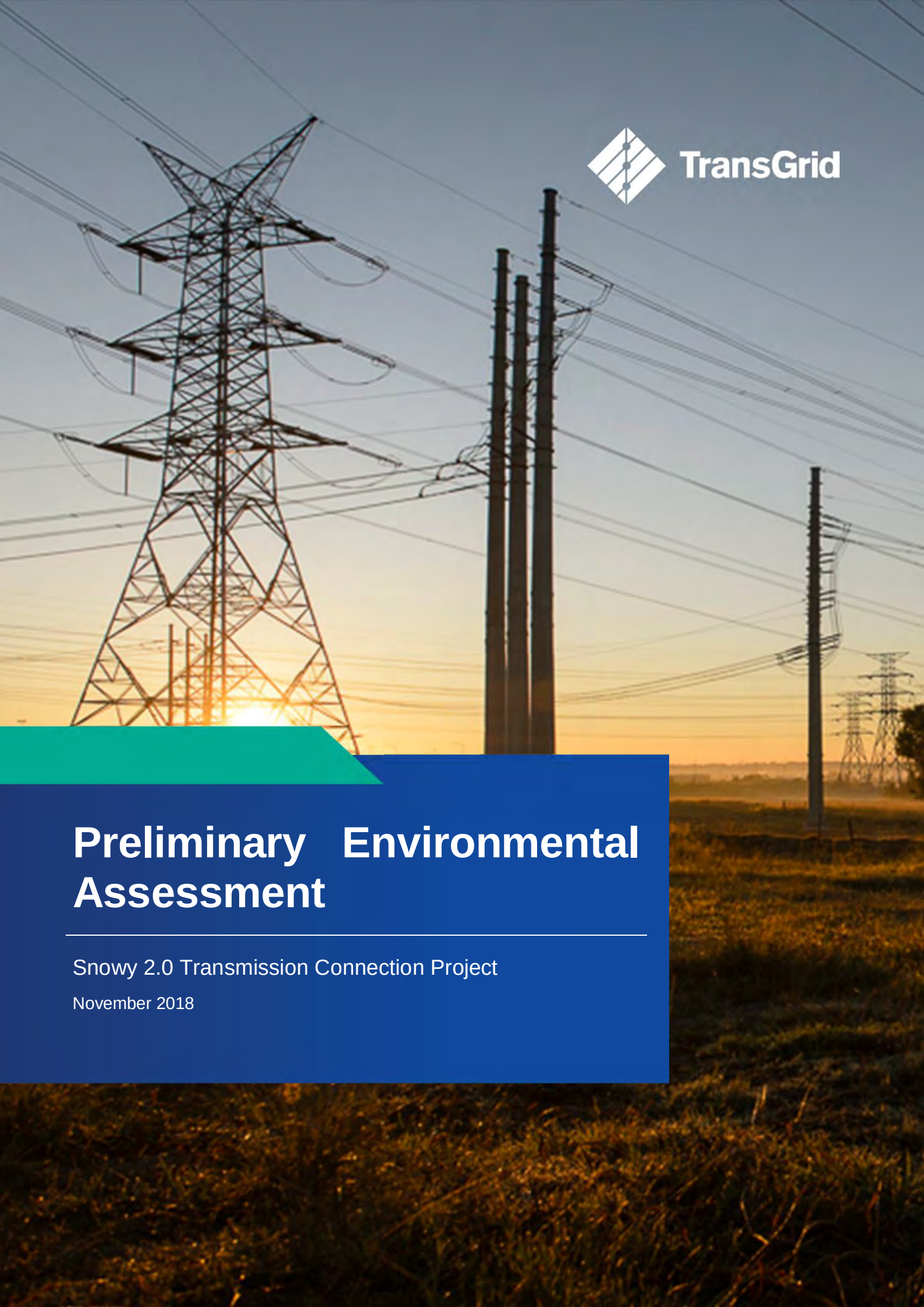


Preliminary Environmental Assessment

Snowy 2.0 Transmission Connection Project

November 2018

Executive Summary

Introduction

This Preliminary Environmental Assessment (PEA) is submitted on behalf of TransGrid in support of an application for the development of the Snowy 2.0 Transmission Connection Project (the Project). The Project is the first phase of SnowyLink North which has been identified as a priority transmission project in the *NSW Transmission Infrastructure Strategy* (DP&E, 2018).

TransGrid is the operator and manager of the electricity transmission network in NSW and the ACT, enabling more than three million homes and businesses to access a safe, reliable and affordable supply of electricity.

The primary purpose of the Project is to connect the proposed Snowy 2.0 pumped hydro and generation project (Snowy 2.0) to the existing high voltage transmission network. Connecting Snowy 2.0 to the transmission system would result in up to 2,000 megawatts (MW) of additional generation being made available to the NSW electricity market and at full capacity, large-scale energy storage for about 175 hours (or 350,000 megawatt (MW) hours).

The Project

The Project would involve the construction and operation of new electricity transmission lines and an electricity substation to the west of the Talbingo Reservoir to connect Snowy 2.0 to the existing electricity transmission network at Nurenmerenmong, east of Tumbarumba.

The scope of the application made by TransGrid for the Project under Part 5, Division 5.2 of the EP&A Act and the basis for this PEA is as follows:

- A new 330/500kV substation, to the west of the Talbingo Reservoir near the existing 330kV transmission line 64 (Line 64)
- Two new 330kV double-circuit transmission lines, with easements, from the connection site with the Snowy 2.0 underground cable to overhead line termination (Snowy 2.0 cable yard) to the new substation
- Transmission line connection between the 330/500kV substation and the existing Line 64
- Establishment and upgrade of access tracks and roads to the new substation and transmission line structures, as required
- Ancillary activities, including brake and winch sites, crane pads, helicopter landing pad, site compounds and equipment laydown areas.

Environmental Assessment

This PEA has been prepared to support an application for the Minister's approval under Part 5, Division 5.2 of the EP&A Act, for the development of this critical SSI project. The PEA is intended to inform the preparation of the Secretary's Environmental Assessment Requirements (SEARs) for an Environmental Impact Statement (EIS) for the Project.

Given the largely undisturbed nature of the site and predominant recreational and tourist uses of the area, most environmental issues would require some level of assessment in the EIS. Key issues for the environmental planning and impact assessment of the Project, identified on the basis that they are both most likely to occur and represent the greatest change to the existing environment, are as follows:

- Terrestrial ecology
- Aboriginal and non-Aboriginal heritage
- Landscape character and visual amenity
- Traffic and access.

Other issues requiring assessment but considered less likely to result in significant impacts, either based on lower likelihood of occurrence or absence of likely receptors, are as follows:

- Soils and water quality
- Land use
- Electromagnetic fields
- Bushfire
- Air quality
- Waste
- Social and economic
- Noise.

As part of the preparation of the EIS, additional assessments would be carried out in conjunction with the further development of the project design. In assessing the Project, the key focus would be avoidance and minimisation of impacts on the environment and local communities, where reasonable and feasible, when taking into consideration engineering constraints and cost implications. The assessment would also identify mitigation and management measures to minimise impacts on the environment during construction and operation of the Project.

Contents

List of Tables

List of Figures

Document Preparation History

Revision	Date	Description	By	Review	Approved
Rev 1	1/6/2018	Draft PEA	A Bowden, Thomas Muddle and Tina Donovan	K Collings	K Collings
Rev 2	05/07/2018	Addressing comments	Tina Donovan	K Collings	K Collings
Rev 3	14/09/2018	Addressing review comments	Tina Donovan	K Collings	K Collings
Rev 4-5	04/10/2018	Including additional information	Tina Donovan	Tina Donovan	Tina Donovan
Rev 06	18/10/2018	Addressing review comments	Tina Donovan	K Collings	K Collings
Rev 07	06/11/2018	Addressing final comments	Tina Donovan	K Collings	K Collings

1. Introduction

1.1 Snowy 2.0 Transmission Connection Project

The critical State Significant Infrastructure (SSI) Application Report and this Preliminary Environmental Assessment (PEA) are limited to the assessment of the construction and operation of new electricity transmission lines and an electricity substation to the west of the Talbingo Reservoir to connect the proposed Snowy 2.0 pumped hydro and generation project (Snowy 2.0) to the existing electricity transmission network at Nurenmerenmong, east of Tumbarumba.

The Project is the first phase of SnowyLink North which has been identified as a priority transmission project in the *NSW Transmission Infrastructure Strategy* (DP&E 2018). The Strategy among other things aims to unlock more power from the Snowy Hydro Scheme by augmenting to the transmission network. Approval for subsequent phases to develop SnowyLink North would be sought under separate applications.

The Snowy 2.0 Transmission Connection Project (the Project) includes:

- A new 330/500kV substation, to the west of the Talbingo Reservoir near the existing 330kV Line 64 (Line 64)
- Two new 330kV double-circuit transmission lines, with easements, from the connection site with the Snowy 2.0 underground cable to overhead line termination (being the Snowy 2.0 cable yard) to the new substation
- Transmission line connection between the 330/500kV substation and the existing Line 64
- Establishment and upgrade of access tracks and roads to the new substation and transmission line structures, as required
- Ancillary activities, including brake and winch sites, crane pads, helicopter landing pad, site compounds and equipment laydown areas.

The location, and key aspects of the Project are illustrated in **Figure 1-1** and **Figure 1-2**.

The following areas are discussed throughout the PEA and are defined as:

- Study area: The study area includes the likely Project impact area base on the preferred option with a 500 metres buffer. This area includes the potential locations of a new 330/500kV substation, 120 metres-wide easement for the 330kV double-circuit transmission lines from the Snowy 2.0 cable yard to the new substation (see **Figure 1.2**). All of the ancillary activities including brake and winch sites, crane pads, helicopter landing pad, site compounds and equipment laydown areas would be within the 500 metre buffer. This will be the study area that will be assessed in the EIS
- Survey area: The survey area is a much larger area that was investigated for the route selection process and field investigation during the preparation of the PEA (refer to **Figure 1-1)**. The survey area includes the study area.

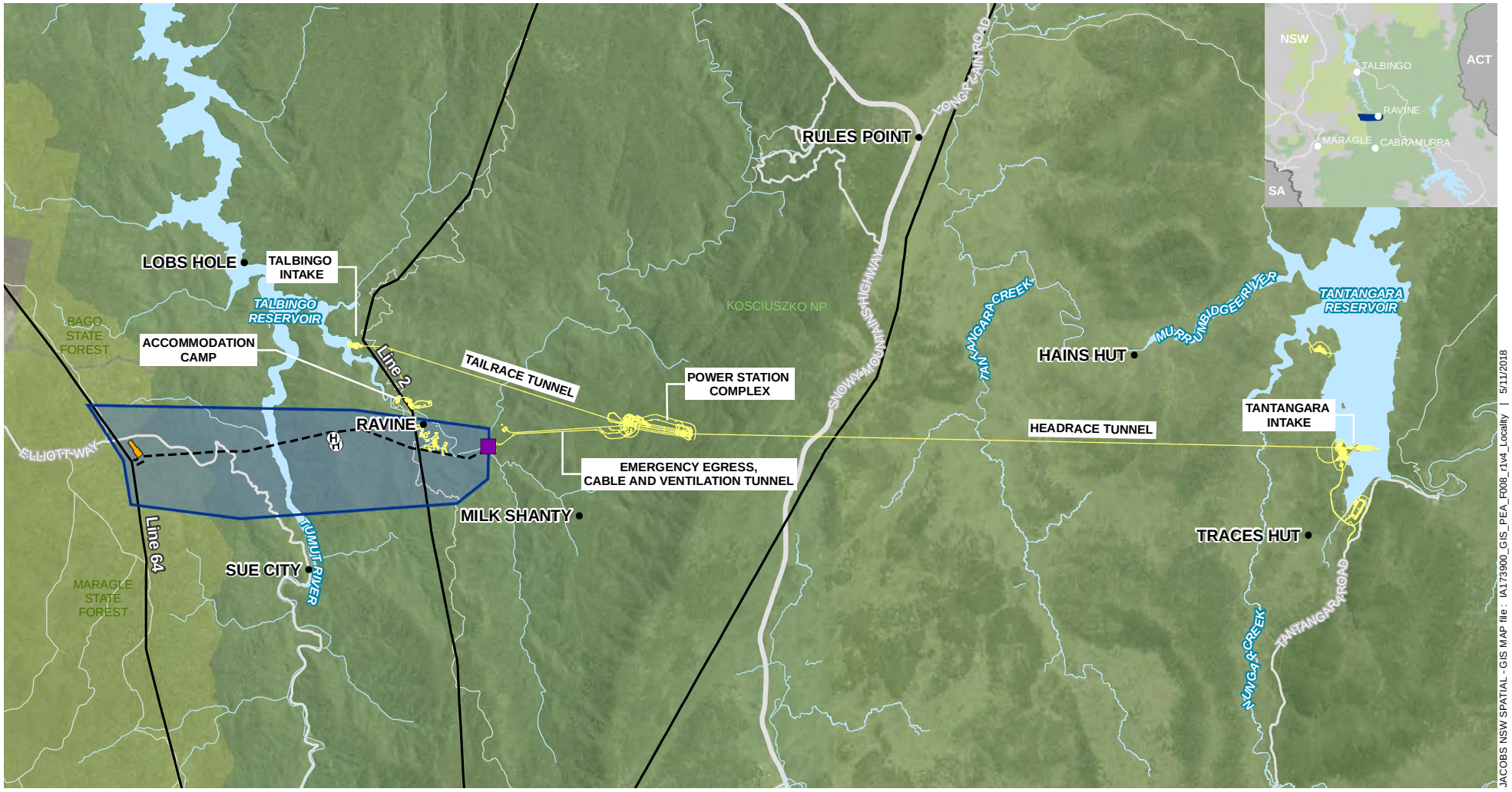


Figure 1.1 | Locality, study area, survey area and preferred option

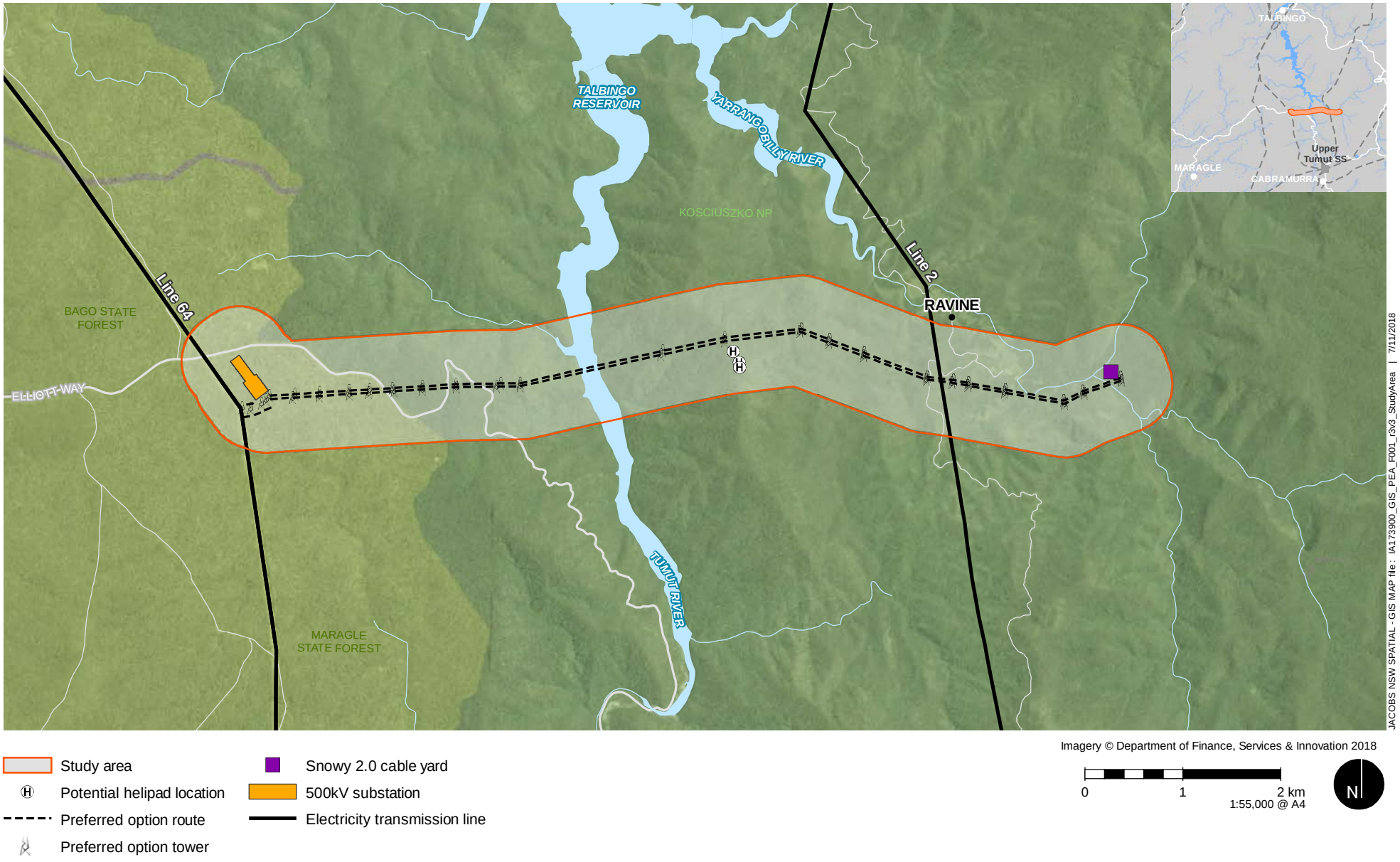


Figure 1.2 | Key components of the Project and study area

1.2 Project Need

Snowy 2.0 is being proposed by Snowy Hydro Limited (Snowy Hydro) to provide up to 2000 megawatts (MW) of generation capacity and at full capacity, large-scale energy storage for about 350,000 MW hours. There is a fundamental requirement that generation plants need to be connected to the transmission network to be able to operate within the electricity market. In addition, a pumped hydro scheme requires the supply of electricity to enable the pumping of water to its reserves.

This assessment considers the proposed direct electrical connection of Snowy 2.0 into TransGrid's existing transmission network. This Project need is therefore a direct response to the proposed Snowy 2.0.

Snowy 2.0 and the Transmission Project were declared critical SSI on 7 March 2018 under *State Environmental Planning Policy (State and Regional Development) 2011* (SRD SEP), and comprise a program of developments. Snowy 2.0 is currently the subject of a separate application and environmental assessment, being proposed by Snowy Hydro.

Each development within the Transmission works as described in the critical SSI declaration, would be subject to separate applications and subsequent detailed environmental assessment and approval. This PEA is for the *'construction and operation of new electricity transmission lines and an electricity substation to the west of the Talbingo Reservoir to connect Snowy 2.0 to the existing electricity transmission network at Nurenmerenmong, east of Tumbarumba'*, as described in Schedule 5 of the SRD SEPP. In the event that Snowy 2.0 does not proceed, the Transmission Project would not be required.

1.3 Overview of Snowy 2.0 and Transmission Project

The New South Wales (NSW) energy system and broader National Electricity Market (NEM) is facing major and unprecedented challenges through rising energy costs, deterioration in energy system security and reliability, and a transition in the generation mix away from coal-fired, dispatchable, base-load power to intermittent renewable wind and solar power.

For the most part, the NEM's current energy mix has been able to cope with the increasing level and uncertain variations in the delivery of the intermittent renewable wind and solar power. However, this would change as these intermittent sources become a larger proportion of the total generation as the NEM energy mix transition continues. As the amount of the variable renewable energy increases in response to economics and retiring coal-fired power stations, energy storage and dispatchable generation would play an increasingly vital role in ensuring the continued provision of reliable and cost efficient energy generation. At the same time, accommodating the intermittency of variable renewable energy generation and having energy generation capacity available when needed.

Snowy Hydro is pursuing Snowy 2.0, which is a pumped hydro-electric storage and generation project to help address the abovementioned challenges. Snowy 2.0 involves linking Talbingo and Tantangara reservoirs within the existing Snowy Mountains Hydro-electric Scheme (Snowy Scheme), and building an underground power station between the two reservoirs. This would increase the current Snowy Scheme generation capacity by almost 50%. The increased quick-start generation and large-scale storage capacity provided by Snowy 2.0 would increase the security and reliability of the NEM.

Snowy 2.0 would be supported by a direct connection to the NSW transmission system (this Project) and by augmenting TransGrid's NSW transmission system (collectively referred to in Schedule 5 of the SRD SEPP as the Snowy 2.0 and Transmission Project). This Project is one of the proposed developments that forms the Snowy 2.0 and Transmission Project. The current transmission network that connects the existing Snowy Scheme was not established to accommodate the expected capacity of the Snowy 2.0. Therefore, transmission augmentations are required to enable the dispatch of additional electricity generated by Snowy 2.0. If Snowy 2.0 were to proceed without additional transmission augmentation it would further exacerbate existing transmission constraints and limit the economic benefits of all existing generators including the existing Snowy Scheme and proposed Snowy 2.0.

The transmission augmentations would therefore ensure that the transmission system has the capacity to efficiently and reliably transmit the additional 2000 MW of renewable energy from Snowy 2.0 to major load centres during periods of peak demand, as well as enable a supply of renewable energy to charge the Snowy 2.0 'battery' during periods of low demand. The transmission augmentations would have the additional benefit of enabling the future expansion of other renewable energy developments across NSW by providing reliable transmission paths across the network, and also providing access to Snowy 2.0 for large capacity storage.

Combined, the Snowy 2.0 and the Transmission Project would be able to dispatch electricity at virtually any time to meet energy demand, and would facilitate an orderly transition to a decarbonised and secure energy system for NSW and the broader NEM.

1.4 The proponent - TransGrid

TransGrid operates and manages the high voltage transmission network in New South Wales and the Australian Capital Territory, connecting generators (including the existing Snowy Scheme) to distributors and major end users. TransGrid's core role is to connect electricity consumers to a safe, secure and reliable network. TransGrid's transmission network is strategically and optimally positioned to service the significant additional power output from Snowy 2.0.

2. Selection of preferred project

2.1 Identification of preferred solution

The primary requirement of the solution is to provide a high voltage connection from the Snowy 2.0 cable yard into TransGrid's transmission network.

As part of the Snowy 2.0 feasibility and design work, Snowy Hydro determined:

- The location of the Snowy 2.0 cable yard to be at the Lob's Hole Ravine area, as a result of engineering requirements and geotechnical constraints
- The voltage that needs to transition from the cable yard onto transmission lines will be at 330kV
- That four 330kV connections are required.

These aspects of Snowy 2.0 are under the control of Snowy Hydro and subject to their separate justification and EIS.

Connection to Line 2 presents the closest connection into TransGrid's existing network being located approximately 1.7 kilometres west of the Snowy 2.0 cable yard. Line 2 is a 330kV line, which runs north-south between Upper Tumut 330 kV switching station and Yass 330 kV substation, refer to **Figure 1-1**. Future transmission line augmentation works (not part of this PEA) are required to distribute the full 2000 MW capacity of Snowy 2.0 across TransGrid's network. Consequently, cutting into Line 2 would require the establishment of a 330/500 kV substation at the cut-in point, which would be located within Kosciuszko National Park. In addition to this, future 500kV lines would need to be built to transmit the full capacity of Snowy 2.0 resulting in the need for additional future clearing within Kosciuszko National Park and long term future disruptions within the Park associated with construction activities. Consequently, connection into Line 64 was identified as the preferred option as future line augmentation works to meet the Snowy 2.0 generation capacity would be located outside of Kosciuszko National Park.

In conjunction with Snowy Hydro, TransGrid has determined that the deeper transmission augmentations (as discussed in **Section 1.3**) are likely to be 500kV. A 330/500kV substation would therefore be required to transform the voltage from 330kV to 500kV. Up to three 500/330 kV transformers would be installed to allow for continued operation of Snowy 2.0 during maintenance and as a backup if a transformer were to fail. This provides an initial set of requirements that need to be met by any proposed solution (i.e. the Project).

2.1.1 Underground versus overhead transmission

For the construction of overhead lines, clearing of vegetation is predominately limited to around structures and in selected areas to limit ground/tree clearance under transmission lines to reduce the risk of bushfire. Overhead lines can be strung high across gullies and environmental sensitivities, resulting in options to reduce potential vegetation clearance and to assist in avoiding site specific impacts.

The construction of underground high voltage transmission cables requires:

- Full vegetation clearing (including root removal) along the entire length of the cable easement for construction purposes
- Extensive open-cut excavations along the entire length of the easement to construct the form work to support the cables
- Significant volumes of concrete to construct cable trenches
- Establishment of access tracks for very large cable drums to be delivered to site.

Most significantly, the terrain in which the transmission connection is proposed to be built is on a steep incline. To safely construct cables trenches, the cable route would wind slowly up the escarpment. Further, as underground cables are not able to easily turn, the total length of the route, with full easement clearing and excavations would become much longer than an overhead option.

Underground cables are also significantly more expensive to procure and construct.

In conclusion, an underground cable option would:

- Take a longer route through Kosciuszko National Park
- Result in more environmental impact
- Make the Project uneconomical.

Overhead lines can also be strung using helicopters if required. This inherently also makes the overhead line option safer to construct.

The option of underground cables was therefore not considered further due to the high additional cost and greater impact to safety and the surrounding environment as opposed to an overhead line option.

2.1.2 Preferred solution

The preferred solution consists of four overhead 330kV transmission lines, from the Snowy 2.0 cable yard (a predefined location) to a new 330/500kV substation (with up to three transformers) and connecting into Line 64.

2.2 Selection of preferred sites and routes

The extent of the site and route selection survey area was constrained by the location of the Snowy 2.0 cable yard in the east, and Line 64 in the west. A survey area between the Snowy 2.0 cable yard and potential substation locations near the existing Line 64 was investigated at a desktop level. The following feasibility criteria were considered for the desktop study:

- Constructability
- Cost effectiveness
- Acceptability to stakeholders
- Significance of environmental impacts
- Operability and maintainability.

Selection of the preferred Project design gave consideration to different options, which are further discussed below.

2.2.1 Substation site selection

The preferred location of the 330/500kV substation was constrained in the west by Line 64, topography to feasibly construct a substation footprint of about 12.5 hectares in size, and the preference to be located outside of the National Parks Estate.

An initial location for the substation, Option S1 “Long Creek” was considered near the intersection of Line 64 and Line 66 north of Nurenmerenmong (refer to **Figure 2-1**). This location was ruled out due to the physical restrictions involved in transporting up to three 330/500kV transformers to this location some distance from the existing road network.

Therefore, a decision was made to locate the substation as close as possible to the Elliott Way, which is a sealed road located near to Line 64. Following a review of topography, Option S2 “Maragle” was identified as a suitable alternative location.

A short transmission line tee would be required to create a 330kV connection between the substation and Line 64.

Detailed site plans would be finalised as part of the detailed design process for the Project.

2.2.2 Transmission line structure selection

Four transmission circuits would be required to transmit the full generation of 2000 MW from Snowy 2.0 into TransGrid’s network, including provision for an outage of one of the four circuits. The most efficient way to arrange the circuits is as a dual double-circuit transmission line design, where each structure supports two complete circuits, in the same easement width as a single circuit structure. Dual double circuit transmission

lines would maintain the reliability of the connection even if there is some damage to part of the transmission line.

As the preferred option is the dual double circuit 330 kV transmission line, from an engineering perspective steel lattice towers are the only feasible structure type option. The steel lattice towers also provide a solution to accommodate snow and ice loads and span across the river as well as providing stability.

2.2.3 Transmission line route selection

Connection to Line 64

The early initial scope provided for the development of route options, which required three double circuit 330kV lines to connect the Snowy 2.0 cable yard with a substation site near the intersection of Lines 64 and 66 (Option S1). On this basis, a desktop study and on-site investigation was conducted, and two feasible route options were developed (T1 and T2). Further assessment of these options ceased when the substation was moved to Option S2. Around this time Snowy Hydro indicated that the location of the Snowy 2.0 cable yard would be moved further to the east.

Three possible route options were considered between the proposed Snowy 2.0 cable yard and the preferred substation site (Option S1). Options T3-5 are shown in **Figure 2-1**.

Option T4 was found to be very constrained with difficult access and therefore was not considered further. The northern of the three options, Option T3, allowed for a feasible access track route enabling tower construction and transport of materials, and became the preferred option as it provided the following advantages:

- The largest area to safely erect the towers at either side of the Talbingo reservoir crossing
- Minimised environmental impact by taking the shortest route
- Avoidance of a planned helicopter pad for Snowy 2.0 near Lobs Hole.

This preferred route (Option T3) and an alternative route (Option T5) were discussed with NPWS representatives, who confirmed their agreement for the preferred route due to the following considerations:

- The preferred route travels through lower terrain, reducing visual impact, especially where taller vegetation would provide greater visual screening from surrounding vantage points such as the Wallace's Creek Lookout
- The preferred route requires fewer and shorter access tracks, several of which run near or in under the proposed transmission line, resulting in a smaller footprint and less impact during construction and maintenance than a perpendicular track.

Option T3 was therefore identified as the preferred transmission line route.

Detailed route plans would be finalised as part of the detailed design process for the Project. It should be noted that any modifications to the location of the Snowy 2.0 cable yard, would result in modifications to the transmission connection route.

2.2.4 Ancillary Works

Access Tracks

New access tracks are required to provide access to each transmission structure for construction and ongoing maintenance activities. At the suggestion of NPWS, access tracks would be located on the northern side of ridges where possible, where soil tends to be less erosive, and there is generally less vegetation present.

Helicopter landing pad options

One helicopter landing pad may be required to facilitate construction activities in the steepest part of the study area. There are three potential locations for the helicopter landing pad as shown on **Figure 1-2**. All three potential helipad options are located at the top of Sheep Station ridge. The preferred option for the helicopter landing pad would be selected during detail design

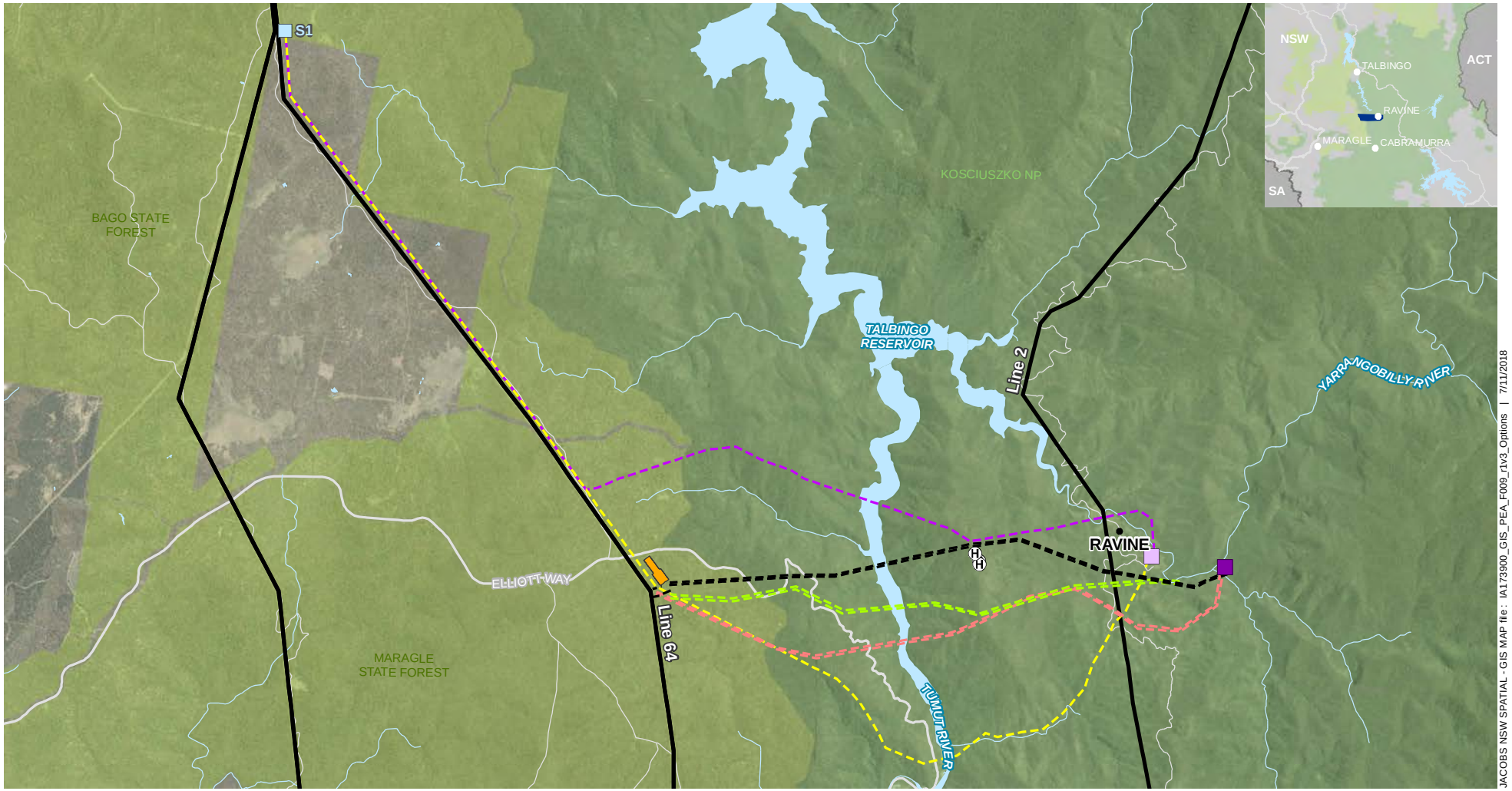


Figure 2.1 | Options considered

3. The Project

3.1 Overview of the Project

The Project would involve the construction and operation of new electricity transmission lines and an electricity substation to the west of the Talbingo Reservoir to connect the proposed Snowy 2.0 to the existing electricity transmission network at Nurenmerenmong, east of Tumbarumba.

The key components of the Project include (refer to **Figure 1-2**):

- A new 330/500kV substation, to the west of the Talbingo Reservoir near the existing Line 64
- Two new 330kV double-circuit transmission lines, with easements, from the connection site with the Snowy 2.0 cable yard to the new substation. Each line would be comprised of about 22 steel lattice towers
- Transmission line connection consisting of about three towers between the substation and Line 64
- Establishment and upgrade of access tracks and roads to the new substation and transmission line structures, as required
- Ancillary activities, including brake and winch sites, crane pads, helicopter landing pad, site compounds and equipment laydown areas.

3.2 Key Components of the Project

Table 1: Summary of key components of the Project

Component	Description
330/500kV substation	The substation footprint is expected to be in the order of about 500 metres by 300 metres. The substation equipment would be built on a new substation bench. The substation area would be fully fenced. The proposed substation would include up to three new 500/330kV transformers, two 500kV reactors, a switchyard to accommodate 330kV switchbays connecting the transmission lines from Snowy 2.0 cable yard, and 330kV switchbays connecting the existing network (Line 64). There would also be 500kV switchbays installed to facilitate the future deeper transmission augmentations. Civil work would include provision of drainage, oil containment, fencing, cable routes and footings for all new outdoor equipment. Buildings required on site would include a Secondary Systems Building and an Auxilliary Services Building to house the new secondary systems and amenities, respectively. The lighting for the substation would be designed to comply with the TransGrid substation design manual requirements. The Network Security Standard lighting on site could be up to 15 lux throughout the yard and at worst case could be on all night. A new access road and gate would be required to access a new site compound off Elliot Way. This access road would split in two to form two access paths into the new switchyard. Vegetation clearing and pruning would be required to facilitate the above substation works. There would also be an asset protection zone (APZ), cleared of vegetation, extending about 40-50 metres from the substation fence. This APZ would potentially be used as a construction compound/laydown area for the construction of the substation.

Component	Description
330kV Transmission Lines	The two new 330kV double-circuit transmission lines would extend approximately nine kilometres from the proposed Snowy Hydro 2.0 cable yard in the east of the route to Line 64 in the west. The transmission lines cross over Tumut River portion of the Talbingo Reservoir at a height of about 150 metres. The transmission lines are proposed to be comprised of about 22 steel lattice towers per line (about 44 in total). Each tower would be approximately 50 metres in height supporting two circuits (comprising six to twelve conductors), and two overhead optical ground wire (OPGW) to facilitate communications and protection of the line. The towers would be designed to handle ice and snow loads. The distance between structures would be designed to manage the sag and swing movement of suspended conductors. An indicative configuration of the steel lattice towers is shown in **Figure 3-1** and **Figure 3-2**. The footings of each tower would cover an approximate area of 15 square metres, which covers the area that the footings would reside within (i.e. combination of piles and/or cruciform concrete footings). Additional disturbance at each tower site to facilitate tower assembly and stringing may be required.
Transmission easements	The transmission lines will be supported by an easement, which provides a right of access to construct, maintain and operate the assets. The easement also identifies the zone of initial vegetation clearance and on-going vegetation management to ensure safe electrical clearances during the operation of the lines. The standard easement width for 330kV transmission lines is 60 metres. The transmission lines would be paralleled where possible therefore requiring an easement of up to 120 metres. Any vegetation within the easement, with a potential mature height that could come within nine metres below the height of the lowest conductor would need to be removed. Where clearance between mature trees and conductors of the transmission line is more than nine metres, vegetation clearance in the transmission line span may not be required. Opportunities to overlap the easements and reduce clearing widths would be considered during detailed design.
Access tracks and roads	The access strategy for the Project is to use existing roads and new access provided in association with the Snowy 2.0 Exploratory Works and Snowy 2.0 to the greatest extent possible and otherwise implement the minimum upgrades and improvements necessary to facilitate the safe movement of plant, equipment, materials and construction staff. The eastern end of the Project would be accessed via Lobs Hole Ravine Road and Mine Trail Road. These roads are proposed to be upgraded for the Snowy 2.0 Exploratory Works and no further upgrades are expected to be required to facilitate access for the Project. The proposed upgrades are described in the *Exploratory Works For Snowy 2.0 - Environmental Impact Statement* (Snowy 2.0 Exploratory Works EIS) (EMM, 2018) and do not form part of the Project. The western end of the route would be accessed via Elliot Way. It is likely that some civil upgrade work would be required to facilitate the interface point (i.e. exit/entry slip/turning lanes) between the substation access road and Elliot's Way. New access roads and tracks would also be required to allow for vehicles, plant, machinery and equipment to be transported to the work locations, including all

Component	Description
	transmission structures during the construction phase. Access tracks to each of the structure locations would be retained to facilitate ongoing maintenance activities at the structures and provide access during emergency events such as bushfire. The new access tracks and roads would be of suitable grade to allow deliveries of large equipment (such as tower structures) and allow for the turning radius of the delivery vehicles. Road base would be added where needed. The establishment of a linear access track along the transmission line easement to each structure location will not be feasible due to the complex terrain. The final layout of access tracks would be established as part of the detailed design process. Vegetation clearing and pruning would be required to facilitate the above access works. The Snowy 2.0 Exploratory Works EIS also proposes the establishment of wharves on Talbingo Reservoir to support the transport of materials and equipment. The detailed construction planning would determine the need for the use of these wharves to facilitate the construction of this Project.
Construction compounds	The Project is likely to require the establishment of two construction compounds to support the construction of the eastern and western sections of the Project. The western compound would be established in the immediate vicinity of the proposed substation and be accessed via Elliot Way. It is expected that this construction compound could be located within the substation APZ which would be required to be cleared of vegetation. The eastern compound of about 50 square metres, would be established near the construction compounds associated with Snowy 2.0 and be accessed via Lobs Hole Ravine Road. This site has been previously disturbed and minimal clearing would be required for this site. A number of smaller construction laydown areas and works areas would be required within the Project impact area, typically within the proposed easements, to support construction of individual towers and stringing of transmission lines including worksites at each tower, brake and winch sites, crane pads, equipment laydown areas and concrete supply / batching. Specific locations would be established as part of the detailed design and construction planning process.
Helicopter landing pad	To help facilitate construction of the Project, helicopters may be used to deliver materials, install structures and string the overhead transmission lines. To enable helicopters to operate safely and allow easy access to the site, a helicopter landing pad would be required. The preferred location for the helicopter landing pad is to be cut into the top of Sheep Station Ridge. The area of vegetation clearing required for the helicopter landing pad is about 30 metres by 30 metres, however, this would depend of the terrain and groundcover.

