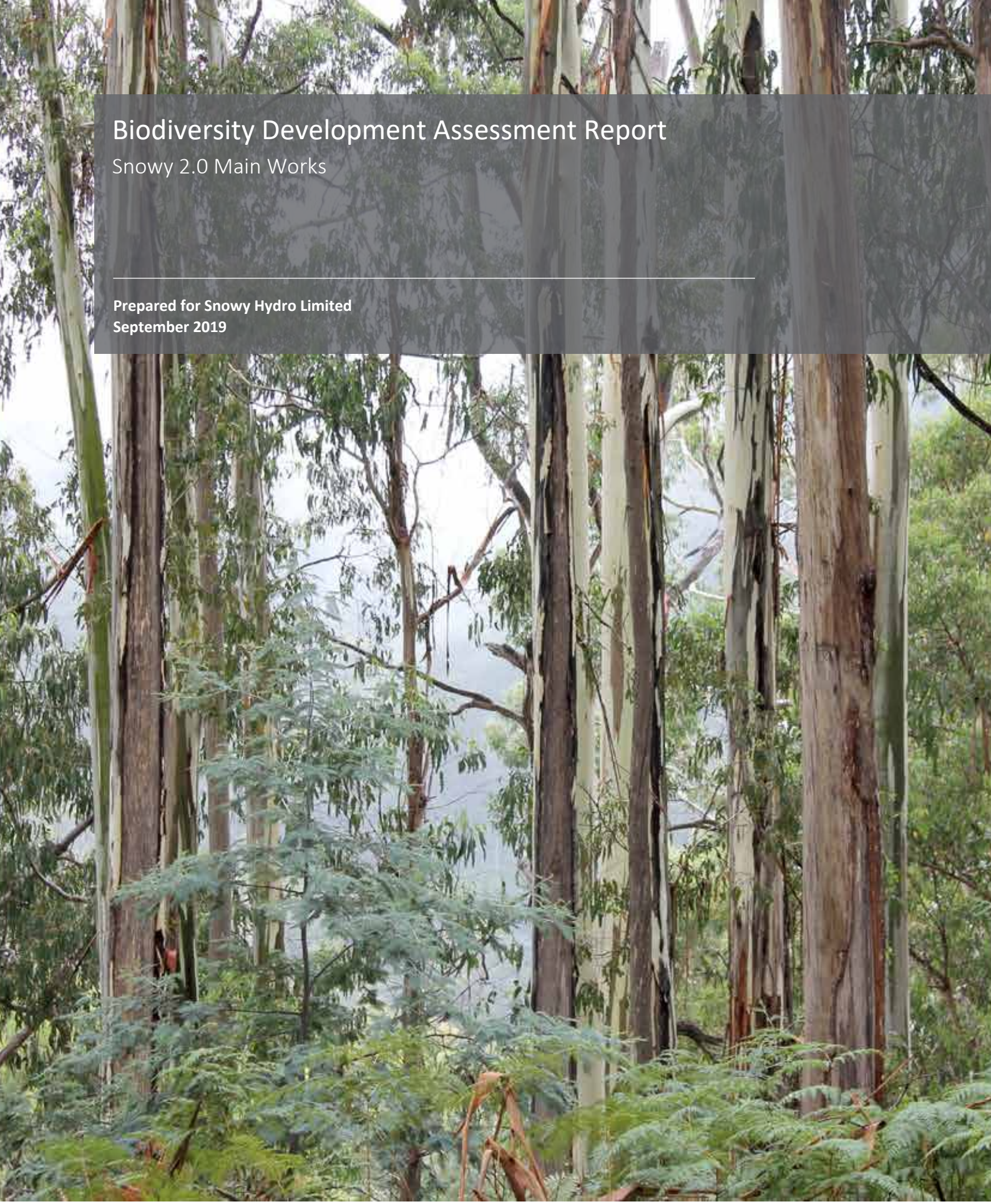
APPENDIX M.1

BIODIVERSITY DEVELOPMENT ASSESSMENT REPORT

Biodiversity Development Assessment Report

Snowy 2.0 Main Works

Prepared for Snowy Hydro Limited
September 2019



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Biodiversity Development Assessment Report

Snowy 2.0 Main Works

Report Number

J17188 RP38

Client

Snowy Hydro Limited

Date

13 September 2019

Version

v2 Final

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Executive Summary

ES1 Introduction and project

Snowy Hydro Limited (Snowy Hydro) proposes to develop Snowy 2.0, a large-scale pumped hydro-electric storage and generation project which would increase hydro-electric capacity within the existing Snowy Mountains Hydro-electric Scheme (Snowy Scheme). This would be achieved by establishing a new underground hydro-electric power station. Snowy 2.0 will link the existing Tantangara and Talbingo reservoirs within the Snowy Scheme through a series of underground tunnels and hydro-electric power station.

This Biodiversity Development Assessment Report (BDAR) supports the EIS for the Snowy 2.0 Main Works. It documents the terrestrial biodiversity assessment methods and results, the initiatives built into the project design to avoid and minimise impacts to terrestrial biodiversity, and the mitigation and management measures, including offset requirements, proposed to address any unavoidable residual impacts.

The BDAR addresses the requirements of the Secretary's Environmental Assessment Requirements (SEARs), including the requirements of the Commonwealth Department of the Environment and Energy (DoEE).

ES2 Landscape

The Snowy 2.0 Main Works will be constructed within the South Eastern Highlands, NSW South Western Slopes and Australian Alps Interim Biogeographic Regionalisation of Australia (IBRA) regions and within the Kosciuszko National Park (KNP). The project area intersects a number of major watercourses, including the Yarrangobilly River, Eucumbene River, Murrumbidgee River, Gooandra Creek, Tantangara Creek and Nungar Creek.

Two areas of geological significance occur within the project area. A series of block streams occur along the upper sections of Lobs Hole Ravine Road, while the Lick Hole formation supporting in-situ calcareous fossils, occurs mid-way down Lobs Hole Ravine Road.

There are no areas of outstanding biodiversity value, as defined in Part 3 of the BC Act, within a 1,500 m buffer of the project area.

The project area is located within KNP, which is largely vegetated across its 673,543 ha extent, with intact remnant vegetation extending into a further 1.6 M ha across the Australian Alps. The extent of vegetation across KNP provides a high degree of connectivity. A total of 36,461 ha of native vegetation was mapped within the 37,559 ha buffer area (Figure 4.2). Native vegetation cover within the buffer area is approximately 97%.

ES3 Native vegetation

Extensive surveys were undertaken across the survey area as a part of the biodiversity assessment for Snowy 2.0. Surveys were undertaken in accordance with the NSW Biodiversity Assessment Method (BAM, OEH 2017a).

These surveys recorded 22 plant community types (PCTs), stratified into 70 vegetation zones, within the disturbance footprint. This included one threatened ecological community listed as follows under NSW and Commonwealth legislation respectively:

- Montane Peatlands and Swamps of the New England Tableland, NSW North Coast, Sydney Basin, South East Corner, South Eastern Highlands and Australian Alps bioregions, listed as an endangered ecological community under the NSW *Biodiversity Conservation Act 2016* (BC Act); and

- Alpine Sphagnum Bogs and Associated Fens listed as an endangered ecological community under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Snowy 2.0 Main Works will impact on 1,053 ha of native vegetation.

ES4 Threatened species

Detailed and comprehensive targeted flora and fauna surveys have been conducted for Snowy 2.0 between August 2017 and June 2019. Surveys have been conducted in accordance with various NSW (DEC 2004, DECC 2009, OEH 2016c, OEH 2018a) and Commonwealth (DoE 2013a, DSEWPaC 2010a, 2010b, 2010c, 2011a, 2011b) guidelines.

These surveys have resulted in a significant addition to our knowledge of the biodiversity values of the northern section of KNP. These surveys have resulted in some significant findings, including several instances where new populations of threatened species have been recorded, or range extensions for threatened species:

- Detailed mapping of over 8,000 ha of native vegetation across the survey area.
- 21,142 records of the Mauve Burr-daisy (*Calotis glandulosa*) from targeted surveys, compared to 520 records of the species across Australia.
- 892 individual records of the Clover Glycine (*Glycine latrobeana*), known from two single records in NSW prior to surveys for Snowy 2.0. Several additional sub-populations identified, including a large population of over 600 plants on Gulf Plain, were identified in areas not impacted by Ox-eye Daisy (L*eucanthemum vulgare*).
- 1,463, individual records of the Kiandra Leek Orchid (*Prasophyllum retroflexum*), known from two records prior to surveys for Snowy 2.0. The species was recorded over large areas of KNP.
- The recording of a large, regional population of the Smoky Mouse (*Pseudomys fumeus*) across an estimated 6,000 to 7,000 ha of suitable habitat in the region.
- The recording of a large population of the Booroolong Frog (*Litoria booroolongensis*) along the Yarrangobilly River and Wallace's Creek.
- The recording of a number of additional sub-populations of the Alpine Tree Frog (*Litoria verreauxii alpina*) in the Eucumbene River, Murrumbidgee River, Tantangara Creek, Gooandra Creek and Nungar Creek; and
- Twenty-four new records of the Alpine She-oak Skink (*Cyclodomorphus praealtus*) across sub-alpine dry grasslands in the survey area, representing a range extension for this species.

In total, 24,282 records of 40 threatened flora and fauna species were recorded during surveys undertaken for Snowy 2.0 in the northern section of KNP. This compares to just over 20,000 records of 70 threatened flora and fauna species across the whole of KNP prior to surveys for Snowy 2.0 being undertaken.

ES5 Groundwater dependent ecosystems

An assessment of groundwater dependent ecosystems (GDEs) was undertaken in accordance with the *NSW Government Risk Assessment Guidelines for Groundwater Dependent Ecosystems* (Serov et al. 2012). This assessment used groundwater levels as modelled by the regional numerical groundwater flow model (EMM 2019b), along with a stygofauna assessment by Macquarie University (2019) to identify GDEs across the project area and classify them according to the criteria in Serov et al. (2012).

The stygofauna assessment identified a total of five specimens from two families, likely to be obligate stygofauna representatives, from one of the 11 fractured rock sites (TMB02A) and two of the five Alpine bog and fen sites (GH01, GH02). Three PCTs were identified as having an entirely/obligate dependence on groundwater:

- PCT 637 - Alpine and sub-alpine peatlands, damp herbfields and fens, South Eastern Highlands Bioregion and Australian Alps Bioregion;
- PCT 765 - Carex - Juncus sedgeland/wet grassland of the South Eastern Highlands Bioregion; and
- PCT 1225 - Sub-alpine grasslands of valley floors, southern South Eastern Highlands Bioregion and Australian Alps Bioregion.

A further six PCTs were identified as having a facultative -proportional or facultative – opportunistic dependence on groundwater:

- PCT 285 - Broad-leaved Sally grass - sedge woodland on valley flats and swamps in the NSW South Western Slopes Bioregion and adjoining South Eastern Highlands Bioregion;
- PCT 299 - Riparian Ribbon Gum - Robertsons Peppermint - Apple Box riverine very tall open forest of the NSW South Western Slopes Bioregion and South Eastern Highlands Bioregion;
- PCT 302 - Riparian Blakely's Red Gum - Broad-leaved Sally woodland - tea-tree - bottlebrush - wattle shrubland wetland of the NSW South Western Slopes Bioregion and South Eastern Highlands Bioregion;
- PCT 300 - Ribbon Gum - Narrow-leaved (Robertsons) Peppermint montane fern - grass tall open forest on deep clay loam soils in the upper NSW South Western Slopes Bioregion and western Kosciuszko escarpment;
- PCT 303 - Black Sally grassy low woodland in valleys in the upper slopes sub-region of the NSW South Western Slopes Bioregion and western South Eastern Highlands Bioregion; and
- PCT 679 - Black Sallee - Snow Gum low woodland of montane valleys, South Eastern Highlands Bioregion and Australian Alps Bioregion.

The impact assessment identified that if groundwater decline is slow or gradual in areas where predicted drawdown is greater than 20 m, it may present opportunities for stygofauna to migrate to saturated areas whilst drawdown is occurring, resulting in minimal impacts. Impacts to surface GDEs may result from groundwater drawdown and changes in hydrology. Impacts may include changes in species composition. GDEs with an entirely/obligate dependence on groundwater are at greatest risk.

It is worth noting that these predicted impacts are based on a modelling assumption of an un-lined tunnel. The main works tunnel will actually be pre-grouted and lined during construction which will considerably reduce groundwater drawdown. Thus, the predicted impacts, derived from the groundwater model, are considered to be an overestimate.

ES6 Impact assessment

ES6.1 Measures to avoid and minimise impacts

Snowy Hydro, in consultation with EMM and the design team, have undertaken significant steps to avoid, minimise and mitigate impacts arising from the Main Works project.

A key focus of project design has been to avoid and minimise impacts to biodiversity values identified during the field surveys. In recognition of the location of the Snowy 2.0 project in the KNP, and associated biodiversity and other values of the Park, the project has undergone significant steps to avoid, minimise and mitigate impacts.

This process has resulted in a number of measures undertaken to avoid and minimise impacts including:

- Investigation of alternative locations for key infrastructure during design works.
- Siting of stockpiles for excavated materials in low-quality vegetation where possible.
- Siting of the Exploratory Works camp in partially cleared areas.
- Siting of the ECVT to minimise clearing due to terrain and access roads.
- Avoidance of on-land emplacement options, which would have resulted in clearing of large areas of native vegetation.
- Emplacement of excavated materials in Talbingo and Tantangara Reservoirs, minimising impacts to native vegetation and threatened species habitat.
- Removal of out of park emplacement, negating the requirement for construction of the Tantangara East Road and associated impacts to native vegetation and threatened species habitat, particularly Clover Glycine.
- Removal of plateau power station complex option, reducing impacts to sensitive habitats in the plateau area.
- Change in power station complex location in the Marica area, including construction method, resulting in removal of elements and reduction in impacts.
- Location of the Marica ventilation shaft in existing cleared areas.
- Investigation of alternative locations for the communications cable routes, including removal of the southern communication route adjacent to the Snowy Mountains Highway.
- Moving of the southern communications route south at Boggy Plain to avoid sensitive Alpine bogs and fens and sub-alpine grassland habitat.
- Installation of the communications cable in existing firetrails.
- Development of a 50 m buffer zone along the Yarrangobilly River and avoidance and minimisation of works within this buffer.
- Siting of key infrastructure away from sensitive receiving environments.
- Detailed design of the project to reduce the disturbance footprint, resulting in further avoidance of impacts to native vegetation and reduction in offset requirements.

These measures have resulted in substantive and significant reductions in impacts, recognising the siting of the project in KNP and sensitive environments. Residual impacts will be managed through a series of mitigation measures, outlined in Table 8.1.

ES6.2 Residual impacts and offsets

Residual impacts arising from Snowy 2.0 Main Works include:

- Impacts to 1,052.68 ha of native vegetation across 22 PCTs, including impacts to 4.09 ha of the Alpine Sphagnum Bogs and Associated Fens EEC.
- Impacts to 992 ha of habitat for fourteen threatened species credit species.

- Potential indirect impacts, including:
    - increase in weeds and pathogens;
    - increase in predatory and pest species;
    - light and noise pollution during night works;
    - changes to runoff regimes;
    - fragmentation, resulting in reduction in connectivity; and
    - groundwater drawdown, resulting in changes in hydrology of GDEs.

A total of 32,118 ecosystem credits and 44,100 species credits are required to offset the residual impacts of Main Works. These offsets will be provided in accordance with the Snowy 2.0 Main Works Offset Strategy (EMM 2019d) appended to the EIS.

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Abbreviations

AHD	Australian Height Datum
BAM	Biodiversity Assessment Method
BC Act	NSW *Biodiversity Conservation Act 2016*
BC Regulation	NSW Biodiversity Conservation Regulation 2017
BDAR	Biodiversity Development Assessment Report
Bionet	BioNet Atlas of NSW Wildlife
Biosecurity Act	NSW *Biosecurity Act 2015*
BOS	Biodiversity Offsets Scheme
CHM	Canopy Height Model
CSSI	Critical State significant infrastructure
DoEE	Commonwealth Department of the Environment and Energy
DFSI	NSW Department of Finance, Services and Innovation
DIWA	Directory of Important Wetlands in Australia
DPI	NSW Department of Primary Industries
DPIE	NSW Department of Planning, Industry and Environment
ECVT	Evacuation, Cable, Ventilation Tunnel
EIS	Environmental Impact Statement
EP&A Act	NSW *Environmental Planning and Assessment Act 1979*
EPBC Act	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
EPIs	Environmental Planning Instruments
FGJV	Future Generation Joint Venture
FM Act	NSW *Fisheries Management Act 1994*
FSL	Full Supply Level
GDEs	Groundwater Dependent Ecosystems
GPS	Geographic Positioning System
IBRA	Interim Biogeographic Regionalisation of Australia
KFH	Key Fish Habitats
KNP	Kosciuszko National Park
KTP	Key Threatening Process
LGA	Local Government Area
LiDAR	Light Detection and Ranging
MAT	Main Access Tunnel
MNES	Matters of National Environmental Significance
MOL	Minimum Operating Level
MW	Main Works
NEM	National Energy Market
NPW Act	NSW *National Parks and Wildlife Act 1974*
NPWS	New South Wales National Parks and Wildlife Service
OEH	Office of Environment and Heritage (now Department of Planning, Industry and Environment)
PCT	NSW Plant Community Type
PMST	Protected Matters Search Tool
PoM	Plan of Management

RtS	Response to Submissions
RVA	Rapid Vegetation Assessment
SEARs	Secretary's Environmental Assessment Requirements
SEPP	State Environmental Planning Policy
Snowy Hydro	Snowy Hydro Limited
Snowy Scheme	Snowy Mountains Hydro-electric Scheme
SRD SEP	State and Regional Development SEPP
SSI	State Significant Infrastructure
TBDC	Threatened Biodiversity Data Collection
TECs	Threatened Ecological Communities
VIS	Vegetation Information System
WoNS	Weed of National Significance

Part A

Stage 1: Biodiversity Assessment

1 Introduction

1.1 The project

Snowy Hydro Limited (Snowy Hydro) proposes to develop Snowy 2.0, a large-scale pumped hydro-electric storage and generation project which would increase hydro-electric capacity within the existing Snowy Mountains Hydro-electric Scheme (Snowy Scheme). 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 Biodiversity Development Assessment Report (BDAR) 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 1.2. If approved, the Snowy 2.0 Main Works would commence before completion of Exploratory Works.

