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AQUATIC HABITAT MANAGEMENT PLAN

Approval Record			
Document preparation, review and approval		Name in print	Signature
Prepared by	Environmental consultant	A. Costenoble	
Reviewed by	Environmental consultant	R. Walker-Edwards	
Verified by	Environmental Manager	L. Coetzee	
Approved by	Project Director	A. Betti	

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ABBREVIATIONS AND DEFINITIONS

Acronym	Definition
AFL	Agreement for Lease
AHD	Australian Height Datum
AqHMP	Aquatic Habitat Management Plan
BC Act	NSW Biodiversity Conservation Act 2016
BCD	Biodiversity and Conservation Division (now part of Department of Planning, Industry and the Environment)
BoM	Bureau of Meteorology
CMP	Construction Management Plan
CoA	Conditions of Approval
DNA	Deoxyribonucleic acid
DoEE	Department of Energy and Environment
DPIE	NSW Department of Planning, Industry and Environment
DoI	NSW Department of Industry
DPI	NSW Department of Primary Industries - Fisheries
EIS	Environmental Impact Statement
Exploratory Works EIS or EIS	*Environmental Impact Statement Exploratory Works for Snowy 2.0*
EHNV	Epizootic Haematopoietic Necrosis Virus
EMS	Environmental Management Strategy
EP&A Act	*Environmental Planning and Assessment Act 1979*
EPA	NSW Environment Protection Authority
EPBC Act	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
EPL	Environment Protection License
EWAR	Exploratory Works Access Roads
FM Act	*Fisheries Management Act 1994*
Future Generation	Future Generation Joint Venture
Future Generation-PMS	Project Management System
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 1974*
NPWS	NSW National Parks and Wildlife Service
PEP	Project Execution Plan
QMP	Quality Management Plan
REMM	Revised environment management measures
Submissions Report or RTS	*Response to Submissions Exploratory Works for Snowy 2.0*

Acronym	Definition
SEP	Site Environmental Plan
SIS	Species Impact Statement
TBM	Tunnel Boring Machine
WMP	Water Management Plan

1. INTRODUCTION

Salini Impregilo, Clough and Lane have formed the Future Generation Joint Venture (Future Generation) to provide the Civil Works Package for Snowy Hydro Limited (Snowy Hydro) on the Snowy 2.0 Project (the Project).

The Project is a pumped hydro project that will increase the generation capacity of the Snowy Mountains Scheme by up to 2,000mW and at full capacity will provide approximately 350,000MW/h of energy storage. The project includes all activities associated with the civil works requirements for the Snowy 2.0 Pumped Hydro-electric Scheme.

Intake and outlet structures will be built at both Tantangara and Talbingo Reservoirs, which are in the Kosciuszko National Park (KNP) in southern NSW. Approximately 27km of concrete-lined tunnels will be constructed to link the two reservoirs and a further 20km of tunnels will be required to support the facility. The power station complex will be located almost one kilometre underground.

The project will deliver one of the largest pumped hydro schemes in the world and underscores the importance of the Snowy Scheme's role in the National Electricity Market.

Future Generation was conceived to deliver an integrated engineering, procurement and construction management service for the project. The joint venture is backed by the combined experience of Salini Impregilo, Clough and Lane, through their experience in the infrastructure, mineral and oil and gas sectors throughout Australia and the world.

1.1. Purpose

The Aquatic Habitat Management Plan (AqHMP or Plan) forms part of the Environmental Management Strategy (EMS) for Snowy 2.0 – Exploratory Works – Stage 2 (Exploratory Works – Stage 2). 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 Main Works or second phase, will be subject to a separate Environmental Impact Statement (EIS) in 2019.

This AqHMP has been prepared to address the requirements of:

- the Infrastructure Approval (SSI 9208) issued for Snowy 2.0 Exploratory Works on the 7 February 2019 and modified on 2 December 2019 and 27 March 2020;
- the *Environmental Impact Statement Exploratory Works for Snowy Hydro 2.0* (Exploratory Works EIS);
- the revised environmental management measures (REMMs) within the *Response to Submissions Exploratory Works for Snowy 2.0* (Submissions Report or RTS);
- the *Modification 1 Assessment Report - Exploratory Works for Snowy 2.0* (Modification 1)*;*
- the REMMs within the *Response to Submissions - Exploratory Works Modification 1* (Submissions Report for Modification 1);
- the Modification 2 Assessment Report - Exploratory Works for Snowy 2.0 (Modification 2); and
- the REMMs within the *Response to Submissions - Exploratory Works Modification 2* (Submissions Report for Modification 2).

The Exploratory Works for Snowy 2.0 includes, but is not limited to:

- an exploratory tunnel to the site of the underground power station for snowy 2.0;
- horizontal and test drilling;

- a portal construction pad;
- an accommodation camp;
- road works and upgrades providing access and haulage routes;
- barge access infrastructure and dredge works;
- excavated rock management, including subaqueous placement within Talbingo reservoir;
- services infrastructure; and
- post-construction revegetation and rehabilitation.

Exploratory Works will be delivered in three distinct stages and these stages will be completed by two different contractors. Leed Engineering (Leed) is the contractor who will be carrying out the Snowy 2.0 Stage 1 work on behalf of Snowy Hydro. Future Generation is the contractor who will be delivering the Snowy 2.0 Stage 2 works on behalf of Snowy Hydro.

Works to be completed by Leed on behalf of Snowy Hydro:

- **Stage 1a – Pre-construction Minor Works** – Stage 1a has been approved and commenced I 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, and minor clearing.
- **Stage 1b - Exploratory Works Access Roads (EWAR)** – Stage 1b has been approved and commenced in the second quarter of 2019. The scope includes roadworks 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, two new bridge crossings and two temporary waterway crossings.

Works to be completed by Future Generation on behalf of Snowy Hydro:

- **Stage 2 – Exploratory Works** – Approval was issued and works commenced in quarter three (Q3) of 2019. The scope for Stage 2 of Exploratory Works, includes:
  - pre-construction minor activities including dilapidation studies, survey, investigations, access etc; and
  - construction works including exploratory tunnel, portal construction pad, accommodation camp, dredging*, barge access infrastructure, excavated rock management and additional geotechnical investigation. This includes subaqueous emplacement within Talbingo Reservoir.

Note: these activities will not proceed unless the relevant management plans are approved by Department of Planning, Industry and Environment (DPIE).

Further detail on construction activities and staging is presented in Section 1.7 and Figure 1-1.

This Plan identifies the Project's environmental management measures in relation to aquatic habitat management for the Exploratory Works – Stage 2.

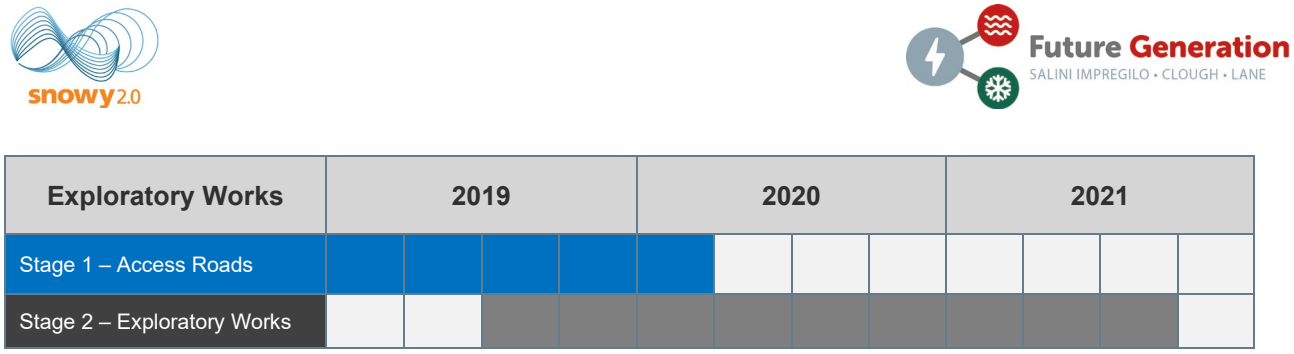


Figure 1-1: Timing of Exploratory Works stages

Stage 2 management plans have been revised from the corresponding Stage 1 management plan, as demonstrated in the document revision section of each Stage 2 plan. The intent of this arrangement is to ensure a consistent approach to managing environmental risk and regulatory requirements for the Exploratory Works project. In the event that both Exploratory Works Stages are undertaken concurrently, and / or in overlapping locations, the Stage 1 management plan will apply to the Stage 1 works, and the Stage 2 management plans will apply to the Stage 2 works. This arrangement would not affect management standards as all relevant measures from each management plan would continue to apply. As the proponent, Snowy Hydro will oversee both Stages of the Exploratory Works project.

The timing of the preparation, consultation, submission and approval of this Plan, along with other management plans required by the Conditions of Approval (CoA), is shown within Table 4.4 and Figure 4.4 of the EMS.

Ongoing revisions to this Plan will occur in accordance with Section 1.6 of the EMS, and as required by condition 4 of schedule 4 of the Infrastructure 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 CoA and directions of the Planning Secretary under condition 4 of schedule 2.

Table 1-1 presents the relationship of activities relating to aquatic habitat management with respect to this Plan and other management plans being prepared for the Project.

Table 1-1: Relationship to other plans

Activities	Relevant plan	Timing of the plan*	
		Stage 1	Stage 2
General environmental compliance including inspection, monitoring and auditing	Environmental Management Strategy	P	R
Road construction	This Plan	P	R
Other construction including site facilities and tunnelling activities	This Plan	P	R
Temporary and permanent bridge construction at Wallaces Creek and Yarrangobilly River	This Plan	P	R
Construction of barge access infrastructure	This Plan	P	R
Excavated material	Excavated Material Management Plan	P	R
Dredging and dredge spoil disposal	Water Management Plan (WMP) Appendix C Dredging Management Plan		P
Monitoring for impacts on Murray crayfish in Talbingo Reservoir	This Plan	P	R

Activities	Relevant plan	Timing of the plan*	
Measures for the management of water quality	WMP WMP Appendix A Surface Water Management Plan WMP Appendix B Groundwater Management Plan WMP Appendix C Dredging Management Plan	P	R

* P – prepare, R – revise

Specific on site management measures identified in this Plan will be incorporated into site documents. 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.

1.2. Background

Snowy Hydro is the proponent of the 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.

Future Generation proposes to carry out the Exploratory Works – Stage 2 project prior to the main construction works for the Project, to inform the detailed design and to reduce project risk. Exploratory Works are required to obtain detailed geological data for the location of the underground power station. An exploratory tunnel is to be constructed to gain this information. The Exploratory Works – Stage 2 project will predominantly be in the Lobs Hole area of KNP. If the Exploratory Works are not undertaken, risks to the design and construct elements of the power station cavern are significantly increased.

The Exploratory Works EIS was prepared to assess the impact of these works on the environment, including an assessment of the aquatic environment within Chapter 5.1 and Appendices F and G.

The RTS included REMMs within Chapter 8. The management measures from that report have been addressed within this AqHMP.

The Exploratory Works 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 *Euastacus armatus* (Murray Crayfish), confirmed to occur within the study area and the *Macquaria australasica* (Macquarie Perch). 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. *Maccullochella macquariensis* (Trout Cod) 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.

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.

Subsequent to the submission of the RTS, a revised Assessment of Significance of *Euastacus armatus* (Murray Crayfish) – listed as vulnerable under the *Fisheries Management Act 1994* (FM Act) was undertaken. During October 2018, a total of 130 hoop nets were deployed throughout Talbingo Reservoir with one Murray crayfish caught. However, a significant impact to this species was considered unlikely and therefore, the preparation of a Species Impact Statement (SIS) was not recommended. No additional control measures for the roads and access works were required.

1.2.1. Modification 1

In accordance with section 5.25 of the EP&A Act, the Infrastructure Approval issued for Exploratory Works was modified to:

- provide additional geotechnical information for the detailed design of the Snowy 2.0 power station and power waterway;
- provide a reliable long term source of construction power for the duration of Exploratory Works and will reduce the reliance on diesel generation and associated on-site storage and emissions;
- improve the efficiency of the Exploratory Works construction power;
- optimise the detailed design of construction areas and access roads; and
- improve worker safety during construction.

The Modification 1 Assessment Report was submitted to Department of Planning, Industry and Environment (DPIE) in June 2019, and was publicly exhibited between 26 June 2019 and 9 July 2019. A total of nine submissions were received, and following consideration, approval was granted by the Minister for Planning and Public Spaces on 2 December 2019.

Though Modification 1 included several changes, only the geotechnical investigations are relevant to the Stage 2 works and Future Generation's activities for the Exploratory Works project. This AqHMP has therefore been revised to address the aquatic habitat requirements and management measures from Modification 1 which are relevant to the geotechnical activities.

1.2.2. Modification 2

In accordance with section 5.25 of the EP&A Act, the Infrastructure Approval issued for Exploratory Works was modified to:

- revise the tunnelling method from drill and blast to predominantly tunnel boring machine (TBM);
- provide for road upgrades required to enable the transport and delivery of TBM equipment and materials required for tunnelling;
- include vegetation trimming, and selective tree lopping/removal on Lobs Hole Ravine Road (south) to provide adequate clearance for transport of the TBMs;
- improve access and egress to Lobs Hole via Lobs Hole Ravine Road (north);
- relocate the Middle Bay Barge ramp;
- increase the capacity of the Lobs Hole accommodation camp from 152 personnel to up to 250;
- provide for additional diesel storage capacity for the TBM until the Lobs Hole substation construction power is available;

- provide for the additional diesel generators required to provide power supply to the TBM prior to Lobs Hole substation commissioning; and
- revise the transport strategy to reduce the use of barging for delivery of materials to site.

The Modification 2 Assessment Report was submitted to DPIE in October 2019, and was publicly exhibited between 5 November 2019 and 21 November 2019. A total of twenty-seven submissions were received, and following consideration, approval was granted by the Minister for Planning and Public Spaces on 27 March 2020.

Modification 2 included several changes related to the Middle Bay barge ramp relocation. A key benefit of the new barge ramp location is to minimise the requirement for dredging as part of the barge ramp construction. A significantly smaller dredge footprint will reduce impacts to aquatic ecology.

This AqHMP has been revised to address the changes which have occurred as a result of Modification 2.

1.3. Environmental Management System

The overall environmental management system for the Project is described in the Future Generation EMS. This AqHMP forms part of Future Generation's environmental management framework for the Project as described in Section 4 of the EMS.

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

1.4. Relationship to Project Management System and other Project Plans

It is a requirement of Volume 4 Employer's Requirements – Project Execution to develop and implement a number of project plans for the project. These plans are defined as deliverables. The AHMP is required to support the deliverable plans.

The Environmental Management Strategy (EMS) will form part of the Project Management System (Future Generation-PMS) and will include any requirements specified in the contract documents, where appropriate. All Future Generation-PMS procedures will support, interface or directly relate to the development and execution of the plan.

The Project Execution Plan (PEP) is the overarching document that outlines the minimum requirements for project management on the project. The PEP is not a standalone document and has been prepared with consideration to other project plan requirements. The PEP will also detail the interfaces between other project plans and provide information on the responsibility and management of the interfaces and project works.

All project plans are reviewed by the Quality Manager and/or Systems Manager to ensure consistency with the Quality Management Plan (QMP) and Future Generation-PMS

1.5. Purpose and Objectives

The purpose of this Plan is to describe how the Project proposes to minimise and manage construction impacts on aquatic habitat during construction of the Project.

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 (CoA). To achieve this, Snowy Hydro and Future Generation will:

- ensure appropriate measures are implemented to address the relevant CoA and the REMMs listed within the Submissions Report, the Submissions Report for Modification 1 and the Submissions Report for Modification 2, as detailed within Section 2.2 of this Plan;

- detail the existing aquatic habitat identified within the project footprint during the Exploratory Works EIS including threatened and endangered flora and fauna;
- ensure reasonable and feasible measures are implemented during construction to avoid or minimise impacts aquatic habitat;
- detail the specific monitoring program for the Murray Crayfish population present in, and adjacent to, the project area; and
- establish a pre-disturbance procedure and permit system.

1.6. Consultation

Consultation was undertaken in accordance with Schedule 3 Condition 8 (a) of the Conditions of Approval.

On 20 May 2019, the Plan was issued to stakeholder agencies for review and comment. Comments from consultation have been incorporated into this Plan where appropriate. Response to the comments have been provided back to the stakeholder agencies.

On 5 July 2019, the Plan was issued to DPIE and Snowy Hydro for review and comment. Comments from consultation have been incorporated into this Plan where appropriate. Response to the comments have been provided back to the stakeholder agencies.

Comments are summarised in Table 1-2. A separate document, titled Agency Consultation Evidence Report has been prepared detailing the consultation process. This document has been provided to DPIE.

Table 1-2: Stage 2 consultation with stakeholder agencies summary

Date	Consultation	Outcomes
Stage 2 Consultation		
17 April 2019	Issued to Snowy Hydro for comment.	Comments accepted and addressed.
27 May 2019	Issued to NPWS & DPI Fisheries for comment.	Comments accepted and addressed.
4 June 2019	Agency briefing meeting with EPA, OEH, NPWS, DPI Fisheries & Snowy Hydro	-
4 July 2019	Incorporated agencies' comments and updated plan. Updated plan submitted to Snowy Hydro and to DPIE on 5 July 2019.	-

Revision 1 of the AqHMP (prepared in response to Modification 1 of the Infrastructure Approval), was issued to the following agencies for consultation:

- NPWS and DPI Fisheries on 1 November 2019.

Revision 4 of the AqHMP (prepared in response to Modification 2 of the Infrastructure Approval), was issued to the following agencies for consultation:

- NPWS and DPI Fisheries.

The plan has been revised following Agency consultation.