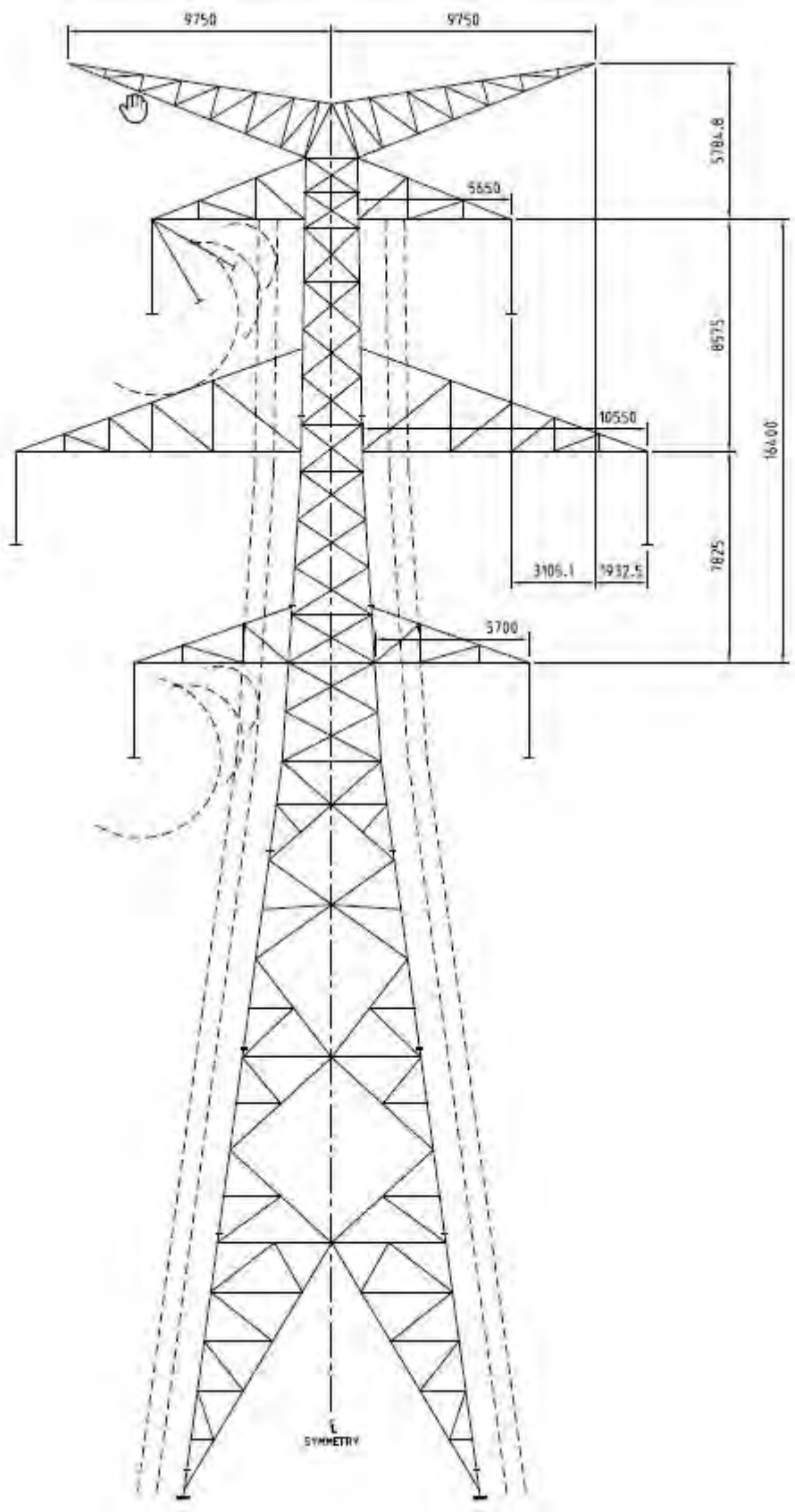


Figure 3-1 Indicative concept design for the suspension towers (About 50 metres in height)

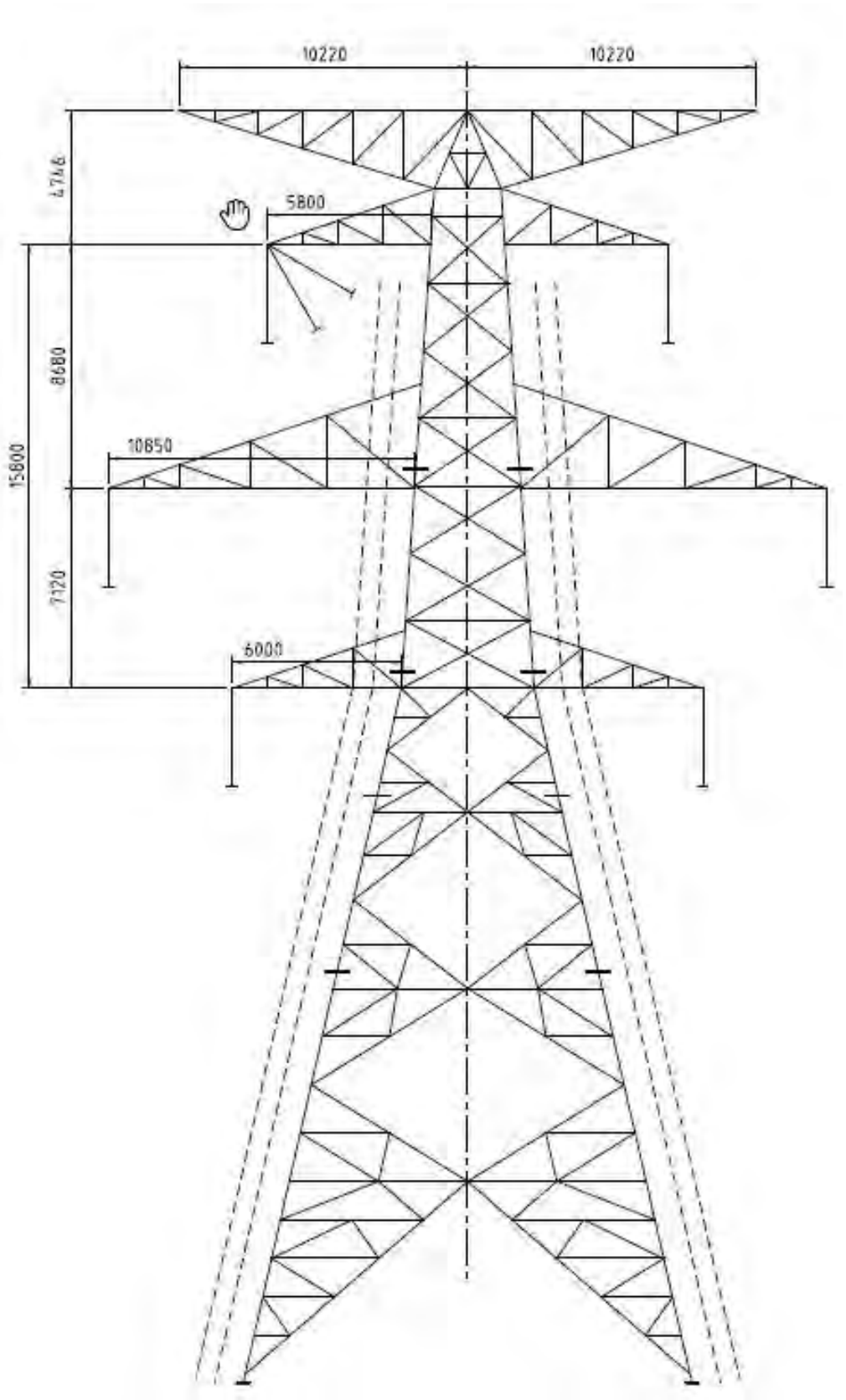


Figure 3-2 Indicative concept design for the tension towers (About 50 metres in height)

3.3 Construction Program

Construction of the substation and transmission connection would take approximately 19 months if compressed but may be staged over a three year period. The program driver is the requirement for the construction of the Project to be completed prior to Snowy 2.0 commencing operations (currently end 2024). Staging the work may allow TransGrid flexibility in its construction program to allow periods of reduced work during sensitive periods and to allow better coordination of construction activities with Snowy 2.0 within Kosciuszko National Park.

Construction of the transmission lines would involve the following activities associated with each tower:

- Access clearing crews of approximately 30 people would construct access tracks to accommodate safe access of construction machinery and materials to each tower site, clear the tower footprint and clear any necessary vegetation on the easement
- Foundation crew of approximately 15 people would construct the four footings at each tower site including boring and excavation, steel fabrication works and concrete pours
- Erection crews of approximately 15 people would install the towers using cranes and or helicopters.

Construction of the substation would involve the following activities:

- Access clearing crew of approximately 15 people would construct the substation access road and clear the substation site and APZ
- A compound area adjacent to the substation site of approximately 100 x 200 metres would be established for site sheds, ablution blocks, vehicle parking, stockpiling of soil, equipment and materials
- Civil benching crew of approximately 30 people would cut and fill the substation site using excavators and bulldozers
- Civil foundation crew of approximately 60 people would construct footings across the substation site for transformer compounds, oil containment tanks and all associated equipment footings including excavation, formwork and concrete pours
- Electrical installation crews of approximately 70 people would erect and install high voltage, secondary and communication equipment across the substation site including steel work, equipment install, cabling, wiring and conductor stringing
- Electrical installation crews of approximately 30 people would install the transformers in the substation site including delivery, installation, cabling and high voltage testing
- Electrical commissioning crews of approximately 30 people would test and commission all high voltage, secondary systems and communication equipment within the substation site.

Where possible, works would be undertaken during the standard construction hours outlined in the Interim Construction Noise Guideline (DECC, 2009), which are:

- Monday to Friday 7:00am to 6:00pm
- Saturday 8:00am to 1:00pm
- No works on Sundays or Public Holidays.

Work outside standard hours may be required for the following:

- Delivery for large plant and equipment may occur outside standard construction hours or as requested by police or other authorities for safety reasons
- Equipment and plant specific works (such as commissioning and testing) which may extend beyond the standard construction hours
- Network outages on Line 64 may be restricted and may require construction work to occur outside of standard construction hours.

4. Planning and Assessment Process

4.1 NSW legislation

4.1.1 Environmental Planning and Assessment Act 1979

The *Environmental Planning and Assessment Act 1979* (EP&A Act) and the *Environmental Planning and Assessment Regulation 2000* (EP&A Regulation) provide the framework for development and environmental assessment in NSW. The approval pathway that applies to a proposed development is determined by the EP&A Act and relevant environmental planning instruments such as State environmental planning policies (SEPPs) and in some cases the local environmental plan (LEP).

State significant infrastructure (SSI)

Under clause 14 of SRD SEPP, the Project is declared to be SSI as a result of the declaration of the Project as critical SSI under the SRD SEPP. The Project would therefore be assessed and determined as critical SSI by the Minister for Planning under Division 5.2 of the EP&A Act.

Critical state SSI declaration

Clause 16 of the SRD SEPP provides that:

Development specified in Schedule 5:

(a) may be carried out without development consent under Part 4 of the Act, and

(b) is declared to be State significant infrastructure for the purposes of the Act if it is not otherwise so declared, and

(c) is declared to be critical State significant infrastructure for the purposes of the Act.

Schedule 5 of the SRD SEPP lists:

9 Snowy 2.0 and Transmission Project

(1) The Snowy 2.0 and Transmission Project is a proposed program of works for the expansion of the generating capacity of the Snowy Mountains Hydroelectric Scheme and for associated upgrades and additions to the electricity transmission network. The object of this clause is to declare development for the purposes of the Snowy 2.0 and Transmission Project that is set out in this clause to be SSI and critical SSI.

(2) This clause applies to development on land in any of the following local government areas:

(a) Cootamundra-Gundagai Regional,

(b) Goulburn Mulwaree,

(c) Snowy Monaro Regional,

(d) Snowy Valleys,

(e) Upper Lachlan Shire,

(f) Yass Valley.

(3) ***Snowy 2.0***

Development for the purpose of pumped hydro and generation works to be known as Snowy 2.0 on land between Tantangara Reservoir and Talbingo Reservoir that involves:

(a) the carrying out of exploratory geotechnical works or engineering investigations, and

(b) the construction and operation of an underground hydroelectric power and pump station capable of supplying approximately 2,000 megawatts of hydroelectric power, and

(c) the construction of water and access tunnels, surge tank and intake and outlet structures at and between the two reservoirs.

(4) ***Transmission works***

Development that involves:

(a) the construction and operation of new electricity transmission lines and an electricity substation to the west of the Talbingo Reservoir to connect Snowy 2.0 to the existing electricity transmission network at Nurenmerenmong, east of Tumbarumba, and

(b) the construction and operation of new electricity transmission lines between the new substation at Nurenmerenmong and an existing substation at Bannaby, north of Marulan, and

(c) the construction and operation of new transmission lines between an existing substation at Khancoban and a location on the NSW-Victorian border generally south-west of Khancoban, and

(d) the augmentation of the existing substation at Bannaby.

(5) The development referred to in this clause does not include:

(a) the carrying out of surveys, sampling, environmental investigations, geotechnical borehole drilling, test drilling, test excavations, or other tests or investigations, for the purposes of feasibility assessment and the preliminary design of the Snowy 2.0 and Transmission Project, or

(b) the carrying out of works to upgrade or modify electricity transmission lines, works within existing switchyards, and the installation of communications infrastructure.

(6) ***Ancillary development***

Development that is ancillary to any other development in this clause, including the carrying out of works to upgrade or construct access roads, utilities infrastructure, construction accommodation, construction compounds and construction power supply.

The Project represents the works described in Schedule 5, clause 9, subclause 4(a) of the SRD SEPP. Accordingly, the Project is critical SSI which requires approval under Division 5.2 of the EP&A Act.

Development specified in Schedule 5 of the SRD SEPP:

- May be carried out without development consent under Part 4 of the EP&A Act
- Is declared to be SSI for the purposes of the Act if it is not otherwise so declared
- Is declared to be critical SSI for the purposes of the Act.

Permissibility

The declaration of the Project as critical SSI has the effect that the Project may be carried out without development consent under Part 4 of the EP&A Act

4.1.2 Other NSW Environmental Approvals

Under sections 5.23 and 5.24 of the EP&A Act, certain separate environmental approvals would not be required for the Project or would be required to be issued consistent with the planning approval granted for the Project. Each of these separate environmental approvals is considered in **Table 2**. Other environmental approvals may be required in addition to those referred to under section 5.23 and 5.24, and these would be considered where relevant as part of the EIS.

Table 2: Other NSW environmental approvals

Approval	Relevant to the Project	Comment
Approvals not required under section 5.23		
A permit under section 201, 205 or 219 of the *Fisheries Management Act 1994*	No	Not applicable to approved SSI or any investigative or other activities that are required to be carried out for the purpose of complying with any environmental assessment requirements in connection with an application for approval.
An approval under Part 4 or an excavation permit under section 139 of the *Heritage Act 1977*	No	
An Aboriginal heritage impact permit under section 90 of the *National Parks and Wildlife Act 1974*	No	
A bushfire safety authority under section 100B of the *Rural Fires Act 1997*	No	
A water use approval under section 89, a water management work approval under section 90 or an activity approval (other than a groundwater interference approval) under section 91 of the *Water Management Act 2000*	No	
Approvals required to be issued consistently under section 5.24		
An aquaculture permit under section 114 of the *Fisheries Management Act 1994*	No	This Project would not involve aquaculture.
Approval under section 15 of the *Mine Subsidence Compensation Act 1961*	No	The Project would not be located within a mine subsidence district.
A mining lease under the *Mining Act 1992*	No	The Project would not involve mining.
A production lease under the *Petroleum (Onshore) Act 1991*	No	The Project would not involve petroleum production.

Approval	Relevant to the Project	Comment
An environment protection licence under Chapter 3 of the *Protection of the Environment Operations Act 1997*	Maybe	The Project would not fall within one of the scheduled development categories listed in Schedule 1 of the *Protection of the Environment Operations Act 1997*. Ancillary activities that would require an EPL in the event that they exceed the criteria listed in Schedule 1 may include: > Concrete works (clause 13) > Crushing, grinding or separating materials (clause 16) > Land-based or water-based extractive activities, such as extraction, dredging, quarrying, processing or storage (clause 19) > Helicopter-related activities (clause 20).
A consent under section 138 of the *Roads Act 1993*	Yes	The Project may involve works within several road reserves to facilitate access upgrades for new and existing access tracks.
A licence under the *Pipelines Act 1967*	No	The Project would not involve the operation of a pipeline requiring a licence under the *Pipelines Act 1967*.

4.2 Commonwealth Legislation

4.2.1 Environment Protection and Biodiversity Conservation Act 1999

Under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), an action requires approval from the Commonwealth Minister for the Environment where that action would have a significant impact on a matter of national environmental significance (MNES).

A search of the EPBC Act Protected Matter Search Tool (PMST) for the Project with a 10 kilometre buffer was conducted in February 2018 to identify potential matters of MNES that may trigger the need for referral of the action to the Australian Department of the Environment and Energy (DEE). Updated searches were also carried out in September 2018. The results are presented in **Table 3**.

A preliminary assessment of potential impacts on MNES indicates that the Project is likely to affect several MNES. On this basis, TransGrid propose to refer the Project to DEE, and it is likely to be considered a Controlled Action.

Under section 26 of the EPBC Act, approval is also required for actions on, or that affect Commonwealth land, that would have a significant impact on the environment. A preliminary assessment of the Project indicates that impacts on, or that would affect Commonwealth land are unlikely.

Table 3: MNES under the EPBC Act

MNES	Matters within the survey area
World heritage properties	None
National heritage places	Australian Alps National Parks and Reserves natural listed place and the Snowy Mountains Scheme historic listed place.
Wetlands of international importance	Seven were recorded over 200 kilometres upstream. The survey area does not contain any of these wetlands of international importance.
Commonwealth listed threatened species and ecological communities	Thirty-six listed threatened species listed and three Threatened Ecological Communities (TECs) are listed to occur in the survey area. The TECs include: > Alpine Sphagnum Bogs and Associated Fens (Endangered) - known to occur within the survey area > Natural Temperate Grassland of the South Eastern Highlands (Critically Endangered) - likely to occur within the survey area > White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland (Critically Endangered) - may occur within the survey area.
Commonwealth listed migratory species	Eleven listed migratory species may occur in the survey area.
Nuclear action	The Project would not result in any nuclear action nor would any nuclear activity need to be undertaken.
Commonwealth marine area	There are no Commonwealth marine areas within the survey area.

5. Consultation

5.1 Consultation Undertaken

TransGrid is committed to an engagement process that is proactive, transparent and represents a genuine desire to work with our stakeholders. TransGrid recognises that two-way communication is the key to understanding the needs and views of stakeholders and communities that are directly and indirectly affected by its operations. Throughout the development of a project, TransGrid will consult effectively with interested parties so that project planning is informed by input from stakeholders and communities as appropriate.

Engagement during the development of the PEA has been focused on developing feasible route and site options with the two affected land managers – NPWS and Forestry Corporation. In addition to initial engagement with Department of Planning and Environment (NSW), and Department of Environment and Energy (Commonwealth), consultation has also commenced with the NPWS Snowy Advisory Committee and the Office of Environment and Heritage.

5.1.1 NPWS

The new transmission lines are primarily located with Kosciuszko National Park, which is managed by NPWS.

TransGrid has had several meetings with NPWS to discuss the Project, potential impacts, and sought input, data and requirements from them. In addition, TransGrid has had ongoing interaction with NPWS's Snowy 2.0 Project Manager, including for site investigations. TransGrid have also attended numerous site visits with NPWS in April 2018 to inform the design of the Project and seek feedback on the constructability and suitability of route options. NPWS were consulted on the transmission route options and the advice provided was critical to the selection of the preferred route through Kosciuszko National Park.

The Kosciuszko National Park's Plan of Management (the Plan) specifically identifies that all new transmission lines within the Park are to be underground. TransGrid discussed this with NPWS advising that the most feasible option with least environmental impact, is for the lines to be overhead. NPWS are generally supportive and understanding of the engagement and consultation undertaken, but requested additional information about the benefits and disadvantages of underground cable connections.

NPWS also advised that amendments to the Plan required consultation with their Advisory Committee, who would then make their recommendation to the relevant body.

NPWS Snowy Advisory Committee

The NPWS Snowy Advisory Committee (the Committee) includes a range of representatives from the general community. On 10 November 2017, TransGrid delivered a presentation to the Committee to start what will be an ongoing conversation about the Project and the environment/social impacts to the Park. The purpose of the consultation is to facilitate any necessary amendments to the Plan and seek early and ongoing feedback on the proposal.

The committee raised the following questions:

- While directional drilling under the river crossing may not be feasible, why not build a tunnel? Why not extend the Snowy 2.0 tunnel a little bit further? After all, all the machinery and expertise will already be on site.
- Can we use a submarine cable for the crossing?
- Can concrete (for the tower footings) be delivered by helicopter, to reduce the need for concrete trucks through the Park?
- Can we take construction and maintenance access by helicopter and completely avoid the need for access tracks? Or at least reduce the need to initially form tracks suitable for construction vehicles?

The key themes raised by the Committee, can be characterised as the desire to avoid surface disturbance and associated visual, ecological and heritage values, and traffic within Kosciuszko National Park associated with construction and ongoing operation of the Project.

TransGrid will provide consideration of options, including justification of the preferred option and construction methodology as part of the EIS.

5.1.2 Forestry Corporation

The western portion of the transmission lines, the new substation, and the connection with Line 64, are located within land managed by Forestry Corporation. TransGrid has commenced consultation with the Forestry Corporation associated with the construction and operation of the Project within the State Forest. Issues raised by the Forestry Corporation include:

- The clearing of a 120 metre wide easement through harvestable timber would be of major concern to the Forestry Corporation.
- Bago State Forest is managed with a mix of plantation areas and native forest areas. Forestry Corporation identified that it would be preferable for the native forest managed areas to be impacted, rather than the plantation areas
- There are also small pockets of flora reserves and swamps, which should be avoided
- Forestry Corporation were open to entering into data sharing arrangements
- Timber is harvested at a height of 35 metres. When considering the width of the easement, TransGrid need to also consider the non-plantation zone along the edge which is imposed to prevent trees falling over onto the conductors.

5.2 Future Consultation

Consultation would continue on specific environmental and community issues relevant to the Project to inform the preparation of the EIS. This stage of community and stakeholder engagement would continue to build on relationships established through early consultation activities and would complement formal consultation required under planning regulations.

Specific engagement activities would be coordinated to support the preparation of the EIS, including consultation activities that may be stipulated in the SEARs. These activities would be focused on providing potentially affected and interested members of the community and other stakeholders with information about the Project and also an opportunity to provide feedback. As investigations are progressed to inform the preparation of the EIS, local communities and stakeholders would be engaged, and feedback would be sought on key issues and concerns. These key issues and concerns would be considered and addressed where relevant in the preparation of the EIS.

The following community and stakeholder engagement mechanisms and activities would occur during the preparation of the EIS:

- Toll free community inquiry number
- Email address
- Project webpage
- Communications materials (newsletters, letters and fact sheets)
- eNewsletter
- Media and advertisements
- Social media
- Community information sessions
- Stakeholder and community group presentations and briefings.

6. Environmental Risk Screening

TransGrid recognises the need to carefully consider potential impacts on the environment and local communities, and to minimise these impacts wherever reasonable and feasible to do so. In taking this approach, the benefits of the Project can be realised with the least net cost to the environment and the public.

6.1 Identification of Key Environmental Issues

An initial screening of potential issues for consideration in the EIS has been undertaken, with the aim of facilitating the avoidance of impacts through the detailed design processes and determining the level of assessment likely to be required to adequately and appropriately address each issue. In undertaking the initial screening, consideration has been given to the significance of each potential environmental impact within the context of the Project location. The identification of key issues has involved ongoing consultation with stakeholders, investigations associated with route options assessment and consideration of available background information on the values and uses of the Kosciusko National Park in the vicinity of the Project.

This environmental issues identification aims to allow for the avoidance of impacts during the detailed design processes and the general prioritisation of environmental assessment issues based on potential significance. The process does not take into account the application of mitigation measures to minimise and manage potential impacts. In all cases, reasonable and feasible mitigation measures would be applied to the Project to minimise potential impacts. Mitigation measures would be developed during the assessment process and presented in detail in the EIS.

6.2 Summary of Environmental Issues

Given the largely undisturbed nature of the locality and predominant recreational and tourist uses of the area, most environmental issues will require some level of assessment in the EIS. Key issues for the environmental planning and impact assessment of the Project, identified on the basis that they are both most likely to occur and represent the greatest change to the existing environment, are as follows:

- Terrestrial ecology
- Aboriginal and non-Aboriginal heritage
- Landscape character and visual amenity
- Traffic and access

Other issues requiring assessment but considered less likely to result in significant impacts, either based on lower likelihood of occurrence or absence of likely receptors, are as follows:

- Soil and water quality
- Land-use
- Electromagnetic fields
- Bushfire
- Air quality
- Waste
- Social and economic
- Noise.

7. Preliminary Environmental Assessment

This section provides preliminary consideration of the identified environmental issues for the Project. In considering each of these issues, both through this PEA and through the future EIS for the project, the key focus has been and would continue to be avoidance of impacts, with residual implications for the environment and local communities mitigated and managed to ensure minimisation of impacts wherever reasonable and feasible. A balanced approach to impacts would be taken to deliver the least net cost outcome for this critical SSI project.

For the purposes of the PEA, the larger survey area for the route selection process was used, which covers the development footprint, the proposed EIS study area, and adjacent areas (that are unlikely to be impacted), refer to **Figure 1-1.**

7.1 Ecology

7.1.1 Existing Environment

A preliminary biodiversity assessment (Jacobs, 2018) has been undertaken and is attached as **Appendix A**. This involved undertaking desktop database searches and literature review, site visits and habitat assessment comparing the preferred habitat features of species identified through searches with the type and quality of the habitats known or predicted to occur in the survey area. Full details of the methodology and results are provided in **Appendix A**.

The Project is located across two bioregions: the South East Highlands bioregion and the Australian Alps Bioregion (Thackway and Cresswell, 1995), and is within the Bondo and Snowy Mountains sub-region of each.

The Project crosses a variety of landscapes as mapped by the NPWS (2002) and described by the NSW Department of Environment and Climate Change (2008) as follows from east to west:

- Pinbeyan - Ravine Ranges - Structurally controlled ranges with prominent bluffs to 120 metres and plateau top on a synclinal fold in Upper Devonian rhyolite, andesitic basalt, tuff, sandstone, shale, slate, limestone, conglomerate and siltstone. Elevation 500 to 1,400 metres, local relief 700 metres. Extensive rock outcrop. Steep debris slope below cliffs with rubbly brown sandy loam grading to red-brown texture-contrast soils on lower slopes
- Cootamundra - Tumut Serpentinite and Ultramafics - Narrow ridges of extended linear outcrops of Devonian schistose serpentine, amphibolite and associated ultramafic rocks and sediments, general elevation 400 to 700 metres, local relief 120 metres. Dark structured clay loam and clay with unusual mineral content
- Cabramurra - Kiandra Basalt Caps and Sands - Tertiary basalt flow remnants capping hills on the high plains. Fluvial quartz gravels, sands and silts of former river channels are exposed beneath the basalt. Soil materials and sediments from the basalt and quartz sands extend down slope over Ordovician meta-sediments or Silurian-Devonian granites toward the alpine valleys. Most basalt outcrops are columnar jointed and formed periglacial block streams during the Pleistocene. General elevation 1,400 to 1,650, local relief to 200 metres. Uniform and gradational, organic rich, brown clay loams, often stony
- Tooma Granite Ranges - Rounded hills, ranges and plateau on Silurian gneissic granite with well-defined rectangular drainage pattern controlled by jointing. General elevation 700 to 1400 metres. Red and yellow gritty texture-contrast soils merging to gradational profiles at about 1,000 metres.

The study area is not in an area that has been declared an area of outstanding biodiversity value.

Due to the diversity of landscapes within the survey area, the native vegetation is also variable. Plant Community Types under the BioNet Vegetation Classification database have been mapped based on available regional mapping as illustrated in **Figure 7-1**.

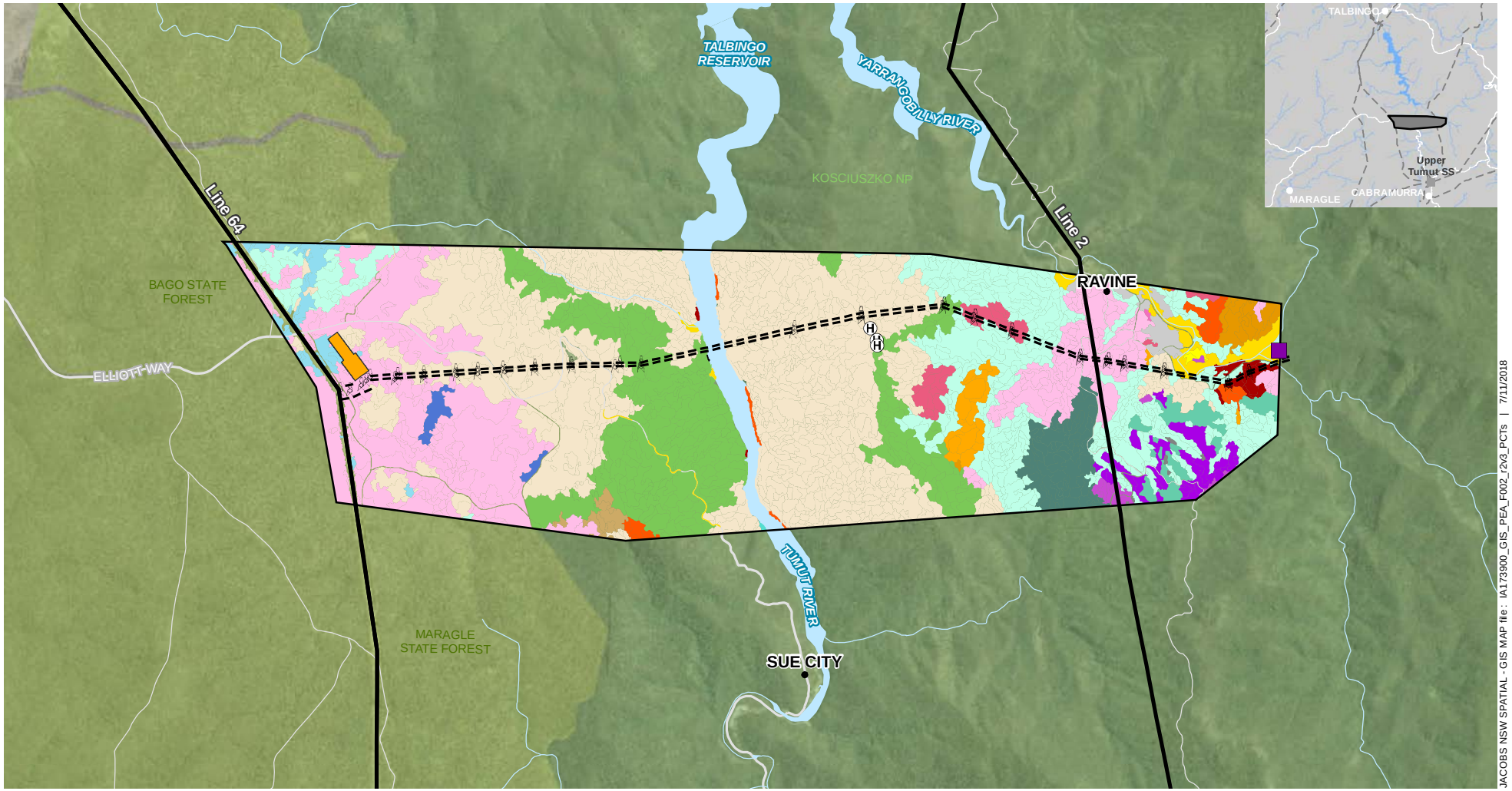


Figure 7.1 | Plant Community Types mapped around the project

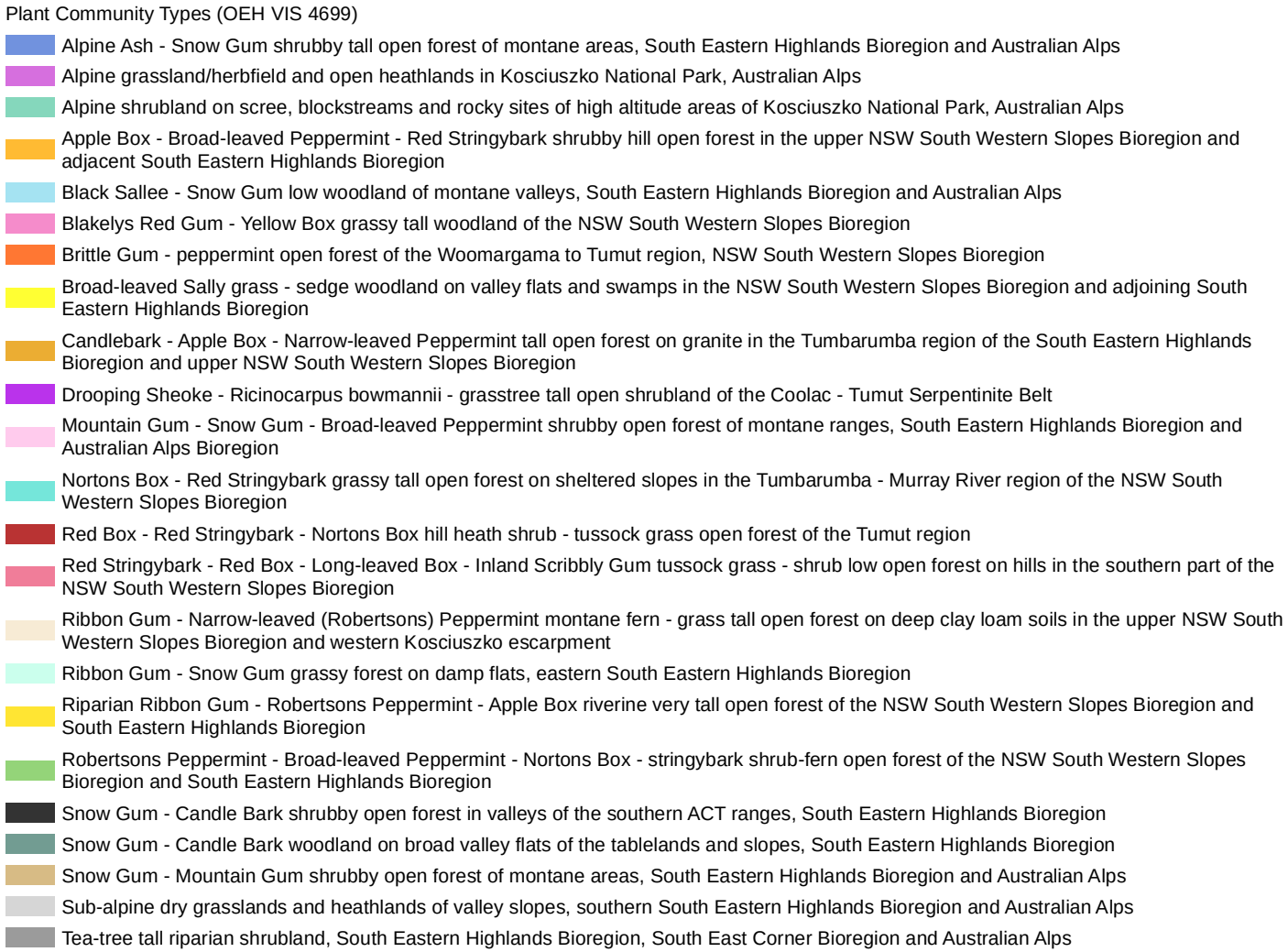


Figure 7.1 | Plant Community Types mapped in the transmission corridor/study area - Legend sheet

Five Threatened Ecological Communities (TECs) listed under the BC Act have been mapped in the survey area:

- Coolac-Tumut Serpentinite Shrubby Woodland in the NSW South Western Slopes and South Eastern Highlands Bioregions
- Montane Peatlands and Swamps of the New England Tableland, NSW North Coast, Sydney Basin, South East Corner, South Eastern Highlands and Australian Alps bioregions
- Tableland Basalt Forest in the Sydney Basin and South Eastern Highlands Bioregions
- Tablelands Snow Gum, Black Sallee, Candlebark and Ribbon Gum Grassy Woodland in the South Eastern Highlands, Sydney Basin, South East Corner and NSW South Western Slopes Bioregions
- White Box Yellow Box Blakely's Red Gum Woodland.

According to the PMST, and review of work undertaken for the Snowy Hydro 2.0 Exploratory Works PEA, the following EPBC Act listed TECs are known to occur, likely to occur or may occur in the vicinity of the Project:

- Alpine Sphagnum Bogs and Associated Fens (Endangered) - known to occur
- Natural Temperate Grassland of the South Eastern Highlands (Critically Endangered) - likely to occur
- White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland (Critically Endangered) - may occur.

The location of these TECs, based on available regional mapping, are illustrated in **Figure 7-2**.

The area around the Project is highly vegetated being within the Kosciuszko National Park and the Maragle and Bago State Forests. The survey area crosses from the South East Highlands Bioregion up into the Australian Alps and there is a corresponding change in vegetation. While the survey area is highly vegetated, it is not without disturbance. There is a long history of human use in the area and signs of disturbance from logging, farming, habitation, tourism, and infrastructure development and maintenance can be found.