The Snowy 2.0 Main Works do not include the direct connection 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, they do not form part of this application and will be subject to separate application and approval processes, managed by TransGrid.

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 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 Chapter 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.

1.2.2 Study area

The study area for the purposes of this biodiversity assessment included a much broader area than will be used for the construction and operation of Snowy 2.0 Main Works. Surveys have been undertaken over a broad area, allowing for identification of key biodiversity values, guidance on measures to avoid and minimise impacts and revisions to the design. This is referred to as the survey area.

This disturbance footprint is the area where land could be directly disturbed by Snowy 2.0 Main Works and includes all areas subject to clearing and ground disturbance. The current design, shown in a number of figures below, includes a disturbance area that is much broader than is likely required to construct the project. It currently represents the maximum extent where construction works will be carried out. As such, indirect impacts have not been calculated separately. The disturbance footprint for the project during construction is less than 0.25% of the total KNP area.

The disturbance area will be minimised as much as possible during detailed design.

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 BDAR supports the EIS for the Snowy 2.0 Main Works. It documents the terrestrial biodiversity assessment methods and results, the initiatives built into the project design to avoid and minimise impacts to terrestrial biodiversity, and the mitigation and management measures, including offset requirements, proposed to address any unavoidable residual impacts.

The specific objectives of this assessment are to:

- describe the existing biodiversity values and existing environment;
- identify and assess the potential for presence of biodiversity values, including threatened species and communities listed under the NSW *Biodiversity Conservation Act 2016* (BC Act) and/or Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act);
- identify ecological constraints within and impacts arising from the Main Works;
- provide mitigation measures to reduce the impacts from the proposal on biodiversity wherever possible; and
- where impacts are unavoidable, consider compensatory measures that are appropriate for the Main Works.

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

1.4.1 Assessment guidelines and requirements

This terrestrial biodiversity 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
An assessment of the biodiversity impacts of the project on terrestrial, aquatic and groundwater-dependent ecosystems, including listed Commonwealth and State threatened species and communities and listed Commonwealth migratory species	This report and the aquatic ecology assessment (Cardno 2019) appended to the EIS.
A strategy to offset any residual impacts of the project on these ecosystems, focusing on enhancing the biodiversity values of the Kosciuszko National Park in the medium to long term.	Snowy 2.0 Main Works Offset Strategy (EMM 2019d) appended to the EIS.

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:

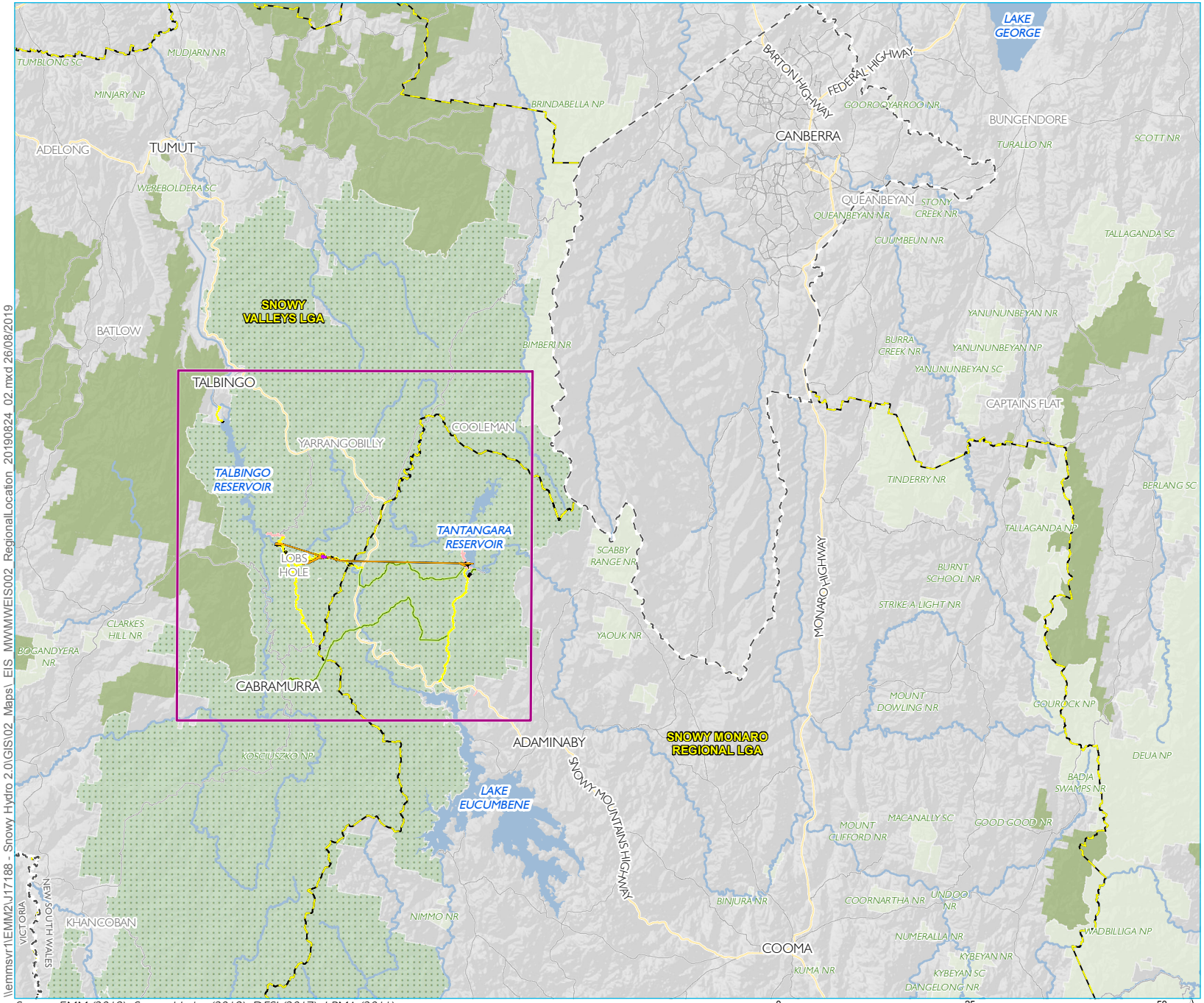
- Snowy 2.0 Exploratory Works (SSI-9208) – a Snowy Hydro project with Minister's approval;
- Snowy 2.0 Transmission Connect Project (SSI-9717) – a project proposed by TransGrid; and
- Snowy 2.0 – Segment Factory (SSI-10034) – a project proposed by Snowy Hydro.

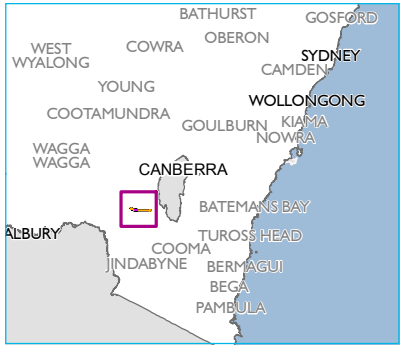
While these projects form part of the CSSI declaration for Snowy 2.0 and Transmission Project, they do not form part of Snowy Hydro's application for Snowy 2.0 Main Works. These related projects are subject to separate application and approval processes. Staged submission and separate approval is appropriate 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 terrestrial biodiversity 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 terrestrial biodiversity assessment are listed below.

- Aquatic ecology assessment (Cardno 2019) – Appended to the EIS;
- Bushfire risk and hazard assessment (Eco Logical 2019) – Appended to the EIS;
- Water assessment (EMM 2019a) – Appended to the EIS;
- Noise and vibration impact assessment (EMM 2019b) – Appended to the EIS;
- Traffic and Transport Assessment Report (SCT 2019) – Appended to the EIS;
- Rehabilitation strategy (SLR Consulting 2019) – Appended to the EIS;
- Palaeozoic geodiversity assessment (Percival 2019) – Appended to the EIS; and
- Cenozoic geodiversity assessment (Troedson 2019) – Appended to the EIS.





KEY

- Project area

Snowy 2.0 Main Works operational elements

- Tunnels, portals, intakes, shafts
- Power station
- Utilities
- Permanent road

Snowy 2.0 Main Works construction elements

- Temporary construction compounds and surface works
- Temporary access road

Existing environment

- Main road
- Local road
- Watercourse
- Waterbodies
- Kosciuszko National Park
- NPWS reserve
- State forest
- Local government area boundary
- State boundary

Regional setting

Snowy 2.0
Biodiversity development assessment report
Main Works
Figure 1.1

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

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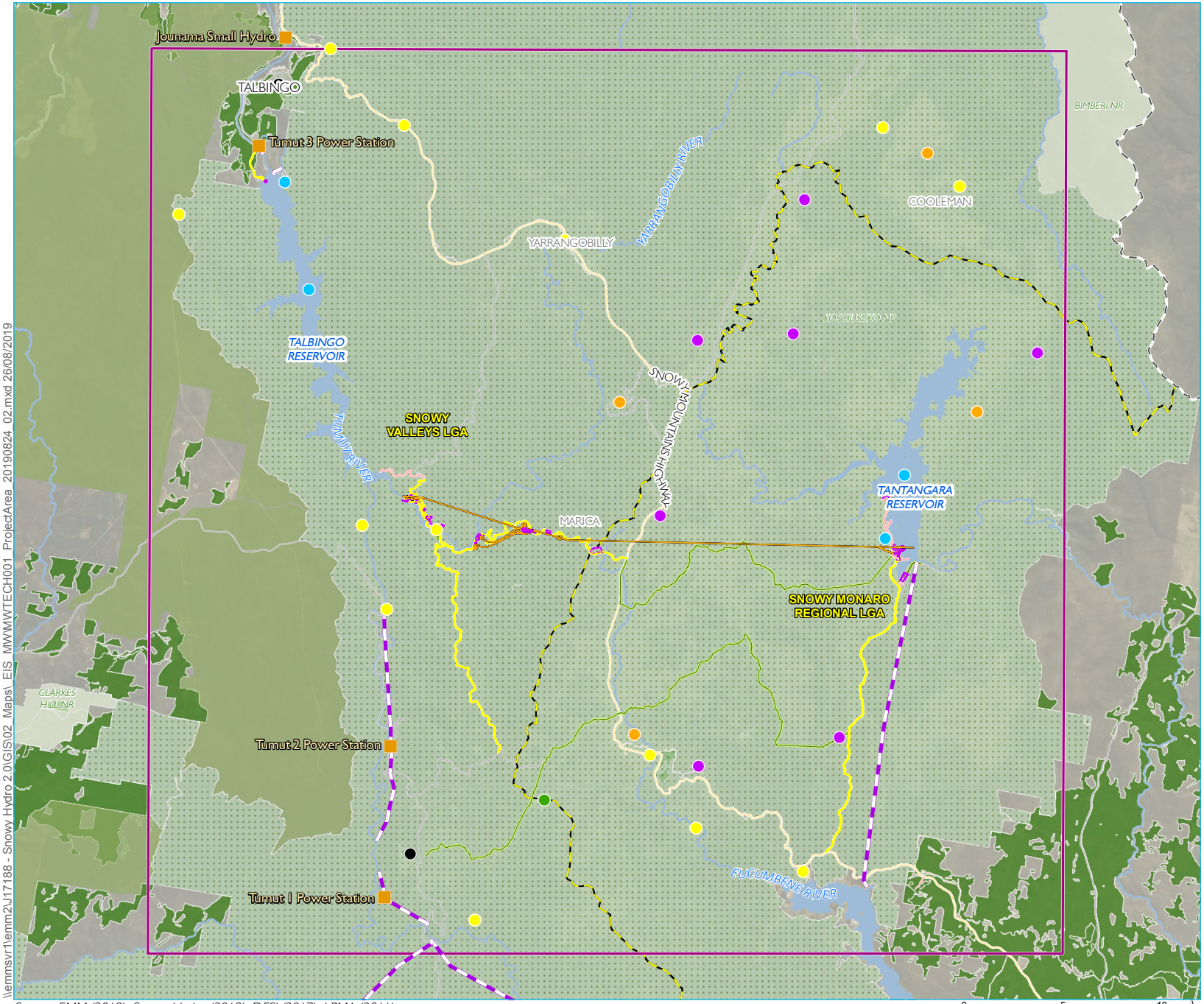

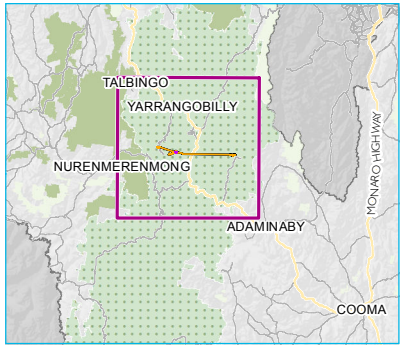

KEY

Existing Snowy Scheme
- Power station

Pipeline tunnel
- Snowy Tumut pipeline tunnel
- Project area

Recreational use areas
- Camping
- Camping - horses permitted
- Fishing and boating
- Place of interest
- Ski resort
- Township

Snowy 2.0 Main Works operational elements
- Tunnels, portals, intakes, shafts
- Power station
- Utilities
- Permanent road

Snowy 2.0 Main Works construction elements
- Temporary construction compounds and surface works
- Temporary access road

Existing environment
- Main road
- Local road
- Watercourse
- Waterbodies
- Kosciuszko National Park
- NPWS reserve
- State forest
- Grazing
- Local government area boundary
- State boundary

Snowy 2.0 project area

Snowy 2.0
Biodiversity development assessment report
Main Works
Figure 1.2

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

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1.7 Information sources

1.7.1 Publications and databases

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

- BioNet Atlas of NSW Wildlife for previous threatened species records;
- Commonwealth Department of the Environment and Energy (DoEE) *Protected Matters Search Tool* (PMST) for Matters of National Environmental Significance (MNES) likely to occur within the Main Works areas; and
- the NSW Plant Community Types (PCTs), as held within the BioNet Vegetation Classification database.

1.7.2 Spatial data

Spatial data encompassing the Main Works project area, including the disturbance footprint, was obtained from Future Generation Joint Venture (FGJV) and Snowy Hydro. Base map data was obtained from Department of Finance, Services and Innovation (DFSI) NSW databases, with cadastral data obtained from DFSI digital cadastral database. Mapping for stream orders was obtained from DPI.

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

- *State Vegetation Type Map: Riverina Region Version v1.2 - VIS_ID 4469* (OEH 2016a);
- *South East Local Land Services Biometric vegetation map – VIS_ID 4211* (OEH 2015);
- *Mitchell Landscapes Version V3.1* (OEH 2016b);
- *Interim Biogeographic Regionalisation of Australia* (IBRA) *Version 7* (DoEE 2017a);
- Directory of important wetlands (DoEE 2018a); and
- NSW Wetlands (OEH 2010).

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

1.8 Legislative requirements

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

- EPBC Act;
- BC Act;
- NSW *Fisheries Management Act 1994* (FM Act);
- NSW EP&A Act;

- NSW *Biosecurity Act 2015*; and
- NSW *National Parks and Wildlife Act 1974* (NPW Act).

These are discussed further in Section 3.