1.7. Construction Activities

This Plan relates to Stage 2 works. Stage 2 will include the following:

- pre-construction minor works (not construction activities) including:

  - building/road dilapidation studies;
  - survey works;
  - installing groundwater bores in the Ravine beds on site for water supply;
  - establishing a temporary site office;
  - minor access roads to facilitate the pre-construction minor works;
  - installation of environmental impact mitigation measures, including the installation of monitoring equipment, erosion and sediment controls, and fencing;
  - minor clearing or translocation of native vegetation within the approved disturbance footprint for the pre-construction minor works;
- the exploratory tunnel which is approximately 3.1 km long and will lead to the site of the underground power station. Excavation of the tunnel will occur through a method of both drill and blast and TBM;
- road upgrades for transport and delivery of the TBM and TBM equipment;
- a turnaround area on Link Road for transportation of the TBM equipment and materials to the construction areas at Lobs Hole and to facilitate set down and turn-back of oversize and overmass (OSOM) deliveries;
- 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;
- borehole drilling and geophysical surveys for further geotechnical investigation of the Snowy 2.0 power station and power waterway at Marica, Talbingo and Tantangara;
- ongoing groundwater monitoring using existing boreholes and access tracks within KNP;
- ongoing maintenance and rehabilitation of existing access tracks required for groundwater monitoring and geotechnical investigations within KNP;
- additional geotechnical drilling is proposed to enable investigation and detailed design of critical bridge works (Nungar Creek bridge) on Tantangara Road;
- additional laydown areas at Talbingo north for the transfer of plant and materials are proposed within Modification 1 to improve constructability;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;
- barge access infrastructure, including one new barge ramp at Middle Bay near Lobs Hole at the southern part of Talbingo Reservoir;
- excavated rock management, including subaqueous placement within Talbingo Reservoir*. Up to 750,000 m3 of excavated rock will need to be tested for its geochemical properties (ie whether the rock is reactive or non-reactive) before being managed by a combination of the following options:
  - re-use – suitable material can be used as construction materials for roads or similar. Some materials will be provided to NPWS for use in road maintenance and upgrades in other areas of KNP;
  - on land placement – material will be placed in one of two on land emplacement areas. The eastern emplacement area has been designed to safely treat reactive material during

temporary storage. The western emplacement area will be used for temporary storage of materials for re-use or offsite disposal (*Note: no material is to remain at any emplacement area and must be either sub-aqueously placed at Talbingo Reservoir or removed to a suitable place outside of KNP within three years of completion of the exploratory works (should Snowy 2.0 Main Works not proceed)*);

- 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.

1.7.1. Works approved through Modification 1

The Exploratory Works - Modification 1 works scope is included in Table 1-3. For clarity this has been divided between Stage 1 and Stage 2 works.

The revised project boundary (disturbance footprint) for the project, as approved through Modification 1 of the Infrastructure Approval, has been included in Appendix F of this plan.

Table 1-3: Exploratory Works - Modification 1 works scope (Stage 1 and Stage 2)

Modification 1 - Stage 1 works	
Activity	**Description**
Lobs 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. 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 in 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).
Lobs Hill Ravine Road and Construction Boundary Changes	Minor changes to the project boundary identified through detailed design 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 1b to 1f and Figure 1i).
Operating Hours	Modify operating hours for the use of Upper Lobs Hole Ravine Road from 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. (The location of the communications towers are illustrated in Appendix F, Figures 1a, 1f and 1l).
Modification 1 - Stage 2 works	
Activity	**Description**
Borehole drilling and geophysical surveys	This includes: • borehole drilling and geophysical surveys for further geotechnical investigation of the Snowy 2.0 power station and power waterway at Marica, Talbingo and Tantangara; • 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; • 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 Appendix F, Figures 1j, 1k, 1l, 1m and 1n).

Talbingo Laydown	Outside of KNP, Snowy Hydro 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 the northern foreshore of Talbingo Reservoir within Snowy Hydro owned land. Additional widening of Spillway Road for accessibility is required. (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).
Operating Hours	Modify operating hours for the use of Upper Lobs Hole Ravine Road from 7 am to 6pm to sunrise to sunset.

1.7.2. Works approved through Modification 2

The Exploratory Works - Modification 2 scope for Stage 2 works is included in Table 1-4.

The revised project boundary (disturbance footprint) for the project, as approved through Modification 2 of the Infrastructure Approval, has been included in Appendix F.

Table 1-4: Exploratory Works - Modification 2 works scope (Stage 2)

Modification 2 - Stage 2 works	
Activity	**Description**
Tunnelling	The tunnelling methodology has been revised and include the following: • TBM method will used to excavate the exploratory tunnel. The TBMs will be fully equipped to perform the excavation, ventilation, lining, and removal of excavated material; • the TBMs will be engineered to facilitate dismantling operations. This will avoid the need to excavate a preliminary dismantling chamber and allow the TBMs to be retrieved from the tunnel, thereby reducing the amount of excavated rock material; • the TBM will be equipped with devices to perform the following surveys: – geophysical seismic reflection surveys; – geoelectrical surveys; and – systematic probe core retrieval ahead of the advancing tunnel face; • the probing results will also be used to determine the presence of potentially acid forming (PAF) and naturally occurring asbestos (NOA) material; • the TBMs will be equipped with drilling machines to drill drainage holes with pipes to relieve groundwater pressures. If required, pre-excavation grouting will also be used to seal-off groundwater inflow and to improve the stability of the excavation face; • post-excavation grouting from the segmental lining may also be used to further consolidate the surrounding rock and/or prevent water ingress if required. (Illustrated in Appendix F)
Design	Detailed design and geotechnical investigations have been optimised. The project optimisation is expected to reduce the exploratory tunnel length by approximately 600 m and reduce the volume of excavated material by approximately 65,000 m^3. (Illustrated in Appendix F)
Road upgrades (undertaken by Future Generation and Snowy Hydro or their contractors)	Minor road upgrade works will be undertaken to enable transport of TBM equipment and materials required for tunnelling. The road upgrades have been designed to avoid additionally impacting any areas of geodiversity significance including the boulder streams, karst and fossil features on Lobs Hole Ravine Road. (Illustrated in Appendix F)

Modification 2 - Stage 2 works	
Activity	**Description**
Vegetation Clearing (undertaken by Future Generation and Snowy Hydro or their contractors)	The additional clearing will include approximately 2.78 ha of vegetation to establish road upgrades on Lobs Hole Ravine Road (south), Lobs Hole Ravine Road (north) and Link Road. (Illustrated in Appendix F)
Transport Strategy	Modification 2 proposes to revise the transport strategy so that materials and equipment required for Exploratory Works will be delivered using Lobs Hole Ravine Road (south) as the primary access road. (Illustrated in Appendix F)
Link Road Turnaround Area (undertaken by Snowy Hydro or their contractors)	A turnaround area will be established on Link Road for safe transportation of the TBM equipment and materials to the construction areas at Lobs Hole. The turnaround area will facilitate set down and turn-back of oversize and overmass deliveries. (Illustrated in Appendix F)
Lobs Hole Ravine Road (south) (undertaken by Snowy Hydro or their contractors)	Minor upgrade works will be undertaken on sections Lobs Hole Ravine Road (south) to enable the transport of the TBM equipment. (Illustrated in Appendix F)
Lobs Hole Ravine Road (north)	Roadworks will be conducted at Lobs Hole Ravine Road (North) to provide improved access and egress to Lobs Hole. Road works will include road upgrade and widening in several sections suitable for passing bays as well as regular maintenance of the existing roadway. (Illustrated in Appendix F)
Middle Bay Barge Ramp	The location of the Middle Bay barge ramp was revised as part of further refinement to the construction methodology. An alternative location for the Middle Bay barge ramp was identified to the west of the approved barge ramp location. A key benefit of the new barge ramp location is that it minimises the requirement for dredging as part of the barge ramp construction. (Illustrated in Appendix F)
Accommodation Camp	Lobs Hole accommodation camp will increase capacity to provide beds for up to 250 personnel. The additional accommodation will be created through an additional storey to the Lobs Hole accommodation camp using modular and stackable accommodation units that will allow the expansion to be entirely within the existing disturbance footprint.
Power Supply	Additional power supply capacity is required to enable TBM tunnelling for Exploratory Works. The Lobs Hole substation proposed under Modification 1 is scheduled to be online from approximately October 2020 and will provide the power supply required for operation of the TBM. It is currently planned to commence tunnelling with the TBM from August 2020. In the period prior to the Lobs Hole substation commissioning the additional power supply required for TBM tunnelling will be provided by additional diesel generator sets. Diesel generator sets with a total capacity of 20 MVa as well as an additional three 65 kL diesel storage tanks will be installed at the portal construction pad. (Illustrated in Appendix F)

2. ENVIRONMENTAL REQUIREMENTS

2.1. Legislation

Legislation relevant to aquatic habitat management includes:

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

2.2. Conditions of Approval

Table 2-1 details the conditions from the Infrastructure Approval which are relevant to aquatic habitat management.

Table 2-1: Conditions of approval relevant to aquatic habitat management

Condition	Requirement	Where addressed
Aquatic Habitat Management Plan		
Sch 3, Cond 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 1.6 of this Plan
	(b) include a description of the measures that would be implemented to: • protect the aquatic habitat outside the approved disturbance areas;	Section 5 of this Plan
	• minimise the loss of key aquatic habitat;	Section 5 of this Plan
	• undertake surveys of the condition of aquatic habitat and the presence of any threatened aquatic species: – in and surrounding the approved disturbance areas prior to disturbing these areas; and – at suitable control sites within the reservoir;	Section 5 Appendix B of this Plan
	• minimise the impacts of the development on threatened fauna species, including the Murray crayfish (*Euastacus armatus*) and Macquarie perch (*Macquaria australasica*);	Section 5 of this Plan Appendix C Appendix E
	• minimise the impact of the development on fish habitat, particularly from the following activities: – in Talbingo Reservoir: ○ subaqueous emplacement;	Section 5 of this Plan Subaqueous Placement Management Plan
	○ dredging;	Section 5 of this Plan Dredging Management Plan

Condition	Requirement	Where addressed
	○ barge infrastructure;	Section 5 of this Plan Dredging management Plan
	○ water treatment outlet;	Section 5.2 of this Plan (pending design)
	○ water intake pipe; and	Section 5.2 of this Plan (pending design)
	○ seismic surveys.	Section 5 of this Plan Subaqueous Placement Management Plan
	– in Yarrangobilly River and Wallaces Creek: ○ Wallaces Creek temporary and permanent bridges; ○ Yarrangobilly River temporary and permanent bridges	Section 5 of this Plan
	• maximise the relocation of any large mobile invertebrates from the shallower parts of the approved disturbance areas prior to disturbing these areas;	Section 5 of this Plan
	• 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 of this Plan Dredging Management Plan Subaqueous Placement Management Plan
	• notify DPI – Fisheries of any fish kills;	Section 5 and Appendix B of this Plan
	(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;	Section 5 and Appendix E of this Plan
	(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 of this Plan
	(e) include a program to monitor and report on the effectiveness of these measures.	Section 6.1 of this Plan
Sch 3, Cond 9	The Proponent must implement the approved Aquatic Habitat Management Plan.	This Plan
Potential Offsets – Murray Crayfish		
Sch 3, Cond 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.	Snowy Hydro

2.3. Revised Environmental Management Measures

Environmental safeguards and management measures are included in the Exploratory Works EIS in Section 6.3. During preparation of the Submissions Report, 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 below. If additional measures are cross-referenced from another section of the Exploratory Works EIS or Submissions Report, these measures are also included. Management measures not related specifically to aquatic habitat have been greyed-out in Table 2-2.

Table 2-2: Management measures relevant to aquatic habitat

Impact	Ref #	Environmental management measure	Where addressed
Impacts to biodiversity	ECO01	The Biodiversity Management Plan (BMP) will include the following: • identification of guidelines relevant to construction, the matters they apply to and what is required to ensure compliance;	Biodiversity Management Plan Aquatic guidelines detailed in Section 2.5 of this Plan
		• pre-disturbance inspection requirements to identify features of conservation significance and select appropriate management measures and environmental controls which will include: – exclusion fencing around all areas of retained significant vegetation and fauna habitat adjacent to construction compounds and the camp (to avoid damage from camp activities); – where works are to be undertaken within the 50 m buffer zone, all vegetation, rocks, logs and other shelter are to be carefully inspected for frog species; and – vegetation clearing is to follow a two-staged process based on non-habitat and habitat vegetation.	Biodiversity Management Plan (BMP)
		• standard precautions and mitigation measures in Fisheries NSW Policy and Guidelines for Fish Habitat Conservation and Management (2013 update) (Fisheries NSW 2013);	Table 5-1
		• tree assessment and management protocols consistent with AS 4970-2009 Protection of trees on development sites; and • terrestrial and aquatic weed, pest and pathogen prevention and management protocols which will include; – construction of wash-down stations or the use of alternate hygiene protocols at suitable locations where practicable; – wash-down or alternate hygiene protocols will be applied to all vehicles prior to movement from Link Road to Lobs Hole Ravine and vice versa where practicable; – implementation of a weed and pathogen monitoring program; – implementation of a weed control program if weeds are identified within the site; – no food waste will be left outside in open areas accessible to feral animals and waste will be stored appropriately in lidded, inaccessible bins and disposed off-site; – remote camera monitoring for feral animals at the accommodation camp; – a predator control program will be implemented, in conjunction with OEH and NPWS, to control feral animals;	BMP

Impact	Ref #	Environmental management measure	Where addressed
		– all equipment and vessel components, such as propellers, hulls, anchors and any other equipment used should be inspected for pest aquatic plants (particularly fragments of Canadian pondweed (Elodea canadensis) known to be present in Talbingo Reservoir) and pest fish; – vessels and vehicles should 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; and – all personnel working within the waters should be instructed on how to identify potential pests.	Table 5-1
		• pre-clearance procedures; and	BMP
		• an unexpected threatened species finds procedure.	Appendix A of this plan
Impacts to threatened species	ECO04	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);	Appendix B of this Plan
		• Smoky Mouse monitoring program; and • Boorolong Frog monitoring program.	BMP
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.	Table 5-1 of this Plan Section 5.2
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 4 and Table 5-1 of this Plan

Impact	Ref #	Environmental management measure	Where addressed
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 4 and Table 5-1 of 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 4 and Section 5 of this Plan
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 4 and Section 5 of this Plan 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:	Subaqueous Placement Management Plan
		• 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;	Surface Water Management Plan
		• the extent of the placement area will be minimised as far as practicable;	Subaqueous Placement Management Plan
		• the extent of the dredge footprint will be minimised as far as practicable;	Table 1-4 and Appendix F

Impact	Ref #	Environmental management measure	Where addressed
		• 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;	Subaqueous Placement Management Plan
		• un-necessary noise and vibration disturbances should be kept to a minimum where practicable to avoid impacts to fish and other aquatic species;	Section 5
		• 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;	Section 5
		• 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;	Section 5 Appendix B
		• 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);	Section 5
		• minimising suspension of sediment and turbidity by implementing WAT14 and WAT15.	Subaqueous Placement Management Plan
Barge ramp establishment	MOD2-001	The following measures will be implemented for barge ramp establishment works at Middle Bay: • all barge ramp construction and dredging works would be closely monitored and carried out according to the Dredge Management Plan, Surface Water Management Plan and Aquatic Habitat Management Plan;	Dredging Management Plan Surface Water Management Plan

Impact	Ref #	Environmental management measure	Where addressed
		• appropriate methods and pre-dredge testing would be implemented so that material is appropriately handled to minimise impacts to aquatic species and habitat; and	
		• removal and subsequent disposal of aquatic macrophytes would be undertaken according to the Dredge Management Plan and / or Waste Management Plan.	

2.4. Permits and Licences

As this project has been designated critical State significant infrastructure and assessed under Part 5 of the *Environmental Planning and Assessment Act 1979* (NSW), permits relating to fish passage or dredging or reclamation works are not required.

Environment Protection Licence (EPL) 21266 has been issued for the Project for the scheduled activity of extractive activities. The EPL details conditions which must be complied with when undertaking the extractive activities works. This plan is written in accordance with all requirements in the EPL.

Future Generation are required to establish an Agreement for Lease (AFL) with NPWS, with an accompanying Works Access Licence in order to carry out the relevant Stage 2 Exploratory Works in accordance with the Exploratory Works EIS, CSSI 9208 and the approved Management Plans.

Ecologists will hold a Scientific Licence under Part 2 of the BC Act (including Animal Ethics Approval under the *Animal Research Act 1985*) for fauna handling/rescue and survey work. Where rescued fauna require rehabilitation and care only wildlife rehabilitation organisations authorised under Part 2 of the BC Act maybe used.

2.5. Guidelines

The guidelines considered in the development and implementation of this management 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;
- 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;
- Department of Sustainability and Environment (2011) - Survey Standards: Spiny Crayfish;
- NSW National Parks & Wildlife Service. 2001. Policy 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 Key Fish Habitat (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 proposed access track improvement work and geotechnical investigations are located at Marica on a ridgeline away from major rivers or watercourses. There are several headwaters of first order watercourses to the immediate west of the main work area which make up the upper reaches of a non-perennial unnamed tributary of the Yarrangobilly River. The remaining boreholes are located close to a mapped non-perennial first order watercourse which drains to the south towards Stable Creek, which flows to the Yarrangobilly River via Wallaces Creek.

Tantangara Reservoir also makes up part of the existing Snowy Hydro Scheme, and it also provides considerable storage for the scheme. Tantangara Reservoir sits at a significantly higher elevation than Talbingo and the main Exploratory Works areas. The main inflows to the reservoir are provided by the Murrumbidgee River to the west, Nungar Creek to the south-west, Mosquito Creek from the north and Kellys Plain Creek from the south. Of most relevance to Modification 1 is Kellys Plain Creek, which has a relatively large upstream catchment area and passes through the existing project access tracks.

