APPENDIX W

NAVIGATION IMPACT ASSESSMENT

REPORT

Snowy 2.0 Excavated Rock Placement

Snowy 2.0: Navigation Impact Assessment for Talbingo and Tantangara Reservoirs

Client: Snowy Hydro Limited

Reference: PA1804 Navigation Impact Assessment

Status: 5.1/Final

Date: 12 September 2019

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Acronym	Definition
ADCP	Acoustic Doppler Current Profiler
AEMO	Australian Energy Market Operator
AHD	Australian Height Datum
ANC	Acid Neutralising Capacity
AMSA	Australian Maritime Safety Authority
ARI	Average Recurrence Interval
APET	Areal potential evapotranspiration data
AWM	AW Maritime Pty Ltd
BOM	Bureau of Meteorology
CFD	Computational Fluid Dynamics
CFL	Courant-Friedrichs-Lewy
COLREGs	Convention on the International Regulations for Preventing Collision at Sea 1972
COPC	Contaminants of Potential Concern
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CSSI	Critical State Significant Infrastructure
CTD	Conductivity, Temperature, Depth (Pressure)
D&B	Drill and Blast
DoEE	Commonwealth Department of Environment and Energy
DEM	Digital Elevation Model
DFL	Design Flood Level
DGV	Default Guideline Value
DIDO	Drive In Drive Out
DPIE	Department of Planning, Industry and Environment (NSW)
ECVT	(Emergency) Egress, Cable and Ventilation Tunnel
EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement
EP&A	Environmental Planning & Assessment Act 1979
EPBC	Environment Protection and Biodiversity Conservation Act 1999
ERP	Excavated Rock Placement
FG	Future Generation
FIFO	Fly In Fly Out
FM	Flexible Mesh
FSL	Full Supply Level

Acronym	Definition
FU	Functional Unit
GIS	Geographic Information System
HD	Mike 3 Flow ‘Hydrodynamic’ Model
ISQG	Interim Sediment Quality Guidelines
KNP	Kosciuszko National Park
L/S	Liquid to Solid Ratio
LGA	Local Government Area
LOA	Length Overall
m	Metres
MAT	Main Access Tunnel
MOL	Minimum Operating Level
MPA	Maximum Potential Acidity
MT	Mud Transport
MVA	Mega Volt Amp
MW	Megawatt
MWh	Megawatt hours
NAGD	National Assessment Guidelines for Dredging
NEM	National Electricity Market
NIA	Navigation Impact Assessment
NOA	Naturally Occurring Asbestos
NPWS	National Parks and Wildlife Service (NSW)
NSW	New South Wales
NTU	Nephelometric Turbidity Unit
PSD	Particle Size Distribution
QA	Quality Assurance
RHDHV	Royal HaskoningDHV
RMS	NSW Roads and Maritime Service
SEARs	Secretary’s Environmental Assessment Requirements
SEPP	State Environmental Planning Policy
SRD	State and Regional Development
SSI	State Significant Infrastructure
T2	Tumut 2 Power Station
T3	Tumut 3 Power Station

Acronym	Definition
TBM	Tunnel Boring Machine
TN	True North
TSS	Total Suspended Sediments
WED	Wake Enhancement Device
XRF	X-ray Fluorescence

1 Introduction

1.1 The Project

Snowy Hydro Limited (Snowy Hydro) proposes to develop Snowy 2.0, a large-scale pumped hydro-electric storage and generation project which would increase hydro-electric capacity within the existing Snowy Mountains Hydro-electric Scheme (Snowy Scheme). Snowy 2.0 is the largest committed renewable energy project in Australia and is critical to underpinning system security and reliability as Australia transitions to a decarbonised economy. Snowy 2.0 will link the existing Tantangara and Talbingo reservoirs within the Snowy Scheme through a series of underground tunnels and a new hydro-electric power station will be built underground.

Snowy 2.0 has been declared to be State significant infrastructure (SSI) and critical State significant infrastructure (CSSI) by the former NSW Minister for Planning under Part 5 of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act) and is defined as CSSI in clause 9 of Schedule 5 of the *State Environmental Planning Policy (State and Regional Development) 2011* (SRD SEPP). CSSI is infrastructure that is deemed by the NSW Minister to be essential for the State for economic, environmental or social reasons. An application for CSSI must be accompanied by an environmental impact statement (EIS).

Separate applications are being submitted by Snowy Hydro for different stages of Snowy 2.0 under Part 5, Division 5.2 of the EP&A Act. This includes the preceding first stage of Snowy 2.0, Exploratory Works for Snowy 2.0 (the Exploratory Works) and the stage subject of this current application, Snowy 2.0 Main Works (the Main Works). In addition, an application under Part 5, Division 5.2 of the EP&A Act is also being submitted by Snowy Hydro for a segment factory that will make tunnel segments for both the Exploratory Works and Main Works stages of Snowy 2.0.

The first stage of Snowy 2.0, the Exploratory Works, includes an exploratory tunnel and portal and other exploratory and construction activities primarily in the Lobs Hole area of the Kosciuszko National Park (KNP). The Exploratory Works were approved by the former NSW Minister for Planning on 7 February 2019 as a separate project application to DPIE (SSI 9208).

This Navigation Impact Assessment (NIA) has been prepared to accompany an application and supporting EIS for the **Snowy 2.0 Main Works**. As the title suggests, this stage of the project covers the major construction elements of Snowy 2.0, including permanent infrastructure (such as the underground power station, power waterways, access tunnels, chambers and shafts), temporary construction infrastructure (such as construction adits, construction compounds and accommodation), management and storage of excavated rock material and establishing supporting infrastructure (such as road upgrades and extensions, water and sewage treatment infrastructure, and the provision of construction power). Snowy 2.0 Main Works also includes the operation of Snowy 2.0.

Snowy 2.0 Main Works is shown in **Figure 1-1**. If approved, the Snowy 2.0 Main Works would commence before completion of Exploratory Works.

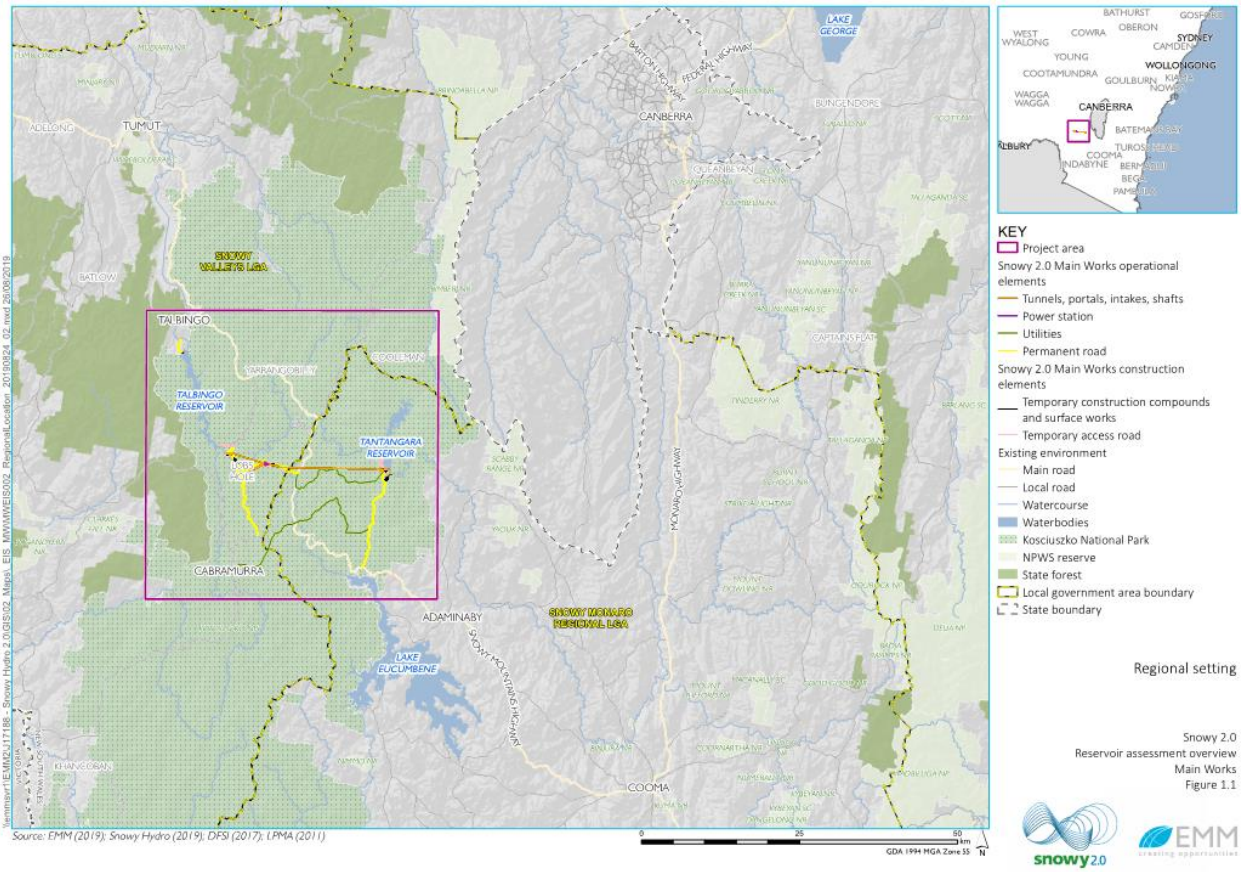


Figure 1-1: Snowy 2.0 regional setting.

The Snowy 2.0 Main Works do not include the main transmission works proposed by TransGrid (TransGrid 2018) that provide connection between the cableyard and the NEM. These transmission works will provide the ability for Snowy 2.0 (and other generators) to efficiently and reliably transmit additional renewable energy to major load centres during periods of peak demand, as well as enable a supply of renewable energy to pump water from Talbingo Reservoir to Tantangara Reservoir during periods of low demand. While the upgrade works to the wider transmission network and connection between the cableyard and the network form part of the CSSI declaration for Snowy 2.0 and Transmission Project, they do not form part of this application and will be subject to separate application and approval processes, managed by TransGrid. This project is known as the HumeLink and is part of AEMO's Integrated System Plan.

With respect to the provisions of the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), on 30 October 2018 Snowy Hydro referred the Snowy 2.0 Main Works to the Commonwealth Department of the Environment and Energy (DoEE) and, on a precautionary basis, nominated that Snowy 2.0 Main Works has potential to have a significant impact on MNES and the environment generally.

On 5 December 2018, Snowy 2.0 Main Works were deemed a controlled action by the Assistant Secretary of the DoEE. It was also determined that potential impacts of the project will be assessed by accredited assessment under Part 5, Division 5.2 of the EP&A Act. This accredited process will enable the NSW Department of Planning, Industry and Environment (DPIE) to manage the assessment of Snowy 2.0 Main Works, including the issuing of the assessment requirements for the EIS. Once the assessment has been completed, the Commonwealth Minister for the Environment will make a determination under the EPBC Act.

1.2 Project Location

Snowy 2.0 Main Works are within the Australian Alps, in southern NSW, about mid-way between Canberra and Albury. Snowy 2.0 Main Works is within both the Snowy Valleys and Snowy Monaro Regional local government areas (LGAs).

The nearest large towns to Snowy 2.0 Main Works are Cooma and Tumut. Cooma is located about 50 kilometres (km) south east of the project area (or 70 km by road from Providence Portal at the southern edge of the project area), and Tumut is located about 35 km north west of the project areas (or 45 km by road from Tumut 3 (T3) power station at the northern edge of the project area). Other townships near the project area include Talbingo, Cabramurra, Adaminaby and Tumbarumba. Talbingo and Cabramurra were built for the original Snowy Scheme workers and their families, while Adaminaby was relocated in 1957 to make way for the establishment of Lake Eucumbene.

The location of Snowy 2.0 Main Works with respect to the region is shown in **Figure 1-1**.

The pumped hydro-electric scheme elements of Snowy 2.0 Main Works are mostly underground between the southern ends of Tantangara and Talbingo reservoirs, a straight-line distance of 27 km. Surface works will also occur at locations on and between the two reservoirs. Key locations for surface works include:

- **Tantangara Reservoir** - at a full supply level (FSL) of about 1,229 metres (m) to Australian Height Datum (AHD), Tantangara Reservoir will be the upper reservoir for Snowy 2.0 and include the headrace tunnel and intake structure. The site will also be used for a temporary construction compound, accommodation camp and other temporary ancillary activities;
- **Marica** - this site will be used primarily for construction including construction of vertical shafts to the underground power station (ventilation shaft) and headrace tunnel (surge shaft), and a temporary accommodation camp;
- **Lobs Hole** - the site will be used primarily for construction but will also become the main entrance to the power station during operation. Lobs Hole will provide access to the Exploratory Works tunnel, which will be refitted to become the main access tunnel (MAT), as well as the location of the emergency egress, cable and ventilation tunnel (ECVT), portal, associated services and accommodation camp; and
- **Talbingo Reservoir** - at a FSL of about 546 m AHD, Talbingo Reservoir will be the lower reservoir for Snowy 2.0 and will include the tailrace tunnel and water intake structure. The site will also be used for temporary construction compounds and other temporary ancillary activities.

Works will also be required within the two reservoirs for the placement of excavated rock and surplus cut material. Supporting infrastructure will include establishing or upgrading access tracks and roads and electricity connections to construction sites.

Most of the proposed pumped hydro-electric and temporary construction elements and most of the supporting infrastructure for Snowy 2.0 Main Works are located within the boundaries of KNP, although the disturbance footprint for the project during construction is less than 0.25% of the total KNP area. Some of the supporting infrastructure and construction sites and activities (including sections of road upgrade, power and communications infrastructure) extends beyond the national park boundaries. These sections of infrastructure are primarily located to the east and south of Tantangara Reservoir. One temporary construction site is located beyond the national park along the Snowy Mountains Highway about 3 km east of Providence Portal (referred to as Rock Forest).

The project is described in more detail in **Section 2**.

1.2.1 Project Area

The project area for Snowy 2.0 Main Works has been identified and includes all the elements of the project, including all construction and operational elements. The project area is shown on **Figure 1-2**. Key features of the project area are:

- the water bodies of Tantangara and Talbingo reservoirs, covering areas of 19.4 square kilometres (km^2) and 21.2 km^2 respectively. The reservoirs provide the water to be utilised in Snowy 2.0
- major watercourses including the Yarrangobilly, Eucumbene and Murrumbidgee rivers and some of their tributaries
- KNP, within which the majority of the project area is located. Within the project area, KNP is characterised by two key zones: upper slopes and inverted treelines in the west of the project area (referred to as the 'ravine') and associated subalpine treeless flats and valleys in the east of the project area (referred to as the 'plateau'), and
- farm land southeast of KNP at Rock Forest.

The project area is interspersed with built infrastructure including recreational sites and facilities, main roads as well as unsealed access tracks, hiking trails, farm land, electricity infrastructure, and infrastructure associated with the Snowy Scheme.

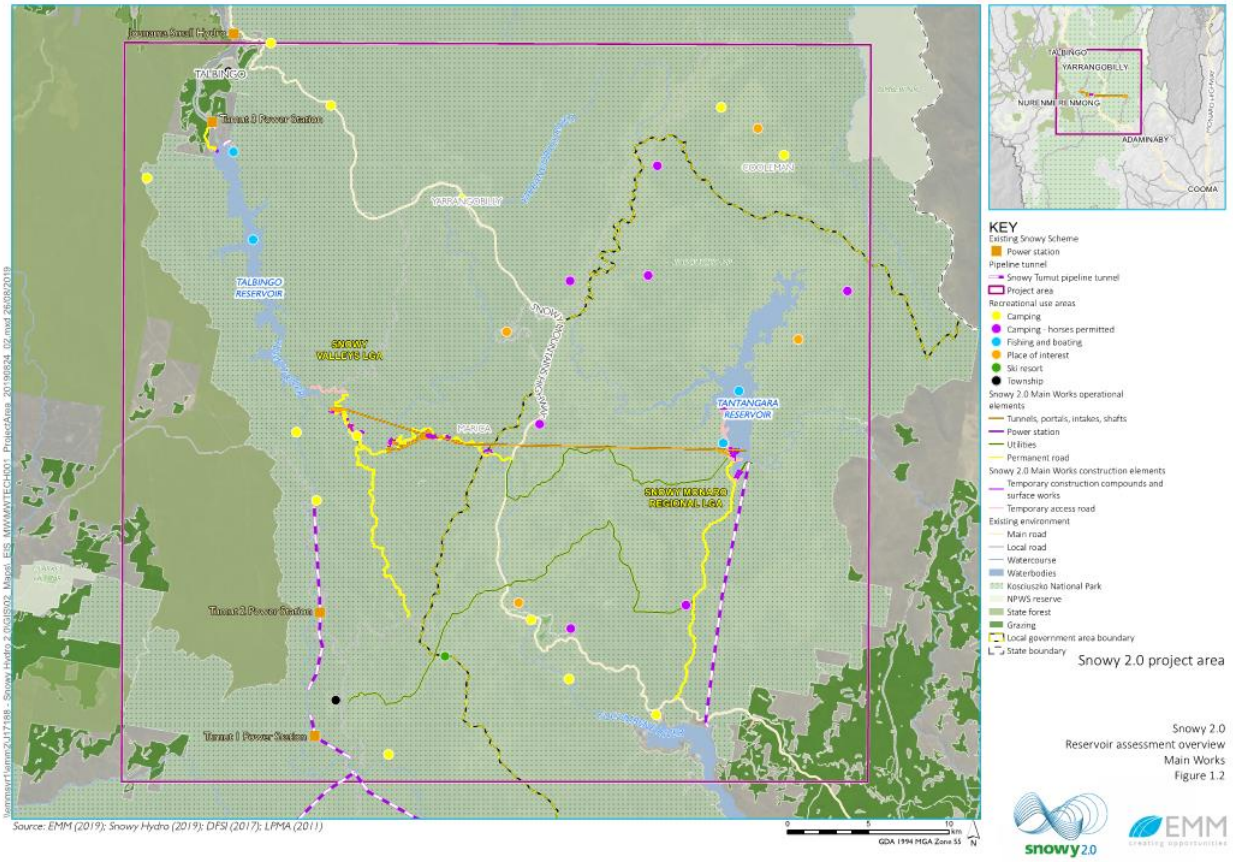


Figure 1-2: Snowy 2.0 project area.

1.3 Proponent

Snowy Hydro is the proponent for the Snowy 2.0 Main Works. Snowy Hydro is an integrated energy business – generating energy, providing price risk management products for wholesale customers and

delivering energy to homes and businesses. Snowy Hydro is the fourth largest energy retailer in the NEM and is Australia's leading provider of peak, renewable energy.

1.4 Purpose of this Report

This report supports the EIS for the Snowy 2.0 Main Works. It documents an assessment of the safety of navigation on the two reservoirs during construction and during operation of Snowy 2.0 and supports the EIS for the Main Works.

Construction of Snowy 2.0 is expected to impact both Talbingo Reservoir and Tantangara Reservoir for a period of up to 6 years. Marine based construction activities may include floating plant and equipment for excavated rock placement (ERP) activities and excavation of the intake channel.

Commissioning and operation of Snowy 2.0 would result in a generating flow (flow from Tantangara Reservoir to Talbingo Reservoir) at design capacity of 372 m^3/s (metres cubed per second) and a pumped flow (flow in reverse) at design capacity of 270 m^3/s. These flows would result in significant current speeds in the vicinity of the intake structures, which would be higher at lower reservoir levels. The movement of water may be potentially hazardous for recreational users and water-based activities (e.g. swimming, fishing, canoeing, kayaking, water skiing).

Snowy Hydro operate reservoirs across the Snowy scheme that are safely enjoyed by public recreational users. This includes implementing a range of measures such as exclusion zones around water intakes. This report documents initiatives built into the Snowy 2.0 project design to avoid and minimise navigation impacts during construction and operations of Snowy 2.0 and the mitigation and management measures proposed to address any residual impacts not able to be avoided. These measures are in line with the measures applied by Snowy Hydro across the scheme.

1.4.1 Assessment Guidelines and Requirements

This Navigation Impact Assessment has been prepared in accordance with the Secretary's Environmental Assessment Requirements (SEARs) for Snowy 2.0 Main Works, issued on 31 July 2019, as well as relevant government assessment requirements, guidelines and policies, and in consultation with the relevant government agencies.

The SEARs must be addressed in the EIS. **Table 1-1** lists the matters relevant to this assessment and where they are addressed in this report.

Table 1-1: Relevant matters raised in SEARs.

Requirement	Section addressed
Transport – an assessment of the impact of the project on the use of navigable waters in the Tantangara and Talbingo Reservoirs.	**Section 5.4** for Tantangara Reservoir and **Section 6.4** for Talbingo Reservoir.
Social – an assessment of the social impacts of the project on users of the Kosciuszko National Park, including recreational fishing, bushwalking, camping and boating.	Waterway users in **Section 5.4** for Tantangara Reservoir and **Section 6.4** for Talbingo Reservoir.

To inform preparation of the SEARs, the DPIE invited relevant government agencies to advise on matters to be addressed in the EIS. These matters were taken into account by the Secretary for DPIE when preparing the SEARs.

1.5 Related Projects

There are three other projects related to Snowy 2.0 Main Works, they are:

- Snowy 2.0 Exploratory Works (SSI-9208) – a Snowy Hydro project with Minister's approval;
- Snowy 2.0 Transmission Connect Project (SSI-9717) – a project proposed by TransGrid; and
- Snowy 2.0 Segment Factory (SSI-10034) – a project proposed by Snowy Hydro.

While these projects form part of the CSSI declaration for Snowy 2.0 and Transmission Project, they do not form part of Snowy Hydro's application for Snowy 2.0 Main Works. These related projects are subject to separate application and approval processes. Staged submission and separate approval is appropriate for a project of this magnitude, due to its complexity and funding and procurement processes. However, cumulative impacts have been considered in this report where relevant.

1.6 Other Relevant Reports

This navigation impact assessment has been prepared with reference to other technical reports that were prepared as part of the Snowy 2.0 Main Works EIS. The other relevant reports referenced in this report are listed below.

- Reservoir assessment overview (RHDHV 2019) – **Appendix L** of the EIS; and,
- Recreational users study (TRC 2019) – **Appendix X.2** of the EIS.

2 Description of the Project

This chapter provides a summary of the Snowy 2.0 Main Works project. It outlines the functional infrastructure required to operate Snowy 2.0, as well as the key construction elements and activities required to build it. A more comprehensive detailed description of the project is provided in Chapter 2 (Project description) of the EIS, which has been relied upon for the basis of this technical assessment.

2.1 Overview of Snowy 2.0

Snowy 2.0 will link the existing Tantangara and Talbingo reservoirs within the Snowy Scheme through a series of underground tunnels and a new hydro-electric power station will be built underground. An overview of Snowy 2.0 is shown on **Figure 2-1**, and the key project elements of Snowy 2.0 are summarised in **Table 2-1**.

Table 2-1: Overview of Snowy 2.0 Main Works.

Project area	The project area is the broader region within which Snowy 2.0 will be built and operated, and the extent within which direct impacts from Snowy 2.0 Main Works are anticipated.
Permanent infrastructure	Snowy 2.0 infrastructure to be built and operated for the life of the assets include the: • intake and gate structures and surface buildings at Tantangara and Talbingo reservoirs; • power waterway tunnels primarily comprising the headrace tunnel, headrace surge structure, inclined pressure tunnel, pressure pipelines, tailrace surge tank and tailrace tunnel; • underground power station complex comprising the machine hall, transformer hall, ventilation shaft and minor connecting tunnels; • access tunnels (and tunnel portals) to the underground power station comprising the main access tunnel (MAT) and emergency egress, communication, and ventilation tunnel (ECVT); • establishment of a portal building and helipad at the MAT portal; • communication, water and power supply including the continued use of the Lobs Hole substation; • cable yard adjacent to the ECVT portal to facilitate the connection of Snowy 2.0 to the NEM; and • access roads and permanent bridge structures needed for the operation and maintenance of Snowy 2.0 infrastructure; and, • fish control structures on Tantangara Creek and near Tantangara Reservoir wall.
Temporary infrastructure	Temporary infrastructure required during the construction phase of Snowy 2.0 Main Works are: • construction compounds, laydown, ancillary facilities and helipads; • accommodation camps for construction workforce; • construction portals and adits to facilitate tunnelling activities; • barge launch ramps; • water and wastewater management infrastructure (treatment plants and pipelines); • communication and power supply; and • temporary access roads.
Disturbance area	The disturbance area is the extent of construction works required to build Snowy 2.0. The maximum disturbance area is about 1,680 hectares (ha), less than 0.25% of the total area of KNP. Parts of the disturbance area will be rehabilitated and landformed and other parts will be retained permanently for operation (operational footprint).
Operational footprint	The operational footprint is the area required for permanent infrastructure to operate Snowy 2.0. The maximum operational footprint is about 99 ha. This is 0.01% of the total area of KNP.
Tunnelling and excavation method	The primary tunnelling method for the power waterway is by tunnel boring machine (TBM), with portals and adits using drill and blast methods. Excavation for other underground caverns, chambers and shafts will be via combinations of drill and blast, blind sink, or raise bore techniques.
Excavated rock management	Excavated rock will be generated as a result of tunnelling activities and earthworks. The material produced through these activities will be stockpiled and either reused by the contractor

	(or NPWS), placed permanently within Tantangara or Talbingo reservoirs, used in final land forming and rehabilitation of construction pads in Lobs Hole, or transported offsite.
Construction water and wastewater management	Water supply for construction will be from the two existing reservoirs (Talbingo and Tantangara) and reticulated via buried pipelines (along access roads). Raw water will be treated as necessary wherever potable water is required (eg at accommodation camps). Water to be discharged (comprising process water, wastewater and stormwater) will be treated before discharge to the two existing reservoirs (Talbingo and Tantangara) as follows: • treated process water will be reused onsite where possible to reduce the amount of discharge to reservoirs, however excess treated water will be discharged to the reservoirs; • collected sewage will be treated at sewage treatment plants to meet the specified discharge limits before discharge and/or disposal; and • stormwater will be captured and reused as much as possible.
Rehabilitation	Rehabilitation of areas disturbed during construction including reshaping to natural appearing landforms or returning to pre-disturbance condition, as agreed with NPWS and determined by the rehabilitation strategy. This includes construction areas at Lobs Hole which comprise surplus cut materials that are required for the construction. Areas to be used by Snowy Hydro in the long-term may be re-shaped and rehabilitated to maintain access and operational capabilities (eg intakes and portal entrances).
Construction workforce	The construction workforce for the project is expected to peak at around 2,000 personnel.
Operational life	The operational life of the project is estimated to be 100 years.
Operational workforce	The operational workforce is expected to be 8-16 staff, with fluctuations of additional workforce required during major maintenance activities.
Hours of operation	Construction of Snowy 2.0 will be 24/7 and 365 days per year. Operation of Snowy 2.0 will be 24/7 and 365 days per year.
Capital investment value	Estimated to be $4.6 billion.

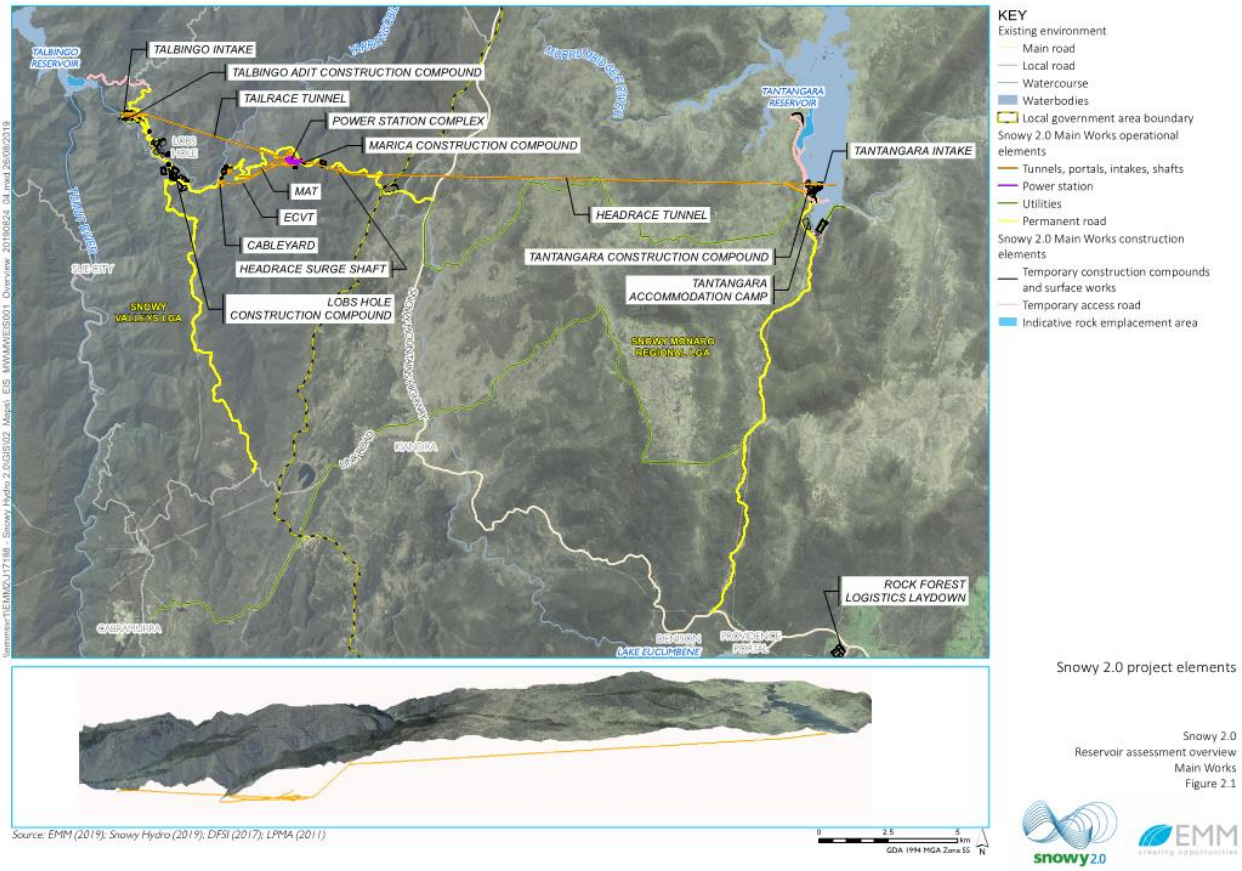


Figure 2-1: Snowy 2.0 project elements.

2.2 Construction of Snowy 2.0

A number of construction activities will be carried out concurrently, and across a number of different sites. Specific details on these activities as well as an indicative schedule of construction activities is provided in Chapter 2 (Project description) of the EIS. This section summarises the key construction elements of the project. **Table 2-2** provides an overview of the construction elements, their purpose and location within the Project area.

Table 2-2: Snowy 2.0 construction elements.