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

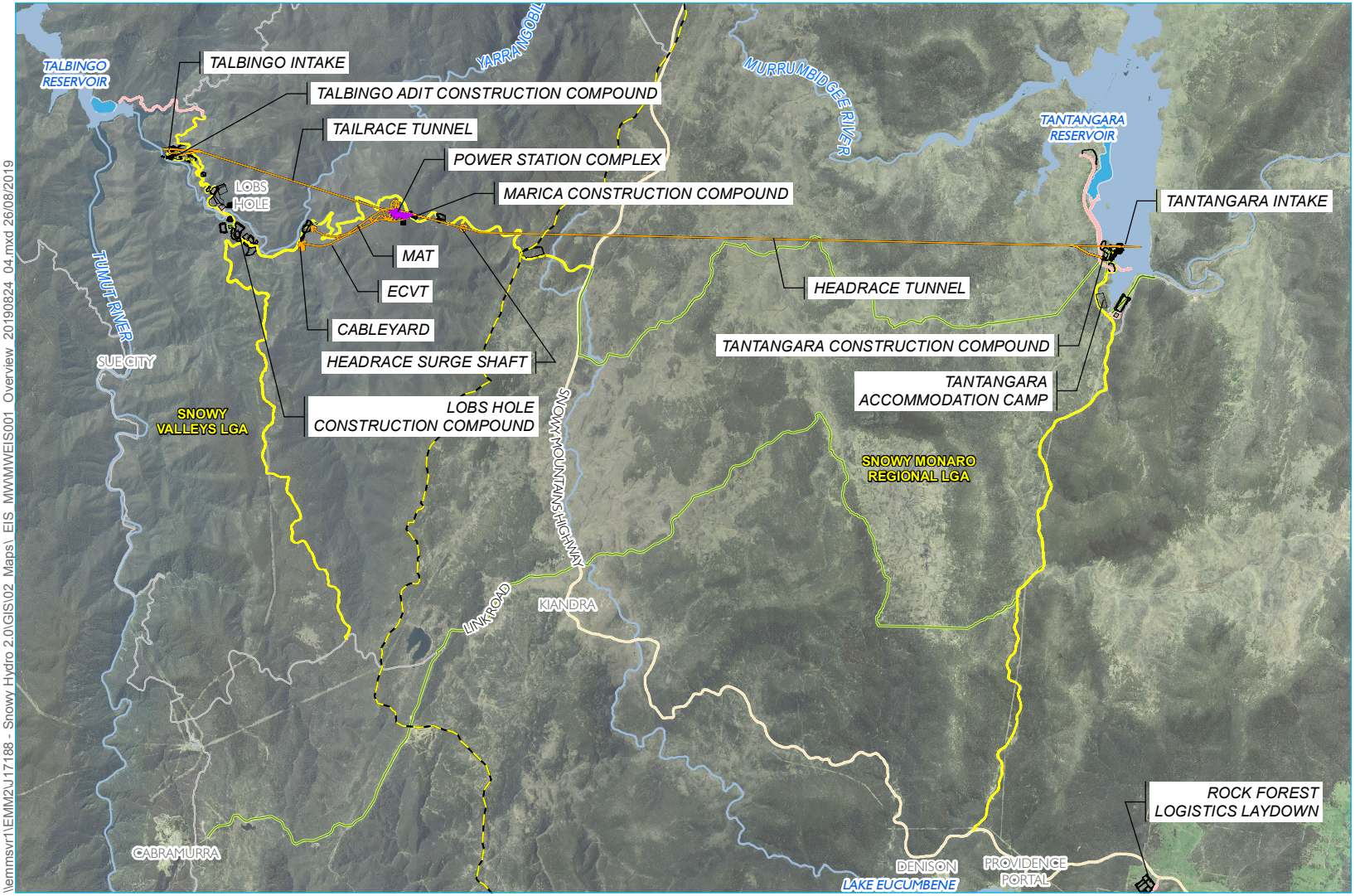
Snowy 2.0 will link the existing Tantangara and Talbingo reservoirs within the Snowy Scheme through a series of underground tunnels and a new hydro-electric power station will be built underground. An overview of Snowy 2.0 is shown on Figure 2.1, and the key project elements of Snowy 2.0 are summarised in Table 2.1.

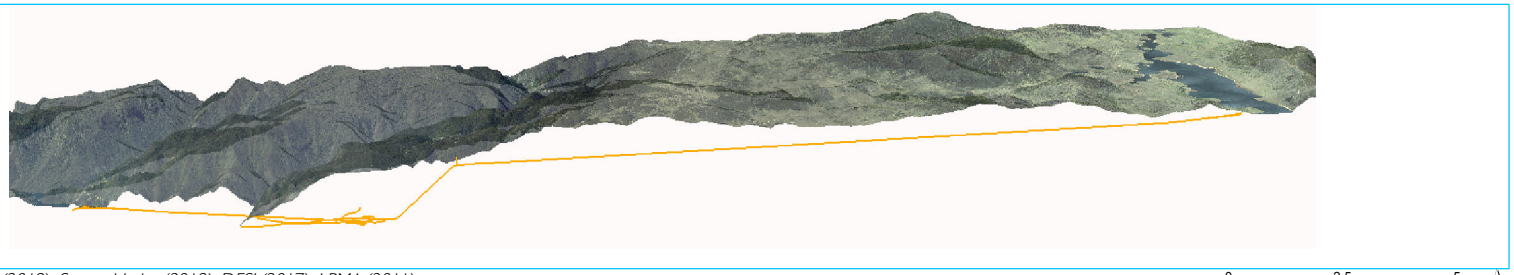
Table 2.1 Overview of Snowy 2.0 Main Works

Project element	Summary of the Project
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; • 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.

Table 2.1 Overview of Snowy 2.0 Main Works

Project element	Summary of the Project
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, and/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.





KEY

Existing environment
- Main road
- Local road
- Watercourse
- Waterbodies
- Local government area boundary

Snowy 2.0 Main Works operational elements
- Tunnels, portals, intakes, shafts
- Power station
- Utilities
- Permanent road

Snowy 2.0 Main Works construction elements
- Temporary construction compounds and surface works
- Temporary access road
- Indicative rock emplacement area

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

0 2.5 5 km
GDA 1994 MGA Zone 55

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Snowy 2.0 project elements

Snowy 2.0
Biodiversity development assessment report
Main Works
Figure 2.1

snowy 2.0

EMM creating opportunities

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2.2 Operation of Snowy 2.0

2.3 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 Figure 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 is proposed as part of a modification to the 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 Tumut 3 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 wastewater 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.

Table 2.2 Snowy 2.0 construction elements

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 m3 (unbulked) 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 2.7.
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 2.7.
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 and 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;

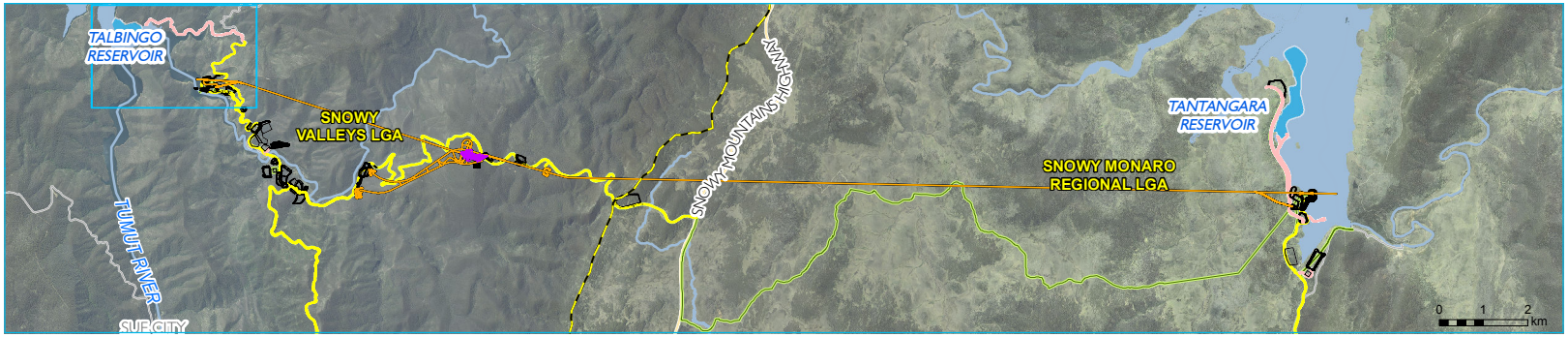
- Plateau – the land area between Snowy Mountains Highway and Tantangara Reservoir is referred to as the Plateau. The Plateau will be used to access and construct a utility corridor and construct a fish weir on Tantangara Creek;

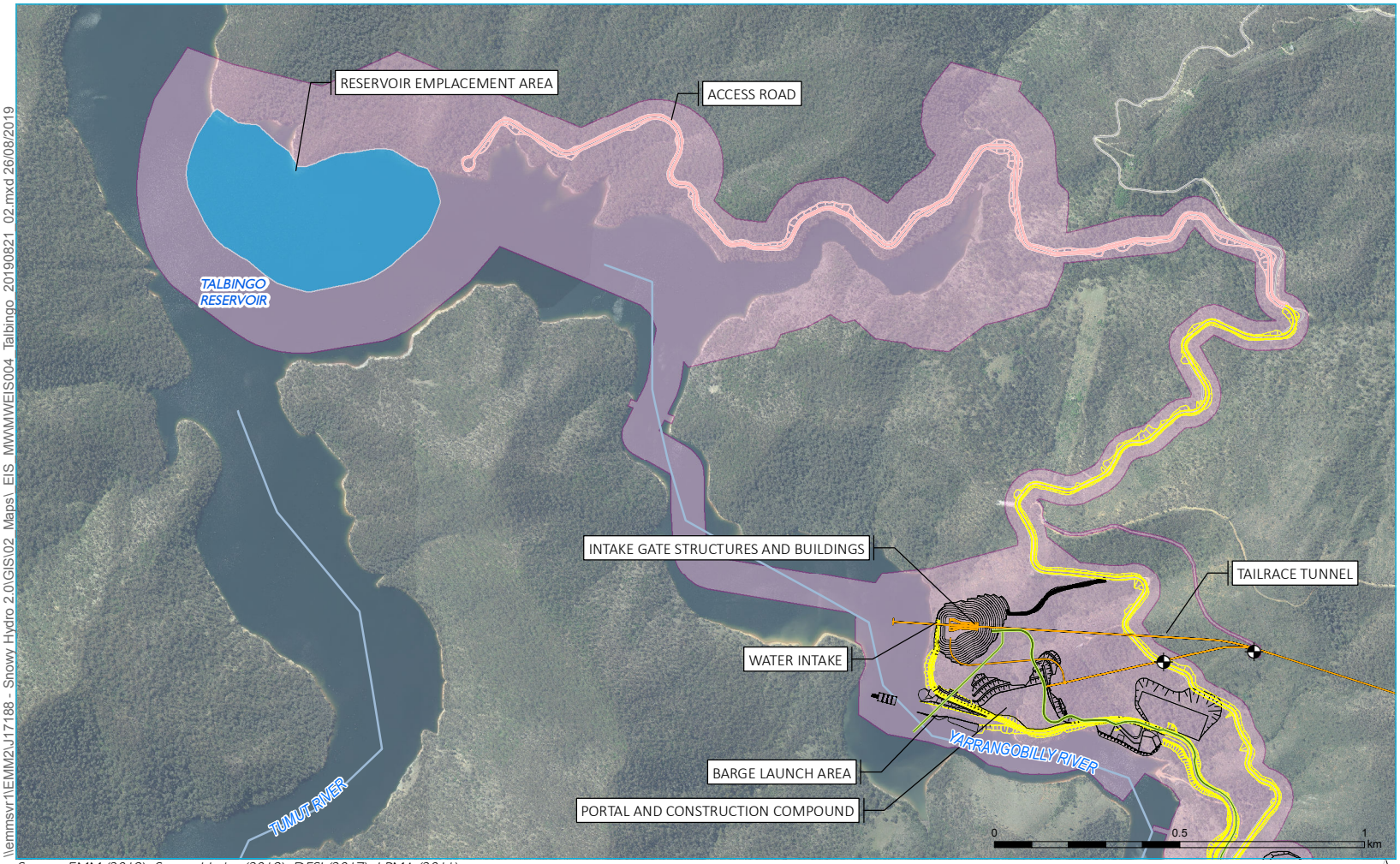
- Tantangara Reservoir – Tantangara Reservoir will be the upper reservoir for the pumped hydro project and include the headrace tunnel and intake structure. The site will also be used for a temporary construction compound, accommodation camp and other temporary ancillary activities; and

- 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 appended to the EIS.





KEY

Existing environment

- Main road
- Local road
- Watercourse
- Waterbodies
- Local government area boundary

Snowy 2.0 Main Works operational elements

- Tunnels, portals, intakes, shafts
- Power station
- Utilities
- Permanent road

Snowy 2.0 Main Works construction elements

- Temporary construction compounds and surface works
- Temporary access road
- Geotechnical investigation
- Indicative rock emplacement area
- Disturbance area*

Note: the disturbance area is the extent of construction works required to build Snowy 2.0. It has been identified to allow an assessment of impacts for the EIS, and represents a defined maximum extent where construction works will be carried out. The area will be minimised as much as possible during detailed design.

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

GDA 1994 MGA Zone 55

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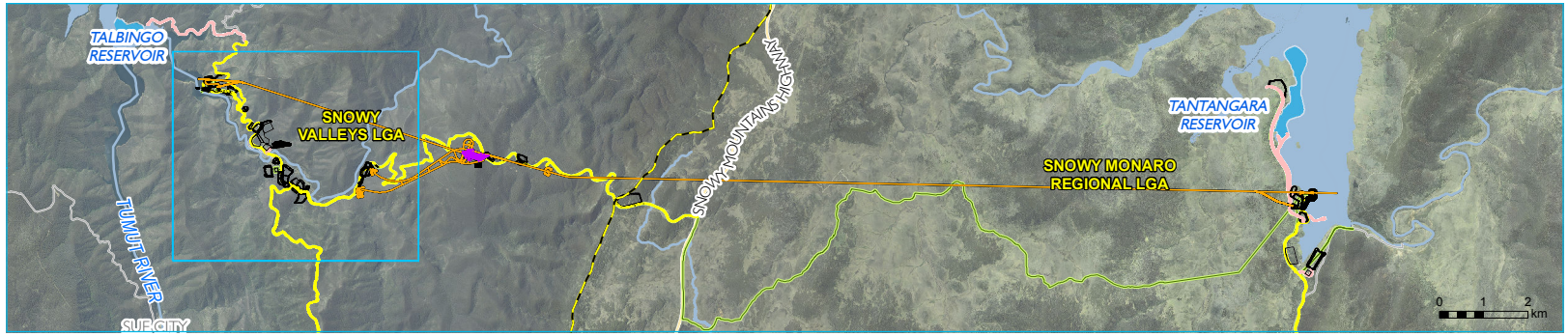
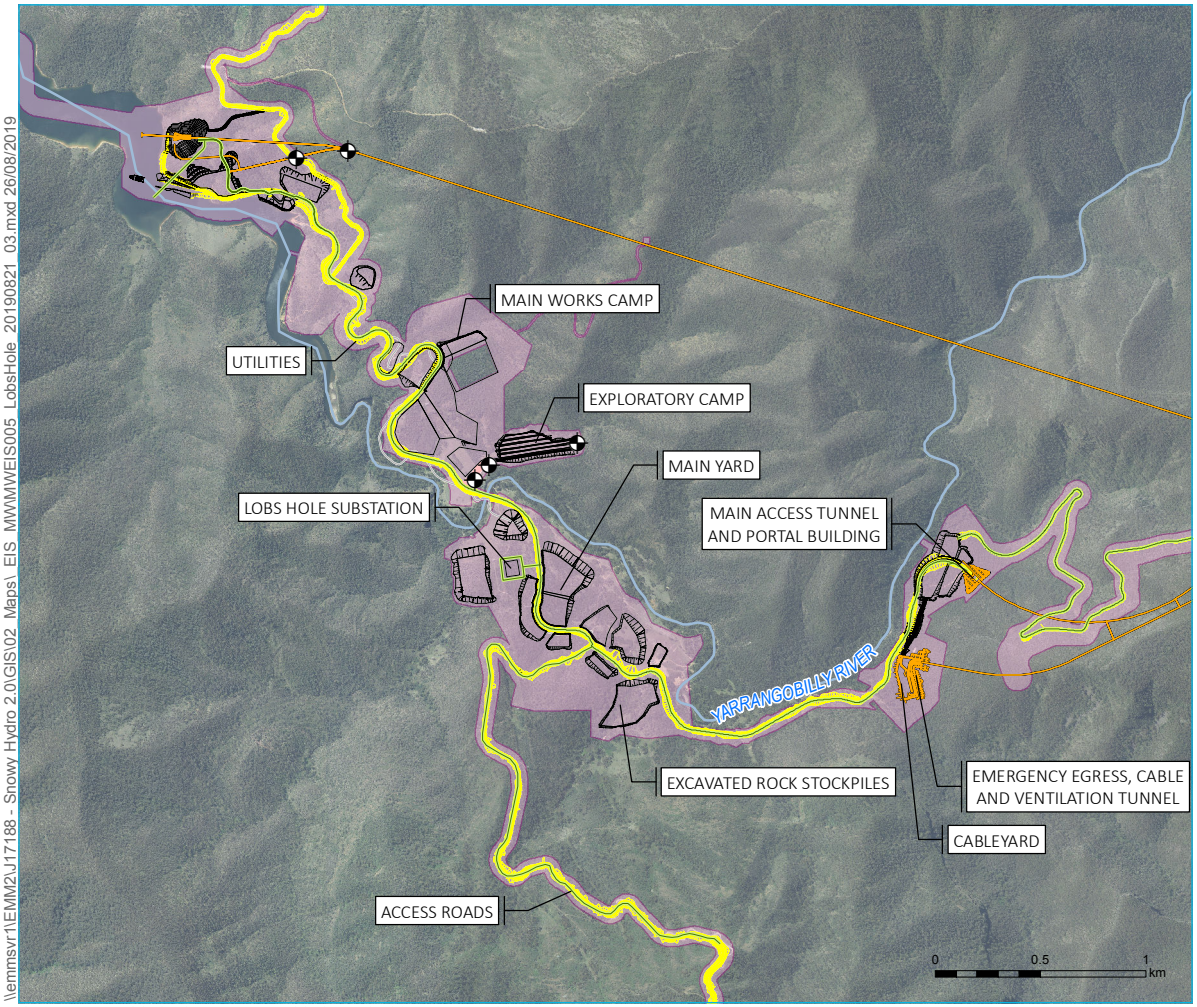
Talbingo Reservoir - project elements, purpose and description

Snowy 2.0
Biodiversity development assessment report
Main Works
Figure 2.2

snowy 2.0

EMM creating opportunities





KEY

Existing environment
- Main road
- Local road
- Watercourse
- Waterbodies
- Local government area boundary

Snowy 2.0 Main Works operational elements
- Tunnels, portals, intakes, shafts
- Power station
- Utilities
- Permanent road

Snowy 2.0 Main Works construction elements
- Temporary construction compounds and surface works
- Temporary access road
- Geotechnical investigation
- Indicative rock emplacement area
- Disturbance area*

Note: the disturbance area is the extent of construction works required to build Snowy 2.0. It has been identified to allow an assessment of impacts for the EIS, and represents a defined maximum extent where construction works will be carried out. The area will be minimised as much as possible during detailed design.

