LHRR SU13	Drainage depression flowing southwest. Low effective survey coverage due to consistent vegetation. High previous disturbance due to road, off road pullover and bridge works. No Aboriginal objects recorded. Subsurface artefact incidence predicted to be negligible	Low	Total	None	None	None
LHRR SU14	Moderate/steep gradient simple slope landform (west facing). Low effective survey coverage due to consistent vegetation cover and thick leaf litter. No Aboriginal objects recorded. Subsurface artefact incidence predicted to be negligible	Low	Total	None	None	None
LHRR SU15	Moderate/steep gradient simple slope landform (west facing). Low effective survey coverage due to consistent vegetation cover and thick leaf litter. No Aboriginal objects recorded. Subsurface artefact incidence predicted to be negligible	Low	Total	None	None	None
LHRR SU16	Narrow moderate gradient crest slope landform (west facing). Junction of LHR Road and fire trail. Low effective survey coverage due to significant mechanical disturbance, vegetation cover and leaf litter. No Aboriginal objects recorded. Subsurface artefact incidence predicted to be negligible	Low	Total	None	None	None

Table 6.3 Aboriginal and historic heritage impact assessment and management measures

Survey unit	Survey results relevant to proposed modification	Significance	Level of impact for survey unit	Changes to management or additional management required	AHIMS sites to be impacted	Historic sites to be impacted
The following survey units were originally found in RSU33						
LHRR SU17	Drainage depression flowing west. Low effective survey coverage due to consistent vegetation. High previous disturbance due to road and culvert works. No Aboriginal objects recorded. Subsurface artefact incidence predicted to be negligible	Low	Total	None	None	None
LHRR SU18	Drainage depression flowing west. Low effective survey coverage due to consistent vegetation. High previous disturbance due to road and culvert works. No Aboriginal objects recorded. Subsurface artefact incidence predicted to be negligible	Low	Total	None	None	None
LHRR SU19	Drainage depression flowing west. Low effective survey coverage due to consistent vegetation cover and thick leaf litter. No Aboriginal objects recorded. Subsurface artefact incidence predicted to be negligible	Low	Total	None	None	None
The following survey units were originally found in RSU32						
LHRR SU20	Moderate gradient crest landform (west facing). Low effective survey coverage due to consistent vegetation cover and thick leaf litter. No Aboriginal objects recorded. Subsurface artefact incidence predicted to be negligible	Low	Total	None	None	None
Ravine Road South survey units						
RSU21	Gently undulating crest landform at south end, becoming steep to north. Dry sclerophyll forest. Erosional context.	Low	Partial: vegetation clearance only.	None	None	None

iii Matters of National Environmental Significance

NSW Archaeology previously assessed the project to determine if it was likely to have a 'significant impact' on any matters of MNES under the EPBC Act (NSW Archaeology 2018c). NSW Archaeology identified that the Exploratory Works occur within two National Heritage Places, the Australian Alps National Parks and Reserves (AANP) and the Snowy Mountains Scheme. These are places with outstanding heritage, and include natural, Aboriginal and historic values.

The assessment found that the Exploratory Works will not have a significant impact on the National Heritage values of either National Heritage place. The assessment for the Exploratory Works found that it will not cause one or more National Heritage value to be lost, degraded or damaged, or notably altered, modified, obscured or diminished. The proposed modification will not impact any of the official values related to the AANP or Snowy Mountains Scheme National Heritage Places listing.

6.3.5 Mitigation and management

The Exploratory Works Aboriginal heritage management plan (AHMP) and historical heritage management plan (HHMP) will be updated to account for the additional areas assessed for the proposed modification.

6.4 Water

6.4.1 Introduction

The water assessment for the proposed modification considers potential impacts to both surface water and groundwater resources. The objectives of the water assessment were to:

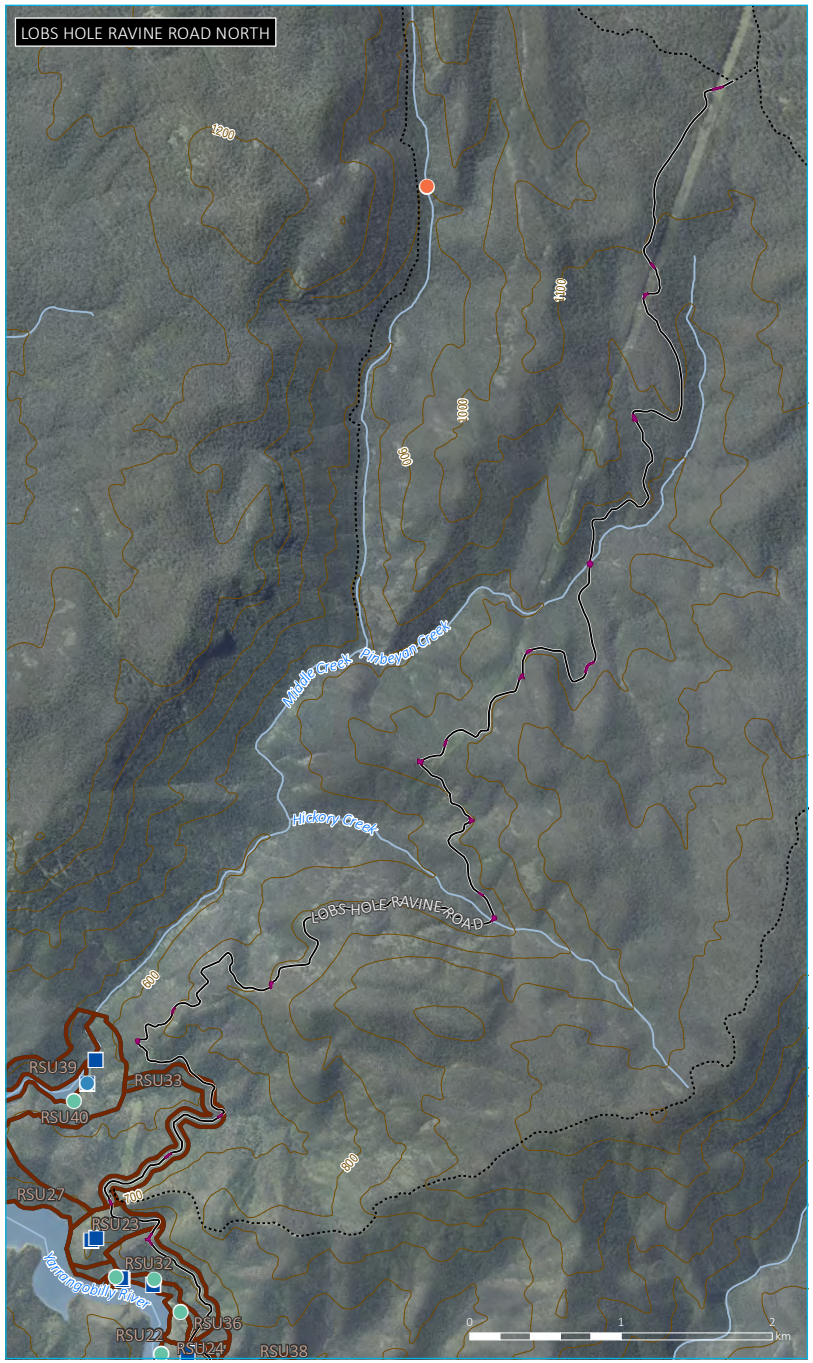
- describe the existing surface water and groundwater environment relevant to the proposed modification area;
- identify relevant impact mechanisms and significance of potential impacts associated with the activities to be undertaken as part of the proposed modification;
- assess the impact of the modification on existing surface water and groundwater resources; and
- identify what (if any) additional management measures may be required.