Due to the large extent, variability and generally high quality of the habitats in the Kosciuszko National Park, Maragle State Forest and Bago State Forest, many threatened fauna and flora species are known to occur or are considered likely to occur. This includes species listed under both the BC Act and EPBC Act and including potential species and their habitat that meet the serious and irreversible impact entities. Details on the likelihood of occurrence of these species is presented in **Appendix A**.

7.1.2 Issue for Consideration

The preliminary biodiversity assessment summarises the findings of the desktop study and initial site visits and identifies the likely distribution of key ecological features and constraints across the survey area. While this is only a preliminary assessment and no detailed ecological field work or impact assessment has been undertaken to inform the findings, this report identifies that the primary ecological concerns with the Project relate to clearing of native vegetation, disturbance to water bodies and associated impacts on habitat for threatened species, populations and communities. Introduction and spread of weeds and pathogens is also a concern during both construction and operation of the Project.

The key ecological constraints are outlined in **Figure 7-3** and are as follows:

- Areas of mapped TECs
- Riparian areas and buffer zones
- Known areas of threatened plant species.

The survey area is extensively covered with native vegetation in moderate to good condition. As the Project has been declared critical SSI, it will be assessed in accordance with the Biodiversity Assessment Method (BAM) and all impacts to native vegetation will be required to be offset. Avoidance and minimisation must be demonstrated at an early stage and this preliminary assessment should be used as a guide to commence this process. Key to minimising impacts to native vegetation will be designing the Project to avoid the most valuable vegetation types and habitats, while being as short as practicable. Wherever practicable, the location of access tracks and compounds should also avoid the most valuable vegetation types and habitats, while being as short

as practicable, and where possible co-located in areas requiring vegetation removal for the proposed development / Project and areas already disturbed or proposed to be disturbed by Snowy 2.0 Exploratory Works and Snowy 2.0.

Due to the large extent, variability and generally high quality of the habitats around the Project, many TECs and threatened plant and animal species listed under the BC Act and/or the EPBC Act are known to occur or are considered likely to occur. In some cases, it will not be possible to entirely avoid impacts to habitat for some threatened species as the suitable habitat is widespread. However, this preliminary assessment allows for a high level of planning and avoidance of some TECs, specific habitat types such as riparian areas, and areas known to contain threatened plant species such as the McPhersons Plain area. As the Project has been declared critical SSI, all impacts to threatened species will be required to be offset.

7.1.3 Method of Assessment

Ecological impacts will be a key consideration in the assessment going forward. Assessments undertaken during the EIS phase will be based on the BAM and field work will be guided by the following documents:

- OEH Biodiversity Assessment Methodology
- Commonwealth EPBC 1.1 Significant Impact Guidelines - Matters of National Environmental Significance
- Commonwealth Department of the Environment survey guidelines for nationally threatened species
- Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities (working draft)
- Threatened species survey and assessment guidelines: field survey methods for fauna – Amphibians
- NSW Guide to Surveying Threatened Plants.

The EIS would also recommend mitigation and management measures to reduce the biodiversity impacts as much as possible. Operation mitigation measures would be provided for the long term management of the transmission easement and substation APZ.

7.2 Heritage

7.2.1 Existing Environment

A preliminary heritage assessment for both Aboriginal heritage and non-Aboriginal heritage has been undertaken for the Project and is provided in **Appendix B**. This preliminary heritage assessment provides information and recommendations to inform options investigations and the ongoing design process as well as providing the heritage context for the Project.

This assessment covers both Aboriginal and non-Aboriginal heritage, and also considers the potential for unrecorded heritage both built and archaeological. An extensive search of the Aboriginal Heritage Information Management System (AHIMS) database maintained by Office of Environment and Heritage (OEH) was undertaken and yielded 39 sites within the survey area. All of the sites within the survey area were artefact sites, either a single artefact (isolated find) or in a group of more than one (artefact scatter).

Data Base Searches

A search of non-Aboriginal heritage databases revealed four recorded heritage items. The Project is located within the Australian Alps National Parks and Reserves, and the Snowy Mountains Scheme, are within the survey area. These are both listed on the National Heritage List, and are therefore of national heritage significance. In the vicinity of the Project are the ruins associated with the former village of Lob's Hole/Ravine (including the Washington Hotel), refer to **Figure 7-4**. These ruins are not listed separately on known heritage databases, however they are part of the nationally listed Australian Alps National Parks and Reserves item and are therefore protected by the heritage provisions of the EPBC Act

The remaining two items are located at Kiandra, approximately 13 kilometres to the south east of the eastern end of the Project. These items are listed on the State Heritage Register.

The AHIMS sites, ethnographic information and previous investigations form a pattern in the recorded sites and their location (refer to **Figure 7-5**). This information allows the development of a predictive model in order to identify areas of Aboriginal archaeological sensitivity:

- The most likely sites to be encountered are artefact sites, either as single artefacts (isolated find) or a group of one or more artefacts (artefact scatters)
- Artefact sites can be found in any context, however they are more likely to be found on elevated, level ground within 200 metres of permanent water
- As with many areas within the south-east of Australia, surface material is not likely to be an indication of the presence or absence of subsurface material
- The dominant raw material of artefacts is likely to be silcrete and/or mudstone with smaller quantities of quartz.

In relation to non-Aboriginal heritage, although there is only sporadic evidence, the historical context and heritage listings demonstrate that non-Aboriginal people have been living and working within the area since the early 19th century. The historical record shows that there have been phases of land use, commencing with pastoralism and subsumed by mining, of both copper and gold. The construction of the Snowy River Scheme brought another wave of habitation into the area, although it is likely that it also destroyed much of the earlier heritage.

Although some non-Aboriginal heritage may remain throughout the survey area, there are two main areas where the potential is higher, being at the Lob's Hole/Ravine site in the east, and the former New Maragle diggings in the west.

Preliminary Site Visit

The preliminary site visit in March 2018, identified no new items of non-Aboriginal heritage. The Lob's Hole/Ravine Washington Hotel ruins, with the closest of the ruins to the preferred route shown in **Figure 7-4**. To the north-east of the Washington Hotel site was an area with a scatter of bricks, metal and other building

material, suggesting potential archaeological remains. The second visit site in April 2018, identified a survey mark noted on the western side of the Tumut River.

Summary

Based on the recorded history and sites, it was concluded that there are areas of both Aboriginal and non-Aboriginal heritage within the survey area. Previous Aboriginal heritage is broadly clustered in two groups at the eastern and western ends of the survey area, and are generally on elevated, level ground in the vicinity of permanent water. These sites are all artefact sites; however, the preliminary site visit was unable to ground-truth all of these sites.

In relation to non-Aboriginal heritage, there is potential for items associated with the copper mining activities and village at Ravine at the eastern end of the survey area, as well as other items such as unlisted survey marks. Given the dense vegetation, harsh winter climate and rugged terrain, it is probable that other items may still exist within the study area but have not yet been recorded.

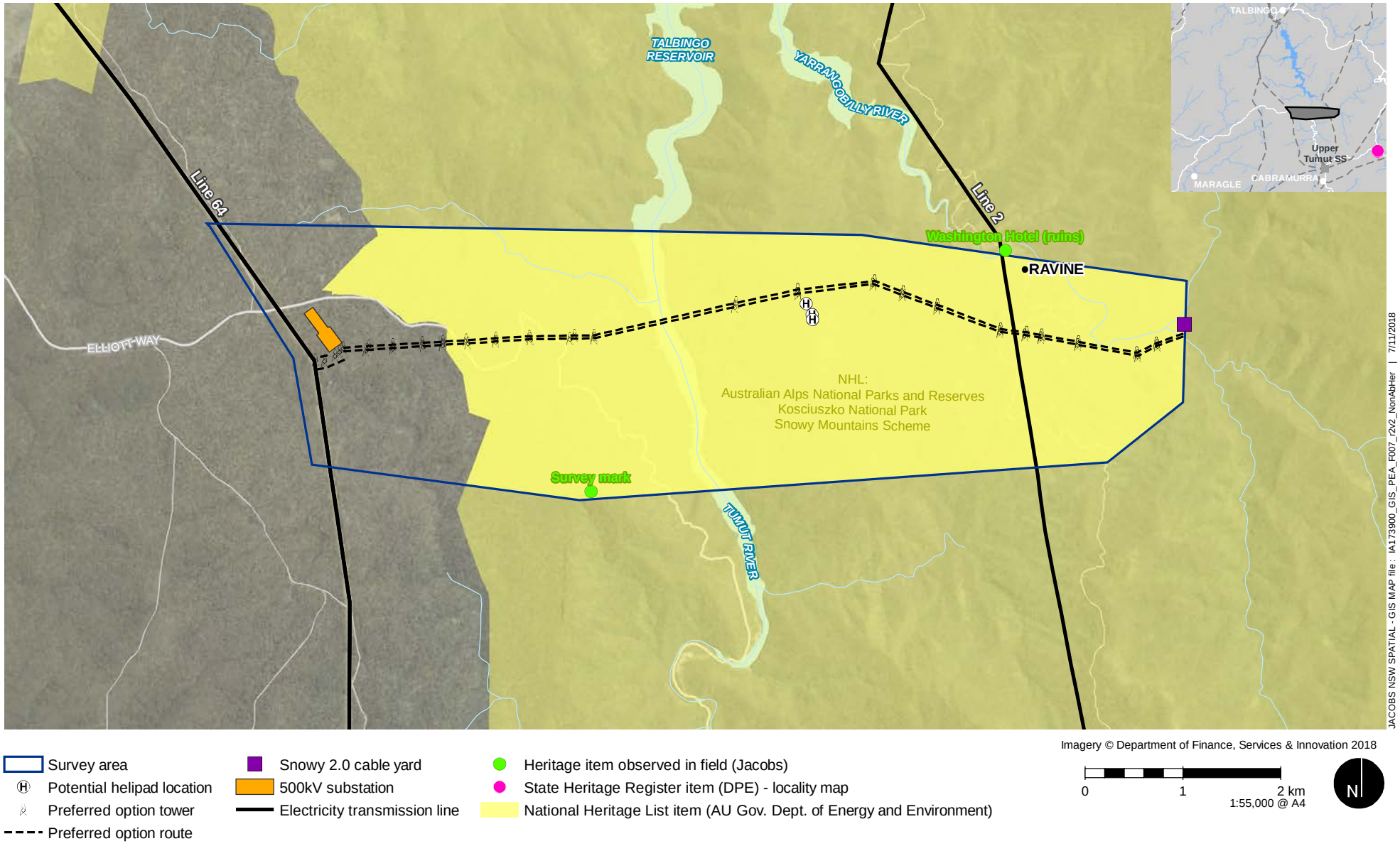


Figure 7.4 | Non-Aboriginal heritage items

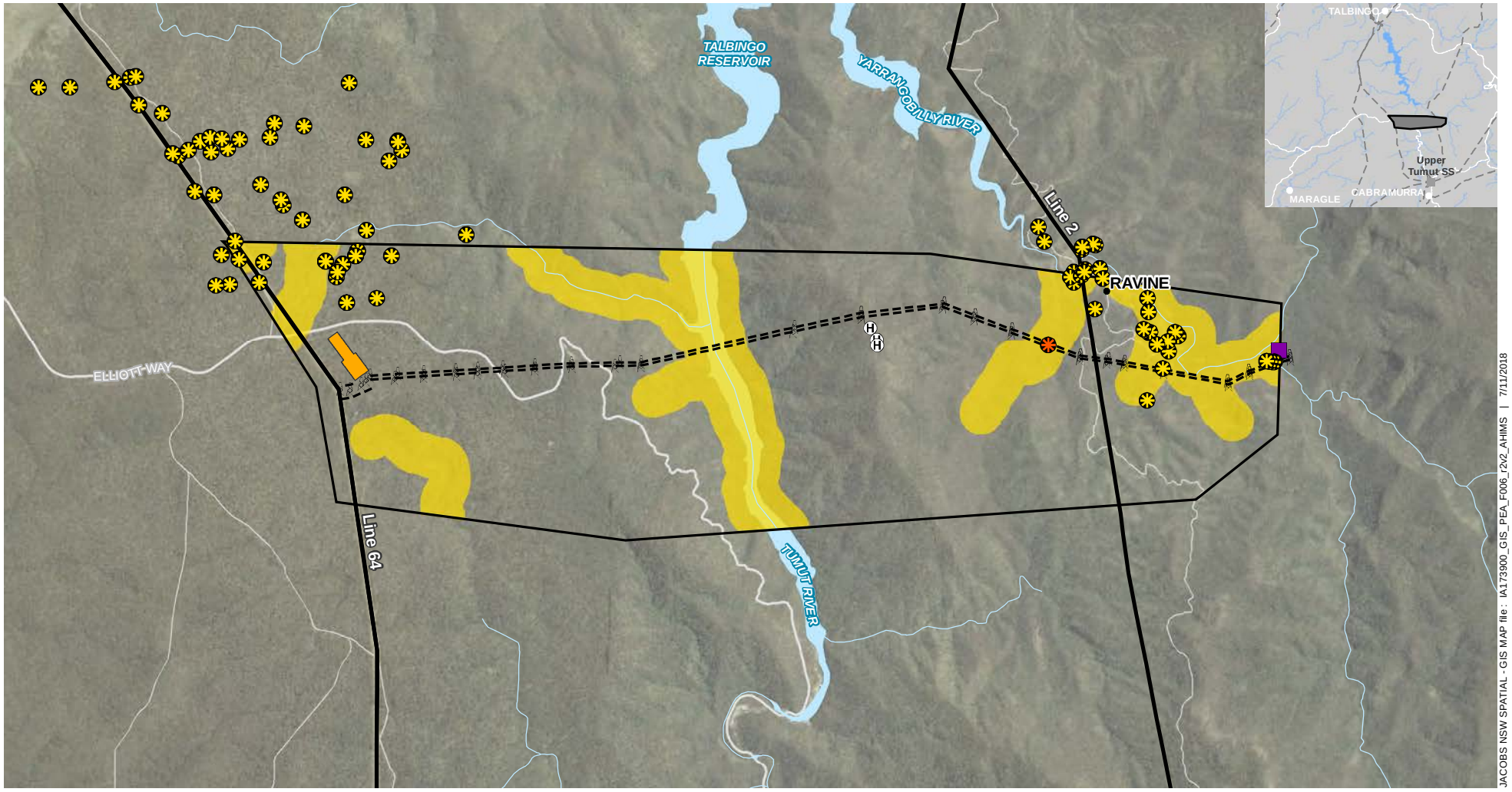


Figure 7.5 | AHIMS records and areas of Aboriginal sensitivity

7.2.2 Issue for Consideration

The previously identified areas of Aboriginal heritage are all artefact sites. The preliminary site visit was unable to ground-truth all of these sites.

In relation to non-Aboriginal heritage, there is a survey mark noted on the western side of the Tumut River, and the items associated with the copper mining activities and village at Ravine at the eastern end of the survey area. Given the dense vegetation, harsh winter climate and rugged terrain, it is probable that other items may still exist but have not yet been recorded.

The Project has the potential to impact on previously unrecorded Aboriginal and non- Aboriginal heritage items. The mechanisms by which these impacts could occur include surface disturbance and excavations associated with the construction of access tracks, work compounds, transmission line towers and the substation.

7.2.3 Method of Assessment

Further Aboriginal cultural heritage assessments including archaeological surveys will be undertaken as part of the EIS, to ensure that Aboriginal cultural heritage values are properly identified, assessed and avoided where possible. An Aboriginal cultural heritage assessment (ACHA) will be required in accordance with the NSW OEH (2011) *Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW* and *Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales* (NSW DECCW 2010a).

Further, a non-Aboriginal heritage assessment will also be undertaken as part of the EIS and would include the consideration of potential impacts on the values, settings and integrity of heritage areas and items and archaeological resources in the study area. The assessment would be undertaken in accordance with principles of *The Australian International Council on Monuments and Sites, Charter for Places of Cultural Significance* (also known as the Burra Charter, Australian ICOMOS 2013) and the *NSW Heritage Manual* (Heritage Office 1996 and 2006).

7.3 Landscape Character and Visual Amenity

7.3.1 Existing environment

The Project would be undertaken in the Kosciusko National Park which is a part of the Australian Alps national heritage listing and contains landscapes with high scenic values. The Australian Alps landscape is characterised by peaked ranges, and broad, forested valleys, and is the only true alpine environment in NSW (NPWS 2003). Elevation across the Project is highest near Tantangara Reservoir at around 1,200 metres and lowest near Talbingo Reservoir at around 550 metres elevation.

For the purposes of this PEA, the following terms are discussed in this section and are defined as:

- Near-field – the immediate foreground when looking at the landscape. For this PEA it refers to the transmission line easement, any receivers immediately adjacent to the easement and any trees in the foreground.
- Mid-field – the intermediate/middle ground when looking at a landscape. For this PEA it refers to the hills, forest, buildings and/or waterways that are not located immediately within the proposed activities surroundings, but are also not located on the horizon. They are located in the middle ground.
- Far-field – the horizon and/or definable feature on the horizon when looking at a landscape. For this PEA it refers to the furthest hills, forest, buildings and/or waterways that the visual receiver can see, most often on the horizon.

The existing landscape character of much of the locality consists of undisturbed and mountainous terrain. This landscape contains limited human disturbance consisting of existing transmission line easements, minor access tracks, and infrastructure associated with the Talbingo Reservoir.

Visual amenity values are considered to be very high and sensitive. Near-field views of the Project are limited to those present where the easement crosses existing publicly accessible roads and recreational users of

Talbingo Reservoir due to its isolated nature. Mid-field to far-field views may be available to users of the National Park.

7.3.2 Issue for consideration

The transmission structures would be about 50 metres in height, along a ridgeline. The transmission lines would cross over the Tumut River portion of the Talbingo Reservoir at a height of about 150 metres. The substation will also have structures up to 50 metres in height. The infrastructure will increase the industrialisation of the Kosciuszko National Park and the surrounding State Forests.

Clearing of vegetation and ground disturbance during construction of the transmission lines (and easement), substation (and APZ), and roads and access tracks, would result in long-term localised visual impacts. In addition, access tracks, excavation and the presence of plant and vehicles during construction may result in short-term temporary visual impacts for State Forest and Kosciuszko National Park visitors as well as road users.

The operation of the new substation, would involve lighting of up to 15 lux throughout the yard for security and safety purposes, and at worst case the lighting could be on all night. This would potentially impact on the amenity of the area and would need to be considered in the assessment of visual impacts.

The scale of the Project would be visible to near-field receptors and due to undisturbed nature of the landscape, any development of the State Forest and Kosciuszko National Park warrants consideration for a visual and landscape impact perspective.

7.3.3 Method of Assessment

The EIS would include an assessment of visual impacts during construction and operation, including a description of existing landscape character and potential visual receivers, and identification of measures to be used to minimise visual impacts.

7.4 Traffic and Access

7.4.1 Existing Environment

The Project location is within steep, forested terrain within the Kosciusko National Park and Bago State Forest on the western side of NSW's Alpine Region. The Project would most likely be accessed via Tumut or Cooma via the Snowy Mountains Highway and then via various existing local roads and access tracks and easement maintenance tracks. The Project is located approximately 60 to 120 kilometre driving distance from Tumut, and a 120 to 150 kilometre drive from Cooma, noting that the overall length of the Project and terrain may favour different access arrangements to different sections of the Project.

The eastern end of the Project would be accessed via Lobs Hole Ravine Road and Mine Trail Road. These roads are proposed to be upgraded for the Snowy 2.0 Exploratory Works, and do not form part of the Project. No further upgrades are expected to be required to facilitate access for the Project.

The western end of the Project would be accessed via Elliot Way. It is likely that some civil upgrade work would be required to facilitate the interface point (i.e. exit/entry slip/turning lanes) between the substation access road and Elliot's Way.

7.4.2 Issue for consideration

Existing access roads and tracks to sections of the Project may be inadequate for the delivery of some material, plant and equipment and the ongoing maintenance access requirements of the transmission lines.

The Project would require the upgrade and maintenance of existing access tracks and waterway crossings and the construction of new access tracks and waterway crossings to provide safe construction and operational access to the new lines and substation. The consultation with NPWS to date, flagged a need to consult with NPWS regarding the long-term treatment of new/upgraded roads and access tracks, which would be assessed/graded in line with NPWS access track management protocols.

It is expected that the Project would utilise Snowy 2.0 Exploratory Works and Snowy 2.0 access tracks where possible and otherwise implement the minimum upgrades and improvements necessary to facilitate the safe movement of plant, equipment, materials and staff.

Deliveries for the construction of the transmission line would include components of new structures, wires and cables, concrete and gravel and other construction materials. While the construction of the substation would require the delivery of large transformers, reactors, pre-fabricated buildings, large earth moving equipment as well as large amounts of soil, concrete and steel.

Equipment to be used in construction would include large earthmoving equipment, cranes, brake and winch machines, skid steers, trucks, generators and various temporary office and amenities.

Plant, equipment and materials would be delivered via trucks and light construction vehicles using the highways and local road network and construction workers would access the construction sites with 4WD utility vehicles. Helicopters may also be used for the delivery of equipment and materials as well as for stringing of the transmission lines. Approximately 30 - 50 vehicle movements per day during construction are anticipated to be required for the various sections of the Project. These movements would be spread across a number of sites per day. Construction traffic would contribute to an increase in local traffic on local roads.

Parking areas for construction workers would be required at the various construction compounds and would otherwise be confined to the easement.

7.4.3 Method of Assessment

The EIS would include an assessment of traffic and access impacts during construction and operation, including a description of existing road network, assessment of construction and operational traffic impacts, need for additional access roads and connection to the road network and identification of measures to be used to minimise traffic and access impacts. The traffic assessment would consider the movements of large equipment and large components (transformer), pre-fabricated buildings as well as spoil and waste on the local and wider road network. The EIS would also consider management measures for traffic impacts on the road network (including NPWS roads).

7.5 Social and Economic

7.5.1 Existing Environment

The survey area is located in the Snowy Valleys local government area (LGA) and within Kosciusko National Parks, Maragle and Bago State Forests.

Given the remoteness of the Project, there is poor access to existing infrastructure, including road, rail, gas, electricity, water and sewerage services.

7.5.2 Issue for Consideration

Impacts to the local community and majority of the local businesses are unlikely as a result of the Project, given the remoteness of the location of the Project. Impacts to localised recreational use of the Kosciusko National Park in the area may be affected due to access restrictions and temporary closure of campgrounds and walking tracks affected by the Project or wider Snowy 2.0 works. The clearing of harvestable timber within the State Forest would potentially impact on the Forestry Corporation operations and their contractual agreements.

Local roads and access tracks would likely need to be upgraded/constructed to facilitate access to the transmission line route and substation during construction and operation.

The Project facilitates the delivery of additional electricity to the NEM. This in turn would require the augmentation of the wider transmission network, removing constraints and facilitating the connection of additional generation to the network in the region. While not directly attributable to the Project, the Project facilitates enhanced security and reliability of energy supply with associated social and economic benefits to consumers across the NEM in South Australia, NSW and Victoria. These benefits are to be assessed and described in the EIS for the Snowy 2.0 scheme.

Opportunities for local employment generation would also be considered in the preparation of the EIS and Project delivery.

The provision of accommodation and services for the combined construction workforce associated with the proposed transmission line and larger Snowy 2.0 may put pressure on available accommodation and services. An employment and accommodation strategy for the Project would be developed as part of construction planning and described in the EIS.

7.5.3 Method of assessment

An assessment of the potential social impacts and benefits of the Project would be included in the EIS. The assessment would include an assessment of potential social impacts on both a broader regional and local scale, and consideration of the ability of local social infrastructure to accommodate the construction workforce. The indicative capital investment value of the Project is about $250 Million, however will be further refined in the EIS and during detailed design. While a detailed economic impact assessment is not considered warranted to justify the Project, on the basis that the Project need and objective is to facilitate the transmission of electricity from Snowy 2.0 the EIS will still considerthe economic impact of connecting Snowy 2.0 to the existing high voltage transmission network.

7.6 Soils and Water

7.6.1 Existing Environment

The geology of the survey area is varied. The eastern extent, in the area of the Snowy Hydro Ravine site, is chiefly made up of conglomerate, with sandstone and siltstone, laid down in the Silurian Period (443 – 416 million years ago). There are small lenses of later Devonian Lick Hole Limestone (limestone and shale; 419-358 million years ago). The western extent is mainly granite (Silurian I-S trans-type granite) with quartz feldspar muscovite and biotite inclusions.

As with the geology, the soils of the survey area are varied dependent on landform. Silurian geology generally produced the Cabramurra soil profile, comprising red earths with sandy and clay loam textures that occur on upper slopes and red/yellow earths on lower slopes. These soils usually occur on elevated, undulating to rolling low hills and rises in the eastern highlands, with slopes of greater than 20% gradient and elevations of 700-1253 metres. Also present is Cabramurra variant A, a colluvial soil found on elevated, moist, steep hills on granite and granodiorite on slopes with a greater than 30% gradient and an elevation of 700-1286 metres. Rock outcrops are rare and generally deep. The soils are generally red and brown earths/structured red earths, with sandy loam and clay loan textures. Erosion was noted on poor constructed or maintained forest tracks.

The Kosciuszko National Park's Plan of Management (the Plan) identifies geodiversity values including the eight karst areas in the park. The nearest karst areas are about 10 kilometres way and include the Yarrangobilly Caves and Cooleman Plain areas.

There is a risk of encountering geological units with low, medium and high naturally occurring asbestos potential within the study area. The highest risk area is west of Talbingo Reservoir as shown in **Figure 7-6**.

The locality is watered by a number of natural watercourses, both permanent and ephemeral. Major water sources include Tumut River, and tributary creeks that feed into Yarrangobilly River in the Snowy Ravine portion of the survey area. The preferred route crosses the Tumut River portion of the Talbingo Reservoir at a height of about 150 metres, refer to **Figure 1-2**. The proposed footprint of the new substation is located at the source of two 1st order creeks. These two creeks contain blackberry shrubs (*Rubus fruticosus agg.*) and are not key fish habitat.

A search of the list of NSW contaminated sites notified to the EPA for Snowy Valleys LGA identified that the closest contaminated sites are in Talbingo; one associated with a landfill site, a T3 spoil dump and adjoining river sediments, and one former grit blasting site. There are no sites in the suburbs intersected by the study area. A search of the public contaminated land record of notices database was undertaken. This search did not identify any properties that are currently or formerly regulated under the *Contaminated Land Management Act 1997*.

There are areas of known contamination and areas of potential contamination within Kosciuszko National Park associated with historical land uses. These areas of potential contamination are mostly associated with past or ongoing storage of hydrocarbons and with existing and former landfill sites that contain solid wastes. It was also noted there is also potential for contamination associated with historical mining at the former Lobs Hole Copper Mine, at the eastern extent of the proposed transmission line (DEC, 2006).

7.6.2 Issue for Consideration

If not adequately managed, the Project may impact local surface water through erosive action and sedimentation, and as a result of changes to the existing surface run-off and flow regimes. Potential erosion and sedimentation impacts may relate to ground disturbance during construction activities, vegetation removal, and poor construction management during storm events.

The establishment of access tracks may require crossing of various natural water courses. Many of these access tracks would need to be maintained during the operational stage of the Project.

As there are known contamination and areas of potential contamination associated with historical land uses, there is the potential to encounter contaminated material during the construction of the Project. In addition, there would be the risk of encountering naturally occurring asbestos around Talbingo Reservoir as shown in **Figure 7-6**. Any excavations or work that would intersect the area of potential asbestos would require a site specific asbestos management plan (AMP). The plan would need to be prepared to satisfy the relevant legislative requirements and guidelines and include a procedure for the identification, testing and remediation of areas identified as containing asbestos.

During the operation of the Project there would be potential to release contaminates into the environmental from hydrocarbon leaks/ spills from machinery and oil filled equipment (such as the substation transformers) as well as site drainage, sewerage and waste water.

The total volume of oil associated within substation equipment is expected to be in the order of about 650,000 litres. This total volume is based on nine 500kV single phase transform each containing about 61,000 litres and two three phase reactor each containing about 45, 000 litres. If a failure were to occur, typically either only one reactor or a single phase of the 500kV substation would fail, therefore, the maximum volume of oil that would need to be managed through the spill oil system would be about 70,000 litres.

7.6.3 Method of Assessment

Geotechnical assessment would be undertaken to inform the detailed design of the Project and would identify any necessary management measures for soil types encountered. The EIS will also consider the risk of impacting on geodiversity values such as the karst areas and encountering contaminated soils (including naturally occurring asbestos) during construction of the Project. This would include a review of the site history, identification of current or historical contaminating activities and the potential for site sampling to confirm contamination or risks.

The EIS would consider the potential impacts to water features and site run-off, and identify a suite of effective and practical mitigation measures to be applied to works to manage these potential impacts. The EIS will also consider the Project's operation impacts related to managing and maintaining access tracks as well as substation related risks such as hydrocarbon leaks/ spills from the transformers.

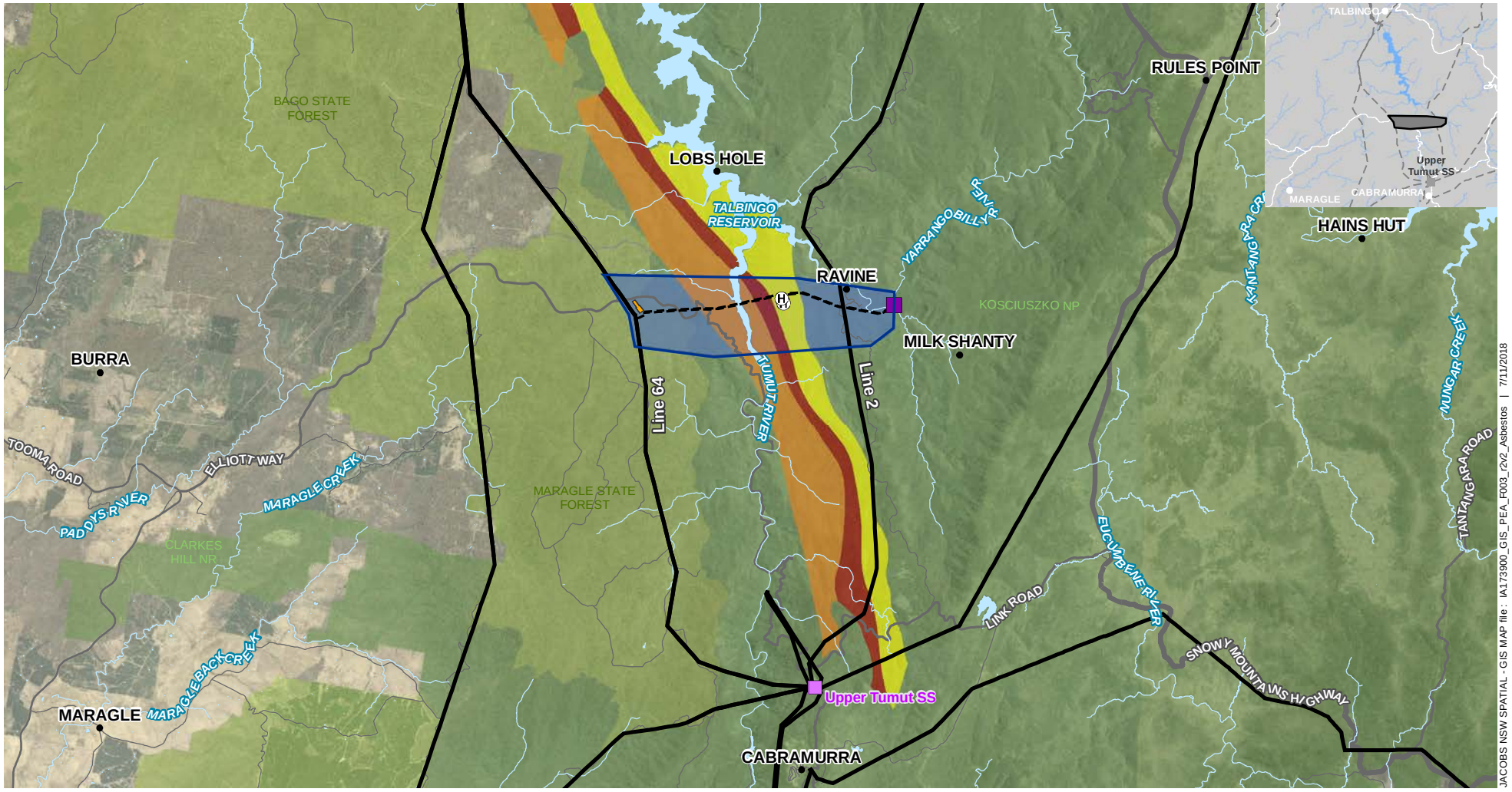


Figure 7.6 | Area of naturally occurring asbestos and know contamination

7.7 Waste

7.7.1 Existing Environment

Given the remoteness of the Project, there is poor access to existing waste management facilities.

7.7.2 Issue for Consideration

Construction of the Project has the potential to generate waste materials including cleared vegetation, construction materials, domestic (employee related) wastes, and spoil. There is potential for the Project to result in adverse impacts to the local environment if waste is not managed appropriately. Inappropriately managed waste may result in impacts to visual amenity, risks to health and safety of construction workers and members of the public, contribution to landfill, and pollution caused by release of chemical waste.

Significant volumes of waste materials are not expected to be generated during maintenance and operation of the Project, beyond occasional minor waste streams associated with infrequent maintenance activities. These waste streams would be typical of maintenance wastes generated across TransGrid's existing transmission supply network. Waste would be disposed of at appropriately licenced facilities.

The Project does not involve the removal of existing infrastructure, and given the undisturbed nature of the area, it is unlikely to generate problematic waste streams. Options to re-use any excavated material and cleared vegetation would be explored to avoid the need for off-site waste disposal during the detailed design. The management of spoil would be considered during ongoing consultation with NPWS, Forestry Corporation and Snowy Hydro. NPWS have flagged potential reuse/storage of spoil for their track maintenance activities.

In terms of earthworks, it's expected that there would be a balanced cut to fill for the substation bench design. However, a further approximately 20,000 cubic metres of imported fill material would be required for the capping layer to the substation bench.

The following estimated earth works quantities may apply to the construction access tracks and tower footings:

- Topsoil: Approximately 10,000 cubic metres of topsoil would need to be transported off site or stockpiled somewhere on site
- Access tracks and roads: Approximately 300 cubic metres of material would need to be transported off site
- Excavated material from footings and compounds: Approximately 30,000 cubic metres of material would be removed from site.

7.7.3 Method of Assessment

The EIS would identify potential waste streams associated with construction of the Project, and would include standard management practices compliant with the *Waste Avoidance and Resource Recovery Act 2001* and other relevant policies and guidelines.

7.8 Air quality and greenhouse Gas

7.8.1 Existing Environment

The Project is located within Kosciuszko National Park and NSW State Forests estate, and is remote from residential or other sensitive receivers. Accordingly, air quality impacts on communities are unlikely.

7.8.2 Issue for Consideration

During construction, disturbance of soil and vehicles driving on unsealed roads would generate dust. Construction plant and equipment, including vehicles required to transport staff and materials to site would also contribute combustion-related pollutants including oxides of nitrogen, sulphur oxides, volatile organic compounds and particulate matter.

The use of construction equipment and manufacture of materials for use in the Project will consume resources and as such are associated with greenhouse gas emissions. In addition, substation equipment and switchgear

such as circuit breakers, disconnectors, and transformers, may contain sulphur hexafluoride (SF6) which is considered a greenhouse gas.

With the exception of minor and occasional vehicle and potential plant emissions associated with maintenance and inspection of Project infrastructure, air quality impacts during operation of the project are expected to be minimal.

7.8.3 Method of Assessment

The EIS would include an assessment of air quality impacts during construction in accordance with the Approved Methods for the Modelling and Assessment of Air Pollutants in NSW (EPA, 2016). The EIS would also recommend mitigation and management measures to reduce construction emissions and associated impacts, where reasonable and feasible.

As the Project is unlikely to generate significant air quality impacts during operation, an operational air quality impact assessment is not proposed.

The use of the SF6 containing substation equipment would need to be managed to prevent inadvertent release into the environment. The greenhouse gas emissions for the Project will be quantified and presented in the EIS. This would include potential impacts of the SF6 contained in substation equipment.

7.9 Noise and Vibration

7.9.1 Existing Environment

The Project area is located within Kosciuszko National Park and NSW State Forests estate, and is remote from existing, permanent residential areas and noise sensitive receivers. Accordingly impacts of noise and vibration on these receiver types would not occur.

The Project area does have short duration visiting recreation users of Kosciuszko National Park and NSW State Forests estate for game hunting, bushwalking, camping and boating on the Talbingo reservoir.

7.9.2 Issue for Consideration

The Project would generate noise and vibration through the construction phase due to construction activities including operation of heavy vehicles, excavation of tower foundations, vegetation clearing, creation of access tracks, road upgrades, increased traffic volumes, and helicopter use. In addition, the operation the new substation would introduce a new noise source to the locality.

At the time of construction of the Project, there could be construction workers on the Snowy 2.0 project residing in temporary accommodation facilities at the Lobs Hole accommodation camp. These workers may be exposed to noise impacts during construction work. Particular noise impacts may occur in the vicinity of Lobs Hole accommodation camp during night time construction activities or if shift workers are required to sleep during daytime hours.

7.9.3 Method of Assessment

Impacts of the Project on the surrounding environment would be assessed in a noise and vibration impact assessment to be included in the EIS. The assessment would be conducted in accordance with the *Interim Construction Noise Guideline* (DECC, 2009) and *Assessing Vibration: A Technical Guideline* (DEC, 2006) and include:

- Identification of sensitive receivers that may be affected by noise and vibration impacts and identification of background noise levels
- Identification of construction and operation noise and vibration goals
- Predictions of noise and vibration emission levels from construction and operation activities
- Assessment of potential noise and vibration impacts
- Recommendation of mitigation measures to minimise construction noise and vibration impacts, where reasonable and feasible.

7.10 Land Use and Property

7.10.1 Existing Environment

The Project is located within the Kosciuszko National Park and NSW State Forests estate.

7.10.2 Issue for Consideration

Forestry Corporation has identified that the potential sterilisation of timber reserves would have implications on the ability to meet contractual obligations (refer to **Section 4.1**). The preferred route, substation and tee connection, have been selected to avoid impact to State Forest timber reserves.

The land use around the Project would be reduced for recreation users, such as game hunting, bushwalking and camping, as the substation area would be fenced off with no further public access and the establishment of easements may require some activities to be subject to safety restrictions. There would be ongoing consultation with NPWS regarding the impacts to Kosciuszko National Park.

