AQUATIC HABITAT MANAGEMENT PLAN

SNOWY 2.0 – EXPLORATORY WORKS

Stage 1 – Exploratory Works Access Roads

December 2019

snowy 2.0

leed

Aquatic Habitat Management Plan

Rev 1

Report Snowy 2.0 - Exploratory Works - Aquatic Habitat Management Plan | Prepared for Snowy Hydro | 16 December 2019

This report has been prepared in accordance with the brief provided by the client and has relied upon the information collected at the time and under the conditions specified in the report. All findings, conclusions or recommendations contained in the report are based on the aforementioned circumstances. The report is for the use of the client and no responsibility will be taken for its use by other parties. The client may, at its discretion, use the report to inform regulators and the public.

© Reproduction of this report for educational or other non-commercial purposes is authorised without prior written permission from EMM provided the source is fully acknowledged. Reproduction of this report for resale or other commercial purposes is prohibited without EMM's prior written permission.

Document Control

Version	Date	Prepared by	Contributions by	Reviewed by
Rev A	15 February 2019	K Reeds	K Cox E Pope	J Slattery
Rev A	25 February 2019			C Buscall
Rev A	10 March 2019	R Walker-Edwards C Bentley		C Buscall
Rev 0	12 April 2019	C Bentley		C Litchfield
Rev 1	16 December 2019	J Slattery		C.Buscall

Plan approved by:

Tom Fallon
Leed Project Director

Charlie Litchfield
Snowy Hydro Environment Manager

T +61 (0)2 9493 9500 | F +61 (0)2 9493 9599

Ground Floor | Suite 01 | 20 Chandos Street | St Leonards | New South Wales | 2065 | Australia

www.emmconsulting.com.au

Table of contents

Appendices

Tables

Figures

Abbreviations and Glossary

AHD	Australian Height Datum
AqHMP	Aquatic Habitat Management Plan
BCD	Biodiversity Conservation Division
BC Act	NSW *Biodiversity Conservation Act 2016*
BoM	Bureau of Meteorology
BMP	Biodiversity Management Plan
Bridge	A structure carrying a road, path, railway, etc. across a river, road, or other obstacle.
CEMP	Construction Environmental Management Plan
DEC	NSW Department of Environment and Conservation (now Office of Environment and Heritage)
DECC	Department of Environment and Climate Change (now Office of Environment and Heritage)
DNA	Deoxyribonucleic acid
DoEE	Department of Energy and Environment
DPIE	NSW Department of Planning, Industry and Environment *Formerly* NSW Department of Planning and Environment
DPI	NSW Department of Primary Industries
EIS	*Environmental Impact Statement Exploratory Works for Snowy 2.0*
EP&A Act	*Environmental Planning and Assessment Act 1979*
EPA	NSW Environment Protection Authority
EPBC Act	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
EWMS	Environmental Work Method Statement
KFH	Key Fish Habitat
KNP	Kosciuszko National Park
MNES	Matters of national environmental significance
NPA	National Parks Association
NPW Act	NSW *National Parks and Wildlife Act 1995*
NPW Regulation	NSW *National Parks and Wildlife Regulation 2009*
NPWS	NSW National Parks and Wildlife Service
OEH	NSW Office of Environment and Heritage
REMM	Revised environment management measures
Submissions Report or RTS	Response to Submissions Exploratory Works for Snowy 2.0
TARP	Trigger Action Response Plan

1 Introduction

1.1 Background

Snowy Hydro Limited (Snowy Hydro) is the proponent of the Snowy 2.0 project which is a pumped hydro-electric storage and generation project proposed to address increasing demands for renewable energy supplies. Snowy 2.0 involves linking Talbingo and Tantangara reservoirs within the existing Snowy Mountains Hydro-electric Scheme (Snowy Scheme) and building an underground power station between the two reservoirs.

Snowy Hydro proposes to carry out Exploratory Works prior to the main construction works for the Snowy 2.0 project, to inform the detailed design and to reduce project risk. Exploratory Works are required to obtain detailed geological data for the proposed location of the underground power station. An exploratory tunnel is to be constructed to gain this information. The Exploratory Works will predominantly be located in the Lobs Hole area of Kosciuszko National Park. If the Exploratory Works are not undertaken, risks to the design and construct elements of the power station cavern are significantly increased.

The *Environmental Impact Statement Exploratory Works for Snowy Hydro 2.0* (EIS) was prepared to assess the impact of these works on the environment and included an assessment of impacts on the aquatic environment (refer to Chapter 5.1 and Appendices F and G). MOD1 also identified aquatic habitat values relevant to the modification area, assessed any impacts, and proposed any required mitigation measures within Chapter 6.5.3, and 7.1. The EIS identified that the main issue in regards to aquatic habitat for the Exploratory Works were potential impacts to threatened species and their habitat. These species include the Murray crayfish (*Euastacus armatus*), confirmed to occur within the study area and the Macquarie perch (*Macquaria australasica*). The Macquarie perch was not detected within the study area but potential key fish habitat exists in Yarrangobilly River, warranting consideration in design and construction. Trout cod (*Maccullochella macquariensis*) has been stocked by DPI Fisheries in Talbingo Reservoir in recent years (2016/17). The *Native Fish Stocking Plan 2018/19 Plan for Impoundments and Dams* (Department of Primary Industries 2017) indicates that 10,000 fingerlings are planned to be stocked in Talbingo Reservoir in 2018/19. There will not be a change in the approved impacts assessed as part of the Exploratory Works EIS as a result of MOD1.

A significant effort was undertaken to understand the aquatic habitat values within the Project area and to design the Project to avoid and minimise impacts to the identified values. Controls will be implemented to minimise and mitigate direct and indirect impacts during construction.

A referral was prepared and lodged with the Commonwealth Department of Energy and Environment (DoEE) under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The Commonwealth Minister's delegate determined on 10 July 2018 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 *Response to Submissions Exploratory Works for Snowy 2.0* (Submissions Report or RTS) included revised environmental management measures (REMMs) within Chapter 8. The management measures from that report have been addressed within this AqHMP.

Subsequent to the submission of the RTS, an Assessment of Significance of the Murray crayfish (*Murray Crayfish (Eustacus armatus) – listed as vulnerable under the FM Act – Revised Assessment of Significance – Snowy 2.0 Exploratory Works,* October 2018) was undertaken. During October 2018, a total of 130 hoop nets were deployed throughout Talbingo Reservoir with one Murray crayfish caught. Further assessment in a

Species Impact Statement was not recommended and no additional control measures for the roads and access works were required.

1.2 Context

This Aquatic Habitat Management Plan (AqHMP or Plan) forms part of the Environmental Management Strategy (EMS) for Snowy 2.0 - Exploratory Works (the Project). The Exploratory Works is the first phase of Snowy 2.0, a pumped hydro-electric storage and generation project which will increase the hydro-electric capacity within the existing Snowy Mountains Hydro-electric Scheme. The second phase, or main project, will be subject to a separate Environmental Impact Statement in 2019.

This AqHMP has been prepared to address the requirements of the Infrastructure Approval (SSI 9208), the *Environmental Impact Statement Exploratory Works for Snowy Hydro 2.0,* and the revised environmental management measures within the *Response to Submissions Exploratory Works for Snowy 2.0*.

The original EIS Exploratory Works scope 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 includes upgrades to 26 km of existing roads and creating about 2 km of new roads;
- barge access infrastructure to enable access and transport by barge on Talbingo Reservoir. This includes 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 temporarily placed in one of two on land emplacement areas.
  - 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;
- post-construction revegetation and rehabilitation, management and monitoring.

Having regard to the design changes identified in Modification 1, the scope now comprises the following listed in Table 1.1 below:

Table 1.1 New scope items for EW (Stage 1 & 2) as a result of MOD1

Stage 1	
Lobbs Hole Substation	Additional disturbance area required for the construction power connection to an existing transmission line (Line 2) at Lobs Hole for power supply to the Exploratory Works accommodation camp and construction areas. This will provide a reliable and long-term source of construction power and will reduce the reliance on diesel generation and associated on-site storage requirements and emissions. Works in this area will include establishing a substation, connection infrastructure, access roads and ancillary construction areas; This will include: • construction of a 330/33 kV substation within Kosciuszko National Park 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 construction power 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; and • ancillary activities, including brake and winch sites, crane pads, site compounds and equipment laydown areas. (Illustrated Appendix F Figure 1i)
Camps Bridge and Wallaces Creek	• 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; (Illustrated in Appendix F Figures 1h and 1i of this plan and Modification 1 Assessment Report Figure 3.9)
Lobs Hill Ravine	• minor changes to the project boundary identified through detailed design

Road and Construction Boundary Changes	including: – revised road upgrade for Lobs Hole/Ravine Road to improve access, 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 road users on Lobs Hole Ravine Road and Mine Trail Road; (Illustrated in Appendix F, Figures 1d, 1e, 1f and 1i)
Operating Hours	• modify operating hours from existing 7 am to 6pm to sunrise to sunset
Miscellaneous	• continued use of existing communications towers within KNP that were previously approved by the 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; and • 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. (location of communications towers illustrated in Appendix F Figures 1a, 1f, 1l)
Stage 2	
Borehole drilling and geophysical surveys	• Borehole drilling and geophysical surveys for further geotechnical investigation of the Snowy 2.0 power station and power waterway at Marica, Talbingo and Tantangara; • clearing of up to 2.79 hectares (ha) of additional vegetation for access tracks and drilling pads. • About 1.33 ha within Smokey Mouse potential habitat; • trimming of overhanging dangerous branches on adjacent trees (these trees will not require removal); • mulching of trees and vegetation; • establishment of an additional 1 km of access tracks (4 m wide), including minor earthworks, • placement of geofabric (as required) and import of stabilised material; • establishment of eight drilling pads and boreholes at top of the cavern area, with an area of 900 m2 per pad, including minor earthworks, placement of geofabric (as required) and import of stabilised material (as required); • undertaking geophysical surveys near Talbingo and Tantangara reservoirs; • establishment of two drilling pads and boreholes at both Tantangara and Talbingo with an area of • 900 m2 per pad, including approximately 400 m of additional access tracks and minor earthworks (as required); • establishment of in-reservoir boreholes including one in Talbingo Reservoir and two in Tantangara Reservoir; • drilling of additional nested vertical boreholes at each of the drilling pads

	up to a depth of 1,100 m; • conversion of the investigation boreholes into monitoring bores; • undertaking geophysical surveys; and • rehabilitation of the drilling pads and access tracks following completion of works • ongoing maintenance of existing access tracks required for geotechnical investigations within KNP (Illustrated in (Illustrated in Appendix F Figure 1j, 1k, 1l, 1m and 1n)
Talbingo Laydown	Outside of KNP, SHL is proposing to add four laydown locations to facilitate the construction of the communications cable linking Lobs Hole with the Tumut 3 Power Station. These are proposed on existing hardstand areas along Talbingo Reservoir within Snowy Hydro owned land. (Illustrated in Appendix F, Figure 1o)
Tantangara Access	Two additional geotechnical boreholes are required to facilitate the detailed design of cuttings, bridge foundations, retaining wall foundations, and drainage structures near Nungar Creek (Illustrated in Appendix F, Figure 1m and 1n)

The Exploratory Works is estimated to take around 30 to 34 months to complete.

As with most of the existing Snowy Scheme, the majority of Snowy 2.0 is within Kosciuszko National Park. Snowy Hydro has been working with NSW National Parks and Wildlife Service (NPWS) since the announcement of Snowy 2.0 to ensure long term management objectives for Kosciuszko National Park are considered in project development.

The Project has been designed in a way that avoids and minimises impacts to Kosciuszko National Park where possible. This has included the planning of access roads and construction areas to avoid impacting the heritage listed Washington Hotel ruins at Lobs Hole, and Smoky Mouse habitat along Upper Lobs Hole Ravine Road. It also includes designing road upgrades to minimise impacts to geodiversity features including a block stream and a fossil outcrop along Lower Lobs Hole Ravine Road. The former copper mine at Lobs Hole is also considered a geo-heritage site, however it is also a source of known contamination and has therefore been avoided as much as possible to prevent disturbance.

While there are some unavoidable impacts during construction, the Exploratory Works will allow for a number of longer-term benefits and contributions to Kosciuszko National Park through a biodiversity offset program, improved access roads and recreational facility upgrades. The completion of Exploratory Works will also allow for the greater benefits of Snowy 2.0 to be realised.

1.3 Construction activities and sequencing

Exploratory works will be delivered in three stages:

- **Stage 1a – Pre-construction Minor Works** - pending the approval process, works may commence in the first quarter of 2019. The scope of pre-construction minor works includes dilapidation studies, survey work, borehole installation, site office establishment, minor access roads, installation of

monitoring equipment, installation of erosion and sediment controls, archaeological salvage and minor clearing;

- **Stage 1b – Exploratory Works Access Roads (EWAR)** - pending the approval process, works may commence in the first quarter of 2019. The scope includes roadworks and upgrades to enable access and haulage routes during Exploratory Works;

- **Stage 2 – Exploratory Works** – pending progress with Stage 1, works may commence in quarter three of 2019. The scope for Stage 2 will be the remainder of the Exploratory Works, including the exploratory tunnel, portal construction pad, accommodation camp and excavated rock management. Stage 2 also includes subaqueous emplacement within Talbingo Reservoir.

To present the staging of plans a separate Staging Report has been prepared and was submitted to Department of Planning and Environment. Timing of the Exploratory Work stages is presented below.

Figure 1 Timing of Exploratory Works stages

1.3.1 Exploratory Works Access Roads

The Exploratory Works Access Roads (EWAR) will provide early access to the tunnel portal located to the east of the Talbingo Reservoir, and to Talbingo Reservoir itself. The works include upgrades to and/or construction of the following roads:

- Ravine Road;
- Mine Trail Road;
- Lobs Hole Road;
- Wharf Road.

The EWAR scope includes but is not limited to the following:

- setting out the works including delineation of site boundaries;
- establishment of all site facilities required and removal upon completion, including all temporary safety and security measures required;
- locating and protecting all public and private utility services;
- maintenance of the existing roadway and associated infrastructure;

- clearing and grubbing of vegetation including creation of mulch and compost;
- establishment of short term and long-term (eg: detention and sedimentation basins) erosion and sedimentation control systems and devices;
- removal and disposal of existing infrastructure including pipes, culverts, drainage channels and other minor structures;
- excavation and stockpiling of topsoil;
- earthworks including excavation of cuttings, construction of fills including selected zone material, and placement of excess spoil in stockpile;
- progressive opening to traffic;
- treatment of cut and fill slope batter surfaces including slope retention systems where shown;
- construction of clean and dirty water drainage systems including culverts, open and subsoil drainage systems;
- construction of pavements including subgrades and pavements and road surfacing;
- design, supply, construction of temporary structures / bridges over Wallace Creek and the Yarrangobilly River and removal of completion;
- construction of permanent bridges over Wallace Creek and the Yarrangobilly River;
- installation of road furniture including but not limited to barriers, line marking, guide posts and road signs;
- placement / replacement of topsoil and revegetation and other surface treatments to disturbed earth surfaces including lining of open drains;
- clean up and restoration of work areas and areas disturbed by the contractor.

The additional EWAR scope as a result of MOD1 will include:

- construction of a 330/33 kV substation within Kosciuszko National Park 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 construction power 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; and
- 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 access, drainage and safety; and
    - 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 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 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;

The works are proposed to commence in the first quarter of 2019

This Plan identifies the project's environmental management measures in relation to aquatic habitat management. It has been specifically developed for Stage 1 of the Exploratory Works project.

This AqHMP will be revised prior to commencement of Stage 2 works as detailed in the Environmental Management Strategy (EMS) Section 2.1 and Section 4.1.3 and the Staging Report (February 2019).

The timing of the preparation, consultation, submission and approval of this and other plans is shown within Figure 4.3 of the EMS. During Stage 1 of the work ongoing revisions to the AQHMP will occur in accordance with Section 1.6.1 of the EMS and as required by the conditions of approval. Circumstances requiring a review, and if necessary revision, of this plan include submission of incident reports or audit reports, approval of modifications to the conditions of approval and directions of the Planning Secretary under condition 4 of schedule 2.

Some work activities such as the management of waste rock from the tunnelling activities, require greater detail and warrant a separate plan. The activities which are also related to aquatic habitat management which are detailed within other management plans, are shown within Table 1.2.

Table 1.2 Relationship to other plans

Activities	Relevant plan	Timing of the plan*	
		Stage 1	Stage 2
Road construction	This plan	P	R
Other construction including site facilities and tunnelling activities	This plan, however detail will be included when this plan is revised prior to Stage 2	P	R
Temporary and permanent bridge construction at Wallaces Creek and Yarrangobilly River	This plan	P	R
Construction of barge access infrastructure	This plan, however detail will be included when this plan is revised prior to Stage 2	P	R
Excavated material	Excavated Material Management Plan	P	R
Subaqueous rock placement in Talbingo Reservoir	Subaqueous Emplacement Management Plan		P
Dredge spoil disposal	Dredge Management Plan		P
Monitoring for impacts on Murray crayfish in Talbingo Reservoir	This Plan	P	R
Measures for the management of water quality	Water Management Plan (WMP) WMP Appendix A Surface Water Management Plan WMP Appendix B Groundwater Management Plan	P	R

* P – prepare, R - revise

Specific management measures identified in this Plan will be incorporated into site specific documents which are to be prepared by the Contractor. These site-specific documents will be prepared for construction activities and will detail the management measures which are to be implemented on the ground. Construction personnel will be required to undertake works in accordance with the mitigation measures identified in the site-specific documents.

1.4 Environmental management system

The overall environmental management system for the Project is described in the Environmental Management Strategy (EMS). This AqHMP forms part of Snowy Hydro Limited's environmental management framework for the Project, as identified in Figure 1.1 and as described in Section 3 of the EMS.

This AqHMP aims to transfer the relevant requirements of the Approval and EIS documents into a management plan which can be practically applied on the Project site.

Figure 1.2 EMS structure

1.5 Purpose and objectives

The key objective of the AqHMP is to describe the management measures that are to be implemented to ensure that impacts to aquatic habitat are minimised and within the scope permitted by the Project conditions of approval. To achieve this, Snowy Hydro and the Contractor will:

- ensure appropriate measures are implemented to address the relevant conditions of approval and the revised environmental management measures listed within the Submissions Report, as detailed within Table 2.1 and Table 2.2 of this Plan;
- detail the existing aquatic habitat identified within the project footprint during the EIS;
- ensure reasonable and feasible measures are implemented during construction to avoid or minimise aquatic habitat impacts;
- detail the monitoring program for the Murray crayfish and Macquarie Perch.

1.6 Consultation

In accordance with condition 8 of schedule 3 of the conditions of approval, the AqHMP has been prepared in consultation with:

- National Parks and Wildlife Services (NPWS);
- Department of Primary Industry – Fisheries.

The MOD1 Assessment Report and associated technical studies were submitted by Snowy Hydro to DPIE in June 2019 and publicly exhibited in accordance with the EP&A Act between 26 June and 9 July 2019. Nine submissions were received during the public exhibition period, including one from a special interest group and two individual community submissions.

Consultation for the AqHMP began in January 2019 and is summarised in Table 1.3.