Construction element	Purpose	Location
Construction sites	Due to the remoteness of Snowy 2.0, construction sites are generally needed to: • provide ancillary facilities such as concrete batching plants, mixing plants and on-site manufacturing; • store machinery, equipment and materials to be used in construction; • provide access to underground construction sites; and • provide onsite accommodation for the construction workforce.	Each construction site needed for Snowy 2.0 is shown on **Figures 2.2** to **Figure 2.7**.
Substations and power connection	One substation is required to provide permanent power to Snowy 2.0, at Lobs Hole. This substation will be built as part of Exploratory Works with a capacity of 80 mega volt amp (MVA). It will continue to be used for Main Works, however requires the establishment of further power supply cables to provide power to the work sites and TBM at Tantangara, as well as Talbingo, in particular to power the TBMs via the MAT, ECVT, Talbingo and Tantangara portals.	The supporting high voltage cable route mostly follows access roads to each of the work sites, using a combination of aerial and buried arrangements.
Communications system	Communications infrastructure will connect infrastructure at Tantangara and Talbingo reservoirs to the existing communications system at the T3 power station (via the submarine communications cable in Talbingo Reservoir established during Exploratory Works) and to Snowy Hydro's existing communications infrastructure at Cabramurra.	The cable will be trenched and buried in conduits within access roads. Crossing of watercourses and other environmentally sensitive areas will be carried out in a manner that minimises environmental impacts where possible, such as bridging or underboring.
Water and waste water servicing	Drinking water will be provided via water treatment plants located at accommodation camps. Water for treatment will be sourced from the nearest reservoir. There are three main wastewater streams that require some form of treatment before discharging to the environment, including: • tunnel seepage and construction wastewater (process water) • domestic sewer (wastewater), and • construction site stormwater (stormwater).	Utility pipelines generally follow access roads. Water treatment plants (drinking water) will be needed for the accommodation camps and will be located in proximity. Waste water treatment plants will similarly be located near accommodation camps. Process water treatment plants will be at construction compounds and adits where needed to manage tunnel seepage and water during construction.

Construction element	Purpose	Location
Temporary and permanent access roads	Access road works are required to: • provide for the transport of excavated material between the tunnel portals and the excavated rock emplacement areas; • accommodate the transport of oversized loads as required; and • facilitate the safe movement of plant, equipment, materials and construction workers into and out of construction sites. The access road upgrades and establishment requirements are shown on **Figure 2.2** to **Figure 2.7**. These roads will be used throughout construction including use of deliveries to and from site and the external road network. Some additional temporary roads will also be required within the footprint to reach excavation fronts such as various elevations of the intakes excavation or higher benches along the permanent roads.	The access road upgrades and establishment requirements are shown across the project area. Main access and haulage to site will be via Snowy Mountains Highway, Link Road and Lobs Hole Ravine Road (for access to Lobs Hole), and via Snowy Mountains Highway and Tantangara Road (for access to Tantangara Reservoir) (see **Figure 2.1**).
Excavated rock management	Approximately 9 million m^3 (unbulked/bank) of excavated material will be generated by construction and require management. The strategy for management of excavated rock will aim to maximise beneficial reuse of materials for construction activities. Beneficial re-use of excavated material may include use for road base, construction pad establishment, selected fill and tunnel backfill and rock armour as part of site establishment for construction. Excess excavated material that cannot be re-used during construction will be disposed of within Talbingo and Tantangara reservoirs, used in permanent rehabilitation of construction pads to be left in situ in Lobs Hole, or transported for on-land disposal if required.	Placement areas are shown on **Figure 2.2** and **Figure 2.6.**
Barge launch facilities	Barge launch facilities on Talbingo Reservoir will have already been established during Exploratory Works for the placement of the submarine communications cable, and will continued to be used for Main Works for construction works associated with the Talbingo intake structure. The Main Works will require the establishment of barge launch facilities on Tantangara Reservoir to enable these similar works (removal of the intake plug).	Barge launch sites are shown on **Figure 2.2** and **Figure 2.6**.
Construction workforce	The construction workforce will be accommodated entirely on site, typically with a FIFO/DIDO roster. Private vehicles will generally not be permitted and the workforce bused to and from site.	Access to site will be via Snowy Mountains Highway

The key areas of construction are shown on **Figure 2-2** to **Figure 2-7** and can be described across the following locations:

- Talbingo Reservoir – Talbingo Reservoir provides the lower reservoir for the pumped hydro-electric project and will include the tailrace tunnel and water intake structure. The site will also be used for temporary construction compounds and other temporary ancillary activities;
- Lobs Hole – this site will be used primarily for construction (including construction of the MAT and ECVT portals and tunnels to the underground power station and the headrace tunnel (and headrace tunnel surge shaft), underground tailrace surge shaft and a temporary accommodation camp);
- Marica – the site will be used primarily for construction to excavate the ventilation shaft to the underground power station as well as for the excavation and construction of the headrace surge shaft;
- Plateau – the land area between Snowy Mountains Highway and Tantangara Reservoir is referred to as the Plateau. The Plateau will be used to access and construct a utility corridor and construct a fish weir on Tantangara Creek;
- Tantangara Reservoir – Tantangara Reservoir will be the upper reservoir for the pumped hydro project and include the headrace tunnel and intake structure. The site will also be used for a temporary construction compound, accommodation camp and other temporary ancillary activities; and
- Rock Forest – a site to be used temporarily for logistics and staging during construction. It is located beyond the KNP along the Snowy Mountains Highway about 3 km east of Providence Portal.

During the construction phase, all work sites will be restricted access and closed to the public. This includes existing road access to Lobs Hole via Lobs Hole Ravine Road. Restrictions to water-based access and activities will also be implemented for public safety and to allow safe construction of the intakes within the reservoirs. Access to Tantangara Reservoir via Tantangara Road will be strictly subject to compliance with the safety requirements established by the contractor.

A key construction element for the project is the excavation and tunnelling for underground infrastructure including the power station, power waterway (headrace and tailrace tunnels) and associated shafts. The primary methods of excavation are shown in **Figure 2-8** with further detail on construction methods provided at **Appendix D** of the EIS.

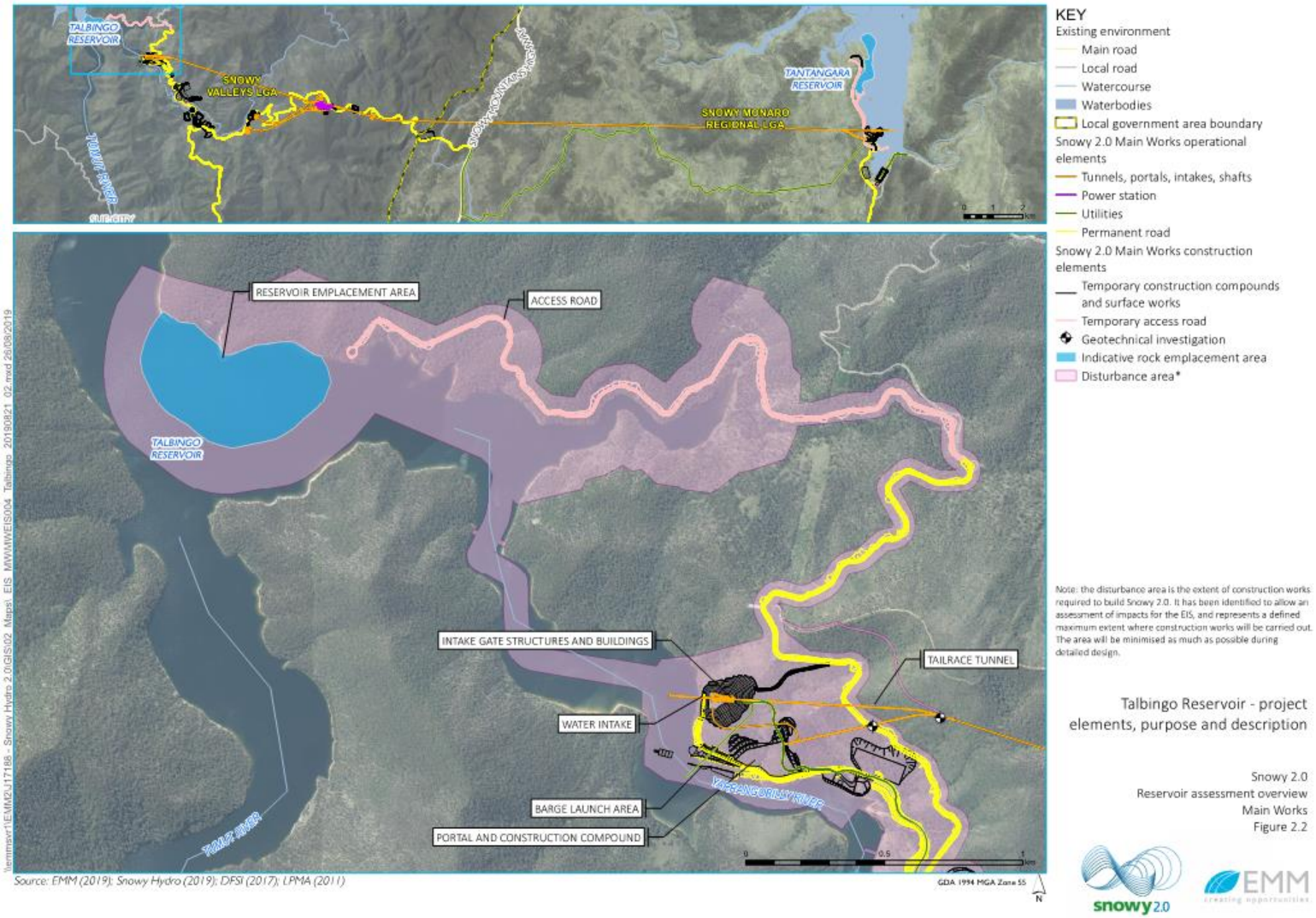


Figure 2-2: Snowy 2.0 locational areas – Talbingo Reservoir.

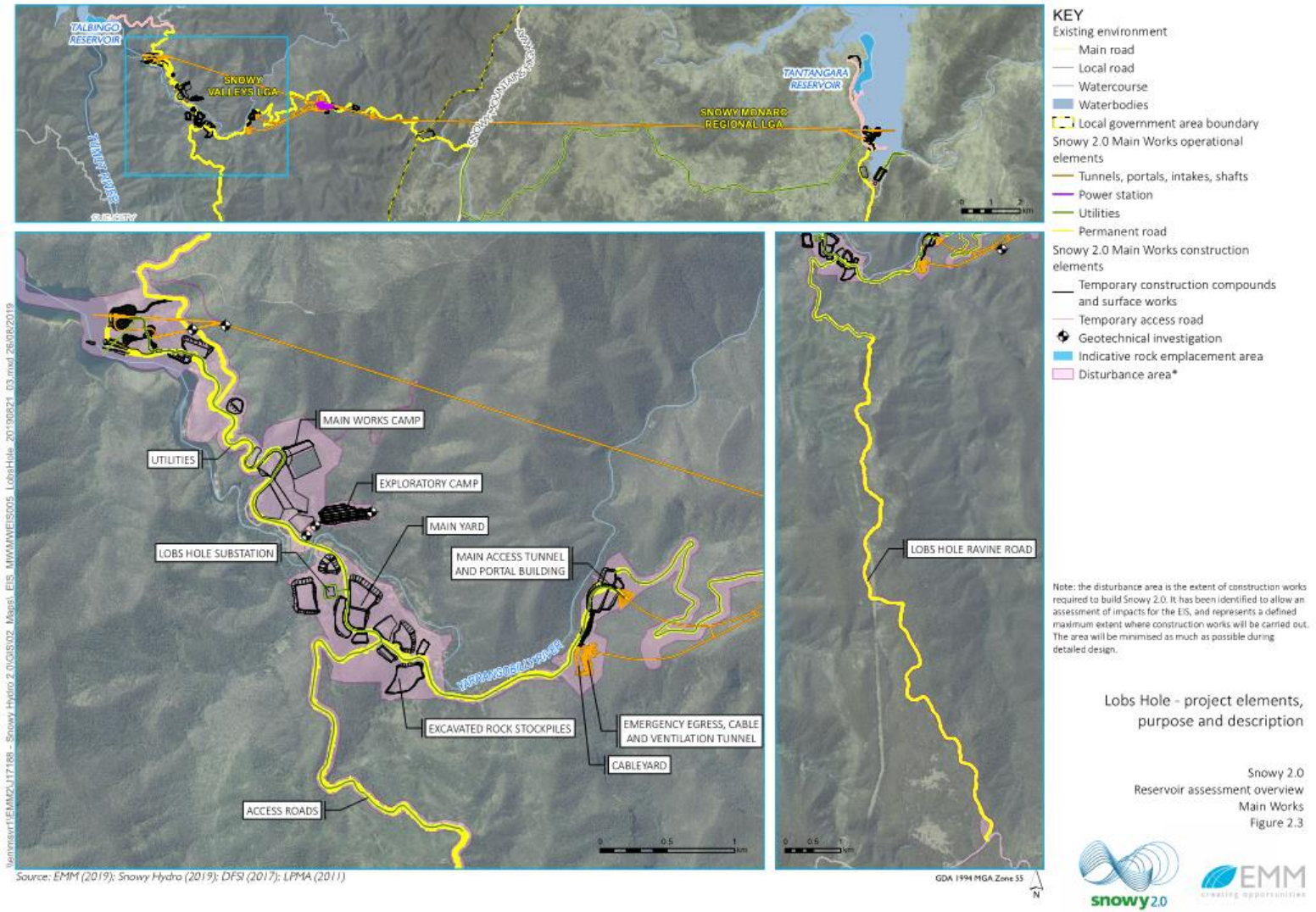


Figure 2-3: Snowy 2.0 locational areas – Lobs Hole.

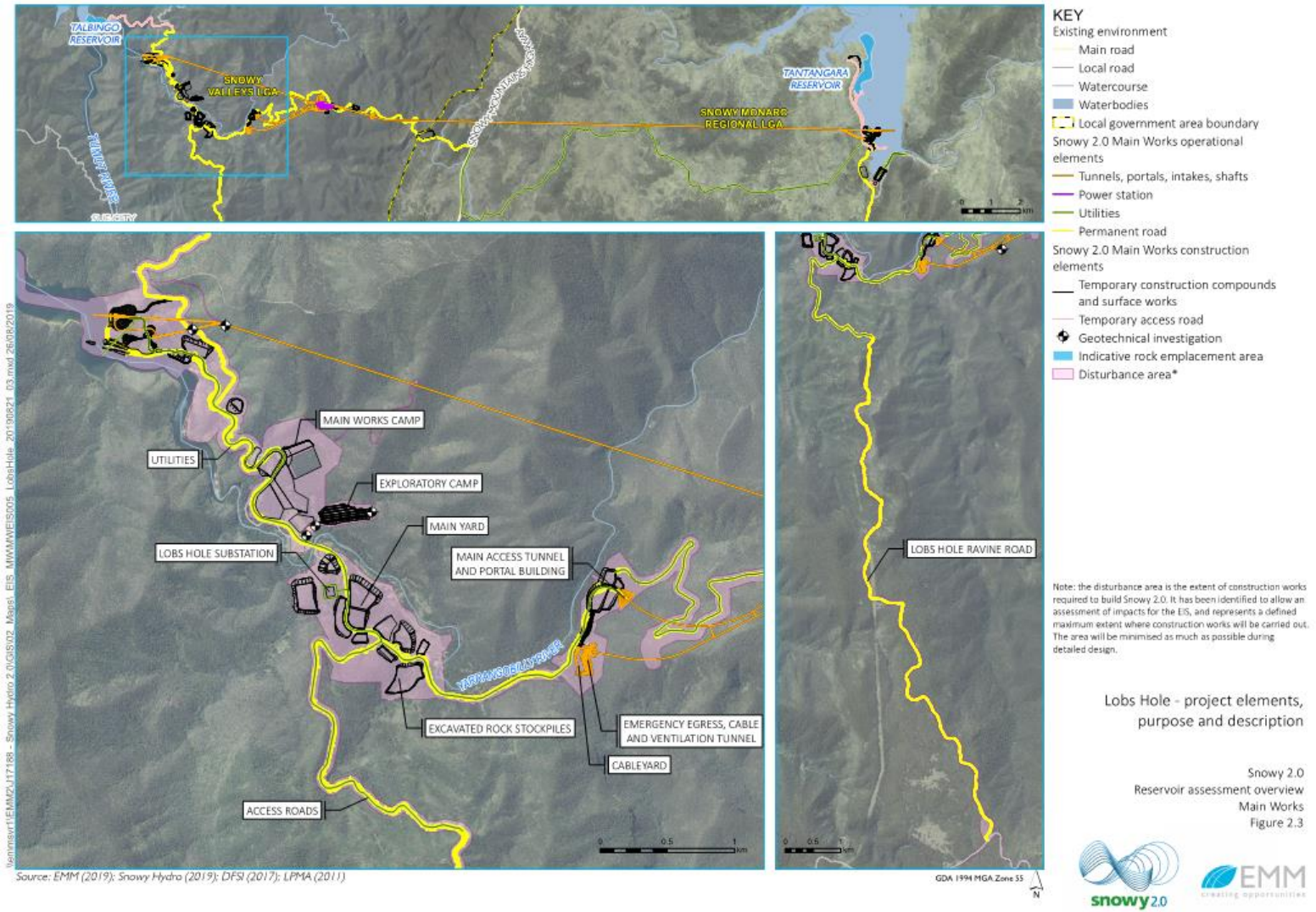


Figure 2-4: Snowy 2.0 locational areas – Marica.

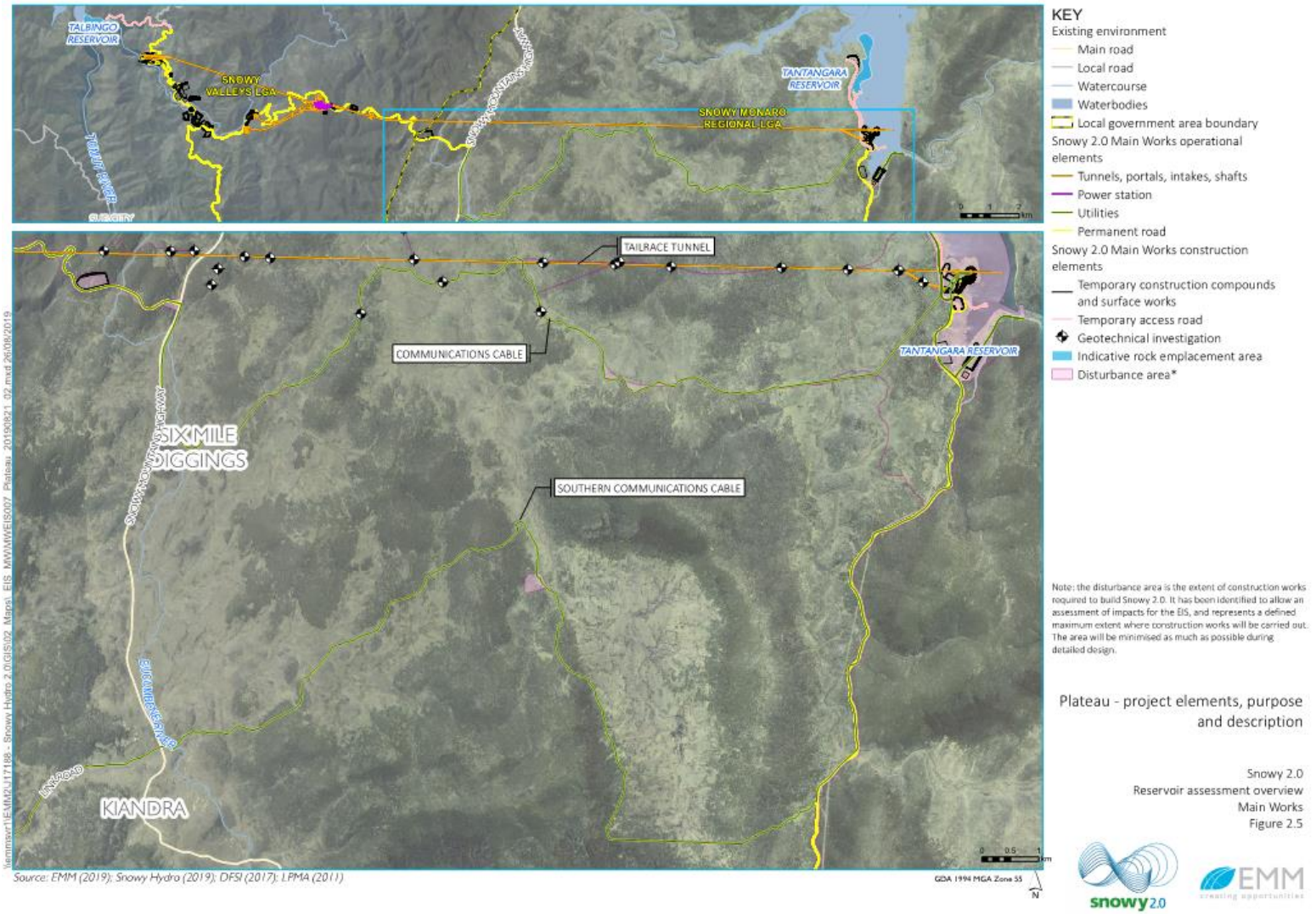


Figure 2-5: Snowy 2.0 locational areas – Plateau.

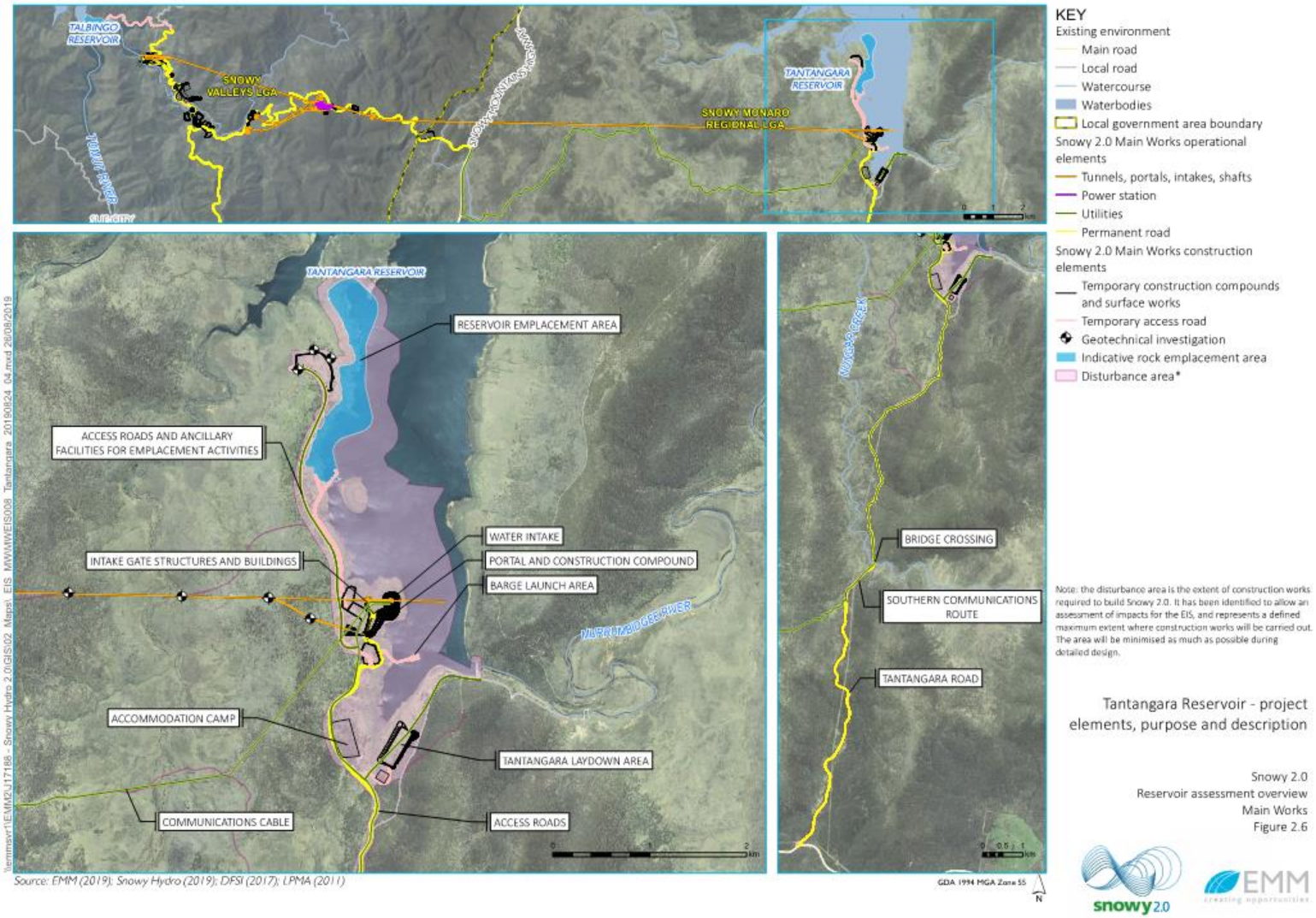


Figure 2-6: Snowy 2.0 locational areas – Tantangara.

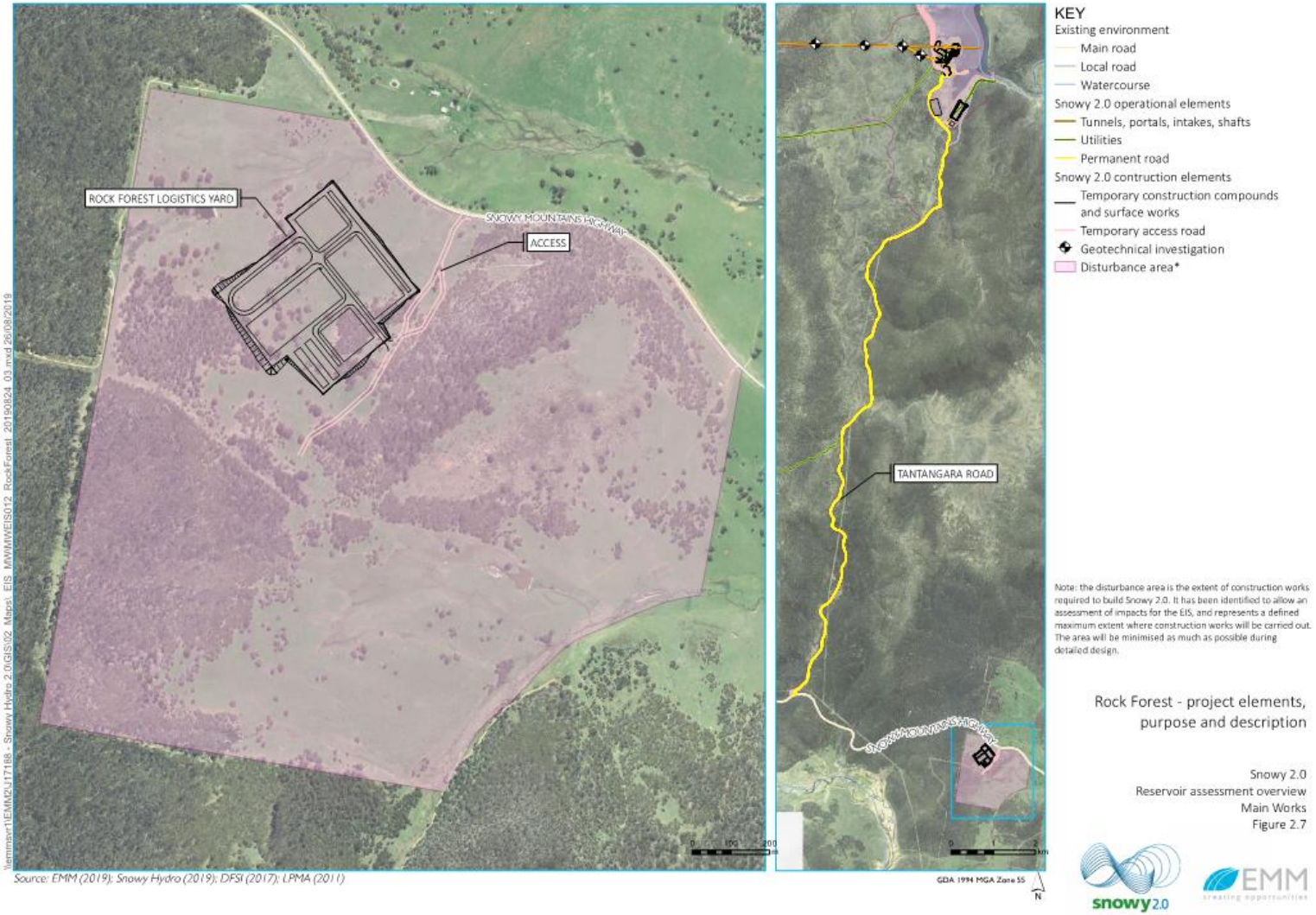


Figure 2-7: Snowy 2.0 locational areas – Rock Forest.

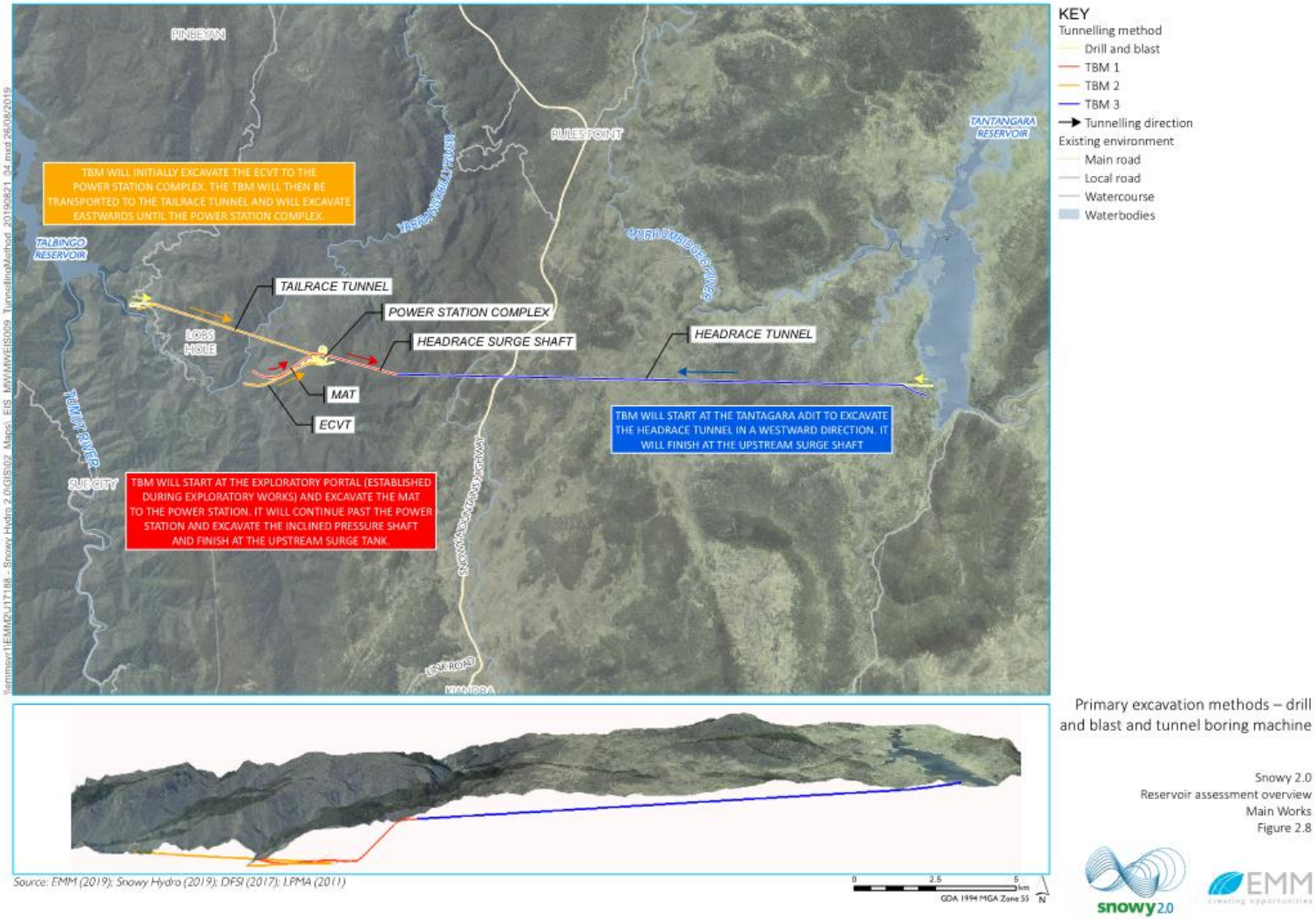


Figure 2-8: Snowy 2.0 excavation and tunnelling methods.