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

GDA 1994 MGA Zone 55

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Lobs Hole - project elements, purpose and description

Snowy 2.0
Biodiversity development assessment report
Main Works
Figure 2.3

snowy 2.0

EMM creating opportunities

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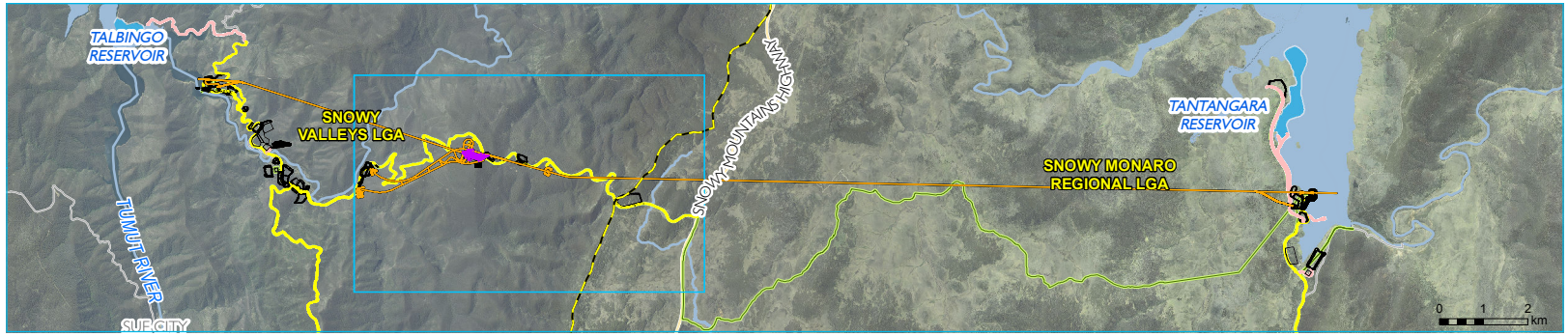

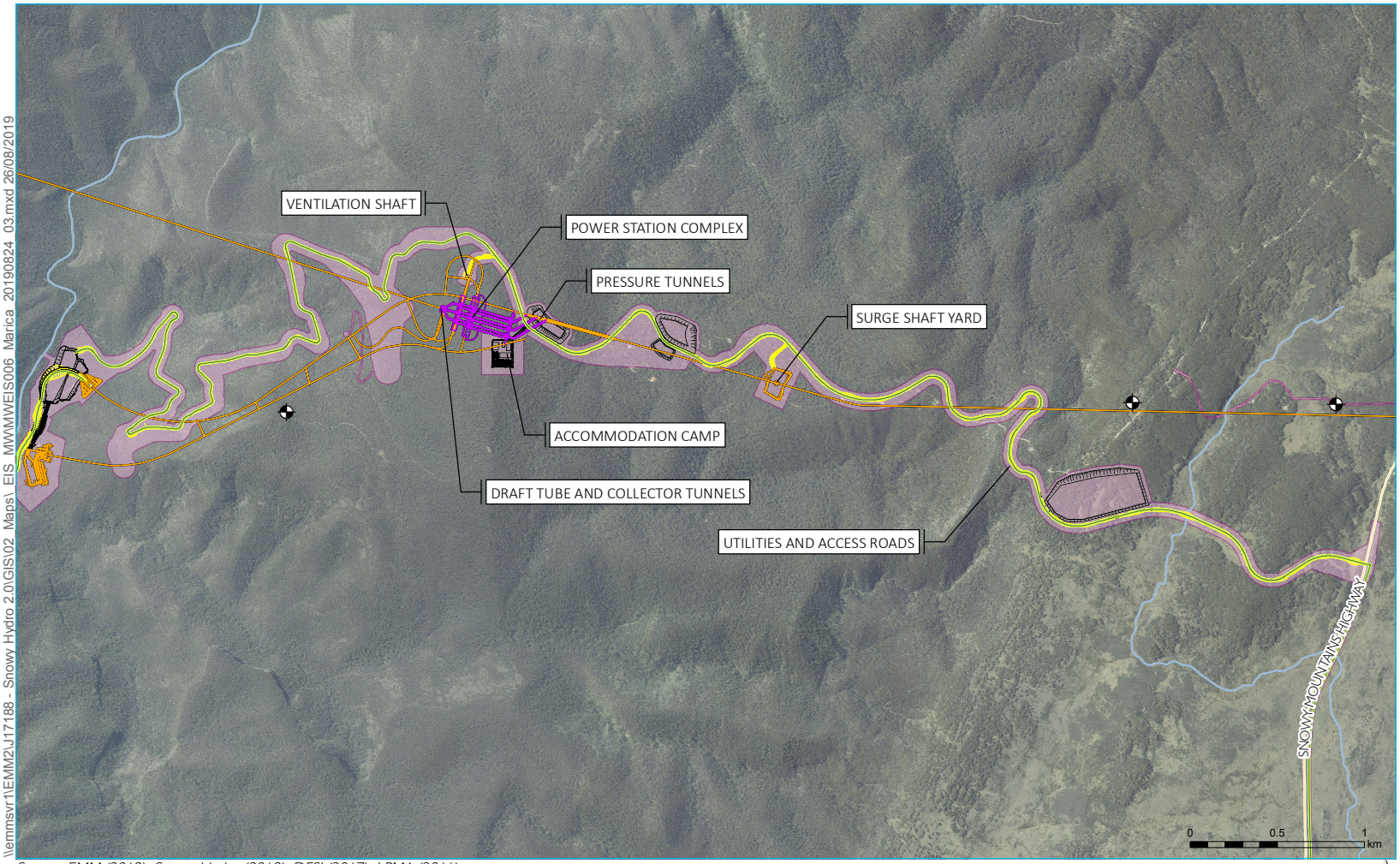

KEY

Existing environment

- Main road
- Local road
- Watercourse
- Waterbodies
- Local government area boundary

Snowy 2.0 Main Works operational elements

- Tunnels, portals, intakes, shafts
- Power station
- Utilities
- Permanent road

Snowy 2.0 Main Works construction elements

- Temporary construction compounds and surface works
- Temporary access road
- Geotechnical investigation
- Indicative rock emplacement area
- Disturbance area*

Note: the disturbance area is the extent of construction works required to build Snowy 2.0. It has been identified to allow an assessment of impacts for the EIS, and represents a defined maximum extent where construction works will be carried out. The area will be minimised as much as possible during detailed design.

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

GDA 1994 MGA Zone 55

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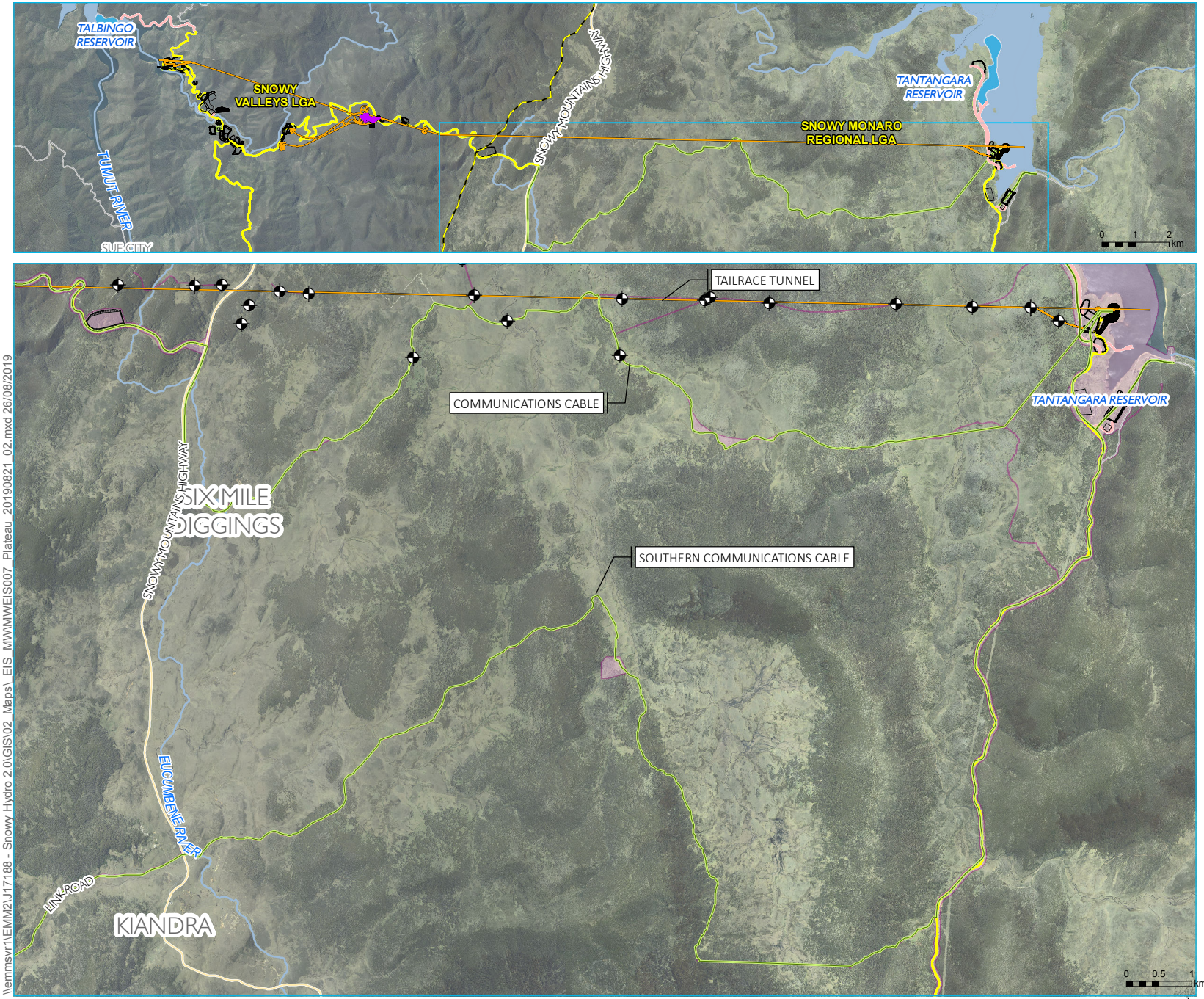
Marica - project elements, purpose and description

Snowy 2.0
Biodiversity development assessment report
Main Works
Figure 2.4

snowy 2.0

EMM creating opportunities



KEY

Existing environment

- Main road
- Local road
- Watercourse
- Waterbodies
- Local government area boundary

Snowy 2.0 Main Works operational elements

- Tunnels, portals, intakes, shafts
- Power station
- Utilities
- Permanent road

Snowy 2.0 Main Works construction elements

- Temporary construction compounds and surface works
- Temporary access road
- Geotechnical investigation
- Indicative rock emplacement area
- Disturbance area*

Note: the disturbance area is the extent of construction works required to build Snowy 2.0. It has been identified to allow an assessment of impacts for the EIS, and represents a defined maximum extent where construction works will be carried out. The area will be minimised as much as possible during detailed design.

Plateau - project elements, purpose and description

Snowy 2.0
Biodiversity development assessment report
Main Works
Figure 2.5

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

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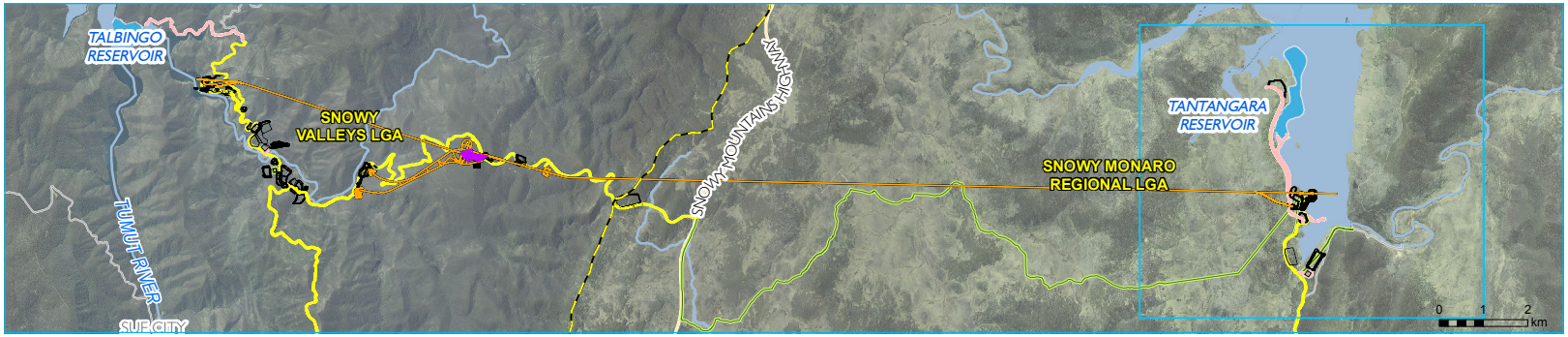

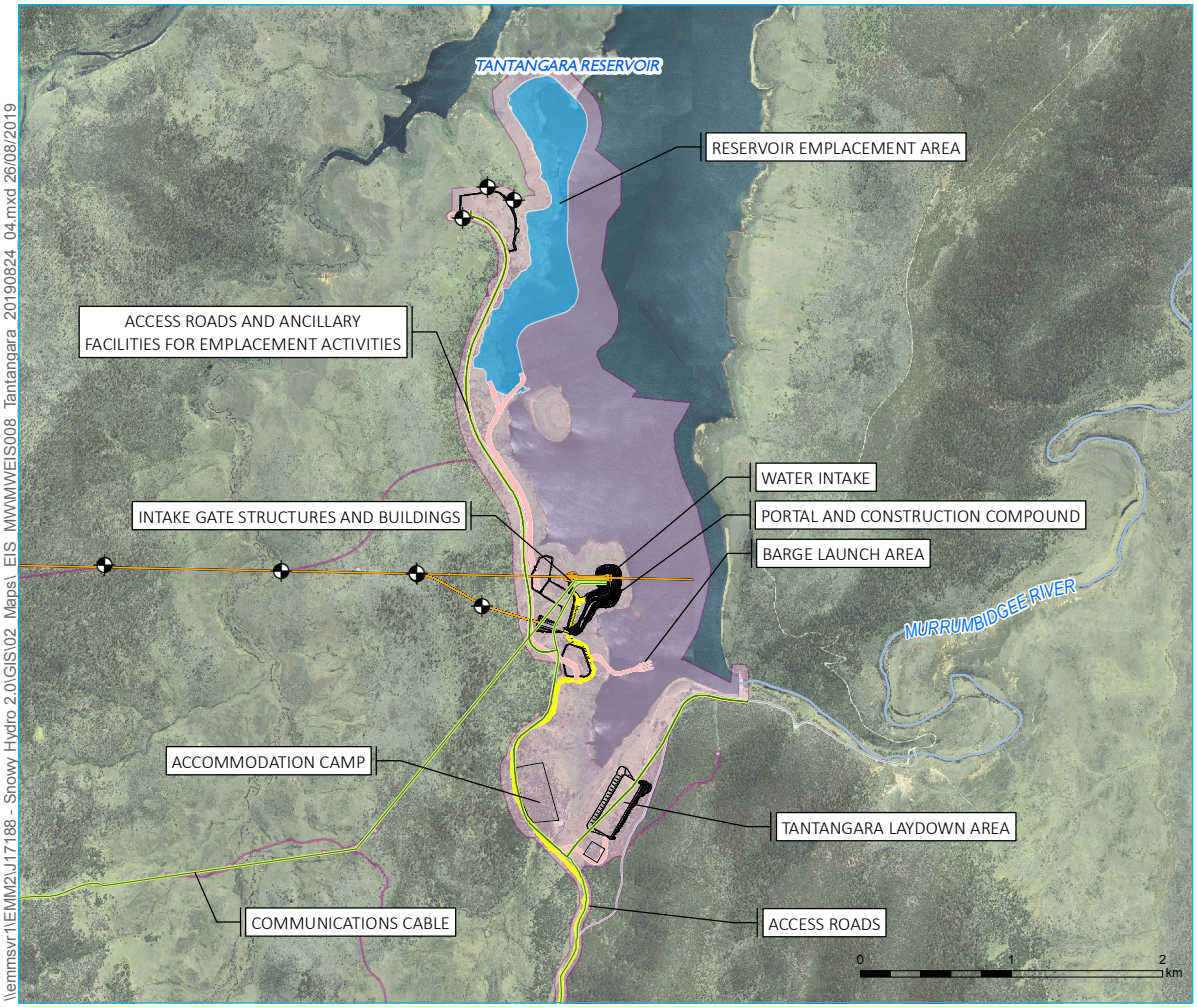

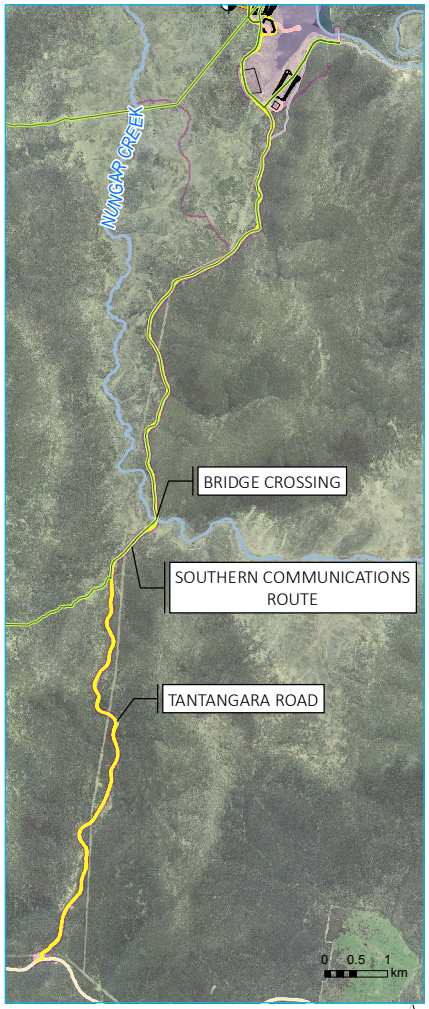

KEY

Existing environment

- Main road
- Local road
- Watercourse
- Waterbodies
- Local government area boundary

Snowy 2.0 Main Works operational elements

- Tunnels, portals, intakes, shafts
- Power station
- Utilities
- Permanent road

Snowy 2.0 Main Works construction elements

- Temporary construction compounds and surface works
- Temporary access road
- Geotechnical investigation
- Indicative rock emplacement area
- Disturbance area*

Note: the disturbance area is the extent of construction works required to build Snowy 2.0. It has been identified to allow an assessment of impacts for the EIS, and represents a defined maximum extent where construction works will be carried out. The area will be minimised as much as possible during detailed design.