7.10.3 Method of Assessment

Key land use issues relevant to the Project relate to impacts on forestry and national parks land uses, and how the Project would affect land uses.

The necessary easements and property agreements would be identified under the relevant provisions of the *National Parks and Wildlife Act 1974* and the *Forestry Act 2012*.

7.11 Electric and Magnetic Fields

7.11.1 Existing Environment

Electric and magnetic fields (EMF) are part of the natural environment and electric fields are present in the atmosphere and static magnetic fields are created by the earth's core. EMF is also produced wherever electricity or electrical equipment is in use. Transmission lines, electrical wiring, household appliances and electrical equipment all produce power frequency EMF.

There are existing transmission lines within the survey area. All existing transmission lines have been designed and maintained to ensure EMF exposure meets industry standards.

The Project is remote from residential or other sensitive receivers. Accordingly, impacts of electric and magnetic fields on communities and recreational users of Kosciuszko National Park are unlikely.

7.11.2 Issues for consideration

All types of electrical equipment, including transmission lines and substations, produce EMF. For a transmission line, the strength of the electric field varies generally with the operating voltage of the line (measured in volts), while the magnetic field strength is related to the current flowing in the line (measured in amps). The current flowing in the line is dependent upon the load or power flow, and would vary with consumer demand (which varies on a daily and seasonal basis). The EMF strengths at ground level below the conductors, are also dependent on the height of the wires above the ground and their geometric arrangements as supported by the transmission tower.

To manage potential chronic exposure scenarios, the principle of 'prudent avoidance' would be applied to the design of the Project. The prudent avoidance principle is commonly defined as what can be done at modest cost without undue inconvenience to avoid a possible risk. Applying this principle, the Project would be designed to ensure exposure levels for the general public are better than industry standards, and chronic exposure is prevented.

Transitory potential exposure to EMF would be considered for the users of the local roads and access tracks as well as recreational users of the State Forests and Kosciuszko National Park. Recreation users of the locality, would include bushwalkers, campers and boat users on Talbingo reservoir.

7.11.3 Method of Assessment

TransGrid relies on expert advice on EMF from competent health authorities in Australia and from around the world. This includes the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA), which is the Federal Government agency responsible for providing health assessments and recommendations to the Government on matters relating to EMF. ARPANSA has adopted the International Commission on Non-Ionizing Radiation Protection (ICNIRP) guidelines for limiting exposure to EMF, published in 2010. Should sensitive receivers be identified during the EIS development, TransGrid would consider the ICNIRP guidelines in its assessment.

7.12 Fire Risk

7.12.1 Existing Environment

The Project would be within both Snowy Monaro and Riverina Highlands Bush Fire Management Committee (BFMC) areas.

The NPWS operational framework for fire management, firefighting and prescribed burning is reviewed annually. The Kosciuszko National Park Fire Management Strategy 2008-2013, indicates that severe unplanned fire conditions are likely to occur every 5-11 years.

The Forestry Corporation also have a fire management policy, and bushfire management and prevention is a key priority.

The declared bush fire danger period from the 1st October to 31st March encompasses the most severe fire weather for the area. This period is subject to revision by BFMC according to prevailing and predicted conditions.

7.12.2 Issues for Consideration

Aspects of construction work and maintenance activities that could potentially start a fire include sparks from plant or equipment and hot works. As most of the study area is densely vegetated, the Project could pose a bushfire risk, particularly during the summer months. This has the potential to impact Kosciuszko National Park and State Forests as well as posing a risk to property and people.

Bushfires pose an ever present risk to life, property and the environment throughout rural and urban areas in New South Wales. Bushfires can be caused by a variety of factors, including lightning strikes, sparks from farm machinery and incinerators, vehicle crashes, and electrical incidents such as fallen powerlines. TransGrid's risk approach to asset management assumes that every transmission line has the potential to be impacted by fire, or to initiate fire, including bush fire.

The design, operation and maintenance of the Project would consider vegetation management within the transmission line easement, and APZ around the substation.

7.12.3 Method of Assessment

The EIS will consider the bushfire hazard and risks of ignition associated with the Project. TransGrid's risk approach to asset management is to minimise the likelihood that an asset will initiate a fire, irrespective of the location of that asset. The Projects maintenance frequencies are determined taking into account the following factors:

- Vegetation density and growth patterns and associated bush fire initiation risks
- Condition of the line
- Public safety and easement encroachment considerations
- Local environmental conditions e.g. steep slopes, fire history, and fire management practices within Kosciuszko National Park and the State Forests.

8. Conclusion

The key environmental assessment issues identified for the Project, and which would be assessed in more detail during the preparation of the EIS are:

- Terrestrial ecology
- Aboriginal and non-Aboriginal heritage
- Landscape character and visual amenity
- Traffic and access.

Other issues requiring assessment but considered less likely to result in significant impacts, either based on lower likelihood of occurrence or absence of likely receptors, are as follows:

- Soils and water quality
- Land use
- Electromagnetic fields
- Bushfire
- Air quality
- Waste
- Social and economic
- Noise.

As part of the preparation of the EIS, further assessments (as proposed in **Sections 6** of this PEA) would be carried out in conjunction with the further development of the project design. In assessing the Project, the key focus would be avoidance and minimisation of impacts on the environment and local communities, where reasonable and feasible, when taking into consideration engineering constraints and cost implications.

The assessment would also identify mitigation and management measures to minimise impacts on the environment during construction and operation of the Project. The EIS would also give further consideration to the Project need (in light of any proposed alternative solutions identified through Snowy 2.0) and operational requirements.

Consultation with affected property owners, stakeholders and the local community will continue throughout the Project assessment, design and construction phases.

9. References

Department of Environment and Conservation NSW (DEC) 2006, *Kosciusko National Park Plan of Management.*

Department of Planning and Environment (DP&E) 2018, *NSW Transmission Infrastructure Strategy.*

EMM, 2018 *Snowy Hydro Preliminary Environmental Assessment Exploratory Works*

ICNIRP – International Commissioning on Non-Ionizing Radiation Protection. 2010. Guidelines for limiting exposure to time-varying electric and magnetic fields (1Hz – 100 kHz).

Jacobs, 2017, *Snowy Hydro 2.0 Transmission Line Augmentation Preliminary Environmental Feasibility Study*, TransGrid, Sydney.

Jacobs, 2018 *Snowy Hydro 2.0 Transmission Line Augmentation TransGrid Preliminary Biodiversity Assessment*

Jacobs, 2018 *Snowy Hydro 2.0 Transmission Line Augmentation TransGrid Preliminary Heritage Assessment*

National Parks and Wildlife Services, 20018. *Kosciuszko National Park fire management strategy 2008-20013.*

Thackway and Cresswell, 1995, *An Interim Biogeographic Regionalisation for Australia: a framework for establishing the national system of reserves*, Version 4.0. Australian Nature Conservation Agency, Canberra.

Appendix A Preliminary biodiversity assessment

Snowy Hydro 2.0 Transmission Connection Project

TransGrid

Preliminary Biodiversity Assessment

Rev | 2

October 2018

Contents

Glossary of terms

Definitions

Cumulative impact	The impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time. Refer to Clause 228(2) of the EP&A Regulation 2000 for cumulative impact assessment requirements.
Direct impact	Where a primary action is a substantial cause of a secondary event or circumstance which has an impact on a protected matter.
Habitat	An area or areas occupied, or periodically or occasionally occupied, by a species, population or ecological community, including any biotic or abiotic component.
Indirect impact	Where an event or circumstance is a direct consequence of the action
Matters of NES	A matter of national environmental significance (NES) protected by a provision of Part 3 of the EPBC Act
Mitchell landscape	Landscapes with relatively homogeneous geomorphology, soils and broad vegetation types, mapped at a scale of 1:250,000.
Mitigation	Action to reduce the severity of an impact.
Population	All the individuals that interbreed within a given area.
Proposal area/ Proposal site	The area of land that is directly impacted on by a proposed Major Proposal that is under the EP&A Act, including access roads, and areas used to store construction materials.
Study area	The survey area includes the likely Project impact area base on the preferred option with a 500 metres buffer. This area includes the potential locations of a new 330/500kV substation, 120 metre wide easement for the 330kV double-circuit transmission lines from the Snowy 2.0 cable yard to the new substation (see Figure 1.2). All of the ancillary actives including brake and winch sites, crane pads, helicopter landing pads, site compounds and equipment laydown areas would be within the 500 metre buffer). This will be the survey area that will be assessed in the EIS.
Survey area	The survey area is a much larger area that was investigated for the route selection process and field investigation during the preparation of the PEA. The survey area includes the study area.

Abbreviations

BC Act	*Biodiversity Conservation Act 2016*
CEMP	Construction Environmental Management Plan
DP&E	Department of Planning and Environment
DPI	Department of Primary Industries
EEC	Endangered ecological community
EIS	Environmental Impact Statement
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (Federal).
FM Act	*Fisheries Management Act 1994* (NSW)
GDE	Groundwater dependent ecosystems
IBRA	Interim Biogeographically Regionalisation of Australia
MNES	Matters of National Environmental Significance
OEH	Office of Environment and Heritage
PCT	Plant Community Type
TECs	Threatened Ecological Communities
VIS	Vegetation information system

Important note about your report

In preparing this report, Jacobs has relied upon, and presumed accurate, any information (or confirmation of the absence thereof) provided by TransGrid and/or from other sources. Except as otherwise stated in the report, Jacobs has not attempted to verify the accuracy or completeness of any such information. If the information is subsequently determined to be false, inaccurate or incomplete then our observations and conclusions as expressed in this report may change.

Jacobs derived the data in this report from information sourced from TransGrid (if any) and/or available in the public domain at the time or times outlined in this report. The passage of time, manifestation of latent conditions or impacts of future events may require further examination of the Proposal and subsequent data analysis, and re-evaluation of the data, findings, observations and conclusions expressed in this report. Jacobs has prepared this report in accordance with the usual care and thoroughness of the consulting profession, for the sole purpose described above and by reference to applicable standards, guidelines, procedures and practices at the date of issue of this report. For the reasons outlined above, however, no other warranty or guarantee, whether expressed or implied, is made as to the data, observations and findings expressed in this report, to the extent permitted by law.

This report should be read in full and no excerpts are to be taken as representative of the findings. No responsibility is accepted by Jacobs for use of any part of this report in any other context.

This report has been prepared on behalf of, and for the exclusive use of, TransGrid, and is subject to, and issued in accordance with, the provisions of the contract between Jacobs and TransGrid. Jacobs accepts no liability or responsibility whatsoever for, or in respect of, any use of, or reliance upon, this report by any third party.

1. Introduction

Jacobs Group (Australia) Pty Limited was commissioned by TransGrid to provide a biodiversity assessment in support of a Preliminary Environmental Assessment (PEA) for the construction and operation of the Snowy 2.0 Transmission Connection Project (the Project).

1.1 Background

Snowy 2.0 pumped hydro and generation project (Snowy 2.0), is being proposed by Snowy Hydro Limited (Snowy Hydro) to provide up to 2000 megawatts (MW) of generation capacity and at full capacity, large-scale energy storage for about 350,000 MW hours. There is a fundamental requirement that generation plants need to be connected to the transmission network to be able to operate within the electricity market. In addition, a pumped hydro scheme requires the supply of electricity to enable the pumping of water to its reserves.

The Project need is a direct response to the proposed Snowy 2.0, and is one of the developments that form a program of works to support Snowy 2.0. Connecting Snowy 2.0 to the transmission system would result in up to 2,000 megawatts (MW) of additional generation being made available to the NSW electricity market and at full capacity, large-scale energy storage for about 175 hours (or 350,000 megawatt (MW) hours).

The Project would involve the construction and operation of new electricity transmission lines and an electricity substation to the west of the Talbingo Reservoir to connect the proposed Snowy 2.0 to the existing electricity transmission network at Nurenmerenmong, east of Tumbarumba.

The key features of the Project include:

- A new 330/500kV substation, to the west of the Talbingo Reservoir near the existing 330kV transmission line 64 (Line 64)
- Two new 330kV double-circuit transmission lines, with easements, from the connection site with the Snowy 2.0 underground cable to overhead line termination (Snowy 2.0 cable yard) to the new substation
- Transmission line connection between the 330/500kV substation and the existing Line 64
- Establishment and upgrade of access tracks and roads to the new substation and transmission line structures, as required
- Ancillary activities, including brake and winch sites, crane pads, Helicopter landing pad, site compounds and equipment laydown areas.

The new transmission lines would be comprised of about 22 steel lattice towers per line (about 44 in total). Each tower would be approximately 50 metres (m) in height supporting two circuits (comprising six to twelve conductors), and two optical ground wire (OPGW). The standard easement width for 330kV transmission lines is 60 m. The transmission lines would be paralleled where possible therefore requiring an easement of up to 120 m.

The location and key features of the Project are shown in **Figure 1-1** and **Figure 1-2**.

1.2 Objectives

The Snowy 2.0 and Transmission Project has been declared critical State Significant Infrastructure (SSI) under State Environmental Planning Policy (State and Regional Development) 2011, and is subject to assessment and determination by the Minister for Planning under Division 5.2 of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

This Preliminary Biodiversity Assessment has been prepared as part of the Preliminary Environmental Assessment (PEA). The PEA is intended to inform the preparation of the Secretary's Environmental Assessment Requirements (SEARs) for an Environmental Impact Statement (EIS) for the Project. This Preliminary Biodiversity Assessment also provides information and recommendations to inform the route options investigations and the ongoing design process.

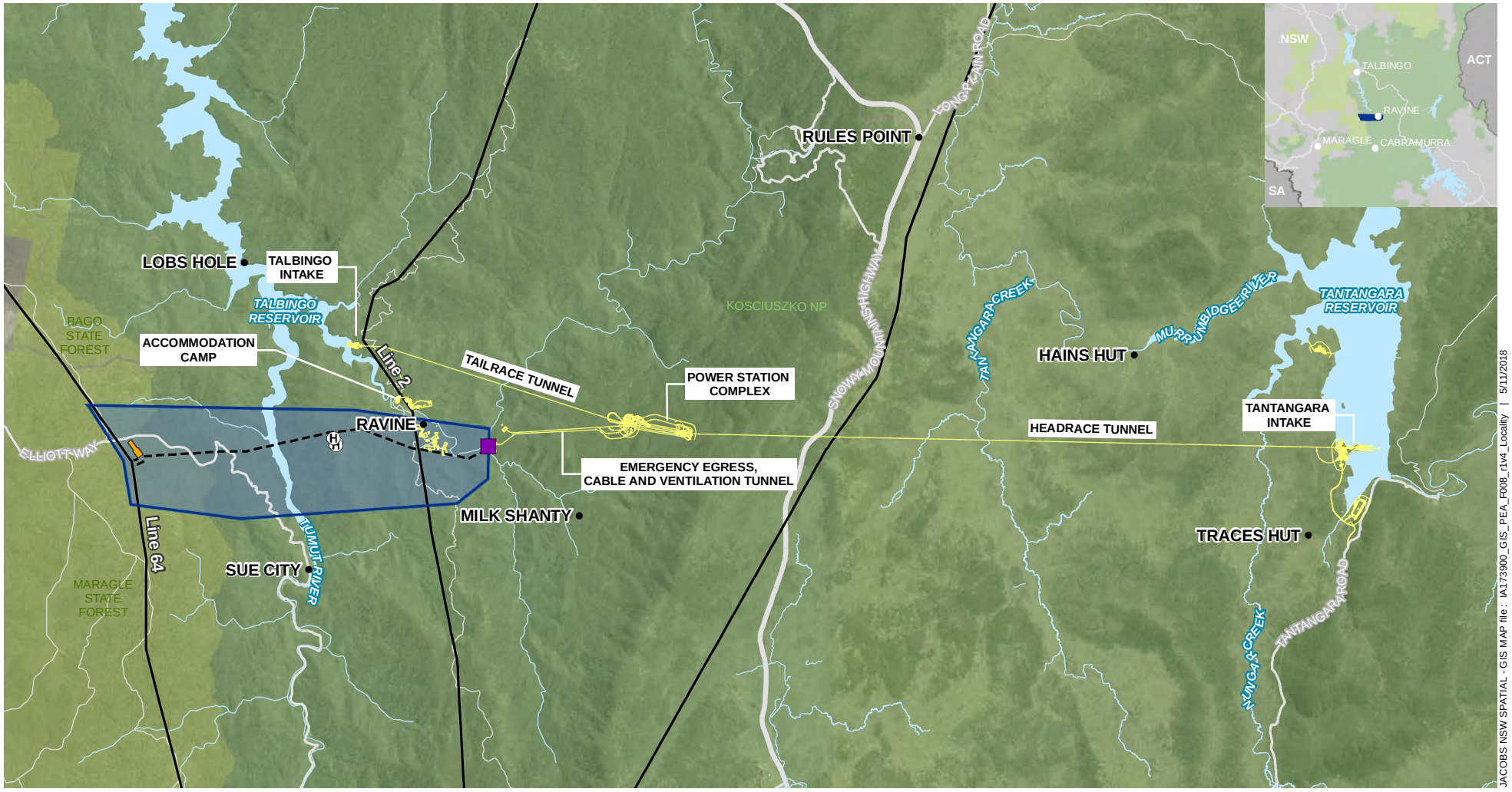


Figure 1.1 | Locality, study area, survey area and preferred option

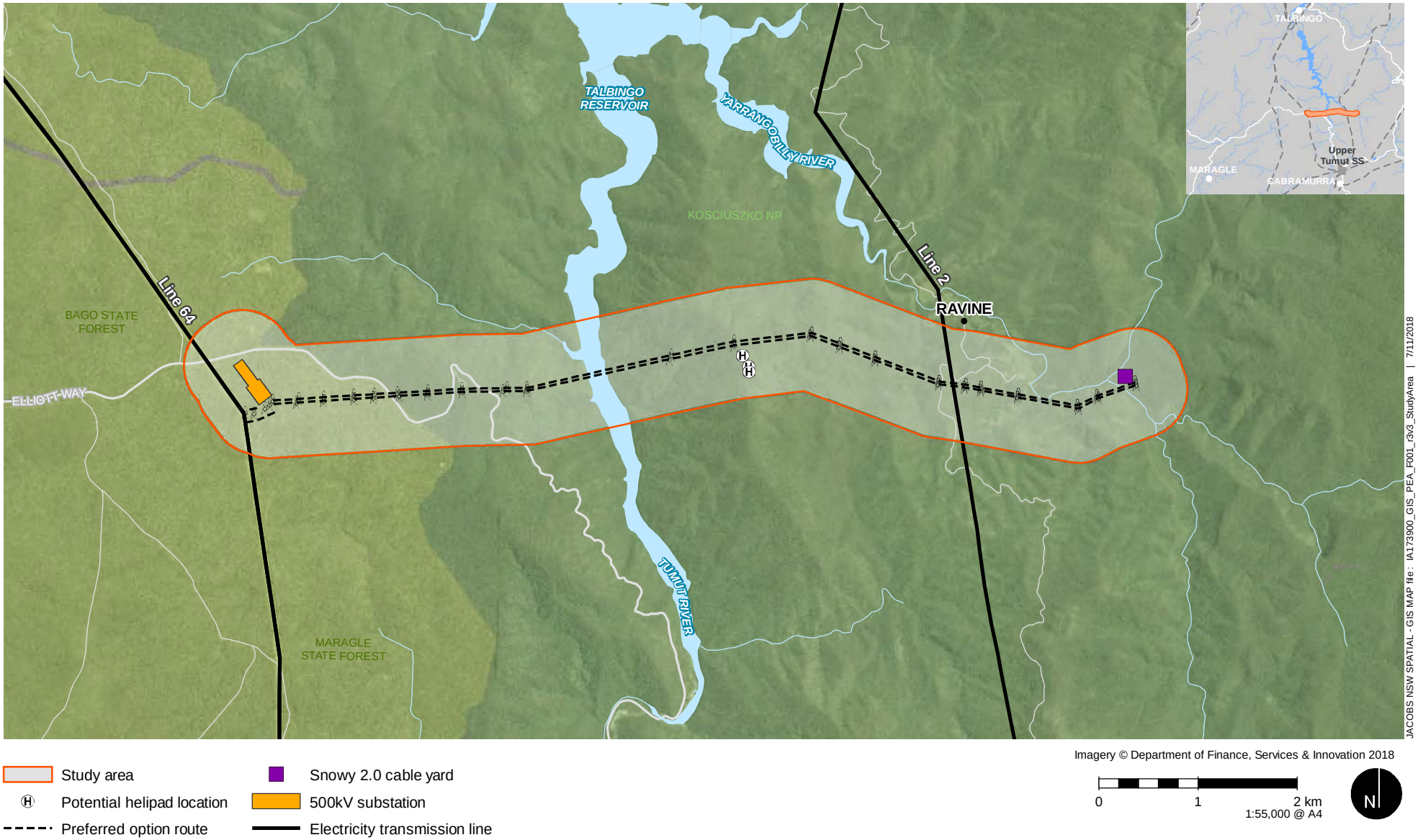


Figure 1.2 | Key components of the Project and study area

2. Methodology

2.1 Personnel

This Preliminary Biodiversity Assessment was undertaken and prepared by appropriately qualified and experienced ecologists as outlined in **Table 2.1**.

Table 2.1 : Personnel, role and qualifications

Name	Role	Qualifications
Lukas Clews	Senior Ecologist - Technical lead, ecology surveys, reporting, GIS analysis	Master of Scientific Studies Graduate Certificate in Applied Science Bachelor of Science Diploma in Conservation and Land Management Certified Environmental Practitioner (CEnvP) by the Environment Institute of Australia and New Zealand (EIANZ) Accredited under Section 6.10 of the *Biodiversity Conservation Act 2016* as a Biodiversity Assessment Method Assessor (No. BAAS17060)
Paul Rossington	Senior Ecologist - Technical review	Master of Wildlife Management Bachelor of Science (Biology) Accredited under Section 6.10 of the *Biodiversity Conservation Act 2016* as a Biodiversity Assessment Method Assessor.

2.2 Study area

The Project is located in the Snowy Valleys local government area (LGA) and within Kosciusko National Park and Bago State Forests as shown on **Figure 1-1**.

The extent of the site and route selection study area was constrained by the location of the Snowy 2.0 cable yard in the east, and Line 64 in the west. An area between the Snowy 2.0 cable yard and potential substation locations near the existing Line 64 was investigated at a desktop level and site field surveys during preparation of the PEA.

The following areas are discussed throughout the report and are defined as:

- Study area: The study area includes the likely Project impact area base on the preferred option with a 500 metres buffer. This area includes the potential locations of a new 330/500kV substation, 120 metre wide easement for the 330kV double-circuit transmission lines from the Snowy 2.0 cable yard to the new substation (see **Figure 1.2**). All of the ancillary activities including brake and winch sites, crane pads, helicopter landing pads, site compounds and equipment laydown areas would be within the 500 metre buffer). This will be the study area that will be assessed in the EIS.
- Survey area: The survey area is a much larger area that was investigated for the route selection process and field investigation during the preparation of the PEA (see **Figure 1-1**). The survey area includes the study area.
- Locality: This is defined as the area within a 10 kilometre (km) radius surrounding the Project footprint.
- Bioregion: The study area is located across two bioregions: the South East Highlands bioregion and the Australian Alps Bioregion (Thackway and Cresswell, 1995) and within the Bondo and Snowy Mountains sub-regions respectively. The majority of the Project is located in the Bondo sub-region of the South East Highlands bioregion.

2.3 Background research

A background review of existing information was undertaken to identify the existing environment of the Project within a search area of 10 km. The review focussed on database searches, relevant ecological reports pertaining to the survey area and relevant GIS layers. The review was used to prepare a list of Plant Community Types (PCTs), threatened species, populations and communities as well as important habitat for migratory species with a likelihood of occurrence in the survey area and locality. The searches were also undertaken to identify if any Areas of Outstanding Biodiversity Value were present.

The following databases were searched:

- BioNet - the website for the Atlas of NSW Wildlife and OEH Threatened Species Profile Database
- NSW Department of Primary Industries (DPI) freshwater threatened species distribution maps
- The federal Department of Environment's Protected Matters Search Tool
- OEH BioNet Vegetation Classification database
- The federal Bureau of Meteorology's Atlas of Groundwater Dependent Ecosystems (GDE)
- Department of Environment's directory of important wetlands.

Regional vegetation mapping, geology and soil mapping projects were reviewed including:

- *Native Vegetation of the southern Forests: south-east Highlands, Australian Alps, South-west Slopes, and SE Corner Bioregions* (Gellie, 2005)
- *Southern CRA / Riverina Highlands Vegetation Mapping Extension* (Maguire et al., 2000)
- *Riverina Regional Native Vegetation Map Version v1.0 - VIS_ID 4469* (Office of Environment and Heritage, 2016)
- *Wagga Wagga 1:250 000 Geological Map* (Adamson and Loudon, 1966)
- *Wagga Wagga 1:250 000 Metallogenic Map* (Degeling, 1977)
- *Australian Soil Classification (ASC) Soil Type map of NSW* (State Government of NSW and Office of Environment and Heritage (OEH), 2012).

Preliminary and provisional determinations to list species and ecological communities as threatened under the BC Act were viewed on the OEH NSW Threatened Species Scientific Committee website. At the time of writing, there are no preliminary or provisional listings of relevance to the Project. The annual Final Priority Assessment List of nominated species and ecological communities that have been approved for assessment by the Minister responsible for the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) was reviewed.

2.3.1 Likelihood of occurrence assessment

A habitat assessment was undertaken within the survey area on the identified list of threatened flora and fauna species known or predicted to occur from the database searches (see **Appendix A** for the habitat assessment results). This list was identified from databases and literature as well as past surveys. The habitat assessment compared the preferred habitat features of these species with the type and quality of the habitats known or predicted to occur in the survey area. This habitat assessment was completed to make an assessment of the likelihood of the species being present in the survey area (i.e. subject species).

The criteria used in the habitat assessment are detailed in **Table 2.2**. The results of the habitat assessment are provided in **Appendix A**.

Table 2.2 : Likelihood of occurrence classification and criteria

Likelihood	Criteria
Known to occur	The species was observed in the survey area during the current survey or is known to occur based on previous, recent surveys in the survey area.
High	It is highly likely that a species inhabits the survey area and is dependent on identified suitable habitat (i.e. for breeding or important life cycle periods such as winter flowering resources), has been recorded recently in the locality (10 km) and is known or likely to maintain resident populations in the study area. Also includes species known or likely to visit the study area during regular seasonal movements or migration. Also includes plant species that were not targeted by surveys and that have been recorded in habitats contiguous with those of the survey area.
Moderate	Potential habitat is present in the survey area. Includes animal species that are unlikely to maintain sedentary populations, but which may seasonally use resources within the survey area sporadically during dispersal or migration, particularly during unusual seasonal conditions such as drought in the species' core range. The species is unlikely to be dependent on habitat (i.e. for breeding or important life cycle periods such as winter foraging on flowering trees or summer foraging by migratory birds on wetlands) within the survey area, or habitat is in a modified or degraded state. Also includes plant species that were not targeted by surveys and that have not been recorded in habitats contiguous with those of the survey area.
Low	Includes animal species that are unlikely to permanently or regularly inhabit the survey area and which have not been recorded recently in the locality (10 km) or are only known only as rare vagrants or from records of questionable reliability in terms of identification and/or location. They may be infrequent visitors, but habitat similar to the survey area is widely distributed in the local area, meaning that the species are not unlikely to be dependent (i.e. for breeding or important life cycle periods such as winter foraging on flowering trees or summer foraging by migratory birds on wetlands) on habitat in the survey area. Includes plant species for which specific habitat features are not present in the survey area or for which habitat is considered very marginal. Also includes plant species for which potential habitat is present that are non-cryptic perennial species which were specifically targeted by surveys according to best-practise guidelines and were not recorded.
None	Suitable habitat is absent from the survey area.

2.4 Field survey

An initial site visit was undertaken within the survey area over two days in March 2018 to ground-truth the results of the background research and initial habitat assessment. This site visit involved a drive through the survey area on accessible roads and tracks. Areas visited included Lobs Hole Ravine Road, Link Road, Goat Ridge Road and Elliott Way in the Kosciuszko National Park. Elliott Way, Boundary road and Black Jack Logging Road and the east Bago Powerline Road in the Maragle and Bago State Forest were also driven. A more detailed walk over survey of some potential transmission line routes, structure locations and access tracks within the Kosciuszko National Park was undertaken over four days in April 2018.

2.5 Limitations

The desktop assessment and field survey undertaken for this Preliminary Biodiversity Assessment provide a limited view into the ecological values of the whole survey area. This report is not a comprehensive assessment of the biodiversity in the survey area and is not a Biodiversity Development Assessment Report (BDAR). The diversity of flora and fauna species recorded from this study should not be seen to be comprehensive. The distribution and type of PCTs outlined in this report are based off desktop research and limited rapid field survey and a detailed survey according to the methods outlined in the Biodiversity Assessment Methodology are required to make a definitive determination of PCTs and to map PCT boundaries. A period of several seasons or years is often needed to identify all the species present in an area, especially as some species are only apparent at certain times of the year e.g. orchids or migratory birds and require specific weather conditions for optimum detection e.g. breeding and flowering periods. The conclusions of this report are therefore based upon available data and limited field survey and are indicative of the environmental condition of the subject sites at the time of the survey. It should be recognised that site conditions, including the presence of threatened species, can change with time. To address this limitation, the assessment has aimed to identify the presence and suitability of the habitat for threatened species as discussed in the following section.

3. Existing environment

3.1 Landscape context

The survey area is located across two bioregions: the South East Highlands bioregion and the Australian Alps Bioregion (Thackway and Cresswell, 1995) and within the Bondo and Snowy Mountains sub-regions respectively. The majority of the Project is located in the Bondo sub-region of the South East Highlands bioregion. The South Eastern Highlands Bioregion covers the dissected ranges and plateau of the Great Dividing Range that are topographically lower than the Australian Alps, which lie to the southwest. The highlands are part of the Lachlan fold belt that runs through the eastern states as a complex series of metamorphosed Ordovician to Devonian sandstones, shales and volcanic rocks intruded by numerous granite bodies. In NSW, the Australian Alps bioregion is entirely surrounded by the South Eastern Highlands Bioregion. The alpine area comprises granites that have formed faulted, stepped ranges at the point where the South Eastern Highlands in NSW turn west into Victoria. More recent volcanic activity produced basalts and, in the Pleistocene, the cold climate superimposed glacial features on the landscape. The bioregion was the only part of the mainland to have been affected by Pleistocene glaciation and contains a variety of unique glacial and periglacial landforms above 1,100 m altitude.

The Project crosses a variety of landscapes as mapped by the NSW National Parks and Wildlife Service (NPWS) (2002) and described by the NSW Department of Environment and Climate Change (2008) as follows from east to west:

- Pinbeyan - Ravine Ranges - Structurally controlled ranges with prominent bluffs to 120 m and plateau top on a synclinal fold in Upper Devonian rhyolite, andesitic basalt, tuff, sandstone, shale, slate, limestone, conglomerate and siltstone. Elevation 500 to 1,400 m, local relief 700 m. Extensive rock outcrop. Steep debris slope below cliffs with rubbly brown sandy loam grading to red-brown texture-contrast soils on lower slopes
- Cootamundra - Tumut Serpentinite and Ultramafics - Narrow ridges of extended linear outcrops of Devonian schistose serpentine, amphibolite and associated ultramafic rocks and sediments, general elevation 400 to 700 m, local relief 120 m. Dark structured clay loam and clay with unusual mineral content
- Cabramurra - Kiandra Basalt Caps and Sands - Tertiary basalt flow remnants capping hills on the high plains. Fluvial quartz gravels, sands and silts of former river channels are exposed beneath the basalt. Soil materials and sediments from the basalt and quartz sands extend down slope over Ordovician meta-sediments or Silurian-Devonian granites toward the alpine valleys. Most basalt outcrops are columnar jointed and formed periglacial block streams during the Pleistocene. General elevation 1,400 to 1,650, local relief to 200 m. Uniform and gradational, organic rich, brown clay loams, often stony
- Tooma Granite Ranges - Rounded hills, ranges and plateau on Silurian gneissic granite with well-defined rectangular drainage pattern controlled by jointing. General elevation 700 to 1400 m. Red and yellow gritty texture-contrast soils merging to gradational profiles at about 1,000 m

3.1.1 Areas of outstanding biodiversity value

Areas of declared critical habitat under the *Threatened Species Conservation Act 1995* have become the first declared areas of outstanding biodiversity value in NSW with the commencement of the *Biodiversity Conservation Act 2016* (BC Act). To date, there are only four declared areas of outstanding biodiversity value and these areas are not located in or near the Project.

3.2 Native vegetation

Due to the diversity of landscapes within the survey area, the native vegetation is also variable. The survey area is highly vegetated being within the Kosciuszko National park and the Maragle and Bago State Forests. The survey area crosses from the South East Highlands Bioregion up into the Australian Alps and there is a corresponding change in vegetation. While the survey area is highly vegetated, it is not without disturbance. There is a long history of human use in the area, and disturbance in the form of logging, farming, habitation, tourism, and infrastructure development and maintenance can be found.

3.2.1 Plant community types

The Plant Community Types (PCTs) present in NSW are described in the BioNet Vegetation Classification database. The PCTs outlined in the BioNet Vegetation Classification database provide a focal point for vegetation type mapping and regulatory assessment processes. An overview of the PCTs mapped in the survey area is provided below in **Table 3.1**. The survey area is large and contains a number of landforms and geologies so there are many PCTs that have been mapped. Detailed field survey is required to determine if these PCTs are present in the survey area.

The location of PCTs, as based on available regional mapping, is outlined in **Figure 3.1**.