2.3 Operation of Snowy 2.0

2.3.1 Scheme Operation and Reservoir Management

Snowy 2.0 would operate within the northern Snowy-Tumut Development, connecting the existing Tantangara and Talbingo reservoirs.

Tantangara Reservoir currently has the following operational functions within the Snowy Scheme:

- collects releases from the Murrumbidgee River and the Goodradigbee River Aqueduct
- provides a means for storage and diversion of water to Lake Eucumbene via the Murrumbidgee-Eucumbene Tunnel, and
- provides environmental releases through the Tantangara Reservoir river outlet gates to the Murrumbidgee River.

Talbingo Reservoir currently has the following operational functions:

- collects releases from Tumut 2 (T2) power station,
- collects releases from the Yarrangobilly and Tumut rivers,
- acts as head storage for water pumped up from Jounama Pondage, and
- acts as head storage for generation at the T3 power station.

Due to its historic relationship to both the upstream T2 Power Station and downstream T3 Power Station, Talbingo Reservoir has had more operational functions than Tantangara Reservoir in the current Snowy Scheme.

Following the commencement of the operation of Snowy 2.0, both Tantangara and Talbingo reservoirs will have increased operational functions. Tantangara Reservoir will have the additional operational functions of acting as a head storage for generation from the Snowy 2.0 power station and also acting as a storage for water pumped up from Talbingo Reservoir. Talbingo Reservoir will have the additional operational function of acting as a tail storage from Snowy 2.0 generation.

As a result of the operation of Snowy 2.0, the water level in Tantangara Reservoir will be more variable than historically. Notwithstanding this, operations will not affect release obligations under the Snowy Water Licence nor will it involve any change to the currently imposed Full Supply Levels (FSL). No additional land will be affected by virtue of the inundation of the reservoirs through Snowy 2.0 operations. Water storages will continue to be held wholly within the footprint of the existing FSLs.

2.3.2 Permanent Access

Permanent access to Snowy 2.0 infrastructure is required. During operation, a number of service roads established during construction will be used to access surface infrastructure including the power station's ventilation shaft, water intake structures and gates, and the headrace tunnel surge shaft. Permanent access tunnels (the MAT and ECVT) will be used to enter and exit the power station. For some roads, permanent access by Snowy Hydro will require restricted public access arrangements.

2.3.3 Maintenance Requirements

Maintenance activities required for Snowy 2.0 will be integrated with the maintenance of the existing Snowy Scheme. Maintenance activities that will be required include:

- maintenance of equipment and systems within the power station complex, intake structures, gates and control buildings;
- maintenance of access roads (vegetation clearing, pavement works, snow clearing);

- dewatering of the tailrace and headrace tunnels (estimated at once every 15 to 50 years, or as required); and
- maintenance of electricity infrastructure (cables, cable yard, cable tunnel).

2.4 Rehabilitation and Final Land Use

A Rehabilitation Strategy has been prepared for Snowy 2.0 Main Works and appended to the EIS.

It is proposed that all areas not retained for permanent infrastructure will be revegetated and rehabilitated. At Lobs Hole, final landform design and planning has been undertaken to identify opportunities for the reuse of excavated material in rehabilitation to provide landforms which complement the surrounding topography in the KNP.

Given that most of Snowy 2.0 Main Works is within the boundaries of the KNP, Snowy Hydro will liaise closely with NPWS in relation to decommissioning of temporary construction facilities and rehabilitation activities to be undertaken following the construction of Snowy 2.0 Main Works.

3 Waterway Navigation

3.1 Acts and Regulations

The *Marine Safety (Domestic Commercial Vessel) National Law Act 2012* is the regulatory framework for certification, construction, equipment, design and operation of domestic commercial vessels in Australia. The *Marine Safety (Domestic Commercial Vessel) National Law Regulation 2013* is made under authority of the Act and dictates how the provisions of the Act are to be applied. A domestic commercial vessel is defined as any vessel that is for use in connection with commercial, governmental or research activities, including construction activities.

The *Marine Safety Act 1998* (the Act) sets out the broad legal policy relating to marine safety and other matters in NSW. The *Marine Safety Regulation 2016* (the Regulation) is made under authority of the Act and dictates how the provisions of the Act are to be applied.

The Regulation makes provisions with respect to:

- safety of navigation
- marine safety licences, including the following:
    - vessel registration
    - aquatic licences (including for commercial aquatic activities), and
    - boat driving licences
- safety equipment that must be carried on vessels including requirements for the wearing of lifejackets.

With regards to safety of navigation in NSW, the Regulation adopts the *Convention on the International Regulations for Preventing Collisions at Sea 1972* (COLREGS) with modifications. Application of the COLREGS (Rule 1) is modified by the Regulation to extend to vessels on all navigable waters in NSW, including inland rivers, lakes and dam waters.

3.2 Regulatory Authority

The Australian Maritime Safety Authority (AMSA) is the Australian Government authority with responsibility for operational activities of the *Navigation Act 2012* and administers the *Marine Safety (Domestic Commercial Vessel) National Law Act 2012, Marine Safety (Domestic Commercial Vessel) National Law Regulation 2013* and marine orders.

The NSW Roads and Maritime Services (RMS) is the NSW Government authority with responsibility for marine safety and regulation of commercial and recreational boating, including enforcement of the *Marine Safety Act 1998* and *Marine Safety Regulation 2016*.

RMS produced the NSW Boating Handbook (RMS, 2016), which is an interpretation of the law and legislation to assist the general public in understanding the navigation rules and requirements.

3.3 Safety of Navigation – Key Rules

The key navigation rules applying to the assessment of navigation in relation to the Snowy 2.0 project are outlined below.

3.3.1 Look Out and Safe Speed

Two key rules in the COLREGS are:

- Rule 5 – Look-Out
  Every vessel shall at all times maintain a proper look-out by sight and hearing as well as by all available means appropriate in the prevailing circumstances and conditions so as to make a full appraisal of the situation and of the risk of collision.

- Rule 6 – Safe Speed
  Every vessel shall at all times proceed at a safe speed so that she can take proper and effective action to avoid collision and be stopped within a distance appropriate to the prevailing circumstances and conditions.

  In determining a safe speed, the following factors shall be among those considered:

  a) the state of visibility;
  b) the traffic density including concentrations of fishing vessels or any other vessels;
  c) the manoeuvrability of the vessel with special reference to stopping distance and turning ability in the prevailing conditions;
  d) at night, the presence of background light such as from shore lights or from back scatter of her own lights;
  e) the state of wind, sea (waves) and current, and the proximity of navigational hazards;
  f) the draught in relation to the available depth of water.

The Regulations provide additional requirements for a minimum distance to be maintained between vessels and other objects. The minimum distance is specified as:

- 30 m from a vessel, towing equipment or person being towed to any vessel, land, structure and other things when travelling at a speed of 6 knots or more, and
- 60 m from a vessel, towing equipment or person being towed to a person in the water or a dive flag.

If these distances are not practical then a safe distance and speed must be maintained, which is defined as a distance and speed that will ensure the vessel will not cause danger or injury to the person, or damage to the thing, having regard to all relevant safety factors, including:

- weather conditions at the time
- visibility
- speed of the vessel, and
- obstructions to navigation that are present.

3.3.2 Collision Avoidance

The conduct of vessels in sight of one another is established in the COLREGS, which sets out international ‘rules of the road’ to avoid a collision. These rules are summarised in the NSW Boating Handbook (RMS, 2016). The general rules of navigation are that a power vessel must give way to:

- sailing vessels
- vessels approaching head on, by altering course to starboard
- vessels approaching from the right (starboard) hand side (i.e. crossing)

- vessels displaying the special lights and signals
- large vessels restricted in their manoeuvrability
- any vessel being overtaken, and
- vessels engaged in fishing activities and showing appropriate signals.

Additional rules apply to a sailing vessel underway, including a requirement for sailing vessels to keep out of the way of a vessel restricted in their ability to manoeuvre.

3.3.3 Wash

The Regulations include a provision to minimise wash and notes that the operator of a vessel must not cause wash that damages or impacts unreasonably on:

a) any dredge or floating plant
b) any construction or other works in progress
c) any bank, shore or waterside structure, or
d) any other vessel, including a vessel that is moored.

This provision impacts the way in which a vessel is operated.

4 Impact Assessment

Having regard to the proposed development and the existing foreshore occupation, vessel use and environmental conditions outlined in **Section 5** and **Section 6** for Tantangara Reservoir and Talbingo Reservoir respectively, the impact assessment involves the following steps:

1) identify reasonably foreseeable hazards associated with the construction and operation of Snowy 2.0. Hazards only consider those that impact safety of navigation, including those that affect workers, employees and recreational users of the waterway
2) if necessary, assess the risks arising from the hazards. The risk assessment would be a justification of the requirement and suitability of mitigation measures
3) eliminate or minimise the risk by designing mitigation measures, and
4) review the mitigation measures.

The risk associated with a particular hazard is a combination of the likelihood of the hazard occurring and its consequence. The description of likelihood and consequence is presented in **Table 4-1** and **Table 4-2** respectively.

Table 4-1: Likelihood table.

Likelihood	Description
5 Almost Certain	Could happen at any time under normal circumstances. Is expected to occur at regular intervals.
4 Likely	Probably will occur under normal circumstances. Has occurred several times in the past on similar projects.
3 Possible	Possibility of occurring under normal circumstances. Has occurred a few times in the past on similar projects.
2 Unlikely	Could happen but unlikely under normal circumstances. Has occurred once in the past on a similar project.
1 Rare	Will probably never occur. May happen in exceptional circumstances.

Table 4-2: Severity table.

Severity	Description
5 Catastrophic	Potential death.
4 Major	Potential permanent or long term disability or illness requiring urgent medical attention and hospital admission.
3 Moderate	Potential temporary disability or illness requiring medical attention.
2 Minor	Minor injury requiring first aid.
1 Insignificant	Negligible injury or discomfort. No medical treatment or measurable physical effects.

The risk assessment scores consider likelihood and consequence, based on the Risk Matrix in **Table 4-3**. An interpretation of risk assessment scores ranging from “acceptable / tolerable” to “unacceptable” is provided in the table.

Table 4-3: Risk Matrix.

Likelihood	Consequence				
	5 Catastrophic	4 Major	3 Moderate	2 Minor	1 Insignificant
5 Almost Certain	E25	E20	H15	H10	M5
4 Likely	E20	H16	H12	M8	L4
3 Possible	H15	H12	M9	M6	L3
2 Unlikely	H10	M8	M6	L4	L2
1 Rare	M5	L4	L3	L2	L1

Risk Assessment Scores	Action Required
Extreme (20-25)	Unacceptable risk requires immediate attention to eliminate or reduce risk.
High (10-20)	
Medium (5-9)	Control the risks and hazards. If residual risk/s exist, which are not possible to control, work may proceed provided stakeholders understand the residual risk.
Low (1-4)	Acceptable to tolerable risk, work can proceed.

Managing “unacceptable” risks is achieved by implementing mitigation or control measures. A hierarchy of control measures is established in the *Safe Design of Structures Code of Practice (*Safe Work Australia, 2018). The Code of Practice is made under the *Work Health and Safety Act 2011.* The most effective mitigation measure should be implemented where practical. The hierarchy of mitigation measures are as follows in order of most effective to least effective:

- eliminate – ‘Design out’ the hazard when new materials, equipment and work systems are being implemented.

If it is not reasonably practicable to eliminate a hazard the following control measures should be considered:

- substitute – substitute or replace a hazardous design component (e.g. materials, equipment or substances) with a less hazardous one through a redesign process
- isolate – isolating or separating the hazard from workers and end users by, for example, using barriers, enclosing noisy equipment and providing exhaust or ventilation systems
- engineering – use engineering controls to reduce the risks such as adequate ventilation and lighting or designing and positioning permanent anchorage and hoisting points into buildings where maintenance needs to be undertaken at height, and
- administrative – Minimise the risk by adopting safe working practices or providing appropriate training, instruction or information.

Detailed risk assessments for Tantangara Reservoir and Talbingo Reservoir are provided in **Section 5** and **Section 6** respectively. The risk assessment appoints a “Risk Manager” for each identified hazard, who is responsible for ensuring controls and mitigation measures are implemented correctly. When a new or unforeseen hazard is identified, or the controls and mitigation measures are deemed insufficient to manage the risk of a hazard, the site and/or works should be made safe and work should cease until the risk is adequately addressed.

5 Tantangara Reservoir

Tantangara Reservoir is located within Kosciuszko National Park and therefore SHL leases the land. The reservoir was formed by damming the Murrumbidgee River. Construction of Tantangara Dam, a 45 m high concrete gravity structure, was completed in 1960. However, RMS has jurisdiction over navigable waters in NSW, including Tantangara Reservoir.

5.1 Existing Foreshore Occupation and Vessel Use

The access roads to Tantangara Reservoir are shown in **Figure 5-1**. The southern end of Tantangara Reservoir is accessible to the public via Tantangara Road while the northern end is accessible via Port Phillip Trail. Both Tantangara Road and Port Phillip Trail are unsealed. Port Phillip Trail crosses the reservoir and connects with Pockets Saddle Road, which joins Tantangara Road near the dam wall. However, Port Phillip Trail is closed at mid to high reservoir levels due to inundation.

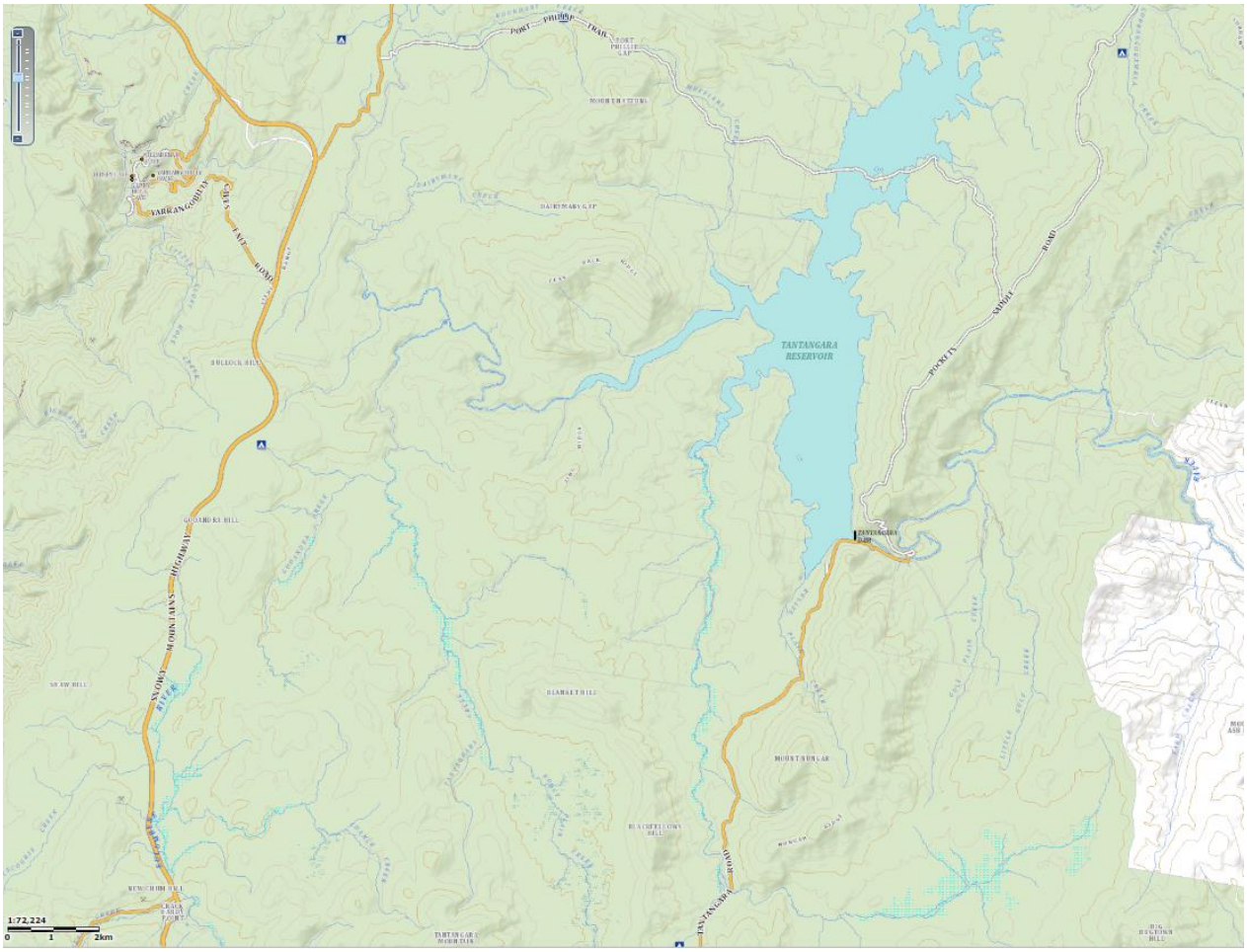


Figure 5-1: Tantangara Reservoir access roads (SIX Maps, 2019).

The reservoir is relatively isolated, and road access is limited. There are a number of other reservoirs within the Snowy scheme that are situated closer to urban centres, and provide easier access, including Blowering Reservoir and Lake Eucumbene. These reservoirs would typically have a higher recreational usage.

There are no vessels permanently stored on Tantangara Reservoir. As such, all vessels are trailerable craft, which are typically up to 7.5 m long with a beam of 2.5 m in accordance with the NSW Boat Ramp Facility Guidelines (RMS, 2015). These dimensions are partially governed by the *Road Transport (Vehicle Registration) Regulation 2017*, which outlines the maximum dimension for light vehicles (including trailers).

These factors are reflected in the level of foreshore occupation and frequency of vessel use.

5.1.1 Boating Facilities

Boating facilities are marked on the RMS Boating Map for Lake Eucumbene and Tantangara Reservoir Area, attached in **Appendix A**. Maritime facilities are restricted to a single unformed boat launching area at the southern end of the reservoir, accessible from Tantangara Road.

A large portion of the foreshore of the reservoir is currently used to launch vessels. Provided the bed material is sufficiently firm, the slope of the foreshore is adequate, and the tow vehicle is suitable for the size of the vessel, launching of vessels is feasible at a number of unmarked and informal locations around the reservoir (particularly along the western foreshore).

5.1.2 Foreshore Occupation and Structures

The only permanent existing structures around Tantangara Reservoir are the dam wall and an intake for the Murrumbidgee-Eucumbene Tunnel that diverts water from Tantangara Reservoir to Lake Eucumbene.

The dam wall includes a gate to control the release of water into the Murrumbidgee River for environmental flows.

The intake for the Murrumbidgee-Eucumbene Tunnel is located near the southern end of the reservoir. The intake is completely submerged, and it is not marked on the RMS Boating Map for Lake Eucumbene and Tantangara Reservoir Area.

Camping is permitted anywhere around the foreshore of Tantangara Reservoir and is a popular past time, particularly during the warmer months between spring and autumn.

5.1.3 Navigation Restrictions

The tributaries of Tantangara Reservoir are not suitable for navigation of vessels due to shallow water depths. Further, there is no provision for vessel access downstream of the dam wall.

Navigation restrictions on Tantangara Reservoir are marked on the RMS Boating Map for Lake Eucumbene and Tantangara Reservoir Area, attached in **Appendix A**. There are no permanent navigation aids on or around Tantangara Reservoir, that are marked on the Boating Map. However, we understand that buoys and a floating boom, east of the boat ramp, prevent access to the dam wall.

Due to the variable water level in the reservoir, the RMS Boating Map includes a warning for submerged rocks, trees and shallow areas.

However, the valley that was flooded to form Tantangara Reservoir, including parts of Currango Plain and Kelly Plain, was naturally devoid of mature (tall) eucalypts. Cold mountain air settles in the valleys and plains at night and the cold air is not suitable for the growth of mature eucalypts that are prominent throughout the region. This reduces the number of navigation restrictions and submerged hazards throughout the reservoir.

There are no speed limit or exclusion zones marked on the RMS Boating Map. However, safe distance and speed requirements outlined in **Section 3.3.1** would still apply.

5.1.4 Vessel Use

Tantangara Reservoir is classified as 'alpine waters' in the Regulation. It is therefore a requirement that each person on a canoe, kayak or vessel less than 4.8 m in length wears a lifejacket.

TRC Tourism undertook a recreational user survey by undertaking a count of the number of cars, boats, caravans/camper trailers and camping tents at a single point in time. The recreational user counts were undertaken at Tantangara North (accessible via Pockets Saddle Road), Tantangara South (accessible via Tantangara Road) and Tantangara Northwest (accessible via Port Phillip Trail). Results from the count are summarised in **Table 5-1**. As the recreational user count was undertaken at a single point in time, the total number of visitors within a 24 hour period may be higher than the count data.

The category of 'boats' includes both trailered boats as well as passive recreational craft transported on the roof of a car. However, the number of boats recorded was typically based on the number of boat trailers near a boat ramp or campsite. Therefore, the recreational user count would not have identified passive recreation craft, transported on the roof of a car, that may have been in use at the time of the survey, unless they were visible from the shoreline.

The recreational user count indicates that the peak number of boats at the reservoir was 34 on the 29th September 2018, which coincided with the October long weekend. The October long weekend marks the start of the fishing season in 'general trout streams', including the Murrumbidgee River that feeds into Tantangara Reservoir. Recreational user counts were not undertaken on the Australia Day public holiday at Tantangara North and Tantangara Northwest. However, the number of boats at Tantangara South was less on the Australia Day public holiday compared to the October Long Weekend.

The typical number of boats on a weekday and weekend is difficult to ascertain as the recreational user count for a particular day rarely covered all three sections of the reservoir. However, the data indicates a typical busy weekend day in summer would attract approximately 15 vessels while a typical busy weekday in summer may attract approximately 5 to 10 vessels. It is evident that demand for the waterway increases over the Christmas and New Year holiday period with up to 30 vessels visiting the reservoir on any given day.

Based on the available recreational user counts, peak recreational boating use of the reservoir is assumed to be 40 vessels per day. However, on a typical weekday in summer, recreational boating use would be less than say 10 vessels per day. While there is no data available for the winter months, it is assumed that recreational boating use of the reservoir would be significantly less.

Table 5-1: Count of recreational users undertaken by TRC Tourism.

Location	Tantangara North				Tantangara South				Tantangara Northwest			
Date	Cars	Boats	Caravans/ Camper Trailers	Camping Tents	Cars	Boats	Caravans/ Camper Trailers	Camping Tents	Cars	Boats	Caravans/ Camper Trailers	Camping Tents
Saturday (October Long Weekend) 29-09-18	14	7	1	7	31	17	5	39	25	10	9	12
Saturday 01-12-18	19	3	4	2	6	1	0	2	No Count			
Saturday 08-12-18	9	6	0	0	15	4	0	5	No Count			
Saturday 15-12-18	7	6	1	0	2	0	2	0	No Count			
Thursday 27-12-18	No Count				No Count				31	13	8	20
Friday 28-12-18	No Count				21	10	2	13	24	10	7	21
Sunday 30-12-18	4	0	4	1	5	3	0	2	No Count			
Thursday 03-01-19	No Count				24	11	5	18	No Count			
Friday 04-01-19	No Count				No Count				3	0	2	0
Saturday 05-01-19	No Count				No Count				10	4	4	3
Friday 11-01-19	No Count				No Count				5	2	1	3
Saturday 12-01-19	No Count				5	0	2	4	No Count			
Thursday 17-01-19	No Count				4	1	1	1	8	5	2	2
Saturday (Australia Day) 26-01-19	No Count				17	10	7	12	No Count			
Saturday 02-02-19	1	0	1	0	No Count				6	5	1	6
Saturday 09-02-19	No Count				14	1	2	7	7	3	1	10
Saturday 16-02-19	No Count				10	1	2	2	No Count			
Saturday 23-02-19	10	3	2	7	7	3	0	2	9	3	2	7
Sunday 21-04-19	No Count				No Count				21	6	5	13
Monday 22-04-19	No Count				4	1	1	2	No Count			

5.1.4.1 Power Boats

Tantangara Reservoir is a 'trophy' trout fishing destination and is one of the few self-sustaining trout hatcheries in Australia. It is classified as a 'General Trout Dam' (NSW Government Gazette No. 76, 12 September 2014). The main fish species targeted by anglers in Tantangara Reservoir are Brown Trout and Rainbow Trout. Unless exempt, anglers are required to hold a NSW Recreational Fishing Licence to fish in public waterways in NSW.

Anglers frequenting Tantangara Reservoir typically use smaller aluminium fishing vessels powered by an outboard motor and/or an auxiliary trawling motor. The vessels are usually around 4 to 5 m LOA[1]. Trawling

[1] *LOA (Length Overall) is the maximum length of a vessel's hull measured parallel to the waterline.*

is the most popular form of fishing from power vessels in Tantangara Reservoir. The speed for trawling is typically around 1-2 knots.

Unsealed access roads and the unsealed boat ramp generally preclude larger vessels from accessing the waterway. The reservoir is infrequently used for tow sport activities (water-skiing, wakeboarding etc.) and general boating.

5.1.4.2 Passive Recreation Craft

Passive recreation craft (unpowered craft) do not frequently operate on Tantangara Reservoir.

The waterway would be occasionally accessed by canoes and kayaks affiliated with campers. Fishing kayaks may also access the waterway. However, fishing kayaks are not generally suitable for trawling or fly fishing, which are the preferred methods for landing the prevalent trout species at Tantangara Reservoir.

5.1.4.3 Commercial Vessels

Guided fishing tours of the area are provided by Adaminaby Angler and the list of destinations includes Tantangara Reservoir. It is understood that Adaminaby Angler favours land-based fly fishing. There are no commercial charter tours (vessel based) operating at Tantangara Reservoir.

Snowy Hydro require infrequent vessel access to intake structures at Tantangara Reservoir to clear the 'trash racks'. The works usually require divers to assist with removal of debris from the racks.

5.1.5 Other Waterway Users

Other users of the reservoir include swimmers and land-based anglers. Due to the remote location, these user groups would usually be affiliated with campers (refer **Section 5.1.2**).

The number of caravans, camper trailers and camping tents was recorded in a recreational user count completed by TRC Tourism. The results from the count are summarised in **Table 5-1**.

The peak number of caravans, camper trailers and camping tents recorded at the reservoir was up to 73 on the 29th September 2018, which coincided with the October long weekend and peak recreational boating use (refer **Section 5.1.4**). As per the recreational boat count, the typical number of caravans, camper trailers and camping tents on a weekday and weekend is difficult to ascertain as the user count for a particular day rarely cover all three sections of Tantangara Reservoir. However, based on the available data, up to 50 caravans, camper trailers and camping tents may occupy the foreshore of the reservoir over the Christmas and New Year holiday period. This is significantly higher than a typical 'busy' weekend during summer that may attract about 10 to 20 caravans, camper trailers and camping tents. While there is no data available for the winter months, it is assumed that the number of caravans, camper trailers and camping tents visiting the reservoir would be significantly less.

These numbers can be used as a proxy to estimate the number of other waterway users including swimmers and land-based anglers. However, the recreational user count does not provide information on the number of occupants per caravan, camper trailer or camping tent or the number of occupants that would partake in water-based activities. Notwithstanding, it is clear that there is a high demand for the waterway during the holiday season and long weekends.

5.1.6 Aquatic Activities and Licences

An aquatic activity is a race, exhibition or any other activity that restricts the availability of navigable waters for normal use by the public. An aquatic licence is issued by RMS for commercial aquatic activities and all other (non-commercial) aquatic activities in accordance with the Regulation.

There are currently no aquatic licences issued by RMS for events proposed at Tantangara Reservoir. There are no annual or recurring events that take place on the reservoir.

5.1.7 Summary

There are two main user groups that would frequent the reservoir on a regular basis:

1. day users (primarily fisherman) launching trailerable vessels from the boat ramp and navigating to all parts of the reservoir.
2. multi-day users (campers) who may partake in swimming activities, boating activities, land based fishing, canoeing/kayaking etc. These users would regularly launch trailerable vessels directly from the bank of the reservoir at any one of a number of informal launching locations (particularly along the western foreshore).

5.2 Environmental Conditions

Environmental conditions are a major factor when assessing safety of navigation. The RMS Boating Map includes a general warning that the high altitude and open nature of Tantangara Reservoir can lead to sudden changes in weather conditions.

5.2.1 Water Levels

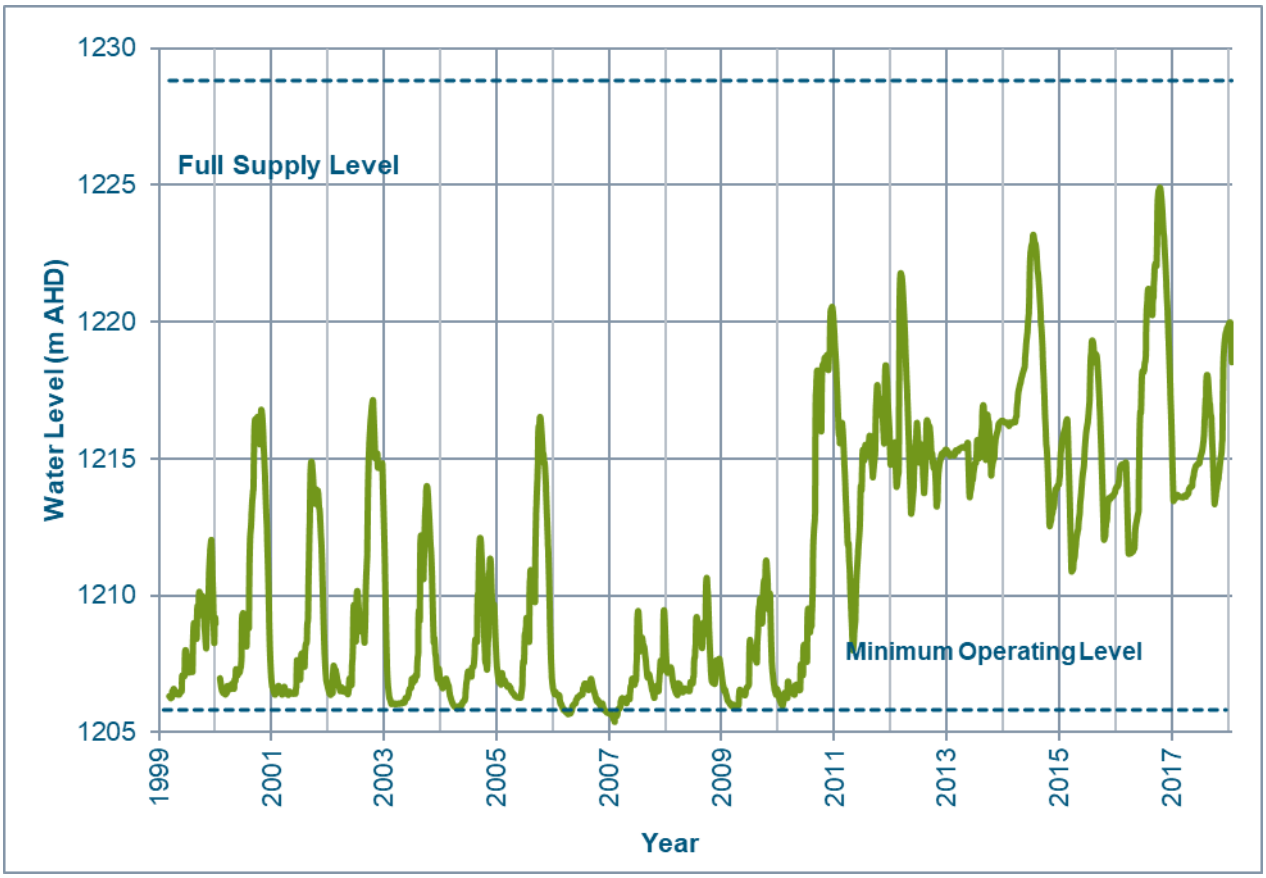
Tantangara Reservoir is fed by runoff and snow melt from a number of tributaries including Murrumbidgee River, Mosquito Creek and Nungar Creek. The release of water from the reservoir is controlled by gates at the dam wall to release water into the Murrumbidgee River and a separate tunnel (Murrumbidgee-Eucumbene Tunnel) to divert water to Eucumbene Reservoir.