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 2 Exploratory Works has potential to impact on aquatic habitat in and around the location of barge access infrastructure, dredge sites and subaqueous placement areas (for dredge spoil and excavated material) and water intakes within the Talbingo Reservoir, as well as from potential overland runoff from on-land surface works along the Yarrangobilly River if not properly controlled.

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.

Overall, the abundance and diversity of native fish fauna in the Talbingo Reservoir is poor. This is due to abundant non-native species which would prey on native species. The fluctuations in water levels due to operation of hydroelectric power generation from the reservoir Talbingo Dam wall and the associated periodic exposure of shallow aquatic habitats, as a result of those fluctuations, could also be influencing fish diversity in the reservoir (Cardno 2018).

As part of Modification 2 Assessment, a shoreline inspection was undertaken on 30 July 2019 to assess the area of the Yarrangobilly River shoreline specific to the Modification 2 barge ramp relocation. The location of the Middle Bay barge ramp is proposed to move approximately 300m west of the existing barge ramp location.

The proposed area was similar in nature to the original site with steep, often vertical banks, consisting of unconsolidated rock, occasional boulders and soft sediments with patches of *Juncus sp*. and other grasses immediately above the water line. The shoreline was notably eroded and slumping in sections along the extent of the Modification 2 footprint. However, this area of shoreline could provide habitat for Murray crayfish.

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). Murray crayfish is known to occur in Yarrangobilly River, Wallaces Creek and Talbingo Reservoir.

Suitable habitat for Macquarie perch (listed as 'endangered' under the FM Act and EPBC Act) 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 Exploratory Works 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.

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

Table 3-1: Threatened aquatic fauna

Common Name	Scientific Name	FM Act	EPBC Act
Murray crayfish	*Euastacus armatus*	Vulnerable	Not listed

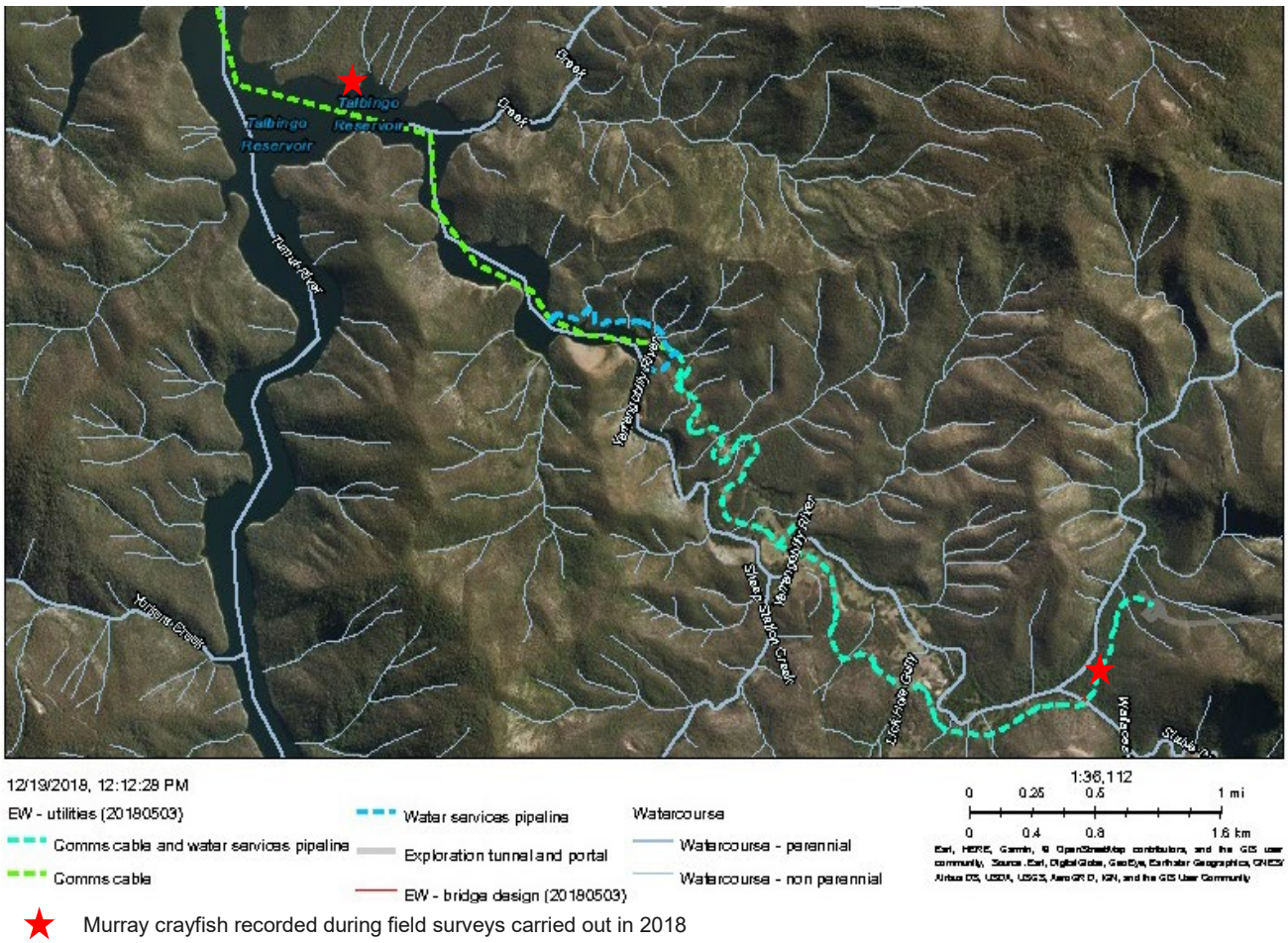


Figure 3-1: Threatened aquatic species identified during aquatic surveys

3.4. Aquatic Weeds, Pests and Diseases

Elodea canadensis (Canadian Pondweed) 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.

Perca fluviatilis (Redfin Perch), *Gambusia holbrooki* (Eastern Gambusia) and *Carassius auratus* Goldfish) 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 iridovirus 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 Stage 2 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, are addressed within the:

- Excavated Material Management Plan;
- Subaqueous Placement Management Plan; and
- Dredging Management Plan.

Table 4-1: Aquatic habitat aspects, impacts and environmental factors – Exploratory Works Stage 2

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 • Soil movement and transfer • Extraction of Potable and Construction Water from Talbingo Reservoir • Material stockpiles and emplacement areas • Operation of compounds • Dredging • Barge access infrastructure construction • Subaqueous placement of dredge material and excavated material • Geotechnical investigations on the reservoir	• 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) • Potential for hydraulic oil or fuel spill	• 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 Exploratory Works EIS, Submissions Report and the CoA. 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. The measures are applicable to Stage 2 scope of works. However Stage 1 mitigation measures/requirements have been included for completeness.

Table 5-1: Aquatic habitat management measures

ID	Measure / Requirement	Stage	When to implement	Responsibility	Source document
General					
AqH01	Training will be provided to all project personnel, including relevant sub-contractors on aquatic habitat management practices, threatened species identification and reporting and other requirements from this plan through inductions, toolbox talks and targeted training.	Stage 2	Construction	Contractor	Good practice
AqH02	Relevant aquatic habitat management measures from this plan will be included in site environmental documents including for example, Work Method Statements (WMS) and/or Site Environmental Plans (SEPs) and/or Construction Management Plans (CMPs).	Stage 1 Stage 2	Construction	Contractor	Good practice
AqH03	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 EMS.	Stage 1 Stage 2	Construction	Contractor	Good practice
AqH04	In the event that threatened species or endangered ecological communities are unexpectedly identified during construction the Unexpected Threatened Species Procedure included in Appendix A will be followed.	Stage 2	Construction	Contractor	REMM ECO01
AqH05	In the event of the discovery of any fish kills within or adjacent to the work area, DPI Fisheries are to be notified in accordance with Appendix D. DPIE are to be notified in writing immediately after SHL becomes aware of an incident in accordance with Section 6 of the EMS and schedule 4, condition 5 of the Approval.	Stage 1 Stage 2	Construction	Contractor	Sch 3, Cond 7 (b) Sch 4, Cond 5
AqH06	Prior to commencing temporary and permanent bridge works a daily visual inspection for crayfish is to be carried out within the work areas in accordance with Appendix B. Ecologists will check areas within Yarrangobilly River and Wallace Creek prior to disturbance and clearing for Murray crayfish 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	Good practice
AqH07	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
AqH08	The water pipeline intake from the Talbingo reservoir will be designed to prevent adult fish from entering the intake and discourage adult fish from approaching the intake, placed in deeper water, where possible with volume phasing.	Stage 2	Construction	Contractor	Good practice
AqH09	Prior to commencing the barge ramp construction appropriate methods and pre-dredge testing would be implemented so that material is appropriately handled to minimise impacts to aquatic species and habitat. The testing will occur in accordance with the Dredging Management Plan.	Stage 2	Construction	Contractor	Modification 2, Table 7.1

ID	Measure / Requirement	Stage	When to implement	Responsibility	Source document
Aquatic habitat and threatened species					
AqH10	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
AqH11	The permanent bridges at Yarrangobilly River and at Wallaces Creek will be designed to comply with the 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 (*Macquaria australasica*)) will be minimised.	Stage 1	Design	Contractor	Sch 3, Cond 40 REMM ECO11

ID	Measure / Requirement	Stage	When to implement	Responsibility	Source document
AqH12	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
AqH13	Construction and removal of the temporary bridge 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
AqH14	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	Good practice
AqH15	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	Good practice EIS App G Table 5-5
AqH16	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	Good practice EIS App G Table 5-5

ID	Measure / Requirement	Stage	When to implement	Responsibility	Source document
AqH17	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	Good practice EIS App G Table 5-5
AqH18	The clearing limits/disturbance footprint will be delineated using highly visible, durable, continuous barrier such as safety flagging, UV-stabilised rope 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	Good practice Sch 3, Cond 8 (b)
AqH19	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. In the event that the Dredging Management Plan or Subaqueous Management Plan are approved, woody debris will be salvaged from the shallower areas of the dredging area and subaqueous emplacement area prior to disturbance.	Stage 1 Stage 2	Construction	Contractor	Sch 3, Cond 8 (b) EIS App G Table 5-5
AqH20	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	Good practice
AqH21	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	Good practice EIS App G Table 5-5
AqH22	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; • the preferred temporary structure for crossing waterways would be consistent with Witheridge (2002) where the use of bridges is the preferred structure for Class 1 (major fish habitat waterways); • scour protection works would be established at temporary crossings as required; • at the completion of construction, of the permanent bridges the temporary crossings would be removed and rehabilitated; • translocation of aquatic fauna needs to be carried out by a suitably qualified and permitted operator.	Stage 1 Stage 2	Construction	Contractor	REMM ECO12 EIS App G Table 5-5

ID	Measure / Requirement	Stage	When to implement	Responsibility	Source document
AqH23	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
AqH24	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
AqH25	Prior to construction in Talbingo reservoir, the disturbance area of that construction activity will be surveyed for aquatic species habitat in accordance with the Aquatic Habitat Monitoring Program (Appendix B).	Stage 2	Construction	Contractor	Sch 3, Cond 8 (b) REMM ECO15
AqH26	During construction activities in aquatic environments including Yarrangobilly River or Talbingo Reservoir the Aquatic Habitat Monitoring Program (Appendix B) will be implemented for the specific work area.	Stage 2	Construction	Contractor	Sch 3, Cond 8 (b) REMM ECO04 REMM ECO15
Aquatic weeds, pests and disease					
AqH27	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 Elodea canadensis (Canadian Pondweed) known to be present in Talbingo Reservoir) and pest fish.	Stage 1 Stage 2	Construction	Contractor	REMM ECO01
AqH28	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
AqH29	All personnel working within the waters would be instructed on how to identify potential pests.	Stage 1 Stage 2	Construction	Contractor	REMM ECO01
AqH30	Visual inspections for Canadian Pondweed 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 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.

Staff training will be provided by the Project Ecologist or a qualified person on identifying threatened aquatic species. This training may be in the form of toolbox talks or specific training, which will include photographs and explanation of key identifying features. This training will also include explanation of the unexpected finds process for threatened species outlined in the Biodiversity Management Plan.

5.2. Water Intake and Outlet

The water pipeline intake at the Talbingo Reservoir will be designed to prevent adult fish from entering the intake and discourage adult fish from approaching the intake, placed in deeper water, where possible with volume phasing.

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.

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 5 of the Surface Water Management Plan. Water quality monitoring undertaken include:
  - comprehensive receiving water quality monitoring within the Yarrangobilly River and Wallaces Creek;
  - basic receiving water quality monitoring within the Yarrangobilly River and Wallaces Creek daily during periods of basin discharge;
  - comprehensive sediment basin overflow 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 8 of the EMS will be implemented. In addition, effectiveness of the implemented management measures will be monitored in accordance with the EMS Section 8. 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 8 of the EMS or an environmental incident report completed in accordance with Section 7 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 5 of the EMS.

6.3. Incidents

Incidents will be managed in accordance with Section 7 of the EMS. In the event of the occurrence of an incident, the Future Generation Environment Manager will immediately inform Snowy Hydro who will contact Department of Planning, Industry and Environment in accordance with the requirements of Schedule 4, Condition 5 of the Infrastructure Approval.

6.4. Auditing

Audits will be undertaken to assess the effectiveness of the management measures, compliance with this AqHMP, the draft baseline conditions, the Exploratory Works EIS, Submissions Reports and other relevant approvals, licences and guidelines. Audit requirements are detailed in Section 8.3 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 consent conditions and the REMMs. Compliance reporting will be undertaken in accordance with Schedule 4, Condition 7 and 8 of the Infrastructure Approval. Reporting requirements and responsibilities are documented in Section 8.4 of the EMS.

The monthly internal project reports and six monthly compliance report will include the following:

- unexpected threatened aquatic species finds (details on Appendix A of this Plan), if there is any;
- threatened species and aquatic habitat monitoring (details on Appendix B of this Plan);
- aquatic habitat restoration program report, following completion of development in disturbed aquatic habitats (details on Appendix C of this Plan);
- internal fish kill reporting protocol, in case of fish kill occurrence (details on Appendix D of this Plan); and
- Murray Crayfish trigger action and response reporting, in occurrence of Level 1 and Level 2 triggers (details on Appendix E of this Plan).

7. REFERENCES

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

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.

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.

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.

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.

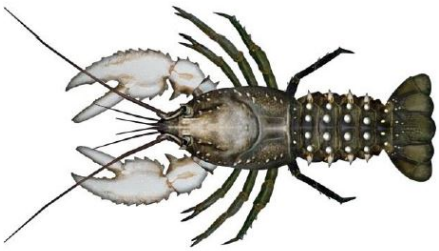
Underwood, A. J. (1992). Beyond BACI: the detection of environmental impacts on populations in the real, but variable, world. Journal of Experimental Marine Biology and Ecology, 161(2), 145-178. doi:http://dx.doi.org/10.1016/0022-0981(92)90094-Q

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

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 works will take place include:

Murray crayfish (*Euastacus armatus*)



Macquarie perch (*Macquaria australasica*)

Works undertaken as part of Stage 2 Exploratory Works will be unlikely to directly impact on preferred habitat for these species in the vicinity of Yarrangobilly River, Wallaces Creek and other smaller unnamed watercourses. The reporting of Murray crayfish in Talbingo Reservoir during surveys conducted in 2018 was attributed to the presence of this species in the Yarrangobilly River rather than Talbingo reservoir (Cardno 2018). The Macquarie perch was not recorded at any sites during surveys undertaken in 2018. The likelihood of occurrence of both of these species in Talbingo reservoir is considered low (Cardno 2018).

Although unlikely it is possible that these species could be detected during construction works. Works areas in proximity to the confluence of Talbingo Reservoir and Yarrangobilly River (particularly where the previous sighting of Murray crayfish were recorded) should be regularly monitored by site staff and contractors for Murray crayfish. 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

Stop Work and contact the Environmental 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 and DPI 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.

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.

3. Relocation PROCEDURE

Any individuals of the threatened species should be observed to see if they are able to relocate themselves.

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 and approvals. Ecologists will hold a Scientific Licence under Part 2 of the BC Act (including Animal Ethics Approval under the Animal Research Act 1985) for fauna handling/rescue and survey work. Where rescued fauna require rehabilitation and care only wildlife rehabilitation organisations authorised under Part 2 of the BC Act maybe used.

Details of any relocation activities should be recorded.

4. Record information

Record information including:

- location of sighting including GPS Coordinates (if possible);
- nearest road;
- 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);
- time of day;
- observations of water quality (turbid, presence of algae, surface scum, odour);
- preliminary identification;
- photographs or video to assist in confirming identification;
- number of individuals;
- condition of individuals;
- any immediate risks to the fish/crayfish; and

- details of any relocation activities undertaken.

APPENDIX B THREATENED SPECIES AND AQUATIC HABITAT MONITORING PROGRAM

B1 Background

This Threatened Species and Aquatic Habitat Monitoring Program has been prepared for the Stage 2 Exploratory Works 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.

B2 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. Other objectives of the monitoring program may include quantifying the existing condition of the aquatic habitat and the distribution and abundance of the threatened species; comprehensively monitoring the distribution and abundance during and post construction, and; initiation of the trigger action response plan if the development is shown to have adversely affected the species. This monitoring program has been prepared to address general construction activities occurring in aquatic habitats only. Dredging and subaqueous emplacement will be monitored in accordance with the Dredging Management Plan and the Subaqueous Placement Management Plan respectively.