Table 3.1 : An overview of the Plant Community Types mapped in the broader survey area

PCT ID	PCT name	Class	Formation	BC Act TEC?	EPBC Act TEC?	Mapped in the survey area?
277	Blakelys Red Gum - Yellow Box grassy tall woodland of the NSW South Western Slopes Bioregion	Western Slopes Grassy Woodlands	Grassy Woodlands	White Box Yellow Box Blakely's Red Gum Woodland	White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	Yes
280	Red Stringybark - Blakelys Red Gum +/- Long-leaved Box shrub/grass hill woodland of the NSW South Western Slopes Bioregion					No
283	Apple Box - Blakelys Red Gum moist valley and footslopes grass-forb open forest of the NSW South Western Slopes Bioregion					No
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	Upper Riverina Dry Sclerophyll Forests	Dry Sclerophyll Forests (Shrub/grass subformation)	Tablelands Snow Gum, Black Sallee, Candlebark and Ribbon Gum Grassy Woodland in the South Eastern Highlands, Sydney Basin, South East Corner and NSW South Western Slopes Bioregions	No	Yes
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, refer to **Photo 7**	Upper Riverina Dry Sclerophyll Forests	Dry Sclerophyll Forests (Shrub/grass subformation)	No	No	Yes
295	Robertsons Peppermint - Broad-leaved Peppermint - Nortons Box - stringybark shrub-fern open forest of the NSW South Western Slopes Bioregion and South Eastern Highlands Bioregion, refer to **Photo 4**	Southern Tableland Wet Sclerophyll Forests	Wet Sclerophyll Forests (Grassy subformation)	No	No	Yes
296	Brittle Gum - peppermint open forest of the Woomargama to Tumut region, NSW South Western Slopes Bioregion			No	No	Yes
297	Broad-leaved Peppermint - Nortons Box - Red Stringybark tall open forest on red clay on hills in the southern part of the NSW South Western Slopes Bioregion	Upper Riverina Dry Sclerophyll Forests	Dry Sclerophyll Forests (Shrub/grass subformation)	No	No	No

PCT ID	PCT name	Class	Formation	BC Act TEC?	EPBC Act TEC?	Mapped in the survey area?
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, refer to **Photo 6**.	Southern Tableland Dry Sclerophyll Forests	Dry Sclerophyll Forests (Shrub/grass subformation)	No	No	Yes
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, refer to **Photo 5**.	Southern Tableland Wet Sclerophyll Forests	Wet Sclerophyll Forests (Grassy subformation)	No	No	Yes
301	Drooping Sheoke - Ricinocarpus bowmannii - grasstree tall open shrubland of the Coolac - Tumut Serpentinite Belt	Western Slopes Grassy Woodlands	Grassy Woodlands	Coolac-Tumut Serpentinite Shrubby Woodland in the NSW South Western Slopes and South Eastern Highlands Bioregions	No	Yes
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	Upper Riverina Dry Sclerophyll Forests	Dry Sclerophyll Forests (Shrub/grass subformation)	Tablelands Snow Gum, Black Sallee, Candlebark and Ribbon Gum Grassy Woodland in the South Eastern Highlands, Sydney Basin, South East Corner and NSW South Western Slopes Bioregions	No	Yes
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	Upper Riverina Dry Sclerophyll Forests	Dry Sclerophyll Forests (Shrub/grass subformation)	No	No	Yes
306	Red Box - Red Stringybark - Nortons Box hill heath shrub - tussock grass open forest of the Tumut region			No	No	Yes
310	Nortons Box - Red Stringybark grassy tall open forest on sheltered slopes in the Tumbarumba - Murray River region of the NSW South Western Slopes Bioregion	Upper Riverina Dry Sclerophyll Forests	Dry Sclerophyll Forests (Shrub/grass subformation)	No	No	Yes
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			No	No	No

PCT ID	PCT name	Class	Formation	BC Act TEC?	EPBC Act TEC?	Mapped in the survey area?
314	Apple Box - Red Stringybark basalt scree open forest in the upper Murray River region			No	No	No
316	Nortons Box - Red Box - Red Stringybark +/- Nodding Flax Lily forb-grass open forest mainly on the Tumut region	Western Slopes Grassy Woodlands	Grassy Woodlands	No	No	No
335	Tussock grass - sedgeland fen - rushland - reedland wetland in impeded creeks in valleys in the upper slopes sub-region of the NSW South Western Slopes Bioregion	Inland Floodplain Swamps	Freshwater Wetlands	No	No	No
352	Red Stringybark - Blakelys Red Gum hillslope open forest on meta-sediments in the Yass - Boorowa - Crookwell region of the NSW South Western Slopes Bioregion and South Eastern Highlands Bioregion	Southern Tableland Dry Sclerophyll Forests	Dry Sclerophyll Forests (Shrub/grass subformation)	White Box Yellow Box Blakely's Red Gum Woodland	White Box Yellow Box Blakely's Red Gum Woodland	No
637	Alpine and sub-alpine peatlands, damp herbfields and fens, South Eastern Highlands Bioregion and Australian Alps Bioregion, refer to **Photo 2**	Alpine Bogs and Fens	Alpine Complex	Montane Peatlands and Swamps of the New England Tableland, NSW North Coast, Sydney Basin, South East Corner, South Eastern Highlands and Australian Alps bioregions	Alpine Sphagnum Bogs and Associated Fens	No
638	Alpine Ash - Mountain Gum moist shrubby tall open forest of montane areas, southern South Eastern Highlands Bioregion and Australian Alps Bioregion	Montane Wet Sclerophyll Forests	Wet Sclerophyll Forests (Shrubby subformation)	No	No	No
639	Alpine Ash - Snow Gum shrubby tall open forest of montane areas, South Eastern Highlands Bioregion and Australian Alps Bioregion			No	No	Yes
641	Alpine grassland/herbfield and open heathlands in Kosciuszko National Park, Australian Alps Bioregion	Alpine Herbfields	Alpine Complex	No	No	Yes
643	Alpine shrubland on scree, blockstreams and rocky sites of high altitude areas of Kosciuszko National Park, Australian Alps Bioregion			No	No	Yes

PCT ID	PCT name	Class	Formation	BC Act TEC?	EPBC Act TEC?	Mapped in the survey area?
644	Alpine Snow Gum - Snow Gum shrubby woodland at intermediate altitudes in northern Kosciuszko NP, South Eastern Highlands Bioregion and Australian Alps Bioregion	Subalpine Woodlands	Grassy Woodlands	No	No	No
679	Black Sallee - Snow Gum low woodland of montane valleys, South Eastern Highlands Bioregion and Australian Alps Bioregion	Subalpine Woodlands	Grassy Woodlands	Tablelands Snow Gum, Black Sallee, Candlebark and Ribbon Gum Grassy Woodland in the South Eastern Highlands, Sydney Basin, South East Corner and NSW South Western Slopes Bioregions	No	Yes
893	Kangaroo Grass - Poa fawcettiae open grassland on limestone in northern Kosciuszko NP, Australian Alps Bioregion	Temperate Montane Grasslands	Grasslands	No	No	No
939	Montane wet heath and bog of the eastern tablelands, South Eastern Highlands Bioregion	Montane Bogs and Fens	Freshwater Wetlands	Montane Peatlands and Swamps of the New England Tableland, NSW North Coast, Sydney Basin, South East Corner, South Eastern Highlands and Australian Alps bioregions	Montane Peatlands and Swamps of the New England Tableland, NSW North Coast, Sydney Basin, South East Corner, South Eastern Highlands and Australian Alps bioregions	No
953	Mountain Gum - Snow Gum - Broad-leaved Peppermint shrubby open forest of montane ranges, South Eastern Highlands Bioregion and Australian Alps Bioregion	Southern Tableland Dry Sclerophyll Forests	Dry Sclerophyll Forests (Shrub/grass subformation)	Tableland Basalt Forest in the Sydney Basin and South Eastern Highlands Bioregions	No	Yes
1100	Ribbon Gum - Snow Gum grassy forest on damp flats, eastern South Eastern Highlands Bioregion, refer to **Photo 9**.	Tableland Clay Grassy Woodlands	Grassy Woodlands	Tablelands Snow Gum, Black Sallee, Candlebark and Ribbon Gum Grassy Woodland in the South Eastern Highlands, Sydney Basin, South East Corner and NSW South Western Slopes Bioregions	No	Yes
1190	Snow Gum - Candle Bark shrubby open forest in valleys of the southern ACT ranges, South Eastern Highlands Bioregion	Subalpine Woodlands	Grassy Woodlands	No	No	Yes

PCT ID	PCT name	Class	Formation	BC Act TEC?	EPBC Act TEC?	Mapped in the survey area?
1191	Snow Gum - Candle Bark woodland on broad valley flats of the tablelands and slopes, South Eastern Highlands Bioregion, refer to **Photo 10** and **Photo 11.**	Subalpine Woodlands	Grassy Woodlands	Tablelands Snow Gum, Black Sallee, Candlebark and Ribbon Gum Grassy Woodland in the South Eastern Highlands, Sydney Basin, South East Corner and NSW South Western Slopes Bioregions	No	Yes
1196	Snow Gum - Mountain Gum shrubby open forest of montane areas, South Eastern Highlands Bioregion and Australian Alps Bioregion	Subalpine Woodlands	Grassy Woodlands	Tableland Basalt Forest in the Sydney Basin and South Eastern Highlands Bioregions	No	Yes
1224	Sub-alpine dry grasslands and heathlands of valley slopes, southern South Eastern Highlands Bioregion and Australian Alps Bioregion	Temperate Montane Grasslands	Grasslands	No	Natural Temperate Grassland of the South Eastern Highlands	Yes
1271	Tea-tree tall riparian shrubland, South Eastern Highlands Bioregion, South East Corner Bioregion and Australian Alps Bioregion	Eastern Riverine Forests	Forested Wetlands	No	No	Yes

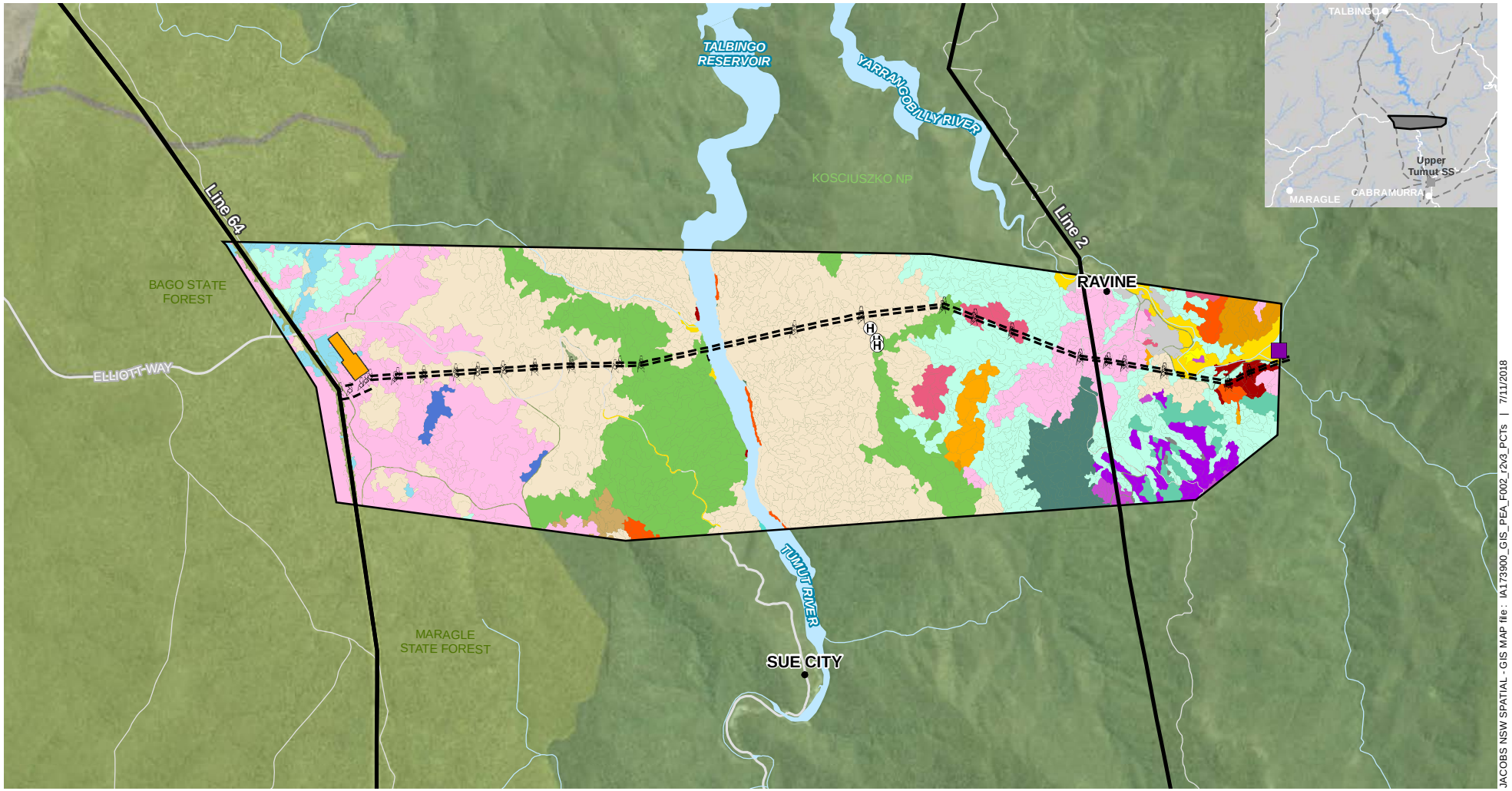


Figure 3.1 | Plant Community Types mapped around the project

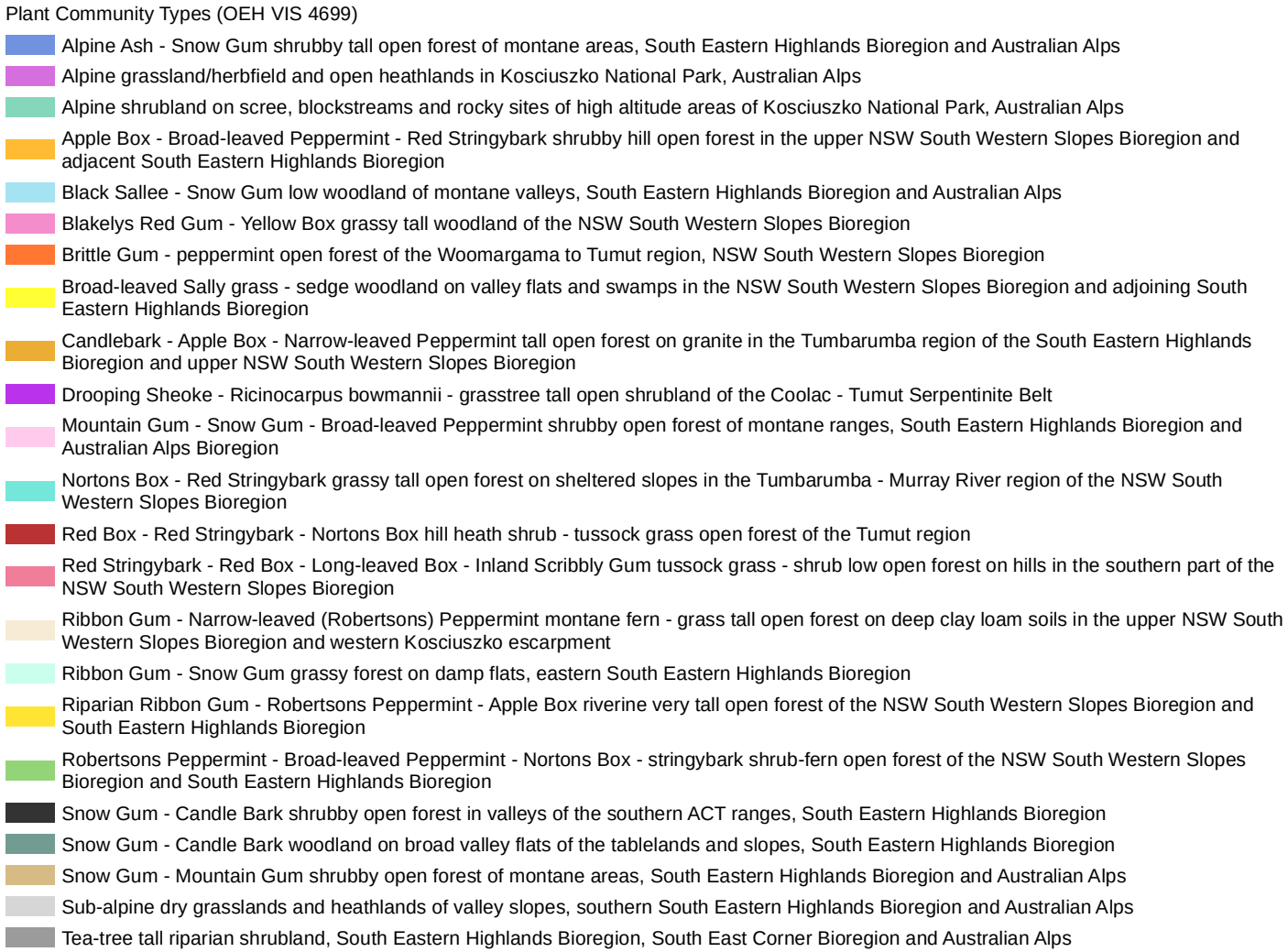


Figure 3.1 | Plant Community Types mapped in the transmission corridor/study area - Legend sheet

3.2.2 Threatened ecological communities

There are five Threatened ecological communities (TECs) as listed under the BC Act mapped in the survey area as follows:

- Coolac-Tumut Serpentinite Shrubby Woodland in the NSW South Western Slopes and South Eastern Highlands Bioregions
- Montane Peatlands and Swamps of the New England Tableland, NSW North Coast, Sydney Basin, South East Corner, South Eastern Highlands and Australian Alps bioregions
- Tableland Basalt Forest in the Sydney Basin and South Eastern Highlands Bioregions
- Tablelands Snow Gum, Black Sallee, Candlebark and Ribbon Gum Grassy Woodland in the South Eastern Highlands, Sydney Basin, South East Corner and NSW South Western Slopes Bioregions
- White Box Yellow Box Blakely's Red Gum Woodland

The location of these TECs, as based on available regional mapping, is outlined in **Figure 3.2**.

Coolac-Tumut Serpentinite Shrubby Woodland in the NSW South Western Slopes and South Eastern Highlands Bioregions

This TEC corresponds directly to the Drooping Sheoke - *Ricinocarpus bowmannii* - grasstree tall open shrubland of the Coolac - Tumut Serpentinite Belt PCT. This TEC is mapped as occurring in the east of the survey area north of Roundtop Mountain and adjacent to Lobs Hole Ravine Road which is on limestone and shale geology. Some of these mapped areas along Lobs Hole Ravine Road were visited in the field and found not to contain the TEC but instead disturbed areas consisting of sparse to dense regrowth of *Eucalyptus rubida, Acacia dealbata, Dodonaea viscosa* subsp. *angustissima, Bursaria spinosa,* and *Calytrix tetragona,* and *Exocarpus strictus*. The characteristic species *Allocasuarina verticillata*, *Acacia implexa*, *Xanthorrhoea glauca* and *Ricinocarpos bowmanii* were not present in the areas visited. Based on the site visits the available mapping of this TEC is likely to be inaccurate. This TEC may still be present in the survey area where small areas of outcropping of serpentenite occur such as the belt of serpentenite and ultramafics on the western slope of Sheep Station Ridge.

Montane Peatlands and Swamps of the New England Tableland, NSW North Coast, Sydney Basin, South East Corner, South Eastern Highlands and Australian Alps bioregions

This TEC corresponds directly to the Alpine and sub-alpine peatlands, damp herbfields and fens, South Eastern Highlands Bioregion and Australian Alps Bioregion PCT (refer to **Photo 2**). This TEC is mapped as occurring in the higher altitude alpine areas in the west of the survey area near Yorkers Creek on the Bago plateau in the Bago State Forest. This TEC is mapped more extensively in that area by the OEH Montane Peat and Swamps layer and may also occur in areas mapped as the Black Sallee - Snow Gum low woodland of montane valleys, South Eastern Highlands Bioregion and Australian Alps Bioregion PCT in the Bago and Maragle State Forests. This TEC may also occur in small areas under Line 64 in the Bago State Forest.

Tableland Basalt Forest in the Sydney Basin and South Eastern Highlands Bioregions

The western portion of the survey area in the Maragle and Bago State Forests where areas of Olivine Basalt occur lies within the Australian Alps bioregion. The portion of the survey area that falls within and near the edge of the South Eastern Highlands bioregions contains PCTs that may form part of this TEC including:

- Snow Gum - Mountain Gum shrubby open forest of montane areas, South Eastern Highlands Bioregion and Australian Alps Bioregion (mapped in the Maragle State Forest on Biotite Granodiorite geology), refer to **Photo 3**
- Mountain Gum - Snow Gum - Broad-leaved Peppermint shrubby open forest of montane ranges, South Eastern Highlands Bioregion and Australian Alps Bioregion (mapped in the Maragle State Forest on Biotite Granodiorite geology and in the Kosciuszko National Park Lobs Hole Ravine area on Quartzite and Siltstone geology), refer to **Photo 8**.

While this PCT is named the Tableland Basalt Forest in the Sydney Basin and South Eastern Highlands Bioregions it may also occur on loam or clay soils derived from mudstones, granites, alluvium and other substrates at altitudes between 600 – 900 m above sea level. This TEC also includes disturbed areas of derived grasslands. This TEC may be present wherever *Eucalyptus viminalis* and/or *E. dalrympleana* subsp.

dalrympleana occurs in the South East Highlands portion of the survey area. Detailed field survey is required to determine the presence and distribution of this TEC.

Tablelands Snow Gum, Black Sallee, Candlebark and Ribbon Gum Grassy Woodland in the South Eastern Highlands, Sydney Basin, South East Corner and NSW South Western Slopes Bioregions

This TEC is mapped in the western portion of the survey area in the Maragle and Bago State Forests associated with the drainage of Yorkers Creek and tributaries. Extensive areas of vegetation in the Kosciusko National Park in the east of the survey area are mapped as PCTs that correspond to parts of this TEC. The PCTs that constitute this TEC that are mapped in the survey area include:

- Black Sallee - Snow Gum low woodland of montane valleys, South Eastern Highlands Bioregion and Australian Alps Bioregion, refer to **Photo 1**
- Broad-leaved Sally grass - sedge woodland on valley flats and swamps in the NSW South Western Slopes Bioregion and adjoining South Eastern Highlands Bioregion
- 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
- Ribbon Gum - Snow Gum grassy forest on damp flats, eastern South Eastern Highlands Bioregion
- Snow Gum - Candle Bark woodland on broad valley flats of the tablelands and slopes, South Eastern Highlands Bioregion.

Detailed field survey is required to determine the presence and distribution of this TEC.

White Box Yellow Box Blakely's Red Gum Woodland

This TEC corresponds to the Blakelys Red Gum - Yellow Box grassy tall woodland of the NSW South Western Slopes Bioregion PCT. This TEC is mapped (based on spatial modelling) in the Ravine area east of the Flying Fox Trail and west of the Yarrangobilly River. This area has not been verified in the field and detailed field survey is required to determine the presence and distribution of this TEC.

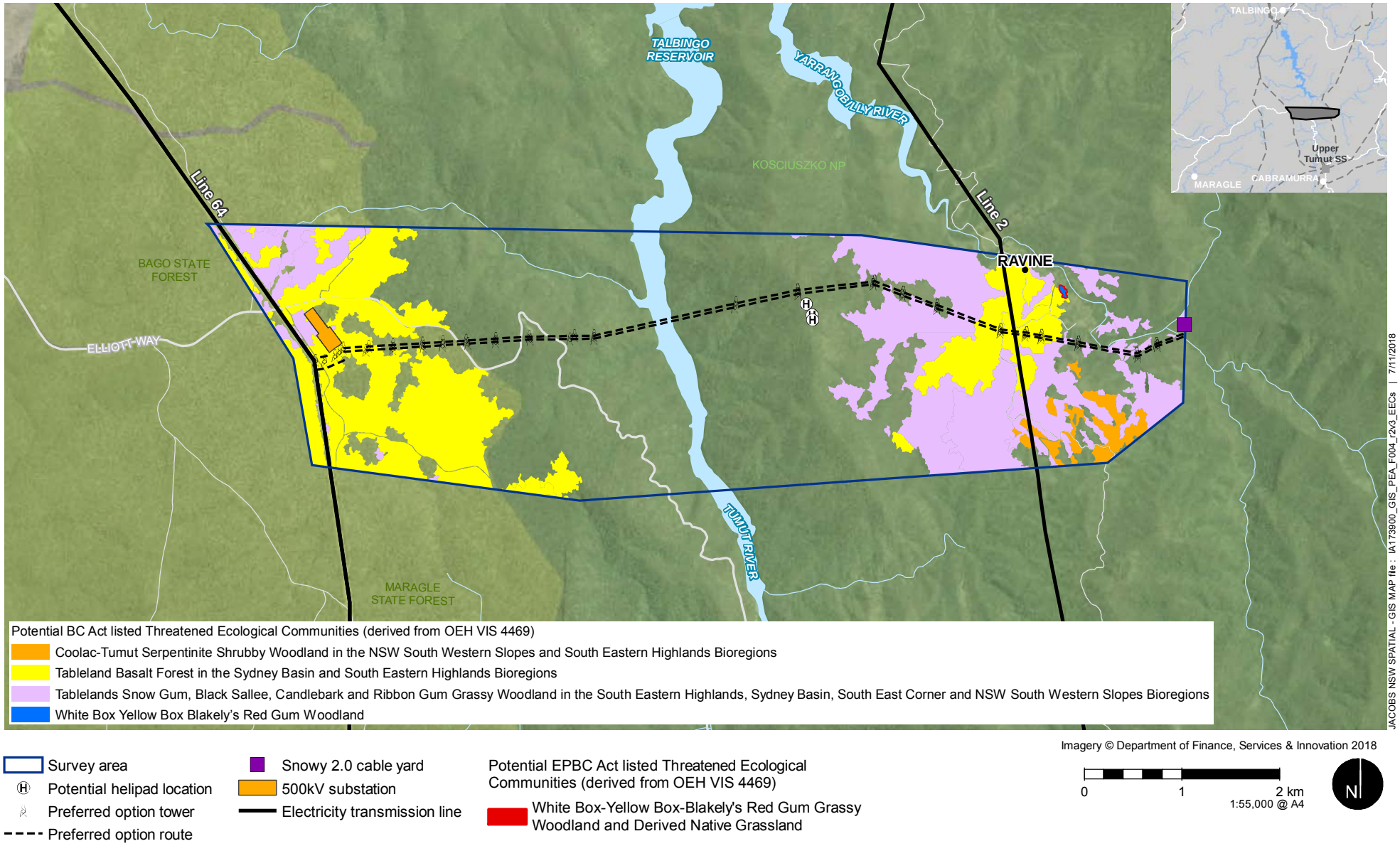


Figure 3.2 | Threatened ecological communities

Photo 1: The Black Sallee - Snow Gum low woodland of montane valleys, South Eastern Highlands Bioregion and Australian Alps Bioregion PCT in the Maragle State Forest

Photo 2: The Alpine and sub-alpine peatlands, damp herbfields and fens, South Eastern Highlands Bioregion and Australian Alps Bioregion PCT in the Maragle State Forest

Photo 3: The Snow Gum - Mountain Gum shrubby open forest of montane areas, South Eastern Highlands Bioregion and Australian Alps Bioregion PCT in the Western portion of Kosciuszko National Park

Photo 4: The Robertsons Peppermint - Broad-leaved Peppermint - Nortons Box - stringybark shrub-fern open forest of the NSW South Western Slopes Bioregion and South Eastern Highlands Bioregion PCT on the slope off Elliott Way

Photo 5: The 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 on the slope off Elliott Way

Photo 6: The 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 on the Tumut River off Elliott Way

Photo 7: The 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 on the ridge to the north of Sheep Station Creek

Photo 8: The Mountain Gum - Snow Gum - Broad-leaved Peppermint shrubby open forest of montane ranges, South Eastern Highlands Bioregion and Australian Alps Bioregion PCT on the slope to the north of Sheep Station Creek

Photo 9: The Ribbon Gum - Snow Gum grassy forest on damp flats, eastern South Eastern Highlands Bioregion PCT on the flats near Sheep Station Creek

Photo 10: The Snow Gum - Candle Bark woodland on broad valley flats of the tablelands and slopes, South Eastern Highlands Bioregion PCT on the limestone and shale along Lobs Hole Ravine Road

Photo 11: An example of the more disturbed areas of the Snow Gum - Candle Bark woodland on broad valley flats of the tablelands and slopes, South Eastern Highlands Bioregion PCT on the limestone and shale along Lobs Hole Ravine Road that is now a regenerating shrubland

Photo 12: The riparian habitat of Sheep Station Creek

3.3 Aquatic habitats

The Project is located within the Murrumbidgee catchment. The study area contains the second order streams of Yorkers Creek, Native Dog Gully and New Zealand Gully that are fed by a six mapped smaller ephemeral first order streams. Yorkers Creek becomes a larger third order and fourth order stream as it flows to the north and east and joins the major waterway of the Tumut River at the Talbingo Reservoir (sixth order stream). In the south of the proposed substation area, New Zealand Gully flows into Native Dog Creek which flows south becoming a larger third order stream until it meets New Maragle Creek where it becomes a larger fourth order stream that flows south and east into the Tumut River.

West of the Talbingo Reservoir, the structures would be built on ridges that are drained by unnamed first order streams that join larger second order streams that flow down the steep terrain and terminate in the Tumut River to the east.

East of the Talbingo Reservoir, The Project would be built on ridges that are drained by unnamed first and second order streams. The unnamed streams on the western side of Sheep Station Ridge flow west down the steep slopes into the major waterway of the Tumut River at the Talbingo Reservoir. On the eastern side of Sheep Station Ridge the area is drained by a number of unnamed first and second order streams that join the third order stream of Sheep Station Creek. East of Lobs Hole Ravine Road the landscape is drained by first and second order streams that flow into Lick Hole Gully and further east Cave Gully which are second and third order streams. Lick Hole Gully and Cave Gully flow north into the major seventh order stream of the Yarrangobilly River which flows north west into the Talbingo Reservoir. Further to the east the Project cross more first and second order streams and the larger fifth order stream of Wallaces Creek (refer to **Photo 13**) that flows north into the Yarrangobilly River (refer to **Photo 14**). The Project cross the fifth order stream of Stable Creek and some minor first order streams.

The DPI Key Fish Habitat (KFH) mapping indicates that the following waterways that are crossed by the preferred route are KFH:

- Tumut River (and Talbingo Reservoir), refer to **Photo 16** and **Photo 17**
- Sheep Station Creek, refer to **Photo 15**
- Lick Hole Gully
- Cave Gully
- Wallaces Creek
- Yarrangobilly River.

There are also other streams mapped as KFH that are not near the preferred route option. These aquatic habitats listed above are recognised as important to the sustainability of the recreational and commercial fishing industries, the maintenance of fish populations generally and the survival and recovery of threatened aquatic species. A map if aquatic habitats is provided in **Figure 3.3**.

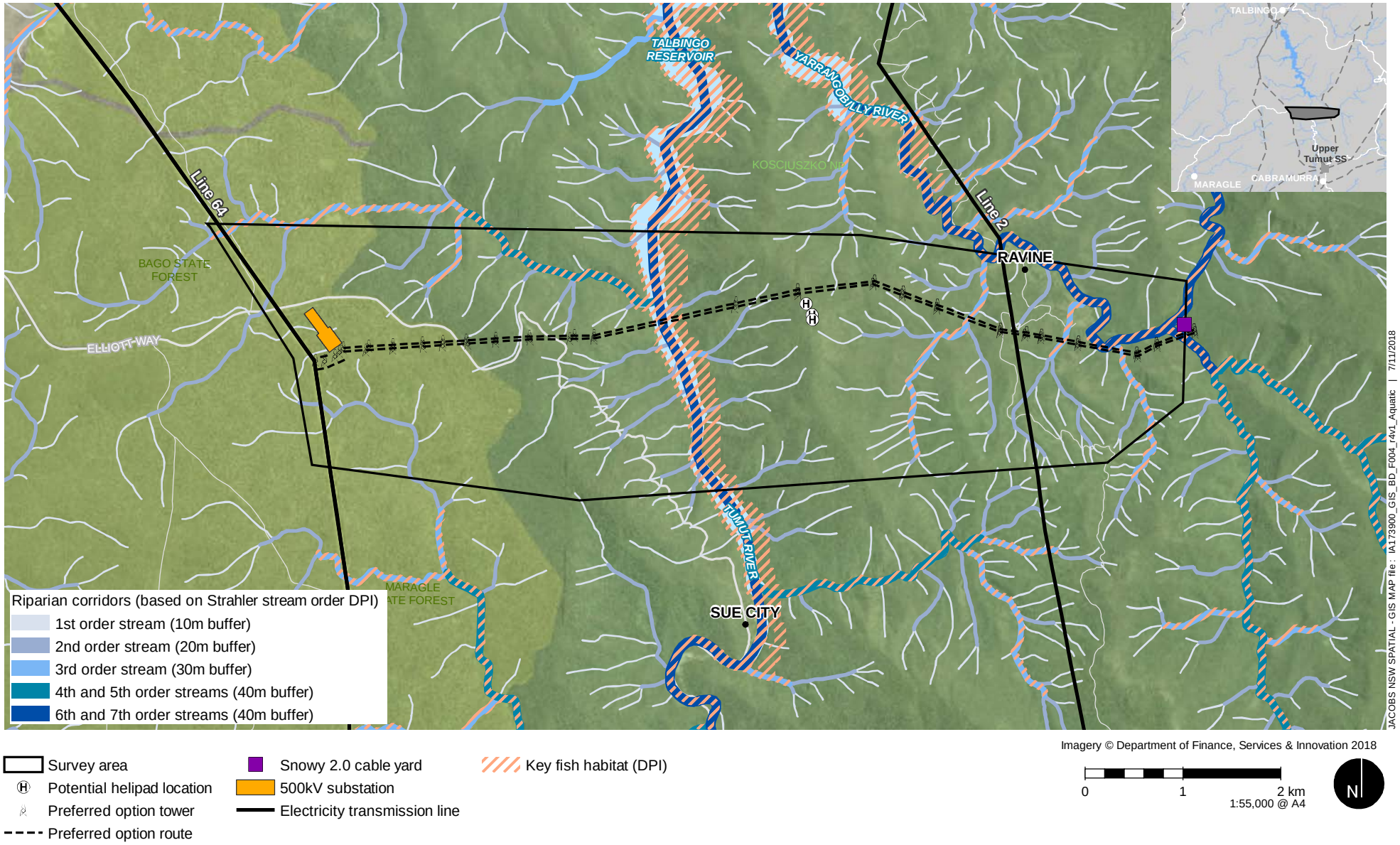


Figure 3.3 | Aquatic habitats around the project

Photo 13: The aquatic habitat of Wallaces Creek in the east of the survey area (Key Fish Habitat)

Photo 14: The aquatic habitat of the Yarrangobilly River in the Ravine area (Key Fish Habitat)

Photo 15: The aquatic habitat of Sheep Station Creek in the Ravine area (Key Fish Habitat)

Photo 16: The aquatic habitat of the Tumut River (Key Fish Habitat)

Photo 17 : The aquatic habitat of the Talbingo Reservoir (Tumut River) (Key Fish Habitat)

Photo 18 : Aquatic habitat of Modder Creek under Elliott Way in the Maragle State Forest to the west of the substation site (mapped as Key Fish Habitat)

3.4 Groundwater dependent ecosystems

There are a number of high and moderate potential aquatic Groundwater Dependent Ecosystems (GDEs) and terrestrial GDEs mapped within the survey area by the Atlas of GDEs (Bureau of Meteorology, 2017). The aquatic GDEs correspond with the larger named water courses. Near study area, the mapped aquatic GDEs include Yorkers Creek, Native Dog Gully and New Zealand Gully and Appletree Gully in the west, the Tumut River, and Sheep Station Creek, Lick Hole Gully, Cave Gully, Wallace Creek, Stable Creek and the Yarrangobilly River to the east.

The Atlas of GDEs (Bureau of Meteorology, 2017) identifies portions of the survey area as containing some areas of moderate to high potential groundwater dependent terrestrial vegetation. The Atlas of GDEs dataset uses the same polygons as the *Riverina Regional Native Vegetation Map Version v1.0 - VIS_ID 4469* (Office of Environment and Heritage, 2016). The study area around Maragle and Bago State Forests and western edge of the Kosciuszko National Park contain some areas of high potential terrestrial GDEs including areas of the:

- Black Sallee - Snow Gum low woodland of montane valleys, South Eastern Highlands Bioregion and Australian Alps Bioregion PCT
- Mountain Gum - Snow Gum - Broad-leaved Peppermint shrubby open forest of montane ranges, South Eastern Highlands Bioregion and Australian Alps Bioregion PCT.
- Alpine Ash - Snow Gum shrubby tall open forest of montane areas, South Eastern Highlands Bioregion and Australian Alps Bioregion PCT
- Robertsons Peppermint - Broad-leaved Peppermint - Nortons Box - stringybark shrub-fern open forest of the NSW South Western Slopes Bioregion and South Eastern Highlands Bioregion PCT
- 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
- Snow Gum - Mountain Gum shrubby open forest of montane areas, South Eastern Highlands Bioregion and Australian Alps Bioregion PCT
- Brittle Gum - peppermint open forest of the Woomargama to Tumut region, NSW South Western Slopes Bioregion PCT.

On the eastern side of the Tumut River there are large areas of the following PCTs mapped as moderate to high potential GDEs:

- Ribbon Gum - Snow Gum grassy forest on damp flats, eastern South Eastern Highlands Bioregion PCT mapped as a moderate to high potential GDE
- Snow Gum - Candle Bark woodland on broad valley flats of the tablelands and slopes, South Eastern Highlands Bioregion
- Riparian Ribbon Gum - Robertsons Peppermint - Apple Box riverine very tall open forest of the NSW South Western Slopes Bioregion and South Eastern Highlands Bioregion
- Tea-tree tall riparian shrubland, South Eastern Highlands Bioregion, South East Corner Bioregion and Australian Alps Bioregion.

While most of these PCTs are considered with a moderate to high likelihood to be GDEs they would not be obligate GDEs (i.e. they are not entirely dependent on groundwater). These PCTs are not restricted to locations of groundwater discharge and are not located within aquifers. These PCTs are likely to be opportunistic facultative GDEs that depend on the subsurface presence of groundwater (often accessed via the capillary fringe – subsurface water just above the water table) in some locations but not in others, particularly where an alternative source of water (i.e. rainfall) cannot be accessed to maintain ecological function. These facultative GDEs should not pose a high constraint on the Project at this stage.

The Alpine and sub-alpine peatlands, damp herbfields and fens, South Eastern Highlands Bioregion and Australian Alps Bioregion PCT in the higher altitude alpine areas in the west of the survey area near Yorkers Creek on the Bago plateau in the Bago and Maragle State Forest presents the highest constraint in terms of terrestrial GDEs as it is likely to be highly dependent on groundwater.

A map of potential GDEs is provided in **Figure 3.4** and the PCT were shown on **Figure 3-1**.

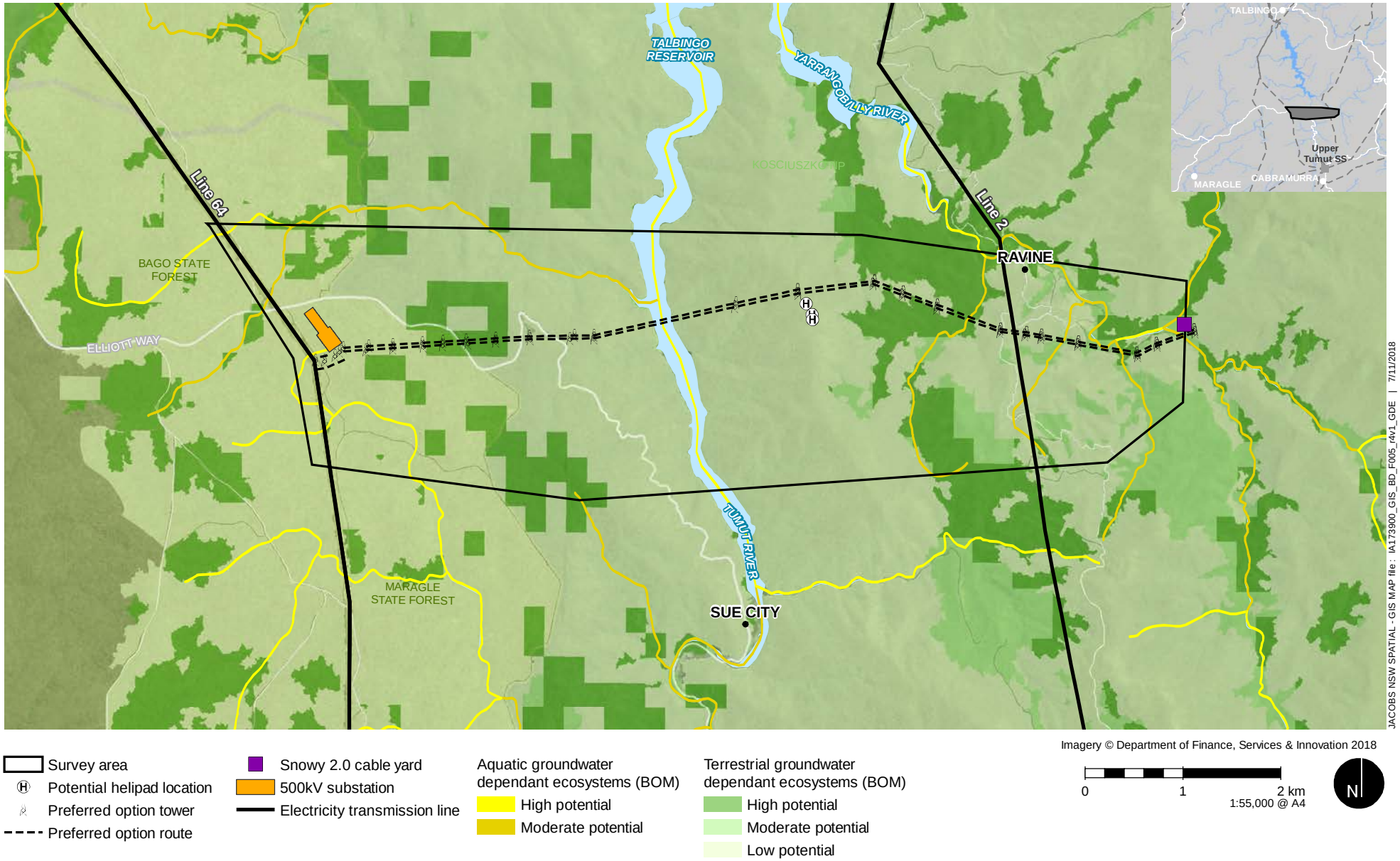


Figure 3.4 | Potential Groundwater dependent ecosystems around the project

3.5 Habitat suitability for threatened species

The desktop searches, including a review of the Threatened Biodiversity Data Collection, identified the threatened species that have been recorded by previous surveys or are considered likely to occur in the survey area. The site visits also provided an opportunity to rapidly observe the quality of the broad habitat types within the survey area. A preliminary assessment of the habitat suitability for threatened species is provided below separated into ecosystem credit species and species credit species.

In some circumstances, the Threatened Biodiversity Data Collection may identify that a species requires assessment for ecosystem credits and species credits (a dual credit species). This occurs where part of the habitat is assessed as a species credit (e.g. breeding habitat, or mapped locations identified as important area that is used by a species). The remaining part of the habitat is assessed as an ecosystem credit (e.g. foraging habitat, unmapped locations used by a species). This is why some species are listed in both **Table 3.2** and **Table 3.3**. In many cases breeding habitat is likely to be present for dual credit species. In the case of the Smoky Mouse, this species is a dual credit species because it is difficult to reliably detect by survey but there are sites known to support resident populations of the species and which are, therefore, considered 'important' (these sites are South East Forests National Park, Nullica State Forest and Gnupa State Forest). These sites are not in the survey area so the Smoky Mouse is treated as an ecosystem credit species only.