The Minimum Operating Level (MOL), Full Supply Level (FSL), and Design Flood Level (DFL) of Tantangara Reservoir, relative to Australian Height Datum (AHD), are:

- MOL – 1205.8 m AHD
- FSL – 1228.7 m AHD
- DFL – 1233.9 m AHD

Daily water level data for each day from 1999 to 2018 is presented in **Graph 5-1**. There is some degree of seasonality evident in the data. The water level generally rises rapidly around September each year, corresponding to snow melt, and falls rapidly around January each year.

There is an evident shift in management of the reservoir around 2010 and 2011. Between 1999 and 2010, the water level was generally allowed to decrease to near MOL and typically remained at close to MOL between about February and May. Since 2011, a higher water level has been typically maintained.



Graph 5-1: Maximum daily water level in Tantangara Reservoir from 1999 to 2018.

5.2.2 Water Depths

Tantangara Reservoir forms a relatively shallow water body over a large area. The surface area of the reservoir increases substantially as the water level increases.

Available hydrographic survey information is shown in **Appendix C**. The thalweg[2] of the reservoir near the dam wall is at approximately 1195 m AHD, representing a water depth of 10.8 m at MOL. The thalweg near the proposed Snowy 2.0 intake structure, approximately 500 m upstream of the dam wall, is marginally higher at approximately 1196 m AHD.

5.2.3 Wave Climate

The wave climate at Tantangara Reservoir is contributed to by wind waves and boat-generated waves, which combine to form the incident wave climate. The wind wave climate has been determined for a location near the boat ramp at Tantangara Reservoir. Boat-generated waves could occur anywhere on the reservoir that is navigable.

5.2.3.1 Wind Waves

Wind waves are generated when the wind blows across a body of water. The size and period of these waves depends on the wind speed, the distance over which the wind blows (fetch) and the water depth. Design wind velocities for the site were obtained from *Australian Standard Structural Design Action Part 2: Wind Actions (AS/NZS1170.2:2011)*. Wind wave hindcast procedures set out in the Coastal Engineering

[2] *Thalweg is a line connecting the lowest points of successive cross-sections along the course of a valley, river or reservoir.*

Manual (USACE, 2008) were used to predict the incident wind wave climate at the site, which is summarised in **Table 5-2**.

Wind waves are defined at primary directions separated by 45 degrees. The fetch is defined as the average length of eight radials separated by 3 degrees, centred on the primary direction (SPM, 1984).

The length of the fetch at Tantangara Reservoir is somewhat dependant on the water level. At lower water levels, land features are exposed that limit the fetch. **Table 5-2** sets out the wave climate at FSL and MOL for the 1 year Average Recurrence Interval (ARI) and 50 year ARI events.

Table 5-2: Significant wind wave height at Tantangara Reservoir boat ramp.

Direction	North at FSL		North at MOL	
Fetch	5.9 km		3.5 km	
Average Recurrence Interval	Significant Wave Height H_s (m)	Wave Period T (s)	Significant Wave Height H_s (m)	Wave Period T (s)
1 year	0.7	2.6	0.5	2.2
50 year	1.0	2.9	0.7	2.4

*Note: Significant wave height Hs is the average of the highest 1/3 of waves in a wave train. H max ~ 1.5*Hs.*

5.2.3.2 Boat Waves

Boat-generated waves are governed by the submerged shape of the boat hull, the boat speed and the water depth. Typically boat waves exhibit a diverging component which emanates at the bow, and a transverse component that follows behind the stern. The boat speed relative to the water depth can affect the form of the waves.

A wave train generated by a boat initially appears as an accumulation of super-imposed waves. As the waves travel away from the sailing line, the wave train develops until all of the waves can be individually characterised by wave height and wave period, at which point the wave train may be considered fully developed. This occurs within 2-5 boat lengths from the sailing line. After the wave train becomes fully developed, the wave period remains constant while the wave height decreases in proportion to distance from the sailing line (Glamore, 2005). Divergent wave attenuation with distance from the sailing line is shown in **Table 5-3**.

Table 5-3: Divergent wave attenuation with distance (Glamore et al, 2005).

Attenuation (%)	Distance from Sailing Line (m)
78.67	22
83.09	35
88.45	75
90.00	100

For a typical tow sport vessel of 6.1 m LOA, Ruprecht et al (2015) measured maximum wave heights 22 m from the sailing line (3.5*LOA). This distance corresponds to the point at which the wave train was considered to be fully developed. Closer than 22 m to the sailing line, where the wave train is not fully developed, they recommend adopting maximum wave heights rather than attenuated wave heights.

For a vessel approximately 4 to 5 m LOA, the fully developed wave would occur approximately 8 to 25 m from the sailing line. The maximum incident boat-generated wave height would be approximately 0.3 m

with a period of 2 seconds (Ruprecht et al, 2015). It is recommended to assume the maximum wave height occurs at a distance of 22 m from the sailing line and apply attenuation factors in **Table 5-3** to determine far field wave heights.

5.2.4 Currents

Currents would be produced by the following processes:

1. wind induced currents, which may be up to approximately 0.1 m/s (0.2 knots)
2. propeller wash from vessels, which can generate high localised currents. Due to the installed engine power on typical trailerable vessels that would operate on Tantangara Reservoir, propeller currents would be negligible and would generally dissipate within about 5 to 10 m of the vessel
3. freshwater flows from creeks, streams, rivers and overland flows. Currents would be higher around the inflow source and would dissipate relatively quickly
4. release of water from Tantangara Reservoir into Murrumbidgee River. The release of water is controlled by gates at the dam wall, and
5. diversion of water from Tantangara Reservoir to Eucumbene Reservoir via the Murrumbidgee-Eucumbene Tunnel.

Items 3 to 5 above have not been assessed in detail. No exclusion zones are currently marked on the RMS Boating Maps, which would suggest that the currents are relatively low and are not a concern for waterway users. Minor 'whirlpooling' has been reported around the Murrumbidgee-Eucumbene Tunnel intake. However, due to the depth of the offtake, surface currents, which would impact boating operations, are expected to be relatively low.

Peak currents on Tantangara Reservoir would typically be less than 0.1 m/s (0.2 knots).

5.3 Proposed Development

5.3.1 Construction Activities

The construction program and methodology for Tantangara Reservoir ensures the majority of the construction activities are land based. Land based activities, that would occupy part of the shoreline of the reservoir, include:

- Land transport of excavated rock and placement of excavated rock between MOL and FSL. It is noted that Snowy Hydro would maintain a relatively low water level in Tantangara Reservoir and the placement of excavated rock would be undertaken in the dry. The placement location is shown in **Figure 2-6**.
- Excavation of the intake channel. A 'plug' would be retained that would allow the majority of the intake channel to be excavated using land based equipment. The proposed method of excavation would be drill and blast (D&B). A cross section of the intake channel and intake structure is shown in **Figure 5-2** indicating 'Dry D&B', that would be undertaken with land based equipment.

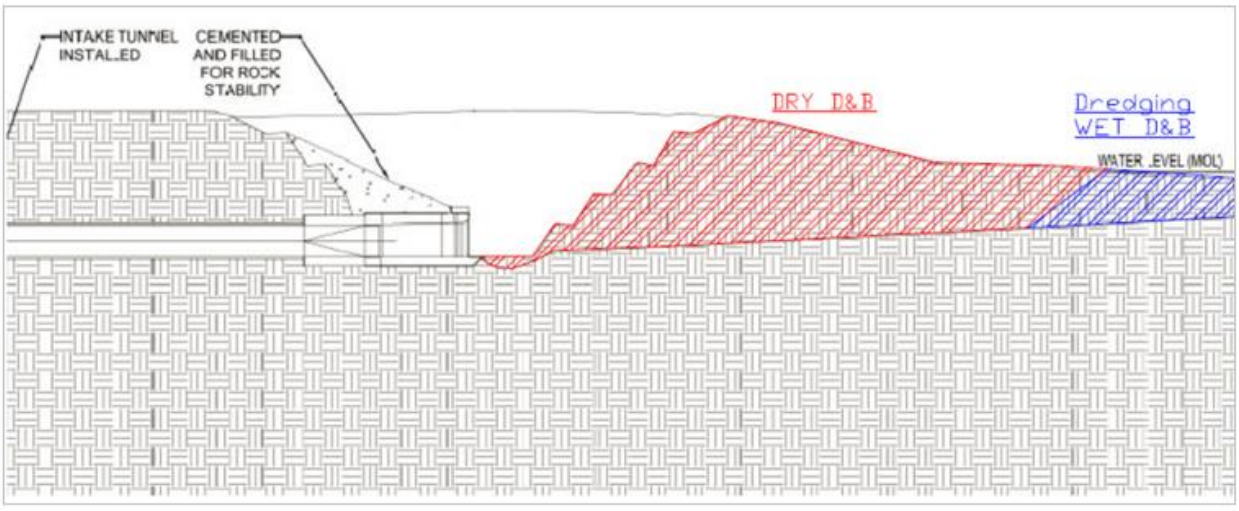


Figure 5-2: Excavation of the intake channel.

Marine based construction activities are limited to marine drill and blasting of the intake channel 'plug', marked as 'Wet D&B' in **Figure 5-2**. It is estimated that approximately 170,000 m^3 (bank) of rock would be excavated. The rock mass would be initially drilled and blasted using floating plant and equipment, similar to that shown in **Figure 5-3**. The blasted rock would be removed with a long reach excavator mounted on a barge, similar to that shown in **Figure 5-4**, or by a grab dredge, depending on water depth.

Based on the available borehole information, there may be up to 8 m of residual soil overlying the bedrock. It is possible that the residual soil could be excavated with a backhoe dredger, without the requirement for prior D&B.

Figure 5-3: Barge mounted rig for marine drill and blasting.

Figure 5-4: Example BHD operating within a 'moon pool'. Note that to extract blasted rock, the 'moon pool' may not be required.

The excavated material would be transported to land by barge and transferred to land based transport equipment for placement with the excavated rock from the tunnel stream.

It is estimated that approximately 3 barges would be required for marine D&B operations, which would be up to approximately 30 m LOA (length overall) and 20 m wide. It is assumed that the barges would be unpropelled. The barges would be modular to enable mobilisation to Tantangara Reservoir and may be fitted with spuds that would be lowered to the reservoir bed during construction activities to hold the barge in position. Alternatively, the barges would be held in position by mooring lines or tugs.

The barges would be manoeuvred using shallow-draft pusher tugs. The minimum engine capacity of the tugs would be approximately 600 hp. The tug would be a twin propeller vessel, which has enhanced manoeuvrability. It is envisaged that approximately 2 tugs may be required.

Suitable mitigation measures would be deployed to minimise shockwave pressure from the marine D&B operations and mitigate the spread of turbid water. Marine survey would also be required to confirm the intake channel profile has been achieved. A small number of work boats (up to approximately 3) may be required to handle and secure the silt curtains and 1 vessel would be required for survey operations.

In total, up to approximately 3 barges, 2 tugs and 4 work boats/survey vessels would be required to complete the construction activities. The barges, tugs and support vessels would be launched from the barge ramp near the intake structure shown on **Figure 2-6**, or other suitable areas within the disturbance footprint. The marine plant and equipment for construction would typically operate at less than 4 knots.

5.3.2 Operation of Snowy 2.0

Following construction, limited access would be required to Snowy 2.0 infrastructure at Tantangara Reservoir. The intake structure would occupy part of the foreshore. Access to the tunnels and gate structures would be required for maintenance.

Marine activities would include cleaning and removal of debris from the trash racks at the intake structure. It is noted that the majority of debris in Tantangara Reservoir would be from freshwater inflows. The reservoir is typically devoid of submerged vegetation.

Commissioning and operation of Snowy 2.0 would result in a peak generating flow (flow from Tantangara Reservoir to Talbingo Reservoir) at design capacity of 372 m^3/s and a peak pumped flow (flow in reverse) at design capacity of 270 m^3/s. The MOL and FSL of the reservoir would not change as a result of Snowy 2.0. However, management of the reservoir for Snowy 2.0 is likely to result in a more highly variable water levels in response to inflows and the National Electricity Market requirements, and a higher average water level.

5.3.3 Working Hours

Given the remote location and distance to sensitive noise receptors, it is assumed that marine construction operations may occur up to 24 hours per day, 7 days per week. Operation of Snowy 2.0 would occur 24 hours per day, 7 days per week.

5.3.4 Nearby Proposed Developments

Investigations as part of Snowy 2.0 Main Works identified the requirement for fish barriers at the following locations:

- across Tantangara Creek, just upstream of the waterfall upstream of Alpine Creek Trail
- at Tantangara Reservoir dam wall, and
- at the intake to the Murrumbidgee-Eucumbene tunnel that transfers water from Tantangara Reservoir to Lake Eucumbene.

These fish barriers are outlined in Chapter 6 of the EIS. Any impacts associated with construction or operation of the fish barriers have not been considered herein.

5.4 Assessment of Impact

The assessment of impacts herein has been developed under the assumption that construction vessels and vessels navigating on Tantangara Reservoir would:

- operate under the control of experienced skipper, and
- comply with the requirements of the *Marine Safety Act 1998, Marine Safety (Domestic Commercial Vessel) National Law Act 2012* and any other relevant national or state legislation (refer **Section 3.1**), including relevant licensing, navigation, safety and communication requirements.

The assessment of navigation impacts is often subjective and dependant on the type of vessel and experience of the operator. All navigation safety requirements, along with Royal HaskoningDHV's (RHDHV) extensive experience in the maritime industry, have been adopted to assess impacts herein.

5.4.1 Construction Hazards

The main potential marine hazards during construction are:

1. interaction between the Project's marine plant and equipment and public boating activities;
2. fixed obstruction/s on the reservoir;
3. lower water level; and,
4. drill and blast operations/ projectiles.

These hazards are discussed below. Risk assessment and mitigation measures are discussed in **Section 5.4.3** and **Section 5.4.4** respectively.

It is noted that the existing boat ramp at Tantangara Reservoir would not be permanently occupied by the construction activities. The existing boat ramp may be temporarily closed for construction activities including launching of work boats and construction equipment to facilitate construction of the barge ramp. However, once the barge ramp is complete, this would be the main location for launching and retrieval of construction plant and equipment. Land-based construction activities would restrict multi-day reservoir users (campers) from accessing the western foreshore and would preclude launching of trailerable vessels directly from the bank of the reservoir at a number of existing unmarked and informal launching locations along the western foreshore.

The surface area of the reservoir at MOL is approximately 218 hectares. As noted in **Section 5.1.4,** peak recreational boating use of the reservoir is assumed to be 40 vessels per day. However, on a typical day in summer, recreational boating use would be less than say 10 vessels per day. At MOL and peak demand, the density of waterway occupation would be approximately 1 vessel per 5.5 hectares. This is the worst case scenario and it is considered to be relatively low for a NSW waterway.

During construction, there would be an increase in vessel traffic and the increase in the size of vessels operating on the reservoir. As per **Section 5.3.1**, there is estimated to be an additional 9 vessels operating on the reservoir, which would be up to approximately 30 m LOA. This represents an increase in the number of vessels on the reservoir of 22.5% relative to peak demand. However, it is considered the impact of construction vessels on recreational waterway users would be relatively minor for the following reasons:

1. navigation of construction vessels would be confined to a localised area within the vicinity of the intake channel and the barge ramp, and the barge transit route to land for marine D&B materials
2. the existing density of waterway occupation is considered low for a NSW waterway. The increase in congestion as a result of construction is therefore considered acceptable, and
3. due to the limited distance that the marine traffic would be navigating, the marine plant and equipment would typically operate at t low speed and therefore the impact on the wave climate resulting from vessel movement would be negligible.

The presence of silt curtains would establish a physical barrier that would locally restrict public access to part of Tantangara Reservoir. The silt curtains in addition to other markers such as buoys or moorings for construction barges or work vessels would create obstacles for navigation and there would be a risk of collision between public waterway users and the obstacles.

The reservoir would be maintained as low as possible for construction. The lower water level reduces the surface area of the reservoir resulting in increased density of waterway occupation. The clearance to submerged obstruction would vary as the water level changes. Some obstruction may become exposed while others could lie just below the water surface.

Uncontrolled D&B operations can result in rock ejected from a blast site (flyrock). The amount of 'flyrock' is dependent on the depth of the charge, amount and type of the charge, capping of the charge and type of rock. Typically in quarry operations, exclusion zones are established for workers and the public is notified of impending blasts.

5.4.2 Operational Hazards

The main marine hazards resulting from Operation of Snowy 2.0 are:

1. high current speeds in vicinity of intake channel;
2. greater variability in water level.

These hazards are discussed below. Risk assessment and mitigation measures are discussed in **Section 5.4.3** and **Section 5.4.4** respectively.

The procedure for cleaning the 'trash racks' of Snowy 2.0 would be similar to existing operations. The increase in boating traffic to clean and maintain the 'trash racks' at the intake structure is considered to be negligible. Snowy Hydro currently accesses the reservoir to undertake similar operations at the Murrumbidgee-Eucumbene Tunnel and at the river outlet gates to the Murrumbidgee River. These operations would typically be undertaken during the week when use of the waterway is relatively low. The maintenance vessels would be launched and retrieved from the boat ramp at Tantangara Reservoir.

The peak generating and pumping flows have been modelled by RHDHV. The resultant current speeds at the surface for the pumping flow and generating flow are shown in **Figure 5-5** and **Figure 5-6** respectively. The water level adopted for the modelling is MOL as this would result in the highest surface current speeds. The flows associated with Snowy 2.0 would alter currents in Tantangara Reservoir reported in **Section 5.2.**

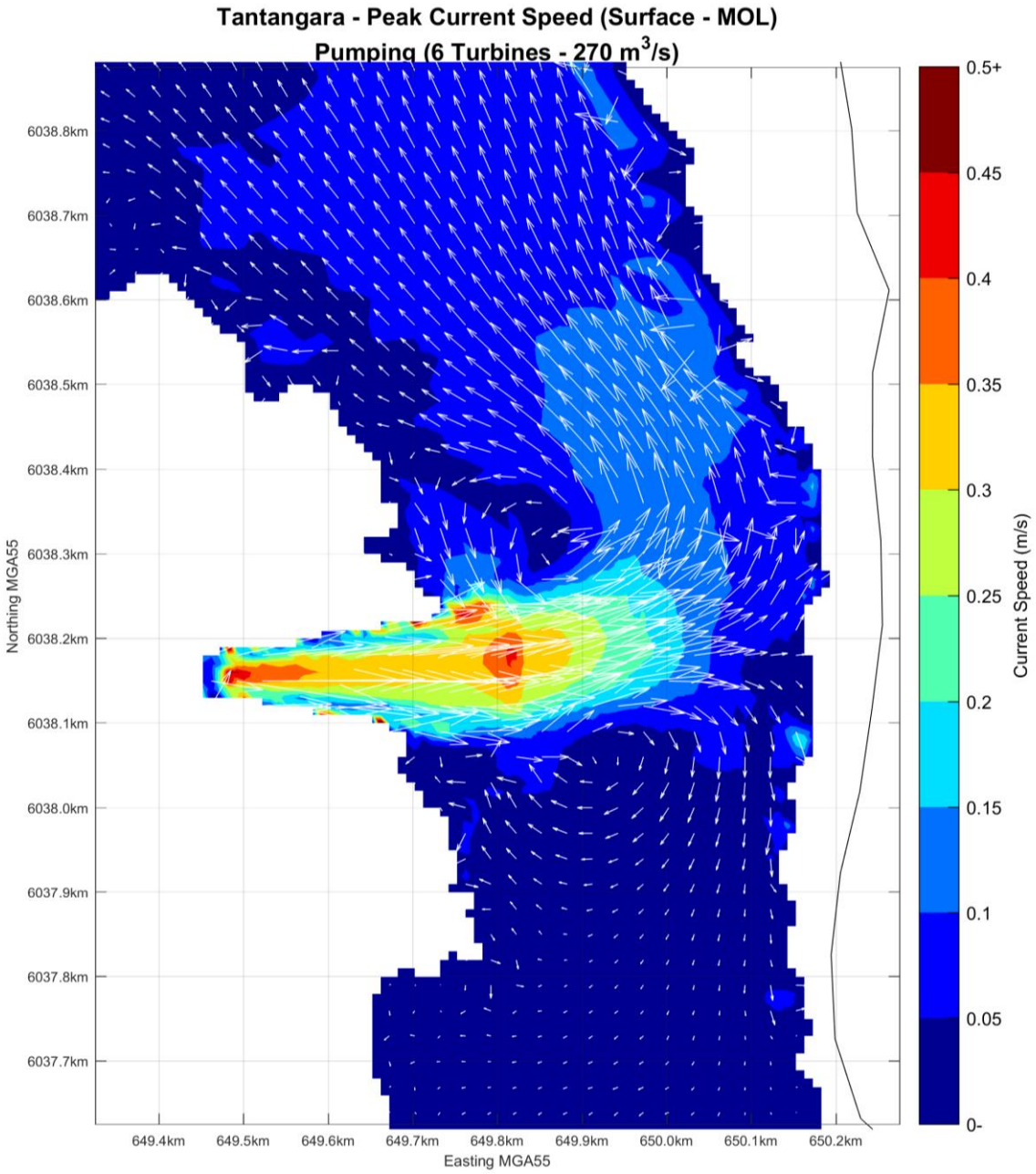


Figure 5-5: Maximum surface current in Tantangara Reservoir resulting from peak pumping flow of 270 m^3/s at MOL.

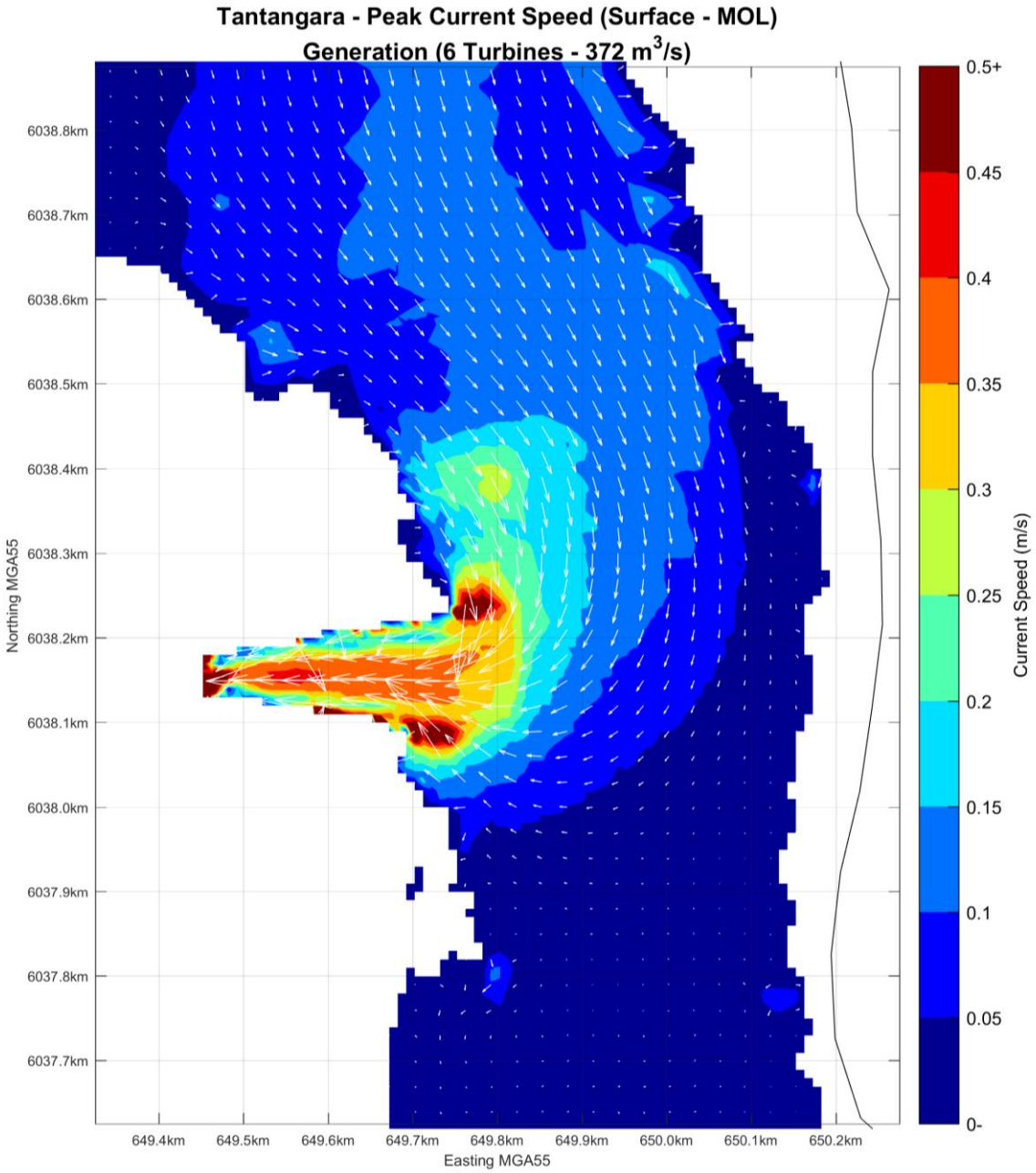


Figure 5-6: Maximum surface current in Tantangara Reservoir resulting from peak generating flow of 372 m^3/s at FSL.

The peak surface current speed is typically higher under generating flows compared to pumping flows. This is a result of the higher flow rate. Surface current speeds are typically higher north of the intake channel compared to south of the intake channel as there is a larger surface area to the north that would be filled/emptied as water is pumped into/out of the reservoir. Surface current speeds in excess of 0.5 m/s (1 knot) are predicted near the intake structure and surface current speeds in excess of 0.3 to 0.4 m/s (0.6 to 0.8 knots) are predicted within the intake channel for both pumping and generating flows. Under generating flows, surface current speeds up to 0.15 to 0.2 m/s (0.3 to 0.4 knots) are predicted up to 300 m north of the intake channel. The surface current speed resulting from pumping flows is somewhat less 300 m north of the intake channel and predicted to be up to 0.1 to 0.15 m/s (0.2 – 0.3 knots).

By way of comparison to Sydney Harbour, the current noted on the Nautical Chart for Port Jackson (Aus201) is 1 knot for a flood tide and ebb tide between South Head and Middle Head reducing to 0.5 knots for an ebb tide and 1 knot for a flood tide near Bradleys Head. These locations are shown on **Figure** 5-7. However, the hazard at Tantangara Reservoir is exacerbated as there is a risk of waterway users being drawn towards the intake structure and 'trash rack' during generating flows with potentially adverse consequences.

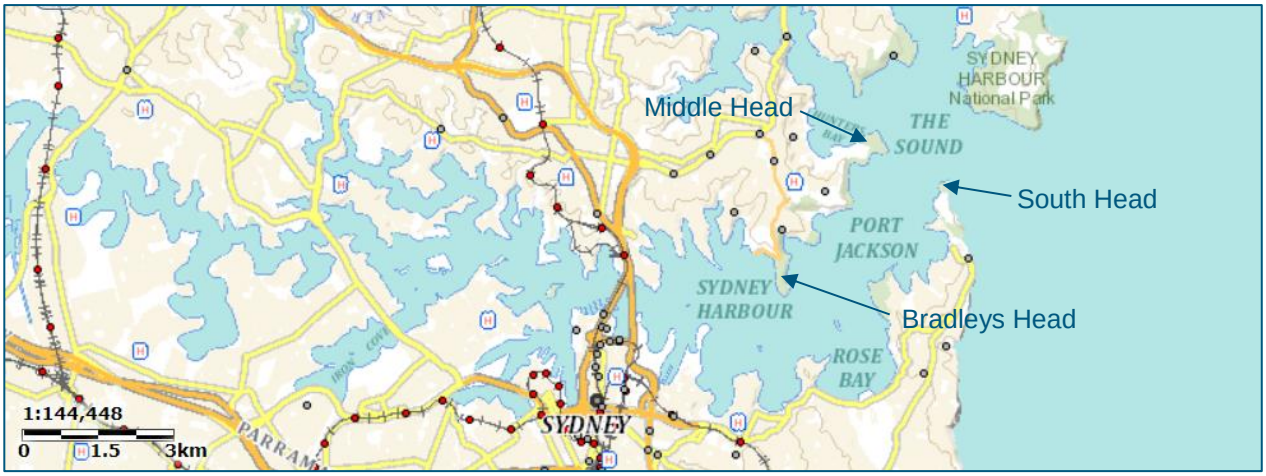


Figure 5-7: Reference currents on Sydney Harbour.

The flows during the pumping phase would cause turbulence near the intake structure and intake channel. Despite lower surface current speeds compared to Sydney Harbour, turbulence and vortices would be significantly more pronounced. Predicting whether a vessel would become unstable or capsize as a result of the turbulence or vortices is difficult and it would be dependent on the size of the vessel and speed of the vessel. If a person fell from a vessel, or if the vessel was to break down and become stricken, it would be drawn towards the intake structure where turbulence and vortices would be pronounced, and the risk of capsizing would increase. However, screens across the intake structure would prevent any ingress of large objects into the headrace tunnel.

Under both generating and pumping flows, it is anticipated that there would be an undertow, in the vicinity of the intake structure, due to higher current speeds lower in the water column. A person in the water could be drawn down by the undertow (similar to a rip at the beach) and there would be a risk of drowning.

Depending on the direction of the surface current and wind, the sea state (waves) may become choppy, irregular and steeper compared to the analysis of existing conditions in **Section 5.2**. However, any such impacts would be locally pronounced to the extent of the reservoir where surface current is more than approximately 0.2 m/s (0.4 knots). Beyond this point, the variation in sea state as a result of Snowy 2.0 would be less noticeable.

The variation in water level is likely to increase as a result of Snowy 2.0 due to the changed operational usage of the reservoir. Variability in water level could potentially result in vehicles (cars and trailers) of waterway users becoming flooded and vessels becoming stranded as the water level decreases. The water level variation (increase) resulting from the peak pumping flow commencing at MOL is shown in **Figure 5-8**. The pumped flow is considered to govern the assessment as it could result in flooding of vehicles (cars and trailers) of waterway users, which is considered to be more severe than stranding of a vessel that could occur if the water level rapidly drops. The rate of change in the water level is up to 3 m

over 12 hours. The rate of change decreases as the water level increases since a larger surface area becomes inundated.