B3 Monitoring program framework

B3.1 Development of the monitoring program

Aquatic habitat monitoring will be carried out in relation to construction activities being undertaken for Exploratory Works. Monitoring activities may be customised to the relevant construction activity being undertaken (as detailed in section B3.2 below). As the scope of works for each construction activity is established and a work methodology proposed, the monitoring program will be implemented for that activity.

If the monitoring program detects adverse impacts to Murray Crayfish habitat then the Murray Crayfish TARP will be implemented (APPENDIX E).

B3.2 Aquatic habitat monitoring phases

A summary of the monitoring phases is provided in Table B-1 with further detail included in Section B4.

The initial monitoring phase involves assessment and mapping of Murray Crayfish habitat in and adjacent to the disturbance area. In the event that suitable Murray Crayfish habitat is found, further monitoring will occur during the relevant construction activity.

Table B 1: Phases of habitat monitoring program

Monitoring Survey Phase	Location	Timing*	Survey interval*	Responsibility
Initial assessment (prior to disturbance)				
Habitat Assessment (Section B4.1)	Known disturbance area	Conduct at least two weeks prior to disturbance	Once for each disturbance area	Project Ecologist
Activity-specific monitoring (during disturbance)				
Habitat monitoring (Section B4.2)	Mapped aquatic habitats^ within 50m of the disturbance area and control site/s.	Begin two weeks after the commencement of construction activities. Complete with cessation of the relevant in-water construction activities.	Monthly for the duration of relevant construction works	Project Ecologist
Daily observations and inspections (Section B4.3)	Immediate works area	For the duration of in-water construction works	Daily	Site personnel
* Survey interval and completion timing may be adjusted if monitoring results indicate the need to do so. This may include increasing or decreasing the frequency of monitoring activities.				

B3.3 Monitoring site selection

The survey sites will be determined following habitat assessment for each construction activity disturbance area. Details of the survey sites, including a description and location, for activity-specific monitoring will be included in the monitoring reports. Section B3.3.1 and B3.3.2 address the criteria for impact and control site selection that will be employed by the Project Ecologist.

B3.3.1 Impact sites

These survey sites will consist of areas of habitat that have been mapped during the initial habitat assessment for the disturbance area of the relevant construction activity. If no suitable aquatic habitat was identified in the habitat assessment (see section B4.1) for the impact area, then aquatic habitat monitoring is not required for construction activities in the relevant disturbance area.

The impact survey sites for each activity would include representative habitat patches occurring within a 50 metre buffer of the disturbance area for the relevant activity. The immediate area directly being impacted by the works would not be monitored because those impacts (clearing, removal, dredging etc.) are known, and in accordance with the approved project, that habitat will be removed. An example of this would be any habitat found within the footprint of the barge ramp. Rather monitoring will assess any adjoining sites associated with the construction activity and for this reason impact sites should be located within 50m of the direct disturbance area, but outside the silt curtain.

Survey sites may be combined into a single survey unit or treated separately if they are spatially discontinuous.

B3.3.2 Control sites

Control sites are only required as a correlate to impact sites. Therefore, if no habitat has been identified in the disturbance area there will be no need for monitoring of impacts sites or control sites. Where monitoring is required at least two control sites will be identified. These control sites will be selected based on the following criteria:

- consist of the same type of habitat features as the relevant impact site;
- are located within the same sub-catchment of the reservoir;
- have the same aspect of the impact sites; and
- are located at least 250 metres from the impact site where possible (or other distance appropriate to establish independence from the impact area).

Two locations were proposed for aquatic habitat monitoring purposes during the Exploratory Works EIS:

- Cascade Bay within the Talbingo reservoir; and
- upstream of surface water monitoring point RW_16 within the Yarrangobilly River. This location is upstream of all Stage 2 works in Talbingo reservoir.

These general locations may be used to identify suitable control sites, however, the Project Ecologist has discretion to nominate alternative control survey sites based on the above criteria.

B3.4 Monitoring criteria

The key mechanism for impacting on aquatic environments will be mobilisation of large amounts of coarse sediment, which clog the interstitial spaces that provide key fish habitat, or long term negative changes to water quality. It is these aspects that will be primarily monitored during construction activities in Talbingo Reservoir. The aquatic habitat monitoring will survey the impact and control sites for evidence of increased turbidity, smothering/burial of habitats and interstitial spaces, aquatic fauna mortality and increased prevalence of aquatic weeds (more detail in section B4). Where the impact sites have been assessed as absent of suitable aquatic habitat (as per section B4.1) then no further habitat monitoring will be required.

B4 Survey activities

B4.1 Habitat assessment

B4.1.1 Study area

Prior to in-water construction activities a survey will be carried out to ascertain the prevalence of aquatic fauna habitat features within and near to the relevant disturbance area. The study area for the habitat assessment will include the known disturbance area plus a buffer of 50 metres and will include the reservoir bank and reservoir bed to a depth of up to 10 metres. The initial habitat assessment study area will cover the known disturbance area for:

- barge access infrastructure;
- communications cable burial locations; and
- water intake and outfall locations.

The initial habitat assessment study area is shown in Figure B 1 below.

Additional habitat assessment surveys will be carried out once the location for subaqueous emplacement and dredging are identified and prior to those activities being undertaken.

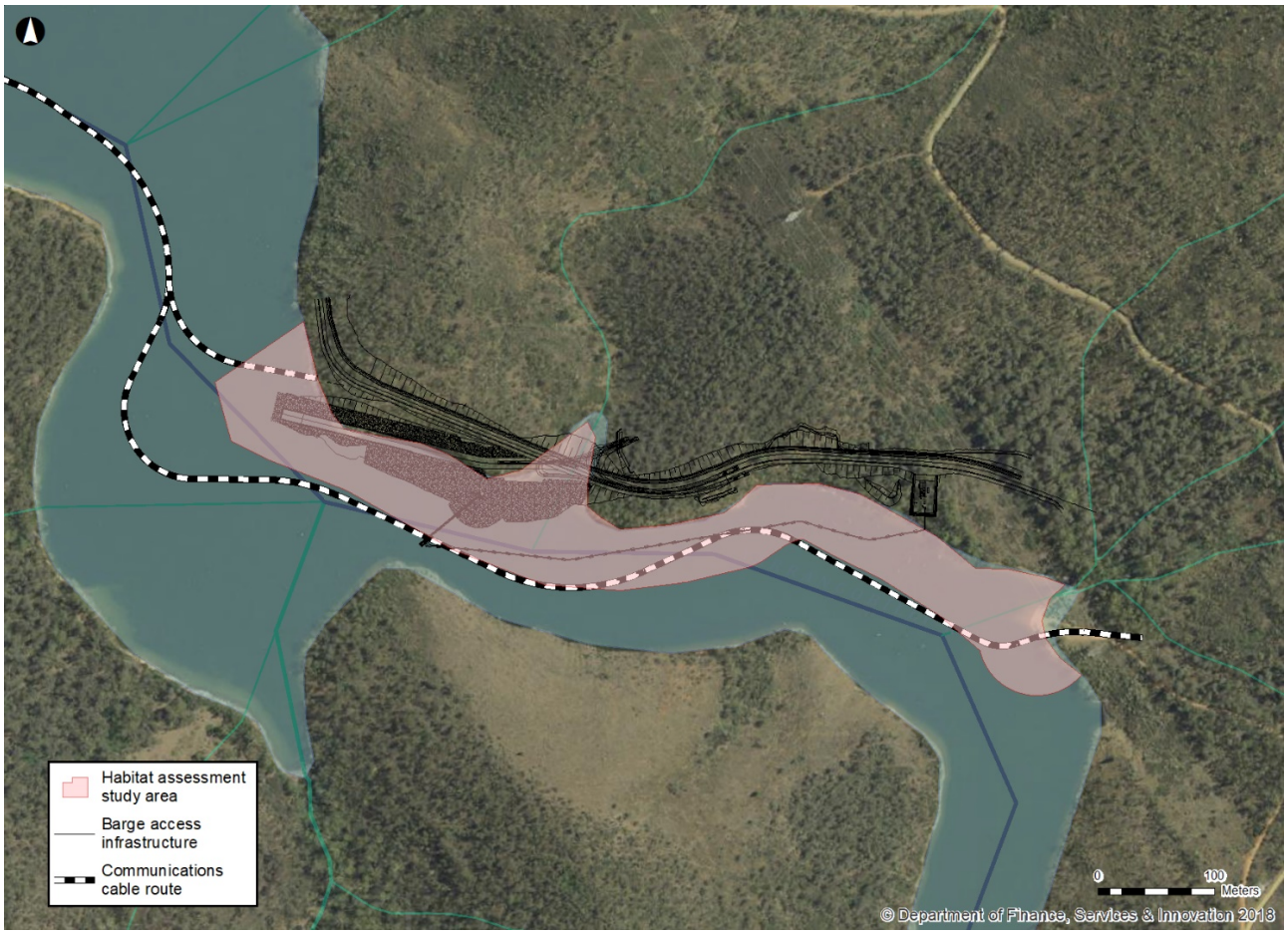


Figure B 1: General construction habitat assessment study area

B4.1.2 Habitat assessment methodology

Habitat assessment will consist of two components:

- reservoir bank habitat visual survey for crayfish burrows; and
- reservoir bed submerged aquatic habitat survey (up to 10m depth).

The reservoir bank survey area will be traversed on foot or by water if necessary. The **bank habitat visual survey** will consist of:

- visual observation/search (along whole study area):
  - for signs of crayfish burrowing activity;
  - for exoskeleton remnants (i.e. from moult or predation);
- physical search (along whole study area):
  - collecting by hand, looking under structure (rocks, logs, undercut banks, inside timber);
  - burrow excavation (only required if burrows located within the disturbance area);
- Mapping of observations:

- GPS coordinates taken for location of burrows, exoskeletons or actual crayfish observations.

Any crayfish seen or collected from the impact areas, will be removed prior to construction and translocated (by a suitably qualified and licensed ecologist) to suitable habitat elsewhere in the reservoir. Release locations will be determined in consultation with DPI Fisheries.

Reservoir bed submerged habitat survey will be conducted by ecologists from a boat using a submerged underwater camera or by swimming in snorkel/scuba equipment. The ecologist will traverse the study area and will collect observations, GPS coordinates and photographs (where possible) of the following habitat features:

- aquatic macrophytes;
- submerged timber;
- rocky rubble;
- crayfish burrows;
- incidental crayfish observations; and
- any other observations of habitat significance.

The submerged habitat surveys will not occur during periods of high turbidity (i.e. not directly after a rainfall event causing surface water runoff into the study area) where visibility would impede the survey effectiveness.

B4.1.3 Aquatic habitat mapping

The Project Ecologist will prepare a summary report for Future Generation which includes a description of their observations and mapping of recorded habitat features. The mapping of aquatic habitats will inform the locations for further monitoring work associated with construction activities as detailed in section B4.2. Only locations identified as having suitable aquatic habitat features (as per section B4.1.2) will require further aquatic habitat monitoring.

B4.2 Habitat monitoring

Habitat monitoring will be undertaken in areas identified in the initial habitat assessment as having suitable aquatic habitat for Murray Crayfish. A habitat assessment is underway for the impact area of the location of known general construction activities (study area mapped in Figure B 1). The scope of the aquatic habitat monitoring activities will be determined following the habitat assessment in accordance with section B3.3 and B3.4 for the timing identified in Table B 1.

B4.2.1 Dredging and subaqueous emplacement monitoring

Upon identification of areas targeted for dredging and subaqueous emplacement a habitat assessment survey will be undertaken as per section B4.1. Should the habitat assessment identify aquatic habitat features within the study area then habitat monitoring will be required during the timeframes detailed in Table B 1. Where appropriate, habitat monitoring will involve observing the monitoring criteria detailed in section B3.4.

B4.3 Daily observations and inspection

As outlined in section 5 of the AqHMP site personnel will be educated about identification of Murray crayfish and, where appropriate, the presence of known suitable habitat in the vicinity of the

works area. Site personnel will report observations of Murray crayfish in the works area and the Unexpected Threatened Species Finds Procedure (APPENDIX A) will be followed.

Daily inspections during bridge works at river crossings will be carried out in accordance with section 5 of the AqHMP.

B5 Project ecologist

A suitably qualified ecologist will undertake the initial aquatic habitat and threatened species surveys. The Project Ecologist will have a minimum of three years' experience and an OEH scientific licence and Section 37 Licence in accordance with the FM Act. The aquatic habitat would be visually assessed.

B6 Reporting

Monitoring reports will be prepared by the Project Ecologists and provided to Future Generation promptly following each survey. Reporting of monitoring activities will be included in the daily inspection sheet developed for the project.

APPENDIX C AQUATIC HABITAT RESTORATION PROGRAM

C1 Introduction

As part of AqHMP, a number of conditions have been issued that require management options to minimise and control potential impacts on aquatic habitat.

For Stage 2 of the project this includes a program to restore and enhance any aquatic habitat that has been disturbed/impacted as part of the Stage 2 scope of works (Refer to Section 1.7).

As part of the works, barge access infrastructure, dredge sites and subaqueous placement areas (for dredge spoil and excavated material) and water intakes within the Talbingo Reservoir at Middle Bay would be constructed. 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 and removal of snags (large woody debris and large rocks) from waterways.

As such, it is required that woody debris is salvaged and relocated to enhance the habitat value of other parts of the reservoir.

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

The monitoring methods applied for the Threatened Species and Aquatic Habitat Monitoring Program (Appendix B) will also be applied for the Restoration monitoring. Response processes consistent with the Murray Crayfish TARP and Unexpected Finds of threatened species will continue to be implemented throughout the Restoration monitoring.

C2 Restoration of cleared riparian vegetation from Stage 2 riparian zone works

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

The riparian zone within the vicinity of the bank works at Middle Bay are well vegetated. 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.

C3 Restoration of snags impacted from Stage 2 riparian zone works

The removal of snags, which includes reservoir 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 Middle Bay within the vicinity of the construction works;
- if snags are required to be removed from the reservoir 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.

Exact locations for habitat enhancement and/or restoration will be completed following detailed site survey and will be directed by the project ecologist and other subject matter specialists as deemed necessary. These locations will be established in consultation with Snowy Hydro, NPWS, DPI Fisheries.

C4 Timeframes for restoration and restoration benchmarks

A program will be implemented to restore and enhance the aquatic habitat of the approved disturbance area as soon as practicable following completion of the development in these areas. This will be informed by detailed construction programs at the completion of the design phase.

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 Future Generation project manager

The Project Manager should contact the Future Generation Environmental Manager. Information recorded in Step 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

Record information including:

- location of sighting including GPS Coordinates (if possible);
- nearest road;
- 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);
- time of day;
- observations of water quality (turbid, presence of algae, surface scum, odour);
- preliminary identification;
- photographs or video to assist in confirming identification;
- number of individuals;
- condition of individuals;
- any immediate risks to the fish/crayfish.

3. Contact Snowy Hydro environment manager

4. Contact DPI Fisheries as per the protocol outlined below.

The Project Manager should contact the Future Generation Environmental Manager. Information recorded in Step 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 Future Generation Environmental Manager will contact DPI Fisheries.

EXTERNAL NOTIFICATION PROTOCOL FOR REPORTING AND INVESTIGATING FISH KILLS

Information on fish kills is available at: www.dpi.nsw.gov.au/fisheries/habitat/threats/fish-kills

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]**. Officers of the Department of Primary Industries (DPI) 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) for their information. Each agency is responsible for information exchange within their respective departments.

APPENDIX E MURRAY CRAYFISH TRIGGER ACTION AND RESPONSE PLAN (TARP)

E1 Overview

This Trigger Action Response Plan (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 2 are shown in the Surface Water Management Plan.

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 Talbingo Reservoir, Yarrangobilly River and Wallaces Creek. A summary is provided in Table E 2.

E2 Application of the TARP

This TARP will only be applicable to monitored habitats identified within close proximity to the disturbance area of the project as mapped during the habitat assessments of the Aquatic Habitat Monitoring Program (Appendix B). If viable Murray Crayfish habitat is not present within the impact area being monitored then there is no need to trigger the TARP as no impact would be expected to occur to the species.

E3 Trigger and response

As detailed in section E2, the following trigger and response process will only be implemented for triggers observed in mapped habitat through habitat assessment in the Aquatic Habitat Monitoring Program. Triggers may be observed through aquatic habitat monitoring activities, surface water monitoring activities or incidental observations of personnel (e.g. staff discover a dead crayfish on site).

Level 1 trigger

Table E 1 details the criteria for a Level 1 trigger. Adverse water quality impacts including increased salinity or turbidity, or decreased dissolved oxygen outside the specified thresholds would constitute a Level 1 trigger. Evidence of habitat impacts occurring at impact sites but not control sites would also constitute a Level 1 trigger.

Level 1 response

Site inspections would be undertaken at locations where exceedances are reported. An assessment would be undertaken to determine whether the Level 1 trigger has been caused by Project activities. A comparison to the control site would be required. 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 Level 1 TARP trigger.

Level 2 trigger

A Level 2 Trigger occurs when a Level 1 event is found to be attributed to the project or when any of the other trigger criteria exceed the parameters listed within Table E 1.

Level 2 response

An investigation into the specific cause of the exceedance should be carried out when a Level 1 trigger has been determined to result from Project activities. Where reasonable and feasible, additional management measures will be implemented to minimise the potential for recurrence of the trigger exceedance.

An assessment of the risk level for Murray crayfish shall be carried out in consultation with Snowy Hydro, the project ecologist and DPI Fisheries using a standard risk assessment framework which considers the existing knowledge of the environmental tolerances of Murray crayfish. This assessment will take into consideration the impact area, the condition of the habitat being affected and the likelihood that Murray crayfish are present in the impact area.

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 impact areas determined to present a moderate to high risk to the species. Translocation will be carried out in consultation with the project ecologist, Snowy Hydro and NSW DPI (Fisheries) officers.