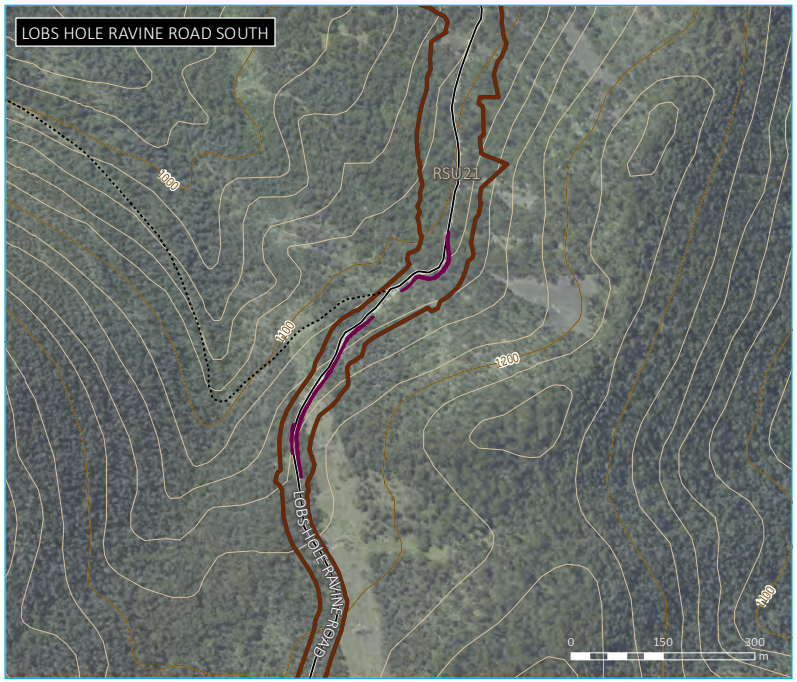
6.4.2 Existing environment

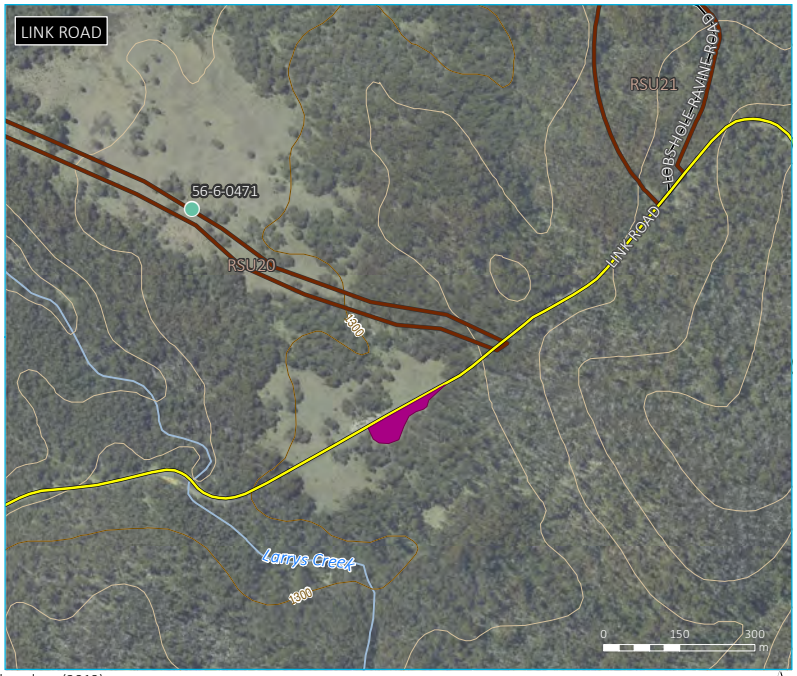
The activities associated with the proposed modification are located in three main work areas:

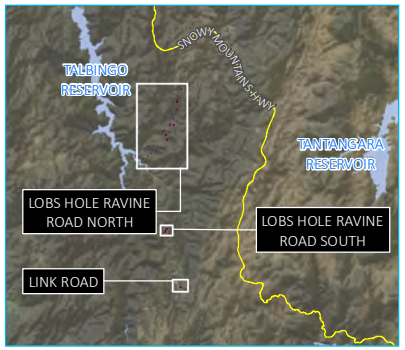
- Lobs Hole;
- existing access roads into Lobs Hole, comprising Link Road, Lobs Hole Ravine Road South and Lobs Hole Ravine Road North; and
- Middle Bay within Talbingo Reservoir.

These areas and the existing surface water and groundwater environment are described in the Exploratory Works EIS (EMM 2018a) and associated Surface Water Assessment (EMM 2018d) and Groundwater Assessment (EMM 2018e). The following provides a brief summary relevant to the proposed modification.









KEY

- Contour (20m)
- Contour (100m)
- Local road
- Vehicular track
- Watercourse / drainage line
- Modification 2 disturbance footprint
- Waterbody
- Heritage survey unit
- Historic heritage site

AHIMS

- Artefact scatter
- Isolated find
- Scarred Tree

Heritage assessment results

Snowy 2.0
Exploratory Works
Modification 2
Figure 6.3

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

GDA 1994 MGA Zone 55

N

snowy 2.0

EMM creating opportunities

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i Lobs Hole and access roads

Lobs Hole is accessed via two main routes; namely Lobs Hole Ravine Road (North) connecting to the Snowy Mountains Highway, and Lobs Hole Ravine Road (South) connecting to Link Road. Most of the works associated with the proposed modification are located along these access roads and surrounding areas.

Proposed road upgrade works along Lobs Hole Ravine Road (North) take place within the Middle Creek catchment, a tributary of the Yarrangobilly River. The terrain in this area is generally steep, largely undisturbed and densely vegetated, with the exception of the existing unsealed road. The existing road crosses several mapped non-perennial watercourses, the majority of which are first order streams with the exception of named watercourses Pinbeyan Creek (fourth order) and Hickory Creek (third order). The locations of these named watercourses are shown on Figure 1.1.

The proposed disturbance areas along Lobs Hole Ravine Road (South) and at the proposed Link Road turnaround are located in catchment headwaters and do not intercept any mapped watercourses.

The predominant soil types in Lobs Hole and surrounds are mapped as kandosols on the lower slopes and flats along the river, and tenosols on the mid to upper slopes. These soils are typically moderately dispersive, with low to moderate water holding capacity and low to moderate erosion potential.

ii Middle Bay within Talbingo Reservoir

Talbingo Reservoir makes up a large portion of the storage of the Snowy Hydro Scheme. It is approximately 200 m lower in elevation than the main Exploratory Works areas located around tunnel portal. The reservoir has inflows from several major rivers and creeks, most notably the Yarrangobilly and Tumut rivers which enter from the south, and Middle Creek which joins the reservoir from the east.

Middle Bay is located at the southern end of Talbingo Reservoir near Lobs Hole. Access is via Middle Bay Road connecting to Lobs Hole Ravine Road North. The area adjacent to the proposed barge ramp location is steep with no major watercourses present.

Soils near Middle Bay are mapped as kandosols. These soils are typically moderately dispersive, with low to moderate water holding capacity and low to moderate erosion potential.

6.4.3 Impact assessment

The proposed works with potential to impact surface water and groundwater include:

- revision of the exploratory tunnelling method from predominantly drill and blast to predominantly TBM method;
- road upgrades for transport and delivery of TBM equipment and materials required for tunnelling;
- 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;
- additional diesel storage capacity for the TBM until construction power (subject to Modification 1) is available; and
- additional diesel generators to provide power supply to the TBM prior to Lobs Hole substation commissioning.

Table 6.4 summarises the key risks to water and assesses impacts for each of the above activities. The need for additional mitigation and management measures (ie additional to those measures already included as part of the approved project) is also presented.