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

GDA 1994 MGA Zone 55

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Tantangara Reservoir - project elements, purpose and description

Snowy 2.0
Biodiversity development assessment report
Main Works
Figure 2.6

snowy 2.0

EMM creating opportunities

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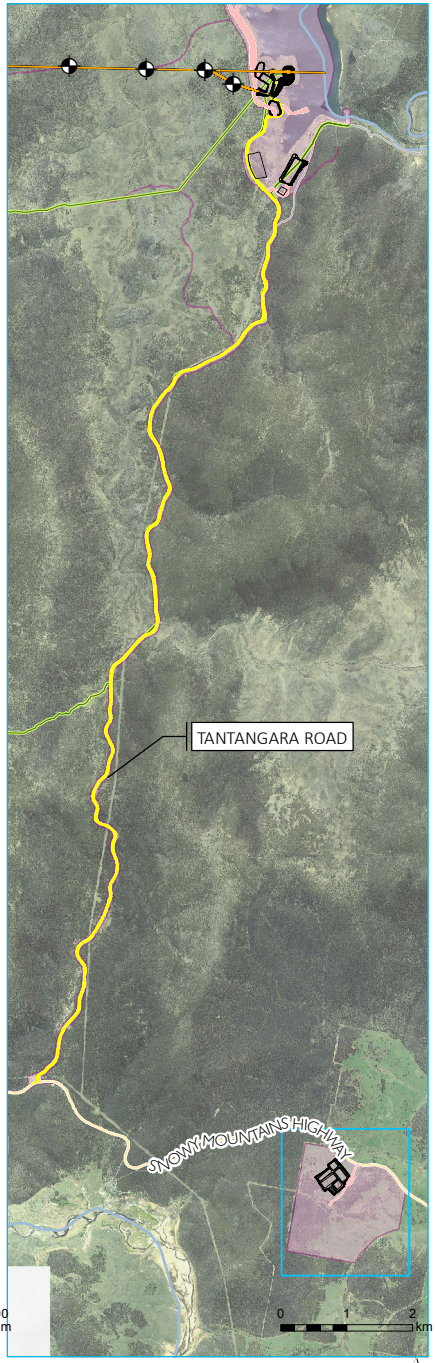

KEY

Existing environment
- Main road
- Local road
- Watercourse

Snowy 2.0 operational elements
- Tunnels, portals, intakes, shafts
- Utilities
- Permanent road

Snowy 2.0 contruction elements
- Temporary construction compounds and surface works
- Temporary access road
- Geotechnical investigation
- Disturbance area*

Note: the disturbance area is the extent of construction works required to build Snowy 2.0. It has been identified to allow an assessment of impacts for the EIS, and represents a defined maximum extent where construction works will be carried out. The area will be minimised as much as possible during detailed design.

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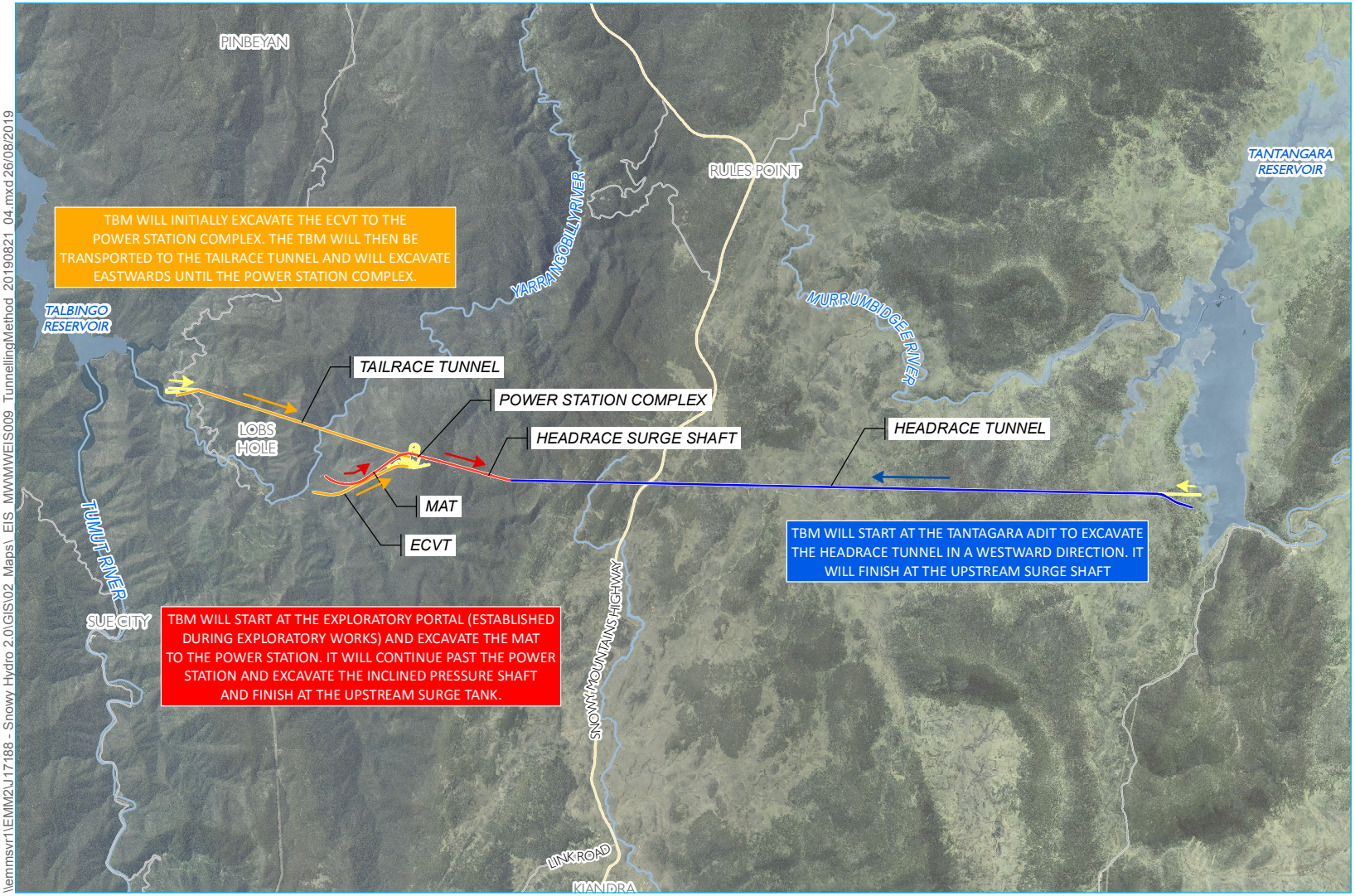
Source: EMM (2019); Snowy Hydro (2019); DFSI (2017); LPMA (2011)

Rock Forest - project elements, purpose and description

Snowy 2.0
Biodiversity development assessment report
Main Works
Figure 2.7

snowy 2.0

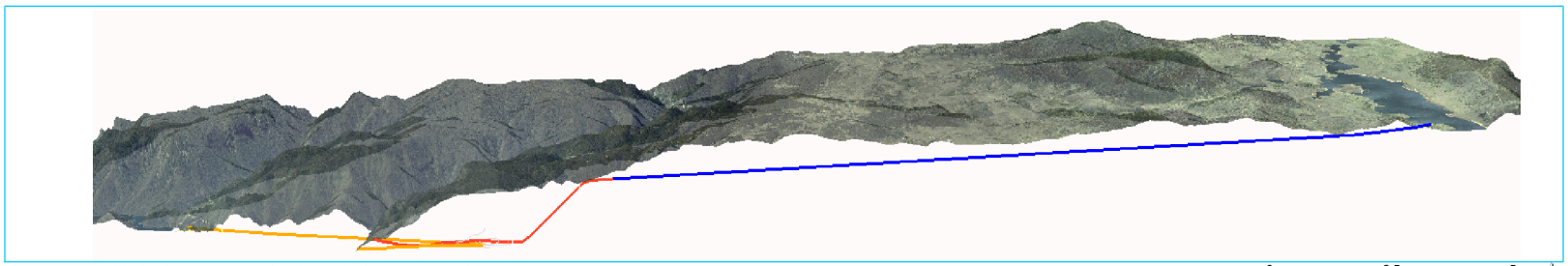
EMM creating opportunities



KEY

Tunnelling method
- Drill and blast
- TBM 1
- TBM 2
- TBM 3
- Tunnelling direction

Existing environment
- Main road
- Local road
- Watercourse
- Waterbodies



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

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Primary excavation methods – drill and blast and tunnel boring machine

Snowy 2.0
Biodiversity development assessment report
Main Works
Figure 2.8

snowy 2.0

EMM creating opportunities

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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 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 Tumut 3 power station.

Due to its historic relationship to both the upstream Tumut 2 power station and downstream Tumut 3 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 (FSLs). 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 tunnel (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 to determine the extent of decommissioning of temporary construction facilities and rehabilitation activities to be undertaken following the construction of Snowy 2.0 Main Works.

3 Legislative context

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

3.1 Commonwealth

3.1.1 Environment Protection and Biodiversity Conservation Act 1999

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

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

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

The Main Works project has been referred to the Commonwealth Minister for the Environment and determined to be a controlled action on 15 December 2018 (EPBC 2018/8322). The project will be assessed by an accredited process. An assessment of the project against the EPBC Act is provided in Section 9. The Secretary determined that the following controlling provisions apply:

- National Heritage places (Sections 15B & 15C o the EPBC Act);
- Listed threatened species and communities (Sections 18 & 18A of the EPBC Act);
- Listed migratory species (Sections 20 & 20A of the EPBC Act); and
- Commonwealth action (Section 28 of the EPBC Act).

3.2 State

3.2.1 Environmental Planning and Assessment Act 1979

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

The EP&A Act provides the overarching structure for planning in NSW and is supported by other statutory environmental planning instruments (EPIs) including SEPPs. EPIs relevant to the natural environment are outlined further below.

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

On 7 March 2018, Snowy 2.0 was declared to be CSSI by the NSW Minister for Planning under the provisions of the EP&A Act 1979 and is defined in clause 9 of Schedule 5 of the SRD SEPP.

ii State Environmental Planning Policy No 44 – Koala Habitat Protection

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

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

3.2.2 Fisheries Management Act 1994

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

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

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

3.2.3 Biodiversity Conservation Act 2016

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

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

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

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

For SSI projects, including CSSI projects, use of the BAM is mandatory unless a waiver is sought. The biodiversity assessment for the Main Works has been undertaken in accordance with the requirements of the BAM (OEH 2017a), as set out in this BDAR.

3.2.4 Biosecurity Act 2015

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

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

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

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

Blackberry (*Rubus fruticosus* species aggregate), a weed of national significance (WoNS) and State Priority was identified within the Main Works survey area. The Biosecurity Act imposes a general duty on persons who deal with biosecurity matters to prevent, minimise and eliminate the risk so far as is reasonably practicable, and also imposes mandatory measures for Blackberry as per Part 2, Division 8, clause 33 of the NSW Biosecurity Regulation 2018, being that a person must not import into the State or sell.

Sweet Briar (*Rosa rubiginosa*), identified within the Main Works survey area, is identified in Appendix 2 of RLLS (2017) as another weed of concern to the Riverina Region. Weeds identified in Appendix 2 may be subject to the General Biosecurity Duty, as outlined in the Biosecurity Act, and may be a focus for local management plans and coordinated campaigns by the community and other stakeholders in the region.

3.2.5 National Parks and Wildlife Act 1979

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

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

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

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

4 Landscape features

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

4.1 Landscape features

4.1.1 Bioregions and landscapes

The Main Works project area occurs across three IBRA regions and four subregions (Figure 4.1):

- South Eastern Highlands IBRA region, Bondo subregion and Monaro subregion;
- NSW South Western Slopes IBRA region and Inland slopes subregion; and
- Australian Alps IBRA region and Snowy Mountains subregion.

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

The Main Works project area occurs across five BioNet NSW Landscapes (formerly Mitchell Landscapes, Figure 4.1):

- Kings Cross Montane;
- Tantangara High Plains and Peaks;
- Pinbeyan – Ravine Ranges;
- Cabramurra – Kiandra Basalt Caps and Sands; and
- Jindabyne Plains (Rock Forest).

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

4.1.2 Watercourses and wetlands

The project area is located within the Murrumbidgee catchment in the Australian Alps, south-eastern NSW. The Murrumbidgee catchment covers 84,000 square kilometres of southern NSW. It is bordered by the Great Dividing Range to the east, the Lachlan Catchment to the north and the Murray Catchment to the south (NOW 2011). A small portion of the project area between Talbingo and Tantangara Reservoirs is located within the Snowy catchment (Eucumbene). The NSW portion of the catchment area is 9,070 square kilometres (DPIE 2019).

The western section of the project area intersects two major watercourses; Wallace's Creek and the Yarrangobilly River. Within the project area, Wallace's Creek forms a sixth-order stream while the Yarrangobilly River forms a seventh-order stream. The Yarrangobilly River and Wallace's Creek are perennial streams. Stream substratum consists of unconsolidated boulder, cobble, pebble and gravel substratum with little evidence of siltation. The riparian zone of both watercourses is reasonably well vegetated, except for the lower section of the Yarrangobilly River, which has been subject to historic clearing in Lobs Hole. In this area some banks are unvegetated. Both watercourses are subject to significant infestation by Blackberry. This section of the project area is situated adjacent to Talbingo Reservoir. The Reservoir was constructed between 1968 and 1970 as a part of the Snowy Mountains Hydro-Electric Scheme (the Snowy Scheme, Lister 2001). It has a surface area of 1,940 ha and has a capacity of 921,000 ML when full. The reservoir supplies water to the Tumut 3 power station. The edges of the reservoir are located largely within the KNP, except for the northern section adjacent to the dam wall. The edges are largely vegetated, including intact native vegetation. Numerous stags are located within the reservoir, resulting from the inundation of forests when the dam was completed. Talbingo Reservoir is mapped in the NSW Wetlands spatial dataset.

Photograph 4.1 The Yarrangobilly River at Lobs Hole, upstream of Lobs Hole Ravine Road crossing

Along the western edge of Tantangara Reservoir, the project area intersects a first order tributary of the Murrumbidgee River. This stream is present as a minor drainage line, and only flows during heavy rainfall. Tantangara Reservoir was constructed between 1958 to 1960 as part of the Snowy Scheme. The reservoir dams the headwaters of the Murrumbidgee River. Before the construction of Tantangara Dam, the flow regime of Murrumbidgee catchment was highly variable. Since 1960 Tantangara Dam has captured and diverted a large portion of its inflows to Eucumbene (Snowy Scientific Committee 2010).

Other project elements intersect a number of minor and major watercourses associated with the Murrumbidgee River, including Gooandra Creek, Tantangara Creek and Nungar Creek. These perennial watercourses consist of open flats, with a main channel and a number of offline pools located in broad valleys, as well as incised channels in steeper terrain. Vegetation consists of wet grasslands and alpine bogs and fens in areas where organic material has accumulated.

A proposed access road also intersects the upper reaches of the Eucumbene River, a tributary of the Snowy River, in a third-order section of the river. At this location, the river consists of a minor channel located in a cold air valley depression.

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

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

4.1.3 Connectivity

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

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

4.1.4 Areas of geological significance and soil hazard features

Several areas of geological significance are located within the project area. A summary is provided below, with further details in the geodiversity assessments (Percival 2019 and Troedson 2019) appended to the EIS.

i Periglacial landforms

The Pleistocene glacial landforms in KNP are the only examples of this landform on the mainland of Australia and are of national and international significance (OEH 2011). Periglacial features of the park include terracing, solifluction lobes, sliding and shattered boulders and block streams (also known as scree slopes or boulder streams, Photograph 4.2). The periglacial evidence can be found in most areas above 1,000 m and possibly as far down as 600 m.

Block streams (or scree slopes) are listed under 'Rocks and Landforms' in Schedule 1 (Significant Natural and Cultural Features) of the KNP PoM (DEC 2006a). They are defined as 'river' or field of rocks that have moved downhill on mass and which were held together by ice. They occur in various areas of KNP, including the project area, where they occur along a section of Lobs Hole Ravine Road (Figure 4.2). The block stream at this location is dated to about 20,000 years ago. Rapid condition assessments are assigned to the Ravine block stream every three years, in accordance with the *KNP Geodiversity Action Plan* (OEH 2011).