In accordance with Schedule 3, Condition 10 of the approval, if the Planning Secretary determines, after reviewing monitoring results, that the project has had a significant impact on the Murray Crayfish population in the Talbingo Reservoir, then Snowy Hydro will be required to offset these impacts to the satisfaction of the Planning Secretary.

Table E 1: Exploratory Works Murray Crayfish Trigger Action Response Plan

Normal (Baseline) Status	Level 1 Trigger	Level 2 Trigger
Monitoring activity		
N/A	• Results of aquatic habitat monitoring • Results of surface water monitoring show exceedance of trigger criteria below	• Cause for Level 1 Trigger attributed to project • Results of surface water monitoring • Results of aquatic habitat monitoring • Mortality of Murray crayfish observed within project disturbance area.
Water quality monitoring triggers*		
• Water quality indicators within range of natural variability for that season	• Water monitoring show exceedance of – **temperature;** – **pH;** – **salinity**; and/or – **dissolved oxygen**, below 10th or 90th percentile exceedance of one or more water quality indicator for > 5 consecutive days within Yarrangobilly River, Wallaces Creek or Talbingo reservoir in vicinity of aquatic construction disturbance areas	• 20th or 80th percentile exceedance of – **temperature;** – **pH;** – **salinity; and/or** – **dissolved oxygen,** for > 3 consecutive days within Yarrangobilly River and Wallaces Creek or Talbingo reservoir in vicinity of aquatic construction disturbance areas and/or • **Level of risk to Murray Crayfish assessed as moderate to high**

Normal (Baseline) Status	Level 1 Trigger	Level 2 Trigger
• Water quality indicators within range of natural variability for that season	• Water monitoring show 90th percentile exceedance of **turbidity** for > 5 consecutive results within Yarrangobilly River, Wallaces Creek or Talbingo reservoir in vicinity of aquatic construction disturbance areas	• Water monitoring show 80th percentile exceedance of **turbidity** for > 3 consecutive results within Yarrangobilly River and Wallaces Creek or Talbingo reservoir in vicinity of aquatic construction disturbance areas; and/or • **Level of risk to Murray Crayfish assessed as moderate to high**
Aquatic Habitat monitoring triggers^		
• Qualitative comparison of control site habitat features	• Results of aquatic habitat monitoring during construction show adverse impact of present habitat features at disturbance area monitoring sites Adverse impacts may include: – visual evidence of increased turbidity; – visual evidence of smothering/burial of habitats and interstitial spaces; or – increased prevalence of aquatic weeds.	• Results of aquatic habitat monitoring during construction show adverse impact of present habitat features at disturbance area monitoring sites despite the implementation of revised management measures. Adverse impacts may include: – visual evidence of increased turbidity; – visual evidence of smothering/burial of habitats and interstitial spaces; or – increased prevalence of aquatic weeds. • Murray crayfish mortality observed within monitoring area • **Level of risk to Murray Crayfish assessed as moderate to high**
Monitoring actions in response to trigger (monitoring sub-contractor)		
• Continue with routine monitoring at control sites	• If triggered by water quality then undertake habitat survey at impact sites where water quality exceedances were reported and promptly provide results to FGJV. • If triggered by habitat monitoring, conduct water quality survey at the relevant impact site/s to determine if water quality exceedances may be a contributing factor. Promptly provide results to FGJV.	• Undertake water quality and/or habitat surveys at relevant locations where adverse impacts are reported. • Initiate a reactive monitoring survey, potentially involving more detailed assessment, increased frequency/duration etc. if further data is required to determine risk to Murray crayfish and pinpoint the source of issue. • Promptly provide report to FGJV

Normal (Baseline) Status	Level 1 Trigger	Level 2 Trigger
Management action (contractor in consultation with Snowy Hydro)		
• NA	• Undertake assessment to determine whether the cause of water quality / aquatic habitat exceedances are related to Project activities. **If cause can be attributed to Project related activities, then Level 2 trigger is initiated**	• Review management of construction activities to attempt to prevent repeat exceedance triggering • Where revised management measures have failed to mitigate impact, assess level of risk to Murray crayfish 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 from 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 Level 1 TARP triggering.	• Snowy Hydro to be notified within 24 hours of Level 2 TARP triggering. • Where the Level 2 Trigger is attributed to the Project, initiate the incident investigation and reporting protocols in accordance with Section 6.1of the AqHMP and Section 6 of the EMS. • Document details of any individuals captured and translocated to Snowy Hydro and NSW DPI (Fisheries).
* Trigger parameters and the survey/analysis method are detailed in Table E 2 ^ Aquatic habitat features are further detailed in the Aquatic Habitat Monitoring Program (Appendix B of AqHMP)		

Table E 2: Monitoring parameters and analysis methods

Category	Proposed sampling analytes	Analysis method
Water quality indicators		
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
Visual inspection	Visible oil and grease on water surface	Visual inspection of erosion and sediment controls, downstream drainage and clean water diversions and aquatic construction disturbance sites.