The following works are associated with this modification but present negligible risk to surface water and groundwater, and are therefore not further addressed:

- vegetation trimming, and selective tree lopping/removal on Lobs Hole Ravine Road (South) to provide adequate clearance for transport of the maximum TBM load.

The proposed modification also covers revision of the transport strategy to reduce the use of barging for delivery of materials to site. This aspect is also considered to have negligible impact on surface water and groundwater resources and is therefore not further addressed.

Table 6.4 Summary of water impacts and management measures

Activity	Location	Key risks	Impact assessment and need for additional mitigation and management measures
Revision of the exploratory tunnelling method from drill and blast to predominantly TBM method	• Exploratory tunnel – refer Figure 3.2	• Change to groundwater inflows with potential for associated surface water impacts • Impacts to Talbingo Reservoir water quality	<u>Change to groundwater inflows with potential for associated surface water impacts</u> The proposed change in construction method is anticipated to result in a reduction in predicted groundwater inflows, given the following: • TBM excavation techniques generate less disturbance on the surrounding rock matrix (ie fracture stimulation), resulting in lower rock permeabilities in the vicinity of the tunnel; and • the proposed length of tunnel has been reduced by about 600 m. Pre- and post-excavation grouting may also be used to improve the stability of the excavated face, further consolidate the surrounding rock and reduce water ingress if required to manage groundwater inflows. Any reduction in groundwater inflows is expected to reduce the potential surface impacts associated with groundwater drawdown and potential loss of baseflow. On this basis, predicted residual impacts are no greater (and likely smaller) than assessed in the Exploratory Works EIS. <u>Impacts to Talbingo Reservoir water quality</u> Any reduction in groundwater inflows is expected to result in a reduced load for the proposed process water management system, including associated water treatment, and lower discharge volumes into Talbingo Reservoir. On this basis, predicted residual impacts are no greater (and likely smaller) than assessed in the Exploratory Works EIS. <u>Summary</u> This activity will be adequately managed by the proposed process water management system and related controls and mitigation measures put forward in the Exploratory Works EIS. No additional management measures are required.

Table 6.4 Summary of water impacts and management measures

Activity	Location	Key risks	Impact assessment and need for additional mitigation and management measures
Road upgrades for transport and delivery of TBM equipment and materials required for tunnelling	• Lobs Hole Ravine Road (South) – refer Figure 3.6 • Link Road – refer Figure 3.3	• Impact to surface water quantity and flow regime • Impacts to surface water quality	Impact to surface water quantity and flow regime Proposed additional disturbance areas along Lobs Hole Ravine Road (South) and Link Road are small relative to existing contributing catchment areas, and do not substantially increase the overall road disturbance area. Any increase in surface runoff quantity and change to existing flow regimes will be minor only with negligible impact on downstream scour potential. Impacts to surface water quality During construction there is an increased risk of erosion and sedimentation of downstream watercourses, until the sites have been stabilised for operational purposes. This is considered low risk provided effective sediment and erosion controls are implemented. Summary This activity will be adequately managed by the proposed sediment and erosion controls and related construction water management measures put forward in the Exploratory Works EIS. No additional management measures are required.
Access via Lobs Hole Ravine Road (North) to provide improved secondary access and egress to Lobs Hole	• Lobs Hole Ravine Road (North) – refer Figure 3.8	• Impacts to surface water quantity and quality • Disturbance of waterfront land and watercourse impacts	Impacts to surface water quantity and quality Proposed additional localised disturbance areas along Lobs Hole Ravine Road (North) to establish passing bays are small relative to existing contributing catchment areas, and do not substantially increase the overall unsealed road disturbance area. Any increase in surface runoff quantity and change to existing flow regimes will be minor only with negligible impact on downstream scour potential. During construction there is an increased risk of erosion and sedimentation of downstream watercourses, until the passing bays have been stabilised for operational purposes. This is considered low risk provided effective sediment and erosion controls are implemented. Disturbance of waterfront land and watercourse impacts Proposed passing bays avoid relatively more sensitive areas adjacent to existing watercourses where possible, but unavoidably are located on waterfront land at several locations where watercourses cross the existing road, including at Pinbeyan Creek and Hickory Creek. At these locations existing culverts that convey the watercourses beneath the existing road will be extended or otherwise modified to suit the proposed road widening works. It is expected that the potential for adverse watercourse impacts in terms of increased scouring and erosion is low provided suitable temporary diversion works and associated sediment and erosion controls are implemented. Summary This activity will be adequately managed by the proposed sediment and erosion controls, clean water management and related construction water management measures put forward in the Exploratory Works EIS. No additional management measures are required.

Table 6.4 Summary of water impacts and management measures

Activity	Location	Key risks	Impact assessment and need for additional mitigation and management measures
Relocation of Middle Bay Barge ramp to significantly reduce dredging area required for its establishment	• Middle Bay in Talbingo Reservoir – refer Figure 3.9	• Impacts to Talbingo Reservoir water quality	Impacts to Talbingo Reservoir water quality The proposed modification represents a minor change in location only and will otherwise involve proposed activities and associated management measures consistent with the approved project, in a similar part of the reservoir. Noting that there is an overall reduction in total disturbance area and also substantial reduction in the requirement for dredging, predicted residual impacts on water quality are no greater (and likely smaller) than assessed in the Exploratory Works EIS. Summary This activity will be adequately managed by proposed erosion and sediment control measures and in-reservoir water quality controls put forward in the Exploratory Works EIS. No additional management measures are required.

Table 6.4 Summary of water impacts and management measures

Activity	Location	Key risks	Impact assessment and need for additional mitigation and management measures
Increase Lobs Hole accommodation camp from 152 personnel to up to 250	• Lobs Hole – refer Figure 1.1	• Impacts to local surface water quantity and quality • Impacts to Talbingo Reservoir water quality • Increase in water demand and water licencing requirements	<u>Impacts to local surface water quantity and quality</u> Impacts to local surface water quantity and quality for the accommodation camp are expected to be unchanged as the additional camp capacity will be created through an additional storey to the approved camp, with no increase in overall disturbance area. <u>Impacts to Talbingo Reservoir water quality</u> The proposed increase to up to 250 personnel will result in an additional wastewater load of about 12 kL/day. Design of the proposed wastewater treatment plant and effluent pipeline discharging to the reservoir will accommodate this increase, with no change to the proposed discharge characteristics set out in the Exploratory Works EIS. Additional concentration impacts at the point of discharge are considered negligible as the proposed discharge quality is unchanged. There will be a small increase in total pollutant loads discharged to the reservoir however predicted residual load impacts assessed in the Exploratory Works EIS were minor and considered unlikely to result in material impacts to water quality or aquatic ecology, so the small additional increase as part of the proposed modification is expected to have minimal impact and require no additional mitigation or management measures. <u>Increase in water demand and water licencing requirements</u> The proposed increase to up to 250 personnel will result in an increase in required water take for potable supply of about 4.5 ML/year, to be sourced from either Talbingo Reservoir or suitable groundwater source. This is a minor increase on the total estimated water take of 227 ML/year identified and assessed as part of the Exploratory Works EIS and will be licenced accordingly to ensure sufficient entitlements are held. There is not expected to be any material impact on surface water or groundwater resources or downstream users as a result of this small increase in water take. <u>Summary,</u> This activity will be adequately managed by the proposed sediment and erosion control measures, camp stormwater management measures, and wastewater management measures put forward in the Exploratory Works EIS. No additional management measures are required. The minor increase in required water take for potable supply will be licenced accordingly.