Photograph 4.2 Boulder streams along Lobs Hole Ravine Road

ii Ravine karst areas

Outcropping strata of the Devonian age Lick Hole Formation is located along the lower section of Lobs Hole Ravine Road, approximately 12 km from the intersection with Link Road (Figure 4.2). The geological formation was formerly known as the Lick Hole Limestone (Geological Survey of New South Wales 1966). It is exposed in a hill slope road cutting which ranges up to about 2 m in height.

The strata consists of grey friable shale with a high density of calcareous, rounded nodules (Photograph 4.3). The nodules are light brown in colour, hard and brittle, and slightly elongated with dimensions typically of about 2 to 3 cm in diameter and 4 to 10 cm in length. Some appear to display the remains of branching structure and are assumed to be corals. Less abundant shell-fish fossils were also observed.

The Australian Stratigraphic Units Database (Geoscience Australia 2017) describes the Lick Hole Formation as a "fossiliferous well-bedded marine limestone with a pronounced rubbly appearance to spheroidal concretions to 10 cm, and calcareous shale; fossils include corals, trilobites, brachiopods and molluscs".

Photograph 4.3 In situ calcareous fossils of the Lick Hole Formation

4.1.5 Areas of outstanding biodiversity value

There are no areas of outstanding biodiversity value, as defined in Part 3 of the BC Act, within a 1,500 m buffer of the project area.

4.2 Assessment of site context

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

Mapping of native vegetation within a 1,500 m buffer of the Main Works Project area was undertaken using vegetation mapping collected as a part of surveys for the Snowy 2.0 project, aerial mapping interpretation and spatial data from OEH (2016a) and OEH (2015). This mapping was modified using the vegetation extent as mapped by EMM (see Section 5). Thirty-eight PCTs were mapped within the 1500 m buffer, including:

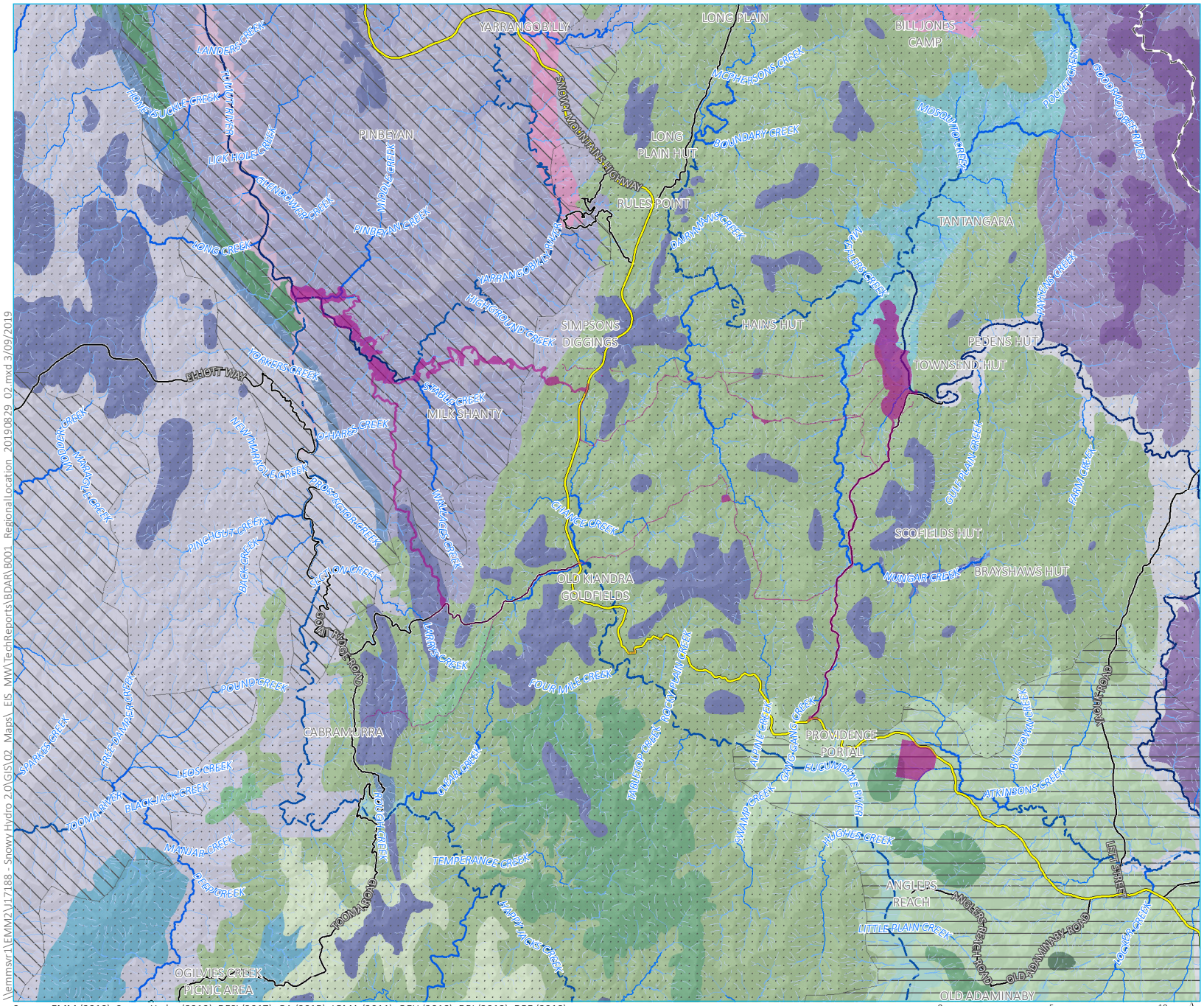
- PCT 266 - White Box grassy woodland in the upper slopes sub-region of the NSW South Western Slopes Bioregion;
- PCT 277 - Blakely's Red Gum - Yellow Box grassy tall woodland of the NSW South Western Slopes Bioregion;
- PCT 280 - Red Stringybark - Blakely's Red Gum +/- Long-leaved Box shrub/grass hill woodland of the NSW South Western Slopes Bioregion;
- PCT 283 - Apple Box - Blakely's Red Gum moist valley and footslopes grass-forb open forest of the NSW South Western Slopes Bioregion;

- PCT 285 - Broad-leaved Sally grass - sedge woodland on valley flats and swamps in the NSW South Western Slopes Bioregion and adjoining South Eastern Highlands Bioregion;
- PCT 287 - Long-leaved Box - Red Box - Red Stringybark mixed open forest on hills and hillslopes in the NSW South Western Slopes Bioregion;
- PCT 290 - Red Stringybark - Red Box - Long-leaved Box - Inland Scribbly Gum tussock grass - shrub low open forest on hills in the southern part of the NSW South Western Slopes Bioregion;
- PCT 295 - Robertson's Peppermint - Broad-leaved Peppermint - Norton's Box - stringybark shrub-fern open forest of the NSW South Western Slopes Bioregion and South Eastern Highlands Bioregion;
- PCT 296 - Brittle Gum - peppermint open forest of the Woomargama to Tumut region, NSW South Western Slopes Bioregion;
- PCT 297 - Broad-leaved Peppermint - Norton's Box - Red Stringybark tall open forest on red clay on hills in the southern part of the NSW South Western Slopes Bioregion;
- PCT 298 - Apple Box - Norton's Box - Blakely's Red Gum valley flat moist grassy tall open forest in the southern NSW South Western Slopes Bioregion and adjoining South Eastern Highlands Bioregion;
- PCT 299 - Riparian Ribbon Gum - Robertson's Peppermint - Apple Box riverine very tall open forest of the NSW South Western Slopes Bioregion and South Eastern Highlands Bioregion;
- PCT 300 - Ribbon Gum - Narrow-leaved (Robertson's) Peppermint montane fern - grass tall open forest on deep clay loam soils in the upper NSW South Western Slopes Bioregion and western Kosciuszko escarpment;
- PCT 301 - Drooping She oak - Ricinocarpus bowmannii - grasstree tall open shrubland of the Coolac - Tumut Serpentinite Belt;
- PCT 304 - Candlebark - Apple Box - Narrow-leaved Peppermint tall open forest on granite in the Tumbarumba region of the South Eastern Highlands Bioregion and upper NSW South Western Slopes Bioregion;
- PCT 305 - Apple Box - Broad-leaved Peppermint - Red Stringybark shrubby hill open forest in the upper NSW South Western Slopes Bioregion and adjacent South Eastern Highlands Bioregion;
- PCT 306 - Red Box - Red Stringybark - Norton's Box hill heath shrub - tussock grass open forest of the Tumut region;
- PCT 310 - Norton's Box - Red Stringybark grassy tall open forest on sheltered slopes in the Tumbarumba - Murray River region of the NSW South Western Slopes Bioregion;
- PCT 313 - Brittle Gum - Broad-leaved Peppermint open forest with tall dense shrub understorey on riparian coarse grained granitic soils in the NSW South Western Slopes Bioregion;
- PCT 314 - Apple Box - Red Stringybark basalt scree open forest in the upper Murray River region;
- PCT 316 - Norton's Box - Red Box - Red Stringybark +/- Nodding Flax Lily forb-grass open forest mainly on the Tumut region;

- PCT 319 - Tumbledown Red Gum - White Cypress Pine hill woodland in the southern part of the NSW South Western Slopes Bioregion;
- PCT 637 - Alpine and sub-alpine peatlands, damp herbfields and fens, South Eastern Highlands Bioregion and Australian Alps Bioregion;
- PCT 638 - Alpine Ash - Mountain Gum moist shrubby tall open forest of montane areas, southern South Eastern Highlands Bioregion and Australian Alps Bioregion;
- PCT 639 - Alpine Ash - Snow Gum shrubby tall open forest of montane areas, South Eastern Highlands Bioregion and Australian Alps Bioregion;
- PCT 641 - Alpine grassland/herbfield and open heathlands in Kosciuszko National Park, Australian Alps Bioregion;
- PCT 643 - Alpine shrubland on scree, blockstreams and rocky sites of high-altitude areas of Kosciuszko National Park, Australian Alps Bioregion;
- PCT 644 - Alpine Snow Gum - Snow Gum shrubby woodland at intermediate altitudes in northern Kosciuszko NP, South Eastern Highlands Bioregion and Australian Alps Bioregion;
- PCT 679 - Black Sallee - Snow Gum low woodland of montane valleys, South Eastern Highlands Bioregion and Australian Alps Bioregion;
- PCT 893 - Kangaroo Grass - Poa fawcettiae open grassland on limestone in northern Kosciuszko NP, Australian Alps Bioregion;
- PCT 939 - Montane wet heath and bog of the eastern tablelands, South Eastern Highlands Bioregion;
- PCT 953 - Mountain Gum - Snow Gum - Broad-leaved Peppermint shrubby open forest of montane ranges, South Eastern Highlands Bioregion and Australian Alps Bioregion;
- PCT 1100 - Ribbon Gum - Snow Gum grassy forest on damp flats, eastern South Eastern Highlands Bioregion;
- PCT 1190 - Snow Gum - Candle Bark shrubby open forest in valleys of the southern ACT ranges, South Eastern Highlands Bioregion;
- PCT 1191 - Snow Gum - Candle Bark woodland on broad valley flats of the tablelands and slopes, South Eastern Highlands Bioregion;
- PCT 1196 - Snow Gum - Mountain Gum shrubby open forest of montane areas, South Eastern Highlands Bioregion and Australian Alps Bioregion;
- PCT 1224 - Sub-alpine dry grasslands and heathlands of valley slopes, southern South Eastern Highlands Bioregion and Australian Alps Bioregion; and
- PCT 1271 - Tea-tree tall riparian shrubland, South Eastern Highlands Bioregion, South East Corner Bioregion and Australian Alps Bioregion.

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

Native vegetation cover within the 1,500 m buffer area (including the project area) was determined as the sum of the areas of native vegetation map units listed above, divided by the entire buffer area. Approximately 36,461 ha of native vegetation was mapped within the 37,559 ha buffer area (Figure 4.2). Native vegetation cover within the buffer area is approximately 97%.



KEY

- Main Works disturbance footprint
- Main road
- Local road
- State boundary

IBRA region - subregion

- South Eastern Highlands - Bondo
- South Eastern Highlands - Monaro
- Australian Alps - Snowy Mountains

Mitchell landscapes

- Alpine Zone
- Cabramurra - Kiandra Basalt Caps and Sands
- Cootamundra - Tumut Serpentinite and Ultramafics
- Dargals Montane
- Doura Volcanics
- Estuary/Water Added
- Jagungal Tops
- Jindabyne Plains
- Kings Cross Montane
- Kings Cross Sub-alpine
- Main Range Sub-alpine
- Minjary Hills and Ranges
- Monaro Plains Basalts and Sands
- Namadgi Range Alpine
- Namadgi Range Montane
- Namadgi Range Sub-alpine
- Pinbeyan - Ravine Ranges
- Tantangara High Plains and Peaks
- Tooma Granite Ranges
- Upper Murrumbidgee Valley
- Water
- Yarrangobilly - Cooleman Karst

Strahler stream order

- 1st order
- 2nd order
- 3rd order
- 4th order
- 5th order
- 6th order
- 7th order

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

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Location map, Main Works

Snowy 2.0
Biodiversity development assessment
Main Works
Figure 4.1

snowy 2.0

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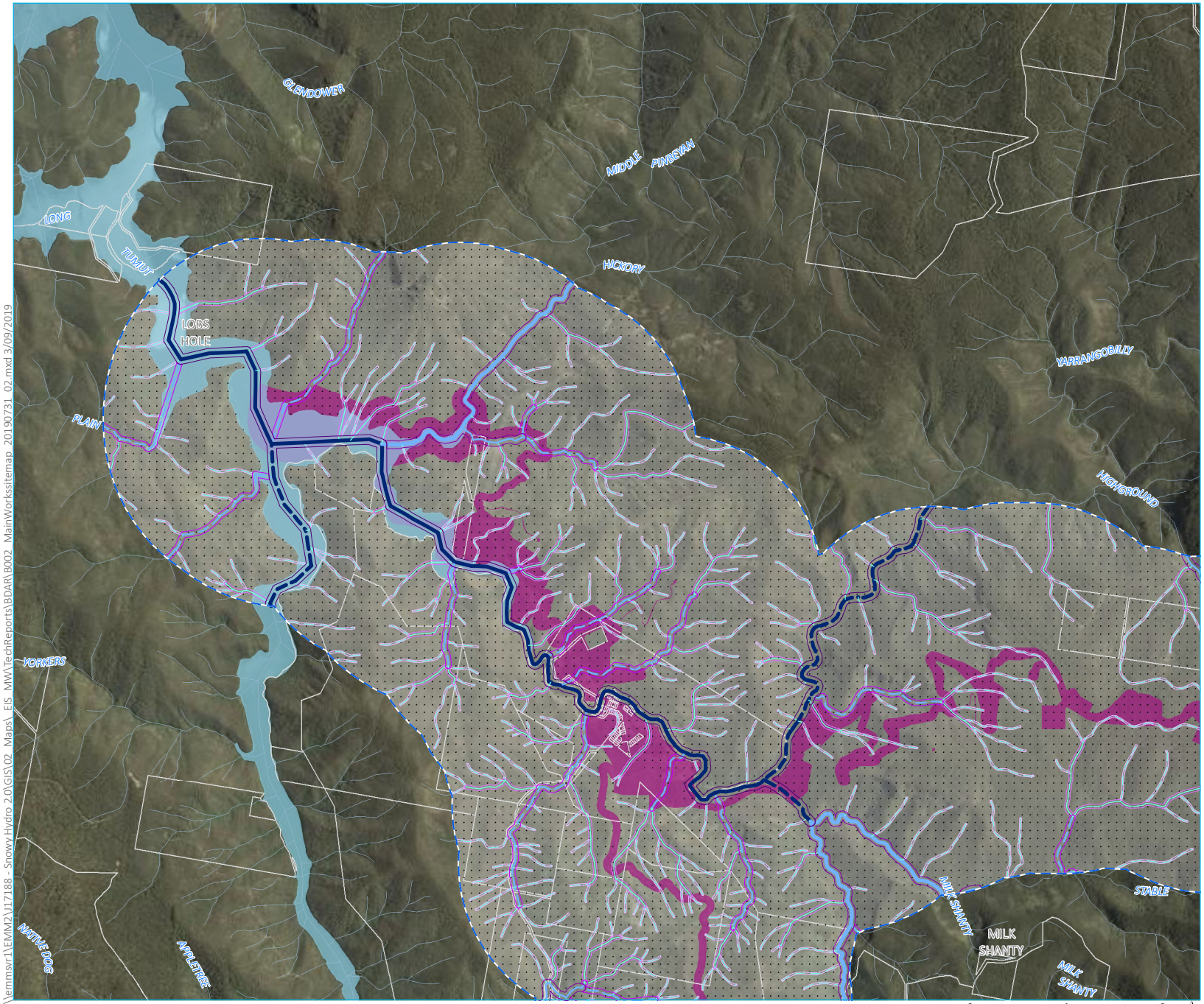

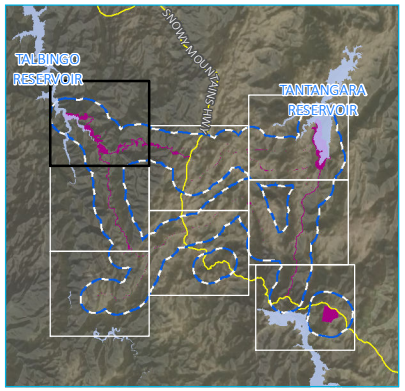

KEY

- Watercourse
- 1500 m buffer
- Main Works disturbance footprint
- NSW Wetlands (OEH, 2009)
- Native vegetation
- Cadastre