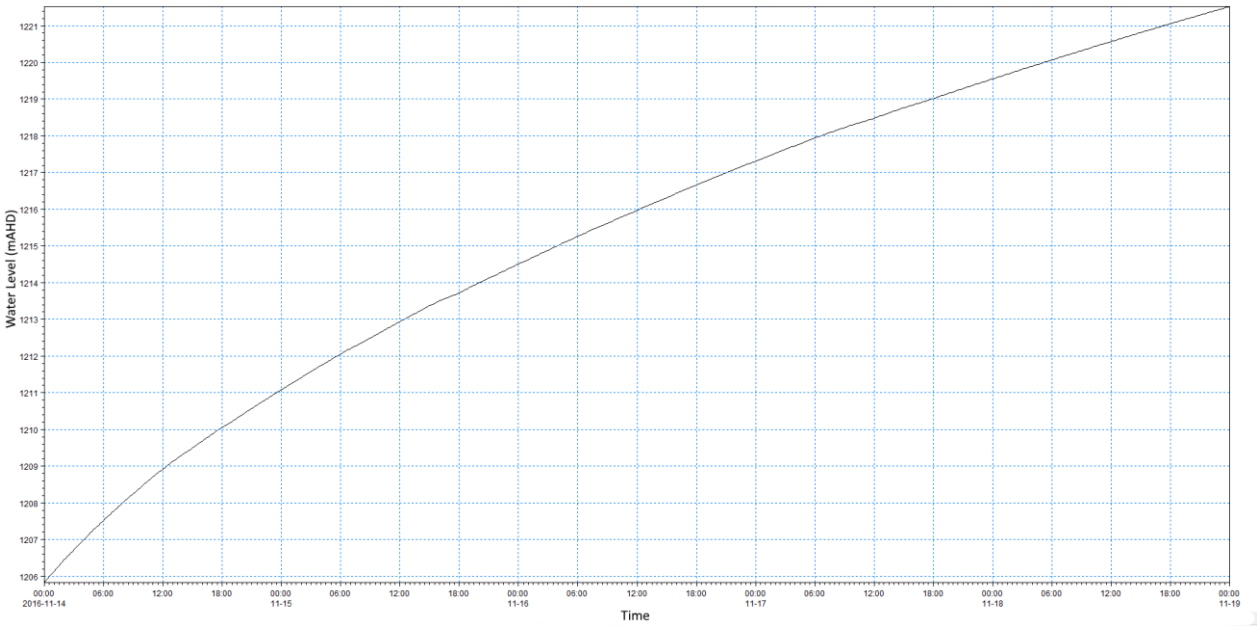


Figure 5-8: Water level resulting from pumping at peak capacity over 5 days with the reservoir level initially at MOL.

5.4.3 Risk Assessment

The risk assessment assessing safety of navigation, attached in **Appendix B**, has been prepared in accordance with **Section 4** and is based on the hazards identified in **Section 5.4.1** and **Section 5.4.2**.

The risk assessment indicates that the risk rating for all risks, following implementation of the mitigation measures, is either low or medium. For those which are medium the works may proceed provided stakeholders understand the residual risk.

5.4.4 Mitigation Measures

The mitigation measures outlined in the Risk Assessment (**Section 5.4.3** and **Appendix B**) would be further developed during the detailed design phase of the project. The mitigation measures currently being considered include:

- **Construction**:
  - establish a public exclusion zone around work areas including the intake channel, silt curtains, barge ramp and navigation route to shore (refer **Appendix C**). Ensure exclusion zone is clearly marked to the satisfaction of RMS. The locations of buoys or markers and the methods for securing them will consider water level fluctuation
  - maintain public access to the existing boat ramp at Tantangara Reservoir, where practical
  - monitor and manage public access within the exclusion zone
  - obtain aquatic licence from RMS for the construction activities and exclusion zone. The aquatic licence will include notification on the RMS website
  - fit work vessels and barges with Automatic Identification System and comply with all licensing requirements of AMSA and RMS under the acts and regulations (refer **Section 3.1**) including specific requirements for Alpine Waters

- ensure any other fixed obstruction such as marker buoys and moorings comply with RMS requirements
- erect notification signs advising of the works, public closures, blasting operations and other relevant activities at:
  - the intersection of Snowy Mountains Highway and Tantangara Road
  - the intersection of Snowy Mountains Highway and Long Plain Road, and
  - Tantangara Boat Ramp.
- designated blast limits and other management measures to minimise impacts will be outlined in the Blast Management Plan.

- **Operation**:
  - establish an exclusion zone around the intake structure and intake channel in consultation with RMS (refer **Appendix C**). Ensure exclusion zone is clearly marked to the satisfaction of RMS. The locations of buoys or markers and the methods for securing them will consider water level fluctuation
  - liaise with RMS to update the RMS Boating Map for Lake Eucumbene and Tantangara Reservoir Area indicating exclusion zone and location of intake structure and intake channel
  - provide material to educate public and create awareness of high water currents near the intake channel and highly variable water levels including the following:
    - liaise with RMS to include warning on the RMS Boating Map for Lake Eucumbene and Tantangara Reservoir Area
    - distribute information pamphlets to local fishing and boating retailers
    - liaise with RMS to erect notification signs at:
      - the intersection of Snowy Mountains Highway and Tantangara Road;
      - the intersection of Snowy Mountains Highway and Long Plain Road; and,
      - Tantangara Boat Ramp.

The primary mitigation measure during construction and operation would be establishment of navigation exclusion zones. The exclusion zones may be delineated with lateral marks (port and starboard), cardinal marks (north, east, south or west) or aqua minibuoys. Design of the buoys or marks would need to accommodate water level fluctuation from MOL to FSL and may comprise fixed poles/piles in shallow water and floating buoys/marks in deep water.

Placement of buoys would need to consider ‘drift’ as the water level fluctuates. Buoys should be placed approximately 20 m further from the intake structure to accommodate drift at MOL.

To improve safety and awareness of high flow velocities and water level variations, Snowy Hydro Limited may consider an automatic notification system at the intake structure indicate pumping or generating flow. The automatic notification system may include an arrangement of lights displayed at a clearly visible location.

Proposed navigation exclusion zones during construction and operation are shown in **Appendix C**. The extent of navigation exclusion zones will be refined following detailed design and consultation, including RMS. The exclusions zones may be further refined during construction and operation by trial and experience. Any refinement to the exclusion zone would include all waterway users including swimmers, kayakers, fishermen etc.

The size of the proposed navigation exclusion zone during construction is approximately 5 hectares at MOL (reduction of 2.3% of the reservoir surface area). The navigation exclusion zone extends around construction activities and accommodates a buffer of 50 m.

The size of the proposed navigation exclusion zone during operation is approximately 11 hectares at MOL (reduction of 5% of the reservoir surface area). The exclusion zone extends approximately 300 m to the north of the intake structure where the surface current speed under generating flow is less than 0.15 m/s (0.3 knots) and approximately 150 m to the south where the surface current speed under generating flow is less than 0.1 m/s (0.2 knots). These surface current speeds are shown in **Figure 5-6**.

6 Talbingo Reservoir

Talbingo Reservoir is primarily surrounded by Kosciuszko National Park. The land adjacent to the reservoir, at the northern end near the dam wall and spillway, is owned and managed by SHL. The reservoir was formed by damming the Tumut River, with the reservoir also flooding part of the Yarrangobilly River. Construction of Talbingo Dam, a 162 m high rock filled, clay core embankment, was completed in 1971.

A portion of the reservoir is located within Kosciuszko National Park and the land is leased by SHL. However, RMS has jurisdiction over navigable waters in NSW, including Talbingo Reservoir.

6.1 Existing Foreshore Occupation and Vessel Use

The northern end of Talbingo Reservoir is accessible to the public via Miles Franklin Drive from the Talbingo township.

The southern end of the reservoir, along the Tumut arm of the reservoir, is accessible via Elliot Way while the Yarrangobilly arm of the reservoir is accessible via Lobs Hole Ravine Road, an unsealed road.

The reservoir is relatively isolated, and road access is limited. The foreshore is generally steep, densely vegetated and inaccessible. These features restrict boating opportunities. There are a number of other reservoirs within the Snowy scheme that are situated closer to urban centres, and provide easier access, including Blowering Reservoir and Lake Eucumbene. These reservoirs would typically have a higher usage.

There are no vessels permanently stored on Talbingo Reservoir. As such, all vessels are trailerable craft, which are typically up to 7.5 m long with a beam of 2.5 m in accordance with the NSW Boat Ramp Facility Guidelines (RMS, 2015).

These factors are reflected in the level of foreshore occupation and frequency of vessel use.

6.1.1 Boating Facilities

Boating facilities are marked on the RMS Boating Map for Talbingo, Tumut Pond, Tooma, Three Mile Dams, Geehi Reservoir and Khancoban Pondage areas, attached in **Appendix A**. Boating facilities are restricted to:

- a public boat ramp adjacent to the dam wall at the northern end of the reservoir
- a public boat ramp and an unformed kayak launching ramp at the southern end of the reservoir, on the Tumut arm, at O'Hares Rest Area. The rest area is accessible via Elliot Way, and
- an unformed boat ramp at Middle Bay, on the Yarrangobilly arm of the reservoir. The ramp is accessible via Lobs Hole Ravine Road.

6.1.2 Foreshore Occupation and Structures

Permanent structures around Talbingo Reservoir, associated with Snowy Hydro operations, include:

- the dam wall
- the T3 pumped hydropower station intake located between the dam wall and the spillway, and
- the T2 hydropower station outlet located near O'Hares Rest Area, on the Tumut arm of the reservoir.

Public facilities around Talbingo Reservoir include:

- picnic facilities and public toilets at:
  - The boat ramp near the dam wall;
  - O'Hares Rest Area; and,
  - Coonara Point Rest Area on the Tumut arm of the reservoir, accessible by boat.
- Swimming enclosure, pontoon and public toilets at the spillway.

Coonara Point Rest Area on the Tumut arm of the reservoir is a popular day use recreation area for swimming and tow sport activities (water-skiing, wakeboarding etc.). It is understood that the Coonara Point Rest Area is maintained by the Tumbarumba Boat & Ski Club.

Camping is permitted at O'Hares Rest Area, Lobs Hole and Coonara Point Rest Area. O'Hares Rest Area and Lobs Hole are both in close proximity to the boating facilities at these locations. Coonara Point Rest Area is only accessible by boat.

6.1.3 Navigation Restrictions

The tributaries of Talbingo Reservoir, including Yarrangobilly River and Tumut River, south of O'Hares Rest Area, are not suitable for navigation of vessels due to shallow water depths and/or submerged obstructions. Further, there is no provision for vessel access downstream of the dam wall. All access is prohibited on Jounama Pondage.

Navigation restrictions at Talbingo Reservoir are marked on the RMS Boating Map for Talbingo, Tumut Pond, Tooma, Three Mile Dams, Geehi Reservoir and Khancoban Pondage areas, attached in **Appendix A**. There are permanent navigation aids at the following locations:

- special aqua buoys near the boat ramp at the dam wall to designate an idle zone to the north
- port aqua buoy near T3 intake, to designate an area to the north where recreational vessel access is prohibited, and
- port and starboard aqua buoys near O'Hares Rest Area, on the Tumut arm of the reservoir, to mark the navigation channel.

There are three speed limit or exclusion zone marked on the RMS Boating Map, which are:

- idle speed area at the northern end of the reservoir, north of the boat ramp at the dam wall
- prohibited access area near T3 intake, and
- no skiing or aquaplaning zone near O'Hares Rest Area.

In addition, safe distance and speed requirements outlined in **Section 3.3.1** would apply.

A number of sub-surface obstructions are marked on the RMS Boating Map. In addition, due to the variable water level in the reservoir, the RMS Boating Map includes a general warning for submerged rocks, trees and shallow areas.

The sub-surface obstructions at Talbingo Reservoir are typically submerged trees. Historic aerial photographs, such as that provided in **Figure 6-1**, indicate that the area was densely vegetated prior to flooding to form the reservoir. Vegetation had been cleared from a couple of areas, where relatively level

and fertile alluvial flood plains had formed, including adjacent to the proposed Snowy 2.0 intake structure and near the confluence of the Tumut and Yarrangobilly Rivers.

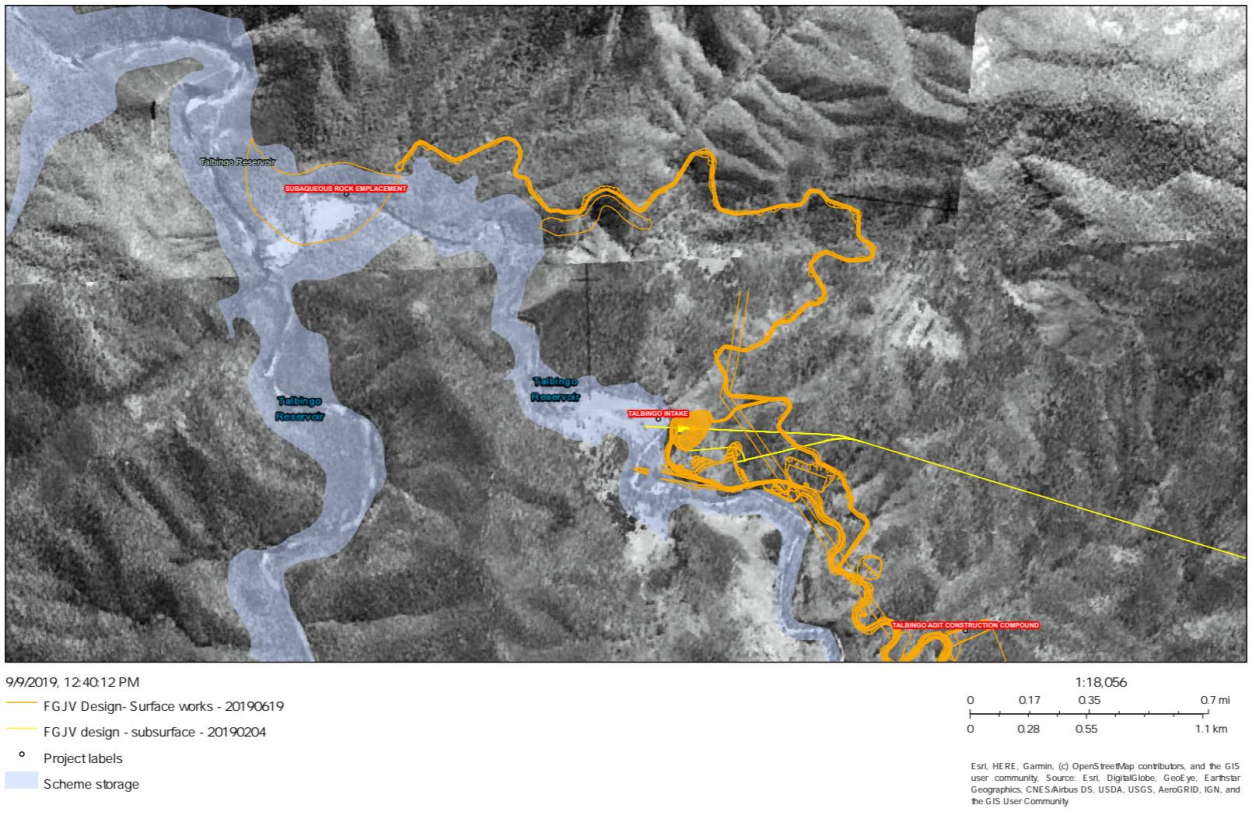


Figure 6-1: Historical aerial prior to flooding of the Tumut River (bottom left) and Yarrangobilly River (bottom right). Current reservoir storage shown in blue.

The submerged vegetation is generally intact below FSL and has been 'trimmed' to approximately FSL as shown in **Figure 6-2** and **Figure 6-3**. It appears that borers have decomposed the emergent woody debris. However, the borers have not attacked the woody debris that is frequently submerged.

Figure 6-2: Submerged trees at Middle Bay, Talbingo Reservoir. Photograph looking south towards proposed intake structure.

Figure 6-3: Submerged trees at Ravine Bay, Talbingo Reservoir. Photograph looking northwest across the proposed excavated rock placement location.

6.1.4 Vessel Use

Talbingo Reservoir is classified as ‘alpine waters’ in the Regulation. It is therefore a requirement that each person on a canoe, kayak or vessel less than 4.8 m in length wears a lifejacket.

Recreational boating demand has been assessed via traffic counts and a recreational user survey undertaken by TRC Tourism.

Traffic counts were undertaken on Miles Franklin Drive between March and April 2018 (including Easter and ANZAC Day public holidays). The traffic counts provide an indication of boat launching at the public

boat ramp adjacent to the dam wall, assuming all cars with trailers are towing a power boat. The traffic count indicated:

- 144 cars and trailers accessed the boat ramp over Easter with 52 of these occurring on Easter Sunday
- the average number of cars and trailers accessing the boat ramp on a weekday (excluding public holidays) was 8 with a maximum of 19 and
- the average number of cars and trailers accessing the boat ramp on a weekend (excluding public holidays) was 11 with a maximum of 18.

This data does not include boat launching at the other boat ramps on Talbingo Reservoir. However, demand at the other two boat ramps is assumed to be less due to the isolated locations.

TRC Tourism undertook a separate recreational user survey by undertaking a count of the number of cars, boats, caravans/camper trailers and camping tents at a single point in time. The recreational user count was undertaken at Lobs Hole, O'Hares Rest Area and Talbingo boat ramp, near the dam wall. Results from the count are summarised in **Table 6-1**. As the recreational user count was undertaken at a single point in time, the total number of visitors within a 24 hour period may be higher than the survey data.

The category of 'boats' includes both trailered boats as well as passive recreational craft transported on the roof of a car. However, the number of boats recorded was typically based on the number of boat trailers near the boat ramp. Therefore, the survey would not have identified passive recreation craft, transported on the roof of a car, that may have been in use at the time of the recreational user count, unless they were visible from the shoreline.

At Talbingo boat ramp, the recreational user count indicated:

- peak number of boats on a public holiday (26th January 2019, Australia Day) was 51. This number of boats would be considered close to a maximum for any given day throughout the year
- average number of boats over the Christmas and New Year period (28th December to 5th January) was 17 with a maximum of 22. The Christmas and New Year period coincides with the summer school holidays and numerous public holidays. Demand for boating activities during this period would be relatively high
- average number boats on a weekday (excluding public holidays and the Christmas/New Year period) was 2 with a maximum of 2, and
- average number of boats on a weekend (excluding public holidays and the Christmas/New Year period) was 3-4 with a maximum of 6.

The recreational user count did not record any boats at Lobs Hole. However, passive recreation craft may have been in use and not visible at the time of the recreational user count.

Only one day of data was recorded for O'Hares Rest Area, which was the 4th January 2019. A total of 5 boats were recorded. Based on the pattern of usage at Talbingo boat ramp, the peak number of boats at O'Hares Rest Area, on a public holiday, could be up to 20.

Table 6-1: Count of recreational users undertaken by TRC Tourism.

Location	Lobs Hole					O'Hares Rest Area				Talbingo Boat Ramp			
Date	Cars	Boats	Caravans/ Camper Trailers	Camping Tents	Motorcycle	Cars	Boats	Caravans/ Camper Trailers	Camping Tents	Cars	Boats	Caravans/ Camper Trailers	Camping Tents
Saturday 1-Dec-2018	7	0	2	1	0	No Count				6	5	0	0
Saturday 8-Dec-2018	0	0	0	0	0	No Count				2	2	0	0
Saturday 15-Dec-2018	2	0	2	0	0	No Count				No Count			
Friday 28-Dec-2018	No Count					No Count				35	22	0	0
Saturday 29-Dec-2018	9	0	5	7	3	No Count				21	17	0	0
Friday 4-Jan-2019	No Count					13	5	4	1	19	12	0	0
Saturday 5-Jan-2019	3	0	2	2	0	No Count				23	18	0	0
Friday 11-Jan-2019	No Count					No Count				5	2	0	0
Saturday 12-Jan-2019	No Count					No Count				8	6	0	0
Thursday 17-Jan-2019	No Count					No Count				2	2	0	0
Saturday (Australia Day) 26-Jan-2019	11	0	3	7	0	No Count				81	51	0	0
Saturday 23-Feb-2019	No Count					No Count				3	1	0	0

Based on the available recreational user count and traffic counts, peak boating demand on Talbingo Reservoir is assumed to be 75 vessels per day. However, on a typical day, demand would be less than 10 vessels per day.

6.1.4.1 Power Boats

Talbingo Reservoir is a popular destination for fishing all year round and tow sports (water skiing, wakeboarding etc.) during the warmer months (October to May).

Talbingo Reservoir is classified as a 'General Trout Dam' (NSW Government Gazette No. 76). The main fish species targeted by anglers in Talbingo Reservoir are Brown Trout, Rainbow Trout, Golden Perch, Macquarie Perch, Redfin, and Trout Cod.

Anglers frequenting Talbingo Reservoir typically use smaller aluminium fishing vessels powered by an outboard motor and/or an auxiliary trawling motor. The vessels are usually around 4 to 5 m LOA. Trawling is a popular form of fishing from power vessels at Talbingo Reservoir. The speed for trawling is around 1-2 knots.

Tow sport activities (water-skiing, wakeboarding, wakesurfing etc.) would typically occur at the northern end of the reservoir, near the spillway, and along the Tumut arm of the reservoir along a stretch known as 'The Ski Run' near Coonara Point Rest Area. Tow sport vessels would typically be 5 to 6.5 m in length, fibreglass construction and powered by either an inboard or outboard motor with power output of between 100 hp and 350 hp. Tow sport vessels typically operate at 10 knots (wakesurfing), 19 knots (wakeboarding) or 30 knots (water-skiing).

6.1.4.2 Passive Recreation Craft

Anecdotal reports suggest that social groups and some school groups periodically canoe and kayak on Talbingo Reservoir, particularly around Lobs Hole and Ravine Bay. These groups would typically access the waterway at O'Hares Rest Area or Lobs Holes. They may canoe or kayak to one of the areas where camping is permitted for an overnight stay, including Coonara Point Rest Area.

Individual passive recreation craft (unpowered craft) do not frequently operate on Talbingo Reservoir. However, the waterway would be occasionally accessed by individuals in canoes and kayaks from the spillway, O'Hares Rest Area or Lobs Holes. These users would typically be affiliated with multi-day users (campers).

6.1.4.3 Commercial Vessels

Snowy Hydro require infrequent vessel access to the T3 intake structure at Talbingo Reservoir to clear the 'trash racks'. The works may also require divers to assist with removal of debris from the racks.

There are no other commercial vessels or operators frequently operating on Talbingo Reservoir. Public boat hire is available from Talbingo Caravan Park.

6.1.5 Other Waterway Users

Other users of the reservoir including swimmers. These users would typically occupy the swimming enclosure at the spillway. Multi-day users (campers) at either O'Hares Rest Area or Lobs Hole may also partake in swimming activities.

Land-based anglers are unlikely to frequent the area, due to the limited foreshore access. However, land-based anglers affiliated with multi-day users (campers) at either O'Hares Rest Area or Lobs Hole may use the waterway.

The number of caravans, camper trailers and camping tents was recorded in a recreational user count completed by TRC Tourism. The results from the count are summarised in **Table 6-1**. The number of caravans, camper trailers and camping tents recorded at Lobs Hole was up to 12 while up to 9 were recorded at O'Hares Rest Area. No caravans, camper trailers and camping tents were recorded at Talbingo boat ramp as camping is prohibited at this location.

These numbers could be used as a proxy to estimate the number of other waterway users including swimmers and land-based anglers. However, the recreational user count does not provide information on the number of occupants per caravan, camper trailer or camping tent, or the number of occupants that would partake in water-based activities.

6.1.6 Aquatic Activities and Licences

There are currently no aquatic licences issued by RMS for events proposed at Talbingo Reservoir.

The Talbingo Fishing Club and Tumbarumba Boating and Fishing Club both organise fishing competitions. However, the competitions do not restrict the availability of navigable waters for normal use by the public and an aquatic licence is not required.

6.1.7 Summary

There are two main user groups that would frequent the reservoir on a regular basis:

1. Day users partaking in fishing or tow sport activities that would typically launch trailerable vessels from the boat ramp near the dam wall or O'Hares Rest Area. Fisherman would navigate all parts of the reservoir while users partaking in tow sport activities would typically remain close to a rest area including the spillway or Coonara Point Rest Area.
2. Multi-day users (campers) who may partake in swimming activities, boating activities, land based fishing, canoeing/kayaking etc. This user group includes canoeing/kayaking groups that may paddle to a location and stay overnight. These users would typically frequent Lobs Hole, O'Hares Rest Area or Coonara Point Rest Area.

6.2 Environmental Conditions

Environmental conditions are a major factor when assessing safety of navigation. The RMS Boating Map includes a general warning that the high altitude and open nature of Talbingo Reservoir can lead to sudden changes in weather conditions.

6.2.1 Water Levels

Talbingo Reservoir is fed by runoff and snow melt from a number of tributaries, primarily Yarrangobilly River and Tumut River. The reservoir receives water from the T2 power station, which diverts water from Lake Eucumbene and Tumut Pond Reservoir, and T3, which is a pumped hydropower scheme linking Talbingo Reservoir to Jounama Pondage.

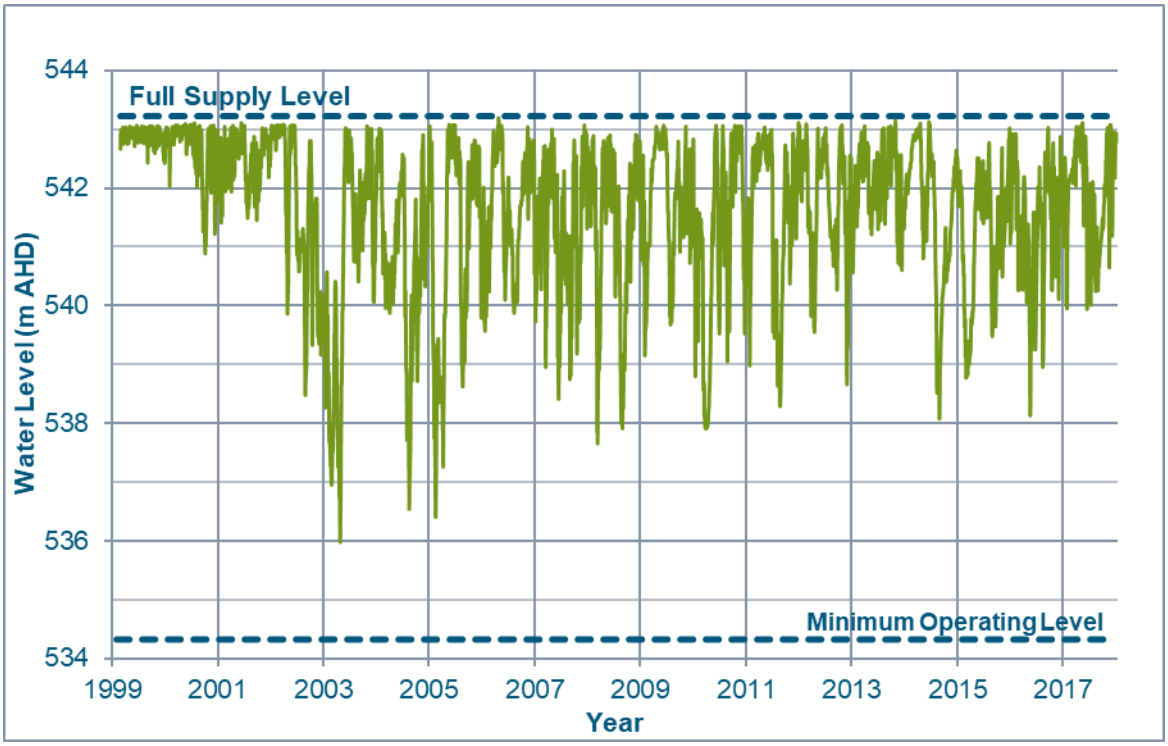
The release of water from the reservoir is controlled by power generation at T3, a pumped hydropower station.

The MOL, FSL and DFL at Talbingo Reservoir are:

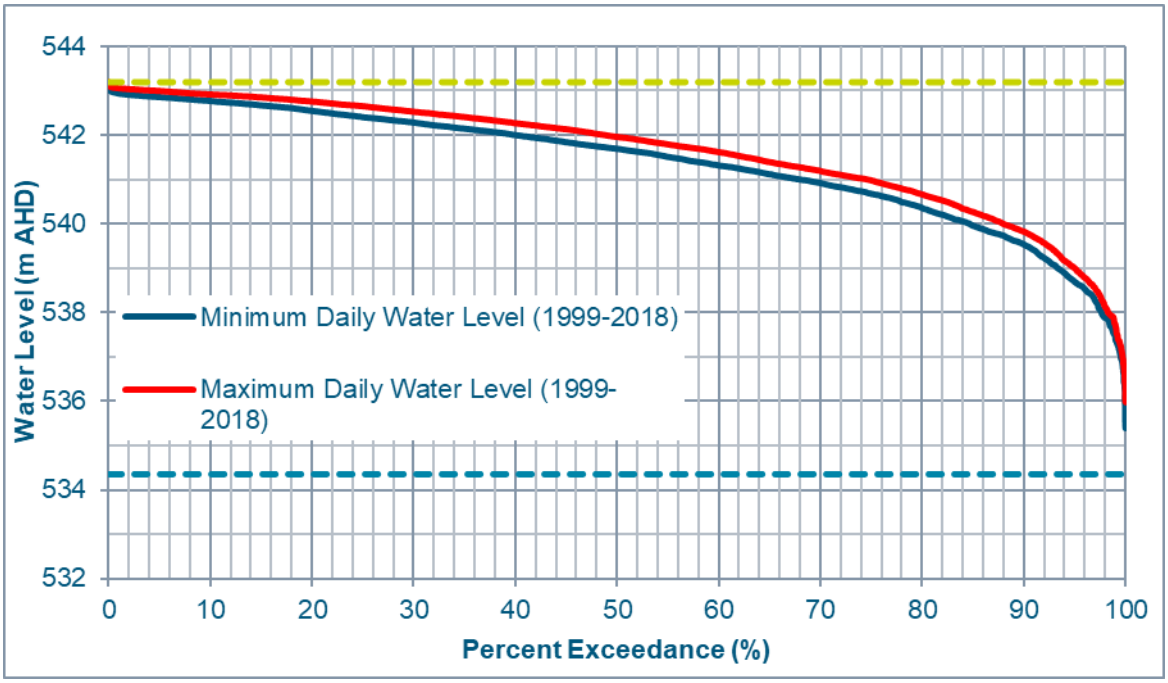
- MOL – 534.4 m AHD
- FSL – 543.2 m AHD, and
- DFL – 545.8 m AHD

Daily water level data for each day from 1999 to 2018 is presented in **Graph 6-1** and a probability exceedance graph of the water level is presented in **Graph 6-2**.

The graphs indicate that historically, the water level has been within 3 m of FSL approximately 80% of the time. The water level fluctuates throughout the year, largely as a result of the operation of the Snowy Hydro scheme, and there is no marked seasonality.



Graph 6-1: Maximum daily water level in Talbingo Reservoir from 1999 to 2018.



Graph 6-2: Probability exceedance curve of the water level in Talbingo Reservoir from 1999-2018.

6.2.2 Water Depths

Talbingo Reservoir is formed in a steep sided valley. The reservoir is relatively deep with a comparatively small surface area. In contrast to Tantangara Reservoir, the surface area of the reservoir does not change substantially as the water level increases.

Available hydrographic survey information is shown in **Appendix C**. The thalweg of the reservoir, near the proposed intake structure, is at approximately 530 m AHD, representing a water depth of 4 to 5 m at MOL. The water depth at the dam wall, approximately 20 km downstream, is in excess of 130 m at MOL.

6.2.3 Wave Climate

The wave climate at Talbingo Reservoir is contributed to by wind waves and boat-generated waves, which combine to form the incident wave climate. The wind-wave climate has been determined for a location at Middle Bay and Talbingo Spillway. Boat-generated waves could occur anywhere on the reservoir, provided the water depth and submerged obstructions permit navigation.