Table 6.4 Summary of water impacts and management measures

Activity	Location	Key risks	Impact assessment and need for additional mitigation and management measures
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	• Additional diesel generator sets and storage tanks to be located within the portal construction pad located at the western end of the exploratory tunnel – refer Figure 1.1	• Impact to surface water quantity and flow regime • Impacts to surface water and groundwater quality	Impact to surface water quantity and flow regime Additional generator sets and fuel storage will be accommodated within the approved portal construction pad footprint and layout. There is no additional disturbance area proposed. On this basis there is no change in stormwater runoff potential as a result of the proposed modification. Impacts to surface water and groundwater quality Whilst the likelihood of spills of oil and fuel is marginally increased as a result of the proposed increase in number of generators and storage tanks, the risk of impact to downstream watercourses and groundwater is considered to remain low provided effective stormwater separation and containment measures are implemented as described in the Exploratory Works EIS. Summary These activities will be adequately managed by the proposed portal construction pad stormwater management measures put forward in the Exploratory Works EIS. No additional management measures are required.

6.4.4 Summary of residual impacts and mitigation and management measures

In summary, predicted residual impacts to surface water and groundwater resources are considered minor and manageable provided water management measures consistent with the management principles and commitments put forward in the Exploratory Works EIS are implemented for activities relevant to this modification.

No additional mitigation and measurement measures are considered warranted.

6.4.5 Summary of water licencing and approvals

No additional water approvals apply to the proposed modification activities.

The proposed increase to up to 250 personnel at the Lobs Hole accommodation camp will result in an increase in required water take for potable supply of about 4.5 ML/year, which will be licenced accordingly to ensure sufficient entitlements are held.

6.5 Traffic

As described in Chapter 3, this modification has implications for traffic and transport with respect to:

- revisions to the construction method from a drill and blast method to the use of a tunnel boring machine for the Exploratory Works;
- increases in on-site accommodation;
- revisions to the transport strategy, reducing the use of barging as a means of gaining access and egress to Lobs Hole; and
- a proposal to rely on Lobs Hole Ravine Road (North) as the means of providing secondary access to the Exploratory Works site.

While traffic volumes remain largely unaffected by the changes, the need to transport a TBM to site has the potential for impacts to road width and roadside clearances and intersection designs.

Project traffic volumes and vehicle types were revised at Modification 1 as a result of the changes that were being sought at the time and included changes to both light and heavy vehicles. Heavy vehicle estimates included a component of OSOM vehicles required for Exploratory Works.

A traffic impact assessment of the proposed modification was prepared by SCT Consulting and is presented in this section.

6.5.1 Construction traffic changes

There are no changes to the forecast traffic movements along Snowy Mountains Highway or Link Road due to Modification 2. Changes to the traffic flows as a result of Modification 2 would be along Link Road, between Lobs Hole Ravine Road and Snowy Mountains Highway, whereby the volume of light vehicles would reduce during periods of peak heavy vehicles movements, to improve efficiency within the worksite for heavy vehicles by allowing light vehicles to exit Lobs Hole via Lobs Hole Ravine Road (North). Construction traffic volumes will also be reduced on Miles Franklin Drive and through Talbingo township due to the revision of the transport strategy and reduced use of barges.

6.5.2 Impact assessment

The key traffic and transport impacts assessed were the proposed use of Lobs Hole Ravine Road (North) for access by light vehicles and the changes required to OSOM arrangements. Assessment of these impacts are provided in the sections below.

i Lobs Hole Ravine Road (North)

With the implementation of a northern access at Lobs Hole Ravine Road (North) and Snowy Mountains Highway, during peak heavy vehicle movements at Link Road, light vehicles are proposed to exit onto Snowy Mountains Highway via the new access point. The northern intersection of Lobs Hole Ravine Road and Snowy Mountains Highway is currently an informal unpaved road access road as shown in Photograph 6.3. As part of Modification 2, this access location would be utilised by light construction vehicles to exit onto Snowy Mountains Highway and travel south-east along Snowy Mountains Highway towards Cooma.

In order to assess the northern access of Lobs Hole Ravine Road, a peak hour light vehicle movement of 33 vehicles is assumed at this location, with a once off event of 66 vehicles accessing the location during a peak, as per Link Road and Lobs Hole Ravine Road south access.

Source: Google Maps Streetview; 2019

Photograph 6.3 Intersection of Lobs Hole Ravine Road (North) and Snowy Mountains Highway

Surveys along Snowy Mountains Highway identified that there were 19 light and 2 heavy vehicles travelling towards Talbingo and 29 light and 2 heavy vehicles travelling towards Cooma during a weekday peak hour. Based on these volumes, the SIDRA intersection assessment for the Lobs Hole Ravine Road (North) and Snowy Mountains Highway intersection is summarised in Table 6.5.

Table 6.5 Lobs Hole Ravine Road (North) / Snowy Mountains Highway intersection assessment

Movement Performance	Volume	Degree of Saturation	Average Delay	Level of Service	95th Percentile Queue (vehicles)	95th Percentile Queue (metres)
South East: Lobs Hole Ravine North	69	0.046	5.0	A	0.1	0.7
North East: Snowy Mountains Highway	22	0.012	0.0	A	0.0	0.0
South West: Snowy Mountains Highway	33	0.017	0.0	A	0.0	0.0
All vehicles	**124**	**0.046**	**2.8**	**A**	**0.1**	**0.7**

Source: SCT Consulting; 2019

Table 6.5 shows that the intersection of Lobs Hole Ravine (North) and Snowy Mountains Highway would operate well within a simple T-junction intersection layout, as per the existing layout, with minimal delays and queuing, even with the one-off maximum flow event.

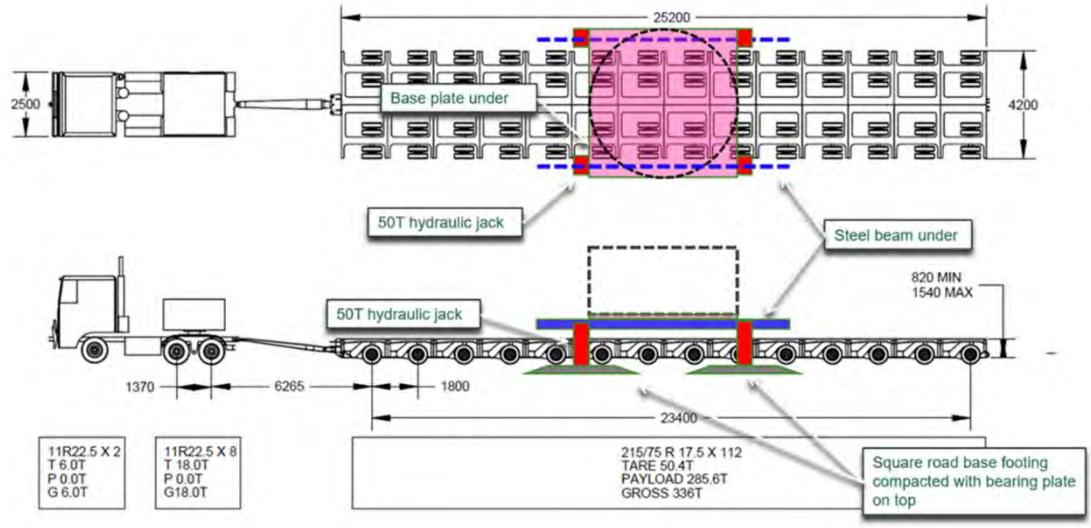
a Lobs Hole Ravine Road (North) - sight distance assessment

Austroads identifies Safe Intersection Sight Distance as a mandatory design condition for all roads and intersections in the normal design domain to enable a normally alert driver, travelling at the design speed on wet pavement, to perceive, react and brake to a stop before reaching a hazard on the road ahead, which in this instance could be a vehicle exiting from Lobs Hole Ravine Road North (*Austroads Guide to Road Design Part 4A – Unsignalised and Signalised Intersections, 2017*).