Table 1.3 Consultation undertaken for the AqHMP

Date	Consultation	Outcomes
12 December 2018	Initial consultation meeting with NPWS	Outlined the Project approval process and management plan development
16 January 2019	Issued draft AqHMP to NPWS	Sent as information for initial review and comment.
29 January 2019	Issued draft AqHMP to DPI Fisheries	Sent as information for initial review and comment.
31 January 2019	Received initial AqHMP comments from NPWS	Comments accepted and plan revised accordingly
31 January 2019	Received initial AqHMP comments from NPWS	Comments accepted and plan revised accordingly
13 February 2019	Received initial AqHMP comments from DPI Fisheries	Comments accepted and plan revised accordingly
18 February 2019	Updated AqHMP sent back to DPI Fisheries for their review and further comments.	Sent for review and comment.
20 February 2019	Received comments from NPWS. NPWS confirmed that this plan was relevant to the	Comments accepted and plan revised accordingly.

	stage of the project and will review updated AqHMP for Stage 2 of the work.	
20 February 2019	Received comments from DPI Fisheries regarding updated management plan.	Plan finalised accordingly.
24 October 2019	Updated AqHMP as a result of MOD1 was sent to DPI Fisheries	There were no comments on the Stage 1 plan.

2 Environmental requirements

2.1 Legislation

Legislation relevant to aquatic habitat includes:

- *Environmental Planning and Assessment Act 1979* (EP&A Act);
- *National Parks and Wildlife Act 1974* (NPW Act);
- *Biodiversity Conservation Act 2016* (BC Act);
- *Fisheries Management Act 1994* (FM Act);
- *Biosecurity Act 2015*; and
- *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

2.2 Conditions of Approval

Project approval for SSI 9208 was granted by DPIE on 7th of February 2019 with the following aquatic habitat management conditions included in the Infrastructure Approval. MOD1 was granted approval by DPIE on 2 December 2019. The conditions relevant to aquatic habitat are presented below.

As outlined in Section 1.4, Exploratory Works will be undertaken in stages, with Stage 1 scheduled for Q1 2019 and the Stage 2 scheduled for Q3 of 2019. **Given this timing, the AqHMP is focussed on meeting the conditions of approval related to Stage 1 (roadworks and bridge crossings) which are relevant to the aquatic ecology of the Yarrangobilly River and Wallaces Creek**.

The AqHMP will be updated prior to Stage 2 Exploratory Works to ensure that all conditions of approval specifically relating to the aquatic ecology of Talbingo Reservoir are addressed.

Table 2.1 Conditions of Approval relevant to aquatic habitat management

Condition	Requirement	Where addressed in this Plan
Aquatic Habitat Management Plan		
8	Prior to carrying out any construction in Talbingo Reservoir, Yarrangobillly River, and Wallaces Creek, unless the Planning Secretary agrees otherwise, the Proponent must prepare an Aquatic Habitat Management Plan for the development to the satisfaction of the Planning Secretary. This plan must:	This Plan
	(a) be prepared in consultation with the NPWS and DPI Fisheries;	Section 1.5
	(b) include a description of the measures that would be implemented to:	
	• protect the aquatic habitat outside the approved disturbance areas;	Section 5
	• minimise the loss of key aquatic habitat;	Section 5
	• undertake surveys of the condition of aquatic habitat and the presence of any threatened aquatic species:	Appendix B
	- in and surrounding the approved disturbance areas prior to disturbing these areas; and	
	- at suitable control sites within the reservoir;	Stage 2 AqHMP
	• minimise the impacts of the development on threatened fauna species, including	

Condition	Requirement	Where addressed in this Plan
	the Murray crayfish (*Euastacus armatus*) and Macquarie perch (*Macquaria australasica*);	Section 5
	• minimise the impact of the development on fish habitat, particularly from the following activities:	
	- in Talbingo Reservoir: o subaqueous emplacement; o dredging; o barge infrastructure; o water treatment outlet; o water intake pipe; and o seismic surveys.	Stage 2 AqHMP, Subaqueous Emplacement Management Plan and Water Management Plan
	- in Yarrangobillly River and Wallaces Creek:	
	o Wallaces Creek temporary and permanent bridges;	Section 5
	o Yarrangobilly River temporary and permanent bridges.	Section 5
	• maximise the relocation of any large mobile invertebrates from the shallower parts of the approved disturbance areas prior to disturbing these areas;	Section 5 and Appendix A
	• salvage woody debris from the dredging area and the shallower parts of the designated subaqueous emplacement areas prior to disturbing these areas, and use this debris to enhance the habitat of other parts of the reservoir;	Section 5 and Stage 2 AqHMP
	• notify DPI – Fisheries of any fish kills.	Section 5 and Appendix D
	(c) include a trigger action and response plan for the Murray Crayfish, which would be implemented if monitoring shows the development is adversely affecting the species;	Appendix E
	(d) include a program to restore and enhance the aquatic habitat of the approved disturbance area as soon as practicable following the completion of development in these areas;	Appendix C
	(e) include a program to monitor and report on the effectiveness of these measures.	Section 6.1 and Appendix B
9	The Proponent must implement the approved Aquatic Habitat Management Plan.	This plan
Potential Offsets – Murray Crayfish		
10	If the Planning Secretary determines, after reviewing monitoring results of the impacts of the development, that the development has had a significant impact on the Murray Crayfish in the Talbingo Reservoir, then the Proponent must offset these impacts to the satisfaction of the Planning Secretary.	Stage 2

2.3 Revised environmental management measures

Environmental safeguards and management measures are included in the EIS in Section 6.3. During preparation of the Submissions Report, revised environmental management measures (REMMs) were developed and are included in Section 8 of the Submissions Report.

The environmental management measures relevant to this Plan are listed in Table 2.2 below. If additional measures are cross-referenced from another section of the EIS or Submissions Report, these measures are also included.

Table 2.2 Management measures from the EIS relevant to aquatic habitats

Impact	Ref #	Environmental management measure	Where addressed in this Plan
Impacts to threatened species	ECO03	Potential impacts to Threatened Species will be managed through the Biodiversity Management Plan during construction. The Biodiversity Management Plan will include: • Murray Crayfish monitoring program (Talbingo Reservoir); • Smoky Mouse monitoring program; and • Boorolong Frog monitoring program.	Stage 2 AqHMP for monitoring in Talbingo Reservoir Biodiversity Management Plan (BMP) Appendix B
Impacts on fish eggs and larvae due to extraction of water from Talbingo Reservoir sedimentation	ECO10	The water pipeline intake will be designed to: • prevent adult fish from entering the intake and discourage adult fish from approaching the intake which may include: - incorporation of an enclosed, dark and long passage approach to the intake; - if feasible, screening of the intake with at least 5 mm to 3 mm mesh screen; - if feasible, installation of a coarse mesh (e.g. cm aperture) screen / cage a few metres around the intake and removal and control of any aquatic vegetation and wood debris within and immediately adjacent to the intake location; and - if feasible, limiting the approach water velocity at the headwall during normal operation ideally to 0.1 m/s. • locate the intake pump in deeper water where possible; and • allow for pump start up procedures involving initial slow water velocity to reduce likelihood of aquatic biota being drawn into the pump.	Stage 2
Impacts to fish passage	ECO11	The permanent bridges at Yarrangobilly River and at Wallaces Creek will be designed with consideration of Policy and Guidelines for Fish Habitat Conservation Update 2013 (DPI 2013) and Why do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings (NSW Fisheries 2003).	Section 5
Impacts to fish passage	ECO12	The temporary bridges at Yarrangobilly River and at Wallaces Creek will be designed, constructed and removed to: • where practicable implement measures in line with the guidelines for temporary structures in Fisheries NSW Policy and Guidelines for Fish Habitat Conservation and Management (2013 update) (DPI 2013) and recommended crossing design considerations in Fairfull and Witheridge (2003) which includes: - temporary in-stream structures will avoid spanning the full width of the waterway channel to ensure base flow conditions are maintained down the waterway where practicable; - maintaining some unmodified channel so that a weir effect or flow through rock interstices only is not created where practicable; and - temporary in-stream structures will be inserted during low-flow periods where practicable • ensure any build-up of debris which potentially obstructs fish passage will be removed; and • the temporary structures will be removed and the river channel rehabilitated following construction of the permanent bridges.	Section 5

Impact	Ref #	Environmental management measure	Where addressed in this Plan
Impacts to fish passage	ECO13	Construction and removal of the temporary bridge at Yarrangobilly River will avoid or minimise in stream works during the migration time of Macquarie Perch (October to January) where possible.	Section 5
Impact to aquatic ecology from erosion and sedimentation	ECO14	The water quality controls described in in WAT01 to WAT05 and WM1.1 to WM 8.8 will be implemented.	Section 5 Surface Water Management Plan
Impacts to aquatic habitat and biota during dredging and subaqueous placement	ECO15	The subaqueous placement monitoring program for Talbingo Reservoir will be developed and implemented. Measures relevant to aquatic ecology will be implemented as described below including: • monitoring of water quality indicators including turbidity, pH and dissolved oxygen within and downstream of the construction area and, if a decline in water quality is detected as a result of the works, investigate potential causes and develop and implement an appropriate response; • the extent of the placement area will be minimised as far as practicable; • the extent of the dredge footprint will be minimised as far as practicable; • subaqueous placement would not occur shallower than 3 m below minimum operating level (i.e. where aquatic habitat, such as aquatic plants are less likely to occur); • placement of large rocks within the placement area will occur and is expected to enhance the value of this habitat for fish and mobile invertebrates by providing hard surface and refuges; • un-necessary noise and vibration disturbances should be kept to a minimum where practicable to avoid impacts to fish and other aquatic species; • removing wood debris from within the dredge footprint and subaqueous placement location and spreading it back into the reservoir in relatively shallow water (0-10 m) where fish are more likely to occur; • where feasible, mapping/identification of aquatic habitats within and adjacent to the subaqueous placement areas and other reference areas to characterise the habitat and place this in context of that present throughout the entire reservoir; and • mapping of aquatic habitats would include searches for crayfish burrows along the shoreline, as these could indicate the presence of Murray crayfish and would inform the final placement area extent. Deployment of crayfish traps along the shorelines adjacent to the placement area and within the placement area could be used to re-locate any large mobile invertebrates (including any Murray crayfish) from these areas to nearby sections of the reservoir that would not be affected by placement; • prior to commencement of seismic surveys, smaller releases of compressed air will be undertaken just below the surface; • during seismic surveys, operators will 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 or review and adjustment of methodology (e.g. magnitude, frequency and/or duration of releases); • minimising suspension of sediment and turbidity by implementing WAT14 and WAT15.	Stage 2 Subaqueous Emplacement Management Plan and Water Management Plan

2.4 Permits and licences

As this project has been designated Critical State Significant Infrastructure and assessed under Part 5 of the EP&A Act, permits relating to fish passage or dredging or reclamation works are not required.

For the work scope an Environment Protection Licence (EPL) has been obtained (EPL# 21266) by Snowy Hydro for the Scheduled Activity of Extractive Activities. The EPL details specific monitoring and reporting conditions which must be complied with when undertaking the extractive activities works.

2.5 Guidelines

The main guidelines, specifications and policy documents relevant to this Plan include:

- Fairfull, S (2013). Fisheries NSW *Policy and Guidelines for Fish Habitat Conservation and Management* (2013 Update). NSW Department of Primary Industries;
- Fairfull, S. and Witheridge, G. (2003) *Why do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings.* NSW Fisheries, Cronulla, 16 pp;
- NSW DPI Fisheries Guidelines (2017) – *A Guide to Acceptable Procedures and Practices for Aquaculture and Fisheries Research*;
- DSEWPaC (2011). *Survey guidelines for Australia's threatened fish. Guidelines for detecting fish listed as threatened under the Environment Protection and Biodiversity Conservation Act 1999;*
- NSW National Parks & Wildlife Service. 2001. P*olicy for the Translocation of Threatened Fauna in NSW: Policy and Procedure Statement No. 9* Threatened Species Unit, Hurstville NSW;
- NSW Fisheries, 1999, DPI Policy and Guidelines: *Aquatic Habitat Management and Fish Conservation*;
- Department of Primary Industries *Guidelines for Controlled Activities on Waterfront Land* (2012);
- NSW Office of Water *Guidelines for working within riparian corridors;*
- relevant recovery plans, priority action statements and best practice guidelines.

3 Existing environment

The following section summarises existing aquatic flora and fauna within and adjacent to the Project including species, communities and habitats based on the Snowy 2.0 Exploratory Works Aquatic Ecology Assessment (Cardno 2018).

The Aquatic Ecology Assessment included field surveys to obtain detailed local information on the aquatic ecology present in the project area (i.e. the sections of watercourses and Talbingo Reservoir that could potentially be impacted by Exploratory Works). The field surveys included:

- aquatic habitat assessment (using a modified version of the Riparian, Channel and Environmental Inventory method (RCE)) including identification of channel morphology, substratum, aquatic plants (macrophytes) and riparian vegetation;
- identification and classification of KFH in rivers, creeks and drainage lines within the Study Area using classification criteria in NSW DPI (Fisheries) (2013a);
- fish and large mobile invertebrate surveys using boat-based electrofishing in Talbingo Reservoir (including the arms of Tumut and Yarrangobilly rivers) and backpack electrofishing in Yarrangobilly River and Middle Creek. Aquatic habitat assessment was also undertaken along sections of the reservoir banks.

3.1 Habitats

The major waterbodies and watercourses potentially affected by the Exploratory Works are Talbingo Reservoir, Yarrangobilly River and Wallaces Creek. Talbingo Reservoir is approximately 15 km long and 1-2 km wide with its headwaters in the Tumut River and Yarrangobilly River. Named third order tributaries of the Yarrangobilly River include Wallaces Creek, Lick Hole Creek and Cave Gully, which flow into the river from the south. Several unnamed first, second and third order tributaries also flow into Yarrangobilly River to the north and south. The Yarrangobilly River catchment is wholly within the KNP. Water sampling results within the River indicate the Yarrangobilly River is in good condition, reflecting the predominantly undisturbed catchment contained within a national park.

Stage 1 Exploratory Works (Roads) has potential to impact on aquatic habitat in and around the location of new permanent and temporary bridge crossings on the Yarrangobilly River and Wallaces Creek. Field sampling undertaken near these locations describe the Yarrangobilly River as a Type 1 (Highly Sensitive), Class 1 (Major Fish Habitat), perennial watercourse with high ecological value as a key fish habitat (Cardno 2018). The watercourse substratum consists of unconsolidated boulder, cobble, pebble and gravel with little natural siltation. This would potentially provide suitable spawning habitat for native species, if present. These habitats are also sensitive to sedimentation and infilling of interstices. The nearby tributaries of Lick Hole Creek and Sheep Station Creek are ephemeral and provide limited habitat value for fish, but may provide refuge for aquatic macroinvertebrates including freshwater crayfish (Cardno 2018).

The Aquatic Ecology Assessment determined aquatic habitat assessment scores of 46 for the Yarrangobilly River and 52 for Wallaces Creek. The maximum score of 52 indicates a stream with little or no obvious physical disruption.

3.2 Water quality

The Yarrangobilly River catchment is characterised by a range of subalpine grasslands and woodlands and montane dry sclerophyll forests. The majority of annual stream flows occur in late winter and early spring with stream flows progressively reducing over summer and are at their lowest in late summer remaining low until

the winter months. Water quality monitoring undertaken in the Yarrangobilly River between February and April 2018 was done during base flow conditions, which are dominant in the summer months. The water quality at this time is characterised as neutral to slightly alkaline, with. high carbonate levels, low salinity, low suspended solids and low levels of nutrients and metals. Water quality during non-base flow conditions is expected to have lower carbonate levels and potentially higher suspended solids and nutrient levels (EMM 2018). Wallaces Creek is a major tributary to the Yarrangobilly River and has a similar stream flow regime and water quality characteristics to the Yarrangobilly River.

Based on a snapshot assessment carried out in March 2018, water quality within Talbingo Reservoir can be characterised as having a neutral pH, low carbonate, low salinity, low levels of suspended solids and low nutrient levels. Elevated concentrations of copper and zinc were identified in most samples from the southern (upstream) portion of the reservoir although the source of the elevated metal concentrations is unknown (EMM 2018).

3.3 Threatened fauna

Threatened species with a moderate to high likelihood of occurrence in waterways affected by the Project include the Murray crayfish (Listed as 'vulnerable' under the FM Act) and Macquarie perch (listed as 'endangered' under the FM Act and EPBC Act). Murray crayfish is known to occur in Yarrangobilly River, Wallaces Creek and Talbingo Reservoir.

Suitable habitat for Macquarie perch occurs in Talbingo Reservoir and Yarrangobilly River, however there are no known records of this species, except for stocking undertaken over 10 years ago. This species was not detected during electrofishing surveys or complimentary environmental DNA (eDNA) analysis carried out as part of the EIS aquatic ecology investigations (Cardno 2018). A summary of the threatened species confirmed to be present within the study area during EIS surveys is provided in Table 3.1. The approximate locations that this species was observed are shown in Figure 3.1.

Table 3.1 Threatened fauna

Common name	Scientific name	FM Act	EPBC Act
Threatened species			
Murray crayfish	*Euastacus armatus*	Vulnerable	Not listed

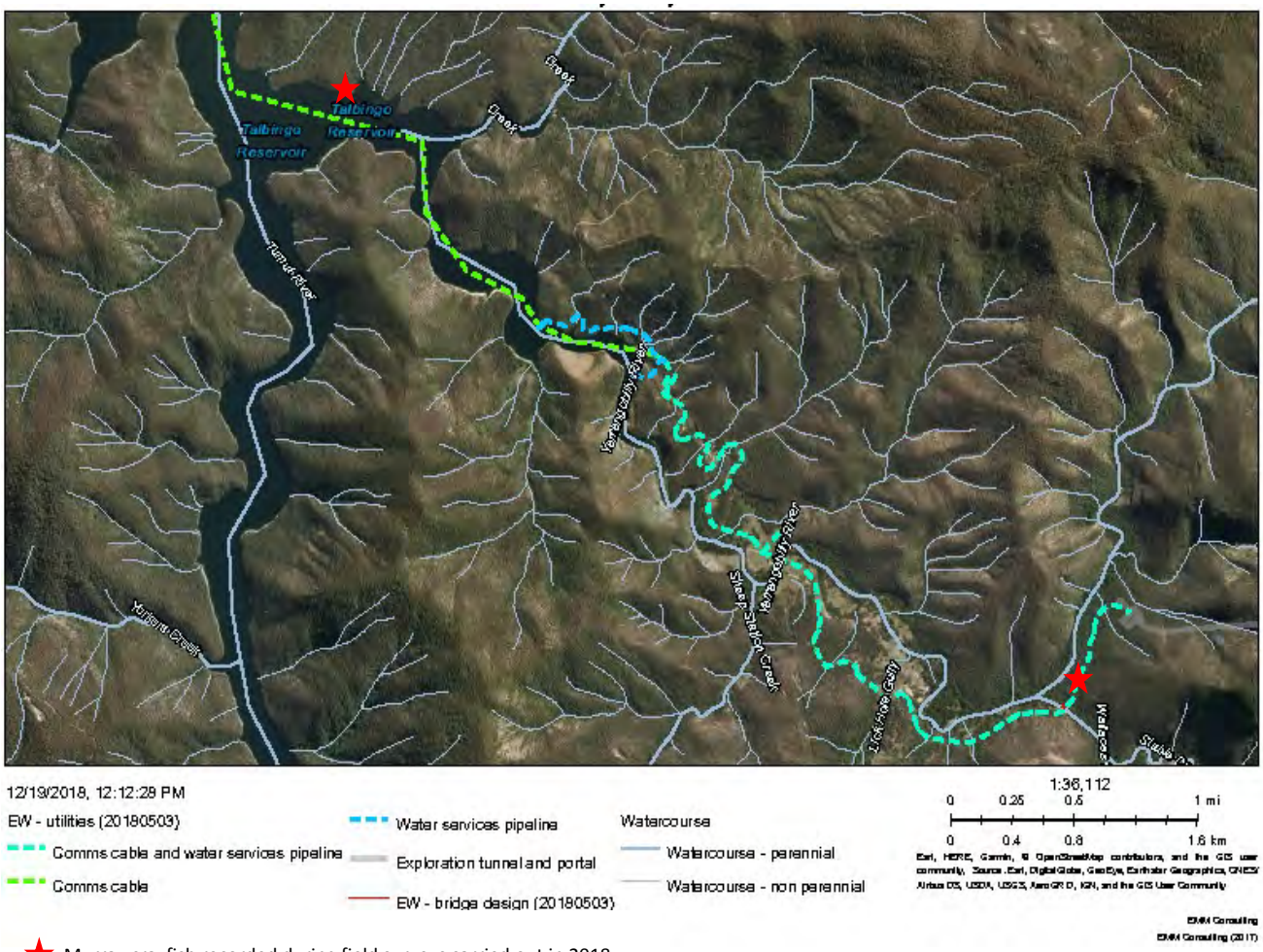


Figure 3.1 Threatened aquatic species identified during aquatic surveys

In October 2018 and subsequent to the submission of the RTS, an Assessment of Significance of the Murray crayfish was undertaken. A total of 130 hoop nets were deployed throughout Talbingo Reservoir over a three day period at depths between 5 m and 58 m. One Murray crayfish was caught; a berried female recorded close to the shore at Ravine Bay (mid to southern section of Talbingo Reservoir). Further assessment in a Species Impact Statement was not recommended and no additional control measures for the roads and access works were required.