APPENDIX F FIGURES EXPLORATORY WORKS – PROJECT BOUNDARY

APPENDIX 2 – SITE LAYOUT

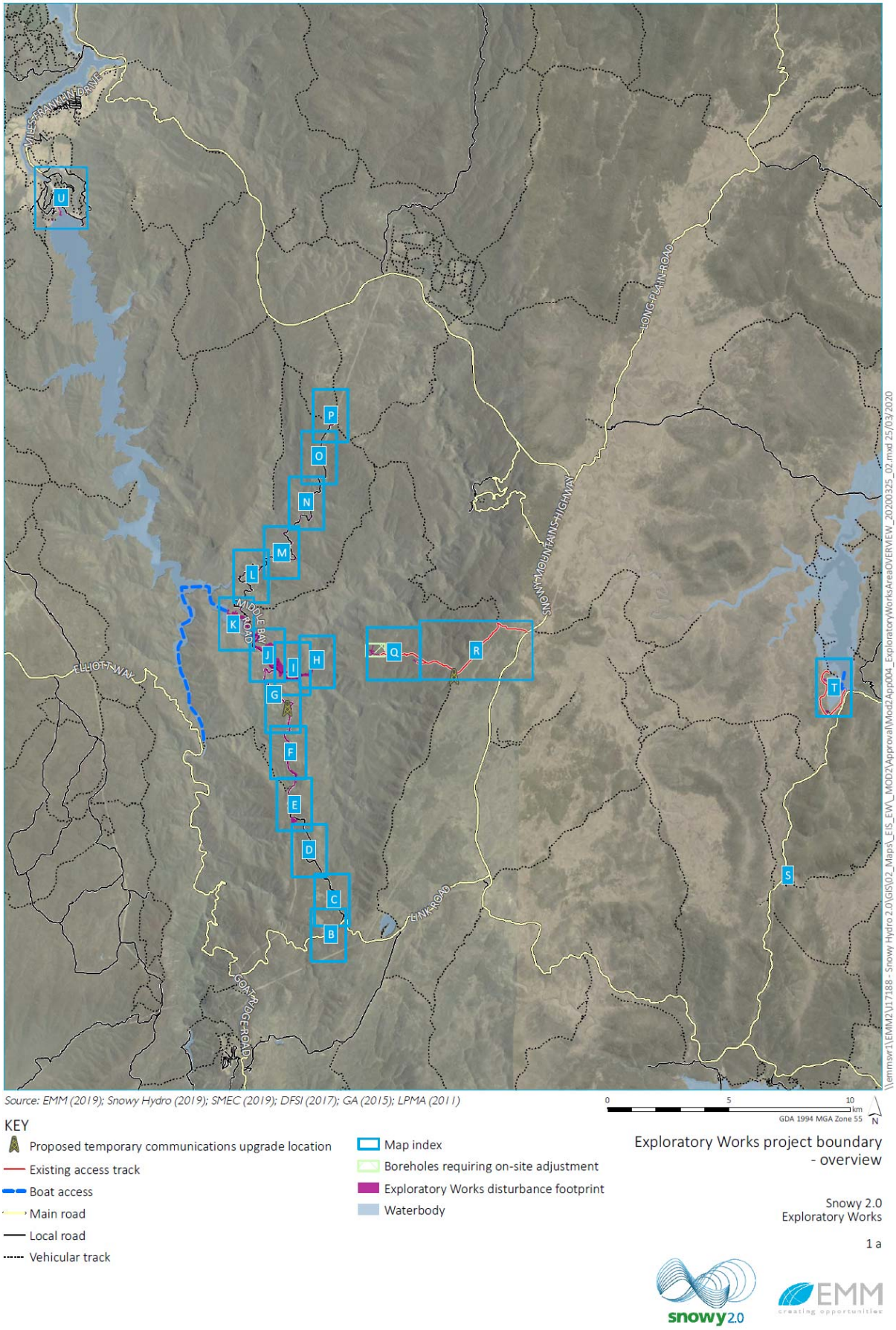


Figure 2-1: Project *Boundary – Overview*

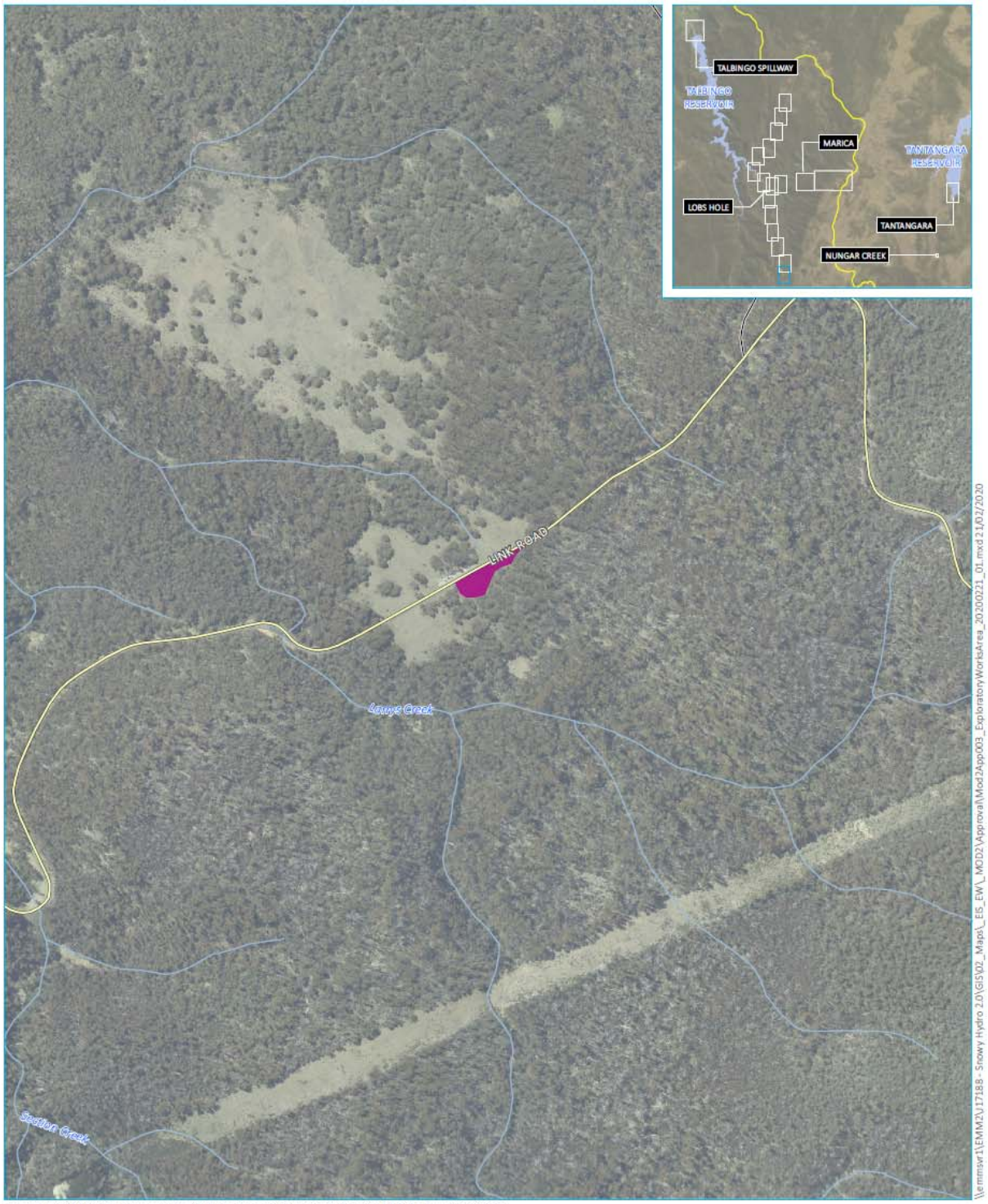


Figure 2-2: *Project Boundary – Link Road turnaround area*

Figure 2-3: *Project Boundary – Lobs Hole Ravine Road (Upper) 1*

Figure 2-4: *Project Boundary – Lobs Hole Ravine Road (Upper) 2*

Figure 2-5: *Project Boundary – Lobs Hole Ravine Road (Upper) 3*

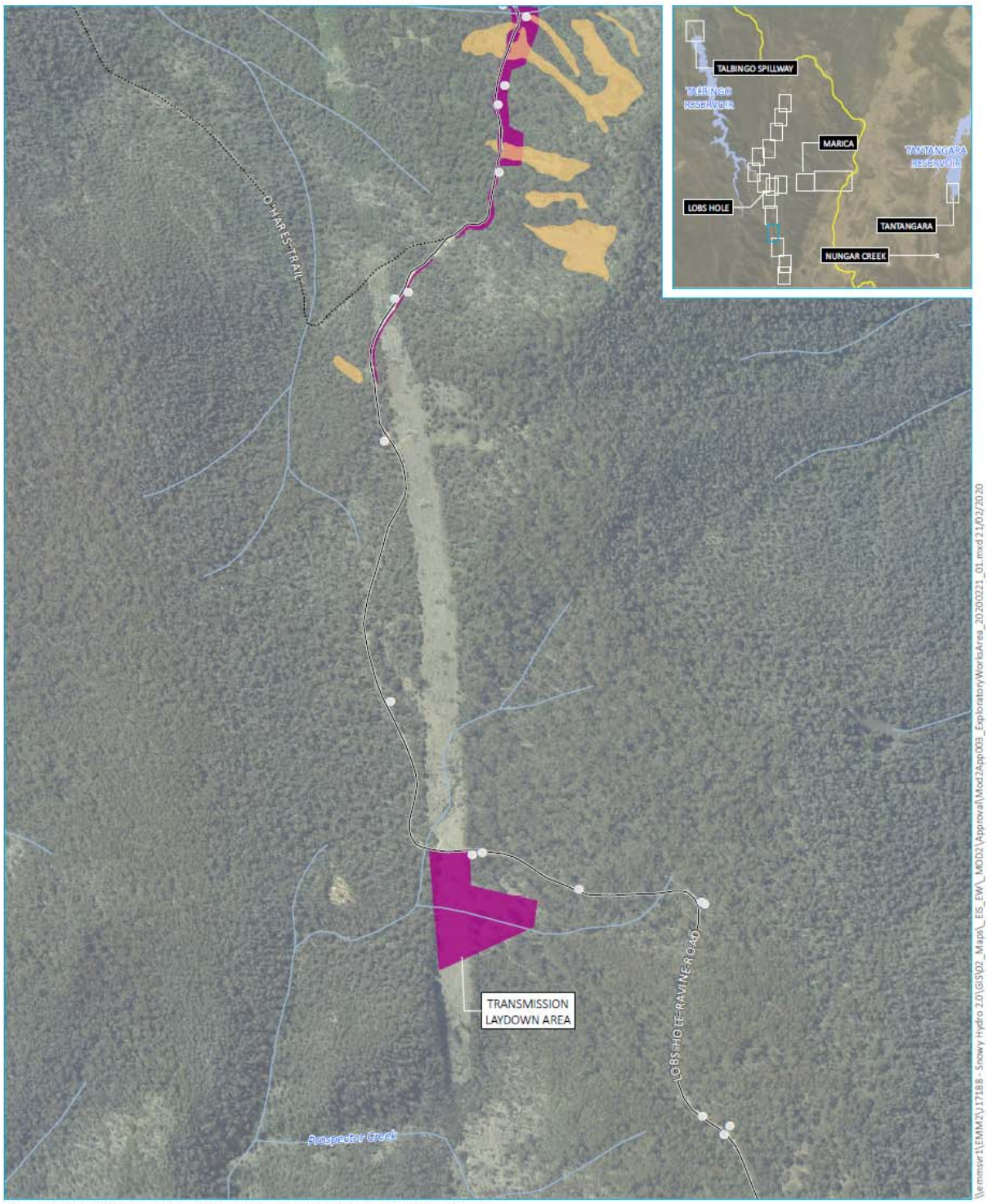


Figure 2-6: *Project Boundary – Lobs Hole Ravine Road (Upper) 3*

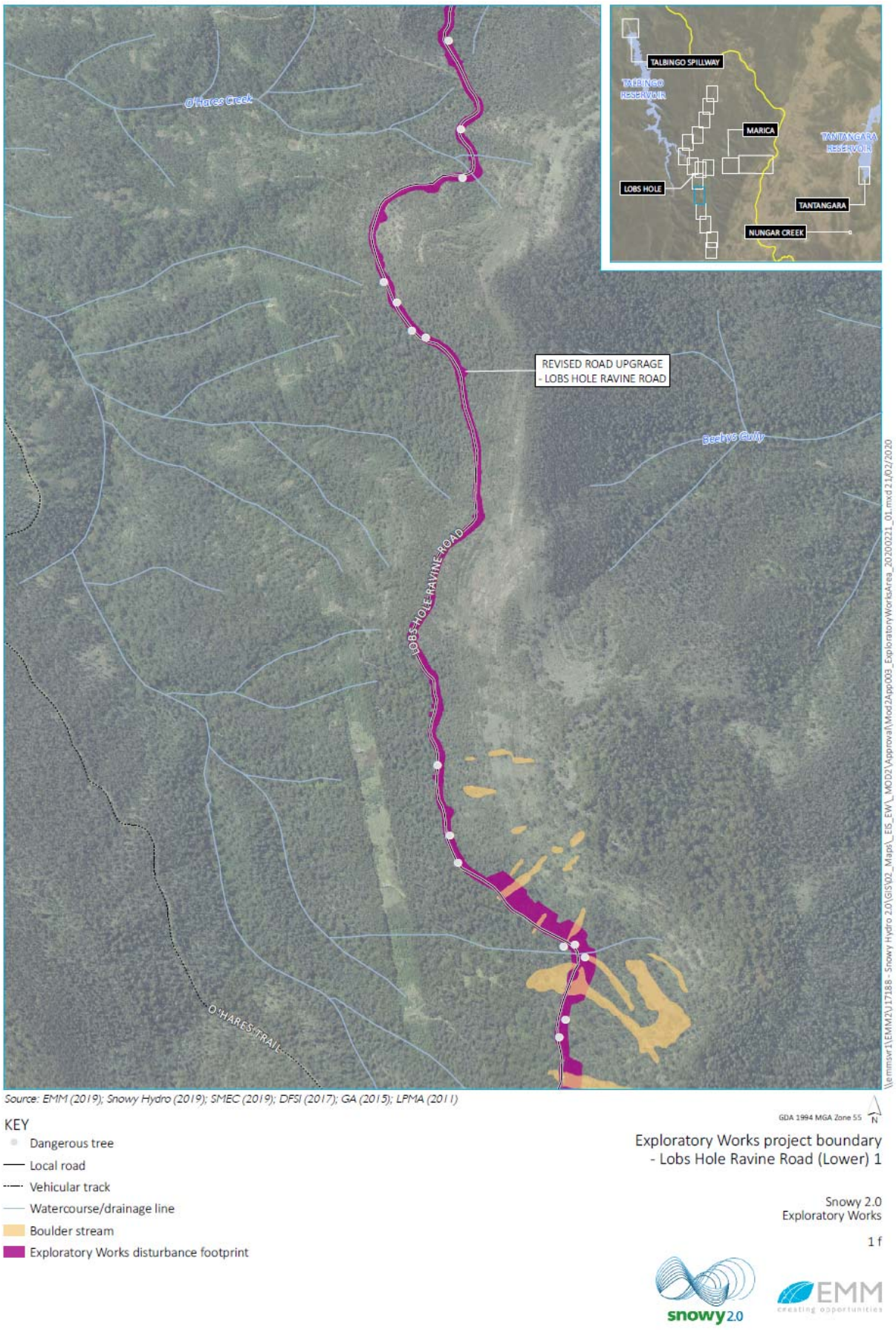


Figure 2-7: *Project Boundary – Lobs Hole Ravine Road (Lower) 1*

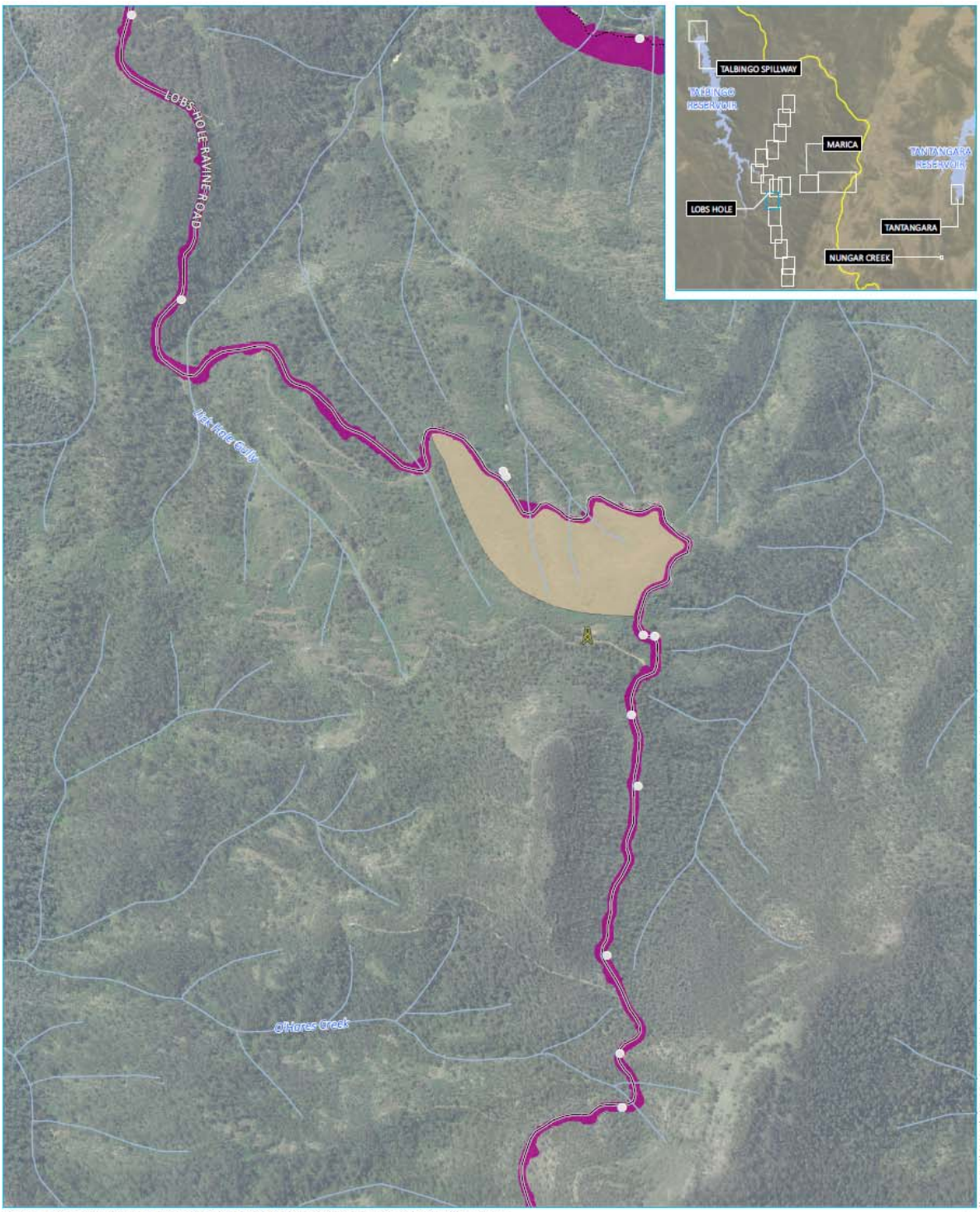