Assessing a heavy vehicle travelling at 100 km/h along Snowy Mountains Highways to fully stop, on approach to Lobs Holes Ravine Road (North), a stopping sight distance of 289 m is required. The current location of the intersection affords greater sight distances than the stopping sight distance specifies, as such it satisfies the sight distance requirement.

ii Oversize overmass movements

As part of Exploratory Works, a TBM and associated infrastructure are now proposed as the preferred method of construction. This will require the importation and transport of the TBM to site during the second half of 2020. Transportation would occur during overnight off-peak periods via the surrounding road network where practical. The TBM would be delivered to the site in various components and assembled on site, with a significant portion of the parts being oversized and exceed the 2.55 m width of a vehicle as specified in the NSW *Roads Act 1993*. In total there would be approximately 140 OSOM movements required as part of the Exploratory Works, with a typical OSOM vehicle configuration as show in Figure 6.4.



Source: FGJV; 2019

Figure 6.4 Typical OSOM configuration

a Link Road turnaround

To facilitate set down and turn-back of OSOM deliveries, with the typical OSOM configuration as shown in Figure 6.4, a laydown / turnback area is proposed along Link Road to the west of Lobs Hole Ravine Road, of approximately 750 m, as shown in Figure 3.3. This facility would minimise the OSOM delivery duration along Link Road and Snowy Mountains Highway.

a OSOM intersection treatments

It is likely that the TBM equipment would be transported as an OSOM delivery to site via Port Kembla. To identify the limitations of the existing corridor between Port Kembla and the project site, a study was undertaken by Rex J Andrews (see *Route Study: Snowy Hydro 2.0 Expansion: Port Kembla to Snowy Mountains Highway* 2017*)*. The report identified key issues along the corridor that would need to be addressed to facilitate the oversized movements at key intersections, bends as well as over height restrictions. Some of the recommendations in the study included:

- intersection upgrades;
- relocation of signs;
- removal of adjacent vegetation;
- temporary parking removals; and
- cut-back of embankments.

It is likely that different components of the TBMs would require different sizes and configurations of heavy vehicles, as such, not all OSOM deliveries may require the recommendations listed above. In contrast, there may be instances where OSOM deliveries may exceed the typical configuration shown on Figure 6.4 which may be affected by the longitudinal alignment of the corridor, that may require temporary one-way operations to allow OSOM deliveries to manoeuvre around tight road curvatures. For such instances, Transport Management Plans (TMP) would be required for each these large OSOM movements.

The report identified two key roundabout intersections of Bombala Street / Sharp Street and Vale Street / Sharp Street, within Cooma, to be limiting locations for the OSOM movements, as such intersection treatment works to facilitate heavy vehicles to traverse through the two roundabout are proposed as shown in Figure 3.7. Indicative treatment works are shown in Appendix B. The project is continuing to engage with the relevant road authority SMRC to determine the most appropriate treatment works.

The proposed roundabout upgrades will be designed to allow oversized vehicles to mount the roundabout kerb when travelling through the intersections, whilst maintaining the existing diameter and character of the roundabout island.

6.5.3 Mitigation and management

Mitigation measures are proposed to manage impacts of OSOM movements. For scheduled OSOM movements and associated road closures, a Transport Management Plans (TMP) would be prepared. The TMP would detail the date, duration, load details, driver detail, proposed route, emergency contact details, communication protocols, route surveys that include road width dimensions (pinch points) and procedures to mitigate the pinch point locations.

The TMP would be prepared, submitted and approved by the RMS, prior to the commencement of any deliveries in accordance with RMS 'high risk' OSOM movements. In addition, the TMPs would be prepared in consultation with Snowy Monaro Regional Council and emergency services and include emergency contingency plans. The TMP would include:

- alternate diversion routes for non-construction vehicles;
- potential lay-by areas for OSOM vehicles to allow vehicles to overtake at various locations along the corridor;
- details of road work / pavement modifications;
- vegetation management;
- temporary parking restriction requirements;
- earthwork and structural modifications; and
- intersection upgrades.

Separate Traffic Control Plans (TCP), as per RMS 'Traffic Control at Worksites Manual Version 5', may also be required to facilitate one-way movements on certain segments of the Snowy Mountains Highway.

6.6 Bushfire

6.6.1 Introduction

The proposed change to the transport strategy will impact the Exploratory Works secondary access and egress. The proposed change to the transport strategy to limit the use of barge transport on Talbingo Reservoir will prevent the use of marine transport as a viable option for emergency access and egress to Lobs Hole. As detailed in Section 3.3.4 minor road widening is proposed to Lobs Hole Ravine Road (North) to provide suitable secondary access. An access review of Lobs Hole Ravine Road (North) was undertaken by EcoLogical Australia and is summarised in this section.

6.6.2 Impact assessment

The existing Lobs Hole Ravine Road (North) was assessed as a proposed secondary access route against the relevant performance criteria and acceptable solutions under:

- NSWRFS (2019) *Fire Trail Standards*. Prepared by the NSWRFS Homebush NSW, March 2019; and
- NSWRFS (2018) *Planning for Bush Fire Protection – A guide for councils, planners, fire authorities.*

The results are shown in Table 6.6 and Table 6.7 below.

Table 6.6 Relevant access requirements from PBP (2018)

Performance criteria	Acceptable solution	Performance criteria achieved?
Firefighting vehicles are provided with safe, all-weather access to structures and hazard vegetation	Where access/egress can only be achieved through forest, woodland or heath vegetation, secondary access shall be provided to an alternate point on the existing public road system.	The acceptable solution and performance criteria can be met through: • Primary access provided by Lobs Hole Ravine Road south of Yarrangobilly River; and • Secondary access provided by Lobs Hole Ravine Road north of Yarrangobilly River to Snowy Mountains Highway.

Table 6.7 Fire trail standards – Category 1 (NSWRFS 2019)

Performance criteria	Acceptable solution	Performance criteria achieved?
Width: The width of the trail provides for safe and reliable unobstructed passage by a Category 1 firefighting vehicle within acceptable operational limits	The trafficable surface has a width of 4 m except for short constrictions to 3.5 m for no more than 30 m in length where an obstruction cannot be reasonably avoided or removed. Curves have a minimum inner radius of 6 m. The minimum distance between inner and outer curves is 6 m.	Acceptable solution can generally be achieved, and Performance criteria can be achieved
Capacity: The construction and formation is trafficable under all weather conditions (other than due to flood, storm surge or snowfall) for a Category 1 firefighting vehicle.	Trail surfaces and crossing structures are capable of carrying vehicles with a gross vehicle mass of 15 tonnes and an axle load of 9 tonnes.	Acceptable solution can be achieved
Grade and crossfall: The vertical profile of the trail provides for traction and safe working angle within the physical operational capability of a Category 1 firefighting vehicle. *Note: This includes design that does not impede the undercarriage of a vehicle*.	The maximum grade of a trail is not more than 15 degrees. The crossfall of the trail surface is not more than 6 degrees. Drainage structures, feature crossings, or other significant changes in the grade of the trail shall be in accordance with the NSW RFS Fire Trail Design, Construction and Maintenance Manual.	Acceptable solution can be achieved

Table 6.7 Fire trail standards – Category 1 (NSWRFS 2019)