Riparian buffer

- 10 m
- 20 m
- 30 m
- 40 m
- 50 m

Strahler stream order

- 1st order
- 2nd order
- 3rd order
- 4th order
- 5th order
- 6th order
- 7th order

Source: EMM (2019); Snowy Hydro (2019); LPI (2019); SMEC (2019); DFSI (2017); GA (2015); LPMA (2011); OEH (2014, 2016); DPI (2013)

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Site map, Main Works

Snowy 2.0
Biodiversity development assessment
Main Works
Figure 4.2 a

snowy 2.0

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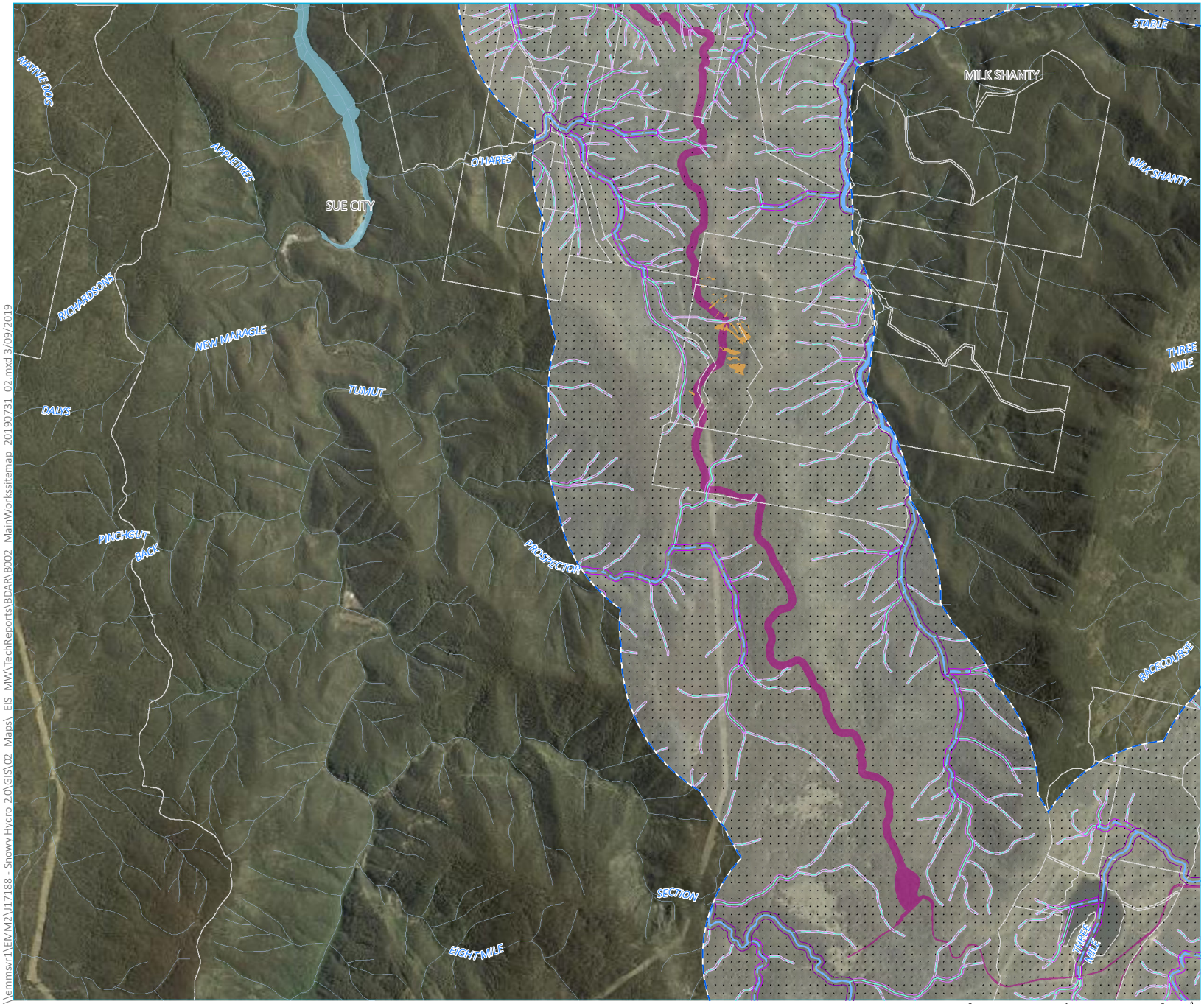

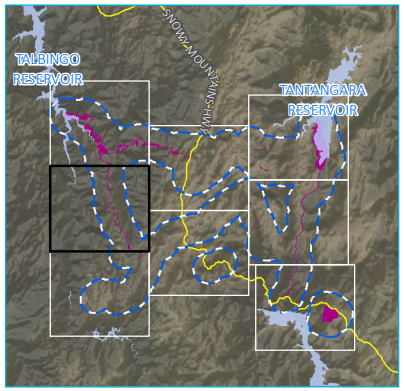

KEY

- Watercourse
- 1500 m buffer
- Main Works disturbance footprint
- NSW Wetlands (OEH, 2009)
- Native vegetation
- Cadastre
- Boulder stream

Riparian buffer

- 10 m
- 20 m
- 30 m
- 40 m

Strahler stream order

- 1st order
- 2nd order
- 3rd order
- 4th order
- 5th order

Site map, Main Works

Source: EMM (2019); Snowy Hydro (2019); LPI (2019); SMEC (2019); DFSI (2017); GA (2015); LPMA (2011); OEH (2014, 2016); DPI (2013)

0 1 2 km

N

GDA 1994 MGA Zone 55

Snowy 2.0
Biodiversity development assessment
Main Works
Figure 4.2 b

snowy 2.0

EMM creating opportunities

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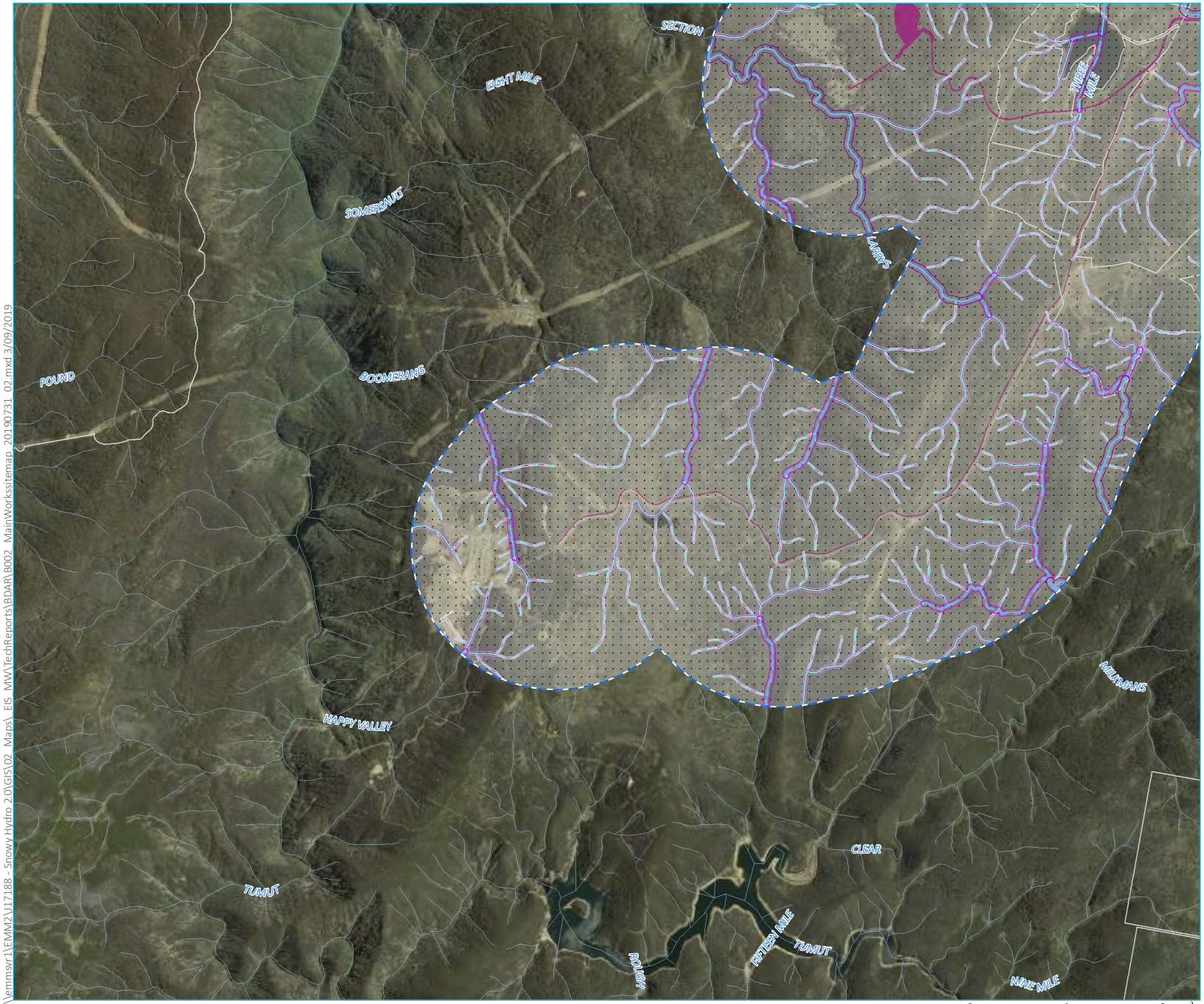

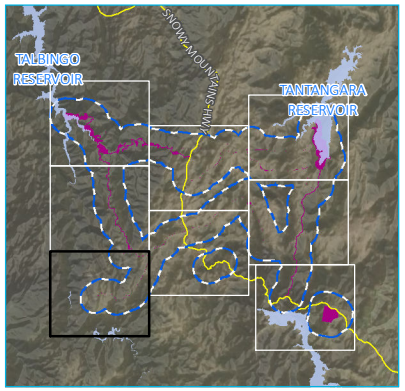

KEY

- Watercourse
- 1500 m buffer
- Main Works disturbance footprint
- Native vegetation
- Cadastre

Riparian buffer

- 10 m
- 20 m
- 30 m
- 40 m

Strahler stream order

- 1st order
- 2nd order
- 3rd order
- 4th order
- 5th order

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Source: EMM (2019); Snowy Hydro (2019); LPI (2019); SMEC (2019); DFSI (2017); GA (2015); LPMA (2011); OEH (2014, 2016); DPI (2013)

0 1 2 km

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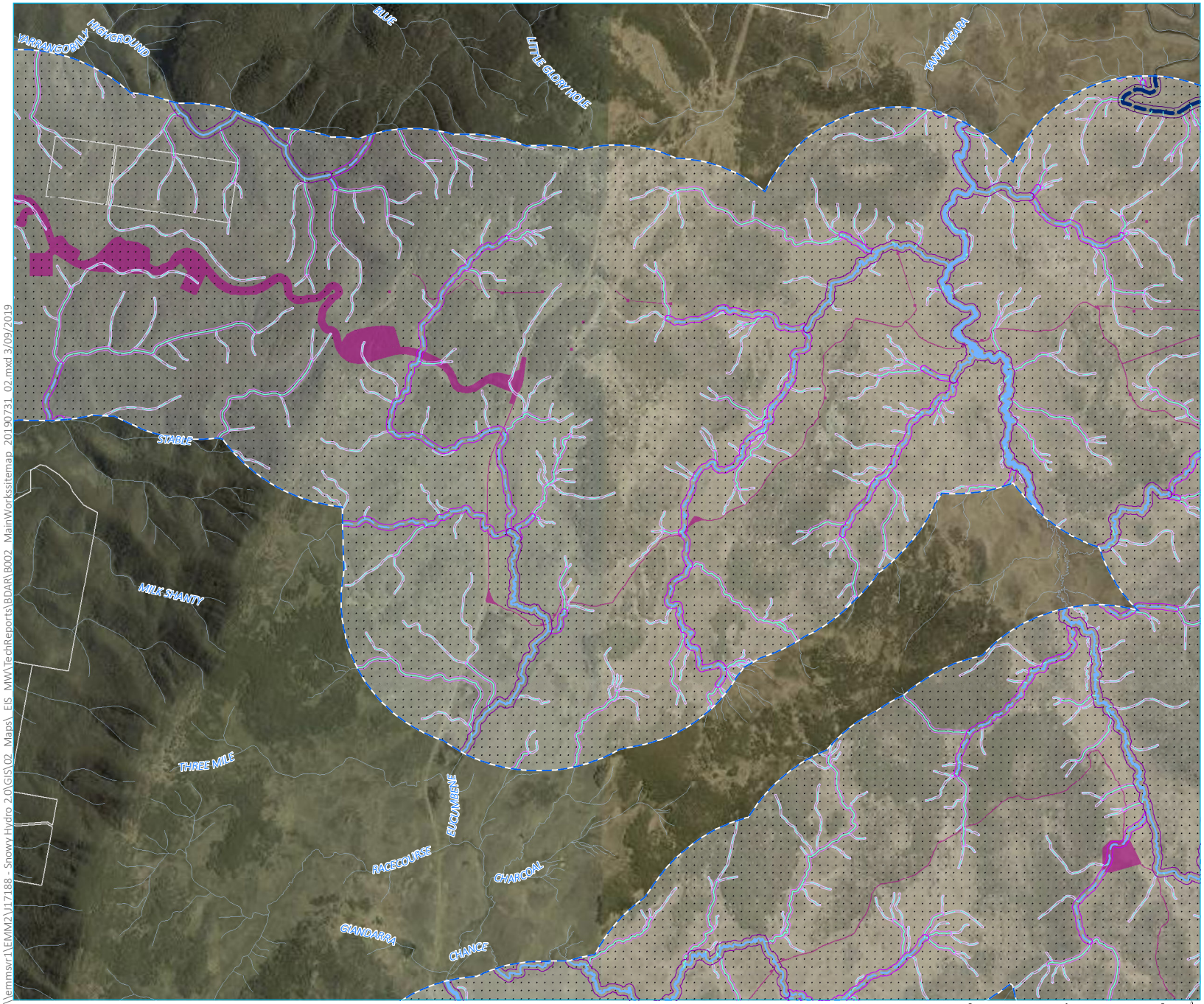
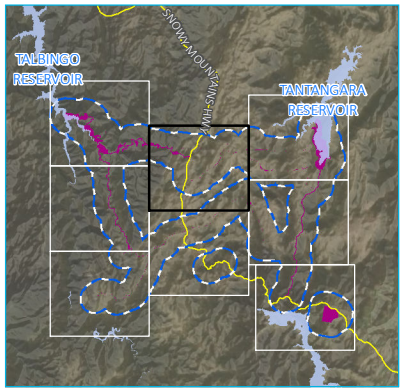
Site map, Main Works

Snowy 2.0
Biodiversity development assessment
Main Works
Figure 4.2 c

snowy 2.0

EMM creating opportunities





KEY

- Watercourse
- 1500 m buffer
- Main Works disturbance footprint
- Native vegetation
- Cadastre

Riparian buffer

- 10 m
- 20 m
- 30 m
- 40 m
- 50 m

Strahler stream order

- 1st order
- 2nd order
- 3rd order
- 4th order
- 5th order
- 6th order

Source: EMM (2019); Snowy Hydro (2019); LPI (2019); SMEC (2019); DFSI (2017); GA (2015); LPMA (2011); OEH (2014, 2016); DPI (2013)