Figure 2-8: *Project Boundary – Lobs Hole Ravine Road (Lower) 2*

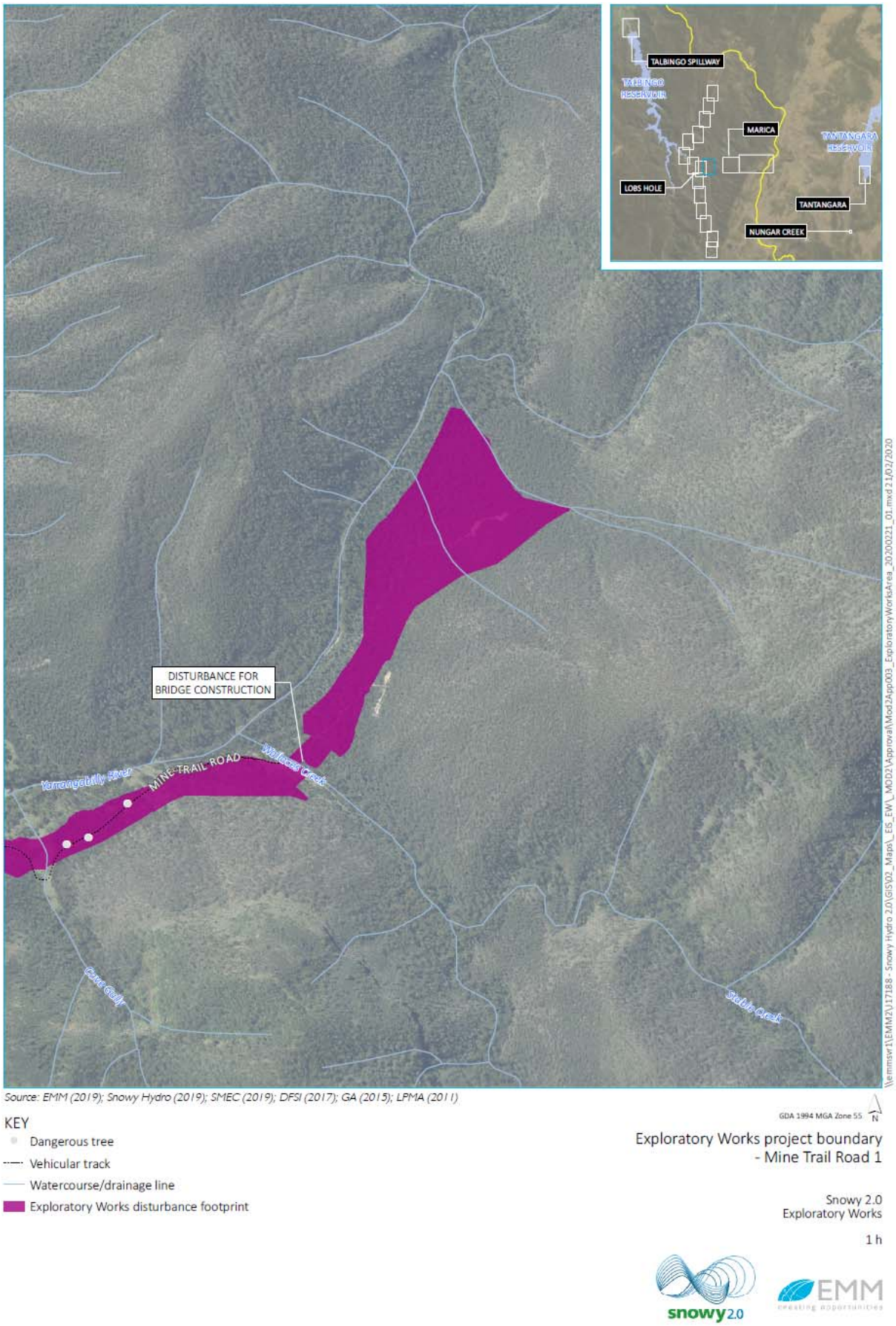


Figure 2-9: *Project Boundary – Mine Trail Road 1*

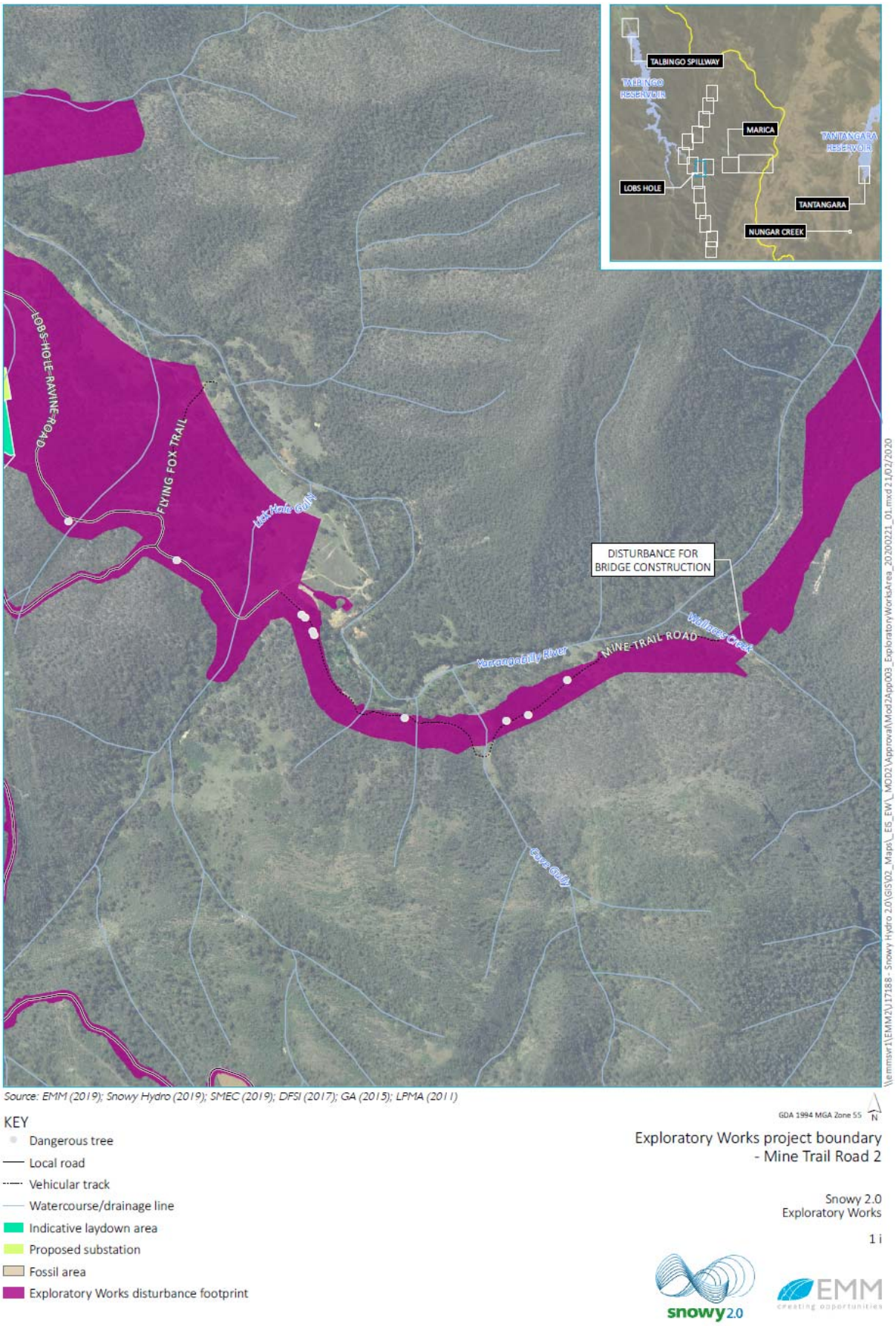


Figure 2-10: *Project Boundary – Mine Trail Road 2*

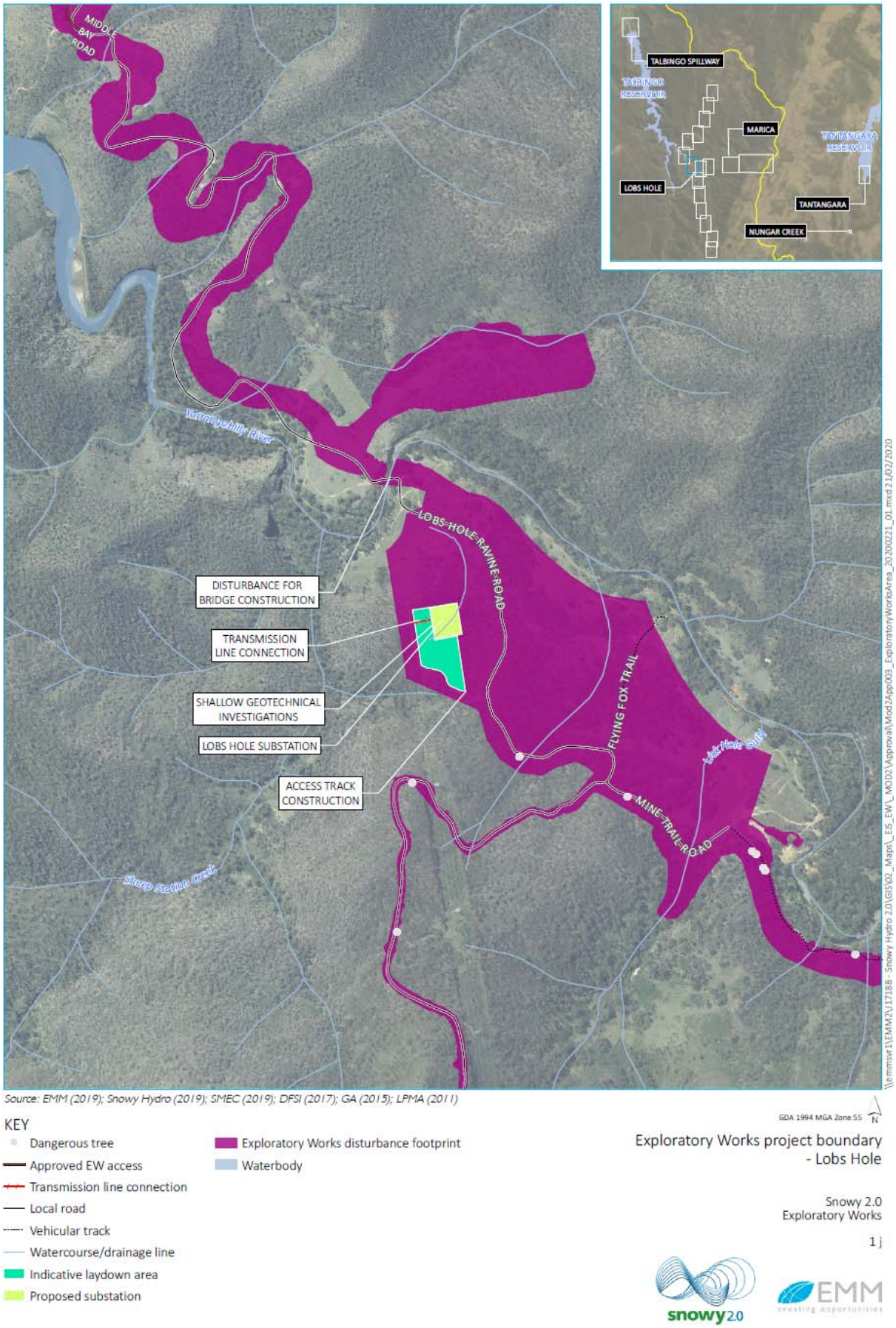


Figure 2-11: *Project Boundary – Lobs Hole*

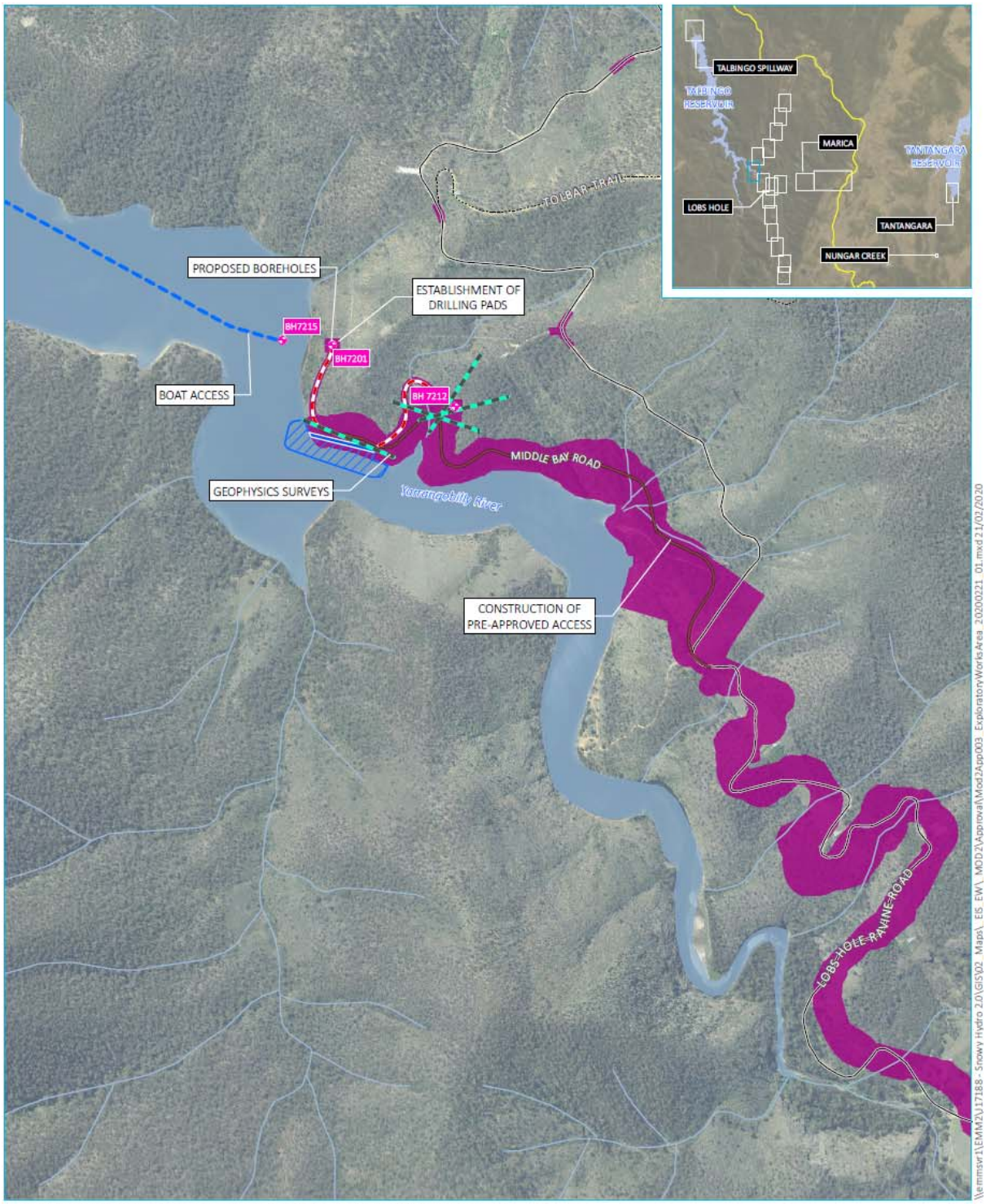


Figure 2-12: *Project boundary – Lobs Hole Ravine Road*

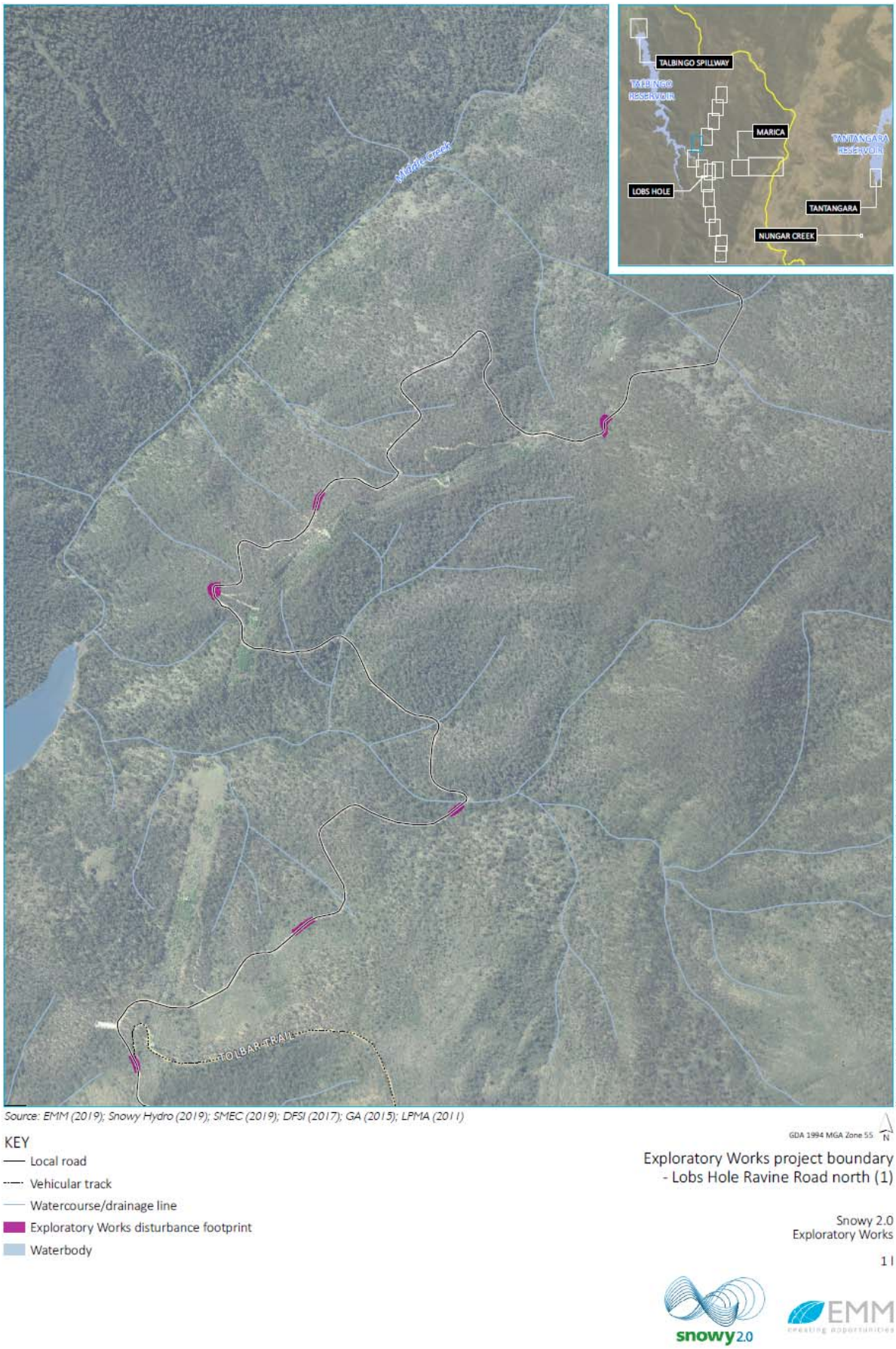


Figure 2-13: *Project boundary – Lobs Hole Ravine Road north (1)*

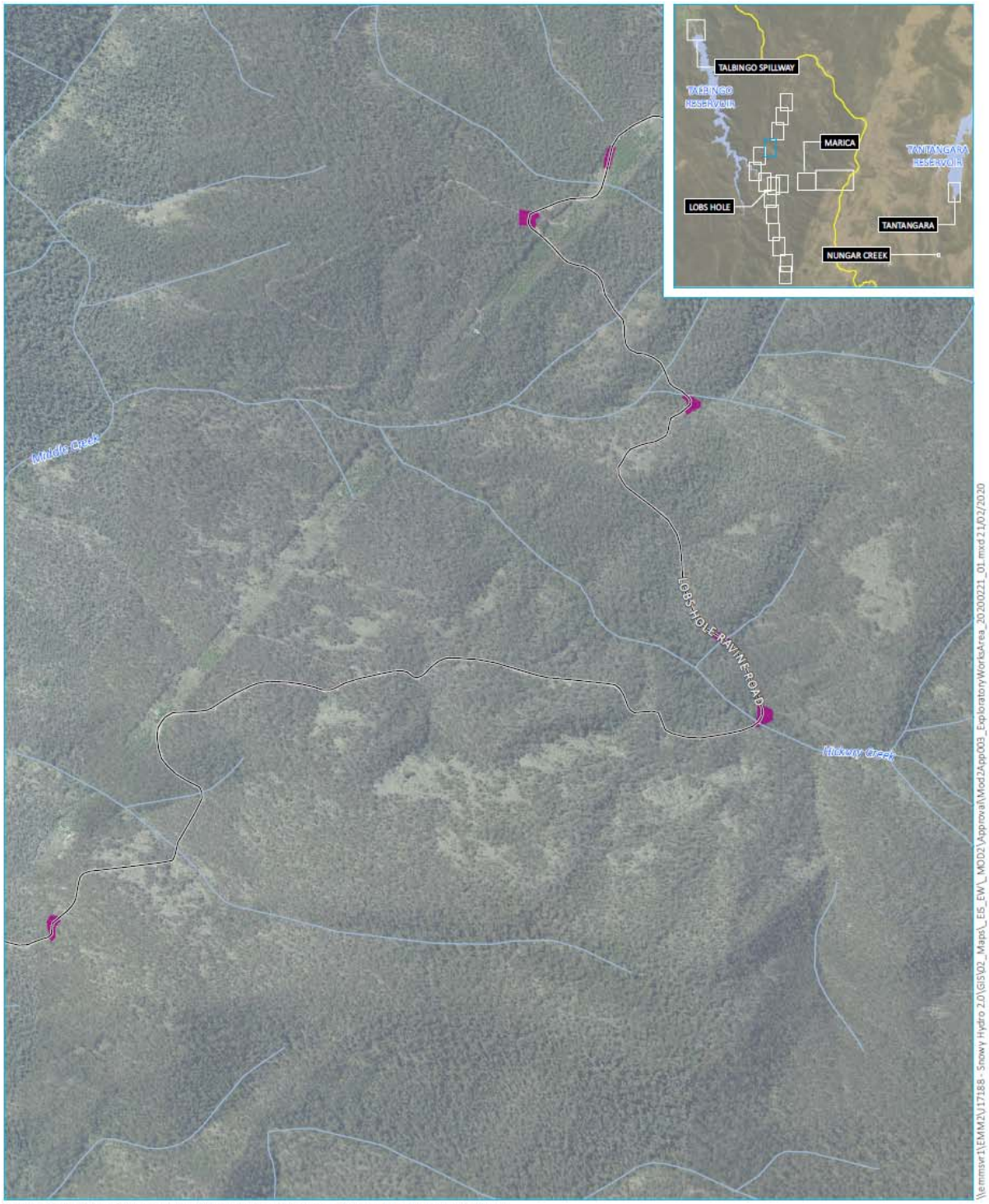


Figure 2-14: *Project boundary – Lobs Hole Ravine Road north (2)*

Figure 2-15: *Project boundary – Lobs Hole Ravine Road north (3)*