Performance criteria	Acceptable solution	Performance criteria achieved?
Clearance: A cleared corridor is provided around the trail which permits the unobstructed passage of a Category 1 firefighting vehicle and for a working corridor either side of the vehicle to enable firefighters to exit from, and access equipment in, the vehicle.	A minimum vertical clearance of 4 m is provided above the surface of the trafficable surface clear of obstructions.	Acceptable solution can be achieved
Passing: The trail provides for two Category 1 firefighting vehicles to pass at appropriate intervals so as to avoid unacceptable delays in operations.	Capacity for passing is provided every 250 m comprising: • A widened trafficable surface of at least 6 m for a length of at least 20 m; or • A 6 m wide and 8 m long area clear of the trafficable surface with a minimum inner curve radius of 6 m and minimum outer radius of 12 m; or • A turnaround as provided for in this table (below).	North of Blue Creek Trail intersection to Snowy Mountains Highway there is sufficient opportunities for passing to meet the acceptable solutions. South of the Blue Creek Trail intersection the acceptable solution cannot be practically achieved due to very steep side slopes. Performance criteria can be achieved by: • Identified (mapped and signed) passing bays which can be used as hold points with a call in/out procedures to manage traffic flow in the event of an emergency; and • Ensure UHF radio communications provide coverage between the Yarrangobilly River and the Blue Creek Trail intersection.
Turnarounds: The trail provides for a turning manoeuvre for a Category 1 firefighting vehicle to return in the direction from which it came at appropriate intervals and at the termination of a trail.	A turning area is provided at the termination of a trail and every 500 m and is achieved by: • An area clear of the trafficable surface 6 m wide and 8 m deep, with a minimum inner curve radius of 6 m and outer minimum radius of 12 m; or • A turning circle of minimum 22 m diameter. • A T-junction with each terminating end of the junction being at least 10 m in length from the intersection of the roads and the inner radius of that intersection being at least 6 m • A fire trail or road intersection.	South of the Blue Creek Trail intersection the acceptable solution cannot be practically achieved due to very steep side slopes. Performance criteria can be achieved by: • Identified turn around points are mapped and include signage and distance).
Drainage: The fire trail is drained effectively to manage rainfall runoff to prevent damage to the trafficable surface.	Drainage of the trail is designed and constructed in accordance with the NSW RFS Fire Trail Design, Construction and Maintenance Manual	Acceptable solution can be achieved

The proposed minor widening on Lobs Hole Ravine Road (North) will establish passing bays and turn around points required to achieve performance criteria for the section of Lobs Hole Ravine Road (North) between Lobs Hole and Blue Creek Trail. The existing Exploratory Works communications towers provided adequate radio coverage for use along this road section.

6.6.3 Mitigation and management

The Exploratory Works Bushfire Management Plan will be reviewed and, if required, updated to include the revised secondary access arrangements for Lobs Hole via Lobs Hole Ravine Road (North).

6.7 Air quality

6.7.1 Introduction

Modification 2 air quality impacts relate to the commissioning of additional diesel generators to provide power to the TBM. It is anticipated that the additional diesel generators would operate until construction power is available. Air quality impacts were assessed based on a conservative estimate of 6 months additional diesel consumption of 24 kilolitres (kL) per day has been assessed.

6.7.2 Impact assessment

Emissions (particulate matter and GHG) from the diesel generators associated with the additional diesel generators have been estimated and are presented in Table 6.8. For context, emissions associated with the approved Exploratory Works are also shown.

Table 6.8 Estimated additional emissions for Modification 2

Emissions source	Diesel consumption (kL)	PM emissions (kg)			GHG emissions (tonnes CO_2-e)
		TSP[1]	PM_{10}	$PM_{2.5}$	Scope 1 and 3
Modification 2 (Diesel generators)	4,320	7,077	7,077	6,912	12,358
Approved Exploratory Works – all sources (Jacobs, 2018)	12,922	721,160	241,792	39,950	65,313
Approved Exploratory Works - diesel combustion (Jacobs, 2018)	8,688	-	-	-	24,801
Modification 2 increase (%) from Approved Exploratory Works		1.0%	2.8%	17.3%	19%

The minor increase in emissions of TSP and PM_{10} (1% and 2.8% increase from approved Exploratory Works) would not change the modelling predictions presented for the approved Exploratory Works. Although the change in $PM_{2.5}$ emissions from Modification 2 is relatively higher (17.3%), the overall conclusion of the air quality assessment for the approved Exploratory Works would not change. For example, the contribution from Modification 2 would have to more than double the contribution from Exploratory Works for air quality goals to be exceeded.

Similarly, although Modification 2 would increase GHG emissions by 19%, when viewed in the context of NSW and national emissions, the increase remains minor. Furthermore, it is noted that the GHG emissions associated with explosive use would decrease for Modification 2, due to the revision of the tunnelling method from drill and blast to predominantly tunnel boring machine.

1 TSP emissions are assumed to be same as PM_{10} (ie all diesel particulate matter is sub PM_{10})

6.8 Other environmental matters

6.8.1 Visual

The proposed works are not expected to have visual impacts on any significant public viewpoints.

6.8.2 Noise and vibration

Noise and vibration impacts may be generated by the proposed works. Activities that may generate noise and vibration impacts include the operation of plant and equipment and blasting during road construction.

The construction methodology for road upgrades will be consistent with the methods proposed in the Exploratory Works EIS. The noise and vibration impacts generated by the Modification 2 works are expected to be equal to those predicted for construction activities previously considered in the Exploratory Works EIS. Accordingly, the proposed modification is unlikely to have additional noise and vibration impacts on nearby sensitive receivers.

6.8.3 Soils and contamination

The overall impact to soil and land capability is expected to be low. The proposed modification will result in a temporary loss or reduction in soil and land capability due to the proposed road works and barge ramp establishment. Permanent losses are expected due to the permanent road establishment works included in the proposed road upgrades.

Rehabilitation principles will be designed to minimise impacts and it is expected that temporarily losses or reductions in land capability will largely be reversed through rehabilitation. While the risk of encountering naturally occurring asbestos is low, works intersecting or excavating in areas of potential asbestos will need a site-specific management strategy as a contingency measure.

The proposed works will avoid all known contaminated including the former Lobs Hole copper mine and naturally occurring asbestos on Lobs Hole Ravine Road.

6.8.4 Social and economic

The proposed modification is expected to have only minimal social and economic impacts. The economic impacts of the proposed modification are expected to be largely consistent with the economic impacts predicted in the Exploratory Works EIS (EMM 2018a).

CHAPTER 7

MITIGATION MEASURES

7 Mitigation measures

7.1 Environmental management

The Exploratory Works has well established and effective environmental management systems that are implemented in accordance with the project approval, environmental management strategy and the EPL. It is expected that the environmental impacts of the proposed modification will generally be adequately managed by the existing environment management framework and controls.

7.2 Additional environmental mitigation measures

Additional management and mitigation measures that will be implemented to avoid and minimise environmental impacts of the proposed modification are provided in Table 7.1.

Table 7.1 Additional environmental mitigation measures

Impact	Mitigation measure
Barge ramp establishment	The following measures will be implemented for barge ramp establishment works at Middle Bay. • all barge ramp construction and dredging works would be closely monitored and carried out according to the Dredge Management Plan, Surface Water Management Plan and Aquatic Habitat Management Plan; • appropriate methods and pre-dredge testing would be implemented to ensure that aquatic biota are not exposed to potentially harmful contaminants mobilised within the water column; and • removal and subsequent disposal of aquatic macrophytes would be undertaken according to the Dredge Management Plan and / or Waste Management Plan.
Impacts to Aboriginal and historic heritage	The Exploratory Works Aboriginal heritage management plan (AHMP) and historical heritage management plan (HHMP) will be updated to account for the additional areas assessed for the proposed modification.
OSOM vehicle movements	For scheduled OSOM movements and associated road closures, a Transport Management Plans (TMP) will be prepared. The TMP will detail the date, duration, load details, driver detail, proposed route, emergency contact details, communication protocols, route surveys that include road width dimensions (pinch points) and procedures to mitigate the pinch point locations. The TMPs will be prepared, submitted and approved by the RMS, prior to the commencement of any deliveries in accordance with RMS 'high risk' OSOM movements. In addition, the TMPs will be prepared in consultation with relevant councils and emergency providers and include emergency contingency plans. Where required a Traffic Control Plans (TCP) for OSOM movements will also be obtained.
Emergency access	The Exploratory Works Bushfire Management Plan will be reviewed and, if required, updated to include the revised secondary access arrangements for Lobs Hole via Lobs Hole Ravine Road (North).