3.4 Aquatic weeds, pests and diseases

Elodea (*Elodea canadensis*) occurs throughout Talbingo reservoir. It is often associated with slow-moving and stationary water bodies, coastal rivers and creeks, especially in colder areas in NSW. It grows and spreads via fragmentation and as stems readily break into pieces, these are easily transported in water.

Redfin perch (*Perca fluviatilis*), eastern gambusia (*Gambusia holbrooki*) and goldfish (*Carassius auratus*) have also been recorded in watercourses affected by the Project. Redfin perch has been recorded in Talbingo Reservoir, Yarrangobilly River and Wallaces Creek in large numbers. Eastern gambusia and goldfish have been recorded in Talbingo Reservoir only.

Epizootic Haematopoietic Necrosis Virus (EHNV) is an Australian type of irido-virus that is known to affect and be spread by wild populations of redfin perch and farmed rainbow trout. This has the potential to negatively impact native fish species although this has not been evident in wild naturally occurring populations. It enters fish through the body surface or gastrointestinal tract, multiplies in the blood forming organs such as the spleen and kidney and destroys them in the process. The liver is also affected by the virus. Most infected fish are believed to quickly succumb and die. EHNV poses no known threat to humans. There have been no reported incidences of fish kills associated with EHNV in Talbingo Reservoir and it is unknown if the disease occurs here, although there have been outbreaks in nearby Blowering Reservoir (Whittington et al. 2011).

4 Environmental aspects and impacts

An environmental aspect is an element of an organisation's activities, products, or services that has, or may have, an impact on the environment (ISO 14001 Environmental management systems). The relationship of aspects and impacts is one of cause and effect.

Key aspects of the Stage 1 of the project that could result in aquatic habitat impacts are identified in Table 4.1. The extent of these impacts will depend on the nature, extent and magnitude of construction activities and their interaction with the natural environment (Column 2). This is further exacerbated by environmental factors (Column 3).

Mobilisation of fine sediments into the watercourses located in the survey area is unlikely to result in long-term impacts to aquatic environments; these events will be pulse events and will be rapidly flushed out of the system resulting in negligible impacts to threatened species. Likewise, short term reductions in water quality are unlikely to result in impacts to aquatic environments, as they will be rapidly flushed out of the system. The key mechanism for impacting on aquatic environments will be mobilisation of large amounts of coarse sediment, which clog interstitial spaces which provided key fish habitat, or long-term negative changes to water quality.

A 50 m buffer zone is proposed on either side of Yarrangobilly River and Wallaces Creek. The Mine Trail Road upgrade will disturb the buffer zone at three discrete locations: the bridge over the Yarrangobilly River; the bridge over Wallaces Creek; and along Mine Trail Road in the eastern section of Lobs Hole Ravine. The permanent bridge design for both locations will include a single span bridge. This has been recommended to minimise structures within the river or creek, to maintain fish passage and to avoid impacts to Macquarie Perch (if present) and Murray crayfish (known to be present).

Impacts to Murray crayfish within Talbingo Reservoir from construction activities, dredging and subaqueous rock placement, which would not occur until Stage 2 Exploratory Works, are addressed within the:

- Excavated Rock Management Plan;
- Subaqueous Rock Trial Management Plan; and
- Dredge Environmental Management Plan.

This AqHMP will also be updated prior to Stage 2 to address issues relating to aquatic habitat and threatened species (primarily Murray crayfish) in Talbingo Reservoir.

Table 4.1 Aquatic habitat aspects, impacts and environmental factors

Environmental Aspects (Activities that may impact aquatic habitat)	**Potential Environmental Impacts**	**Environment Factors** (Conditions)
Clearing native riparian vegetation leaving exposed topsoil Bulk earthworks Soil movement and transfer Bridge construction and waterway crossings Soil movement and transfer Material stockpiles Operation of compounds	Mobilisation of sediments during periods of wet weather and surface run-off into waterways Loss of riparian habitat for native aquatic flora and fauna Disturbance of river/creek beds and banks Full or partial permanent barriers to fish passage associated with in-stream structures Alterations to natural flow regimes associated with instream structures Potential for increase in weeds, pest fish and pathogens from habitat disturbance Entrainment / impingement of fish eggs and larvae into extraction pipes Fauna species movement, reproduction and gene flow due to impacts on connectivity Fragmentation of habitats and associated impacts to connectivity and fauna movement Loss/disturbance of instream wooded debris (snags)	Site conditions and prior site disturbance Water quality Weed and pest species presence and abundance

5 Environmental management measures

A range of environmental requirements and control measures are identified in the Infrastructure Approval, EIS and Submissions Report. Safeguards and management measures will be implemented to avoid, minimise or manage impacts to aquatic habitat.

Specific safeguards and management measures to address potential aquatic habitat impacts of the Project are identified in Table 5.1.

Table 5.1 Aquatic habitat management measures

ID	Measure / Requirement	Stage	When to implement	Responsibility	Source document
General					
AqH001	Training will be provided to all project personnel, including relevant sub-contractors on aquatic habitat management practices and the requirements from this plan including approved limits of disturbance through inductions, toolboxes and targeted training.	Stage 1 Stage 2	Construction	Contractor	Tender guideline
AqH002	Relevant aquatic habitat management measures from this plan will be included in site environmental documents including for example, Environmental Work Method Statements (EWMS) and/or Site Environmental Plans (SEPs) and/or Construction Management Plans (CMPs).	Stage 1 Stage 2	Construction	Contractor	Good practice
AqH003	If design change indicates that there may be a requirement for works outside the approved construction footprint, the issue will be referred to Snowy Hydro for approval and advice regarding further assessment and approval requirements in accordance with the CEMP.	Stage 1 Stage 2	Construction	Contractor	Good practice
AqH004	In the event that threatened species or endangered ecological communities are unexpectedly identified during construction the Unexpected Threatened Aquatic Species Procedure included in Appendix A will be followed.	Stage 1 Stage 2	Construction	Contractor	REMM ECO01
AqH005	In the event of the discovery of any fish kills within or adjacent to the work area, DPI Fisheries are to be notified immediately after Snowy Hydro or the Contractor becomes aware of the fish kill in accordance with Appendix D. Within 24 hours of initial notification to DPI Fisheries form *Fish Kill Notification & Investigation Report (Part A)* will be emailed to ahp.central@dpi.nsw.gov.au and the relevant regional offices of DPI and EPA. DPE are to be notified in writing immediately after Snowy Hydro becomes aware of an incident in accordance with Section 6 of the EMS and schedule 4, condition 5 of the Approval. Where the fish kill is potentially related to the project further investigation and reporting will be conducted in accordance with the EMS Section 6.	Stage 1 Stage 2	Construction	Contractor	Sch 3, Condition 7 (b) Sch 4, Condition 5
AqH006	Prior to any disturbance of waterways and riparian areas, a thorough inspection will be undertaken by a qualified ecologist for aquatic habitat and threatened aquatic fauna. Ecologists will check areas within Yarrangobilly River and Wallace Creek prior to disturbance and clearing for Murray crayfish and Macquarie Perch and if found translocate them to adjacent habitats away from impacts in accordance with the procedure included in Appendix A. Semi-aquatic species if found are to be managed in accordance with the Biodiversity Management Plan.	Stage 1 Stage 2	Construction	Contractor	Sch 3, Condition 8 (b) Tender guideline
AqH007	During instream works for the temporary crossings and permanent bridges a daily visual inspection for Murray crayfish is to be carried out within the work areas in accordance with Appendix B.	Stage 1	Construction	Contractor	Good practice
Aquatic habitat and threatened species					

ID	Measure / Requirement	Stage	When to implement	Responsibility	Source document
AqH008	The water pipeline intake will be designed to prevent adult fish from entering the intake and discourage adult fish from approaching the intake which will include; • incorporation of an enclosed, dark and long passage approach to the intake; • screening of the intake with at least 5 mm to 3 mm mesh screen; • if feasible, installation of a coarse mesh (e.g. cm aperture) screen / cage a few metres around the intake and removal and control of any aquatic vegetation within and immediately adjacent to the intake location; • if feasible, limiting the approach water velocity at the headwall during normal operation ideally to 0.1 m/s; • locate the intake pump in the deepest possible water with consideration of the engineering and maintenance constraints away from fish habitat such as woody debris and aquatic plants; and • allow for pump start up procedures involving initial slow water velocity to reduce likelihood of aquatic biota being drawn into the pump.	Stage 1 Stage 2	Construction	Contractor	REMM ECO10
AqH009	The permanent bridges at Yarrangobilly River and at Wallaces Creek will be designed and constructed to comply with the relevant requirements of: • Guidelines for Controlled activities on Waterfront Land (NRAR, 2018); and • Policy and Guidelines for Fish Habitat Conservation Update 2013 (DPI 2013) and Why do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings (NSW Fisheries 2003). The permanent bridges will be designed and constructed to comply with the relevant requirements of the relevant Austroads Standards (such as elevating them above the 1% AEP flood level). During construction of the permanent bridges, in stream works between October to January (the migratory period of the Macquarie Perch (*Macquarie australasica*)) will be minimised.	Stage 1	Design and construction	Contractor	Sch 3, Condition 40 REMM ECO11

ID	Measure / Requirement	Stage	When to implement	Responsibility	Source document
AqH010	The temporary crossings at Yarrangobilly River and at Wallaces Creek will be designed, constructed and removed to: • where practicable implement measures in line with the guidelines for temporary structures in Fisheries NSW Policy and Guidelines for Fish Habitat Conservation and Management (2013 update) (DPI 2013) and recommended crossing design considerations in Fairfull and Witheridge (2003) including: – temporary in-stream structures will avoid spanning the full width of the waterway channel to ensure base flow conditions are maintained down the waterway where practicable; – maintaining some unmodified channel so that a weir effect or flow through rock interstices only is not created where practicable; – guidelines on the type of suitable fill material will be applied; and. – temporary in-stream structures will be inserted during low-flow periods where possible, with management plans being submitted to NSW DPI detailing how high flow events will be managed to limit erosion of the structures and associated sedimentation of downstream waterways. • ensure any build-up of debris which is potentially obstructing to fish passage will be removed; and • the temporary structures will be removed and the river channel rehabilitated following construction of the permanent bridges. • Temporary in-stream structures will be installed during periods of low flow.	Stage 1	Construction	Contractor	REMM ECO12 EIS App G Table 5-5
AqH011	Construction and removal of the temporary crossing at Yarrangobilly River will avoid or minimise in-stream works likely to affect fish passage during the migration time of Macquarie perch (October to January). If this is not possible then further consultation with NSW DPI Fisheries is required.	Stage 1	Construction	Contractor	REMM ECO13
AqH012	Streams to be crossed perpendicular to flow and where possible crossing sites selected to avoid unstable banks, bends in the channel, deep pools and confluences with other channels.	Stage 1 Stage 2	Construction	Contractor	Tender guideline
AqH013	The bed and banks are to be reinstated to a condition similar to or better than the original condition ensuring that there are no adverse impacts on the aquatic values (different measures may be required for each crossing) and where feasible and reasonable, avoid impacts on geomorphic processes. Suitable native species will be planted in riparian areas including shade tolerant species below the bridges where practicable.	Stage 1 Stage 2	Construction	Contractor	Tender guideline EIS App G Table 5-5
AqH014	All construction materials used for watercourse crossings (rocks and gravel) are to be free of fine particles to minimise turbidity.	Stage 1 Stage 2	Construction	Contractor	Tender guideline EIS App G Table 5-5

ID	Measure / Requirement	Stage	When to implement	Responsibility	Source document
AqH015	Instream and riparian disturbance will be minimised and sediment, woody snags or debris removed from a stream or stream channel will be minimised. Trimming or 'lopping' of branches and logs will be considered as a first option before moving.	Stage 1 Stage 2	Construction	Contractor	Tender guideline EIS App G Table 5-5
AqH016	The clearing limits/disturbance footprint will be delineated using highly visible, durable, continuous barrier such as safety flagging, or other similarly robust and durable material. Delineation will be installed consistently through the project to reduce the risk of error or misinterpretation of boundaries. Where a continuous rope is impractical due to terrain and vegetation density, highly visible flagging will be placed on vegetation to maintain line of sight of the clearing boundary. Buoys are to be utilised in deep section of Talbingo Reservoir to identify the limits of disturbance. "Environmental Protection Area" signs will be placed in prominent positions along each section of exclusion fencing as shown on the sensitive area pans or directed by the Snowy Hydro.	Stage 1 Stage 2	Construction	Contractor	Sch 3, Condition 8 (b) Tender guideline
AqH017	Any instream woody debris removed during construction will be replaced at the completion of the works within the same waterways from which it was removed.	Stage 1 Stage 2	Construction	Contractor	Tender guideline EIS App G Table 5-5
AqH018	Fish that become stranded due to temporary access crossings or construction of temporary or permanent creek diversions must be captured and translocated following the DPI Fisheries Guidelines – A Guide to Acceptable Procedures and Practices for Aquaculture and Fisheries Research.	Stage 1	Construction	Contractor	Tender guideline
AqH019	Where possible, existing crossings would be used. Where this is not feasible or reasonable, the temporary crossings would be designed to minimise impacts on the existing aquatic ecology and water quality.	Stage 1 Stage 2	Construction	Contractor	Tender guideline EIS App G Table 5-5
AqH020	General temporary waterway access track mitigation measures would be undertaken: • temporary crossings would be constructed from clean fill using pipe or box culvert cells to carry flows; • all temporary works (e.g. crossings, flow diversion barriers) would be removed as soon as practicable and in a way that does not promote future channel erosion; • where practicable implement measures in line with the recommended crossing design considerations in Fairfull and Witheridge (2003)scour protection works would be established at temporary crossings as required; • at the completion of construction, of the permanent crossings the temporary crossings would be removed and rehabilitated; and • translocation of aquatic fauna needs to be carried out by a suitably qualified and permitted operator.	Stage 1 Stage 2	Construction	Contractor	Tender guideline EIS App G Table 5-5
AqH021	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.	Stage 2	Construction	Contractor	REMM ECO15

ID	Measure / Requirement	Stage	When to implement	Responsibility	Source document
AqH022	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).	Stage 2	Construction	Contractor	REMM ECO15
Aquatic weeds, pests and disease					
AqH023	All equipment and vessel components, such as propellers, hulls, anchors and any other equipment used in the reservoirs or waterways would be inspected for pest aquatic plants (particularly fragments of Canadian pondweed (*Elodea canadensis*) known to be present in Talbingo Reservoir) and pest fish.	Stage 1 Stage 2	Construction	Contractor	REMM ECO01
AqH024	Vessels and vehicles would be washed down and cleaned prior to arriving at the boat ramp to be launched onto the reservoir and before travelling off-site from the reservoir.	Stage 1 Stage 2	Construction	Contractor	REMM ECO01
AqH025	All personnel working within the waters would be instructed on how to identify potential pests.	Stage 1 Stage 2	Construction	Contractor	REMM ECO01
AqH026	Visual inspections for Elodea or other aquatic macrophytes would be undertaken 50 m up and downstream of locations where new or temporary crossings and other infrastructure are to be constructed prior to works commencing. If excessive weed growth is detected, then the possible pathway or mechanisms causing the weed growth would be investigated (e.g. water quality related issues). Following this, measures to control the causes and spread of aquatic weeds would be considered in consultation with Snowy Hydro and relevant regulators.	Stage 1	Construction	Contractor	Good Practice

5.1 Unexpected threatened aquatic species finds procedure

If any threatened aquatic species is unexpectedly encountered during construction activities, the *Unexpected Threatened Aquatic Species Finds Procedure* provided in Appendix A will be followed.

In the event that any non-aquatic threatened species may be found, the Unexpected Threatened Species Find Procedure in Appendix D of the Biodiversity Management Plan will be followed.

5.2 Temporary waterway crossings

As part of Stage 1 temporary waterway crossings are required to be installed within the Yarrangobilly Riverand Wallaces Creek. These crossings will facilitate construction of the two permanent bridges. The crossings are anticipated to remain in place for a period of six months from April 2019 to September 2019. Temporary Bailey (or similar) Bridges will be installed across the Yarrangobilly River and Wallaces Creek. The locality of the Yarrangobilly River crossing is shown in

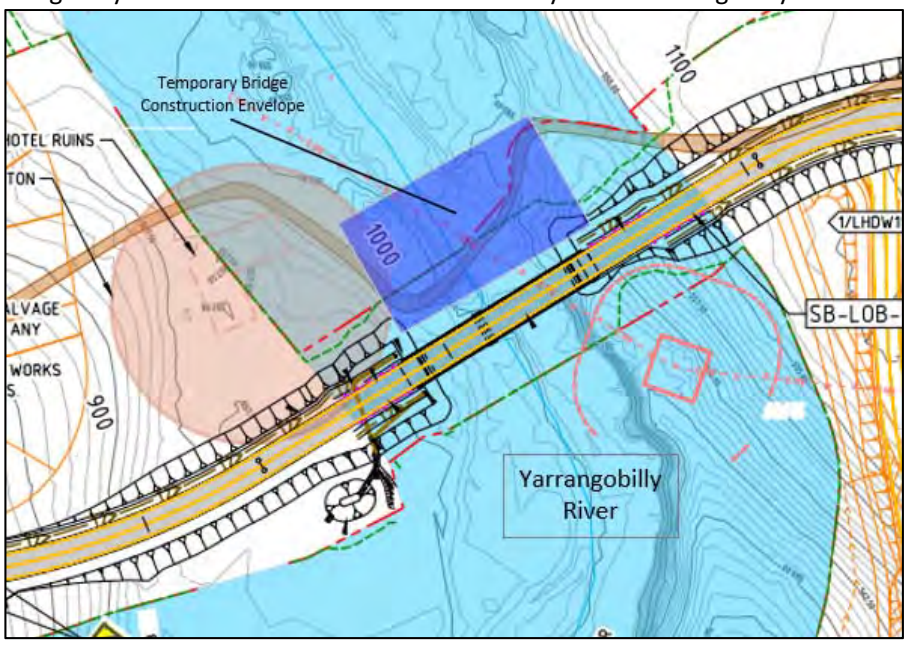


Figure 5.1. The locality of the Wallaces Creek crossing is shown in Figure 5.2.