6.2.3.1 Wind Waves

As per **Section 5.2.3.1**, wind wave hindcast procedures set out in the Coastal Engineering Manual (USACE, 2008) were used to predict the incident wind wave climate at the site. The primary direction and fetch resulting in the highest significant wave height are outlined in **Table 6-2** for Middle Bay and Talbingo Spillway. The tables summarise the significant wave height for the 1 year ARI and 50 year ARI events.

Table 6-2: Incident wind wave height at Talbingo Reservoir.

Location	Talbingo Spillway		Middle Bay	
Fetch and Direction	0.85 km, northwest		2.1 km, southeast	
Average Recurrence Interval	Significant Wave Height H_s (m)	Wave Period T (s)	Significant Wave Height H_s (m)	Wave Period T (s)
1 year	0.3	1.5	0.4	1.8
50 year	0.5	1.6	0.5	2.0

Notes: significant wave height H_s is the average of the highest 1/3 of waves in a wave train. $H_{max} \sim 1.5H_s$.

6.2.3.2 Boat Waves

The maximum wave height and peak period is associated with vessels participating in wakesurfing activities at the ideal operational speed (approximately 10 knots) (Ruprecht et al, 2015). The wave height and peak period are outlined in **Table 6-3**. Wakesurfing is a recreational activity that is increasing in popularity and involves creating a large wave that can be surfed without a tow rope. Wake Enhancement Devices (WEDs) are usually fitted to the vessels to maintain the critical speed, which ensures a large displacement wave is generated resulting in increased wave height.

Maximum wave heights and peak periods produced by other waterway users, such as fishermen and water-skiers, are formed at the critical speed (approximately 8 knots). The wave height and peak period are outlined in **Table 6-3** (Ruprecht et al, 2015). These wave heights are larger than the predicted maximum wave height presented previously at Tantangara Reservoir as vessels on Talbingo Reservoir are anticipated to be larger. These users do not typically operate at the critical speed. The wave height and peak period associated with the operational speed for water-skiing (approximately 30 knots) are outlined in **Table 6-3** and are significantly less than the wave height produced at the critical speed.

Table 6-3: Maximum boat wave height and peak period 22 m from the sailing line.

Vessel Type	Operating Condition	Maximum Wave Height (m)	Peak Wave Period (sec)
Wakesurfing Vessel	10 knots (typical operational speed)	0.45	2.2
Water-skiing and Fishing Vessel	8 knots (critical speed)	0.35	2.0
Water-skiing Vessel	30 knots (typical operational speed)	0.13	1.6

Divergent wave attenuation with distance from the sailing line is shown in **Table 5-3**.

6.2.4 Currents

Currents would be produced by the following processes:

1. Wind induced currents, which may be up to approximately 0.1 m/s (0.2 knots).
2. Propeller wash from vessels, which can generate high localised currents. Due to the installed engine power on typical trailerable vessels that would operate on Talbingo Reservoir, propeller currents would be negligible and would generally dissipate within say 10 m of the vessel.
3. Freshwater flows from creeks, streams, rivers and overland flows. Currents would be highest around the inflow source may be relatively high for some distance downstream given the waterway is relatively narrow and constrained.
4. Inflow of water from T2 power station and T3 power station on the Tumut arm of the reservoir and near the dam wall respectively.
5. Release of water for energy generation at the T3 power station near the dam wall.

Items 3 to 5 above have not been assessed in detail. An exclusion zone is marked on the RMS Boating Maps around the T3 intake and covers the approach channel. This would suggest that the currents are a concern for waterway users. The approach channel to the T3 intake is approximately 100 m wide.

Peak currents on Talbingo Reservoir, outside of the exclusion zone, would typically be less than 0.5 m/s (1 knot). These currents would be isolated to the vicinity of stream inflows, T2 power station inflow and T3 power station outflow. Throughout the remainder of the reservoir, currents would be less than about 0.1 m/s (0.2 knots).

6.3 Proposed Development

6.3.1 Construction Activities

The construction program and methodology for Talbingo Reservoir ensures the majority of the construction activities are land based. These land based activities, that would occupy part of the shoreline of the reservoir, include:

- Land transport of excavated rock and placement of excavated rock below FSL. The placement location is shown in **Figure 2-2**.
- Excavation of the intake channel. A ‘plug’ would be retained that would allow the majority of the intake channel to be excavated using land based equipment. The proposed method of excavation would be D&B. A cross section of the intake channel and intake structure is shown in **Figure 6-4** indicating ‘Dry D&B’, that would be undertaken with land based equipment.

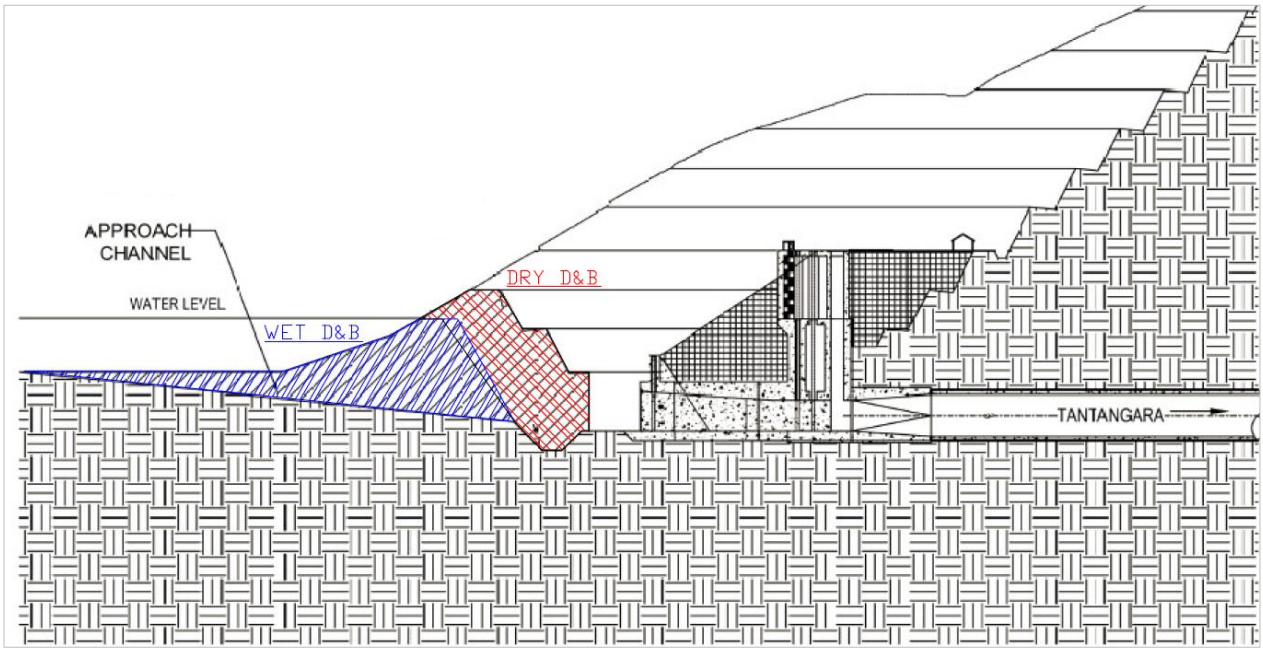


Figure 6-4: Excavation of the intake channel.

Marine based construction activities are limited to:

- Marine drill and blasting of the intake channel 'plug', marked as 'Wet D&B' in **Figure 6-4**. It is estimated that approximately 50,500 bank cubic metres of rock would be excavated by marine drill and blasting. The rock mass would be initially drilled and blasted using floating plant and equipment, similar to that shown in **Figure 5-3**. The blasted rock would be removed with a long reach excavator mounted on a barge, similar to that shown in **Figure 5-4**, or a grab dredge.
- Marine transport of the intake channel 'plug' from the intake channel to the excavated rock placement location rock shown in **Figure 2-2**. The blasted rock would be loaded into a barge for transport to the Ravine Bay excavated rock placement area. It is estimated that the barge capacity would be a minimum of approximately 300 m^3.

A possible alternate option to marine transport of the intake channel 'plug' material is to transfer the excavated rock to land based transport equipment for transport the Ravine Bay excavated rock placement area.

It is estimated that a small number of barges (approximately 2) would be required for marine D&B operations and an additional number of barges (approximately 2) for the marine transport. The barges would be up to approximately 30 m LOA (length overall) and 20 m wide. It is assumed that the barges would be unpropelled. The barges would be modular to enable mobilisation to Talbingo Reservoir. The barges for D&B operations would be held in position by mooring lines or tugs.

The barges would be positioned and moved from one location to another using shallow-draft pusher tugs. The minimum engine capacity of the pusher tugs would be approximately 600 hp. The tug would be a twin propeller vessel, which has enhanced manoeuvrability for navigating narrow channels. It is envisaged that approximately 2 tugs may be required.

Suitable mitigation measures would be deployed around the intake channel to minimise shockwave pressure from the marine D&B operations and mitigate the spread of turbid water. Silt curtains would also

be deployed around the rock placement area for the duration of the rock placement activities to reduce the spread of turbid water. A marine survey would be required to confirm the intake channel profile and rock placement profile has been achieved. About 4 work boats may be required to handle and secure the silt curtains and 1 vessel would be required for survey operations.

In total, approximately 4 barges, 2 tugs and 5 work boats/survey vessels would be required to complete the construction activities. The barges, tugs and support vessels would be launched from the barge ramp near the intake structure shown on **Figure 2-2**.

6.3.2 Operation of Snowy 2.0

Following construction, limited access would be required to Snowy 2.0 infrastructure at Talbingo Reservoir. The intake structure and intake channel would occupy part of the foreshore. Access to the tunnels and gate structures would be required for maintenance, including cleaning and removal of debris from the trash racks at the intake structure.

Commissioning and operation of Snowy 2.0 would result in a peak generating flow (flow from Tantangara Reservoir to Talbingo Reservoir) at design capacity of 372 m^3/s and a peak pumped flow (flow in reverse) at design capacity of 270 m^3/s. The MOL and FSL of the reservoir would not change as a result of Snowy 2.0 operations. Further, it is assumed that there would be little change in the range of water level fluctuation in Talbingo Reservoir as a result of Snowy 2.0 operations for two reasons:

1. Talbingo has a relatively large surface area at MOL and a large storage capacity. However, the operating range is relatively small (approximately 9 m from MOL to FSL), and
2. Talbingo will continue to be maintained close to FSL to maximise energy generation opportunities for T3.

6.3.3 Working Hours

Given the remote location and distance to sensitive noise receptors, it is assumed that marine construction operations may occur up to 24 hours per day, 7 days per week. Operation of Snowy 2.0 would occur 24 hours per day, 7 days per week

6.3.4 Nearby Proposed Developments

At the time of preparing this report, there are no other proposed developments on Talbingo Reservoir.

6.4 Assessment of Impact

The assessment of impacts herein has been developed based on the same assumptions as for Tantangara (see **Section 5.4**).

6.4.1 Construction Hazards

The main potential marine hazards during construction are similar to Tantangara Reservoir and include:

1. interaction between the construction marine plant and equipment and public boating activities
2. fixed obstruction/s on the reservoir, and
3. D&B operations/ projectiles

These hazards are discussed below. Risk assessment and mitigation measures are discussed in **Section 6.4.3** and **Section 6.4.4** respectively.

It is understood that Lobs Hole Ravine Road would be closed for the duration of construction and land access to the Lobs Hole boat ramp would be prohibited. The remaining boat ramps at the dam wall and O'Hares Rest Area would remain open for public access.

The surface area of the reservoir at MOL is approximately 1,616 hectares. However, navigation in a large part of the reservoir is restricted as a result of submerged obstructions (trees). As noted in **Section 6.1.4,** peak recreational boating use of the reservoir is assumed to be 75 vessels per day. However, on a typical day in summer, recreational boating use would be less than about 10 vessels per day. At MOL and peak demand, the density of waterway occupation would be approximately 1 vessel per 21.5 hectares. This is the worst case scenario and it is considered to be extremely low for a NSW waterway.

During construction, there would be an increase in vessel traffic and an increase in the size of vessels operating on the reservoir. As per **Section 6.3.1**, there is estimated to be up to an additional 13 vessels operating on the reservoir, which would be up to approximately 30 m LOA. This represents an increase in the number of vessels on the reservoir of 17% relative to peak demand. However, the impact of construction vessels on recreational waterway users would be relatively minor as the existing density of waterway occupation is considered extremely low for a NSW waterway and the increase in congestion as a result of construction activities is considered acceptable.

The presence of silt curtains would establish a physical barrier that would locally restrict public access to parts of Talbingo Reservoir. The silt curtains in addition to other marker buoys or moorings for construction barges or work vessels would create obstacles for navigation and there would be a risk of collision between public waterway users and the obstacle.

Uncontrolled D&B operations can result rock ejected from a blast site (flyrock). The amount of 'flyrock' is dependent on the depth of the charge, amount and type of the charge, capping of the charge and type of rock. Typically in quarry operations, exclusion zones are established for workers and the public is notified of impending blasts.

6.4.2 Operational Hazards

The main potential marine hazards resulting from Operation of Snowy 2.0 are:

1. high current speeds in vicinity of intake channel, and
2. greater variability in water level.

These hazards are discussed below. Risk assessment and mitigation measures are discussed in **Section 6.4.3** and **Section 6.4.4** respectively.

The increase in boating traffic to clean and maintain the 'trash racks' at the intake structure is considered to be negligible. Snowy Hydro currently accesses the reservoir to undertake similar operations at the T3 intake. These operations would typically be undertaken during the week when demand for the waterway is relatively low. The procedure for clearing the 'trash racks' of Snowy 2.0 would be similar to existing operations.

The peak generating and pumping flows have been modelled by RHDHV. The resultant surface current speeds for the pumping flow and generating flow are shown in **Figure 6-5** and **Figure 6-6** respectively. The water level adopted for the modelling is MOL as this would result in higher surface current speeds. The flows associated with Snowy 2.0 would alter existing currents in Talbingo Reservoir reported in **Section 6.2.**

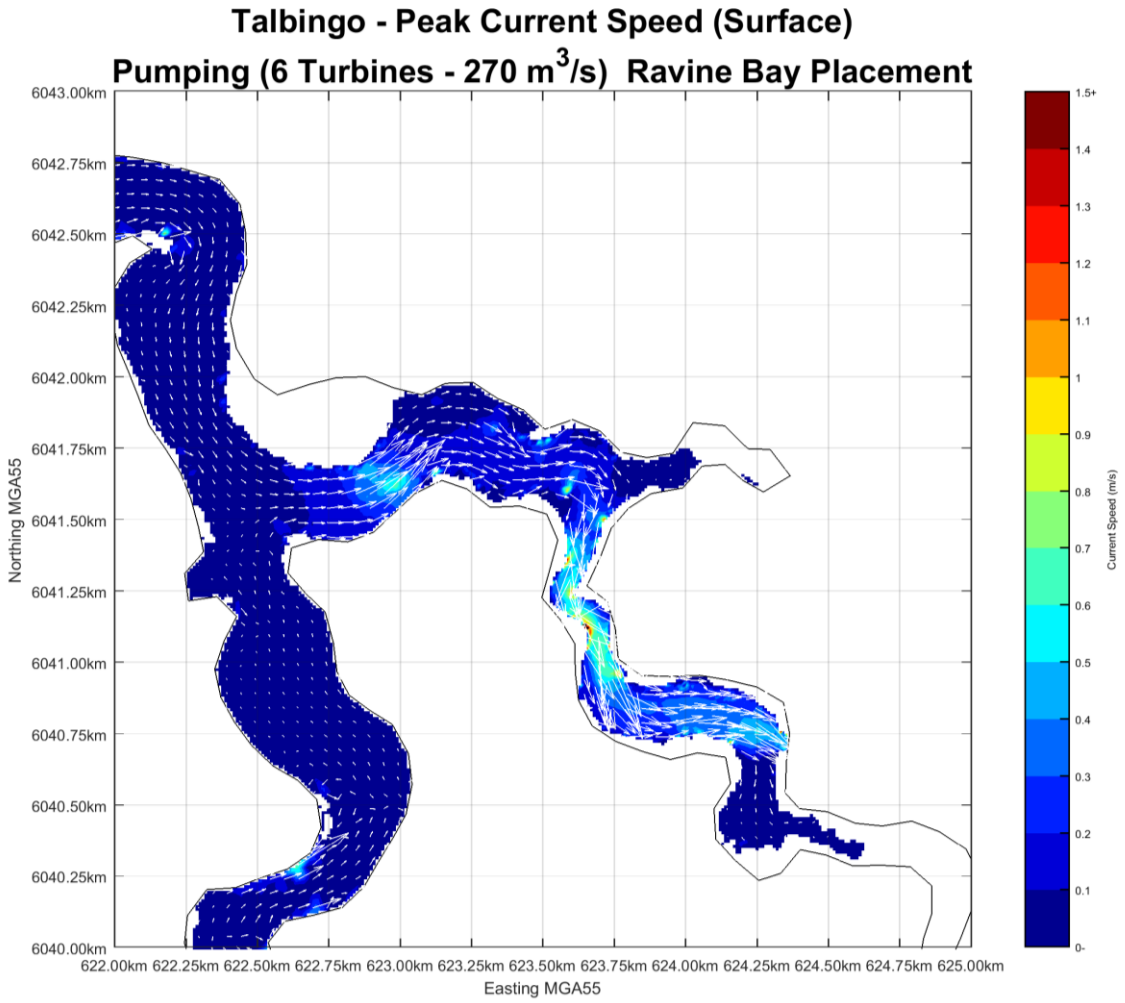


Figure 6-5: Maximum surface current in Talbingo Reservoir resulting from peak pumping flow of 270 m^3/s at MOL.

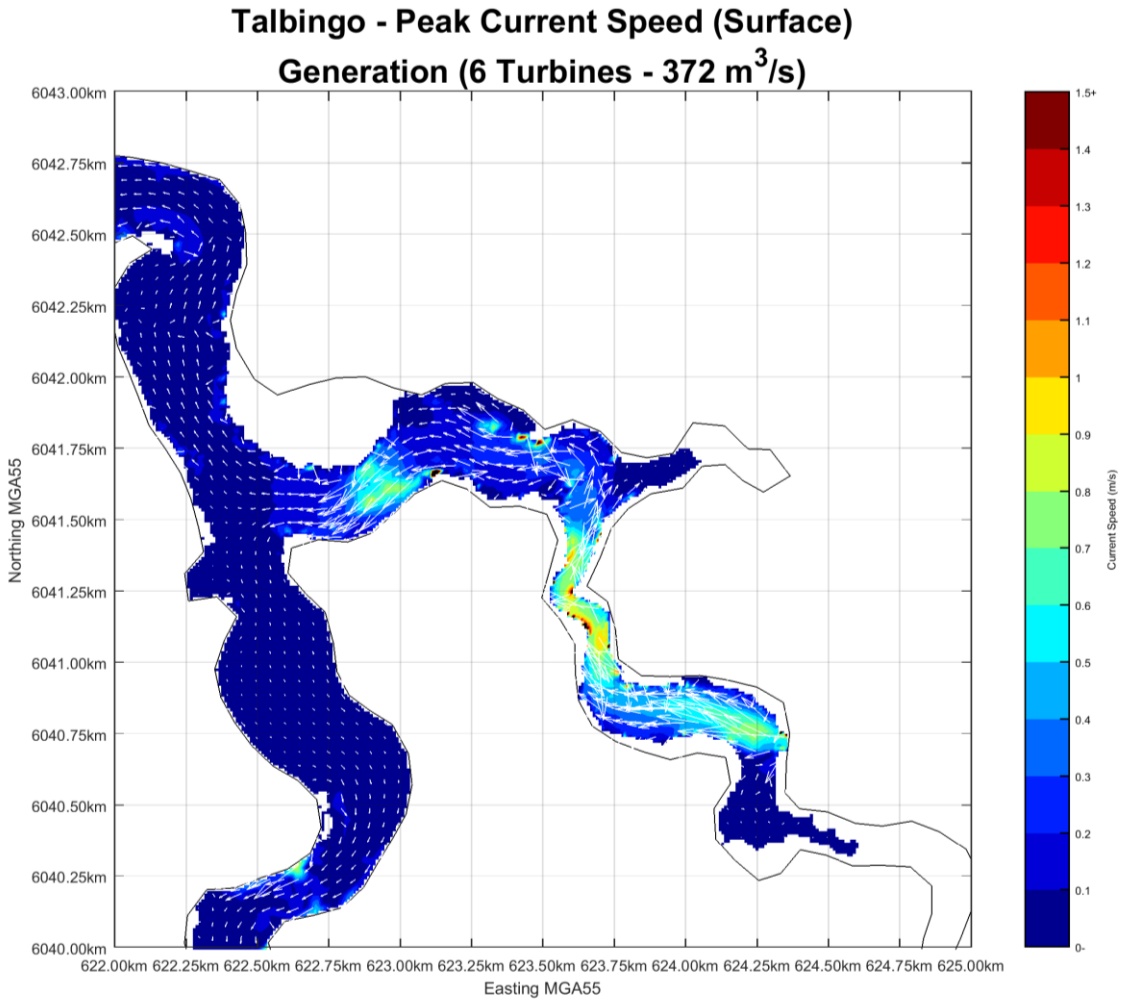


Figure 6-6: Maximum surface current in Talbingo Reservoir resulting from peak generating flow of 372 m^3/s at MOL.

The peak surface current speed is typically higher under generating flows compared to pumping flows. This is a result of the higher flow rate. Surface current speeds up to 0.6 m/s (1.2 knots) and 0.8 m/s (1.6 knots) are predicted around the intake channel under pumping and generating flows respectively. Surface current speeds increase up to approximately 0.9 m/s (1.8 knots) along the narrow channel, approximately 1 km downstream of the intake channel, for both pumping and generating flows. Around the placement area in Ravine Bay, where the rock placement reduces the channel width, surface current speeds up to 0.6 m/s (1.2 knots) and 0.8 m/s (1.6 knots) are predicted under pumping and generating flows respectively.

An assessment of surface current speed under peak pumping flows at FSL was conducted to assess the impact on safety of navigation at higher water levels. The surface current speeds are shown in **Figure 6-7.** Surface current speeds at the intake channel reduce to 0.2 m/s (0.4 knots). Along the narrow channel to the north, surface current speeds reduce to less than 0.4 m/s (0.8 knots) and near the placement area, surface current speeds are less than 0.15 m/s.

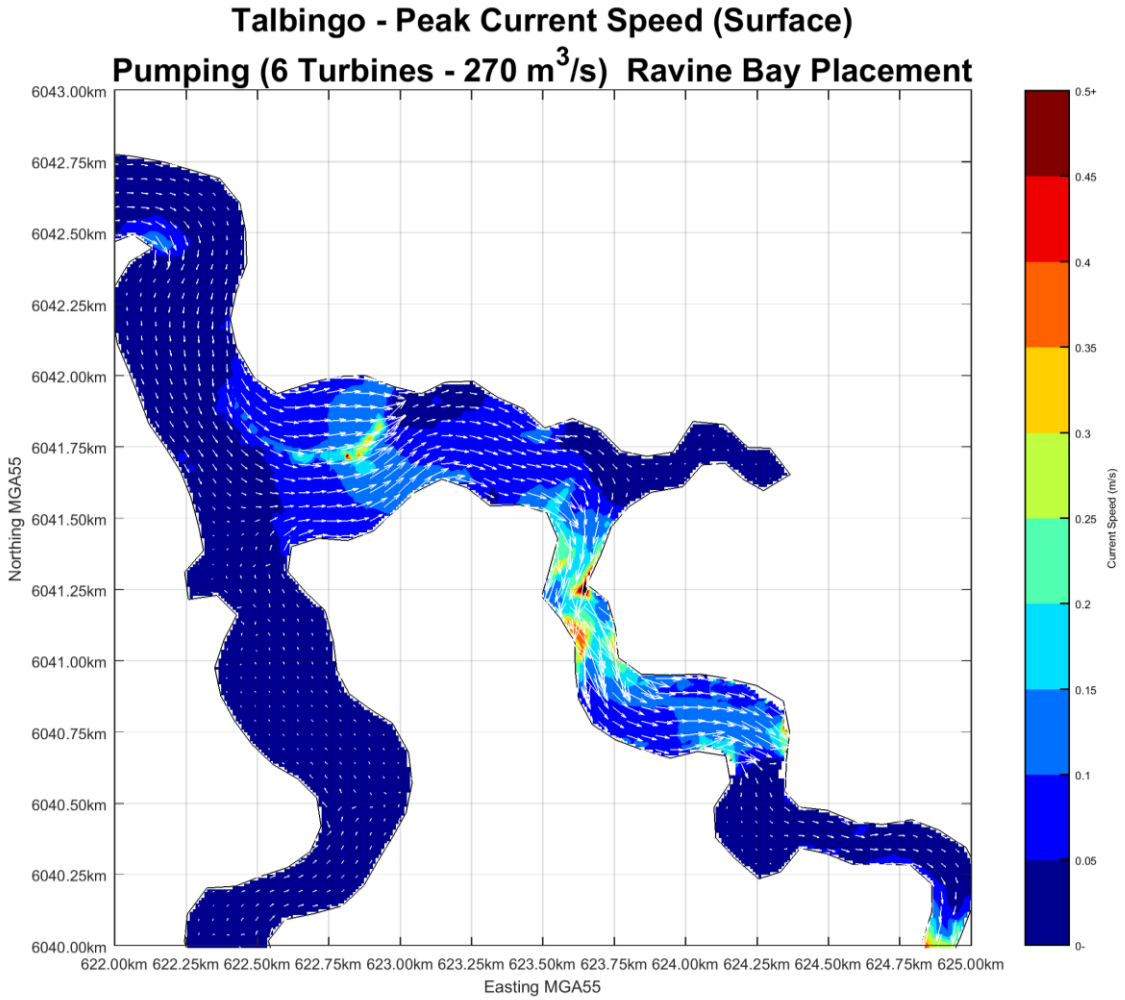


Figure 6-7: Maximum surface current in Talbingo Reservoir resulting from peak pumping flow of 270 m^3/s at FSL.

As per **Section 5.4.2**, tidal currents in Sydney Harbour are up to 1 knot around South Head and Middle Head. However, the hazard at Talbingo Reservoir is exacerbated as there is a risk of waterway users being drawn towards the intake structure and 'trash rack' with potentially adverse consequences.

As per **Section 5.4.2**, the flows during the pumping phase would cause turbulence near the intake structure and intake channel. Predicting whether a vessel would become unstable or capsize as a result of the turbulence or vortices is difficult and it would be dependent on the size of the vessel and speed of the vessel. If a person fell from a vessel, or if the vessel was to break down and become stricken, it would be drawn towards the intake structure where turbulence and vortices would be pronounced, and the risk of capsizing would increase. However, screens across the intake structure would prevent any ingress of large objects.

Under both generating and pumping flows, it is anticipated that there would be an undertow, in the vicinity of the intake structure, due to higher current speeds lower in the water column. A person in the water could be drawn down by the undertow (similar to a rip at the beach) and there would be a risk of drowning.

Depending on the direction of the surface current and wind, the sea state (waves) may become choppy, irregular and steeper compared to the analysis of existing conditions in **Section 6.2.**

As noted in **Section 6.3**, there would be little change in the water level in Talbingo Reservoir as a result of Snowy 2.0 operations. Boating facilities, foreshore occupation and foreshore structures outlined in **Section 6.1.1** and **Section 6.1.2**, including ancillary facilities such as car and trailer parking and camping areas, are above FSL. Unlike Tantangara Reservoir, the foreshore at Talbingo Reservoir between MOL and FSL does not provide recreational amenity. Variations in water level alter the clearance to submerged obstructions. However, at MOL, navigation throughout most of the reservoir remains feasible. Any change in water level or change in the rate of water level fluctuation would not be expected to significantly affect safety of navigation.

6.4.3 Risk Assessment

The risk assessment assessing safety of navigation, attached in **Appendix B**, has been prepared in accordance with **Section 4** and is based on the hazards identified in **Section 6.4.1** and **Section 6.4.2**.

The risk assessment indicates that the risk rating for all risks, following implementation of the mitigation measures, is either low or medium. For those which are medium the works may proceed provided stakeholders understand the residual risk.

6.4.4 Mitigation Measures

The mitigation measures outlined in the Risk Assessment (**Section 6.4.3** and **Appendix B**) would be further developed during the detailed design phase of the project. The mitigation measures currently being considered include:

- **Construction:**
  - establish a public exclusion zone around work areas including the intake channel, silt curtains, barge ramp and rock placement area (refer **Appendix C**). Ensure exclusion zone is clearly marked to the satisfaction of RMS. The location of buoys or markers and methods for securing them shall consider water level fluctuations and submerged trees
  - monitor and manage public access within the exclusion zone
  - obtain aquatic licence from RMS for the construction activities and exclusion zone. The aquatic licence will include notification on the RMS website
  - fit work vessels and barges with Automatic Identification System and comply with all licensing requirements of AMSA and RMS under the acts and regulations (refer **Section 3.1**) including specific requirements for Alpine Waters
  - erect notification signs advising of the works, public closures, blasting operations and other loud activities at:
    - Talbingo boat ramp near the dam wall, and
    - O'Hares Boat Ramp.
  - ensure any other fixed obstruction such as marker buoys and moorings comply with RMS requirements, and
  - designated blast limits and other management measures to minimise impacts will be outlined in the Blast Management Plan.

- **Operation:**
  - establish an exclusion zone around the intake structure and intake channel in consultation with RMS (refer **Appendix C**). Ensure exclusion zone is clearly marked to the satisfaction of RMS. The location of buoys or markers and methods for securing them shall consider water level fluctuations and submerged trees

- liaise with RMS to update the RMS Boating Map for Talbingo, Tumut Ponds, Tooma, Three Mile Dams, Geehi Reservoir and Khancoban Pondage Areas indicating exclusion zone and location of intake structure and intake channel
- provide material to educate the public and create awareness of high current speeds near the intake channel and highly variable water levels including the following:
  - liaise with RMS to include warning on the RMS Boating Map for Talbingo, Tumut Ponds, Tooma, Three Mile Dams, Geehi Reservoir and Khancoban Pondage Areas
  - distribute information pamphlets to local fishing and boating retailers
  - liaise with RMS to erect notification signs at:
    - the intersection of Lobs Hole Ravine Road and Link Road
    - the intersection of Lobs Hole Ravine Road and Snowy Mountains Highway
    - Talbingo boat ramp near the dam wall
    - O'Hares Boat Ramp, and
    - Lobs Hole Boat Ramp.

The primary mitigation measure during construction and operation would be establishment of navigation exclusion zones. The exclusion zone may be delineated with lateral marks (port and starboard), cardinal marks (north, east, south or west), aqua minibuoys or shore based signage where clear line of site over an acceptable distance to the edge of the reservoir is viable. Design of the buoys or marks would need to accommodate water level fluctuation from MOL to DFL and may comprise fixed poles/piles in shallow water and floating buoys/marks in deep water.

Placement of buoys would need to consider the location of submerged vegetation and the slope of the reservoir bed. Steep side slopes may not be suitable for placement of anchors of mooring blocks. The placement or buoys would also need to consider 'drift' as the water level fluctuates. Buoys should be placed approximately 10 m further from the intake structure to accommodate drift at MOL.

To improve safety and awareness of high flow velocities, Snowy Hydro Limited may consider an automatic notification system at the intake structure indicate pumping or generating flow. The automatic notification system may include an arrangement of lights displayed at a clearly visible location.

Proposed navigation exclusion zones during construction and operation are shown in **Appendix C**. The extent of navigation exclusion zones would be refined following detailed design and consultation, including RMS. The exclusion zones may be further refined during construction and operation by trial and experience. Any refinement to the exclusion zone would include all waterway users including swimmers, kayakers, fishermen etc.