3.5.1 Ecosystem credit species

Threatened species, for which the likelihood of occurrence of the species or elements of the species' habitat can be predicted by vegetation surrogates and landscape features, or for which targeted survey has a low probability of detection, are identified in the Threatened Biodiversity Data Collection as ecosystem credit species. Based on the preliminary assessment of habitat in the survey area, and review of work undertaken for the Snowy Hydro 2.0 exploratory works PEA, the following ecosystem credit species are likely to require assessment (see **Table 3.2**) (see **Appendix A** for the complete likelihood of occurrence assessment).

Due to the large extent, variability and generally high quality of the habitats in the Kosciuszko National Park, Maragle State Forest and Bago State Forest, many ecosystem credit species are known to occur or are considered likely to occur. Targeted survey is not required for these species to meet BC Act requirements however, targeted survey in accordance with Commonwealth guidelines will be required for those species that are also listed under the EPBC Act.

Table 3.2 : Summary of ecosystem credit species considered likely to occur in the survey area

Species name	Common name	EPBC Act	BC & FM Act	Likelihood of occurrence in survey area	Likelihood of occurrence in study area
Birds					
Artamus cyanopterus cyanopterus	Dusky Woodswallow	-	V	Moderate	Moderate
Botaurus poiciloptilus	Australasian Bittern	E	E	Moderate	Moderate
Callocephalon fimbriatum	Gang-gang Cockatoo	-	V	Present	Present
Climacteris picumnus victoriae	Brown Treecreeper (eastern subspecies)	-	V	Moderate	Moderate
Daphoenositta chrysoptera	Varied Sittella	-	V	Present	Present
Grantiella picta	Painted Honeyeater	V	V	Moderate	Moderate
Haliaeetus leucogaster	White-bellied Sea-Eagle	M	V	Moderate.	Moderate
Hieraaetus morphnoides	Little Eagle	-	V	Moderate	Moderate
Lophoictinia isura	Square-tailed Kite	-	V	Moderate	Moderate
Melanodryas cucullata cucullata	Hooded Robin (south-eastern form)	-	V	Moderate	Moderate

Species name	Common name	EPBC Act	BC & FM Act	Likelihood of occurrence in survey area	Likelihood of occurrence in study area
Ninox strenua	Powerful Owl	-	V	High	High
Oxyura australis	Blue-billed Duck	-	V	Moderate	Moderate
Pachycephala olivacea	Olive Whistler	-	V	High	High
Petroica boodang	Scarlet Robin	-	V	Present	Present
Petroica phoenicea	Flame Robin	-	V	Present	Present
Rostratula australis	Australian Painted Snipe	E, M	E	Moderate	Moderate
Stagonopleura guttata	Diamond Firetail	-	V	Present	Present
Tyto novaehollandiae	Masked Owl	-	V	Moderate	Moderate
Tyto tenebricosa	Sooty Owl	-	V	High	High
Mammals					
Dasyurus maculatus	Spotted-tailed Quoll	E	V	High	High
Falsistrellus tasmaniensis	Eastern False Pipistrelle	-	V	High	High
Miniopterus schreibersii oceanensis	Eastern Bentwing-bat	-	V	High	High
Petaurus australis	Yellow-bellied Glider	-	V	High	High
Phascolarctos cinereus	Koala	V	V	Moderate	Moderate
Pseudomys fumeus	Smoky Mouse	E	CE	Present	High
Reptiles					
Varanus rosenbergi	Rosenberg's Goanna, Heath Monitor	-	V	Moderate	Moderate

Key:
CE = critically endangered
E = endangered
V = vulnerable
M = migratory

3.5.2 Species credit species

Threatened species for which the likelihood of occurrence of the species, or elements of suitable habitat for the species, cannot be confidently predicted by vegetation surrogates, and landscape features and which can be reliably detected by survey, are identified in the Threatened Biodiversity Data Collection as species credit species. Based on the preliminary assessment of habitat in the survey area, and review of work undertaken for the Snowy Hydro 2.0 exploratory works PEA, the following species credit species are considered likely to occur and would be considered 'candidate species' for assessment under the Biodiversity Assessment Method (see **Table 3.3**) (see **Appendix A** for the complete likelihood of occurrence assessment).

Due to the large extent, variability and generally high quality of the habitats in the Kosciuszko National Park, Maragle State Forest and Bago State Forest, many species credit species are known to occur or are considered likely to occur. As the Project progresses to the EIS stage, these candidate species would require targeted survey in accordance with relevant state and Commonwealth guidelines, or an expert report, to confirm presence/absence and distribution on the subject land.

Table 3.3 : Summary of species credit species considered likely to occur in the survey area

Species name	Common name	EPBC Act	BC & FM Act	Likelihood of occurrence in the study area	Likelihood of occurrence in survey area corridor
Plants					
Caladenia montana	-	-	V	Moderate	Moderate
Carex raleighii	Raleigh Sedge	-	E	Moderate	Moderate
Discaria nitida	Leafy Anchor Plant	-	V	Moderate	Low
Euphrasia scabra	Rough Eyebright	-	E	Moderate	Moderate
Genoplesium vernale	East Lynne Midge-orchid	V	V	Moderate	Moderate
Haloragis exalata subsp. *exalata*	Wingless Raspwort	V	V	Moderate	Moderate
Pilularia novae-hollandiae	Austral Pillwort	-	E	Moderate	Moderate
Prasophyllum bagoense	Prasophyllum bagoense	CE	CE	High	Moderate
Prasophyllum innubum	Prasophyllum innubum	CE	CE	High	Moderate
Prasophyllum keltonii	Kelton's Leek Orchid	CE	CE	High	Moderate
Prasophyllum retroflexum	Kiandra Leek Orchid	V	V	Moderate	Moderate
Pterostylis alpina	Alpine Greenhood	-	V	Moderate	Moderate
Pterostylis foliata	Slender Greenhood	-	V	High	High
Pterostylis oreophila	Blue-tongued Greenhood	CE	CE	Moderate	Moderate
Thelymitra atronitida	Black-hooded Sun Orchid	-	CE	Moderate	Moderate
Thesium australe	Austral Toadflax	V	V	High	High
Birds					
Callocephalon fimbriatum	Gang-gang Cockatoo	-	V	Present	Present
Haliaeetus leucogaster	White-bellied Sea-Eagle	M	V	Moderate	Moderate
Hieraaetus morphnoides	Little Eagle	-	V	Moderate	Moderate
Lophoictinia isura	Square-tailed Kite	-	V	Moderate	Moderate
Ninox strenua	Powerful Owl	-	V	High	High
Petroica rodinogaster	Pink Robin	-	V	High	High
Tyto novaehollandiae	Masked Owl	-	V	Moderate	Moderate
Tyto tenebricosa	Sooty Owl	-	V	High	High
Frogs					
Litoria booroolongensis	Booroolong Frog	E	E	Present	Present
Litoria verreauxii alpina	Alpine Tree Frog	V	E	High	High
Mammals					
Cercartetus nanus	Eastern Pygmy-possum	-	V	Present	Present
Mastacomys fuscus	Broad-toothed Rat	V	V	Present	High
Miniopterus schreibersii oceanensis	Eastern Bentwing-bat	-	V	High	High
Myotis macropus	Southern Myotis	-	V	High	High
Petaurus australis (endangered population)	Yellow-bellied Glider population on the Bago Plateau	-	EP	High	High

Species name	Common name	EPBC Act	BC & FM Act	Likelihood of occurrence in the study area	Likelihood of occurrence in survey area corridor
Petaurus norfolcensis	Squirrel Glider	-	V	Moderate	Moderate
Reptiles					
Cyclodomorphus praealtus	Alpine She-oak Skink	E	E	Moderate	Moderate

Key:
CE = critically endangered
E = endangered
EP = endangered population
V = vulnerable
M = migratory

During the preparation of the PEA, Jacobs and TransGrid consulted with NPWS, who indicated that a number of the threatened orchid species are known to occur in the locality. These species include:

- *Caladenia montana*
- *Diuris ochroma*
- *Pterostylis alpina*
- *Pterostylis foliata*
- *Pterostylis oreophila*
- *Prasophyllum bagoense*
- *Prasophyllum innubum*
- *Prasophyllum keltonii*
- *Prasophyllum retroflexum*
- *Thelymitra alpicola*
- *Thelymitra atronitida.*

These species would be considered during the investigations as part of the EIS phase.

3.6 Serious and irreversible impact entities

The concept of serious and irreversible impacts (SAII) is fundamentally about protecting threatened entities that are most at risk of extinction from potential development. The Biodiversity Offsets Scheme recognises that there are some types of serious and irreversible impacts that the community expects will not occur except where the consent authority considers that this type of impact is outweighed by the social and economic benefits that the development will deliver to the State. The principles for determining SAII are outlined in the Biodiversity Conservation Regulation 2017.

The BC Act permits the Minister for Planning to give consent to or approve State Significant Infrastructure which is likely to have serious or irreversible impacts. The Minister must take those impacts into consideration, and determine whether there are any additional and appropriate measures that will minimise those impacts if consent or approval is to be granted. This generally translates into additional avoidance and mitigation measures, and offset requirements.

Potential species (and their habitat) that meet the SAII principles and criteria are outlined in the *Guidance, criteria and lists of potential serious and irreversible impacts* as made by the Chief Executive of OEH. During the EIS phase, the BDAR must provide additional impact assessment information for these entities to support

decision makers. The preliminary assessment indicates that the potential SAII entities that may be of relevance include:

- Coolac-Tumut Serpentinite Shrubby Woodland in the NSW South Western Slopes and South Eastern Highlands Bioregions TEC
- Tableland Basalt Forest in the Sydney Basin and South Eastern Highlands Bioregions TEC
- White Box Yellow Box Blakely's Red Gum Woodland TEC
- Smoky Mouse
- Eastern Bentwing-bat
- Sooty Owl
- *Diuris ochroma*
- *Prasophyllum keltonii*
- *Prasophyllum bagoense*
- *Prasophyllum innubum*
- *Prasophyllum retroflexum*
- *Pterostylis oreophila*
- *Thelymitra atronitida*
- *Euphrasia scabra*
- *Carex raleighii.*

3.7 Threatened fish

The desktop searches, including a review of work undertaken for the Snowy Hydro 2.0 exploratory works PEA, identified the following two threatened 'fish' species that have been recorded by previous surveys and are known to occur in the Tumut River and Yarrangobilly River:

- Macquarie Perch (*Macquaria australasica*)
- Murray Crayfish (*Euastacus armatus*).

Assessment of these species during the EIS phase must be undertaken in accordance with the *Fisheries NSW policy and guidelines for fish habitat conservation and management (Update 2013)* (Fisheries NSW policy and guidelines).

4. Matters of National Environmental Significance

The EPBC Act provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities and heritage places – defined as matters of national environmental significance as follows (as applicable to the Project):

- World heritage properties
- National heritage places
- Wetlands of international importance (often called 'Ramsar' wetlands after the international treaty under which such wetlands are listed)
- Nationally threatened species and ecological communities
- Migratory species.

4.1 World heritage properties and national heritage places

The study area contains the Australian Alps National Parks and Reserves natural listed place and the Snowy Mountains Scheme historic listed place. Heritage values are dealt with in the heritage section of the Preliminary Environmental Assessment.

4.2 Wetlands of international importance

The study area does not contain any wetlands of international importance. However, it is within proximity to several wetlands of national importance as follows:

- Banrock station wetland complex 700 – 800 km upstream
- Barmah forest 200 – 300 km upstream
- Gunbower forest 300 – 400 km upstream
- Hattah-kulkyne lakes 500 – 600 km upstream
- NSW central murray state forests 200 – 300 km upstream
- Riverland 600 – 700 km upstream
- The Coorong and Lakes Alexandrina and Albert - 700 – 800 km upstream.

Due to the distance of these wetlands of national importance from the study area they are considered unlikely to be affected.

4.3 Threatened ecological communities

According to the Protected Matters Search Tool (PMST), and review of work undertaken for the Snowy Hydro 2.0 exploratory works PEA, the following EPBC Act listed TECs are known to occur, likely to occur or may occur in the survey area:

- Alpine Sphagnum Bogs and Associated Fens (Endangered) - known to within area
- Natural Temperate Grassland of the South Eastern Highlands (Critically Endangered) - likely to occur within area
- White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland (Critically Endangered) - may occur within area.

As outlined in **Table 3.1**, these EPBC Act listed TECs are likely to correspond with the following PCTs that are mapped in the survey area, and could occur in the study area:

- Alpine and sub-alpine peatlands, damp herbfields and fens, South Eastern Highlands Bioregion and Australian Alps Bioregion

- Blakelys Red Gum - Yellow Box grassy tall woodland of the NSW South Western Slopes Bioregion
- Sub-alpine dry grasslands and heathlands of valley slopes, southern South Eastern Highlands Bioregion and Australian Alps Bioregion.

4.4 Threatened plants

Due to the large extent, variability and generally high quality of the habitats in the Kosciuszko National Park, Maragle State Forest and Bago State Forest, many EPBC Act listed threatened plant species known to occur or are considered likely to occur. The McPherson's Plain area contains many of the orchids of concern (but these species may also be present in adjacent habitats). As the Project progresses to the EIS stage, these species would need to be subject to targeted surveys to confirm presence/absence and distribution in the preferred route corridor.

The EPBC Act listed threatened plant species that are considered likely to occur are outlined below in **Table 4.1**.

Table 4.1 : EPBC Act listed threatened plant species that are considered likely to occur

Species name	Common name	EPBC Act	Likelihood of occurrence
Genoplesium vernale	East Lynne Midge-orchid	V	Moderate
Haloragis exalata subsp. *exalata*	Wingless Raspwort	V	Moderate
Prasophyllum bagoense	Prasophyllum bagoense	CE	High
Prasophyllum innubum	Prasophyllum innubum	CE	High
Prasophyllum keltonii	Kelton's Leek Orchid	CE	High
Prasophyllum retroflexum	Kiandra Leek Orchid	V	Moderate
Pterostylis oreophila	Blue-tongued Greenhood	CE	Moderate
Thesium australe	Austral Toadflax	V	High

Key:

CE = critically endangered

E = endangered

V = vulnerable

4.5 Threatened animals

Due to the large extent, variability and generally high quality of the habitats in the Kosciuszko National Park, Maragle State Forest and Bago State Forest, many EPBC Act listed threatened animal species are either known to occur or are considered likely to occur. The Australasian Bittern and Australian Painted Snipe may occur in the riparian habitats. The Painted Honeyeater may occur in the habitats in the Ravine area. The Spotted-tailed Quoll is likely to be present throughout the habitats on the east and west of the Tumut River and breeding habitat is likely to be present. The Broad-toothed Rat and Smoky Mouse are known to occur in the survey area as identified by a review of work undertaken for the Snowy Hydro 2.0 exploratory works PEA. A low density Koala population may be present as suitable food tree species are common. There are some records of the Greater Glider in the State Forests to the west of the Tumut River and the habitat appears suitable for this species. The rivers and streams in the east are suitable for the Booroolong Frog (recorded in many locations along the Yarrangobilly River) as indicated in the Snowy Hydro 2.0 exploratory works PEA. The higher altitude aquatic habitats on the alpine areas to the west are likely to be suitable for the Alpine Tree Frog. The Alpine She-oak Skink may be present at higher altitudes if suitable microhabitats occur and this species was also recorded during work undertaken for the Snowy Hydro 2.0 exploratory works PEA. As the Project progresses to the EIS stage, these species would need to be subject to targeted surveys to confirm presence/absence and distribution on the subject land.

The EPBC Act listed threatened animal species that are considered likely to occur are outlined below in **Table 4.2.**

Table 4.2 : EPBC Act listed threatened animal species that are considered likely to occur

Species name	Common name	EPBC Act	Likelihood of occurrence in the survey area	Likelihood of occurrence in the survey
Birds				
Botaurus poiciloptilus	Australasian Bittern	E	Moderate	Moderate
Grantiella picta	Painted Honeyeater	V	Moderate	Moderate
Rostratula australis	Australian Painted Snipe	E, M	Moderate	Moderate
Mammals				
Dasyurus maculatus	Spotted-tailed Quoll	E	High	High
Mastacomys fuscus	Broad-toothed Rat	V	Present	High
Phascolarctos cinereus	Koala	V	Moderate	Moderate
Pseudomys fumeus	Smoky Mouse	E	Present	High
Petauroides volans	Greater Glider	V	Moderate	Moderate
Frogs				
Litoria booroolongensis	Booroolong Frog	E	Present	Present
Litoria verreauxii alpina	Alpine Tree Frog	V	High	High
Reptiles				
Cyclodomorphus praealtus	Alpine She-oak Skink	E	Moderate	Moderate

Key:

CE = critically endangered

E = endangered

EP = endangered population

V = vulnerable

M = migratory

4.6 Migratory species

Based on the results of the PMST, 11 listed migratory species may occur in the survey area. Based on the preliminary likelihood of occurrence assessment, and review of work undertaken for the Snowy Hydro 2.0 exploratory works PEA, eight of these species are considered likely to occur in the survey area (see **Table 4.3**).

Table 4.3 : EPBC Act listed Migratory species that are considered likely to occur

Species name	Common name	EPBC Act	Overall likelihood of occurrence
Birds			
Rostratula australis	Australian Painted Snipe	E, M	Moderate
Apus pacificus	Fork-tailed Swift	M	Moderate
Gallinago hardwickii	Latham's Snipe	M	Moderate
Haliaeetus leucogaster	White-bellied Sea-Eagle	M	Moderate
Hirundapus caudacutus	White-throated Needletail	M	Moderate
Merops ornatus	Rainbow Bee-eater	M	Present
Myiagra cyanoleuca	Satin Flycatcher	M	Present
Rhipidura rufifrons	Rufous Fantail	M	High

5. Conclusions and recommendations

This preliminary biodiversity assessment summarises the findings of the desktop study and initial site visits and identifies the likely distribution of key ecological features and constraints across the survey area. While this is only a preliminary assessment and no detailed ecological field work or impact assessment has been undertaken to inform the findings, this report can identify that the primary ecological concerns with the Project relate to clearing of native vegetation, disturbance to water bodies and associated impacts on habitat for threatened species, populations and communities. Introduction and spread of weeds and pathogens is also a concern.

The key ecological constraints are outlined in **Figure 5.1** and are as follows:

- Areas of mapped TECs.
- Riparian areas and buffer zones.
- Known areas of threatened plant species.

Habitat for threatened species is extensive and habitat mapping would not provide much value at this stage as detailed field work is required to determine specific areas of habitat for individual species, particularly those species listed as species-credit species, and species listed under the EPBC Act.

5.1 Impacts to native vegetation

The survey area, including the preferred route corridor, is extensively covered with native vegetation in moderate to good condition. As the Project has been declared critical SSI, it will be assessed in accordance with the Biodiversity Assessment Method and all impacts to native vegetation will be required to be offset. Avoidance and minimisation must be demonstrated at an early stage and this preliminary assessment should be used as a guide to commence this process. Key to minimising impacts to native vegetation will be designing the project to avoid the most valuable vegetation types and habitats, while being as short as practicable. Wherever practicable, location of access tracks should also avoid the most valuable vegetation types and habitats, while being as short as practicable, and where possible co-located in areas requiring vegetation removal for towers and clearance distances under power lines. This approach to access is preferable from the perspective of reducing impacts to native vegetation.

5.2 Threatened species impacts

Due to the large extent, variability and generally high quality of the habitats in the study area, many TECs and threatened plant and animal species listed under the BC Act and/or the EPBC Act are known to occur or are considered likely to occur. In some cases, it will not be possible to entirely avoid impacts to habitat for some threatened species as the suitable habitat is widespread. However, this preliminary assessment allows for a high level of planning and avoidance of some TECs, specific habitat types such as riparian areas, and areas known to contain threatened plant species such as the McPhersons Plain area. As the project has been declared critical SSI it will be assessed in accordance with the Biodiversity Assessment Method and all impacts to threatened species will be required to be offset.

5.3 Biodiversity offsets

As the Biodiversity Offsets Scheme will apply to the Project, TransGrid will have an offset obligation which will be outlined in the BDAR that will be prepared for the EIS. There are several ways that TransGrid can meet the offset obligation and these are governed by a set of offset rules established through the Biodiversity Conservation Regulation 2017. The offset rules permit proponents to meet their offset obligation by one or more of the following actions:

- Retiring credits based on the like-for-like rules
- Funding a biodiversity conservation action that benefits the threatened entity impacted by the development. The action must be listed in the Ancillary rules: Biodiversity conservation actions and meet the other requirements set out by these rules

- Committing to deliver mine site ecological rehabilitation that creates the same ecological community or threatened species habitat (available for major mining projects only). The ecological rehabilitation must meet the requirements set out in the "ancillary rules for mine site ecological rehabilitation" which will be published by the OEH Chief Executive
- Making a payment to the Biodiversity Conservation Fund calculated using the offset payments calculator.

If a proponent can demonstrate they were not able to find like-for-like credits and chooses not to use the other offset options, they can seek approval to offset with a broader suite of biodiversity values using the variation rules. The fastest and most efficient method of meeting an offset obligation is to make a payment to the Biodiversity Conservation Fund. There are some financial penalties involved with this method as administration fees are charged by the Biodiversity Conservation Trust. However, this method is still preferable as there are unlikely to be credits available on the open market (no trades have ever been made for the PCT credits that would be required by the Project) and paying into the Biodiversity Conservation Fund immediately eliminates the offset obligation.

As a guide, one credit for a PCT such as the Mountain Gum - Snow Gum - Broad-leaved Peppermint shrubby open forest of montane ranges, South Eastern Highlands Bioregion and Australian Alps Bioregion would cost $1,690.36. Most PCTs are priced at this rate. Credits for species credit species are more variable. For example, one credit for the *Petaurus australis* - endangered population (Yellow-bellied Glider population on the Bago Plateau) would cost $6,934.03. One credit for the Eastern Pygmy-possum would cost $520. The credit price for some species such as *Pterostylis foliata* are not currently available and would be determined on a case by case basis by the Biodiversity Conservation Trust.

The number of credits required to meet the offset obligation can only be determined after surveys according to the Biodiversity Assessment Method have been undertaken for the EIS and the data has been entered into the Credit Calculator. Minimising the credit obligation up front through design to avoid and minimise impacts to the greatest extent practicable is advisable.

In October 2018, TransGrid consulted with NPWS and OEH regarding offsets and compensation for impacts to Kosciusko National. Both agencies outlined their preference for providing in-Park offsets, as well as compensation for impacts within the Park. The NPWS project Manager has stated that he would like to commence high-level discussions with TransGrid about agreed compensation principles. These offsetting and compensation principles will be considered further in the EIS phase.

5.4 Assessment approach

Ecological impacts will be a key consideration in the assessment going forward. Assessments undertaken during the EIS phase will be based on the Biodiversity Assessment Method and field work will be guided by the following documents:

- OEH Biodiversity Assessment Methodology
- Commonwealth EPBC 1.1 Significant Impact Guidelines - Matters of National Environmental Significance
- Commonwealth Department of the Environment survey guidelines for nationally threatened species
- Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities (working draft)
- Threatened species survey and assessment guidelines: field survey methods for fauna – Amphibians
- NSW Guide to Surveying Threatened Plants.

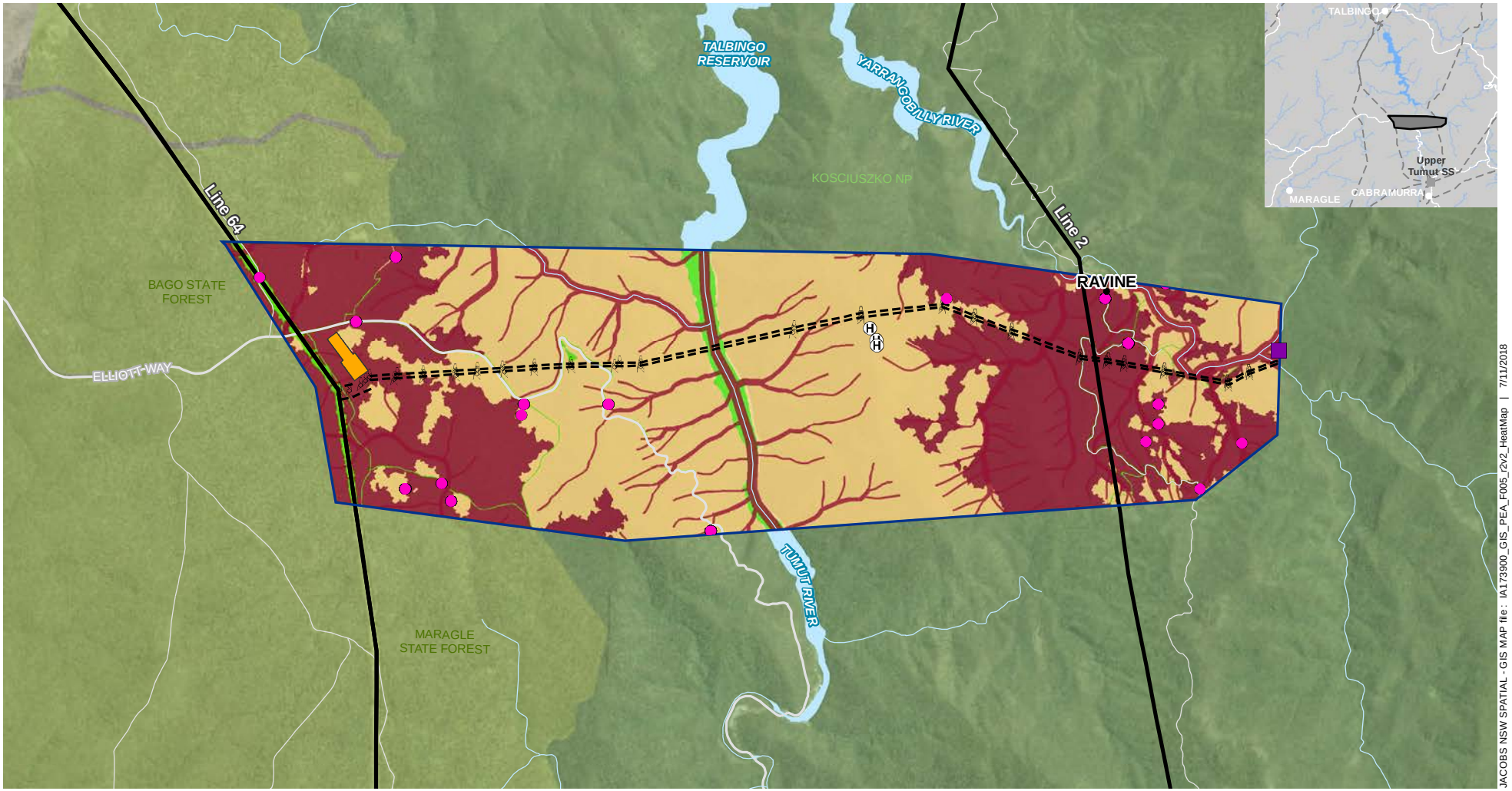


Figure 5.1 | Ecological constraints

6. References

ADAMSON, C. L. & LOUDON, A. G. 1966. Wagga Wagga 1:250 000 Geological Sheet SI/55-15, 1st edition. Sydney: Geological Survey of New South Wales.

BUREAU OF METEOROLOGY. 2017. *Atlas of Groundwater Dependent Ecosystems* [Online]. Available: http://www.bom.gov.au/water/groundwater/gde/.

DEGELING, P. R. 1977. Wagga Wagga 1:250 000 Metallogenic Map, 1st edition. Sydney: Geological Survey of New South Wales.

DEPARTMENT OF ENVIRONMENT AND CLIMATE CHANGE 2008. Descriptions for NSW (Mitchell) Landscapes Version 2 (2002) Sydney: Department of Environment and Climate Change.

GELLIE, N. 2005. Native vegetation of the southern forests: South-east Highlands, Australian Alps, South-west Slopes and South-east Corner bioregions. *Cunninghamia,* 9**,** 219-254.

MAGUIRE, O., THOMAS, V. & HUNTER, S. 2000. Southern CRA / Riverina Highlands Vegetation Mapping Extension.

NSW NATIONAL PARKS AND WILDLIFE SERVICE. 2002. *Landscapes (Mitchell) of NSW*. Hurstville NSW National Parks and Wildlife Service.

OFFICE OF ENVIRONMENT AND HERITAGE 2016. Riverina Regional Native Vegetation Map Version v1.0 - VIS_ID 4469.

STATE GOVERNMENT OF NSW AND OFFICE OF ENVIRONMENT AND HERITAGE (OEH) 2012. Australian Soil Classification (ASC) Soil Type map of NSW.

THACKWAY, R. & CRESSWELL, I. D. 1995. *An Interim Biogeographic Regionalisation of Australia,* Canberra, Australian Nature Conservation Agency.

Appendix A. Likelihood of occurrence assessment

State and nationally listed threatened species identified from the literature review and database search were considered in terms of their likelihood to occur in the habitats present within the survey area based on identified habitat requirements. The likelihood of occurrence was classified according to the criteria described **in Table A.1**. The preliminary assessment of the likelihood of threatened terrestrial species or communities occurring in the Project area is provided in **Table A.2** and **A.3**.

Table A.1 : Criteria for determining likelihood of occurrence

Likelihood	Criteria
Recorded	The species was observed in the survey area during the current survey
High	It is highly likely that a species inhabits the survey area and is dependent on identified suitable habitat (i.e. for breeding or important life cycle periods such as winter flowering resources), has been recorded recently in the locality (10 x 10 km area) and is known or likely to maintain resident populations in the survey area. Also includes species known or likely to visit the survey area during regular seasonal movements or migration.
Moderate	Potential habitat is present in the survey area. Species unlikely to maintain sedentary populations, however may seasonally use resources within the survey area opportunistically or during migration. The species is unlikely to be dependent (i.e. for breeding or important life cycle periods such as winter flowering resources) on habitat within the survey area, or habitat is in a modified or degraded state. Includes cryptic flowering flora species that were not seasonally targeted by surveys and that have not been recorded.
Low	It is unlikely that the species inhabits the survey area and has not been recorded recently in the locality (10 km x 10 km area). It may be an occasional visitor, but habitat similar to the survey area is widely distributed in the local area, meaning that the species is not dependent (i.e. for breeding or important life cycle periods such as winter flowering resources) on available habitat. Specific habitat is not present in the survey area or the species are non-cryptic perennial flora species that were specifically targeted by surveys and not recorded.
None	Suitable habitat is absent from the survey area.

Table A.2 : Likelihood of occurrence assessment for threatened plant species

Species name	Common name	EPBC Act	BC Act	Distribution and habitat	Likelihood of occurrence
Ammobium craspedioides	Yass Daisy	V	V	Found from near Crookwell on the Southern Tablelands to near Wagga Wagga on the South Western Slopes. Most populations are in the Yass region. Found in moist or dry forest communities, Box-Gum Woodland and secondary grassland derived from clearing of these communities. Grows in association with a large range of eucalypts (*Eucalyptus blakelyi, E. bridgesiana, E. dives, E. goniocalyx, E. macrorhyncha, E. mannifera, E. melliodora, E. polyanthemos, E. rubida*).	Low. Not known from the survey area. Modelled habitat present to the north of the survey area and the nearest records are from near Goobarragandra. Some suitable woodland habitats do exist.
Argyrotegium nitidulum	Shining Cudweed	V	V	In NSW Shining Cudweed is found only in the higher parts of Kosciuszko National Park strictly associated with the Alpine grassland/herbfield and open heathlands in Kosciuszko National Park, Australian Alps Bioregion PCT. The species also occurs in Victoria and the south island of New	Low. The nearest records and modelled habitat is to the south of Cabramurra in the Jagungal Wilderness however there is potential for this species to occur in

Species name	Common name	EPBC Act	BC Act	Distribution and habitat	Likelihood of occurrence
				Zealand, in similarly high mountain areas. Usually found in herbfield or open heathland, above or close to the treeline. Flowers appear from December to March.	the Alpine grassland/herbfield and open heathlands in Kosciuszko National Park, Australian Alps Bioregion PCT (although this PCT does not occur near any of the proposed structures or access tracks).
Caladenia concolor	Crimson Spider Orchid	V	E	The current NSW Scientific Committee listing incorporates two populations which have each been described as separate species by D.L. Jones. One of these populations comprises a few hundred plants on private property near Bethungra and the other of about 100 plants occurs in Burrinjuck Nature reserve. The other occurrences of the Crimson Spider Orchid in NSW are from the Nail Can Hill Crown Reserve near Albury. Habitat is regrowth woodland on granite ridge country that has retained a high diversity of plant species, including other orchids. The dominant trees are Blakely's Red Gum (*Eucalyptus blakelyi*), Red Stringybark (*E. macrorhyncha*), Red Box (*E. polyanthemos*) and White Box (*E. albens*); the diverse understorey includes Silver Wattle (*Acacia dealbata*), Hop Bitter-pea (*Daviesia latifolia*), Common Beard-heath (*Leucopogon virgatus*), Spreading Flax-lily (*Dianella revoluta*) and Poa Tussock (*Poa sieberiana*).	Low. Only two populations are known and the nearest records of this species are from Bethungra. Some suitable habitat does occur in the survey area in the form of 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 (although this PCT does not occur near any of the proposed structures or access tracks).
Caladenia montana	-	-	V	*Caladenia montana* is restricted to high montane areas 700–1000 m a.s.l. where it grows in well-drained loam on slopes and ridges of montane forest among an understorey of shrubs. The species occurs in mainly in the east alps section of the Alpine National Park in Victoria. There are records in the ACT and adjacent areas in NSW, but these are now referred to Caladenia fitzgeraldii. Caladenia montana may occur in southern Kosciuszko National Park adjacent to Victoria. Generally found after fires.	Moderate. There is a record of *Caladenia montana* in Maragle State Forest from 2005 (although exact location is obscured) and this plant may now be recognised as a different species *Caladenia fitzgeraldii*. There is potential for this species to occur in the higher altitude montane areas in the west of the survey area in the Kosciuszko National Park and Maragle and Bago State Forests in the tall wetter forests dominated by *Eucalyptus dalrympleana, E. dives, E. viminalis* and *E. robertsonii*.
Calotis glandulosa	Mauve Burr-daisy	V	V	The distribution of the Mauve Burr-daisy is centred on the Monaro and Kosciuszko regions. There are old and possibly dubious records from near Oberon, the Dubbo area and Mt Imlay. Found in montane and subalpine grasslands in the Australian Alps. Found in subalpine grassland (dominated by *Poa* spp.), and montane or natural temperate grassland dominated by Kangaroo Grass (*Themeda australis*) and Snow Gum (*Eucalyptus pauciflora*) Woodlands on the Monaro and Shoalhaven area. Appears to be a coloniser of bare patches, which explains why it often occurs on roadsides. Apparently common on roadsides in parts of the Monaro, though it does not persist for	Low. Known records and modelled habitat are to the east of the survey area on the montane or natural temperate grasslands. This habitat type is not present in the survey area.

Species name	Common name	EPBC Act	BC Act	Distribution and habitat	Likelihood of occurrence
				long in such sites. Does not persist in heavily-grazed pastures of the Monaro or the Shoalhaven area.	
Calotis pubescens	Max Mueller's Burr-daisy	-	E	This species has been recorded from five sites in the Snowy Mountains of NSW (four of which, all in Kosciuszko National Park, are extant). It was first recorded in Victoria in the 19th Century but not seen again there until 2009 when a single large population was discovered south-east of Mt Hotham. Grows in subalpine treeless plains in herb-rich grassland (often dominated by *Poa hookeri*); not subject to periodic inundation. Its response to disturbance is largely unknown.	Low. Only known to occur in the grasslands to the east of the survey area on the sub-alpine treeless plains. No suitable habitat occurs in the survey area.
Carex archeri	Archer's Carex	-	E	In NSW, Archer's Carex is only known from Kosciuszko National Park (Club Lake and upper Thredbo River areas). It is also found in the high country of Victoria and Tasmania. Occurs in damp alpine herbfields.	Low. Only known from south of the survey area on Mt Kosciuszko. No suitable damp alpine herb fields are present in the survey area.
Carex raleighii	Raleigh Sedge	-	E	In NSW Raleigh Sedge is found only in areas above about 1,000 m on the Southern Tablelands. Most populations are in Kosciuzsko National Park (e.g. Charlottes Pass area, Muellers Pass, Tantangara area and the upper Tooma and Tumut valleys). Also occurs in vicinity of Snowy Plain (private land and travelling stock reserve) and on the coastal escarpment at the headwaters of Tantawangalo Creek within South East Forests National Park. Grows in sphagnum bogs and high mountain wetlands, as well as damp grasslands and stream-edges of sub-alpine plains.	Moderate. There may be potential habitat for *Carex raleighii* in the higher altitude areas in the west of the survey area in the Maragle and Bago State Forests where areas of alpine and sub-alpine peatlands and fens occur.
Colobanthus curtisiae	Curtis' Colobanth	V	-	Curtis' Colobanth occurs in Tasmania, Victoria and New South Wales. Curtis' Colobanth is found in grassland and grassy woodland. The species can also be found in areas subject to a variety of environmental conditions. It is commonly found on gentle slopes with elevations between 160 m in lowland areas and 1,300 m in alpine areas. The species is found in areas of annual rainfall between 530 mm in the Midlands and 1400 mm on Ben Lomond. Curtis' Colobanth is commonly found on soils derived from sandstone as well as clay loams derived from dolerite and basalt. It can persist in remnant grasslands grazed by stock.	Low. Not known from habitats near the preferred option.
Discaria nitida	Leafy Anchor Plant	-	V	The Leafy Anchor Plant is confined to the far south of the Southern Tablelands of NSW and the north-east highlands of Victoria. In NSW the Leafy Anchor Plant grows mostly within Kosciuszko National Park, south from the Blue Water Holes - Yarrangobilly Caves area to south-west of Jindabyne, at altitudes above 900 m. In NSW 18 sites are known with a total population of about 2,800 plants. Generally, it occurs on or close to stream banks and on rocky areas near small waterfalls. The species occurs in woodland with heathy riparian vegetation and on treeless grassy sub-alpine plains. Most populations survive in sites that appear to be rarely burnt "fire refugia". The	Moderate. Known habitat is to the east of the survey area but there is some potential habitat in Black Sallee - Snow Gum low woodland of montane valleys, South Eastern Highlands Bioregion and Australian Alps Bioregion and areas of alpine and sub-alpine peatlands and fens.