The EIS contemplated the construction of a splash crossing within the Yarrangobilly River. However, alternative design options were considered during the Response to Submissions. The following is noted from the RTS.

Section 4.1.3, page 49:

Comment - *OEH seeks clarification on whether a temporary bridge or the splash crossing will be used prior to the establishment of a new permanent bridge over the Yarrangobilly River.*

Response - *Continued access across the Yarrangobilly River during the construction of the permanent bridge is required. The EIS contemplated and assessed the construction of a splash crossing in this location. However, alternative design options have now been identified, which subject to detailed design, would result in the*

same or reduced environmental impact than the assessed splash crossing. These options include the installation of a pipe and culvert or a pre-fabricated 'Bailey bridge.

Section 4.3.5, page 126:

Comment - *Page 14 Section 1.3.3.4.2 Watercourse Crossings – The existing crossing over the Yarrangobilly River will have the level raised and be used as a temporary crossing during construction of the new bridge. Information regarding the nature and level of the proposed raising of the existing crossing and the time frame that the crossing will be utilised for should be provided.*

Response - The existing crossing over the Yarrangobilly River consists of a natural cobble/gravel bed which is impassable when river levels rise. Continued access across the Yarrangobilly River during the construction of the permanent bridge is required. The EIS contemplated and assessed the construction of a splash crossing in this location. However, alternative design options have now been identified, which subject to detailed design, would result in the same or reduced environmental impact than the assessed splash crossing. These options include the installation of a pipe and culvert or a pre-fabricated 'Bailey bridge'.

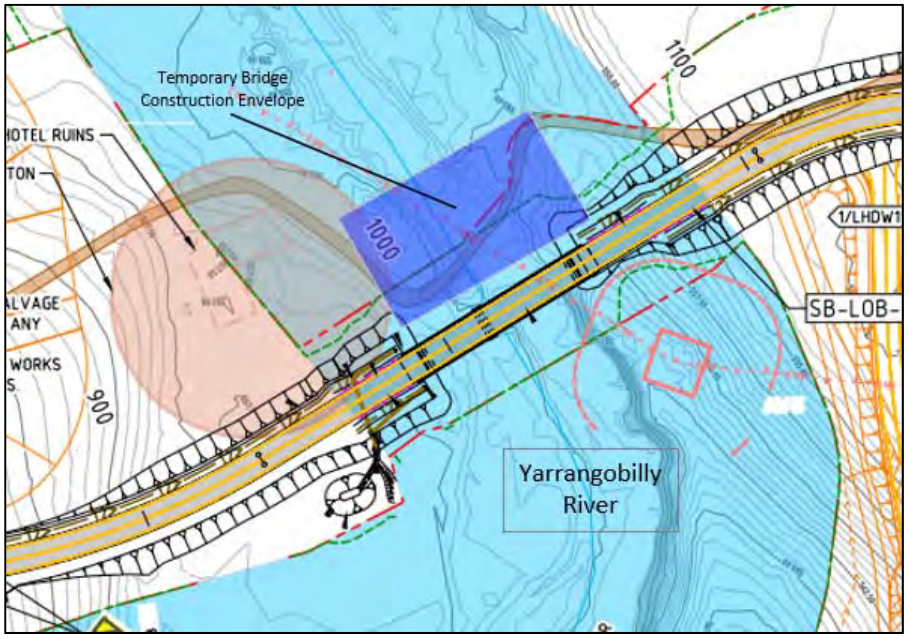


Figure 5.1 Yarrangobilly River temporary crossing location plan

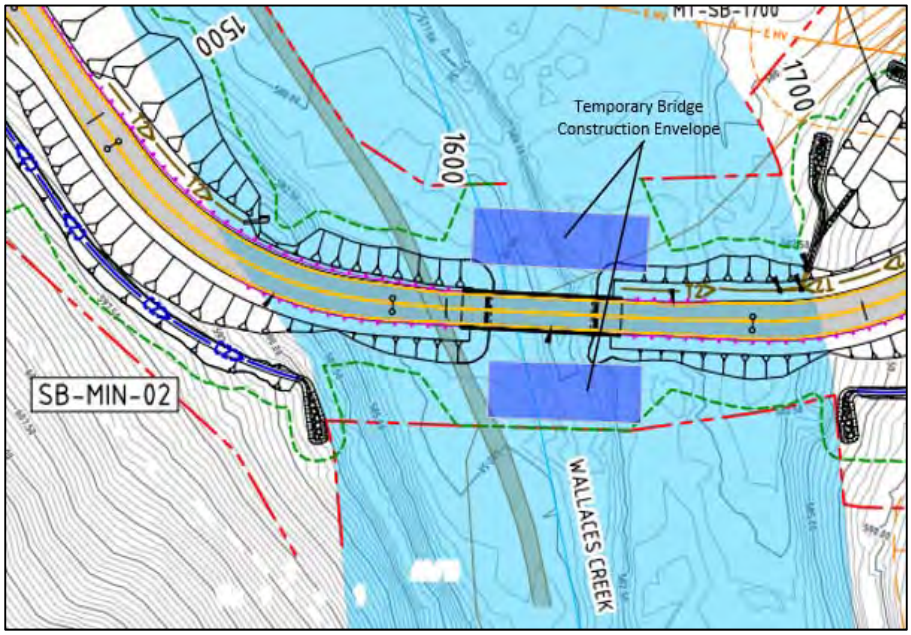


Figure 5.2 Wallaces Creek temporary crossing location plan

6 Compliance management

6.1 Monitoring and reporting

A number of monitoring programs will occur which will be relevant to impacts on and survival of aquatic species within the study area. These include:

- Surface Water Quality Monitoring Program – refer to Section 6.1 of the Surface Water Management Plan. Water quality monitoring undertaken include:
    - comprehensive receiving water quality monitoring within the Yarrangobilly River and Wallaces Creek, 12 samples per site per year;
    - basic receiving water quality monitoring within the Yarrangobilly River and Wallaces Creek daily during periods of basin discharge;
    - comprehensive sediment basin discharge water quality monitoring on a quarterly basis during basin discharge; and
    - basic sediment basin discharge water quality monitoring on a daily basis during periods of basin discharge.
- Weed and pathogen monitoring in accordance with the Weed and Feral Animal Management Plan (Appendix F of the Biodiversity Management Plan);
- Threatened Species and Aquatic Habitat Monitoring Program (Appendix B of this Plan);
- Aquatic Habitat Restoration Program (Appendix C of this Plan).

Where appropriate, the monitoring programs listed above include performance indicators to assess the effectiveness of the monitoring program and whether there is a need to review the current procedures. Irrespective of the type of monitoring conducted, the results will be used to identify potential or actual problems arising from construction processes and implementation of management measures. Where a non-conformance is detected or monitoring results are outside of the expected range, the process described in Section 7.7 of the EMS will be implemented. In addition, effectiveness of the implemented management measures will be monitored in accordance with the EMS Section 7.1. This includes monitoring through the implementation of a regular program of environmental inspections. Weekly inspections are intended to:

- provide for surveillance to ensure that safeguards are being implemented;
- identify where problems might be occurring;
- identify where sound environmental practices are not being implemented; and
- facilitate the identification and early resolution of problems.

Any non-conformances identified through the inspection process will be highlighted and an environmental inspection report (minor issues) accordance with Section 7.7 of the EMS or an environmental incident report completed in accordance with Section 6 of the EMS.

6.2 Training

All site personnel will undergo site induction training relating to biodiversity including threatened species and habitat protection management issues.

The induction training will address elements related to biodiversity management including:

- existence and requirements of this AqHMP;
- relevant legislation;
- roles and responsibilities for aquatic habitat management;
- aquatic habitat mitigation and management measures.

Targeted training in the form of toolbox talks or specific training will also be provided to personnel. Examples of training topics include:

- clearing procedures;
- no-go zones;
- identification of threatened species within the project area; and
- the unexpected finds procedure for threatened species.

Further details regarding the staff induction and training are outlined in Section 4.4 of the EMS.

6.3 Incidents

Incidents will be managed in accordance with Section 6 of the EMS and the Snowy Hydro Quality Management System procedure '*QP14-07 - Incident Management Procedure*' (Procedure).

The Secretary and other relevant agencies will be notified of incidents via the Major Projects portal as detailed within Section 6.2 of the EMS.

6.4 Auditing

Audits will be undertaken to assess the effectiveness of the management measures, compliance with this AqHMP, the draft baseline conditions, EIS, Submissions Reports and other relevant approvals, licences and guidelines. Audit requirements are detailed in Section 7.3 of the EMS.

6.5 Reporting

Reporting will include monthly internal project reports and six monthly compliance reports as required by conditions of approval. The six-monthly reports will track compliance against the Project conditions of approval and the revised environmental management measures and will be reported in accordance with, the

relevant Compliance Reporting requirements (DPE 2018) as per, Schedule 4, Conditions 7 and 8.. Reporting requirements and responsibilities are documented in Section 7 of the EMS.

These are summarised in Table 6.1. Other environmental reporting requirements are further described in Table 7.4 of the EMS.

Table 6.1 Reporting

Report	Responsibility	Timing	Recipient	When issued
Inspection reports	Contractor	Weekly	Snowy Hydro	At the end of each month
Reports for Threatened Species and Aquatic Habitat Monitoring	Contractor	Refer Appendix B of the AqHMP	Snowy Hydro	At the end of each month
Non-conformance and corrective action reports	Contractor	As required	Snowy Hydro	Initial report within 24 hours of occurrence. Final report within 7 days of close out
Non-compliance reports	Contractor	As required	Snowy Hydro DPE	Contractor to notify Snowy Hydro within 5 days of becoming aware. Snowy hydro to notify DPE within 7 days of becoming aware
Internal audit reports	Contractor	Six monthly	Snowy Hydro	Within 1 month of the audit
External audit reports	Snowy Hydro	As required	Snowy Hydro	Within 1 month of the audit
Independent external audit reports	Snowy Hydro/Independent auditor	Within 1 year of commencement then every 3 years	DPE	Within 12 weeks of commissioning of the audit
Compliance reporting	Contractor/Snowy Hydro	Refer Table 7.3 of the EMS	DPE and NPWS	Refer Table 7.3 of the EMS

7 References

Cardno (2018). Snowy 2.0 Exploratory Works Aquatic Ecology Assessment prepared for EMM Consulting 13 July 2018.

EMM (2018). EIS - Exploratory Works for Snowy 2.0 Volume 4 Appendices M and N. Surface Water Assessment July 2017. Prepared for Snowy Hydro Limited.

DSEWPaC (2011). Survey guidelines for Australia's threatened fish. Guidelines for detecting fish listed as threatened under the Environment Protection and Biodiversity Conservation Act 1999. Australian Government Department for Sustainability, Environment, Water, Population and Communities.

Fairful, S (2013). Fisheries NSW Policy and Guidelines for Fish Habitat Conservation and Management (2013 Update). NSW Department of Primary Industries.

Fairfull, S. and Witheridge, G. (2003) Why do Fish Need to Cross the Road? Fish Passage. Requirements for Waterway Crossings. NSW Fisheries, Cronulla, 16 pp.

Gilligan, D., Rolls, R., Merrick J., Lintermans, M., Duncan, P., and Kohen, J. (2007). Scoping the knowledge requirements for Murray crayfish (*Euastacus armatus*). NSW Department of Primary Industries – Fisheries Final Report Series No. 89 ISSN 1449-996.

Lintermans, M. (2018). A review of fish information from the Upper Murrumbidgee and Upper Tumut catchments.

NSW DPI (2017) Protecting Macquarie Perch – a guide for fishers and land managers. https://www.dpi.nsw.gov.au/__data/assets/pdf_file/0010/747379/protecting-macquarie-perch-a-guide-for-fishers-and-land-managers.pdf

NSW DPI (2012a). Guidelines for vegetation management plans on waterfront land. NSW DPI (Office of Water).

NSW DPI (2012b). *Guidelines for riparian corridors on waterfront land*. NSW DPI (Office of Water).

NSW DPI (2017). Native Fish Stocking Plan 2018/19 Plan for Impoundments and Dams. Department of Primary Industries.

Whittington. R., Joy Becker, Alison Tweedie, Dean Gilligan and Martin Asmus, (2011), Susceptibility of previously untested basin fish species to Epizootic Haematopoietic Necrosis Virus (EHNV) and its epidemiology in the wild. Final Report. The University of Sydney. Project No. MD743

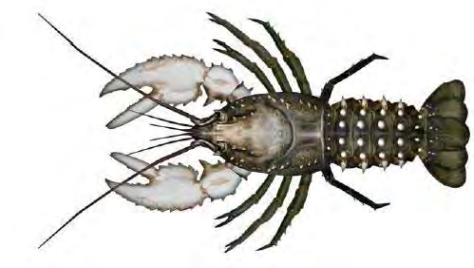
Underwood, A. J. (1992). Beyond BACI: the detection of environmental impacts on populations in the real, but variable, world. Journal of Experimental Marine Biology and Ecology, 161(2), 145-178. doi:http://dx.doi.org/10.1016/0022-0981(92)90094-Q

Appendix A

Unexpected threatened aquatic species finds procedure

Aquatic species of concern that are known to occur, or for which there is potential habitat, in the vicinity of the Yarrangobilly River, Wallaces Creek and potentially other smaller unnamed watercourses where Stage 1 works will take place include:

Murray crayfish (*Euastacus armatus*)



Macquarie perch (*Macquaria australasica*)

Habitat for these species occurs in the vicinity of the permanent and temporary crossings of the Yarrangobilly River and Wallaces Creek, and along these watercourses generally in the vicinity of access roads and portal construction pad. However, it is unlikely they would incidentally occur within works areas as they would be mobile within the watercourses.

It is possible, however, that they could become isolated in areas where standing water, ponding or coffer dams occur during the construction phase. These areas in particular should be incidentally monitored by site staff and contractors. Murray crayfish in particular appear to be sensitive to water quality and are occasionally observed leaving the water (crawling onto river banks or snags), during periods of low dissolved oxygen (McKinnon 1995, Whitworth et al. 2011, King et al. 2012) and could therefore be found on land if such conditions occurred.

The effectiveness of the threatened species finds procedure will be dependent on all contractors and staff having appropriate training in the identification of these species and having knowledge of the types of habitat in which they are likely to be found.

Note that this procedure relates only to aquatic species, other semi aquatic fauna such as amphibians are addressed in the Biodiversity Management Plan and associated unexpected threatened species finds procedure.

In the instance that Murray crayfish or Macquarie perch are thought to be found within the works area the following procedure should be undertaken:

1. **Contact the Project Manager**

   The Project Manager should contact the relevant Environment Manager. Information recorded in steps 4 should be documented. This form would ideally be in an online format that can be quickly uploaded with any attached photo or video.

2. **External notification and reporting**

   In the event of a threatened species find the Environmental Manager would notify OEH, DPI and DPE as appropriate within 24 hours of the find and prior to impacts. Where impacts are likely to occur, the Environmental Manager would consult with OEH and DPI regarding the management measures to be implement and other approvals, permits and licences required for relocation to occur.

   A written report will be prepared by the Project Ecologist detailing the find and the proposed course of action. The report will be submitted to OEH, DPI and DPE within 7 days of initial notification.

   Should additional impacts or new species be identified (additional to those assessed as part of the EIS) the Project Ecologist would prepare an assessment of significance of likely impacts and management options in consultation with OEH and DPI.

3. **Relocation procedure**

   Fauna shall be relocated by a suitably trained person to a designated relocation area downstream of the worksite. Any relocations should be carried out by a suitably qualified person holding all necessary permits. Details of any relocation activities should be recorded.

4. **Record information including**

   a. Location of sighting including GPS Coordinates (if possible)
   b. Nearest road
   c. Site features (water level, whether it is an artificially created enclosure/pool/dammed area, presence of any burrows in the banks i.e. for crayfish)
   d. Time of day
   e. Observations of water quality (turbid, presence of algae, surface scum, odour)
   f. Preliminary identification
   g. Photographs or video to assist in confirming identification
   h. Number of individuals
   i. Condition of individuals
   j. Any immediate risks to the fish/crayfish
   k. Details of any relocation activities undertaken

Appendix B

Stage 1 - Threatened species and aquatic habitat monitoring program

1 Introduction

This Threatened Species and Aquatic Habitat Monitoring Program has been prepared for the Stage 1 Exploratory Works Access Roads project. It incorporates the requirements of condition 8 of schedule 3 of the Infrastructure Approval, namely to:

- undertake surveys of the condition of aquatic habitat and threatened species prior to disturbance; and

- to include a program to monitor and report on the effectiveness of the management measures within this AqHMP. This is additional to the monitoring detailed within Section 6.1 of this plan.

2 Aims and objectives

The overall aim of the program is to ensure that together with environmental management measures outlined in Section 5 of the AqHMP, impacts to threatened species and their habitat are minimised.

The key objective of the monitoring program is to implement an adaptive monitoring approach to ensure that Murray crayfish are not within the disturbance areas (crossing locations) prior to and during key stages of construction.

3 Monitoring program

The Stage 1 monitoring program will be conducted to reflect the construction of temporary and permanent bridge crossings at Yarrangobilly and Wallaces Creek. As a result of this, the following surveys would be undertaken:

1) Within two weeks prior to commencement of temporary crossing and permanent bridge construction

- 1 x survey at Yarrangobilly River and 1 x survey at Wallaces Creek. Site areas include 50 m up and 50m downstream of crossings.

- These surveys will be undertaken by the Project Ecologist.

- Targeted visual surveys will record the condition of aquatic habitat and the presence of any threatened aquatic species, exotic weeds in and around the temporary crossing and bridge disturbance areas. These surveys will have a specific a focus on Murray crayfish.

- These surveys will identify suitable relocation areas for Murray crayfish that can be used during construction for relocating individuals identified in the vicinity of disturbance areas.

- Undertake an aquatic habitat assessment using the Riparian, Channel and Environmental Inventory Method (RCE) over the surveyed sections.

2) During instream disturbance for temporary crossings and permanent bridges

- As outlined in Table 5.1 the daily pre-commencement inspections of work areas in the Yarrangobilly River and Wallaces Creek will include the visual inspection for threatened aquatic fauna. Should threatened aquatic fauna be identified then procedures in Appendix A will be followed.
- These inspections will be undertaken by the Project Ecologist.
- In addition to targeted surveys and inspections, all site staff would be appropriately trained in the identification of threatened species, particularly Murray crayfish, and the requirements to report unexpected threatened aquatic species finds in accordance with the Unexpected Threatened Aquatic Species Finds Procedure provided in Appendix A.