0 1 2 km

N

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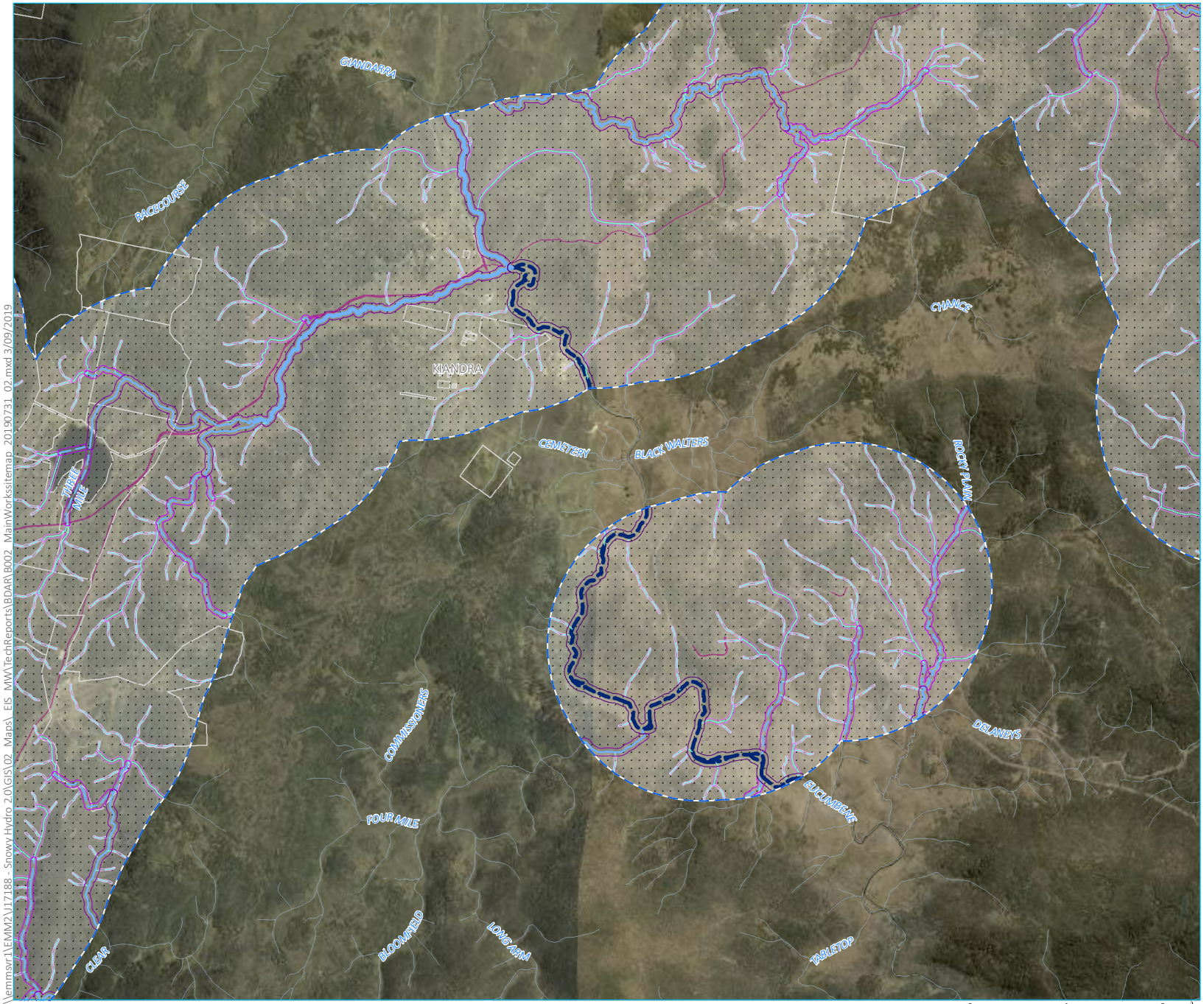
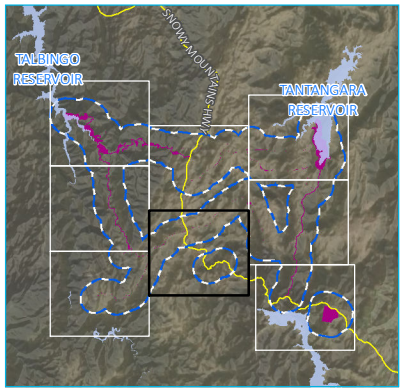
Site map, Main Works

Snowy 2.0
Biodiversity development assessment
Main Works
Figure 4.2 d

snowy 2.0

EMM creating opportunities





KEY

- Watercourse
- 1500 m buffer
- Main Works disturbance footprint
- Native vegetation
- Cadastre

Riparian buffer

- 10 m
- 20 m
- 30 m
- 40 m
- 50 m

Strahler stream order

- 1st order
- 2nd order
- 3rd order
- 4th order
- 5th order
- 6th order

Source: EMM (2019); Snowy Hydro (2019); LPI (2019); SMEC (2019); DFSI (2017); GA (2015); LPMA (2011); OEH (2014, 2016); DPI (2013)

0 1 2 km

GDA 1994 MGA Zone 55

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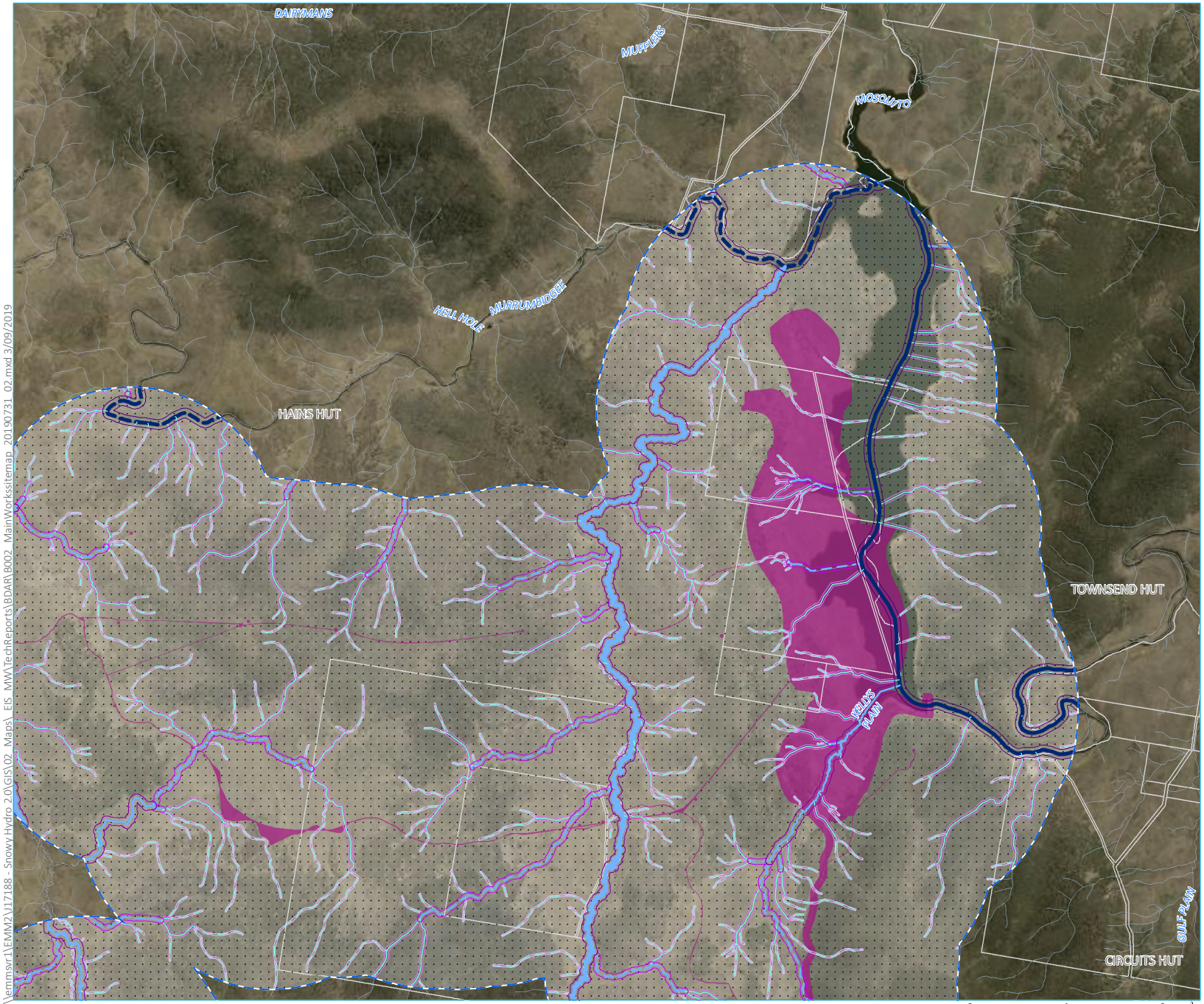
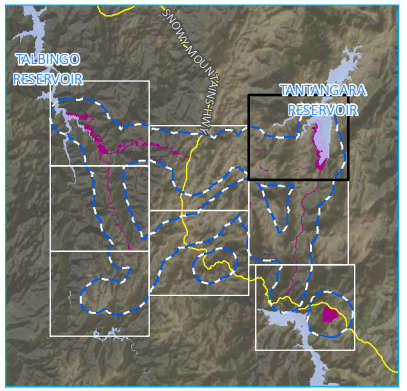
Site map, Main Works

Snowy 2.0
Biodiversity development assessment
Main Works
Figure 4.2 e

snowy 2.0

EMM creating opportunities





KEY

- Watercourse
- 1500 m buffer
- Main Works disturbance footprint
- Native vegetation
- Cadastre

Riparian buffer

- 10 m
- 20 m
- 30 m
- 40 m
- 50 m

Strahler stream order

- 1st order
- 2nd order
- 3rd order
- 4th order
- 5th order
- 6th order
- 7th order

Site map, Main Works

Source: EMM (2019); Snowy Hydro (2019); LPI (2019); SMEC (2019); DFSI (2017); GA (2015); LPMA (2011); OEH (2014, 2016); DPI (2013)

0 1 2 km

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GDA 1994 MGA Zone 55

Snowy 2.0
Biodiversity development assessment
Main Works
Figure 4.2 f

snowy 2.0

EMM creating opportunities

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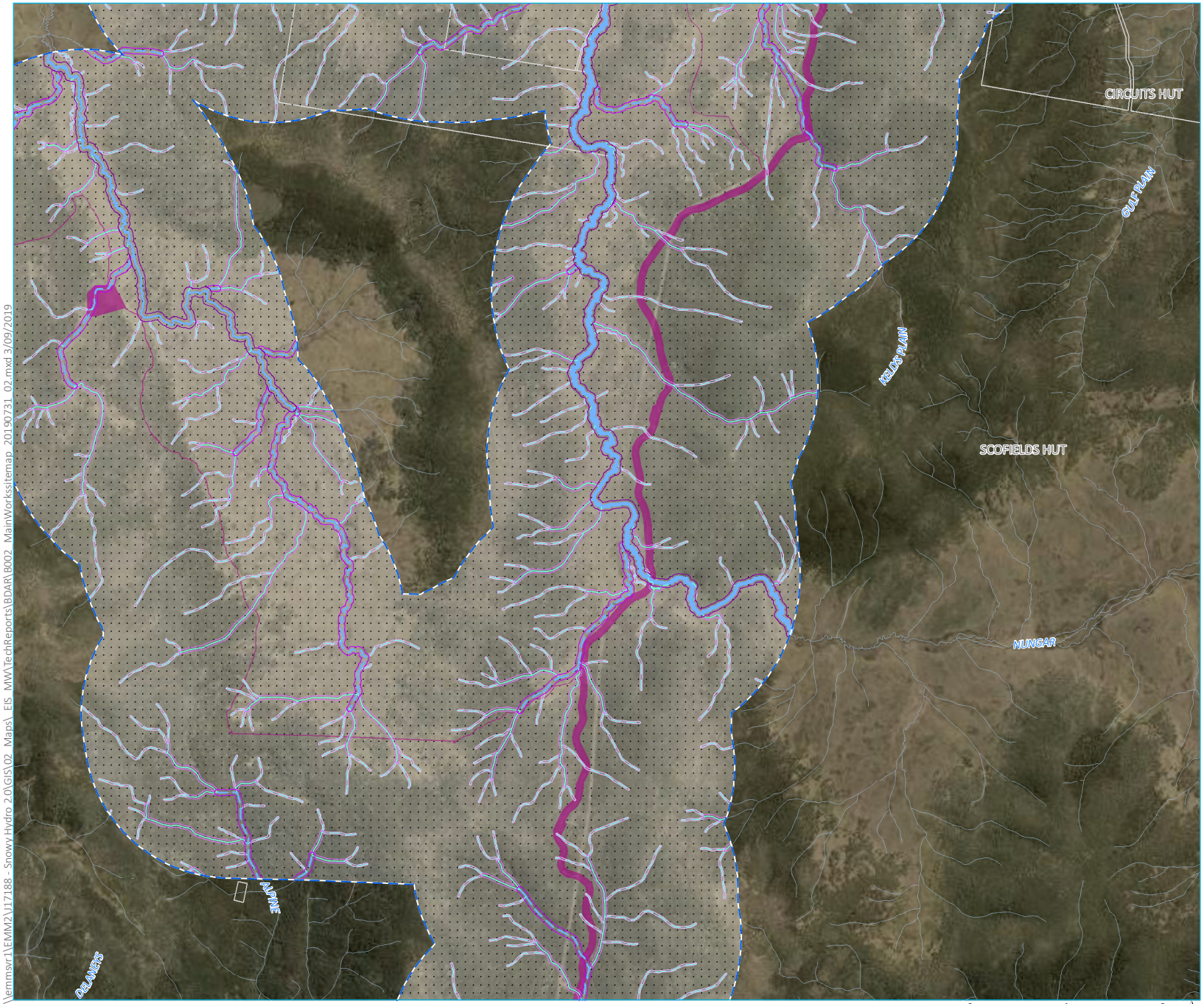

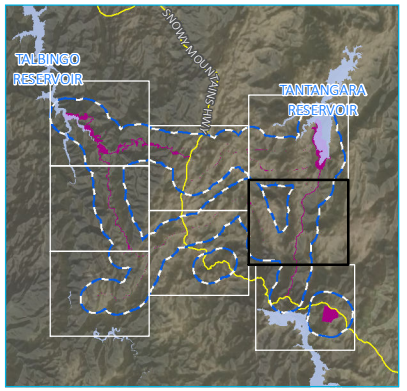

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- Cadastre

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Source: EMM (2019); Snowy Hydro (2019); LPI (2019); SMEC (2019); DFSI (2017); GA (2015); LPMA (2011); OEH (2014, 2016); DPI (2013)

0 1 2 km

GDA 1994 MGA Zone 55

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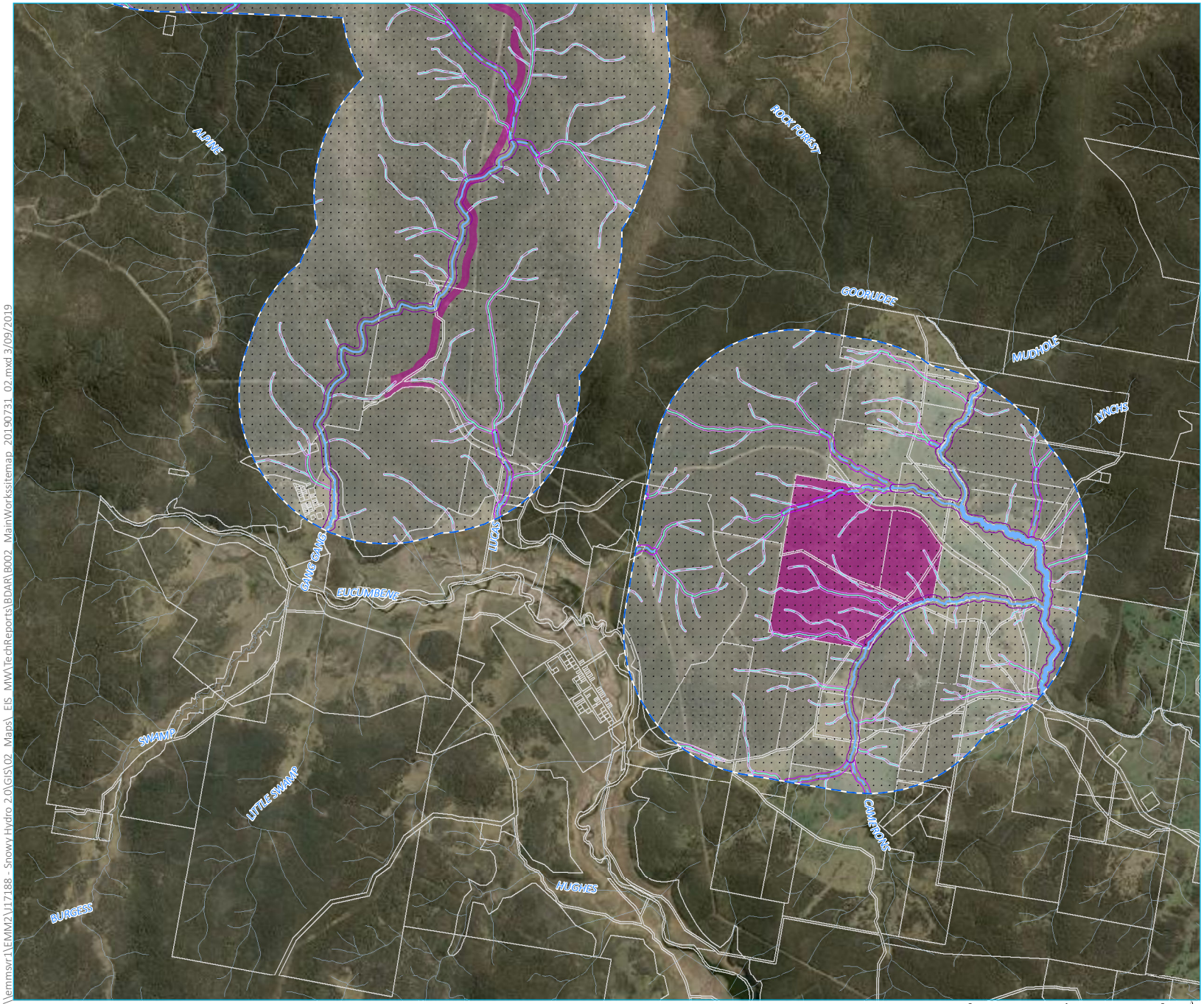
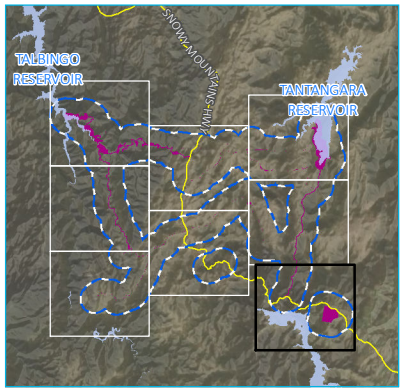
Site map, Main Works

Snowy 2.0
Biodiversity development assessment
Main Works
Figure 4.2 g

snowy 2.0

EMM creating opportunities





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- Cadastre

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GDA 1994 MGA Zone 55

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Site map, Main Works

Snowy 2.0
Biodiversity development assessment
Main Works
Figure 4.2 h

snowy 2.0

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