7.3 Environmental mitigation measures to be removed

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. As discussed in Section 3.5, it is proposed that condition 45 be removed from Schedule 3 of the Exploratory Works consent.

Similarly, as discussed in Section 3.5.1, it is proposed that condition 4 be removed from Schedule 3 of the Exploratory Works consent. As impacts of barge use on recreational users of Talbingo Reservoir will be significantly reduced by the change in scope proposed as part of Modification 2, the proposed recreational area is no longer considered to be a necessary condition of approval.

CHAPTER 8

EVALUATION AND CONCLUSION

8 Evaluation and conclusion

This chapter presents the overall impacts and benefits of the proposed modification with regard to strategic need, environmental, social and economic impacts.

8.1 Strategic need

The Snowy Scheme is the largest engineering project ever undertaken in Australia and is one of the largest and most complex hydro-electric schemes in the world. Its construction is seen by many as a defining point in Australia's history. Snowy 2.0 involves linking Talbingo and Tantangara reservoirs within the existing Snowy Scheme and will increase the generation capacity of the Snowy Scheme by almost 50%. Snowy 2.0 will provide an additional 2,000 megawatts generating capacity and make approximately 350,000 megawatt hours (about 175 hours at full power) of storage available to the NEM at any one time.

The development of Snowy 2.0 is consistent with Commonwealth and NSW strategic planning and policy objectives, including the NSW Renewable Action Plan. With the planned retirement of generation powered by fossil fuels, there is a need for reliable electricity supply to counteract a decline in the reserve generation capacity available in the NEM. The development of Snowy 2.0 will play a key role in helping NSW and the broader NEM achieve energy system reliability and security, with relatively low costs and emissions. Compared with other alternatives, Snowy 2.0 provides:

- increased storage capacity, longer lifespan for storage, and cheaper full life cycle cost when compared to current lithium-ion storage batteries;
- more efficient dispatch of electricity to major load centres and less emission generation when compared to traditional electricity generating plants; and
- improved security and reliability of supply when compared to the intermittency of primary renewable energy sources (such as wind and solar).

Snowy 2.0 will also increase generation competition in the NEM at peak times, and thus exert downward pressure on peak energy prices and providing economic benefits to the consumer. The Feasibility Study delivered in December 2017 confirmed that Snowy 2.0 is economic, technically feasible and financeable (Snowy Hydro 2017).

Before the detailed design of the power station cavern for Snowy 2.0 can be finalised, Exploratory Works are needed to gain a better understanding of the underground conditions and confirm the precise location of the power station and its construction method.

Design and construction of excavations of the size and complexity proposed are highly dependent on the rock properties and structural geology at the identified locations. No existing Snowy Scheme tunnel or excavation currently intersects the Ravine Beds geological unit, and therefore it is extremely important to understand excavation conditions, water seepage, rock bedding and faulting conditions, particularly in the area of the power station cavern.

Modification 2 will enhance the outcomes of Exploratory Works. The proposed modification will contribute to the aims of Exploratory Works by providing the following benefits:

- improve worker safety during construction;
- reduce environmental impact of blasting and aquatic environment disturbance;
- improve schedule and increase reliability;

- improve constructability through standardising construction processes and decreasing double handling of materials; and
- optimise cost.

8.2 Design development and assessment principles

Consistent with the principles of ecologically sustainable development, the proposed modification has been designed to avoid and minimise impacts where possible. In the first instance this has included consideration of site suitability based on design and construction needs, existing assets and infrastructure (such as road access), and environmental conditions.

Snowy Hydro has been working with NPWS since the announcement of Snowy 2.0. Consultation on the Exploratory Works has been undertaken to ensure its development and design avoids and minimises impacts to biodiversity, heritage, recreation, and considers their long-term objectives for land management in KNP.

The avoidance and minimisation of impacts has been carried through the proposed modification as an iterative process between design and environment assessment and supported by consultation activities. This process has been described throughout this report. The proposed modification has been informed and refined by the results of field surveys and consultation with key stakeholders, in particular NPWS and OEH. On this basis, a number of significant impacts on biodiversity, heritage, recreation and land use have been avoided and minimised.

8.3 Biophysical, social and economic impacts

The Exploratory Works project area supports a variety of natural settings and landscape features including escarpments, ravines, rivers, creeks and reservoirs associated with KNP. It is also used for recreational pursuits such as remote camping at Lobs Hole and fishing in Talbingo Reservoir. There has been a long history of Aboriginal presence in the Snowy Mountains and the Walgalu people continue to have a cultural association with the region. The high country also has a rich history from early exploration, pastoralism and settlement, as well as the construction of the Snowy Scheme. A number of nearby townships were originally established as a result of the Snowy Scheme, some of which continue to support the Snowy Scheme's workforce today.

8.3.1 Biophysical environment

Impacts to the biophysical environment are likely to arise in two ways; via direct impacts from clearing of vegetation and ground disturbance, and via indirect impacts (eg water runoff, noise and light) to adjacent areas during construction activities. Following the avoidance and minimisation measures adopted through design, the main impacts concluded for the proposed modification are described and assessed as follows.

i Conservation

Conservation values include biodiversity and heritage, which contribute to the overall values of KNP.

The heritage assessment provided in Section 6.2 found that the proposed modification will have only minimal impacts on known Aboriginal or historic heritage items. The potential impacts to Aboriginal and historic heritage are able to be adequately managed using the revised mitigation measures provided in Table 6.3. The Exploratory Works AHMP and HHMP will be updated to include the revised mitigations.

The biodiversity assessment provided in Section 6.1 found that the project area contains habitat for native and threatened flora and fauna including the Eastern Pygmy-possum and Smoky Mouse. Residual impacts to biodiversity are considered to be one of the most important issues to be managed during Exploratory Works.

The impacts on Smoky Mouse habitat is potentially the most serious and therefore specific limitations to design and construction along identified habitat on Lobs Hole Ravine Road and Link Road have been minimised. The minor loss of native vegetation and impacts to threatened species will require offsets in accordance with legislation, and implementation of a biodiversity offset strategy will be determined in consultation with NPWS and OEH.

ii Land

The proposed modification has been designed with consideration to impacts on landform and soil characteristics, including ground movement and geodiversity features. The disturbance footprint has been reduced as far as practical to avoid and minimise disturbance to landforms and soils.

iii Water

Exploratory Works has established management systems to minimise disturbance to water resources by avoiding discharge to or extraction from the Yarrangobilly River, and implementing on-site controls for sediment and erosion, water re-use and for safe storage of chemicals. The predicted residual impacts to surface water and groundwater resources of the proposed modification are considered minor and manageable provided water management measures consistent with the management principles and commitments put forward in the Exploratory Works EIS are implemented for activities relevant to this modification.

These minor impacts will, however, be minimised through the continued use of design and control measures that are in place for the Exploratory Works.

8.3.2 Social and economic

Impacts to social values are primarily connected to the amenity and conservation values of KNP as part of recreational uses. The main impacts concluded for the proposed modification are described and assessed as follows.

i Amenity and public safety

The primary public safety risk of the proposed modification is the change to the transport strategy to minimise the use of barges which removes an option for emergency access to Lobs Hole. The proposed modification has identified the use of Lobs Hole Ravine Road (North) as a suitable replacement for secondary access and proposes works to improve the safety and performance of this road.