3) One week after the completion of temporary crossings and permanent bridges and at the conclusion of the habitat restoration program outlined in Appendix C

- 1 x survey at Yarrangobilly and 1 x survey at Wallaces Creek. Site areas include 50 m up and 50m downstream of crossings.
- These surveys will be undertaken by the Project Ecologist.
- Undertake targeted visual survey of aquatic habitat of Yarrangobilly River and Wallaces Creek work sites. These targeted visual surveys will record the post-works condition of aquatic habitat and the presence of any threatened aquatic species in and around the completed bridges.
- Undertake an aquatic habitat assessment using the Riparian, Channel and Environmental Inventory Method (RCE) over the surveyed sections and compare the results with those obtained in 1), those detailed within Section 3.1.

4 Survey methodology

A suitably qualified ecologist will undertake the aquatic habitat and threatened species inspections and surveys. The aquatic habitat would be visually assessed. This would involve assessment of habitat condition 50 m up and downstream of the crossing disturbance areas in the Yarrangobilly River and Wallaces Creek. General features assessed would include channel depth, width, and any bank instability/erosion, the presence of natural barriers to fish passage and instream habitat including snags and riffles and pools.

Any changes to these key habitat features and / or impacts to fish passage would be qualitatively assessed and documented during the pre and post construction surveys. Any significant impacts to fish habitat would be reported and the need for mitigation assessed as required.

Relocation of Murray crayfish identified in disturbance areas will be in accordance with Appendix A.

5 Reporting

Survey reports will be prepared by the Project Ecologists for the pre and post construction habitat and threatened species surveys.

Reporting of monitoring activities will be included in the daily inspection sheet developed for the project.

Appendix C

Aquatic habitat restoration program

1 Introduction

As part of the Aquatic Habitat Management Plan (AqHMP), a number of conditions have been issued that require management options to minimise and control potential impacts on aquatic habitat.

For Stage 1 of the project this includes a program to restore and enhance any aquatic habitat that has been disturbed/impacted as part of the roadwork and associated bridge construction

As part of the works, permanent bridge structures will be constructed over both the Yarrangobilly River and Wallaces Creek, as well as temporary waterway crossings at these locations during the construction of the permanent bridge structures. A number of impacts on aquatic habitat have been identified to potentially occur as part of the works (Section 4 of the AqHMP). This includes activities that may result in the clearing of riparian vegetation, removal of snags (large woody debris and large rocks) from waterways and temporary modifications to fish passage.

As such, it is required that a localised and targeted restoration program be initiated as part of the Stage 1 works.

The below activities will be implemented throughout the duration of, and following the Stage 1 construction works. Issues relating to water quality are specifically addressed in the surface water quality management plan.

2 Restoration of cleared riparian vegetation from Stage 1 Bridge works

Riparian corridors form ecological transition zones between terrestrial and aquatic environments.

The riparian zone within the vicinity of the bridge construction works for both Yarrangobilly River and Wallaces Creek are well vegetated with a high presence of blackberry. After the removal of riparian vegetation erosion and sediment controls will be implemented to manage sediment run-off throughout the works.

Post-construction the cleared riparian areas will be stabilised and if required replanted with appropriate, native plants with a similar species composition to nearby riparian corridors.

A maintenance program (i.e. ongoing weed removal, maintenance of erosion control etc.) will be implemented following the replanting process. The maintenance program should take into account how the revegetation will be protected from risks such as weed invasion, fire and feral animals.

A targeted monitoring program will be implemented to measure the success of the restoration and guide any maintenance efforts. The monitoring program should encompass the revegetated areas, as well as control areas (both before and after the restoration) to assess whether changes in revegetated areas are of a positive benefit to the riparian corridor of the watercourse.

3 Restoration of snags impacted from Stage 1 Bridge works

The removal of snags, which includes in-stream woody habitat and large rocks, has the potential to impact on a number of aquatic functions.

As such, it is important that provisions are made that restore any snag habitat that is disturbed or removed from waterways. The following management actions have been developed to aid in the restoration of snag habitat as part of the construction works if snag management is required:

- a snag is defined as 'any piece of woody debris that is both greater than 3m in length and 300 mm in diameter, or any rock larger than 500 mm in two dimensions, that is located within a waterway (either fresh, estuarine or marine) and is, or would be, wholly or partly submerged at a 'bank-full' flow level or highest astronomical tide level' (NSW DPI 2013);

- large rocks and woody debris are present in Yarrangobilly River and Wallaces Creek within the vicinity of the construction works;

- if snags are required to be removed from the watercourse during construction activities, the following should be undertaken:

  - a site assessment identifying the location of snags potentially affected;

  - the suitability of each snag for its potential movement and/or modification;

  - identification of the methodology and machinery that would be required to move/modify each snag; and

  - carry out the snag removal/modification;

- re-snagging should be considered for all removed snags;

- both Macquarie Perch and Murray crayfish prefer extensive cover in the form of large boulders and woody debris in flowing streams, therefore the alignment and positioning of any re-deployed snags is an important consideration to enhance or restore aquatic habitat for these species and to maintain natural river flows:

  - the placement or re-alignment of snags should be undertaken so that the snag is to point downstream and water is deflected towards the centre of the watercourse. The base (root wad) of a timber snag should be placed close to the bank, where possible;

  - snags should be placed in congregations or piles and evenly distributed throughout the reach to ensure suitable connectivity is established and maintained between areas of fish habitat.

4 Restoration of temporary barriers to fish passage

It is critical that fish passage is maintained in the Yarrangobilly River and Wallaces Creek.

The most effective way in maintaining and restoring fish passage with regards to waterway crossings is through the appropriate design and construction, which has been adopted as part of mitigation measures outlined in the AqHMP. In addition to this environmental inspections will occur to ensure that the temporary and new crossings are functioning as expected with desired flow velocities and fish passage outcomes. The inspection will be undertaken daily for the first 2 weeks following installation of the crossings and then weekly.

5 Timeframes for restoration and restoration benchmarks

Restoration works at the Yarrangobilly Bridge and Wallace Creek bridge sites will occur within one month of completion of the permanent bridge and within one month of removal of the temporary crossings.

Successful restoration of riparian areas will have occurred when the following has been achieved:

- the landscape is stable and there are no significant losses during or after a heavy rain/high wind event;
- there is minimal bare ground;
- at least 70% of planted seedlings are established and are in healthy condition;
- when there is 'natural' litter on the ground, i.e. leaves, bark, seed provided by the planted seedlings or from the surrounding environment;
- recruitment of native species – either from planted seedlings or from vegetation outside of the rehabilitation area; and
- evidence of invertebrate use and activity such as ants, saw fly, wasps etc.

This is anticipated to occur six months after restoration works have been completed.

Successful restoration of waterway, snags and aquatic habitat will have occurred when the following has been achieved:

- the waterway, snags and large rocks are stable;
- there is evidence of natural sediment build up in and around the snags and large rocks;
- recruitment of new snags – either from riparian vegetation or from vegetation outside of the rehabilitation area; and
- evidence of aquatic fauna such as frogs and fish etc.

This is anticipated to occur two months after restoration works have been completed.

Appendix D

Internal fish kill reporting protocol

1. **Contact Project Manager**

   The Project Manager should contact the Environment Manager. Information recorded in steps 1 and 2 should be documented. This form would ideally be in an online format that can be quickly uploaded with any attached photo or video.

2. **Record information including**

   a. Location of sighting including GPS Coordinates (if possible)

   b. Nearest road

   c. Site features (water level, whether it is an artificially created enclosure/pool/dammed area, presence of any burrows in the banks i.e. for crayfish)

   d. Time of day

   e. Observations of water quality (turbid, presence of algae, surface scum, odour)

   f. Preliminary identification

   g. Photographs or video to assist in confirming identification

   h. Number of individuals

   i. Condition of individuals

   j. Any immediate risks to the fish/crayfish

   Refer also DPI form *Fish Kill Notification & Investigation Report (Part A)*

3. **Contact Snowy Hydro Environment Manager**

4. **Contact DPI Fisheries as per the Protocol outlined below.**

   The Project Manager should contact the relevant Site Environment Manager. Information recorded in steps 1 and 2 should be documented. This form would ideally be in an online format that can be quickly uploaded with any attached photo or video.

   The Environment Manager will contact DPI Fisheries immediately after becoming aware of the fish kill. Within 24 hours of initial notification to DPI Fisheries form Fish Kill Notification & Investigation Report (Part A) will be emailed to ahp.central@dpi.nsw.gov.au and the relevant regional offices of DPI and EPA.

EXTERNAL NOTIFICATION PROTOCOL FOR REPORTING AND INVESTIGATING FISH KILLS

Information on fish kills is available at: https://www.dpi.nsw.gov.au/fishing/habitat/threats/fish-kills/info-sheet

Notification

When a report of a fish kill is received all information is to be recorded on the ***Fish Kill Notification & Investigation Report*** **[Part A of the DPI *Protocol for reporting and investigating fish kills*]**. DPI Officers who receive this information must notify the Environmental Protection Agency (EPA) on 131 555 office and vice versa. Local offices of the Local Land Service and the relevant local council should also be notified.

Email the completed Part A form to ahp.central@dpi.nsw.gov.au and the relevant Regional Offices of DPI and EPA (see contact list within the DPI *Protocol for reporting and investigating fish kills*) for their information. Each agency is responsible for information exchange within their respective departments.

Appendix E

Murray Crayfish Trigger Action and Response Plan (TARP)

Overview

This Trigger Action Response Plan or 'TARP' has been developed to identify appropriate response measures for exceedances of key indicators measured during the Threatened species and aquatic habitat monitoring program detailed in Appendix B and the surface water monitoring detailed in the Surface Water Management Plan. Surface water monitoring locations for Stage 1 are shown in Figure E1 and sampling analytes are included in Table E1.

The Surface Water Management Plan and monitoring program provide full details of the baseline water quality data and proposed water quality objectives (WQOs) for the Yarrangobilly River and Wallaces Creek.

With reference to the ANZECC/ARMCANZ 2000 guidelines the following approach has been adopted in determining the WQOs:

- Yarrangobilly River is of high conservation and ecological value:
    - physical and chemical stressor trigger values – no change beyond natural variability. Provisional Site Specific Trigger Values (SSTVs) will be calculated and updated monthly using available data. The calculation of provisional SSTVs will consider seasonal trends in water quality and variations in water quality during wet weather conditions. The provisional SSTVs will be presented with the default values until there is sufficient data available to calculate SSTVs for a full range of flow conditions, including summer baseflow, winter baseflow and wet weather conditions; and

Trigger

Level 1 Trigger

In accordance with Table E1 a Level 1 trigger is initiated when the water quality results exceeds one or more of the parameters listed within Table E1.

Response

Site inspections would be undertaken at locations where exceedances are reported. An assessment would be undertaken to determine whether the cause of the water quality exceedance is in relation to Project activities. If the cause can be attributed to Project related activities then a Level 2 trigger is initiated.

Snowy Hydro would be notified within 24 hours of the water quality exceedance.

Level 2 Trigger

A Level 2 Trigger occurs when a Level 1 event is found to be attributed to the project or when the water quality results exceed one or more of the parameters listed within Table E1.

Response

A Level 2 Trigger would include an assessment of the risk level in consultation with Snowy Hydro, the project ecologist and DPI Fisheries using a standard risk assessment framework and relating to existing knowledge of the environmental tolerances of Murray crayfish.

The management response would consider whether action to translocate any Murray crayfish would be necessary. If translocation is considered necessary, the Project would capture and translocate Murray crayfish in locations at moderate to high risk in consultation with the project ecologist, Snowy Hydro and NSW DPI (Fisheries) officers.

Table E1 Stage 1 Exploratory Works Murray crayfish Trigger Action Response Plan

Stage 1 Exploratory Works - Murray crayfish Trigger Action Response Plan (TARP)

Component	Normal (Baseline) Status	Level 1 Trigger	Level 2 Trigger
Indicators/s	N/A	• Results of surface water monitoring • Results of Murray crayfish surveillance monitoring during construction	• Cause for Level 1 Trigger attributed to project • Results of surface water monitoring • Results of Murray crayfish surveillance monitoring during construction Mortality of Murray crayfish identified
Trigger Temperature pH Salinity DO	Water quality indicators within range of natural variability for that season	20th or 80th %ile exceedance of one or more water quality indicator for > 5 consecutive days within Yarrangobilly River and Wallaces Creek	10th or 90th %ile exceedance of one or more water quality indicator for > 3 consecutive days within Yarrangobilly River and Wallaces Creek **and/or** **Level of risk assessed as moderate to high**
Trigger Turbidity	Water quality indicators within range of natural variability for that season	80th %ile exceedance of one or more water quality indicator for > 5 consecutive results within Yarrangobilly River and Wallaces Creek	90th %ile exceedance of one or more water quality indicator for > 3 consecutive results within Yarrangobilly River and Wallaces Creek **and/or** **Level of risk assessed as moderate to high**
Monitoring Action (Monitoring Contractor)	Continue with routine monitoring	Undertake site inspections at locations where exceedances are reported and where Murray crayfish are reported to occur	Undertake site inspections at locations where exceedances are reported and where Murray crayfish are reported to occur Initiate a reactive monitoring survey if further data is required to determine risk to Murray crayfish
Management Action (Contractor in consultation with Snowy Hydro)	No action	Undertake assessment to determine whether the cause of water quality exceedance is related to Project activities. Take additional actions to limit further exceedance of water quality indicator/s **If cause can be attributed to Project related activities then Level 2 trigger is initiated**	Assess level of risk in consultation with the project ecologist, Snowy Hydro and DPI Fisheries and whether action to translocate Murray crayfish is necessary. If translocation is considered necessary undertake capture and translocation of Murray crayfish in locations at moderate to high risk in consultation with the project ecologist, Snowy Hydro and NSW DPI (Fisheries) officers.
Notification and Reporting (Contractor)	Routine reporting as per Murray crayfish and surface water quality monitoring programs	Snowy Hydro to be notified within 24 hours of water quality exceedance.	Snowy Hydro to be notified within 24 hours of water quality exceedance. Where the Level 2 Trigger is attributed to the Project, initiate the incident investigation and reporting protocols in accordance with Section 6.1 of the AqHMP and Section 6 of the EMS. Document details of any individuals captured and translocated to Snowy Hydro and NSW DPI (Fisheries).

Table E2 Sampling analytes and analysis methods included in the surface water monitoring program that will inform the TARP

Category	Proposed sampling analytes	Analysis method
Monitoring		
Physico-chemical Properties	pH, electrical conductivity (EC), turbidity, dissolved oxygen, temperature, redox potential	To be measured using a portable water quality meter in the field
Inspection	Visible oil and grease	Inspection of erosion and sediment controls, downstream drainage and clean water diversions

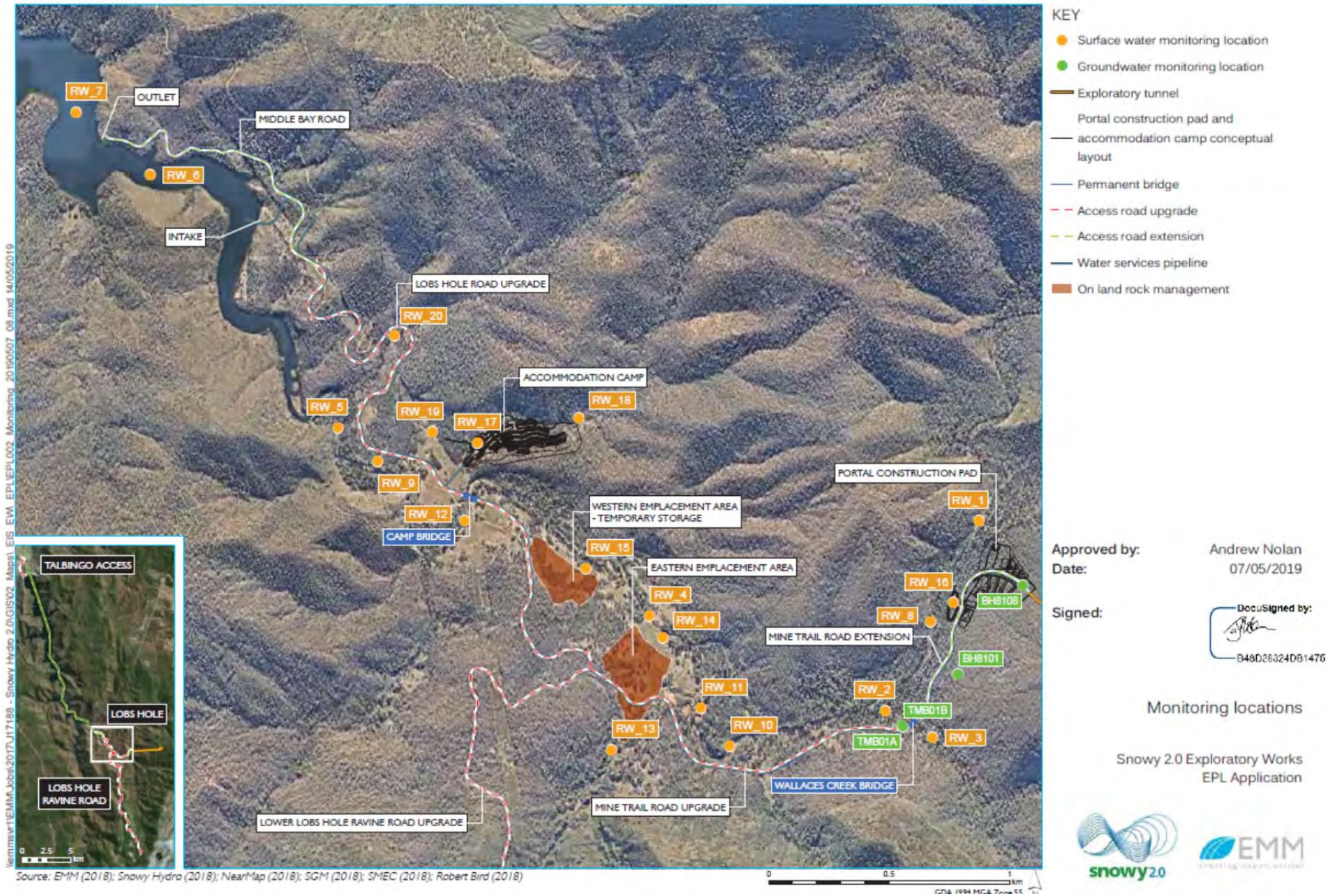
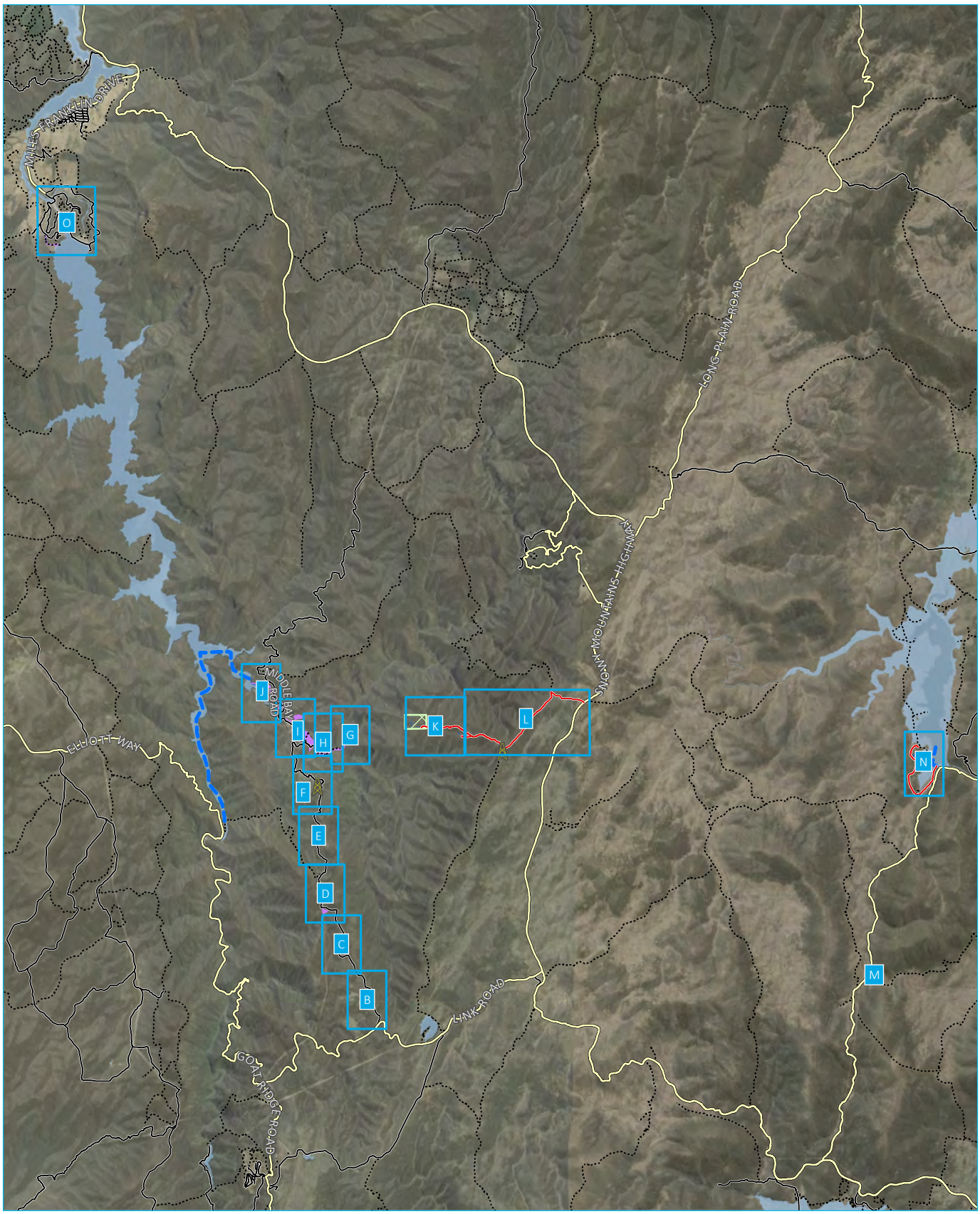