The size of the proposed navigation exclusion zone during construction is approximately 83 hectares at MOL (reduction of 5% of the reservoir surface area). The navigation exclusion zone extends around construction activities and accommodates a buffer of 50 m.

The size of the proposed navigation exclusion zone during operation is approximately 20.6 hectares at MOL (reduction of 1.3 % of the reservoir surface area). The exclusion zone extends approximately 1,250 m north of the intake structure where surface current speed under pumping flow at MOL is less than 0.3 m/s (0.6 knots). The exclusion zone extends approximately 200 m south of the intake where surface current speed is less than 0.1 m/s (0.2 knots) for pumping flows at MOL. The surface current speeds are shown in **Figure 6-5**.

It is noted that construction and operation of Snowy 2.0 will impact on the unformed boat ramp at Lobs Hole. During construction, the boat ramp would be closed and following construction, the proposed navigation exclusion zone near the intake structure will prevent navigation from the boat ramp to broader section of Talbingo Reservoir. Demand for the boat ramp at Lobs Hole is relatively low compared to O'Hares Rest Area or the boat ramp near the dam wall. SHL will discuss solutions to this in consultation with NPWS and RMS as detailed design and operation needs are finalised.

7 Conclusion

The SEARS required a report to address marine safety and navigation including:

1. Transport – an assessment of the impact of the project on the use of navigable waters in the Tantangara and Talbingo Reservoirs, and
2. Social – an assessment of the social impacts of the project on users of the Kosciuszko National Park, including recreational fishing, bushwalking, camping and boating.

The report herein assesses the safety of waterway users, it does not consider land based recreational users. Mitigation measures are proposed in **Section 5.4.4** and **Section 6.4.4** for Tantangara Reservoir and Talbingo Reservoir respectively to manage the safety of recreational boating users during construction and operation of Snowy 2.0.

The primary mitigation measure is the establishment of navigation exclusion zones during construction and operation. While it is recognised that this mitigation measure would impact to a degree on recreational amenity and reduce the extent of the reservoir that can be accessed by recreational boaters, the safety of the public, particularly on remote alpine waters such as Talbingo and Tantangara Reservoirs is deemed to be of primary importance. The exclusion zones are based on numerical modelling of generating and pumping flows through Snowy 2.0 where current speeds towards the intake structures govern the risk assessment. During operation, it is recommended to validate the numerical modelling and, if necessary, review the extent of the exclusion zones based on experience and trial.

8 References

Australian Standard (AS/NZS1170.2:2011), *Structural Design Action Part 2: Wind Actions.*

Department of the Army - Coastal Engineering Research Centre (SPM, 1984), *Shoreline Protection Manual.*

Glamore W.C., Hudson R., Cox R.J. (2005), *Measurement and Analysis of Boat Wake Waves: Management Implications,* paper presented at the Australasian Coasts & Ports Conference 2005, Adelaide, South Australia, September 2005.

Glamore (2005), *A Decision Support Tool for Assessing the Impact of Boat Wake Waves on Inland Waterways.*

NSW Environmental Protection Authority (EPA, 2017), *Noise Policy for Industry.*

NSW Roads and Maritime Services (RMS, 2015), *NSW Boat Ramp Facility Guidelines*, September 2015.

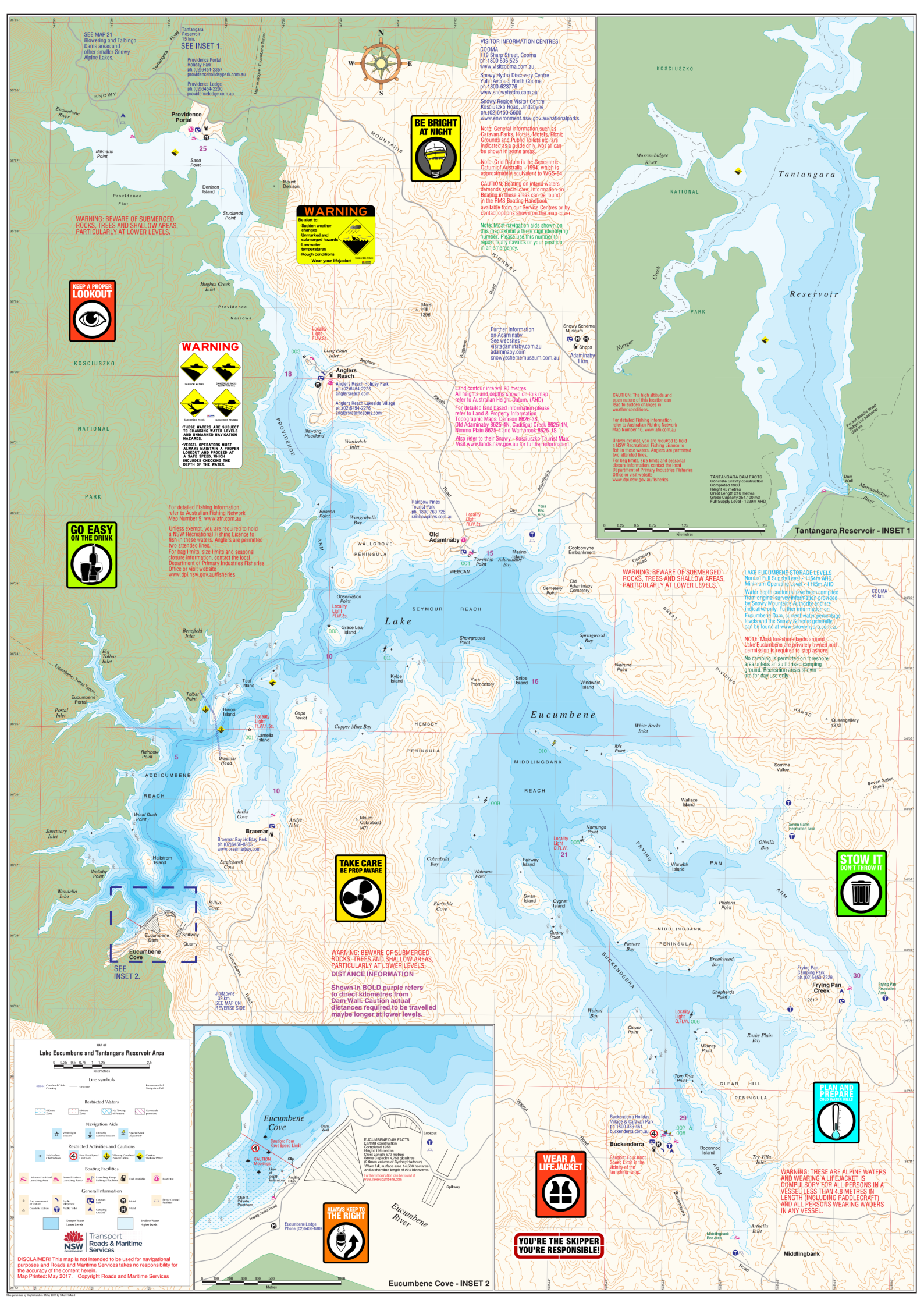
NSW Roads and Maritime Services (RMS, 2016), Boating *Handbook*, prepared by Roads and Maritime Services, NSW Transport Maritime, October 2016.

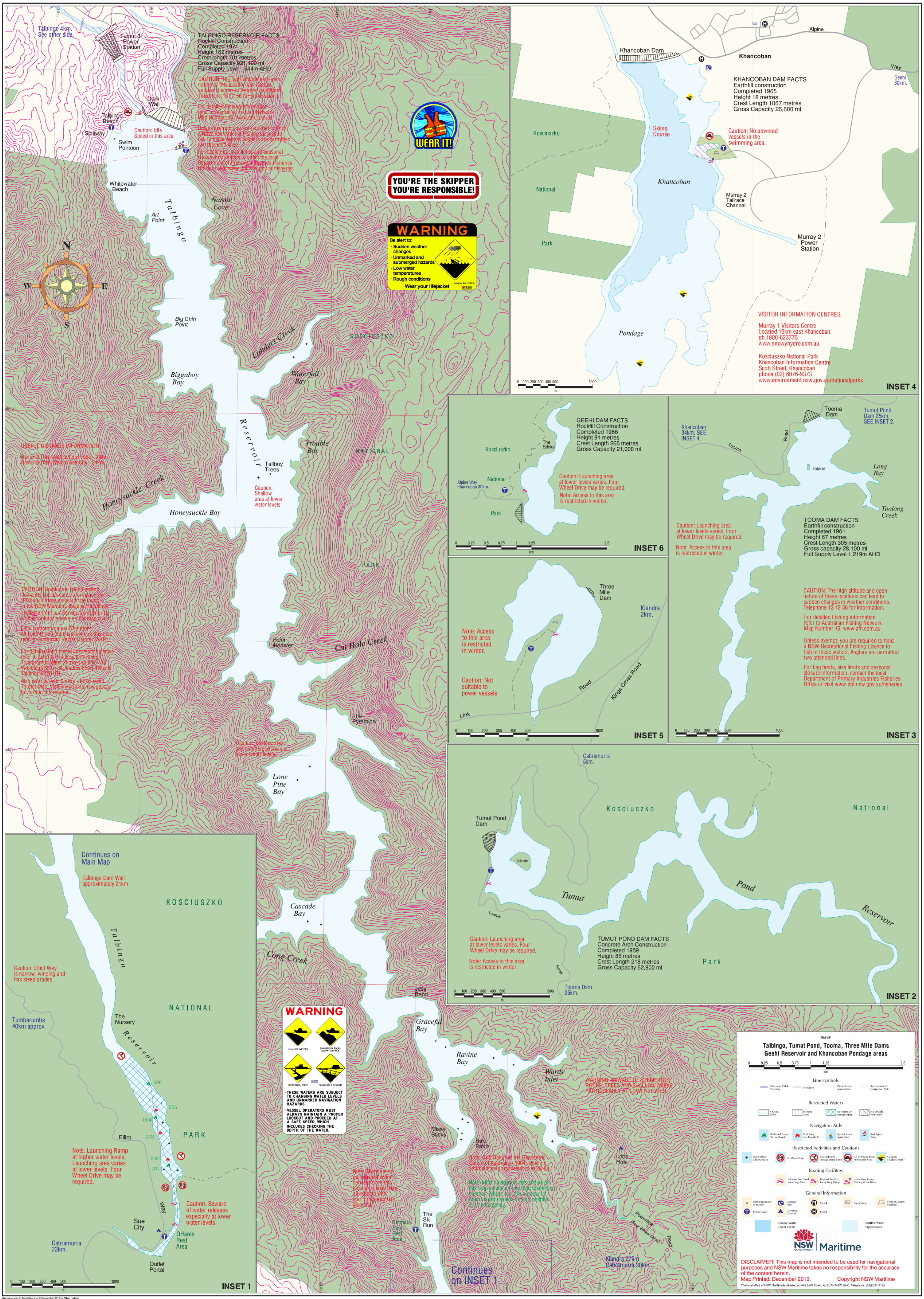
Ruprecht J.E., Glamore W.C., Coghlan I.R., Flocard F. (2015), *Wakesurfing: Some Wakes are More Equal than Others*, paper presented at the Australasian Coasts & Ports Conference 2015, Auckland, New Zealand, September 2015.

Safe Work Australia (2018), *Safe Design of Structures Code of Practice.*

US Army Corps of Engineers (USACE, 2008), *Coastal Engineering Manual*, publication EM 1110-2-1100.

Appendix A: Roads and Maritime Services Boating Maps


SEE MAP 21
Blowering and Talbingo Dams areas and other smaller Snowy Alpine Lakes.
Tantangara Reservoir 15 km.
SEE INSET 1.
Providence Portal Holiday Park ph.(02)6454-2357 providenceholidaypark.com.au
Providence Lodge ph.(02)6454-2200 providencelodge.com.au
SNOWY
Eucumbene River
Providence Portal
Billimans Point
Sand Point
Denison Island
Providence Flat
Studlands Point
Mount Denison
MOUNTAINS
HIGHWAY
Murrumbidgee - Eucumbene Tunnel
Tantangara Road
WARNING: BEWARE OF SUBMERGED ROCKS, TREES AND SHALLOW AREAS, PARTICULARLY AT LOWER LEVELS.
KEEP A PROPER LOOKOUT
KOSCIUSZKO
NATIONAL
PARK
Hughes Creek Inlet
Providence Narrows
PROVIDENCE
Illawong Headland
Wattledale Inlet
Mac's Hill 1396
Long Plain Inlet
Anglers
Anglers Reach
Anglers Reach Holiday Park ph.(02)6454-2223 anglersreach.com
Anglers Reach Lakeside Village ph.(02)6454-2276 anglerslakeside.com
Locality Light FLW.3s.
003
18
WARNING
SHALLOW WATERS
DANGEROUS ROCKY REEFS AHEAD
SUBMERGED TREES
SUBMERGED FENCING
•THESE WATERS ARE SUBJECT TO CHANGING WATER LEVELS AND UNMARKED NAVIGATION HAZARDS.
•VESSEL OPERATORS MUST ALWAYS MAINTAIN A PROPER LOOKOUT AND PROCEED AT A SAFE SPEED, WHICH INCLUDES CHECKING THE DEPTH OF THE WATER.
GO EASY ON THE DRINK
For detailed Fishing information refer to Australian Fishing Network Map Number 9. www.afn.com.au
Unless exempt, you are required to hold a NSW Recreational Fishing Licence to fish in these waters. Anglers are permitted two attended lines.
For bag limits, size limits and seasonal closure information, contact the local Department of Primary Industries Fisheries Office or visit website www.dpi.nsw.gov.au/fisheries
BE BRIGHT AT NIGHT
WARNING
Be alert to:
· Sudden weather changes
· Unmarked and submerged hazards
· Low water temperatures
· Rough conditions
Wear your lifejacket
VISITOR INFORMATION CENTRES
COOMA
119 Sharp Street, Cooma
ph.1800 636 525
www.visitcooma.com.au
Snowy Hydro Discovery Centre
Yullin Avenue, North Cooma
ph.1800-623776
www.snowyhydro.com.au
Snowy Region Visitor Centre
Kosciuszko Road, Jindabyne
ph.(02)6450-5600
www.environment.nsw.gov.au/nationalparks
Note: General information such as Caravan Parks, Hotels, Motels, Picnic Grounds and Public Toilets etc. are indicated as a guide only. Not all can be shown in some areas.
Note: Grid Datum is the Geocentric Datum of Australia - 1994, which is approximately equivalent to WGS-84.
CAUTION: Boating on inland waters demands special care. Information on Boating in these areas can be found in the RMS Boating Handbook available from our Service Centres or by contact options shown on the map cover.
Note: Most navigation aids shown on this map exhibit a three digit identifying number. Please use this number to report faulty navaids or your position in an emergency.
Further Information on Adaminaby See websites visitadaminaby.com.au adaminaby.com snowyschememuseum.com.au
Snowy Scheme Museum
Shops
Adaminaby 1 km.
Land contour interval 20 metres. All heights and depths shown on this map refer to Australian Height Datum, (AHD)
For detailed land based information please refer to Land & Property Information Topographic Maps: Denison 8626-3S, Old Adaminaby 8625-4N, Caddigat Creek 8625-1N, Nimmo Plain 8625-4 and Wambrook 8625-1S.
Also refer to their Snowy - Kosciuszko Tourist Map. Visit www.lands.nsw.gov.au for further information.
Rainbow Pines Tourist Park ph. 1800 760 726 rainbowpines.com.au
Locality Light FLW.3s.
Beacon Point
Wangrabelle Bay
WALLGROVE PENINSULA
Old Adaminaby
Township Point
Adaminaby Bay
Marina Island
004
15
WEBCAM
Coolcowyne Embankment
Cemetery Road
Old Adaminaby Cemetery
Cemetery Point
Observation Point
Locality Light FLW.3s.
002
Grace Lea Island
SEYMOUR REACH
Lake
Eucumbene
Benefield Inlet
Big Tolbar Inlet
Eucumbene - Tumut Tunnel
Eucumbene Portal
Portal Inlet
Tolbar Point
Teal Island
Heron Island
Locality Light FLW.1.5s.
001
Larmella Island
Cape Tevlot
Copper Mine Bay
HEMSBY PENINSULA
Showground Point
Springwood Bay
Kybe Island
York Promontory
Snipe Island
16
Windward Island
Wairuna Point
White Rocks Inlet
Ibis Point
MIDDLINGBANK REACH
010
009
Somme Valley
Seven Gates Recreation Area
Seven Gates Road
Wallace Islands
Namungo Point
Locality Light Q.FL.W.
005
21
ONeills Bay
FRYING PAN ARM
Warwick Island
PAN
Phalaris Point
Rainbow Point
5
ADDICUMBENE REACH
10
Braemar Head
Jacks Cove
Andys Inlet
Braemar
Braemar Bay Holiday Park ph.(02)6456-6805 www.braemarbay.com
Mount Gobrabald 1477
Wood Duck Point
Sanctuary Inlet
Hallstrom Island
Eaglehawk Cove
Wallaby Point
Wandella Inlet
Billyo Cove
Eucumbene Dam
Spillway
Quarry
Eucumbene Cove
SEE INSET 2.
Eucumbene
Jindabyne - 39 km.
SEE MAP ON REVERSE SIDE
Cobrabald Bay
Wahrane Point
Fairway Island
Swan Island
Cygnet Island
Quarry Point
Eximble Cove
MIDDLINGBANK PENINSULA
Pasture Bay
Brookwood Bay
Shepherds Point
Frying Pan Camping Park ph.(02)6459-7229.
Frying Pan Creek
1281
30
Frying Pan Recreation Area
Wairui Bay
Locality Light Q.FL.W.
006
Clover Point
Rocky Plain Bay
Midway Point
Tom Frys Point
CLEAR HILL PENINSULA
Buckenderra Holiday Village & Caravan Park ph 1800 339 461 buckenderra.com.au
29
007 & 008
Buckenderra
Caution: Four Knot Speed Limit to the vicinity of the launching ramp.
Boconnoc Island
Try Villa Inlet
Arrhella Inlet
Middlingbank Rec Area
Middlingbank
Buckenderra Road
Walnut Road
TAKE CARE BE PROP AWARE
STOW IT DON'T THROW IT
PLAN AND PREPARE COLD WATER KILLS
WEAR A LIFEJACKET
YOU'RE THE SKIPPER YOU'RE RESPONSIBLE!
ALWAYS KEEP TO THE RIGHT
WARNING: BEWARE OF SUBMERGED ROCKS, TREES AND SHALLOW AREAS, PARTICULARLY AT LOWER LEVELS.
DISTANCE INFORMATION
Shown in BOLD purple refers to direct kilometres from Dam Wall. Caution actual distances required to be travelled maybe longer at lower levels.
LAKE EUCUMBENE STORAGE LEVELS
Normal Full Supply Level - 1164m AHD
Minimum Operating Level - 1115m AHD
Water depth contours have been compiled from original survey information provided by Snowy Mountains Authority and are indicative only. Further information on Eucumbene Dam, current water percentage levels and the Snowy Scheme generally can be found at www.snowyhydro.com.au
NOTE: Most foreshore lands around Lake Eucumbene are privately owned and permission is required to step ashore.
No camping is permitted on foreshore area unless an authorised camping ground. Recreation areas shown are for day use only.
COOMA 46 km.
Queengallery 1372
WARNING: THESE ARE ALPINE WATERS AND WEARING A LIFEJACKET IS COMPULSORY FOR ALL PERSONS IN A VESSEL LESS THAN 4.8 METRES IN LENGTH (INCLUDING PADDLECRAFT) AND ALL PERSONS WEARING WADERS IN ANY VESSEL.
KOSCIUSZKO
Tantangara
NATIONAL
PARK
Murrumbidgee River
Nungar
Creek
Reservoir
Pocket Saddle Road Subject to seasonal closure
Dam Wall
Murrumbidgee River
CAUTION: The high altitude and open nature of this location can lead to sudden changes in weather conditions.
For detailed Fishing Information refer to Australian Fishing Network Map Number 16. www.afn.com.au
Unless exempt, you are required to hold a NSW Recreational Fishing Licence to fish in these waters. Anglers are permitted two attended lines.
For bag limits, size limits and seasonal closure information, contact the local Department of Primary Industries Fisheries Office or visit website www.dpi.nsw.gov.au/fisheries
TANTANGARA DAM FACTS
Concrete Gravity construction
Completed 1960
Height 45 metres
Crest Length 216 metres
Gross Capacity 254,100 m3
Full Supply Level - 1220m AHD
Tantangara Reservoir - INSET 1
Eucumbene Cove
Caution: Four Knot Speed Limit
CAUTION Moorings
Ski
Lines of depth indicators
Angling Club
Club & Private Pontoons
Happy Jacks Road
Eucumbene Lodge Phone (02)6456-5805
Lookout
EUCUMBENE DAM FACTS
Earthfill construction
Completed 1958
Height 116 metres
Crest Length 570 metres
Gross Capacity 4,798 gigalitres
(9 times volume of Sydney Harbour)
When full, surface area 14,500 hectares and a shoreline length of 224 kilometres.
Further information can be found at www.lakeeucumbene.com
Spillway
Eucumbene River
Eucumbene Cove - INSET 2
Lake Eucumbene and Tantangara Reservoir Area
Kilometres
Line symbols
Overhead Cable Crossing
Structure
Recommended Navigation Path
Restricted Waters
4 Knots Zone
8 Knots Zone
No Towing of Persons
No vessels permitted
Navigation Aids
White light Beacon
Lit north Cardinal Beacon
Special Mark Aqua Buoy
Restricted Activities and Cautions
Safe Surface Obstructions
Four Knot Speed Limit Area
Warning Overhead Power Cables
Caution Shallow Water
Boating Facilities
Uniformed or Hand Launching Area
Formed Surface Launching Ramp
Launching Ramp, Parking & Facilities
Fuel Available
Boat Hire
General Information
Point monument or Feature
Public telephone
Public Toilet
Caravan Park
Camping Ground
Motel
Hotel
Picnic Ground Facilities
Deeper Water Lower Levels
Shallow Water Higher levels
Transport Roads & Maritime Services
DISCLAIMER! This map is not intended to be used for navigational purposes and Roads and Maritime Services takes no responsibility for the accuracy of the content herein.
Map Printed: May 2017. Copyright Roads and Maritime Services
Map generated by MapWizard on 8 May 2017 by Mitch Holland



Talbingo 4km. See other side
Tumut 3 Power Station
Dam Wall
Talbingo Beach
Spillway
Swim Pontoon
Caution: Idle Speed in this area
TALBINGO RESERVOIR FACTS
Rockfill Construction
Completed 1971
Height 162 metres
Crest length 701 metres
Gross Capacity 921,400 ml
Full Supply Level - 544m AHD
CAUTION: The high altitude and open nature of this location can lead to sudden changes in weather conditions. Telephone 13 12 56 for information.
For detailed Fishing information refer to Australian Fishing Network Map Number 16. www.afn.com.au
Unless exempt, you are required to hold a NSW Recreational Fishing Licence to fish in these waters. Anglers are permitted two attended lines.
For bag limits, size limits and seasonal closure information, contact the local Department of Primary Industries Fisheries Office or visit www.dpi.nsw.gov.au/fisheries
WEAR IT!
YOU'RE THE SKIPPER YOU'RE RESPONSIBLE!
WARNING
Be alert to:
· Sudden weather changes
· Unmarked and submerged hazards
· Low water temperatures
· Rough conditions
Wear your lifejacket
Whitewater Beach
Narnie Cove
Art Point
Talbingo
N
W
E
S
Big Chin Point
Landers Creek
KOSCIUSZKO
Waterfall Bay
Biggaboy Bay
USEFUL DISTANCE INFORMATION
Ramp at Dam Wall to Lobs Hole - 20km.
Ramp at Dam Wall to Sue City - 24km.
Reservoir
Trouble Bay
NATIONAL
Tallboy Trees
Caution: Shallow area at lower water levels
Honeysuckle Creek
Honeysuckle Bay
PARK
CAUTION: Boating on inland waters demands special care. Information on Boating in these areas can be found in the NSW Maritime Boating Handbook available from our Service Centres or by contact options shown on the map cover.
Land contour interval 20 metres. All heights and depths shown on this map refer to Australian Height Datum. (AHD)
For detailed land based information please refer to Land & Property Information Topographic Maps: Blowering 8527-2S, Wondalga 8527-3S, Batlow 8526-4N and Talbingo 8526-1N.
Also refer to their Snowy - Kosciuszko Tourist Map. Visit www.lpma.nsw.gov.au for further information.
Point Monster
Cat Hole Creek
The Pyramids
Caution: Shallow area and submerged trees at lower water levels
Lone Pine Bay
Cascade Bay
Cong Creek
Jess Bend
WARNING
SHALLOW WATERS
DANGEROUS ROCKS BELOW SURFACE
SUBMERGED TREES
SUBMERGED FENCING
•THESE WATERS ARE SUBJECT TO CHANGING WATER LEVELS AND UNMARKED NAVIGATION HAZARDS.
•VESSEL OPERATORS MUST ALWAYS MAINTAIN A PROPER LOOKOUT AND PROCEED AT A SAFE SPEED, WHICH INCLUDES CHECKING THE DEPTH OF THE WATER.
Graceful Bay
Ravine Bay
Wards Inlet
WARNING: BEWARE OF SUBMERGED ROCKS, TREES AND SHALLOW AREAS PARTICULARLY AT LOWER LEVELS.
Missy Sticks
Bald Patch
Lobs Hole
Note: Grid Datum is the Geocentric Datum of Australia - 1994, which is approximately equivalent to WGS-84.
Note: Most navigation aids shown on this map exhibit a three digit identifying number. Please use this number to report faulty navaids or your position in an emergency.
Note: There are no garbage collection services from this location, please take all rubbish with you for appropriate disposal.
Coonara Point Rest Area
The Ski Run
Powerline (Four Wheel Drive) Road
Kiandra 27km Cabramurra 30km.
Continues on INSET 1
Continues on Main Map
Talbingo Dam Wall approximately 21km
KOSCIUSZKO
Talbingo
Caution: Elliot Way is narrow, winding and has steep grades.
NATIONAL
Tumbarumba 40km approx.
The Nursery
Reservoir
PARK
Elliot
Note: Launching Ramp at higher water levels. Launching area varies at lower levels. Four Wheel Drive may be required.
Caution: Beware of water releases especially at lower water levels.
Sue City
OHares Rest Area
Way
Cabramurra 22km.
Outlet Portal
INSET 1
Khancoban Dam
Khancoban
Alpine
Way
Geehi 30km.
KHANCOBAN DAM FACTS
Earthfill construction
Completed 1965
Height 18 metres
Crest Length 1067 metres
Gross Capacity 26,600 ml
Kosciuszko
Skiing Course
Caution: No powered vessels in the swimming area.
National
Khancoban
Murray 2 Tailrace Channel
Park
Murray 2 Power Station
VISITOR INFORMATION CENTRES
Murray 1 Visitors Centre
Located 10km east Khancoban
ph.1800-623776
www.snowyhydro.com.au
Kosciuszko National Park
Khancoban Information Centre
Scott Street, Khancoban
phone (02) 6076-9373
www.environment.nsw.gov.au/nationalparks
Pondage
INSET 4
GEEHI DAM FACTS
Rockfill Construction
Completed 1966
Height 91 metres
Crest Length 265 metres
Gross Capacity 21,000 ml
Kosciuszko
The Sticks
Alpine Way Khancoban 30km.
National
Park
Caution: Launching area at lower levels varies. Four Wheel Drive may be required.
Note: Access to this area is restricted in winter.
INSET 6
Tooma Dam
Tumut Pond Dam 25km. SEE INSET 2.
Khancoban 34km. SEE INSET 4.
Tooma
Road
Island
Long Bay
Toolong Creek
Caution: Launching area at lower levels varies. Four Wheel Drive may be required.
Note: Access to this area is restricted in winter.
TOOMA DAM FACTS
Earthfill construction
Completed 1961
Height 67 metres
Crest Length 305 metres
Gross capacity 28,100 ml
Full Supply Level 1,219m AHD
CAUTION: The high altitude and open nature of these locations can lead to sudden changes in weather conditions. Telephone 13 12 56 for information.
For detailed Fishing information refer to Australian Fishing Network Map Number 16. www.afn.com.au
Unless exempt, you are required to hold a NSW Recreational Fishing Licence to fish in these waters. Anglers are permitted two attended lines.
For bag limits, size limits and seasonal closure information, contact the local Department of Primary Industries Fisheries Office or visit www.dpi.nsw.gov.au/fisheries
INSET 3
Three Mile Dam
Kiandra 2km.
Note: Access to this area is restricted in winter.
Caution: Not suitable to power vessels
Road
Kings Cross Road
Link
INSET 5
Cabramurra 5km.
Kosciuszko
National
Tumut Pond Dam
Island
Tumut
Pond
Reservoir
Tooma
Caution: Launching area at lower levels varies. Four Wheel Drive may be required.
Note: Access to this area is restricted in winter.
Road
TUMUT POND DAM FACTS
Concrete Arch Construction
Completed 1959
Height 86 metres
Crest Length 218 metres
Gross Capacity 52,800 ml
Park
Tooma Dam 25km.
INSET 2
MAP OF
Talbingo, Tumut Pond, Tooma, Three Mile Dams
Geehi Reservoir and Khancoban Pondage areas
km
Line symbols
Overhead Cable Crossing
Structure
Oyster Lease Aquaculture
Recommended Navigation Path
Restricted Waters
4 Knots Zone
8 Knots zone
No Skiing or Aquaplaning
No Vessels Permitted
Navigation Aids
Starboard Buoy No Top Mark
Port Buoy No Top Mark
Special Mark Aqua Buoy
Red Aqua Buoy
Restricted Activities and Cautions
Sub Surface Obstructions
No Wash Zone
No Skiing or Aquaplaning Zone
All or Power Boats Prohibited Area
Caution Shallow Water
Boating Facilities
Unformed or Hand Launching Area
Formed Surface Launching Ramp
Launching Ramp Parking & Facilities
General Information
Post monument or feature
Caravan Park
Motel
Post Office
Picnic Ground Facilities
Public Toilet
Camping Ground
Hotel
Deeper Water Lower Levels
Shallow Water Higher levels
NSW GOVERNMENT Maritime
DISCLAIMER! This map is not intended to be used for navigational purposes and NSW Maritime takes no responsibility for the accuracy of the content herein.
Map Printed: December 2010.
Copyright NSW Maritime
The local office of NSW Maritime is situated at: 440 Swift Street, ALBURY NSW 2640. Telephone: (02)6021-7188

Appendix B: Risk Assessment

Royal HaskoningDHV
Enhancing Society Together

Tantangara Reservoir

Risk ID	Hazard	Initial Risk or Risk at Previous			Strategy/Mitigation Measure (Eliminate, Substitute, Isolate, Engineering Controls, Administrative Controls)	Residual Risk			Risk Manager
		Severity	Likelihood	Rating		Severity	Likelihood	Rating	
		1-5	1-5			1-5	1-5		
Construction									

C1	Interaction between the Project's marine plant and equipment and public boating activities	3 - primarily an interruption to the Contractor. However, severity could be major or higher.	3 - despite the available space on the Reservoir, it is a possibility that the public could navigate close to the Contractors activities.	9	• Establish a public exclusion zone around work areas including the intake channel, silt curtains, barge ramp and navigation route to shore. Ensure exclusion zone is clearly marked to the satisfaction of RMS. Location and securing of buoys or markers shall consider water level fluctuation.
					• Maintain public access to the existing boat ramp at Tantangara Reservoir, where practical.
					• Monitor and manage public access within the exclusion zone.
					• Obtain aquatic licence from Roads and Maritime Services for the construction activities and exclusion zone. The aquatic licence will include notification on the Roads and Maritime Services website.
					• Fit work vessels and barges with Automatic Identification System and comply with all licensing requirements of Australian Maritime Safety Authority and Roads and Maritime Services including specific requirements for Alpine Waters.
					• Erect notification signs advising of the works and public closures at:
					  • the intersection of Snowy Mountains Highway and Tantangara Road;
					  • the intersection of Snowy Mountains Highway and Long Plain Road; and,
					  • Tantangara Boat Ramp.
						3 - mitigation measures do not reduce severity.	1 - mitigation measures isolate the Contractor's activities from the public.	3	Contractor