Species name	Common name	EPBC Act	BC Act	Distribution and habitat	Likelihood of occurrence
				species is known to be highly fire sensitive and most plants that have been observed to have been burnt, even lightly, have died and there has been very little post fire recruitment.	
Diuris ochroma	Pale Golden Moths	E	V	Recorded in south-eastern NSW on the sub-alpine plains of Kosciuszko National Park and the Kybean area. Also recorded in eastern Victoria. Open grassy woodland of *Eucalyptus viminalis / E. pauciflora* or *E. pauciflora / E. parvula* (or secondary grassland). Also found in sub-alpine grassland.	Low. No records of this species exist in the survey area and the survey area does not contain any modelled habitat. No suitable open grassy woodlands are present.
Diuris pedunculata	Small Snake Orchid	E	E	Once considered to be present over a wide range in eastern Australia, *Diuris pedunculata* has been taxonomically separated into the new species *D. subalpina* (found in southeast NSW, ACT and north-east Victoria) with the populations restricted to the New England area of NSW to remain as *D. pedunculata*.	None. This species has been reclassified and is now recognised as an endemic restricted to the New England tablelands area.
Eucalyptus saxatilis	Suggan Buggan Mallee	-	E	The Suggan Buggan Mallee is currently known from ten populations in NSW and Victoria. In NSW it is confined to the Lower Snowy area of Kosciuszko National Park. Two populations occur south of Running Water Creek, one on Black Jack Mountain, one near Windmill Hill and two near Kangaroo Ground Creek. At all known locations this species grows as pure stands, surrounded by eucalypt woodland, with the majority growing adjacent to Long-leaved or Bundy Box woodland (*E. goniocalyx* and *E. nortonii*). At all sites in NSW this species is associated with rocky outcrops and cliff areas with shallow soils, at elevations between 720 and 1,000 m. Flowers in autumn and winter.	Low. *Eucalyptus saxatilis* is restricted to areas in or close to Snowy River gorge which is outside of the survey area.
Euphrasia scabra	Rough Eyebright	-	E	There are three extant populations in NSW: Bondi State Forest, South East Forests National Park and near Nunnock Swamp. Total NSW population is between 250 and 500 plants. This number varies with season with few plants appearing in some years. Occurs in or at the margins of swampy grassland or in sphagnum bogs, often in wet, peaty soil.	Moderate. Known from the Yarrangobilly Caves area and the west near Tumbarumba. Potential habitat exists on the valley flats and in any peatlands, bogs or fens that are in the survey area.
Genoplesium vernale	East Lynne Midge-orchid	V	V	The East Lynne Midge Orchid is currently known from only a narrow belt, approximately 12 km wide, of predominantly Dry Sclerophyll Forest from 17 km south of Batemans Bay to 24 km north of Ulladulla. The East Lynne Midge Orchid grows in 'poorer' dry sclerophyll woodland and forest on the south coast of New South Wales between Mogo and Ulladulla. It is confined to areas with good drainage and shallow, low fertility soils. Confined to areas with well-drained shallow soils of low fertility. The plant exists only as a dormant tuber for part of the year, dying back after flowering and fruiting in mid-November to late December.	Moderate. There is habitat modelled in the Bago and Maragle State Forests and generalised records exist in the Bago and Maragle State Forests from 2004 and 2005. More detailed sire specific information on these records is required to determine likelihood of occurrence.
Glycine latrobeana	Glycine latrobeana	V	CE	The Clover Glycine is endemic to south-eastern Australia, where it is widely distributed from Port Pirie in South Australia, through much of Victoria to near Hobart in Tasmania. It was recently discovered in Kosciuszko National Park. The Clover Glycine occurs mainly in grassland and grassy	Low. Known from the east of the survey area on the grasslands near the Tantangara Reservoir. Restricted to the Sub-alpine dry grasslands and heathlands of

Species name	Common name	EPBC Act	BC Act	Distribution and habitat	Likelihood of occurrence
				woodland habitats, less often in dry forests, and only rarely in heathland. Populations occur from sea level to c. 1,200 m altitude 6 (900 m in Tasmania). The NSW population is in subalpine grassland (at about 1300 m asl).	valley slopes, southern South Eastern Highlands Bioregion and Australian Alps Bioregion PCT.
Grevillea iaspicula	Wee Jasper Grevillea	E	CE	The Wee Jasper Grevillea is found only in the Wee Jasper area and on the shores of Lake Burrinjuck near Burrinjuck village on the border of the Southern Tablelands and South Western Slopes. Grows on rocky limestone outcrops and around sink holes and cave entrances. Vegetation is open woodland dominated by White Box (Eucalyptus albens) and Apple Box (E. bridgesiana) trees Often occurs as a co-dominant species within the shrubby understorey of its open woodland habitat.	Low. In the Bondo subregion this species is confined to an area between 0 & 10 km west of the Goodradigbee R. & extending 5 km to the S. & 15 km to the N. of Wee Jasper.
Haloragis exalata subsp. *exalata*	Wingless Raspwort	V	V	Square Raspwort occurs in 4 widely scattered localities in eastern NSW. It is disjunct distributed in the Central Coast, South Coast and North Western Slopes botanical subdivisions of NSW. Square Raspwort appears to require protected and shaded damp situations in riparian habitats. Flowering specimens in NSW are recorded from November to January.	Moderate. Many records exist to the south near the Geehi Reservoir. Habitat may exist in shaded riparian areas.
Irenepharsus magicus	Elusive Cress	-	E	Although the location information provided with the single NSW collection is vague, it would appear that it was made in the vicinity of Geehi Dam, which is within Kosciuszko NP. Habitat preference for the species is unclear, although two collections in Victoria have been made in or on the edge of recently logged Messmate Stringybark (Eucalyptus obliqua) forest. One of these sites had been burnt. The record of the species in NSW includes the habitat note "growing on mineral soil of embankment". The species was recently found in a rocky limestone area in eastern Victoria after the 2003 fires.	Low. Records exist to the south near the Geehi Reservoir. Suitable habitat appears to be Alpine Ash communities.
Leucochrysum albicans subsp. *tricolor*	Hoary Sunray	E	-	The Hoary Sunray occurs at relatively high elevations in woodland and open forest communities, in an area roughly bounded by Goulburn, Albury and Bega. The species has been recorded in the Yass Valley, Tumut, Upper Lachlan, Snowy River and Galong. It is known from the South Eastern Highlands, Australian Alps and Sydney Basin bioregions.	Low. Known from the highway near the Providence Portal and Adaminaby areas. Unlikely to occur in the habitat of the survey area.
Pilularia novae-hollandiae	Austral Pillwort	-	E	In NSW, Austral Pilwort has been recorded from suburban Sydney, Khancoban, the Riverina between Albury and Urana (including Henty, Walbundrie, Balldale and Howlong) and at Lake Cowal near West Wyalong. The population at Lake Cowal is the only known extant population in NSW. The species has also been recorded in the Australian Capital Territory, Victoria, Tasmania, South Australia and Western Australia. Austral Pillwort grows in shallow swamps and waterways, often among grasses and sedges. It is most often recorded in drying mud as this is when it is most conspicuous. Most of the records in the Albury-Urana area were from table drains on the sides of roads.	Moderate. Potential habitat exists at the edges of shallow waterways and waterbodies.

Species name	Common name	EPBC Act	BC Act	Distribution and habitat	Likelihood of occurrence
Pomaderris cotoneaster	Cotoneaster Pomaderris	E	E	Cotoneaster Pomaderris has a very disjunct distribution, being known from the Nungatta area, northern Kosciuszko National Park (near Tumut), the Tantawangalo area in South-East Forests National Park and adjoining freehold land, Badgery's Lookout near Tallong, Bungonia State Conservation Area, the Yerranderie area, Kanangra-Boyd National Park, the Canyonleigh area and Ettrema Gorge in Morton National Park. The species has also been recorded along the Genoa River in Victoria. Cotoneaster Pomaderris has been recorded in a range of habitats in predominantly forested country. The habitats include forest with deep, friable soil, amongst rock beside a creek, on rocky forested slopes and in steep gullies between sandstone cliffs.	Low. Nearest known populations are from the area around Goobarragandra. Potential habitat exists in the 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.
Prasophyllum bagoense	Prasophyllum bagoense	CE	CE	Currently known from a single population on land covered by a Crown Lease on State Forest near Tumbarumba on the Southern Tablelands of NSW. The species occurs over about 12 ha of sub-alpine grassy plain and wetland at an elevation of about 1,100 m. Its distribution may extend into adjacent woodlands. Bago Leek Orchid is a tuberous ground orchid with leaves that normally regenerate from underground tubers each year in spring. Found in grassy, low heathland dominated by *Poa clivicola*, *Epacris gunnii* and *E. celata* on a subalpine plain bordered by Snow Gum and Mountain Gum.	High. This species is only known from the McPhersons Plain area. May also occur in nearby habitats including Alpine and sub-alpine peatlands, damp herbfields and fens, South Eastern Highlands Bioregion and Australian Alps Bioregion PCT, and Alpine grassland/herbfield and open heathlands in Kosciuszko National Park, Australian Alps Bioregion PCT.
Prasophyllum innubum	Prasophyllum innubum	CE	CE	In New South Wales, Prasophyllum innubum is known from a single population comprising about seven small colonies, totalling about 400 individuals, from a small area about 30 km north-west of Cabramurra and about 17 km south of Talbingo, in the Tumbarumba Local Government Area. The species occurs in Bago State Forest and apparently also on adjacent Crown forestry lease and private freehold. The species is known only from a highly restricted streamside habitat and Sphagnum hummocks, and rarely on adjacent grassy flats, at altitudes of 1150-1180 m.	High. This species is only known from the McPhersons Plain area. May also occur in nearby habitats including Alpine and sub-alpine peatlands, damp herbfields and fens, South Eastern Highlands Bioregion and Australian Alps Bioregion PCT, and Alpine grassland/herbfield and open heathlands in Kosciuszko National Park, Australian Alps Bioregion PCT.
Prasophyllum keltonii	Kelton's Leek Orchid	CE	CE	Kelton's Leek Orchid is known from a single population that occurs in a small area known as McPhersons Plain, about 30 km north-west of Cabramurra and about 17 km south of Talbingo, in the Tumbarumba Local Government Area. The species is known only from a highly restricted habitat on the treeless McPhersons Plain, an area that includes sub-alpine grassland, sphagnum bogs, and open heathland, at an elevation of 1,100 m. The species has a preference for grassland. The species apparently has a preference for moderately boggy ground, though not sphagnum-dominated areas, but also occurs on some drier patches.	High. This species is only known from the McPhersons Plain area. May also occur in nearby habitats including Alpine and sub-alpine peatlands, damp herbfields and fens, South Eastern Highlands Bioregion and Australian Alps Bioregion PCT, and Alpine grassland/herbfield and open heathlands in Kosciuszko National Park, Australian Alps Bioregion PCT.

Species name	Common name	EPBC Act	BC Act	Distribution and habitat	Likelihood of occurrence
Prasophyllum retroflexum	Kiandra Leek Orchid	V	V	All populations are thought to occur within Kosciuszko NP (in the Long Plain, Kiandra, Tantangara area). The species occurs in subalpine grasslands and woodlands.	Moderate. This species is known from the east of the survey area on the subalpine grasslands and woodlands in the Long Plain, Kiandra, Tantangara area. May also occur in nearby habitats including Sub-alpine dry grasslands and heathlands of valley slopes, southern South Eastern Highlands Bioregion and Australian Alps Bioregion PCT.
Pterostylis alpina	Alpine Greenhood	-	V	The Alpine greenhood grows in moist forests on foothills and ranges, extending to montane areas in New South Wales, the Australian Capital Territory and Victoria. In NSW the species occurs in the Southern Tablelands south from Bondo State Forest.	Moderate. There is suitable habitat in the form of the Black Sallee - Snow Gum low woodland of montane valleys, South Eastern Highlands Bioregion and Australian Alps Bioregion PCT and the Snow Gum - Mountain Gum shrubby open forest of montane areas, South Eastern Highlands Bioregion and Australian Alps Bioregion PCT. Other moist forests may also be suitable, particularly the sheltered southern slopes.
Pterostylis foliata	Slender Greenhood	-	V	*Pterostylis foliata* is found in NSW, Australian Capital Territory (ACT), Victoria, South Australia, Tasmania and New Zealand (type location). In NSW the species occurs mainly in the Southern Tablelands south from Batlow. In NSW, *Pterostylis foliata* grows in eucalypt forest amongst an understorey of shrubs, ferns and grasses. It grows on loam or clay loam soils found on sheltered sloping to steep ground and populations may be found in localised open seepage areas. Flowering occurs from August to January.	High. Detailed descriptions of preferred habitat are not available but it is likely to be found in the wetter forests including the 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, Robertsons Peppermint - Broad-leaved Peppermint - Nortons Box - stringybark shrub-fern open forest of the NSW South Western Slopes Bioregion and South Eastern Highlands Bioregion PCT and the Snow Gum - Mountain Gum shrubby open forest of montane areas, South Eastern Highlands Bioregion and Australian Alps Bioregion PCT where there are steep sheltered slopes.

Species name	Common name	EPBC Act	BC Act	Distribution and habitat	Likelihood of occurrence
Pterostylis oreophila	Blue-tongued Greenhood	CE	CE	In New South Wales, the Blue-tongued Greenhood is known from a few small populations within Kosciuszko National Park and a population of about 40 plants (possibly now extinct) in Bago State Forest and adjoining Crown Leases south of Tumut. The known distribution includes parts of the Snowy River, Tumbarumba and possibly Tumut Local Government Areas. Grows along sub-alpine watercourses under more open thickets of Mountain Tea-tree in muddy ground very close to water. Less commonly grows in peaty soils and sphagnum mounds.	Moderate. Likely to occur in the western sub-alpine parts of the survey area near watercourses where thickets of Mountain Tea-tree occur. Known to be found in the Alpine and sub-alpine peatlands, damp herbfields and fens, South Eastern Highlands Bioregion and Australian Alps Bioregion PCT.
Ranunculus anemoneus	Anemone Buttercup	V	V	The Anemone Buttercup occurs in a narrow band, only about 8km wide and 32km long, along the Great Dividing Range within Kosciuszko National Park. The Anemone Buttercup generally occurs in environments with late melting snow; on south to east facing, steep grassy slopes, or rocky crevices, or short alpine herbfields. The species has also been collected along watercourses, in grassland, heathland (below snowpatches) and on roadside batters. Soils at Anemone Buttercup sites include loams (alpine humus soils), peats and decomposing granite.	Low. Only known to occur on the Great Dividing Range within Kosciuszko National Park.
Rutidosis leiolepis	Monaro Golden Daisy	V	V	The Monaro Golden Daisy is found in scattered populations on the Monaro, and in low subalpine plains of Kosciuszko National Park (e.g. Long Plain and Happy Jacks Plain). Found in Natural Temperate Grassland on the Monaro. Occurs in sub-alpine grasslands in Kosciuszko National Park. Grows on basalt, granite and sedimentary substrates.	Low. This species is known from the treeless plains to the east of the survey area. Suitable habitat is not present.
Rytidosperma pumilum	Feldmark Grass	V	V	Felmark Grass is limited to a tiny area - about 3ha - of the Main Range of Kosciuszko National Park between Mt Northcote and Mt Lee. This species also occurs in alpine parts of New Zealand. Feldmark Grass is found only in the feldmark - the sparse low vegetation of the bare rocky alpine slopes and ridges, one of the harshest environments in Australia. There is little snow cover in winter because the prevailing westerly winds blow it off into lee snow patches.	Low. Only known from the Main Range of Kosciuszko National Park between Mt Northcote and Mt Lee on windswept feldmark.
Rytidosperma vickeryae	Perisher Wallaby-grass	-	E	Perisher Wallaby-grass is restricted to Kosciuszko National Park. It has been recorded in the Perisher valley and nearby creeks that drain into the Snowy River. An outlying population has been recorded at Happy Jacks Plain. Commonly grows in Sphagnum moss in montane peatland communities or along stream edges.	Low. Grows in the alpine bogs and fens south from the survey area.
Senecio garlandii	Woolly Ragwort	-	V	This daisy is found between Temora, Bethungra and Albury and possibly Burrinjuck near Yass. The largest populations are at The Rock and Mt Tabletop (and surrounds). Woolly Ragwort occurs on sheltered slopes of rocky outcrops.	Low. Known to occur in the Bondo subregion but Some habitat present in the Long-leaved Box - Red Box - Red Stringybark mixed open forest on hills and hillslopes in the NSW South Western Slopes Bioregion PCT but it is not known from the survey area.

Species name	Common name	EPBC Act	BC Act	Distribution and habitat	Likelihood of occurrence
Thelymitra atronitida	Black-hooded Sun Orchid	-	CE	In New South Wales, The Black-hooded Sun Orchid is known from two localities, Cape Solander in Botany Bay National Park in southern Sydney, and Bago State Forest south of Tumut. The known occurrences in this state fall in parts of the Sutherland and either or both of the Tumut and Tumbarumba Local Government Areas. At Cape Solander this species is recorded from shallow black peaty soil in coastal heath on sandstone. In the Bago area it is recorded as occurring in open forest with a heathy understorey on well-drained sand or clay-loam soils.	Moderate. This species is known from the Bago State Forest where it occurs in the Snow Gum - Mountain Gum shrubby open forest of montane areas, South Eastern Highlands Bioregion and Australian Alps Bioregion PCT.
Thesium australe	Austral Toadflax	V	V	Found in very small populations scattered across eastern NSW, along the coast, and from the Northern to Southern Tablelands. It is also found in Tasmania and Queensland and in eastern Asia. Occurs in grassland on coastal headlands or grassland and grassy woodland away from the coast. Often found in association with Kangaroo Grass (*Themeda australis*).	High. This species is known to occur in the survey area and many records exist. Likely to occur in areas of natural grassland, derived grassland under transmission lines and roadsides, and in the sub alpine woodlands.
Xerochrysum palustre	Swamp Everlasting	V	-	Swamp Everlasting is endemic to south-eastern Australia, where it is widely distributed from south-eastern New South Wales through Victoria to north-eastern Tasmania. In New South Wales it occurs as far north as the Southern Tablelands and ranges up to about 1,300 m altitude. In Victoria, the species is widely but patchily distributed from the South Australian border to near Bairnesdale, generally below 500 m altitude. Grows in wetlands including sedge-swamps and shallow freshwater marshes, often on heavy black clay soils.	Low. This species is known from the Kosciuszko National Park in the high altitude Alpine Creek, Boggy Plain, Rocky Plain areas but not from the habitats near the alternative and preferred option.

* Distribution and habitat requirement information adapted from: Australian Government Department of the Environment http://www.environment.gov.au/biodiversity/threatened/index.html, NSW Office of Environment and Heritage http://www.environment.nsw.gov.au/threatenedspecies/

Key:

CE = critically endangered

E = endangered

EP = endangered population

Ex = extinct

V = vulnerable

Table A.3 : Likelihood of occurrence assessment for threatened animal species

Type of animal	Species name	Common name	EPBC Act	BC & FM Act	Distribution and habitat	Likelihood of occurrence
Bird	*Actitis hypoleucos*	Common Sandpiper	M	-	Found along all coastlines of Australia and in many areas inland, the Common Sandpiper is widespread in small numbers. The species utilises a wide range of coastal wetlands and some inland wetlands, with varying levels of salinity, and is mostly found around muddy margins or rocky shores and rarely on mudflats.	Low. No wading bird habitat is present.
Bird	*Anthochaera Phrygia*	Regent Honeyeater	CE	CE	The Regent Honeyeater that has a patchy distribution between south-east Queensland and central Victoria. It mostly inhabits inland slopes of the Great Dividing Range, in areas of low to moderate relief with moist, fertile soils. It is most commonly associated with box-ironbark eucalypt woodland and dry sclerophyll forest, but also inhabits riparian vegetation such as sheoak (*Casuarina* spp.) where it feeds on needle-leaved mistletoe and sometimes breeds. It sometimes utilises lowland coastal forest, which may act as a refuge when its usual habitat is affected by drought. It also uses a range of disturbed habitats within these landscapes including remnant patches in farmland and urban areas and roadside vegetation. It feeds primarily on the nectar of eucalypts and mistletoes and, to a lesser extent, lerps and honeydew; it prefers taller and larger diameter trees for foraging. It is nomadic and partly migratory with its movement through the landscape being governed by the flowering of select eucalypt species.	Low. Not known to utilise alpine areas but is known from the Bondo subregion of the south eastern highlands. May utilise the habitats dominated by *Eucalyptus mannifera* and *E. viminalis* in east of the survey area near the Yarrangobilly river and the Ravine area but unlikely to be frequent.
Bird	*Apus pacificus*	Fork-tailed Swift	M	-	Recorded in all regions of NSW. The Fork-tailed Swift is almost exclusively aerial, flying from less than 1 m to at least 300 m above ground and probably much higher.	Moderate. Likely to fly over the survey area during migration.
Bird	*Artamus cyanopterus cyanopterus*	Dusky Woodswallow	-	V	The Dusky Woodswallow has two separate populations. The eastern population is found from Atherton Tableland, Queensland south to Tasmania and west to Eyre Peninsula, South Australia. The other population is found in south-west Western Australia. The Dusky Woodswallow is found in open forests and woodlands, and may be seen along roadsides and on golf courses.	Moderate. Habitat for this species is widespread. Records of this species are widespread in the region.

Type of animal	Species name	Common name	EPBC Act	BC & FM Act	Distribution and habitat	Likelihood of occurrence
Bird	*Botaurus poiciloptilus*	Australasian Bittern	E	E	Occurs from south-east Queensland to south-east South Australia, Tasmania and the south-west of Western Australia. The Australasian Bittern's preferred habitat is comprised of wetlands with tall dense vegetation, where it forages in still, shallow water up to 0.3 m deep, often at the edges of pools or waterways, or from platforms or mats of vegetation over deep water. It favours permanent and seasonal freshwater habitats, particularly those dominated by sedges, rushes and reeds (e.g. Phragmites, Cyperus, Eleocharis, Juncus, Typha, Baumea, Bolboschoenus) or cutting grass (Gahnia) growing over a muddy or peaty substrate	Moderate. Some areas at the edge of the Tumut River and Yarrangobilly River may provide suitable habitat for this species.
Bird	*Calidris acuminata*	Sharp-tailed Sandpiper	M	-	The Sharp-tailed Sandpiper spends the non-breeding season in Australia with small numbers occurring regularly in New Zealand. Most of the population migrates to Australia, mostly to the south-east and are widespread in both inland and coastal locations and in both freshwater and saline habitats. Many inland records are of birds on passage. Prefers muddy edges of shallow fresh or brackish wetlands, with inundated or emergent sedges, grass, saltmarsh or other low vegetation.	Low. No wading bird habitat is present.

Type of animal	Species name	Common name	EPBC Act	BC & FM Act	Distribution and habitat	Likelihood of occurrence
Bird	*Calidris ferruginea*	Curlew Sandpiper	CE	E	In Australia, Curlew Sandpipers occur around the coasts of all states and are also quite widespread inland, though in smaller numbers. They occur in Australia mainly during the non-breeding period but also during the breeding season when many non-breeding one year old birds remain. Curlew Sandpipers mainly occur on intertidal mudflats in sheltered coastal areas, such as estuaries, bays, inlets and lagoons, and also around non-tidal swamps, lakes and lagoons near the coast, and ponds in saltworks and sewage farms. They are also recorded inland, though less often, including around ephemeral and permanent lakes, dams, waterholes and bore drains, usually with bare edges of mud or sand. They generally roost on bare dry shingle, shell or sand beaches, sandspits and islets in or around coastal or near-coastal lagoons and other wetlands, occasionally roosting in dunes during very high tides and sometimes in saltmarsh and in mangroves.	Low. No wading bird habitat is present.
Bird	*Calidris melanotos*	Pectoral Sandpiper	M	-	In New South Wales (NSW), the Pectoral Sandpiper is widespread, but scattered. Records exist east of the Great Divide, from Casino and Ballina, south to Ulladulla. West of the Great Divide, the species is widespread in the Riverina and Lower Western regions. Prefers shallow fresh to saline wetlands. The species is found at coastal lagoons, estuaries, bays, swamps, lakes, inundated grasslands, saltmarshes, river pools, creeks, floodplains and artificial wetlands.	Low. No wading bird habitat is present.

Type of animal	Species name	Common name	EPBC Act	BC & FM Act	Distribution and habitat	Likelihood of occurrence
Bird	*Callocephalon fimbriatum*	Gang-gang Cockatoo	-	V	In summer, occupies tall montane forests and woodlands, particularly in heavily timbered and mature wet sclerophyll forests with an acacia understorey. Also occur in subalpine Snow Gum woodland and occasionally in temperate or regenerating forest. In winter, occurs at lower altitudes in drier, more open eucalypt forests and woodlands, particularly in box ironbark assemblages, or in dry forest in coastal areas, occasionally feeding on exotic plant species on urban fringe areas. Favours old growth forest and woodland attributes for nesting and roosting. Nesting occurs in Spring and Summer with nests located in hollows that are 10 cm in diameter or larger and at least 9 m above the ground in eucalypts.	Present. Habitat for this species is widespread. Records of this species are widespread in the region and this species was observed using the habitats to the west of the Tumut River during the field surveys. Breeding habitat is likely to be present.
Bird	*Climacteris picumnus victoriae*	Brown Treecreeper (eastern subspecies)	-	V	Endemic to eastern Australia and occurs in eucalypt forests and woodlands of inland plains and slopes of the Great Dividing Range. It is less commonly found on coastal plains and ranges. Found in eucalypt woodlands (including Box-Gum Woodland) and dry open forest of the inland slopes and plains inland of the Great Dividing Range; mainly inhabits woodlands dominated by stringybarks or other rough-barked eucalypts, usually with an open grassy understorey, sometimes with one or more shrub species; also found in mallee and River Red Gum (Eucalyptus camaldulensis) Forest bordering wetlands with an open understorey of acacias, saltbush, lignum, cumbungi and grasses; usually not found in woodlands with a dense shrub layer; fallen timber is an important habitat component for foraging; also recorded, though less commonly, in similar woodland habitats on the coastal ranges and plains. Hollows in standing dead or live trees and tree stumps are essential for nesting.	Moderate. Habitat for this species is widespread. There are scattered records of this species in the region.

Type of animal	Species name	Common name	EPBC Act	BC & FM Act	Distribution and habitat	Likelihood of occurrence
Bird	*Daphoenositta chrysoptera*	Varied Sittella	-	V	The Varied Sittella is sedentary and inhabits most of mainland Australia except the treeless deserts and open grasslands. Distribution in NSW is nearly continuous from the coast to the far west. Inhabits eucalypt forests and woodlands, especially those containing rough-barked species and mature smooth-barked gums with dead branches, mallee and Acacia woodland. Feeds on arthropods gleaned from crevices in rough or decorticating bark, dead branches, standing dead trees and small branches and twigs in the tree canopy. Nests in an upright tree fork high in the living tree canopy.	Moderate. Habitat for this species is widespread. There are scattered records of this species in the region.
Bird	*Gallinago hardwickii*	Latham's Snipe	M	-	Recorded along the east coast of Australia from Cape York Peninsula through to south-eastern South Australia. Occurs in permanent and ephemeral wetlands up to 2000 m above sea-level.	Moderate. Some areas of the Tumut River and Yarrangobilly River are likely to provide suitable habitat for this species.
Bird	*Grantiella picta*	Painted Honeyeater	V	V	The Painted Honeyeater is nomadic and occurs at low densities throughout its range. The greatest concentrations of birds, and almost all breeding, occur on the inland slopes of the Great Dividing Range in NSW, Victoria and southern Queensland. During the winter it is more likely to be found in the north of its distribution. Inhabits Boree, Brigalow and Box-Gum Woodlands and Box-Ironbark Forests. A specialist feeder on the fruits of mistletoes growing on woodland eucalypts and acacias. Prefers mistletoes of the genus Amyema.	Moderate. Vegetation in the survey area is suitable habitat for this species. There are numerous scattered records of this species in the region
Bird	*Haliaeetus leucogaster*	White-bellied Sea-Eagle	M	V	Distributed along the coastline (including offshore islands) of mainland Australia and Tasmania. Found in coastal habitats (especially those close to the sea-shore) and around terrestrial wetlands in tropical and temperate regions of mainland Australia and its offshore islands. The habitats occupied by the sea-eagle are characterised by the presence of large areas of open water (larger rivers, swamps, lakes, and the sea).	Moderate. This species is likely to hunt and nest in the survey area.

Type of animal	Species name	Common name	EPBC Act	BC & FM Act	Distribution and habitat	Likelihood of occurrence
Bird	*Hieraaetus morphnoides*	Little Eagle	-	V	The Little Eagle is found throughout the Australian mainland excepting the most densely forested parts of the Dividing Range escarpment. It occurs as a single population throughout NSW. Occupies open eucalypt forest, woodland or open woodland. Sheoak or Acacia woodlands and riparian woodlands of interior NSW are also used.	Moderate. This species is likely to hunt and nest in the survey area.
Bird	*Hirundapus caudacutus*	White-throated Needletail	M	-	Widespread in eastern and south-eastern Australia. Almost exclusively aerial, from heights of less than 1 m up to more than 1000 m above the ground. They also commonly occur over heathland but less often over treeless areas, such as grassland or swamps.	Moderate. This species may fly over the survey area during migration.
Bird	*Lathamus discolor*	Swift Parrot	CE	E	The swift parrot breeds in Tasmania during the summer and the entire population migrates north to mainland Australia for the winter. Whilst on the mainland the swift parrot disperses widely to forage on flowers and psyllid lerps in eucalypt species, with the majority being found in Victoria and NSW. In NSW they forage in forests and woodlands throughout the coastal and western slopes regions each year. Coastal regions tend to support larger numbers of birds when inland habitats are subjected to drought. Non-breeding birds preferentially feed in inland box-ironbark and grassy woodlands, and coastal swamp mahogany (*E. robusta*) and spotted gum (*Corymbia maculata*) woodland when in flower; otherwise often in coastal forests. On the mainland they occur in areas where eucalypts are flowering profusely or where there are abundant lerp (from sap-sucking bugs) infestations. Favoured feed trees include winter flowering species such as *Eucalyptus robusta, Corymbia maculata, C. gummifera, E. sideroxylon*, and *E. albens*. Commonly used lerp infested trees include *E. microcarpa, E. moluccana* and *E. pilularis*.	Low. No records of this species exist from the locality and the mainland migration route is generally to the west of the ranges.

Type of animal	Species name	Common name	EPBC Act	BC & FM Act	Distribution and habitat	Likelihood of occurrence
Bird	*Lophoictinia isura*	Square-tailed Kite	-	V	Typically inhabits coastal forested and wooded lands of tropical and temperate Australia. In NSW it is often associated with ridge and gully forests dominated by Eucalyptus longifolia, Corymbia maculata, E. elata, or E. smithii. Individuals appear to occupy large hunting ranges of more than 100 km^2. They require large living trees for breeding, particularly near water with surrounding woodland /forest close by for foraging habitat. Nest sites are generally located along or near watercourses, in a tree fork or on large horizontal limbs.	Moderate. Although records are lacking, this species is likely to hunt and nest in the survey area based on the presence of suitable habitat.
Bird	*Melanodryas cucullata cucullata*	Hooded Robin (south-eastern form)	-	V	The Hooded Robin is widespread, found across Australia, except for the driest deserts and the wetter coastal areas - northern and eastern coastal Queensland and Tasmania. However, it is common in few places, and rarely found on the coast. Prefers lightly wooded country, usually open eucalypt woodland, acacia scrub and mallee, often in or near clearings or open areas. Requires structurally diverse habitats featuring mature eucalypts, saplings, some small shrubs and a ground layer of moderately tall native grasses. The nest is a small, neat cup of bark and grasses bound with webs, in a tree fork or crevice, from less than 1 m to 5 m above the ground.	Moderate. Some records exist in the locality. The open habitats around the Ravine area and on the Bago Plateau may be suitable.
Bird	*Melithreptus gularis gularis*	Black-chinned Honeyeater (eastern subsp.)	-	V	Extends south from central Queensland, through NSW, Victoria into south eastern South Australia, though it is very rare in the last state. In NSW it is widespread, with records from the tablelands and western slopes of the Great Dividing Range to the north-west and central-west plains and the Riverina. Occupies mostly upper levels of drier open forests or woodlands dominated by box and ironbark eucalypts, especially Mugga Ironbark (*Eucalyptus sideroxylon*), White Box (*E. albens*), Inland Grey Box (*E. microcarpa*), Yellow Box (*E. melliodora*), Blakely's Red Gum (*E. blakelyi*) and Forest Red Gum (*E. tereticornis*). Also inhabits open forests of smooth-barked gums, stringybarks, ironbarks, river sheoaks (nesting habitat) and tea-trees.	Low. Some suitable is likely to be present within the survey area but there are few records from the locality and the survey area is on the south eastern edge of the known distribution.

Type of animal	Species name	Common name	EPBC Act	BC & FM Act	Distribution and habitat	Likelihood of occurrence
Bird	*Merops ornatus*	Rainbow Bee-eater	M	-	Distributed across much of mainland Australia, and occurs on several near-shore islands. Occurs mainly in open forests and woodlands, shrublands, and in various cleared or semi-cleared habitats, including farmland and areas of human habitation.	Moderate. Suitable habitat is widespread and this species is likely to occur seasonally in low numbers.
Bird	*Motacilla flava*	Yellow Wagtail	M	-	Rare but regular visitor around Australian coast, especially in the NW coast Broome to Darwin. Found in open country near swamps, salt marshes, sewage ponds, grassed surrounds to airfields, bare ground; occasionally on drier inland plains.	Low. Habitat unsuitable for this species.
Bird	*Myiagra cyanoleuca*	Satin Flycatcher	M	-	Widespread in eastern Australia and vagrant to New Zealand. Inhabit heavily vegetated gullies in eucalypt-dominated forests and taller woodlands, and on migration, occur in coastal forests, woodlands, mangroves and drier woodlands and open forests.	Moderate. Suitable habitat is widespread and this species has been frequently recorded in the locality.
Bird	*Neophema pulchella*	Turquoise Parrot	-	V	Range extends from southern Queensland through to northern Victoria, from the coastal plains to the western slopes of the Great Dividing Range. Lives on the edges of eucalypt woodland adjoining clearings, timbered ridges and creeks in farmland.	Low. The survey area is outside of the known range of this species and the habitat in the survey area is not considered suitable for this species.
Bird	*Ninox connivens*	Barking Owl	-	V	Found throughout continental Australia except for the central arid regions. Inhabits woodland and open forest, including fragmented remnants and partly cleared farmland. It is flexible in its habitat use, and hunting can extend in to closed forest and more open areas.	Low. This species is not known from the survey area and it is on the edge of the expert distribution.

Type of animal	Species name	Common name	EPBC Act	BC & FM Act	Distribution and habitat	Likelihood of occurrence
Bird	*Ninox strenua*	Powerful Owl	-	V	In NSW, it is widely distributed throughout the eastern forests from the coast inland to tablelands, with scattered records on the western slopes and plains suggesting occupancy prior to land clearing. Now at low densities throughout most of its eastern range, rare along the Murray River and former inland populations may never recover. The Powerful Owl inhabits a range of vegetation types, from woodland and open sclerophyll forest to tall open wet forest and rainforest. The Powerful Owl requires large tracts of forest or woodland habitat but can occur in fragmented landscapes as well. The species breeds and hunts in open or closed sclerophyll forest or woodlands and occasionally hunts in open habitats. It roosts by day in dense vegetation comprising species such as Turpentine *Syncarpia glomulifera*, Black She-oak *Allocasuarina littoralis*, Blackwood *Acacia melanoxylon*, Rough-barked Apple *Angophora floribunda*, Cherry Ballart *Exocarpus cupressiformis* and a number of eucalypt species.	High. Suitable habitat is widespread. The survey area is likely to contain habitat for breeding pairs.
Bird	*Numenius madagascariensis*	Eastern Curlew	CE, M	-	Within Australia, the Eastern Curlew has a primarily coastal distribution. The species is found in all states, particularly the north, east, and south-east regions including Tasmania. The Eastern Curlew is most commonly associated with sheltered coasts, especially estuaries, bays, harbours, inlets and coastal lagoons, with large intertidal mudflats or sand flats, often with beds of seagrass.	Low. Habitat in the survey area is not considered suitable for this species.

Type of animal	Species name	Common name	EPBC Act	BC & FM Act	Distribution and habitat	Likelihood of occurrence
Bird	*Oxyura australis*	Blue-billed Duck	-	V	Endemic to south-eastern and south-western Australia. It is widespread in NSW, but most common in the southern Murray-Darling Basin area. Birds disperse during the breeding season to deep swamps up to 300 km away. It is generally only during summer or in drier years that they are seen in coastal areas. Prefers deep water in large permanent wetlands and swamps with dense aquatic vegetation. The species is completely aquatic, swimming low in the water along the edge of dense cover. It will fly if disturbed, but prefers to dive if approached. Partly migratory, with short-distance movements between breeding swamps and overwintering lakes with some long-distance dispersal to breed during spring and early summer. Usually nest solitarily in Cumbungi over deep water between September and February. They will also nest in trampled vegetation in Lignum, sedges or Spike-rushes, where a bowl-shaped nest is constructed. The most common clutch size is five or six. Males take no part in nest-building or incubation.	Moderate. One record of this species to the north of the survey area near Sandy Creek. This species may occur in any of the watercourses in the survey area.

Type of animal	Species name	Common name	EPBC Act	BC & FM Act	Distribution and habitat	Likelihood of occurrence
Bird	*Pachycephala inornata*	Gilbert's Whistler	-	V	The Gilbert's Whistler is sparsely distributed over much of the arid and semi-arid zone of inland southern Australia, from the western slopes of NSW to the Western Australian wheatbelt. The Gilbert's Whistler occurs in a range of habitats within NSW, though the shared feature appears to be a dense shrub layer. It is widely recorded in mallee shrublands, but also occurs in box-ironbark woodlands, Cypress Pine and Belah woodlands and River Red Gum forests, though at this stage it is only known to use this habitat along the Murray, Edwards and Wakool Rivers. Within the mallee the species is often found in association with an understorey of spinifex and low shrubs including wattles, hakeas, sennas and hop-bushes. In woodland habitats, the understorey comprises dense patches of shrubs, particularly thickets of regrowth Callitris pine. Parasitic 'cherries' (Exocarpus species) appear to be an important habitat component in Belah and Red Gum communities, though in the latter case other dense shrubs, such as Lignum and wattles, are also utilised.	Low. The survey area is not within the known distribution of this species but a vagrant bird has been recorded in the Bago State Forest.
Bird	*Pachycephala olivacea*	Olive Whistler	-	V	The Olive Whistler inhabits the wet forests on the ranges of the east coast. It has a disjunct distribution in NSW chiefly occupying the beech forests around Barrington Tops and the MacPherson Ranges in the north and wet forests from Illawarra south to Victoria. In the south it is found inland to the Snowy Mountains and the Brindabella Range. Mostly inhabit wet forests above about 500m. During the winter months they may move to lower altitudes.	High. This species is known to occur in the – higher altitude areas (>500m) in the survey area.
Bird	*Petroica boodang*	Scarlet Robin	-	V	The Scarlet Robin lives in dry eucalypt forests and woodlands. The understorey is usually open and grassy with few scattered shrubs. This species lives in both mature and re-growth vegetation. It occasionally occurs in mallee or wet forest communities, or in wetlands and tea-tree swamps. This species' nest is built in the fork of tree usually more than 2 m above the ground; nests are often found in a dead branch in a live tree, or in a dead tree or shrub.	High. This species has been recorded in the survey area and surround sin the past and suitable habitat for this species is widespread.