Figure E1 EPL 21266 Surface water monitoring locations

Appendix F

Project Boundary



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

0 5 10 km

GDA 1994 MGA Zone 55

N

KEY

- Proposed temporary communications upgrade location
- Existing access track
- Boat access
- Main road
- Local road
- Vehicular track
- Map index
- EW approved construction footprint
- EW modification construction footprint (additional)
- Boreholes requiring on-site adjustment
- Waterbody

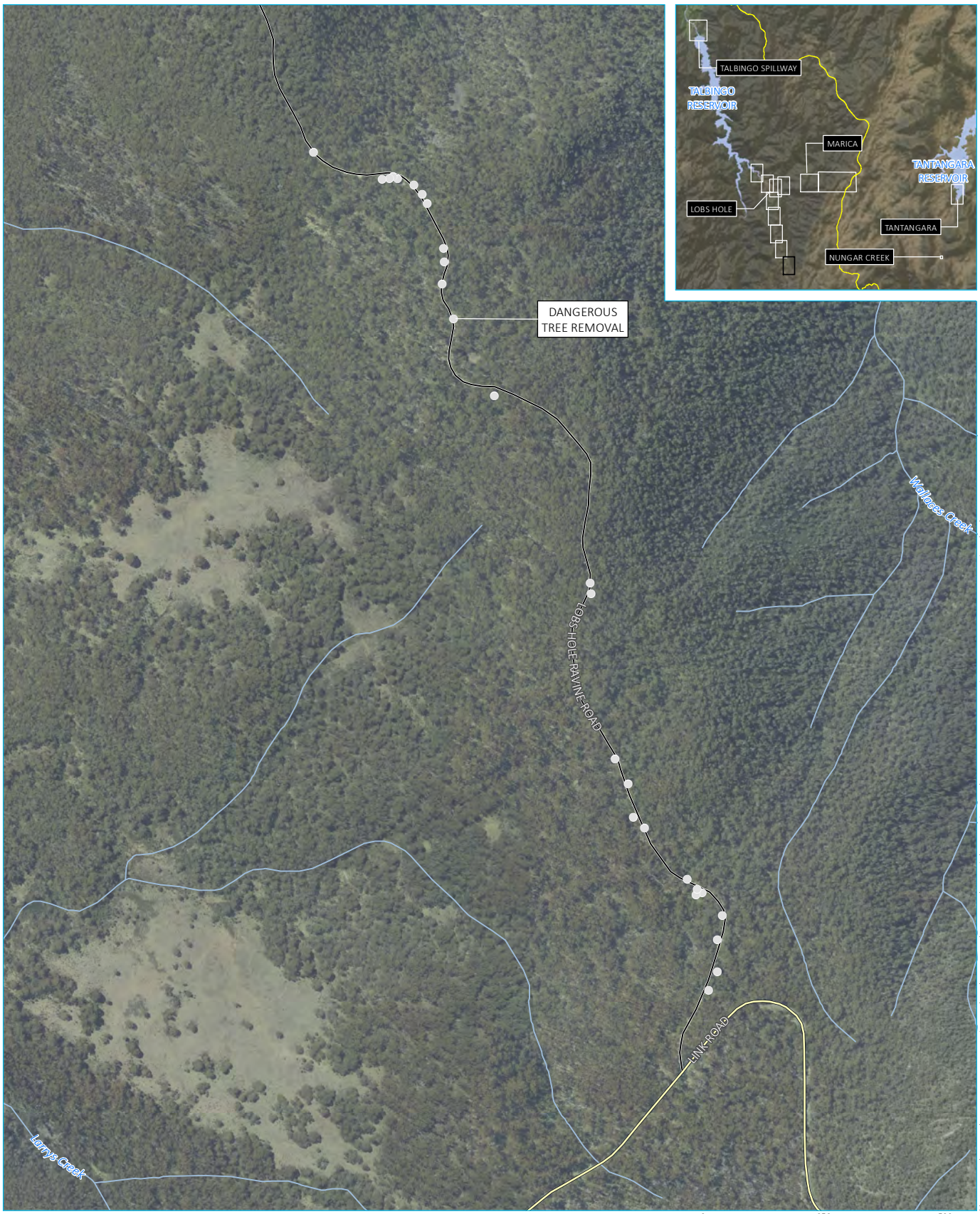
Exploratory Works project boundary - overview

Snowy 2.0
Exploratory Works EIS
Modification 1
1 a

snowy 2.0

EMM creating opportunities

\\emmsvr1\EMM2\117188 - Snowy Hydro 2.0\GIS\02_Maps_EIS_EW_Mod1\AppendixB_rts\G002_MOD1ProjectElementsOVERVIEW_20191119_04.mxd 19/11/2019



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

0 250 500 m

GDA 1994 MGA Zone 55

N

KEY

- Dangerous tree
- Main road
- Local road
- Watercourse/drainage line

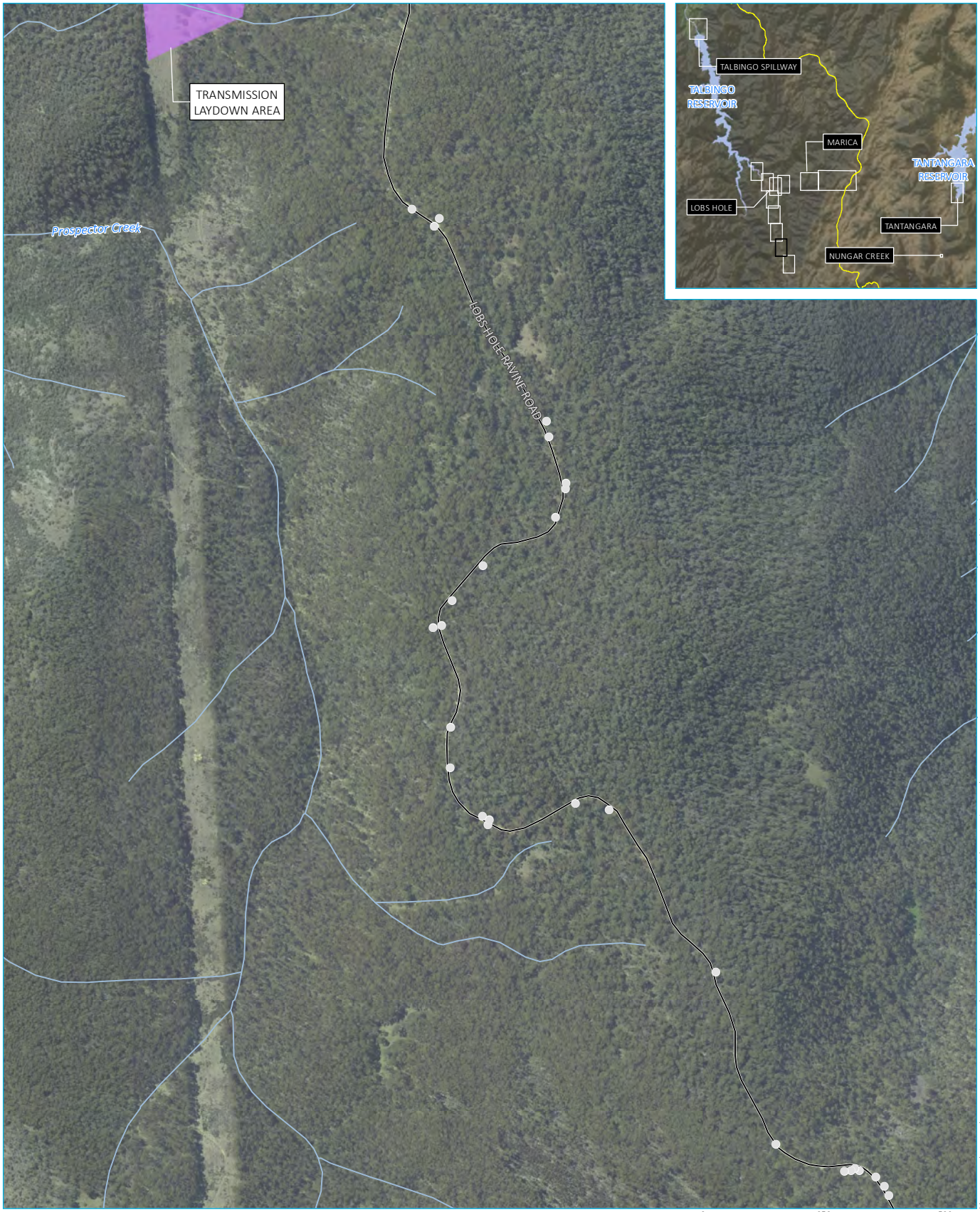
Exploratory Works project boundary
- Lobs Hole Ravine Road (Upper) 1

Snowy 2.0
Exploratory Works EIS
Modification 1
1 b

snowy 2.0

EMM creating opportunities

\\emmsvr1\EMM2\177188 - Snowy Hydro 2.0\GIS\02_Maps_EIS_EWA_Mod1\AppendixB_rts\G001_MOD1ProjectElements_20190830_03.mxd 25/10/2019



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

0 250 500 m

GDA 1994 MGA Zone 55

KEY

- Dangerous tree
- Local road
- Watercourse/drainage line
- EW approved construction footprint

Exploratory Works project boundary
- Lobs Hole Ravine Road (Upper) 2

Snowy 2.0
Exploratory Works EIS
Modification 1
1 c

\\emmsvr1\EMM2\177188 - Snowy Hydro 2.0\GIS\02_Maps_EIS_EW_Mod1\AppendixB_rts\G001_MOD1ProjectElements_20190830_03.mxd 25/10/2019

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

0 250 500 m

GDA 1994 MGA Zone 55

N

KEY

- Dangerous tree
- Local road
- Vehicular track
- Watercourse/drainage line
- EW approved construction footprint
- EW modification construction footprint (additional)

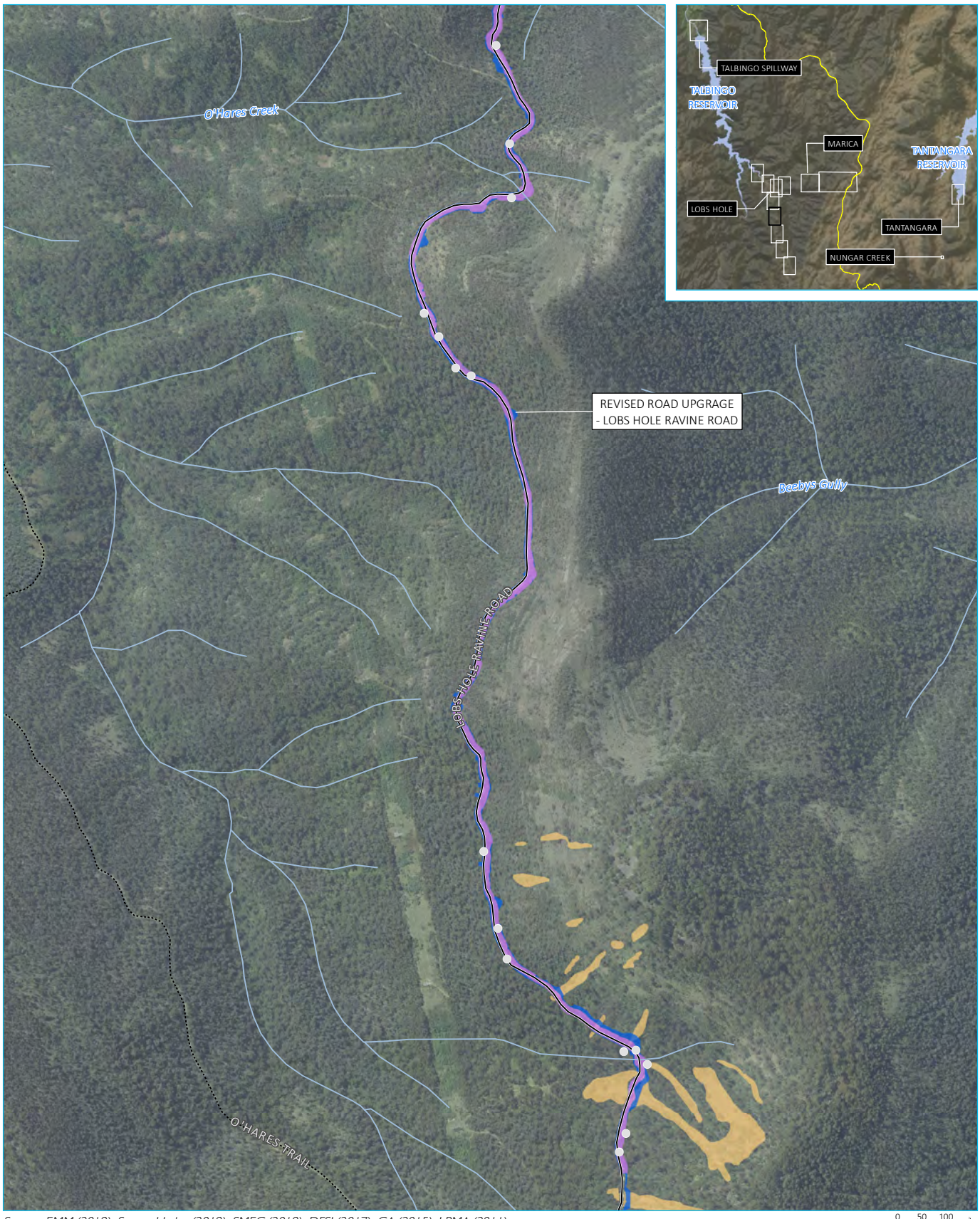
Exploratory Works project boundary - Lobs Hole Ravine Road (Upper) 3

Snowy 2.0
Exploratory Works EIS
Modification 1
1 d

snowy 2.0

EMM creating opportunities

\\emmsvr1\EMM2\171188 - Snowy Hydro 2.0\GIS\02_Maps_EIS_EWA_Mod1\AppendixB_rts\G001_MOD1ProjectElements_20190830_03.mxd 25/10/2019



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

KEY

- Dangerous tree
- Local road
- Vehicular track
- Watercourse/drainage line
- EW approved construction footprint
- EW modification construction footprint (additional)
- Boulder stream

0 50 100 m

GDA 1994 MGA Zone 55

N

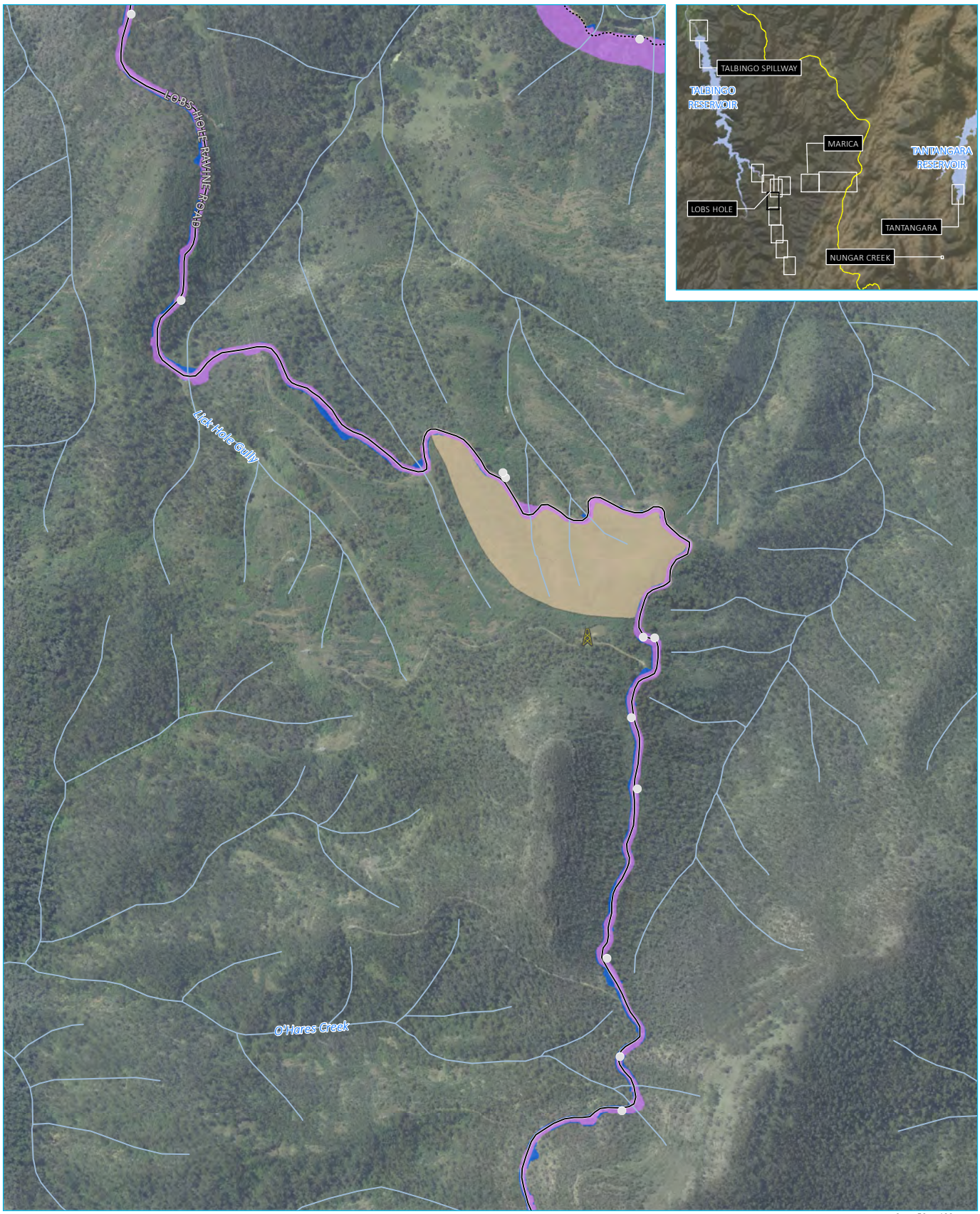
Exploratory Works project boundary
- Lobs Hole Ravine Road (Lower) 1