C2	Fixed obstruction/s on the reservoir such as marker buoys and moorings	3 - possibility of collision with fixed obstructions resulting in moderate injury.	2 - likelihood of collision unlikely given that the majority of boating activities on the Reservoir would be between Sunrise and Sunset.	6	• As per Risk ID C1, establish exclusion zone around the silt curtain.
					• Ensure any other fixed obstruction such as marker buoys and moorings comply with Roads and Maritime Services requirements.
					• Erect notification signs advising of the works at:
					  • the intersection of Snowy Mountains Highway and Tantangara Road;
					  • the intersection of Snowy Mountains Highway and Long Plain Road; and,
					  • Tantangara Boat Ramp.
						3 - mitigation measures do not reduce severity.	1 - engineering controls ensure visibility of obstructions.	3	Contractor

C3	Lower water level	3 - possibility of collision with vessel/ submerged obstruction resulting in moderate injury.	4 - reduced surface area of the reservoir will result in an increase in the number of users per hectare and alter the clearance to submerged obstructions.	12	• Ensure the current reservoir level remains publicly available on SHL's website and that the public is aware that the reservoir level will remain low for the duration of construction by distributing education and awareness material including:
					  • General note as part of the Roads and Maritime Services aquatic license.
					  • Distribute information pamphlets to local fishing and boating retailers.
					  • Include notification signs at:
					  ○ the intersection of Snowy Mountains Highway and Tantangara Road;
					  ○ the intersection of Snowy Mountains Highway and Long Plain Road; and,
					  ○ Tantangara Boat Ramp.
					• Install/maintain signs at the boat ramp notifying public of submerged obstructions.
					• Mark any obstruction that present a danger at a water level of around 1213 m AHD.
						3 - possibility of collision with vessel/ submerged obstruction resulting in moderate injury.	2 - notifying public of low water level and works may reduce the number of waterway users and increase awareness of users.	6	SHL

C4	Drill and blast operations/ projectiles (flyrock)	4 - injury due to projectiles from blast operations.	3 - possibility if construction activity is uncontrolled.	12	• Designated blast limits and other management measures to minimise impacts will be outlined in the Blast Management Plan.	Blast Management Plan not available. Residual risk cannot be assessed.			Contractor
Operation									

O1	High current speed in vicinity of intake channel	5 - potential for vessel capsize resulting in drowning, hypothermia, exposure etc.	3 - possibility that the public would navigate near the intake structure and be in a situation where they could be drawn towards the intake structure.	15	• Establish an exclusion zone around the intake structure and intake channel in consultation with RMS. Ensure exclusion zone is clearly marked to the satisfaction of RMS. The locations of buoys or markers and the methods for securing them will consider water level fluctuation
					• Liaise with Roads and Maritime Services to update RMS Boating Map for Lake Eucumbene and Tantangara Reservoir Area indicating exclusion zone and location of intake structure and intake channel.
					• Provide material to educate the public and create awareness including the following:
					  • Liaise with Roads and Maritime Services to include warning on RMS Boating Map for Lake Eucumbene and Tantangara Reservoir Area noting high current speed in vicinity of the intake structure.
					  • Distribute information pamphlets to local fishing and boating retailers outlining the risks around the intake channel and intake structure.
					  • Liaise with Roads and Maritime Services to erect notification signs advising of high current speed around the intake channel at:
					  ○ the intersection of Snowy Mountains Highway and Tantangara Road;
					  ○ the intersection of Snowy Mountains Highway and Long Plain Road; and,
					  ○ Tantangara Boat Ramp.
						3 - mitigation measures including floating barrier decreases severity if a boat or person is adrift in the high current speed near the intake.	2 - mitigation measures isolate operations from waterway users. Education and awareness program would decrease chance of the public being caught unaware of high current speed.	6	SHL

O2	Greater variability in water level	1 - potential for discomfort and financial loss (flooding of vehicles etc.). In extreme situations, could lead to exposure/ hypothermia.	5 - almost certain that the water level variability will increase and impact on recreational users.	5	• Include notification on SHL and National Parks and Wildlife Services website, liaise with Roads and Maritime Services to include a note on the RMS Boating Map for Lake Eucumbene and Tantangara Reservoir Area, distribute information pamphlets to local fishing and boating retailers and include notification signs as per Risk ID O1 warning of:
					  • highly variable water levels and up to 3 m change in the water level over a 12 hour period;
					  • general warning to establish camps and park vehicles a suitable elevation above the reservoir level; and,
					  • outline risk of submerged obstructions including variable clearance.
						1 - mitigation measures do not reduce severity.	3 - education and awareness program would decrease chance of the public being caught unaware or rising/falling water.	3	SHL

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Talbingo Reservoir

Risk ID	Hazard	Initial Risk or Risk at Previous			Strategy/Mitigation Measure (Eliminate, Substitute, Isolate, Engineering Controls, Administrative Controls)	Residual Risk			Risk Manager
		Severity	Likelihood	Rating		Severity	Likelihood	Rating	
		1-5	1-5			1-5	1-5		
Construction									
C1	Interaction between the Project's marine plant and equipment and public boating activities	3 - primarily an interruption to the Contractor. However, severity could be major or higher.	3 - despite the available space on the Reservoir, it is a possibility that the public could navigate close to the Contractors activities.	9	• The boat ramp at Lobs Hole would be closed for the duration of the works due to land based construction activities. • Establish a public exclusion zone around work areas including the intake channel, silt curtains, barge ramp and rock placement area. Ensure exclusion zone is clearly marked to the satisfaction of RMS. The location of buoys or markers and methods for securing them shall consider water level fluctuations and submerged trees • Monitor and manage public access within the exclusion zone. • Obtain aquatic licence from Roads and Maritime Services for the construction activities and exclusion zones. The aquatic licence will include notification on the Roads and Maritime Services website. • Fit vessels and barges with Automatic Identification System and comply with all licensing requirements of Australian Maritime Safety Authority and Roads and Maritime Services including specific requirements for Alpine Waters. • Erect notification signs advising of the works and public closures at: • the intersection of Lobs Hole Ravine Road and Link Road; • the intersection of Lobs Hole Ravine Road and Snowy Mountains Highway; • Talbingo boat ramp near the dam wall; and, • O'Hares Boat Ramp.	3 - mitigation measures do not reduce severity.	1 - mitigation measures isolate the Contractor's activities from the public.	3	Contractor
C2	Fixed obstruction/s on the reservoir such as marker buoys and moorings	3 - possibility of collision with fixed obstructions resulting in moderate injury.	2 - likelihood of collision unlikely given that the majority of boating activities on the Reservoir would be between sunrise and sunset.	6	• As per Risk ID C1, establish exclusion zone around the silt curtain. • Ensure any other fixed obstruction such as marker buoys and moorings comply with Roads and Maritime Services requirements. • Erect notification signs advising of the marine works at: • Talbingo boat ramp near the dam wall; and, • O'Hares Boat Ramp.	3 - mitigation measures do not reduce severity.	1 - engineering controls ensure visibility of obstructions.	3	Contractor
C3	Drill and blast operations/ projectiles (flyrock)	4 - injury due to projectiles from blast operations.	1 - possibility if construction activity is uncontrolled. However, extent of exclusion zone in Risk ID C1 will eliminate any impact on the public.	4	• Designated blast limits and other management measures to minimise impacts will be outlined in the Blast Management Plan.	Blast Management Plan not available. Residual risk cannot be assessed.			Contractor
Operation									
O1	High current speeds in vicinity of intake channel	5 - potential for vessel capsize resulting in drowning, hypothermia, exposure etc.	3 - possibility that the public would navigate near the intake structure and be in a situation where they could be drawn towards the intake structure.	15	• Establish an exclusion zone around the intake structure and intake channel in consultation with RMS. Ensure exclusion zone is clearly marked to the satisfaction of RMS. The location of buoys or markers and methods for securing them shall consider water level fluctuations and submerged trees • Liaise with Roads and Maritime Services to update RMS Boating Map for Talbingo, Tumut Ponds, Tooma, Three Mile Dams, Geehi Reservoir and Khancoban Pondage Areas indicating exclusion zone and location of intake structure and intake channel. • Provide material to educate the public and create awareness including the following: • Liaise with Roads and Maritime Services to include warning on RMS Boating Map for Talbingo, Tumut Ponds, Tooma, Three Mile Dams, Geehi Reservoir and Khancoban Pondage Areas noting high current speeds in vicinity of the intake structure. • Distribute information pamphlets to local fishing and boating retailers outlining the risks around the intake channel and intake structure. • Liaise with Roads and Maritime Services to erect notification signs advising of high current speeds around the intake channel at: ○ the intersection of Lobs Hole Ravine Road and Link Road; ○ the intersection of Lobs Hole Ravine Road and Snowy Mountains Highway; ○ Talbingo boat ramp near the dam wall; ○ O'Hares Boat Ramp; and, ○ Lobs Hole Boat Ramp.	3 - mitigation measures including floating barrier decreases severity if a boat or person is adrift in the high current speed near the intake.	2 - mitigation measures isolate operations from waterway users. Education and awareness program would decrease chance of the public being caught unaware of high current speed.	6	SHL

Appendix C: Bathymetry and Indicative Navigation Exclusion Zone

DRAWING No.
S2-RHD-TAN-SKE-0111

DO NOT SCALE

RESERVOIR EMPLACEMENT AREA

WATER INTAKE

BARGE LAUNCH AREA

DAM WALL

TANTANGARA UNFORMED BOAT RAMP

Kosciuszko National Park

Tantangara Rd

Pockets Saddle Rd

INSET

KEY PLAN

LEGEND

- FULL SUPPLY LEVEL (FSL) = RL 1228.69mAHD
- MIN. OPERATING LEVEL (MOL) = RL 1205.88mAHD
- INDICATIVE ROCK EMPLACEMENT AREA
- INDICATIVE CONSTRUCTION NAVIGATION EXCLUSION ZONE

DEPTH RELATIVE TO FSL		
MIN. (m)	MAX. (m)	COLOUR
0	10	
10	20	
20	30	
30	37	

PROJECT:
SNOWY 2.0

DRAWING TITLE:
TANTANGARA RESERVOIR CONSTRUCTION NAVIGATION EXCLUSION ZONE

Royal HaskoningDHV
Enhancing Society Together
Level 14, 56 Berry Street
North Sydney NSW 2060
Australia
Tel +61 2 88545000
Fax +61 2 99290960
Email: project.admin.australia@rhdhv.com
Website: www.royalhaskoningdhv.com

DRAWN	COORD. SYSTEM	DATUM	DATE
-	MGA	AHD	05.09.2019
SCALE AT A1 AS SHOWN	REF. S2-RHD-TAN-MOD-0111-NAVIGATION		

DRAWING No. S2-RHD-TAN-SKE-0111 REVISION A

INSET
1:7500 (A1)

NOT FOR CONSTRUCTION

AUSTRALIAN HEIGHT DATUM

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1:15000 (A3) 1:7500 (A1)

I:\PA1804\TECHNICAL_DATA\~PA1804 - SNOWY HYDRO DAMS\E02 WORKING DRAWINGS\S2-RHD-TAN-MOD-0111-NAVIGATION.DWG 9/6/2019 12:35 PM

DRAWING No.
S2-RHD-TAN-SKE-0112

DO NOT SCALE

RESERVOIR
EMPLACEMENT AREA

WATER INTAKE

DAM WALL

TANTANGARA
UNFORMED
BOAT RAMP

Kosciuszko National Park

Hungar Creek

Tantangara

Rockets Saddle Rd

Tantangara Rd

INSET

KEY PLAN

LEGEND

- FULL SUPPLY LEVEL (FSL) = RL 1228.69mAHD
- MIN. OPERATING LEVEL (MOL) = RL 1205.88mAHD
- INDICATIVE ROCK EMPLACEMENT AREA
- INDICATIVE OPERATION NAVIGATION EXCLUSION ZONE

DEPTH RELATIVE TO FSL		
MIN. (m)	MAX. (m)	COLOUR
0	10	
10	20	
20	30	
30	37	

PROJECT:
SNOWY 2.0

DRAWING TITLE:
TANTANGARA RESERVOIR OPERATION NAVIGATION EXCLUSION ZONE

Level 14, 56 Berry Street
North Sydney NSW 2060
Australia
Tel +61 2 8854 5000
Fax +61 2 99290960
Email: project.admin.australia@rhdhv.com
Website: www.royalhaskoningdhv.com

Royal HaskoningDHV
Enhancing Society Together

DRAWN	COORD. SYSTEM	DATUM	DATE
-	MGA	AHD	05.09.2019
SCALE AT A1 AS SHOWN	REF. S2-RHD-TAN-MOD-0111-NAVIGATION		

DRAWING No. S2-RHD-TAN-SKE-0112 | REVISION A

INSET
1:7500 (A1)

NOT FOR CONSTRUCTION

AUSTRALIAN HEIGHT DATUM

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1:15000 (A3) 1:7500 (A1)

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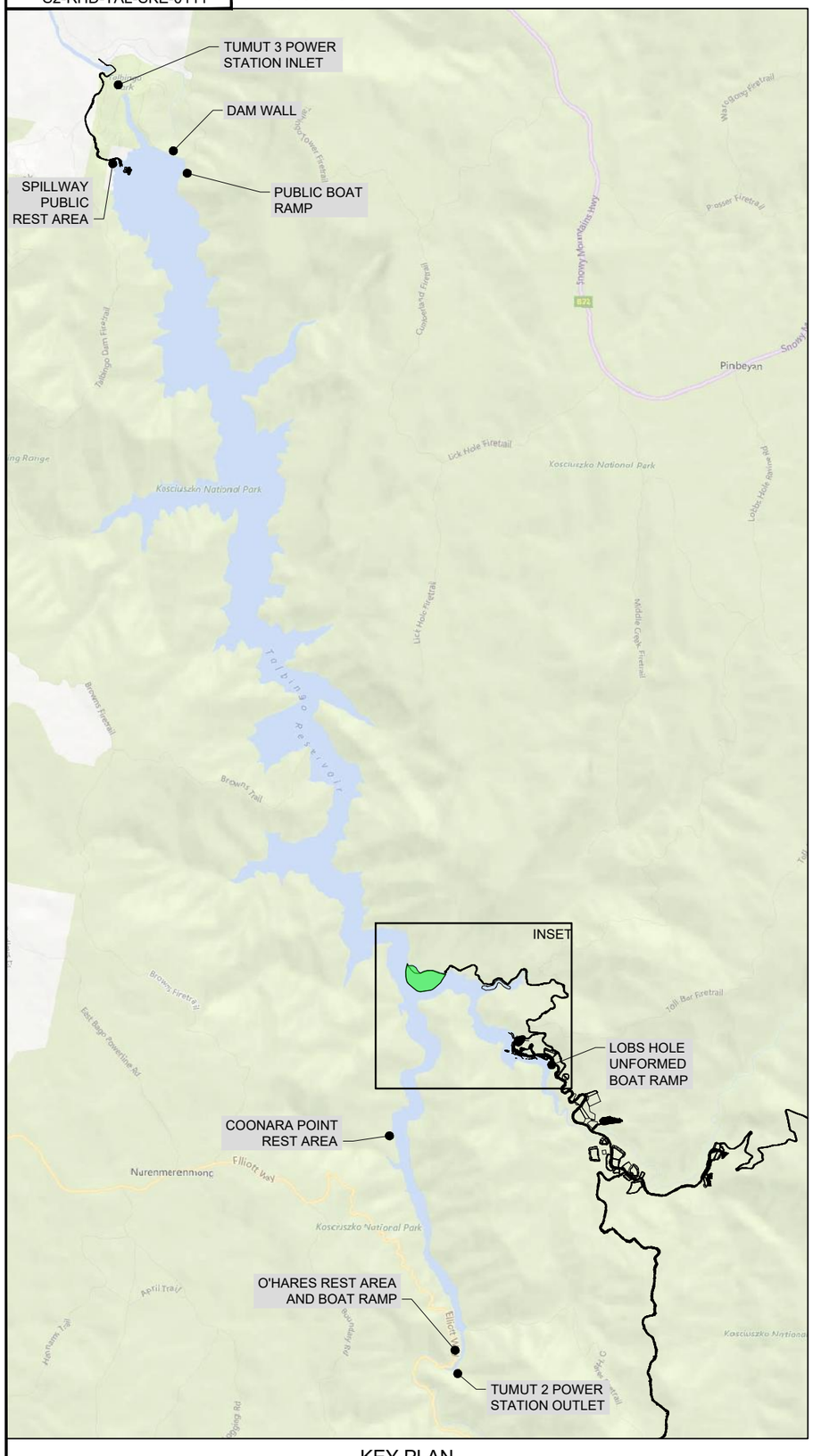
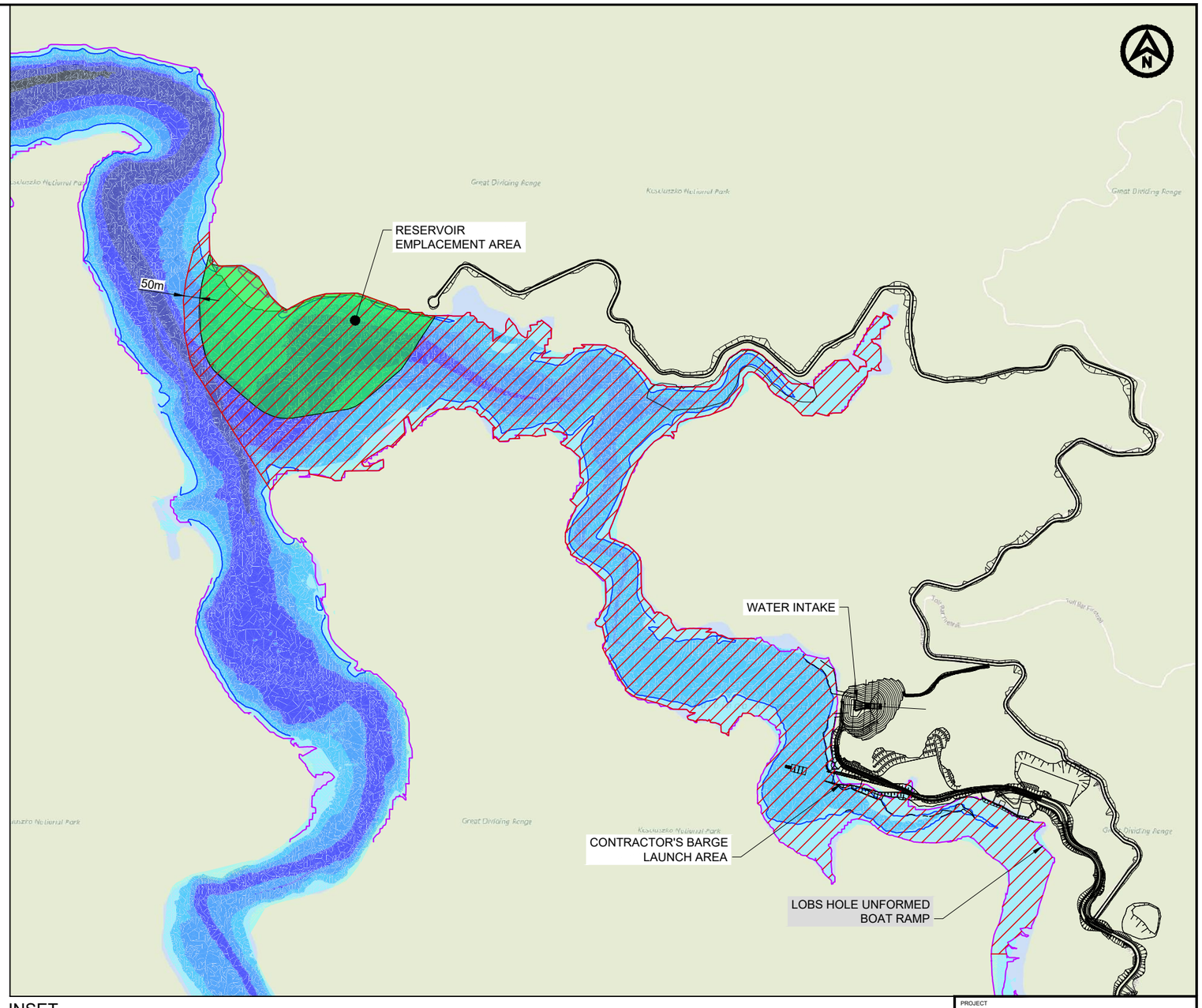
DRAWING No.
S2-RHD-TAL-SKE-0111

DO NOT SCALE



KEY PLAN



INSET
1:7500 (A1)

LEGEND

- FULL SUPPLY LEVEL (FSL) = RL 543.19mAHD
- MIN. OPERATING LEVEL (MOL) = RL 534.35mAHD
- INDICATIVE ROCK EMPLACEMENT AREA
- INDICATIVE CONSTRUCTION NAVIGATION EXCLUSION ZONE

DEPTH RELATIVE TO FSL		
MIN. (m)	MAX. (m)	COLOUR
0	10	
10	20	
20	30	
30	40	
40	50	
50	54	

S2 FOR INFORMATION

NOT FOR CONSTRUCTION

150 0 150 300 450 600 750m
1:15000 (A3) 1:7500 (A1)

PROJECT
SNOWY 2.0

TITLE
TALBINGO RESERVOIR CONSTRUCTION NAVIGATION EXCLUSION ZONES

Royal HaskoningDHV
Enhancing Society Together
Level 14, 56 Berry Street
North Sydney NSW 2060
Australia
Tel +61 2 88545000
Fax +61 2 99290960
Email: project.admin.australia@rhdhv.com
Website: www.royalhaskoningdhv.com

DRAWN	COORD. SYSTEM	DATUM	DATE
BAM	MGA ZONE 55	AHD	05.09.2019
SCALE AT A1 AS SHOWN	REF S2-RHD-TAL-MOD-0111-NAVIGATION		

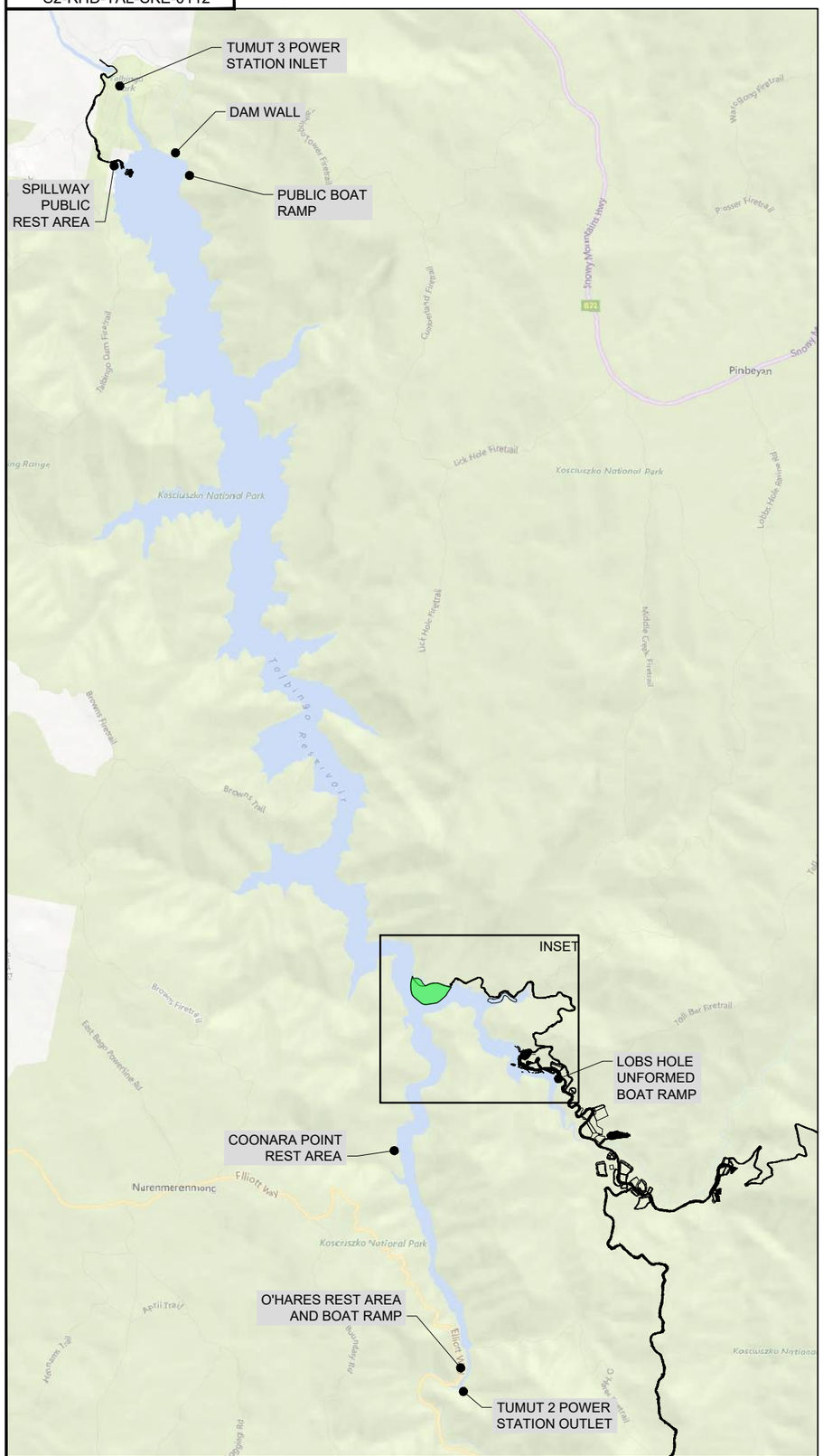
DRAWING No. S2-RHD-TAL-SKE-0111

REVISION A

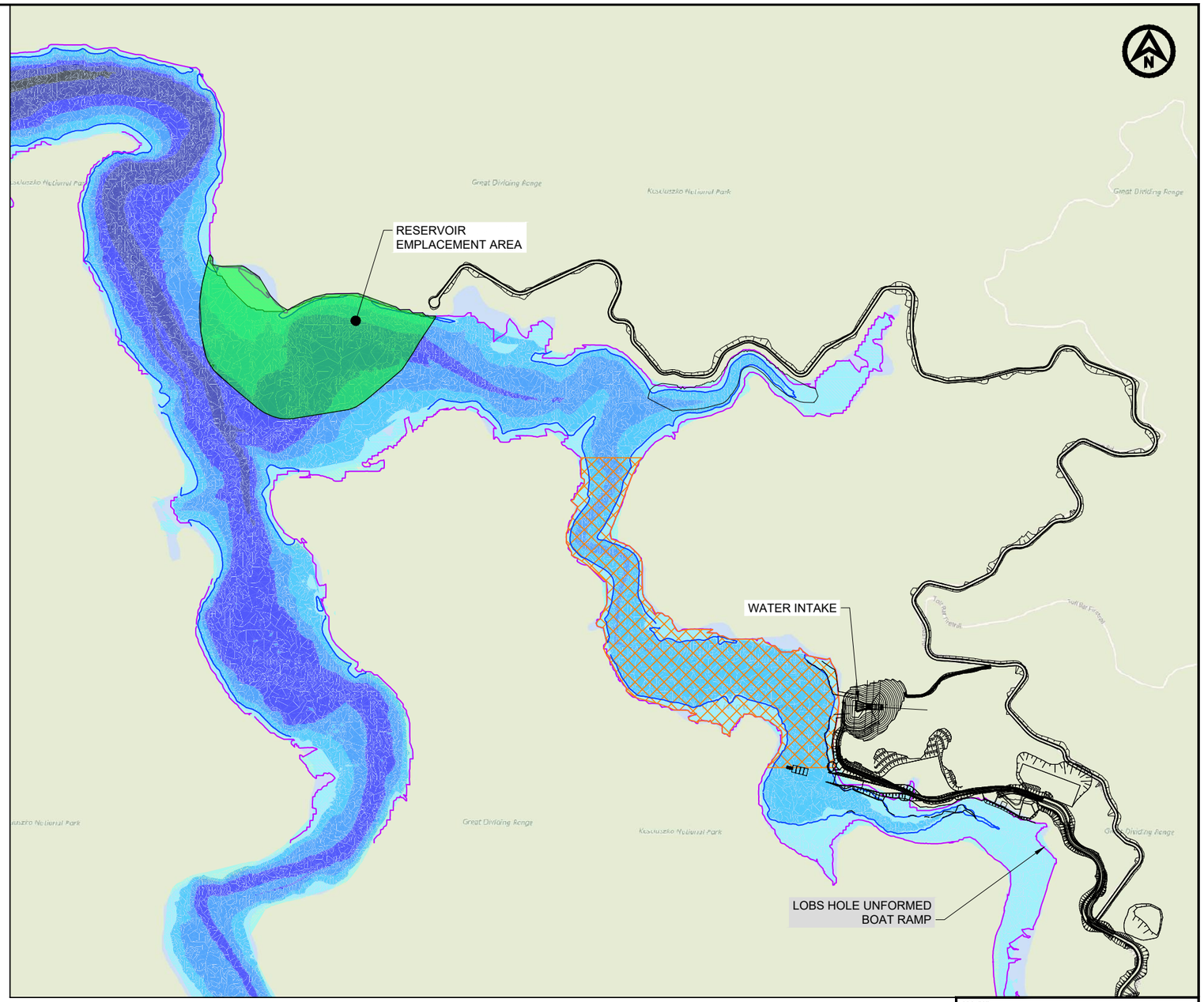
I:\PA1804\TECHNICAL_DATA\~PA1804 - SNOWY HYDRO DAMS\E02 WORKING DRAWINGS\S2-RHD-TAL-MOD-0111-NAVIGATION

DRAWING No.
S2-RHD-TAL-SKE-0112

DO NOT SCALE



KEY PLAN



INSET
1:7500 (A1)

LEGEND

- FULL SUPPLY LEVEL (FSL) = RL 543.19mAHD
- MIN. OPERATING LEVEL (MOL) = RL 534.35mAHD
- INDICATIVE ROCK EMPLACEMENT AREA
- INDICATIVE OPERATION NAVIGATION EXCLUSION ZONE

DEPTH RELATIVE TO FSL		
MIN. (m)	MAX. (m)	COLOUR
0	10	
10	20	
20	30	
30	40	
40	50	
50	54	

S2 FOR INFORMATION

NOT FOR CONSTRUCTION

150 0 150 300 450 600 750m
1:15000 (A3) 1:7500 (A1)

PROJECT
SNOWY 2.0

TITLE
TALBINGO RESERVOIR OPERATION NAVIGATION EXCLUSION ZONES

Royal HaskoningDHV
Enhancing Society Together
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North Sydney NSW 2060
Australia
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DRAWN	COORD. SYSTEM	DATUM	DATE
BAM	MGA ZONE 55	AHD	05.09.2019
SCALE AT A1 AS SHOWN	REF S2-RHD-TAL-MOD-0111-NAVIGATION		

DRAWING No. S2-RHD-TAL-SKE-0112
REVISION A

I:\PA1804\TECHNICAL_DATA\~PA1804 - SNOWY HYDRO DAMS\E02 WORKING DRAWINGS\S2-RHD-TAL-MOD-0111-NAVIGATION