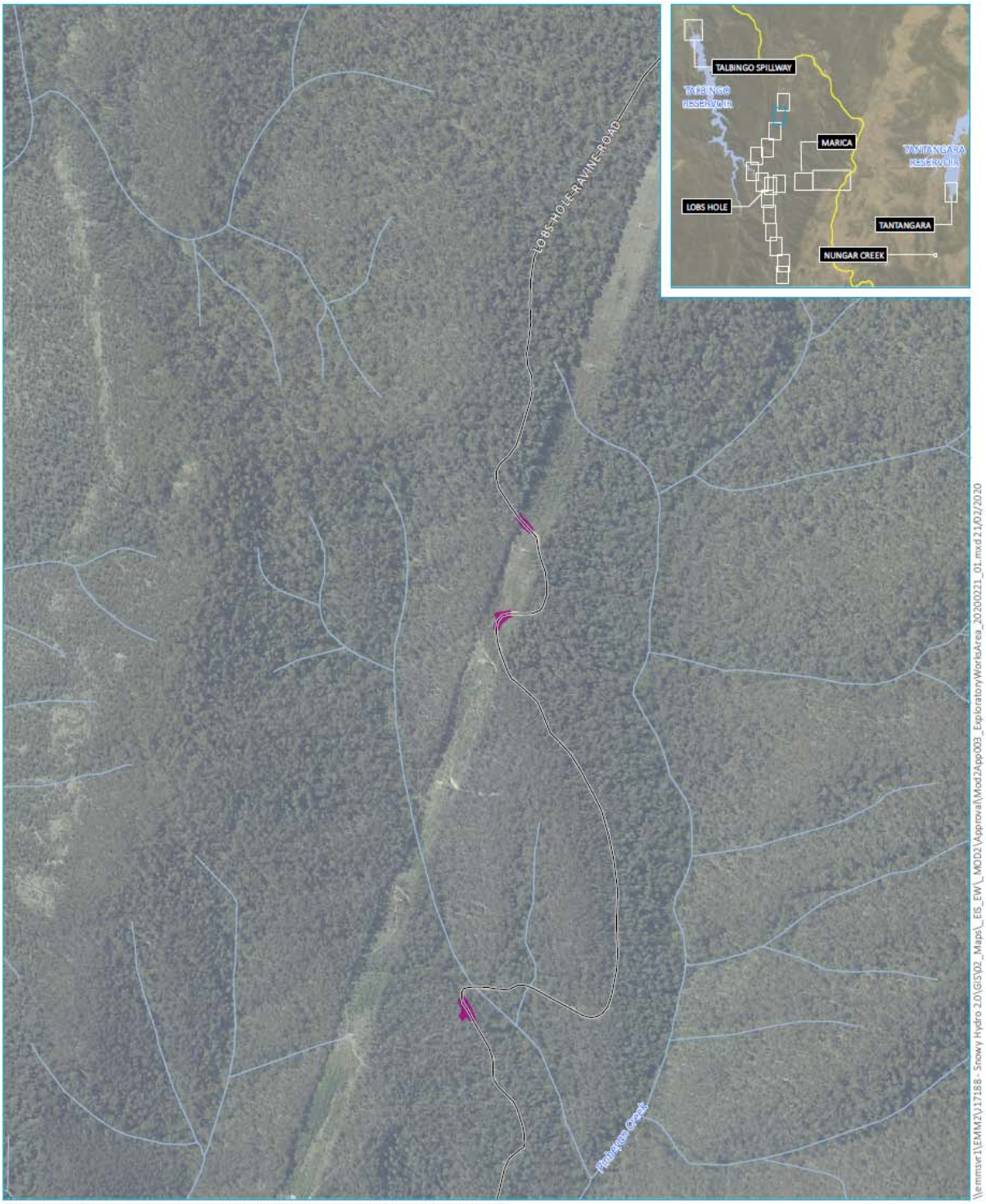


Figure 2-16: *Project boundary – Lobs Hole Ravine Road north (4)*

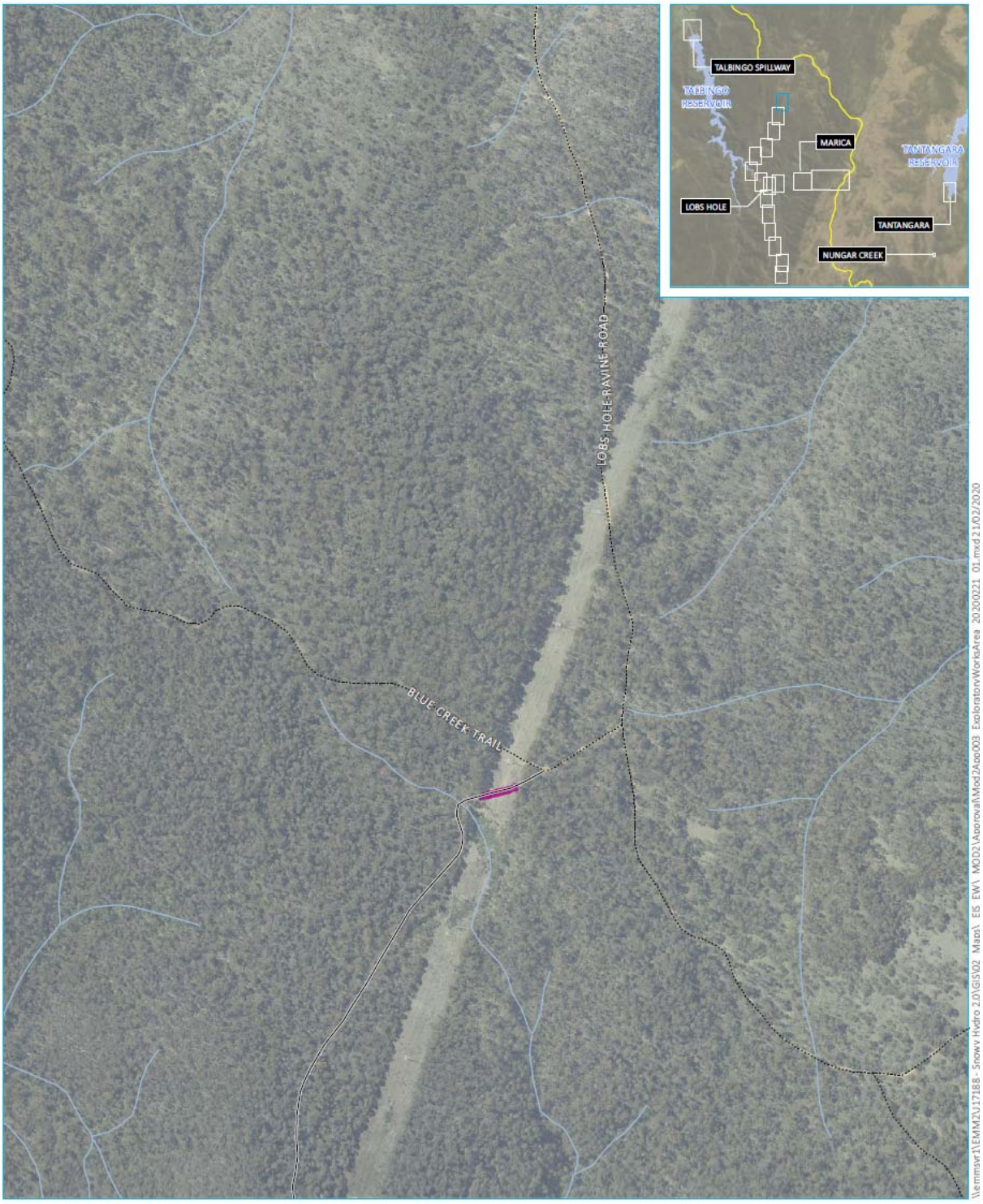


Figure 2-17: *Project boundary – Lobs Hole Ravine Road north (5)*

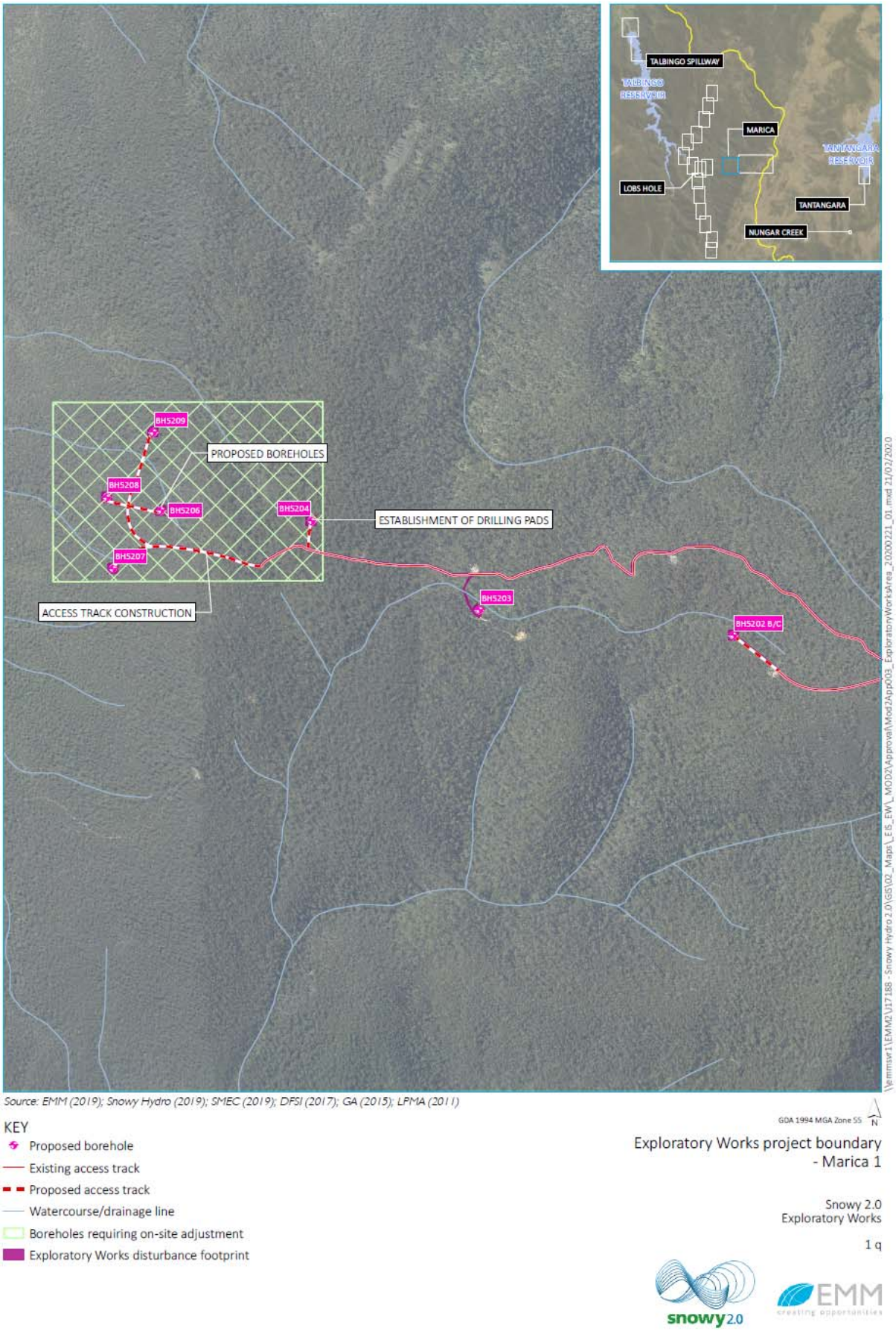


Figure 2-18: *Project boundary – Marica 1*

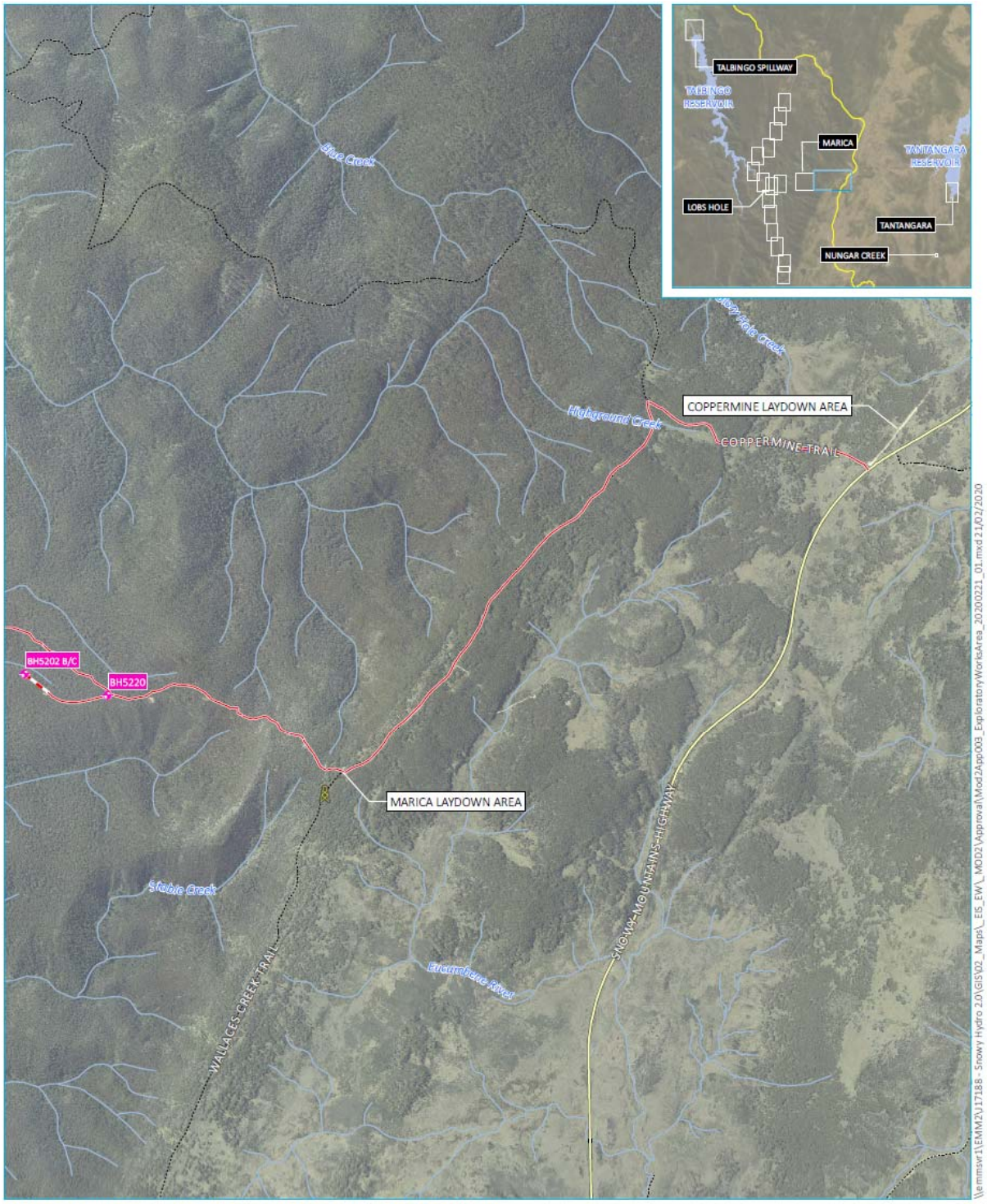


Figure 2-19: *Project boundary – Marica 2*

Figure 2-20: *Project boundary – Nungar Creek*

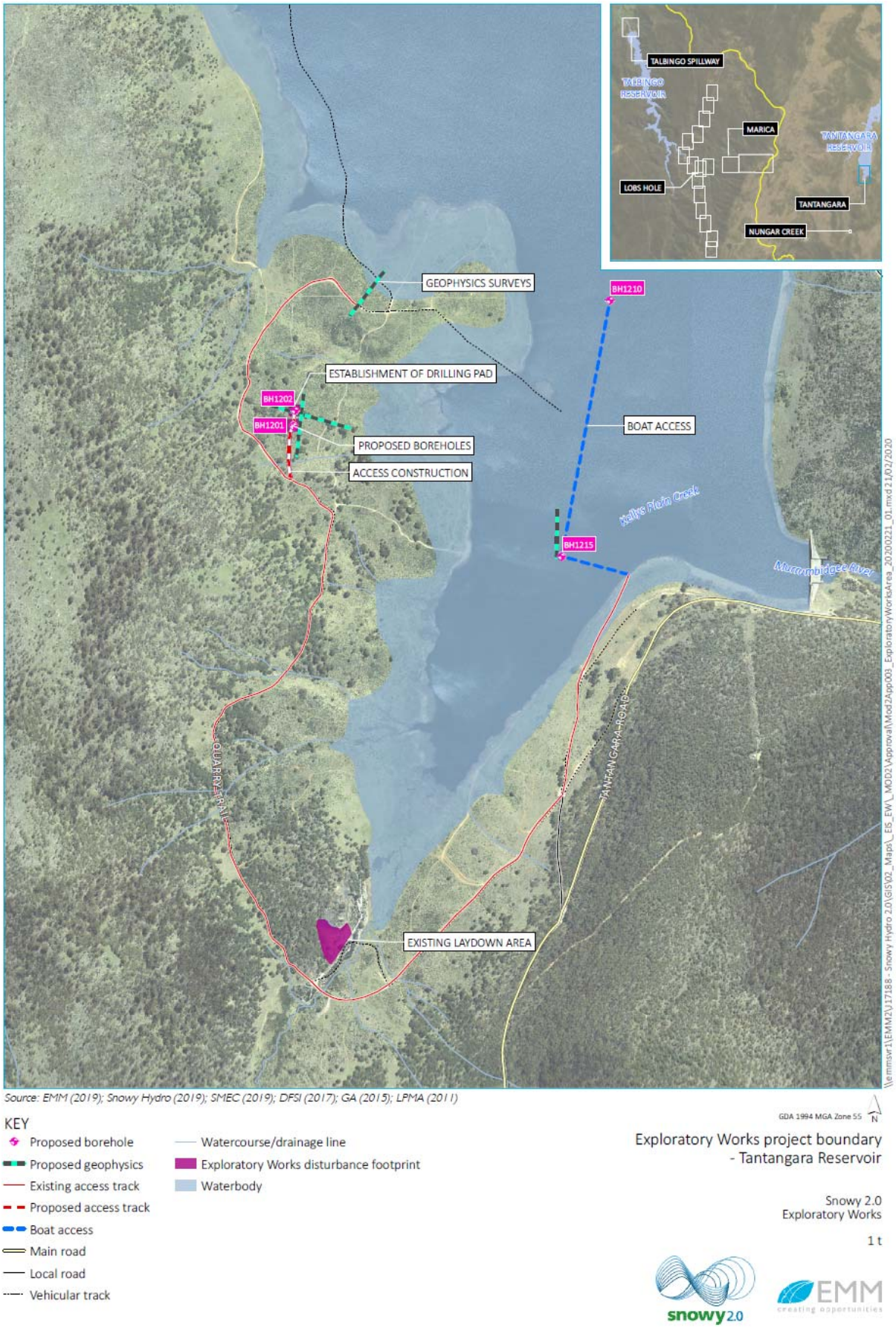


Figure 2-21: *Project boundary – Tantangara Reservoir*

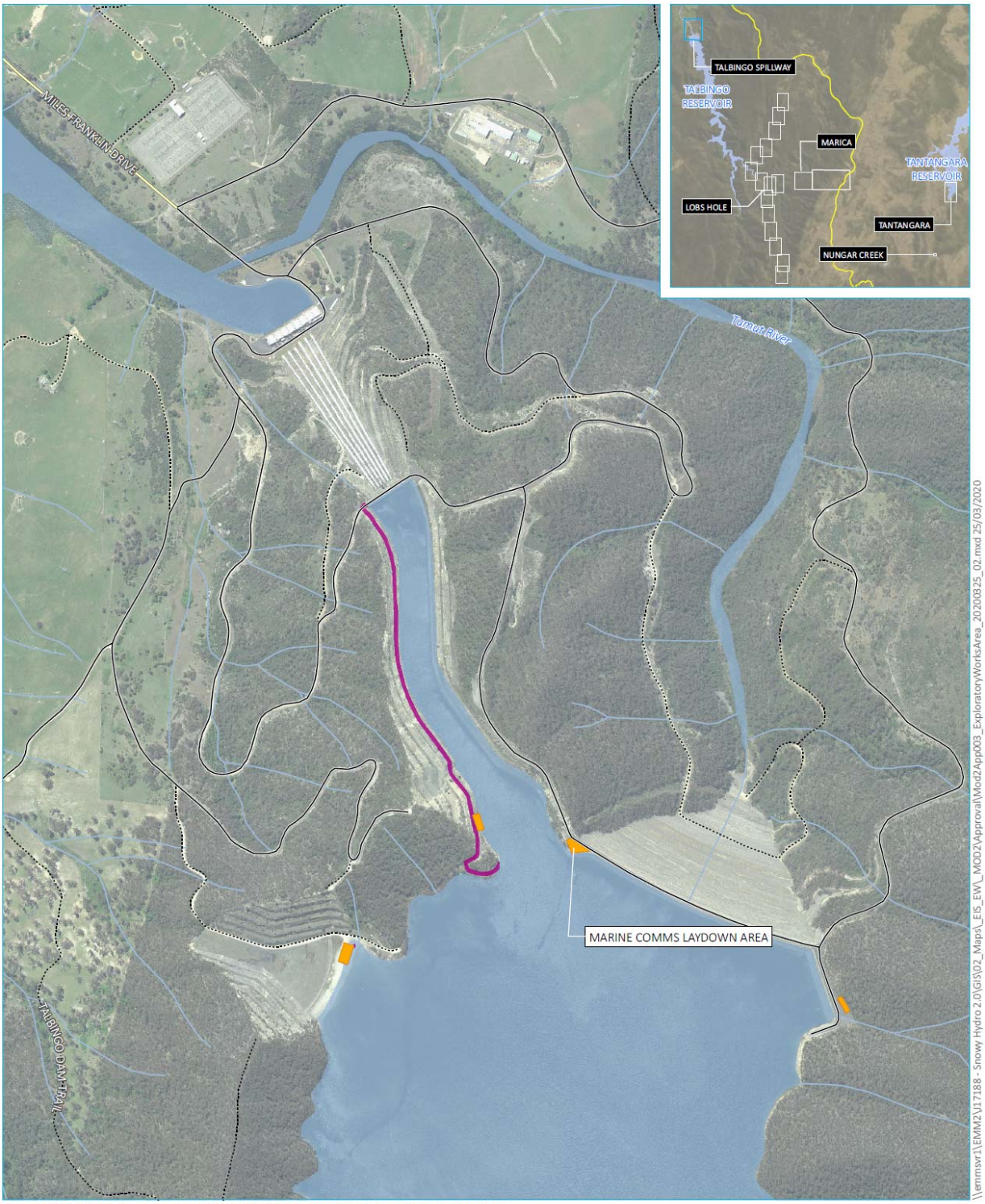


Figure 2-22: *Project boundary – Talbingo spillway*

2-24: Road Upgrades Sharp Street/Bombala Street and Sharp Street/Vale Street Roundabouts