Snowy 2.0
Exploratory Works EIS
Modification 1
1 e

snowy 2.0

EMM creating opportunities

O:\J17188 - Snowy Hydro 2.0\GIS\02_Maps_EIS_EW_Mod1\AppendixB_rts\G001_MOD1ProjectElements_20191127_05.mxd 27/11/2019



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

0 50 100 m

GDA 1994 MGA Zone 55

N

KEY

- Dangerous tree
- Existing temporary communications
- Local road
- Vehicular track
- Watercourse/drainage line
- EW approved construction footprint
- EW modification construction footprint (additional)
- Fossil area

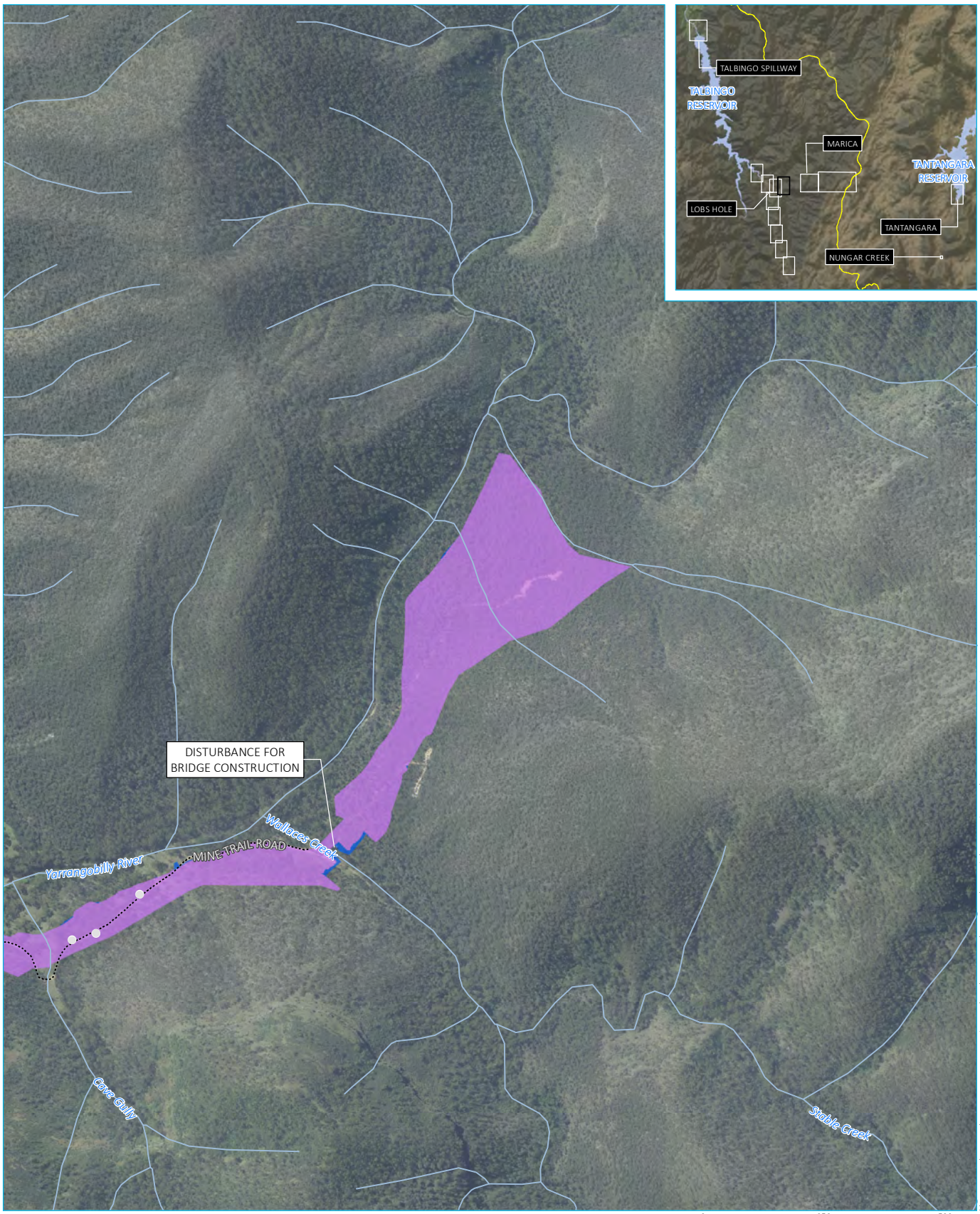
Exploratory Works project boundary - Lobs Hole Ravine Road (Lower) 2

Snowy 2.0
Exploratory Works EIS
Modification 1
1 f

snowy 2.0

EMM creating opportunities

O:\17188 - Snowy Hydro 2.0\GIS\02_Maps_EIS_EW_Mod1\AppendixB_rts\G001_MOD1ProjectElements_20191127_05.mxd 27/11/2019



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

0 250 500 m

GDA 1994 MGA Zone 55

N

KEY

- Dangerous tree
- Vehicular track
- Watercourse/drainage line
- EW approved construction footprint
- EW modification construction footprint (additional)

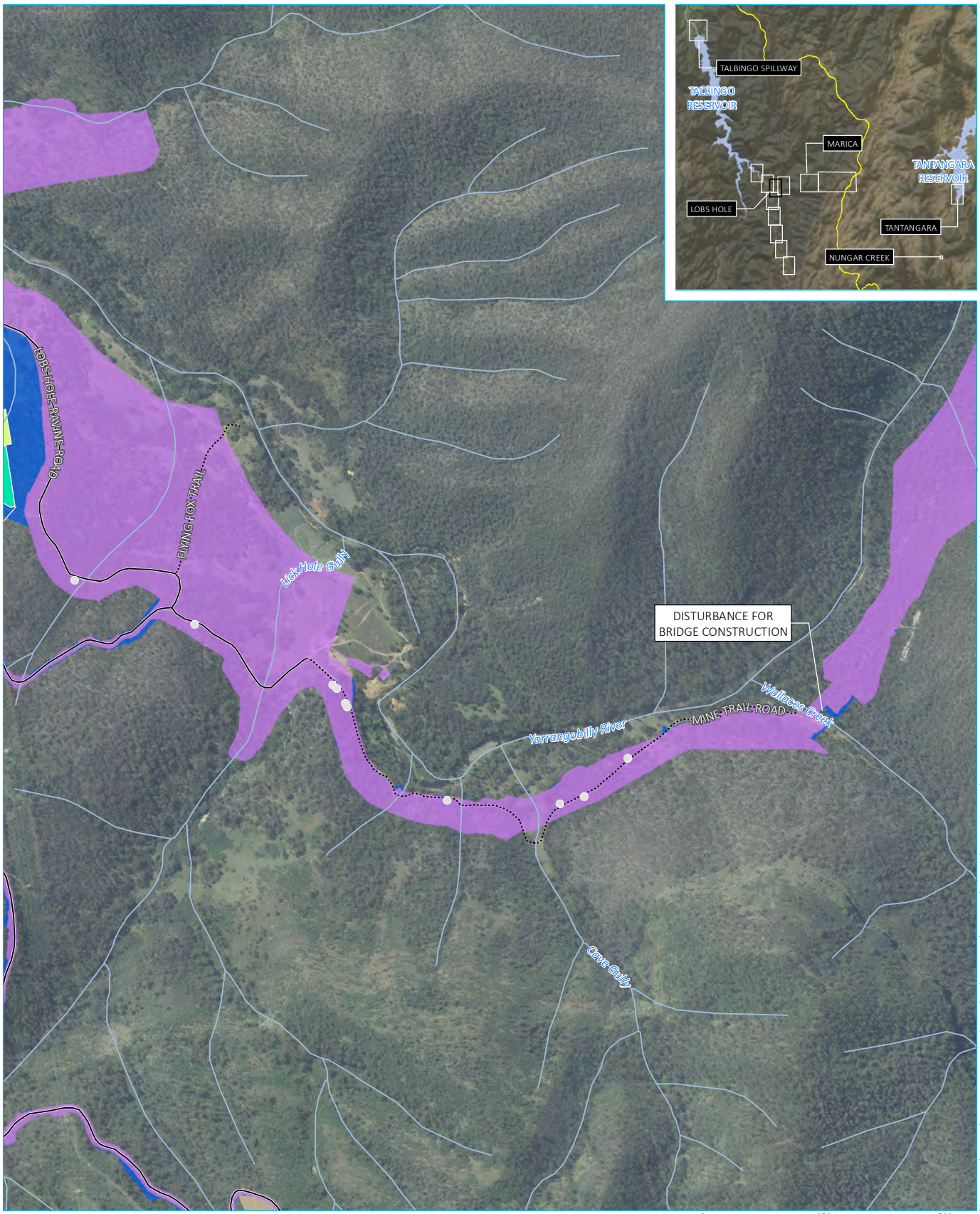
Exploratory Works project boundary
- Mine Trail Road 1

Snowy 2.0
Exploratory Works EIS
Modification 1
1 g

snowy 2.0

EMM creating opportunities

\\emmsvr1\EMM2\17188 - Snowy Hydro 2.0\GIS\02_Maps_EIS_EWA_Mod1\AppendixB_rts\G001_MOD1ProjectElements_20190830_03.mxd 25/10/2019



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

0 250 500 m

GDA 1994 MGA Zone 55

N

KEY

- Dangerous tree
- Local road
- Vehicular track
- Watercourse/drainage line
- EW approved construction footprint
- EW modification construction footprint (additional)
- Indicative laydown area
- Proposed substation
- Fossil area

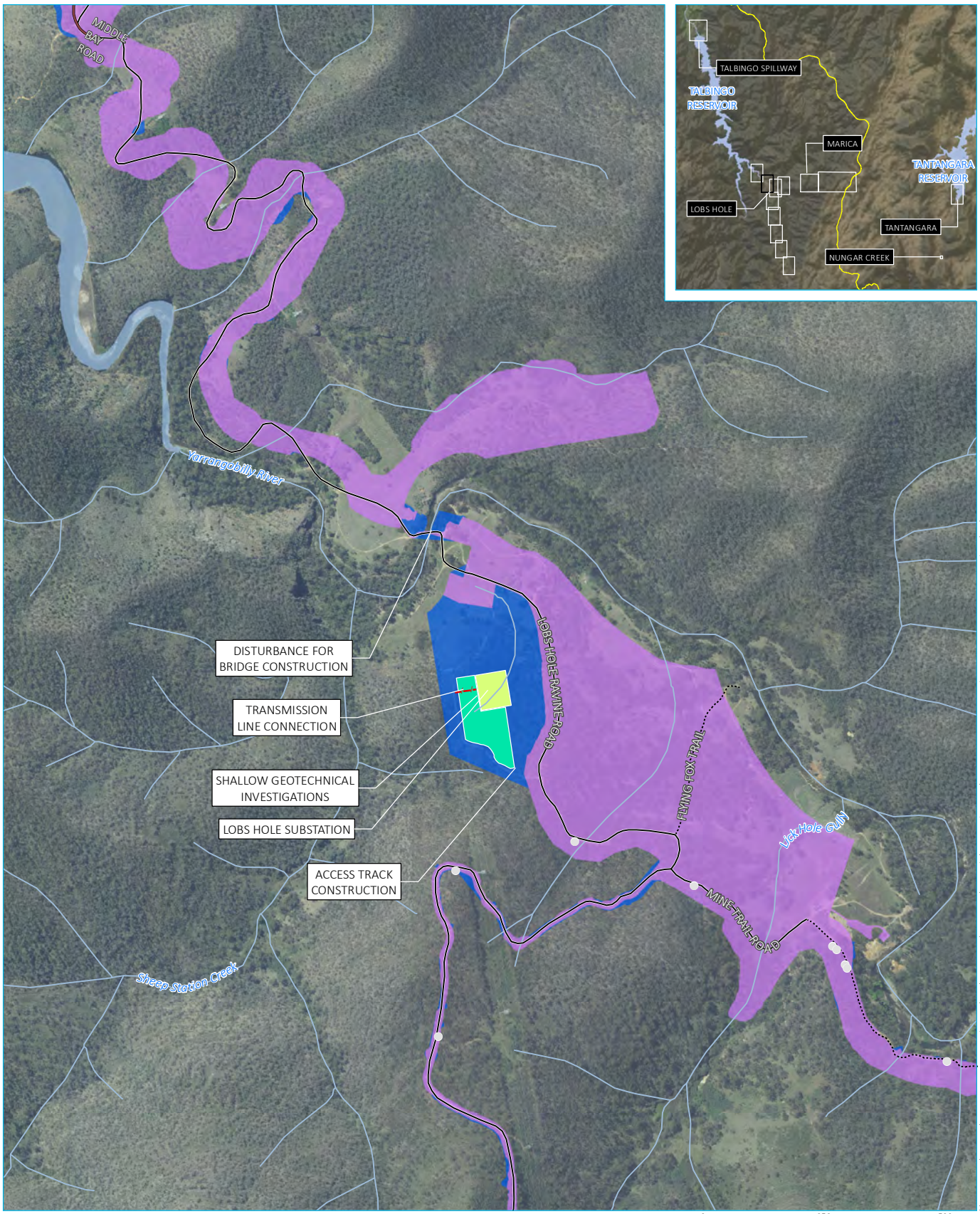
Exploratory Works project boundary - Mine Trail Road 2

Snowy 2.0
Exploratory Works EIS
Modification 1
1 h

snowy 2.0

EMM creating opportunities

\\emmsvr1\EMM2\171188 - Snowy Hydro 2.0\GIS\02_Maps_EIS_EWA_Mod1\AppendixB_rts\G001_MOD1ProjectElements_20190830_03.mxd 25/10/2019



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

0 250 500 m

GDA 1994 MGA Zone 55

N

KEY

- Dangerous tree
- Approved EW access
- Transmission line connection
- Local road
- Vehicular track
- Watercourse/drainage line
- EW approved construction footprint
- EW modification construction footprint (additional)
- Indicative laydown area
- Proposed substation
- Waterbody

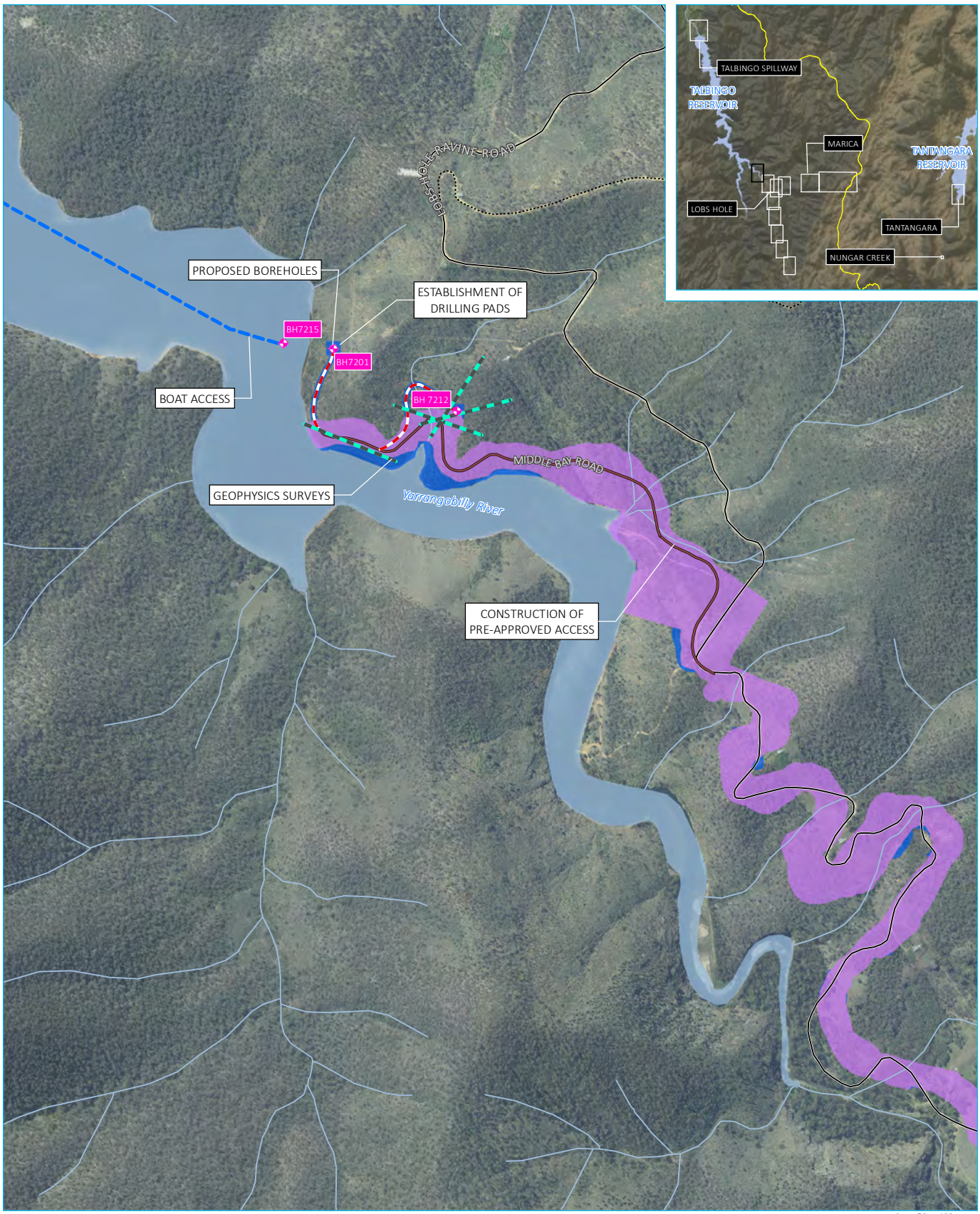
Exploratory Works project boundary - Lobs Hole