Prior to the establishment of the Lobs Hole substation, the proposed use of TBM will have potential to cause a minor increase to the project emissions from the increased use of diesel generators. However, due to the isolated and remote location and short-term nature of the works, the proposed modification is expected to have no perceptible amenity impacts on any identified sensitive receivers.

ii Recreation

Impacts to recreational users of Talbingo Reservoir are expected to be minimised as a result of the proposed change to the transport strategy. By minimising the use of barge transport during Exploratory Works impacts to recreational users at Talbingo Spillway will be minimised.

iii Economic factors

No additional economic impacts are expected due to the proposed modification.

8.4 Snowy Hydro's commitments

Snowy Hydro is committed to maintaining its excellent environmental track record of work within the KNP. The environmental management and mitigation measures required to govern the avoidance, minimisation and management of impacts from the proposed mitigation are set out in Chapter 7. It is expected that the existing environment management framework and controls for the Exploratory Works will be sufficient to adequately manage the majority of impacts from the proposed modification.

8.5 Conclusion

The proposed modification will contribute to achieving the objectives of the Exploratory Works and is essential to the final design of Snowy 2.0.

Snowy 2.0 is in the public interest as it will ultimately provide the ability to counteract the predicted shortfall in reliable electricity supply and generation capacity available in the NEM, as it transitions from a predominantly fossil fuel based market to a renewable one. It will provide a reliable, secure and relatively low cost and emission solution compared to other alternatives.

The proposed modification has been designed to avoid and minimise impacts where possible. The residual impacts have been identified and assessed. The key impacts of the proposed modification are associated with direct and indirect impacts from vegetation clearance and ground disturbance, such as loss of native habitat for threatened species, impacts to known heritage items and potential for impacts to water quality from construction activities.

The proposed modification will provide several benefits that contribute to the objectives of the Exploratory works. These include improving the schedule and reliability of tunnelling, improved worker safety, minimising environmental impacts from blasting and dredging and improving the efficiency and reliability of the construction transport strategy.

The proposed modification is considered to be justified and in the public interest because:

- it seeks to promote the management and conservation of resources, while also permitting appropriate development to occur which is in line with the objects of the EP&A Act;
- Snowy 2.0 will provide long term reliable energy, environmental and economic benefits;
- It will accelerate the detailed design for Snowy 2.0 by improving the schedule for exploratory tunnelling through the use of TBM methods;
- the design of the proposed modification has been an iterative design and environmental assessment process to ensure impacts have been avoided and minimised as much as possible.
- the environmental impact assessment has identified that residual impacts can be appropriately managed;
- consultation with NPWS, OEH and other key stakeholders has been undertaken to ensure appropriate management objectives are identified for the proposed works; and
- Snowy Hydro has committed to the long-term environmental management and rehabilitation of impacted sites, including removal, decommissioning and rehabilitation if needed. Therefore, should Snowy 2.0 not proceed, long term negative environmental issues can be reasonably avoided.

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10 Glossary

Term	Meaning
Access road upgrade	Upgrade works (realignment, widening or no widening) of existing access roads
Access road extension	A new access road that is an extension of an existing access road
Accommodation camp	Area used for temporary housing and facilities for construction personnel
Avoidance footprint	Exploratory Works areas excluded from clearing and ground disturbance due to sensitive environmental constraints
Barge access infrastructure	A ramp and associated facilities to allow the loading and unloading of barge(s) on Talbingo Reservoir
Base-load	Represents the minimum continuous level of energy demand in a grid system
Camp Bridge	The permanent bridge structure across Yarrangobilly River
Communications cable	Fibre optic communications cable in Talbingo Reservoir
Disturbance footprint	The area subject to clearing and ground disturbance
Exploratory tunnel	A 3.1 km tunnel to the cavern of the proposed Machine Hall for the purposes of understanding geotechnical and underground conditions
Exploratory Works	A program of exploratory works for Snowy 2.0, subject of this EIS and as described in Section 2
Firming generation/capacity	Energy available within the network to respond to demand when other energy sources, such as intermittent renewables are not operating (due to low wind or low sunlight)
Hydro-electric	Generation of electricity using flowing water (typically from a reservoir held behind a dam or barrage) to drive a turbine which powers a generator
Kosciuszko National Park	A National Park protected under the NSW *National Parks and Wildlife Act 1974* and managed by NSW National Parks and Wildlife Service. It covers an area of 673,543 hectares and forms part of Australia's only Alpine area
Lobs Hole	A former settlement location within Kosciuszko National Park, and primary location of Exploratory Works
Lobs Hole Mine	The site of a former copper mine circa 1908, located at Lobs Hole
Lobs Hole Road	The road at Lobs Hole, not the main access down to Lobs Hole
Lobs Hole Ravine Road	The main access road to Lobs Hole
Lower Lobs Hole Ravine Road	The section of Lobs Hole Ravine Road from Link Road to where it crosses the transmission easement
Middle Bay barge ramp	Location of barge access infrastructure at the southern end of Talbingo Reservoir
Middle Bay Road	The access road from the accommodation camp to the Middle Bay barge ramp. An extension to Middle Bay Road is proposed as part of Exploratory Works
Miles Franklin Drive	Existing road leading to Spillway Road, for access to the Talbingo barge ramp
Mine Trail Road	The access road from the intersection with Lower Lobs Hole Ravine Road and the portal construction pad. An extension to Mine Trail Road is proposed as part of Exploratory Works
On land rock emplacement area	The locations for rock emplacement at Lobs Hole being the western emplacement area and the eastern emplacement area
Permanent bridge	The permanent bridge crossings comprising Wallace Creek Bridge and Camp Bridge
Portal	Location of surface connection with the exploratory tunnel
Portal construction pad	Area used for construction for the exploratory tunnel and portal, including ancillary facilities, laydown and storage, and environmental controls
Power station	An industrial facility for the generation of electric power
Project area	The area required to access and build project infrastructure, including surface and tunnel components of the project

Term	Meaning
Snowy 2.0	A pumped hydro-electric expansion of the Snowy Scheme that will link the two existing reservoirs of Tantangara and Talbingo through underground tunnels, and include a new underground power station with pumping capabilities
Spillway Road	The access road to Talbingo barge ramp
Subaqueous rock emplacement area	The location for rock emplacement within Talbingo Reservoir
Subaqueous rock placement trial program	An initial trial program of rock emplacement within Talbingo Reservoir of up to 50,000 m^3 will be carried out. The program will be implemented in accordance with a detailed management plan. The program may be continued to include subaqueous placement of a greater proportion of excavated rock (ie up to 750,000 m^3) subject to further consultation with relevant authorities
Talbingo barge ramp	Location of barge access infrastructure at the northern end of Talbingo Reservoir
Talbingo Spillway	Structure used to provide the controlled release of flows from Talbingo Dam into the reservoir
Temporary bridge	A temporary structure or causeway across a watercourse to allow construction of permanent bridges
Tumut 2 power station	Underground power station south of Talbingo Reservoir
Tumut 3 power station	Power station at the northern end of Talbingo Reservoir
Upper Lobs Hole Ravine Road	The section of Lobs Hole Ravine Road from where it crosses the transmission easement to Lobs Hole
Variable renewable generation	Intermittent renewable wind and solar energy sources that are non-dispatchable and fluctuating in nature
Wallaces Creek Bridge	The permanent bridge structure across Wallaces Creek
Water services pipeline	Utility pipeline for Exploratory Works providing water supply and wastewater discharge between accommodation camp, portal construction pad and Talbingo Reservoir