Snowy 2.0
Exploratory Works EIS
Modification 1
1 i

snowy 2.0

EMM creating opportunities

\\emmsvr1\EMM2\171188 - Snowy Hydro 2.0\GIS\02_Maps_EIS_EWA_Mod1\AppendixB_rts\G001_MOD1ProjectElements_20190830_03.mxd 25/10/2019



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

0 50 100 m

GDA 1994 MGA Zone 55

N

KEY

- Proposed borehole
- Proposed geophysics
- Proposed access track
- Approved EW access
- Boat access
- Local road
- Vehicular track
- Watercourse/drainage line
- EW approved construction footprint
- EW modification construction footprint (additional)
- Waterbody

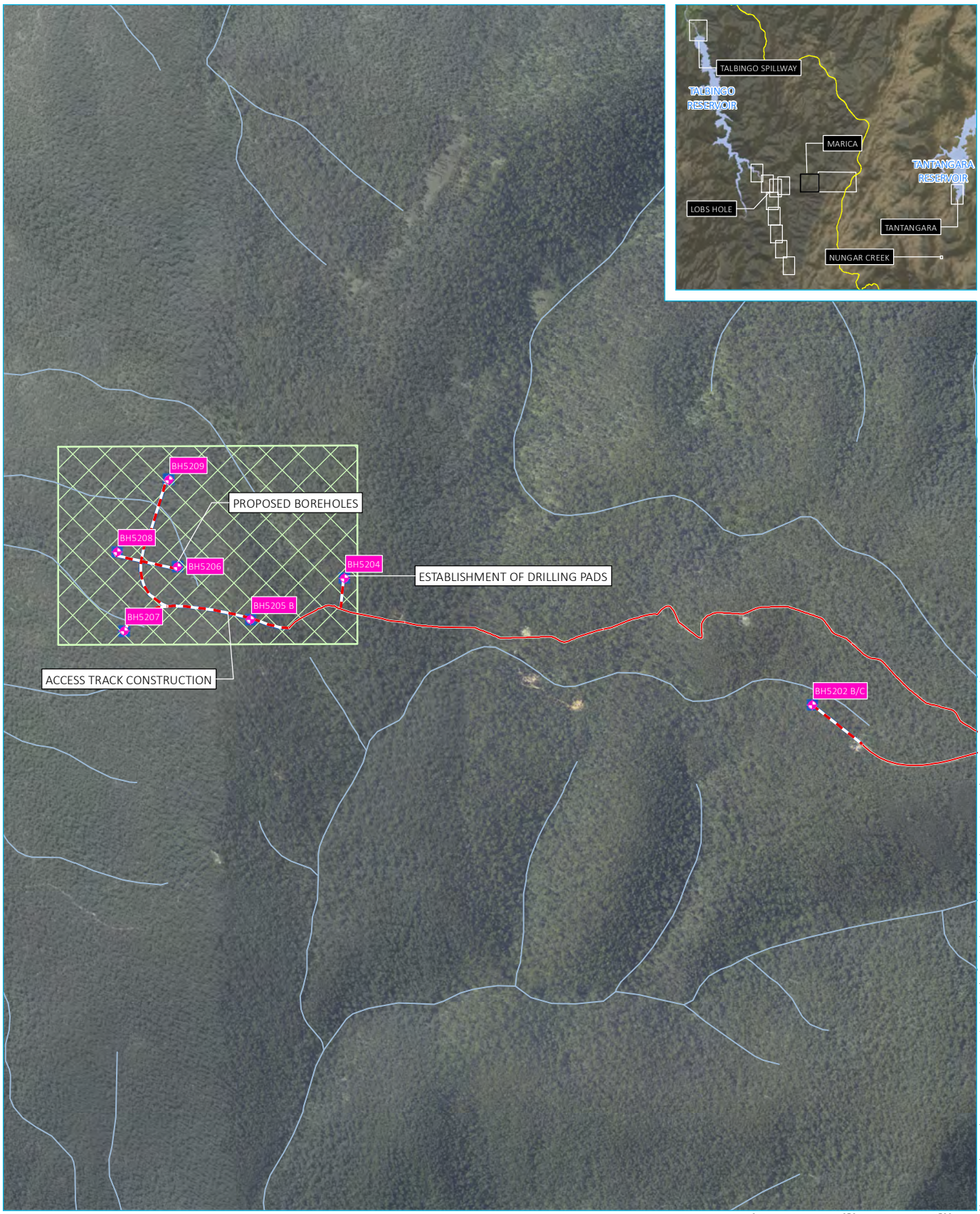
Exploratory Works project boundary - Lobs Hole Ravine Road

Snowy 2.0
Exploratory Works EIS
Modification 1
1 j

snowy 2.0

EMM creating opportunities

\\emmsvr1\EMM2\117188 - Snowy Hydro 2.0\GIS\02_Maps_EIS_EW_Mod1\AppendixB_rts\G001_MOD1ProjectElements_20191119_04.mxd 19/11/2019



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

0 250 500 m

GDA 1994 MGA Zone 55

N

KEY

- Proposed borehole
- Existing access track
- Proposed access track
- Watercourse/drainage line
- EW modification construction footprint (additional)
- Boreholes requiring on-site adjustment

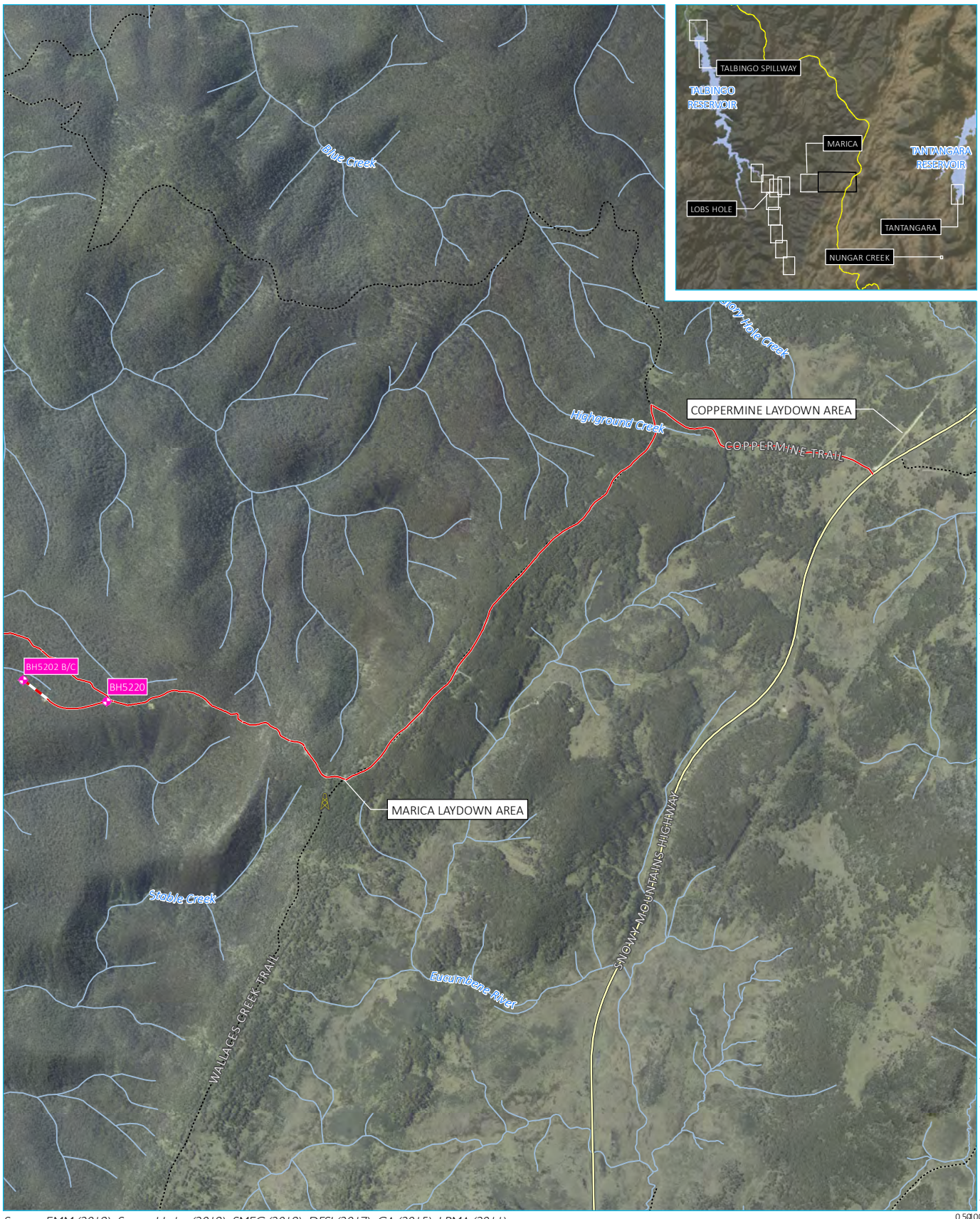
Exploratory Works project boundary - Marica 1

Snowy 2.0
Exploratory Works EIS
Modification 1
1 k

snowy 2.0

EMM creating opportunities

\\emmsvr1\EMM2\117188 - Snowy Hydro 2.0\GIS\02_Maps_EIS_EWA_Mod1\AppendixB_rts\G001_MOD1ProjectElements_20190830_03.mxd 25/10/2019



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

KEY

- Proposed borehole
- Existing temporary communications
- Existing access track
- Proposed access track
- Main road
- Vehicular track
- Watercourse/drainage line
- EW modification construction footprint (additional)

0 5000 m

GDA 1994 MGA Zone 55

N

Exploratory Works project boundary - Marica 2

Snowy 2.0
Exploratory Works EIS
Modification 1
1 I

snowy 2.0

EMM creating opportunities

O:\J17188 - Snowy Hydro 2.0\GIS\02_Maps_EIS_EW_Mod1\AppendixB_rts\G001_MOD1ProjectElements_20191127_05.mxd 27/11/2019

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

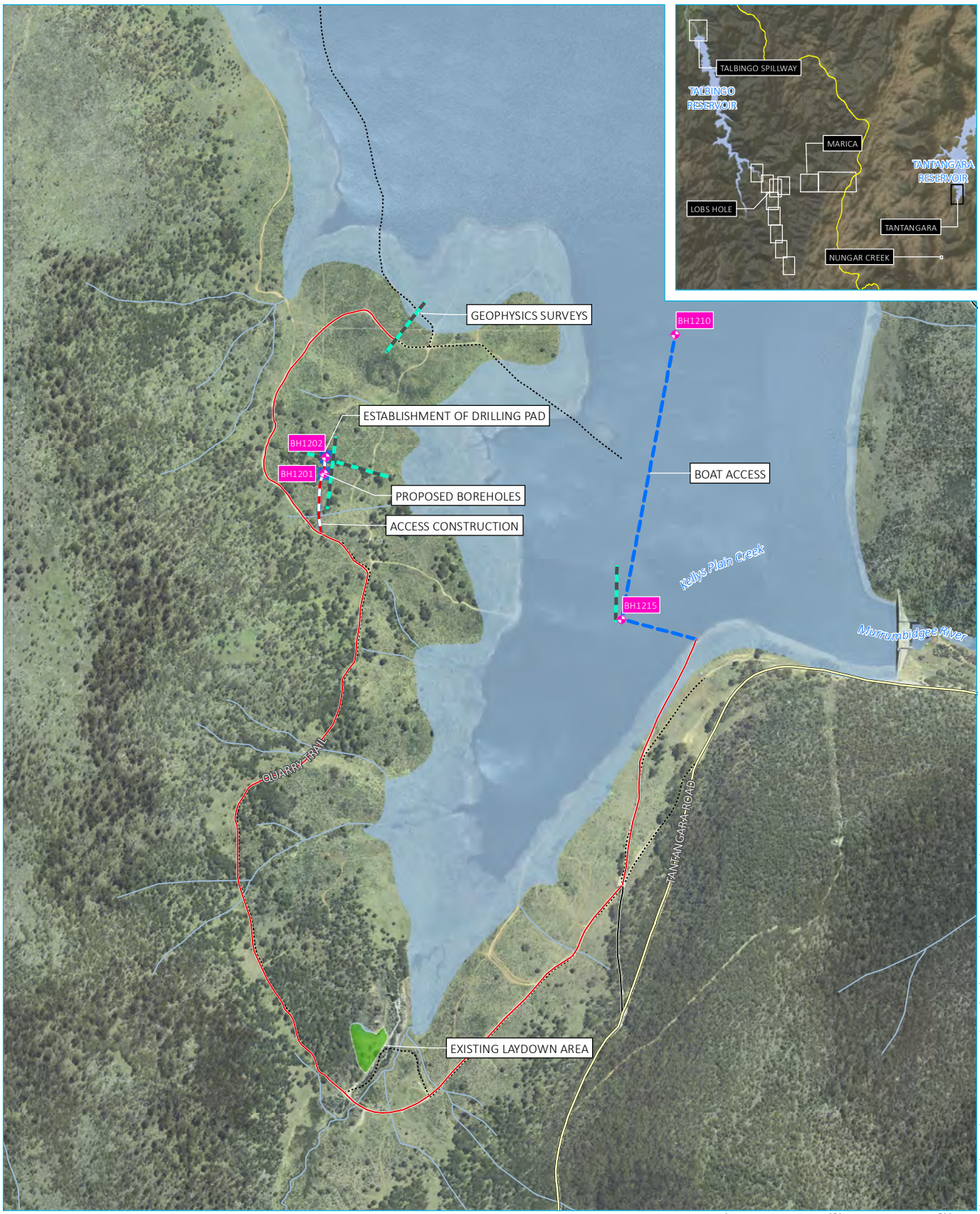
KEY

- Proposed borehole
- Main road
- Watercourse/drainage line
- Proposed work area

Exploratory Works project boundary - Nungar Creek

Snowy 2.0
Exploratory Works EIS
Modification 1
1 m

\\emmsvr1\EMM2\17188 - Snowy Hydro 2.0\GIS\02_Maps_EIS_EWL_Mod1\AppendixB_rts\G001_MOD1ProjectElements_20190830_03.mxd 25/10/2019



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

0 250 500 m

GDA 1994 MGA Zone 55

N

KEY

- Proposed borehole
- Proposed geophysics
- Existing access track
- Proposed access track
- Boat access
- Main road
- Local road
- Vehicular track
- Watercourse/drainage line
- EW modification construction footprint (additional)
- Existing laydown area
- Waterbody

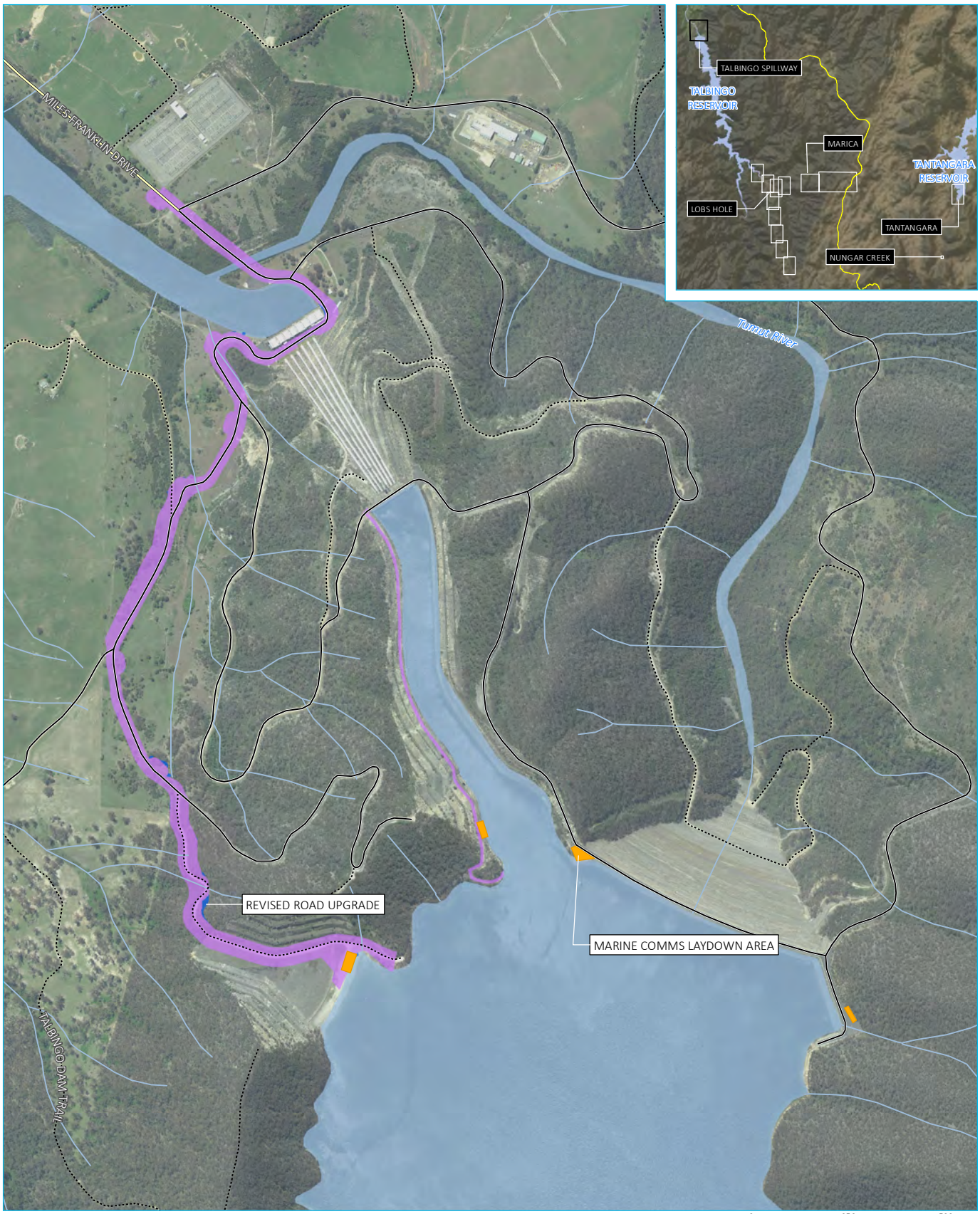
Exploratory Works project boundary - Tantangara Reservoir

Snowy 2.0
Exploratory Works EIS
Modification 1
1 n

snowy 2.0

EMM creating opportunities

\\emmsvr1\EMM2\117188 - Snowy Hydro 2.0\GIS\02_Maps_EIS_EW_Mod1\AppendixB_rts\G001_MOD1ProjectElements_20190830_03.mxd 25/10/2019



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

0 250 500 m

GDA 1994 MGA Zone 55

N

KEY

- Main road
- Local road
- Vehicular track
- Watercourse/drainage line
- EW approved construction footprint
- EW modification construction footprint (additional)
- Marine comms laydown (proposed)
- Waterbody

Exploratory Works project boundary
- Talbingo spillway

Snowy 2.0
Exploratory Works EIS
Modification 1
1 o

snowy 2.0

EMM creating opportunities

\\emmsvr1\EMM2\177188 - Snowy Hydro 2.0\GIS\02_Maps_EIS_EW_Mod1\AppendixB_rts\G001_MOD1ProjectElements_20190830_03.mxd 25/10/2019