Type of animal	Species name	Common name	EPBC Act	BC & FM Act	Distribution and habitat	Likelihood of occurrence
Bird	*Petroica phoenicea*	Flame Robin	-	V	The Flame Robin ranges from near the Queensland border to south east South Australia and also in Tasmania. In NSW, it breeds in upland areas and in winter, many birds move to the inland slopes and plains. It is likely that there are two separate populations in NSW, one in the Northern Tablelands, and another ranging from the Central to Southern Tablelands. Breeds in upland tall moist eucalypt forests and woodlands, often on ridges and slopes. Prefers clearings or areas with open understoreys. The groundlayer of the breeding habitat is dominated by native grasses and the shrub layer may be either sparse or dense. Occasionally occurs in temperate rainforest, and also in herbfields, heathlands, shrublands and sedgelands at high altitudes.	High. This species has been recorded in the survey area and surrounds in the past and suitable habitat for this species is widespread.
Bird	*Petroica rodinogaster*	Pink Robin	-	V	The Pink Robin is found in Tasmania and the uplands of eastern Victoria and far south-eastern NSW, almost as far north as Bombala. On the mainland, the species disperses north and west and into more open habitats in winter, regularly as far north as the ACT area, and sometimes being found as far north as the central coast of NSW. Inhabits rainforest and tall, open eucalypt forest, particularly in densely vegetated gullies.	High. This species has been recorded in the survey area and surrounds in the past and suitable habitat for this species is widespread.
Bird	*Rhipidura rufifrons*	Rufous Fantail	M	-	Occurs in coastal and near coastal districts of northern and eastern Australia. In east and south-east Australia, the Rufous Fantail mainly inhabits wet sclerophyll forests, often in gullies dominated by eucalypts such as Tallow-wood (Eucalyptus microcorys), Mountain Grey Gum (E. cypellocarpa), Narrow-leaved Peppermint (E. radiata), Mountain Ash (E. regnans), Alpine Ash (E. delegatensis), Blackbutt (E. pilularis) or Red Mahogany (E. resinifera); usually with a dense shrubby understorey often including ferns.	High. This species has been recorded in the survey area and surrounds in the past and suitable habitat for this species is widespread.

Type of animal	Species name	Common name	EPBC Act	BC & FM Act	Distribution and habitat	Likelihood of occurrence
Bird	*Rostratula australis*	Australian Painted Snipe	E, M	E	Most records are from the south east, particularly the Murray Darling Basin, with scattered records across northern Australia and historical records from around the Perth region in Western Australia. Prefers fringes of swamps, dams and nearby marshy areas where there is a cover of grasses, lignum, low scrub or open timber. Nests on the ground amongst tall vegetation, such as grasses, tussocks or reeds.	Moderate. Some areas of the Tumut River and Yarrangobilly River are may provide suitable habitat for this species.
Bird	*Stagonopleura guttata*	Diamond Firetail	-	V	Found in grassy eucalypt woodlands, including Box-Gum Woodlands and Snow Gum (*Eucalyptus pauciflora*) Woodlands. Also occurs in open forest, mallee, Natural Temperate Grassland, and in secondary grassland derived from other communities. Often found in riparian areas (rivers and creeks), and sometimes in lightly wooded farmland. Nests are globular structures built either in the shrubby understorey, or higher up, especially under hawk's or raven's nests. Birds roost in dense shrubs or in smaller nests built especially for roosting.	Moderate. Records of this species are scattered all over the region. Suitable habitat is present in the survey area.
Bird	*Tyto novaehollandiae*	Masked Owl	-	V	Extends from the coast where it is most abundant to the western plains. Overall records for this species fall within approximately 90% of NSW, excluding the most arid north-western corner. There is no seasonal variation in its distribution. Dry eucalypt forests and woodland, typically prefers open forest with low shrub density. Requires old trees for roosting and nesting.	Moderate. Suitable habitat is widespread and there are records from around the locality. Study area may contain nesting individuals.
Bird	*Tyto tenebricosa*	Sooty Owl	-	V	Occupies the easternmost one-eighth of NSW, occurring on the coast, coastal escarpment and eastern tablelands. Territories are occupied permanently. Occurs in rainforest, including dry rainforest, subtropical and warm temperate rainforest, as well as moist eucalypt forests.	High. Suitable habitat is widespread and this species has been recorded from the gullies near the Tumut River The survey area is likely to contain nesting pairs. Tall forest dominated by Mountain Gum likely to be optimal.

Type of animal	Species name	Common name	EPBC Act	BC & FM Act	Distribution and habitat	Likelihood of occurrence
Fish	*Euastacus armatus*	Murray Crayfish	-	V	The Murray Crayfish is a 'spiny' crayfish endemic to the southern tributaries of the Murray Darling Basin. This iconic species was once widespread in the Murray and Murrumbidgee River systems in South Australia, Victoria, New South Wales and the Australian Capital Territory. The Murray Crayfish is the largest of over 40 species in the genus Euastacus which represents freshwater 'spiny' crayfish; and is the second largest freshwater crayfish in the world.	Moderate – the indicative distribution of this species is mapped in the south of the survey area, where the Yarrangobilly River meets the Tumut River.
Fish	*Maccullochella macquariensis*	Trout Cod	E	E	The Trout Cod is a riverine species, inhabiting a variety of flowing waters in the mid to upper reaches of rivers and streams. Trout Cod use river positions where large cover, in the form of woody debris and boulders, is present in high quantity, close to deeper water and high surface velocity, further from the river bank. At present only two potentially sustainable populations are known; a naturally occurring population in the Murray River (NSW) downstream of the Yarrawonga Weir between Yarrawonga and Barmah and the translocated population in Seven Creeks below Polly McQuinns Weir (Vic). There have been no recent records in the Murray River downstream from Echuca (NSW, SA), Macquarie River (NSW), Murrumbidgee River (NSW, ACT), and the Goulburn, Broken, Campaspe, Ovens, King, Buffalo and Mitta Mitta Rivers (Vic). The wild populations formerly occurring in these rivers are now probably extinct. Trout Cod and Murray Cod translocated into Cataract Dam (Nepean River NSW) have hybridised, and the cod population existing there is composed largely of hybrids.	Low. This species' indicative distribution is restricted to the Murray River, Murrumbidgee River and some tributaries.

Type of animal	Species name	Common name	EPBC Act	BC & FM Act	Distribution and habitat	Likelihood of occurrence
Fish	*Maccullochella peelii*	Murray Cod	V	-	The Murray Cod occurs naturally in the waterways of the Murray-Darling Basin (ACT, SA, NSW and Vic) and is known to live in a wide range of warm water habitats that range from clear, rocky streams to slow flowing turbid rivers and billabongs. The upper reaches of the Murray and Murrumbidgee Rivers are considered too cold to contain suitable habitat. Some translocated populations exist outside the species' natural distribution in impoundments and waterways in NSW and Vic which are maintained by the release of hatchery bred fish.	Low. This species is not known from the locality.
Fish	*Macquaria australasica*	Macquarie Perch	E	E	The Macquarie Perch is a riverine species that prefers clear water and deep, rocky holes with abundant cover cover such as aquatic vegetation, large boulders, debris and overhanging banks. In Victorian parts of the Murray-Darling, only small natural populations remain in the upper reaches of the Mitta Mitta, Ovens, Broken, Campaspe and Goulburn Rivers; translocated populations occur in the Yarra River and Lake Eildon. In NSW, natural inland populations are isolated to the upper reaches of the Lachlan and Murrumbidgee Rivers. Populations of the eastern form are confined to the Hawkesbury-Nepean and Shoalhaven river systems. Translocated populations in NSW are found in the Mongarlowe River, Queanbeyan River upstream of the Googong Reservoir and in Cataract Dam. In the ACT, it is restricted to the Murrumbidgee, Paddys and Cotter Rivers	High. The indicative distribution of this species is mapped in the south of the survey area, where the Yarrangobilly River meets the Tumut River.
Frogs	*Litoria booroolongensis*	Booroolong Frog	E	E	Restricted to tablelands and slopes in NSW and north-east Victoria at 200–1300 m above sea level. Occurs along permanent streams with some fringing vegetation cover such as ferns, sedges or grasses.	High. This species is considered highly likely to inhabit the permanent rivers and streams in the survey area.

Type of animal	Species name	Common name	EPBC Act	BC & FM Act	Distribution and habitat	Likelihood of occurrence
Frogs	*Litoria raniformis*	Southern Bell Frog	V	E	The species is currently widespread throughout the Murray River valley and has been recorded from six Catchment Management Areas in NSW: Lower Murray Darling, Murrumbidgee, Murray, Lachlan, Central West and South East. Found mostly amongst emergent vegetation, including *Typha* sp. (bullrush), *Phragmites* sp. (reeds) and *Eleocharis* sp.(sedges), in or at the edges of still or slow-flowing water bodies such as lagoons, swamps, lakes, ponds and farm dams.	Low. The survey area is mapped in the expert distribution (maybe) for this species and there are isolated records from Lake Blowering and Adaminaby but the habitat near the alternative and preferred option is not typical.
Frogs	*Litoria verreauxii alpina*	Alpine Tree Frog	V	E	The Alpine Tree Frog occurs in the south-eastern NSW and Victorian high country (alpine and sub-alpine zones) generally above 1100 m asl. Most locations are within National Park and some are close to alpine resorts. Found in a wide variety of habitats including woodland, heath, grassland and herb fields. Breed in natural and artificial wetlands including ponds, bogs, fens, streamside pools, stock dams and drainage channels that are still or slow flowing. It does not climb well, and spends most of its time on the ground.	High. The survey area is mapped in the expert distribution (likely) for this species and there are many records of this species from around the Talbingo Reservoir and Bago Plateau.
Frogs	*Pseudophryne corroboree*	Southern Corroboree Frog	CE	CE	The Southern Corroboree Frog is limited to sphagnum bogs of the northern Snowy Mountains, in a strip from the Maragle Range in the north-west, through Mt Jagungal to Smiggin Holes in the south. Its range is entirely within Kosciuszko National Park. Summer breeding habitat is pools and seepages in sphagnum bogs, wet tussock grasslands and wet heath. Outside the breeding season adults move away from the bogs into the surrounding heath and snowgum woodland to overwinter under litter, logs and dense groundcover.	Low. The distribution of this species is fairly well known, which is south of the survey area.

Type of animal	Species name	Common name	EPBC Act	BC & FM Act	Distribution and habitat	Likelihood of occurrence
Frogs	*Pseudophryne pengilleyi*	Northern Corroboree Frog	CE	CE	The Northern Corroboree Frog occurs in forests, sub-alpine woodlands and tall heath in the Brindabella Ranges from Mt Bimberi to north of Mt Coree, and the Fiery Range from the Snowy Mountains Highway to Wee Jasper. Populations also occur in the pine plantations near Tumut. The distribution is within National Park, State Forest and other public land. Summer breeding habitat is pools and seepages in sphagnum bogs, wet heath, wet tussock grasslands and herbfields in low-lying depressions. Outside the breeding season adults move away from the bogs into the surrounding heath, woodland and forest to overwinter under litter, logs and dense groundcover.	Low. The distribution of this species is fairly well known, which is north of the survey area.
Invertebrate	*Synemon plana*	Golden Sun Moth	CE	E	The Golden Sun Moth's NSW populations are found in the area between Queanbeyan, Gunning, Young and Tumut. The species' historical distribution extended from Bathurst (central NSW) through the NSW Southern Tablelands, through to central and western Victoria, to Bordertown in eastern South Australia. Occurs in Natural Temperate Grasslands and grassy Box-Gum Woodlands in which groundlayer is dominated by wallaby grasses *Austrodanthonia* spp. Grasslands dominated by wallaby grasses are typically low and open - the bare ground between the tussocks is thought to be an important microhabitat feature for the Golden Sun Moth, as it is typically these areas on which the females are observed displaying to attract males. Habitat may contain several wallaby grass species, which are typically associated with other grasses particularly spear-grasses *Austrostipa* spp. or Kangaroo Grass *Themeda australis*.	Low. The survey area is part of an area that may contain habitat for this species (SPRAT profile) but there are no records of this species from the locality.

Type of animal	Species name	Common name	EPBC Act	BC & FM Act	Distribution and habitat	Likelihood of occurrence
Mammals	*Burramys parvus*	Mountain Pygmy-possum	E	E	The Mountain Pygmy-possum lives only in alpine and subalpine areas on the highest mountains of Victoria and NSW. In NSW the entire range is in a 30 km by 8 km area of Kosciuszko National Park between Thredbo and Kerries Ridge, where it occupies less than four square km of habitat. The total population size is less than 500 adults. Two of the four main sub-populations in NSW are found within ski resort areas. Lives on the ground in rocky areas where boulders have accumulated below mountain peaks; frequently associated with alpine heathland shrubs dominated by the Mountain Plum-pine (*Podocarpus lawrencei*).	Low. This species is known from discrete, restricted higher altitude habitats to the south of Cabramurra but the preferred option and substation are not located near this habitat.
Mammals	*Cercartetus nanus*	Eastern Pygmy-possum	-	V	Found in a broad range of habitats from rainforest through sclerophyll (including Box-Ironbark) forest and woodland to heath, but in most areas woodlands and heath appear to be preferred, except in north-eastern NSW where they are most frequently encountered in rainforest. Feeds largely on nectar and pollen collected from banksias, eucalypts and bottlebrushes; soft fruits are eaten when flowers are unavailable. Shelters in tree hollows, rotten stumps, holes in the ground, abandoned bird-nests, Ringtail Possum dreys or thickets of vegetation, (e.g. grass-tree skirts); nest-building appears to be restricted to breeding females; tree hollows are favoured but spherical nests have been found under the bark of eucalypts and in shredded bark in tree forks. Important habitat requirements include trees with hollows >2cm, loose bark of eucalypts or accumulations of shredded bark in tree forks for nesting; and associated vegetation types and with an understorey containing heath, banksias or myrtaceous shrubs and soft-fruited plants in rainforests.	High. There are several records of this species in the survey area and suitable foraging and breeding habitat is widespread, particularly in areas with high abundance of *Banksia canei*.
Mammals	*Dasyurus maculatus*	Spotted-tailed Quoll	E	V	Wet and dry sclerophyll forests and rainforests, and adjacent open agricultural areas. Generally associated with large expansive areas of habitat to sustain territory size. Requires hollow-bearing trees, fallen logs, small caves, rock crevices, boulder fields and rocky-cliff faces as den sites.	High. There are extensive areas of suitable habitat for this species in the survey area and many records from Bago State Forest and adjacent land. The survey area is likely to contain several individuals and breeding habitat may be present.

Type of animal	Species name	Common name	EPBC Act	BC & FM Act	Distribution and habitat	Likelihood of occurrence
Mammals	*Falsistrellus tasmaniensis*	Eastern False Pipistrelle	-	V	Prefers moist habitats, with trees taller than 20 m. Generally roosts in eucalypt hollows, but has also been found under loose bark on trees or in buildings.	High. There are extensive areas of suitable habitat for this species in the survey area and many records from Bago State Forest and adjacent land. Breeding habitat is likely to be present.
Mammals	*Mastacomys fuscus*	Broad-toothed Rat	V	V	In NSW the Broad-toothed Rat occurs in two widely separated areas: the wet alpine and subalpine heaths and woodlands in Kosciuszko National Park, adjacent Nature Reserves (Bimberi and Scabby NR) and State Forest (Buccleuch SF) in the south of the State, and on the Barrington Tops, north-west of Newcastle. In Victoria - South Gippsland and the Otways - and western Tasmania, it can be found in wet sedge and grasslands at lower elevations. The Broad-toothed Rat lives in a complex of runways through the dense vegetation of its wet grass, sedge or heath environment, and under the snow in winter. This relatively warm under-snow space enables it to be active throughout winter. Sheltering nests of grass are built in the understorey or under logs, where two or three young are born in summer. In winter the rats huddle together in nests, for warmth.	High. There are many records of this species to the east of the survey area on the high altitude plains. There may be suitable habitat on the Bago plateau in the west of the survey area and there are some records of this species from habitat along the Elliott Way (found in Fox scats) near the general location of the substation which indicates this species is present in the habitat.
Mammals	*Miniopterus schreibersii oceanensis*	Eastern Bentwing-bat	-	V	Occurs on east and north west coasts of Australia. Caves are the primary roosting habitat, but also use derelict mines, storm-water tunnels, buildings and other manmade structures.	High. Suitable foraging habitat is widespread. Potential cave roosts are present along the Tumut River. This species has been frequently recorded in the locality.
Mammals	*Myotis macropus* (*Myotis adversus*)	Southern Myotis	-	V	Generally roost in groups close to water in caves, mine shafts, hollow-bearing trees, and storm water channels, buildings, under bridges and in dense foliage. Forages over streams and pools catching insects and small fish.	High. Suitable foraging habitat is widespread. Potential roosting habitat in hollow-bearing trees and bridges over the Tumut River are present. This species has been frequently recorded in the locality.

Type of animal	Species name	Common name	EPBC Act	BC & FM Act	Distribution and habitat	Likelihood of occurrence
Mammals	*Petauroides volans*	Greater Glider	V	-	The Greater Glider occurs in eucalypt forests and woodlands along the east coast of Australia from north east Queensland to the Central Highlands of Victoria from sea level to 1200 m altitude. It feeds exclusively on eucalypt leaves, buds, flowers and mistletoe and favours forests with a diversity of eucalypt species, due to seasonal variation in its preferred tree species. It roosts in tree hollows, with a particular selection for large hollows in large, old trees. Individuals use multiple hollows and a relatively high abundance of tree hollows (at least 4-8 suitable hollows per hectare) seems to be needed for the species to persist. Individuals occupy relatively small home ranges with an average size of 1 to 3 ha but the species has relatively low persistence in small forest fragments, and disperses poorly across vegetation that is not native forest. Forest patches of at least 160 km^2 may be required to maintain viable populations.	Moderate. There are numerous records of this species from the Bago State Forest. Suitable habitat is likely widespread in the survey area west of the Tumut River in the tall wet forests.
Mammals	*Petaurus australis*	Yellow-bellied Glider	-	V	Found along the eastern coast to the western slopes of the Great Dividing Range, from southern Queensland to Victoria. Occur in tall mature eucalypt forest generally in areas with high rainfall and nutrient rich soils. Forest type preferences vary with latitude and elevation; mixed coastal forests to dry escarpment forests in the north; moist coastal gullies and creek flats to tall montane forests in the south. Feed primarily on plant and insect exudates, including nectar, sap, honeydew and manna with pollen and insects providing protein. Extract sap by incising (or biting into) the trunks and branches of favoured food trees, often leaving a distinctive 'V'-shaped scar.	High. There is a known population of Yellow-bellied Glider on the Bago Plateau. This species is likely to use vegetation in the west of the survey area including the tall wet forests in the area of the substation.

Type of animal	Species name	Common name	EPBC Act	BC & FM Act	Distribution and habitat	Likelihood of occurrence
Mammals	*Petaurus australis (endangered population)*	Yellow-bellied Glider population on the Bago Plateau	-	EP	The endangered population of the Yellow-bellied Glider occurs on the Bago Plateau; a westward extension of the Kosciuszko highlands in southern New South Wales. The population is disjunct owing to the steep valleys and unsuitable habitat surrounding the Bago Plateau which includes cleared agricultural land to the west and the Tumut River and Talbingo Reservoir to the east. The area of the population includes a large portion of Bago and Maragle State Forests, a small area of Kosciuszko National Park and some freehold land. Den, often in family groups, in hollows of large trees. The habitat on the Bago Plateau consists of tall wet sclerophyll forest dominated by Eucalyptus delegatensis (Alpine Ash), E. dalrympleana (Mountain Gum), E. radiata (Narrow-leaved Peppermint) and E. rubida (Candlebark). Feed primarily on plant and insect exudates, including nectar, sap, honeydew and manna with pollen and insects providing protein.	High. There is a known population of Yellow-bellied Glider on the Bago Plateau. This species is likely to use vegetation in the west of the survey area including the tall wet forests in the area of the substation.
Mammals	*Petaurus norfolcensis*	Squirrel Glider	-	V	The species is widely though sparsely distributed in eastern Australia, from northern Queensland to western Victoria. Inhabits mature or old growth Box, Box-Ironbark woodlands and River Red Gum forest west of the Great Dividing Range and Blackbutt-Bloodwood forest with heath understorey in coastal areas. Prefers mixed species stands with a shrub or Acacia midstorey.	Moderate. There are only six records of this species most from the McPhersons Plain area on the Bago plateau where it has been found tangled on fences. Likely to be more widespread than currently known and suitable habitat is present in the survey area.
Mammals	*Phascolarctos cinereus*	Koala	V	V	In NSW it mainly occurs on the central and north coasts with some populations in the west of the Great Dividing Range. Inhabit eucalypt woodlands and forests. Feed on the foliage of more than 70 eucalypt species and 30 non-eucalypt species, but in any one area will select preferred browse species.	Moderate. The survey area is within the expert distribution (maybe) for this species but there are not many records from the locality with some from Talbingo, Tumbarumba and Lake Eucumbene. There may be a low density population that uses the survey area or the habitat may be used by dispersing juvenile males as there are forests dominated by some primary food tree species (*Eucalyptus viminalis*) and secondary food tree species (*Eucalyptus rubida, Eucalyptus dalrympleana, Eucalyptus nortonii, Eucalyptus bridgesiana, Eucalyptus mannifera*) present.

Type of animal	Species name	Common name	EPBC Act	BC & FM Act	Distribution and habitat	Likelihood of occurrence
Mammals	*Pseudomys fumeus*	Smoky Mouse	E	CE	The Smoky Mouse is currently limited to a small number of sites in western, southern and eastern Victoria, south-east NSW and the ACT. The Smoky Mouse appears to prefer heath habitat on ridge tops and slopes in sclerophyll forest, heathland and open-forest from the coast (in Victoria) to sub-alpine regions of up to 1800 m, but sometimes occurs in ferny gullies.	High. The survey area is within the expert distribution (maybe) for this species and it has recently been recorded in the locality during surveys undertaken for the Snowy Hydro 2.0 EIS. This species may be more widespread than currently known and there may be large areas of suitable habitat in the shrubby higher altitude Mountain Gum dominated forests in west of the survey area.
Mammals	*Pteropus poliocephalus*	Grey-headed Flying-fox	V	V	Generally found within 200 km of the eastern coast of Australia, from Rockhampton in Queensland to Adelaide in South Australia. In times of natural resource shortages, they may be found in unusual locations. Occur in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops. Roosting camps are generally located within 20 km of a regular food source and are commonly found in gullies, close to water, in vegetation with a dense canopy. Individual camps may have tens of thousands of animals and are used for mating, and for giving birth and rearing young.	Low. The closest known camp is >130 km from the survey area and there are no records of this species from the locality.
Reptiles	*Aprasia parapulchella*	Pink-tailed Legless Lizard	V	V	The Pink-tailed Legless Lizard is only known from the Central and Southern Tablelands, and the South Western Slopes. There is a concentration of populations in the Canberra / Queanbeyan Region. Other populations have been recorded near Cooma, Yass, Bathurst, Albury and West Wyalong. This species is also found in the Australian Capital Territory. Inhabits sloping, open woodland areas with a predominantly native grassy groundlayer, particularly those dominated by Kangaroo Grass (*Themeda australis*). Sites are typically well-drained, with rocky outcrops or scattered, partially-buried rocks. Commonly found beneath small, partially-embedded rocks and appear to spend considerable time in burrows below these rocks; the burrows have been constructed by and are often still inhabited by small black ants and termites.	Low. The survey area is within the expert distribution (maybe) for this species but it has not been recorded and is not known from the Bondo subregion.

Type of animal	Species name	Common name	EPBC Act	BC & FM Act	Distribution and habitat	Likelihood of occurrence
Reptiles	*Cyclodomorphus praealtus*	Alpine She-oak Skink	E	E	The Alpine She-oak Skink is endemic to NSW and Victoria, where it is restricted to sub-alpine and alpine grasslands. In NSW, the Alpine She-oak Skink has only been observed within Kosciuszko National Park between Smiggin Holes and Kiandra. The Alpine She-oak Skink has specific habitat requirements, preferring tree-less or very lightly treed areas that contain tussock grasses, low heath or a combination of both. Within this habitat the species shelters beneath litter, rocks, logs and other ground debris, and has been observed basking on grass tussocks. In NSW, Alpine She-oak Skinks have been observed in alpine to sub-alpine grasslands in flat to gently sloping areas.	Moderate. This species has a restricted distribution and prefers treeless areas but there may be some suitable habitat present in the survey area in the higher altitude areas where the following PCTs occur: · Alpine and sub-alpine peatlands, damp herbfields and fens, South Eastern Highlands Bioregion and Australian Alps Bioregion · Alpine grassland/herbfield and open heathlands in Kosciuszko National Park, Australian Alps Bioregion · Alpine shrubland on scree, blockstreams and rocky sites of high altitude areas of Kosciuszko National Park, Australian Alps Bioregion · Alpine Snow Gum - Snow Gum shrubby woodland at intermediate altitudes in northern Kosciuszko NP, South Eastern Highlands Bioregion and Australian Alps Bioregion · Black Sallee - Snow Gum low woodland of montane valleys, South Eastern Highlands Bioregion and Australian Alps Bioregion
Reptiles	*Delma impar*	Striped Legless Lizard	V	V	The Striped Legless Lizard occurs in the Southern Tablelands, the South West Slopes and possibly on the Riverina. Populations are known in the Goulburn, Yass, Queanbeyan, Cooma and Tumut areas. Found mainly in Natural Temperate Grassland but has also been captured in grasslands that have a high exotic component. Habitat is where grassland is dominated by perennial, tussock-forming grasses such as Kangaroo Grass *Themeda australis*, spear-grasses *Austrostipa* spp. and Poa tussocks *Poa* spp., and occasionally wallaby grasses *Austrodanthonia* spp. Sometimes present in modified grasslands with a significant content of exotic grasses. Sometimes found in grasslands with significant amounts of surface rocks, which are used for shelter.	Low. The survey area is outside the known distribution for this species and no records are present in the locality.

Type of animal	Species name	Common name	EPBC Act	BC & FM Act	Distribution and habitat	Likelihood of occurrence
Reptiles	*Varanus rosenbergi*	Rosenberg's Goanna, Heath Monitor	-	V	Rosenberg's Goanna occurs on the Sydney Sandstone in Wollemi National Park to the north-west of Sydney, in the Goulburn and ACT regions and near Cooma in the south. There are records from the South West Slopes near Khancoban and Tooma River. Also occurs in South Australia and Western Australia. Found in heath, open forest and woodland. Associated with termites, the mounds of which this species nests in; termite mounds are a critical habitat component. Shelters in hollow logs, rock crevices and in burrows, which they may dig for themselves, or they may use other species' burrows, such as rabbit warrens.	Moderate. This species is known from the southern Highlands and is predicted to occur in the Australian Alps bioregion. There are records from the South West Slopes near Khancoban and Tooma River. Has been recorded from the Kosciuszko National Park from peppermint dominated forest near Black Perry lookout. Large areas of suitable habitat are present in the survey area including critical habitat features such as termite mounds, rocky crevices, hollow logs, and burrows.

Distribution and habitat requirement information adapted from: Australian Government Department of the Environment http://www.environment.gov.au/biodiversity/threatened/index.html NSW Office of Environment and Heritage http://www.environment.nsw.gov.au/threatenedspecies/

Key:

CE = critically endangered

E = endangered

V = vulnerable

M = migratory

Appendix B Preliminary heritage assessment

Snowy Hydro 2.0 Transmission Connection Project

TransGrid

Preliminary Heritage Assessment

IA173900 | 2

October 2018

Contents

Tables

Figures

1. Introduction

1.1 Background

Jacobs Group (Australia) Pty Limited was commissioned by TransGrid to provide a heritage assessment in support of a Preliminary Environmental Assessment (PEA) for the construction and operation of the Snowy 2.0 Transmission Connection Project (the Project).

This assessment covers both the known and potential Aboriginal and non-Aboriginal heritage constraints for Project.

1.2 Project background

Snowy 2.0 pumped hydro and generation project (Snowy 2.0), is being proposed by Snowy Hydro Limited (Snowy Hydro) to provide up to 2000 megawatts (MW) of generation capacity and at full capacity, large-scale energy storage for about 350,000 MW hours. There is a fundamental requirement that generation plants need to be connected to the transmission network to be able to operate within the electricity market. In addition, a pumped hydro scheme requires the supply of electricity to enable the pumping of water to its reserves.

The Project need is a direct response to the proposed Snowy 2.0 and is one of the developments that form a program of works to support Snowy 2.0. Connecting Snowy 2.0 to the transmission system would result in up to 2,000 megawatts (MW) of additional generation being made available to the NSW electricity market and at full capacity, large-scale energy storage for about 175 hours (or 350,000 megawatt (MW) hours).

The Project would involve the construction and operation of new electricity transmission lines and an electricity substation to the west of the Talbingo Reservoir to connect the proposed Snowy 2.0 to the existing electricity transmission network at Nurenmerenmong, east of Tumbarumba.

The key features of the Project include:

- A new 330/500kV substation, to the west of the Talbingo Reservoir near the existing 330kV transmission line 64 (Line 64)
- Two new 330kV double-circuit transmission lines, with easements, from the connection site with the Snowy 2.0 underground cable to overhead line termination (Snowy 2.0 cable yard) to the new substation
- Transmission line connection between the 330/500kV substation and the existing Line 64
- Establishment and upgrade of access tracks and roads to the new substation and transmission line structures, as required
- Ancillary activities, including brake and winch sites, crane pads, helicopter landing pad, site compounds and equipment laydown areas.

The new transmission lines would be comprised of about 22 steel lattice towers per line (about 44 in total). Each tower would be approximately 50 metres (m) in height supporting two circuits (comprising six to twelve conductors), and two optical ground wire (OPGW). The standard easement width for 330kV transmission lines is 60 m. The transmission lines would be paralleled where possible therefore requiring an easement of up to 120 m.

The location and key features of the Project are shown in **Figure 1-1** and **Figure 1-2**.

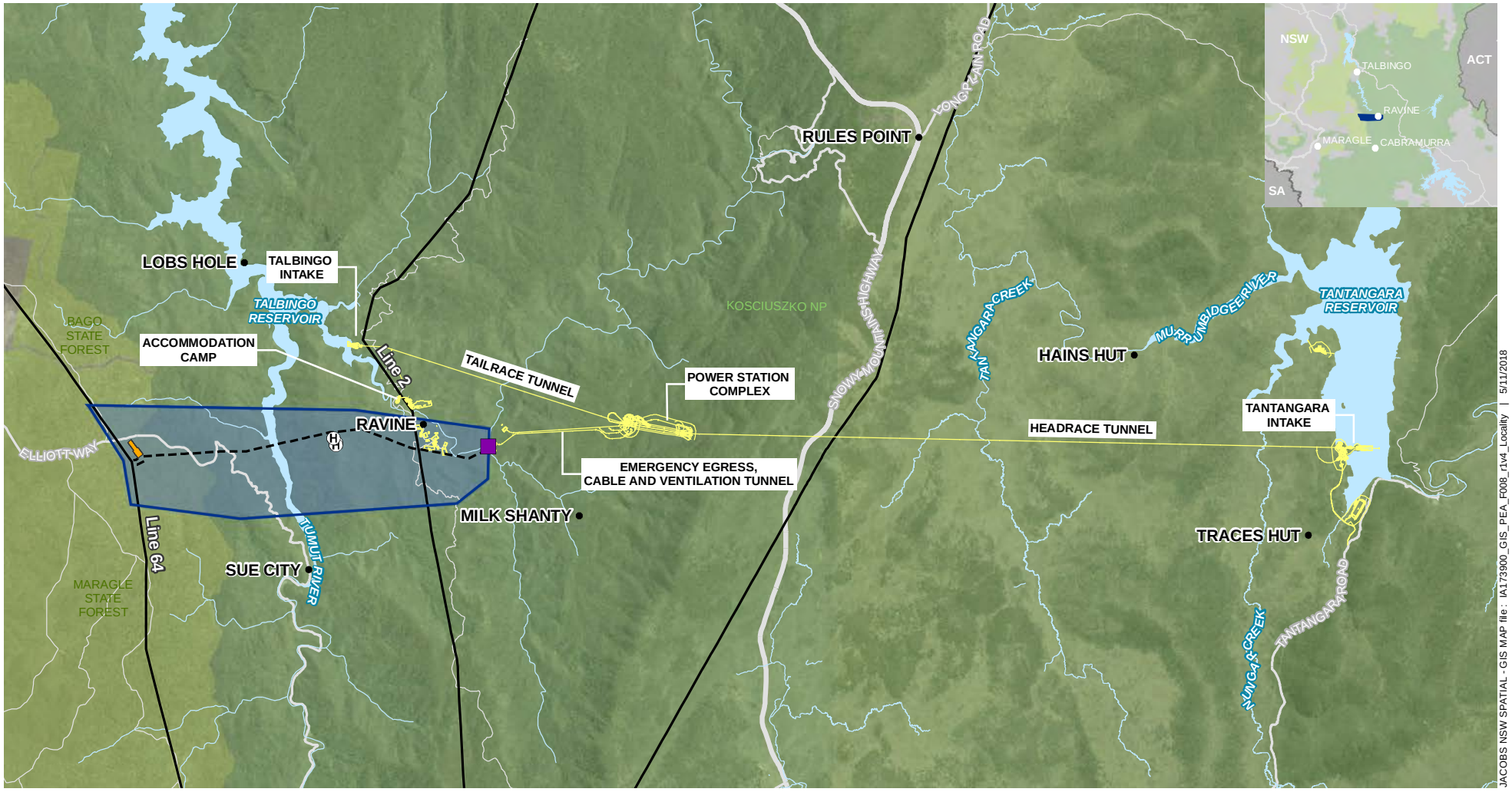


Figure 1-1 | Locality, study area, survey area and preferred option

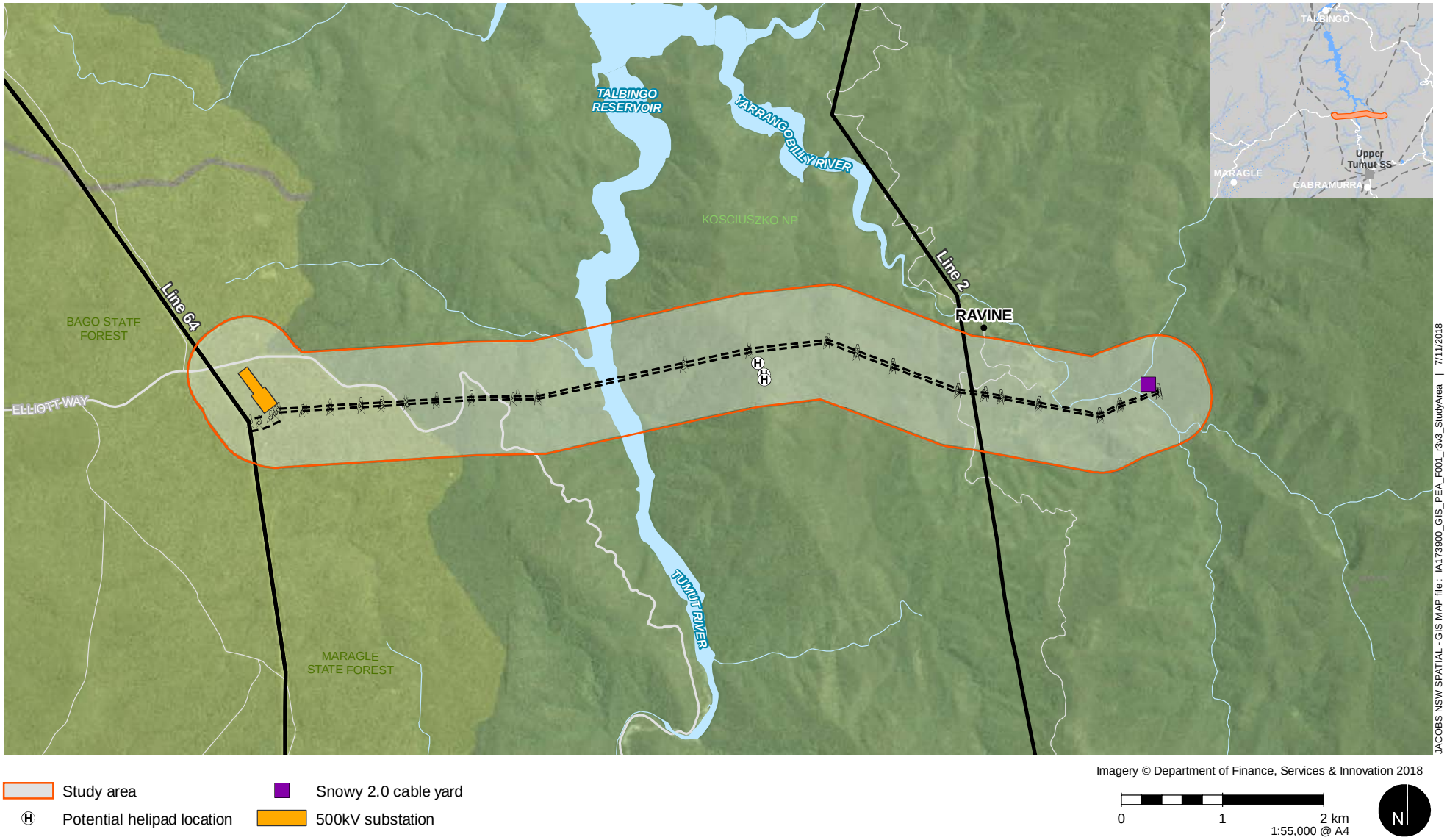


Figure 1-2 | Key components of the Project and study area

1.3 Objectives

The Snowy 2.0 and Transmission Project (where this Project is one of the developments that forms the Transmission Project) has been declared critical State Significant Infrastructure under State Environmental Planning Policy (State and Regional Development) 2011 and is subject to assessment and determination by the Minister for Planning under Division 5.2 of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

This preliminary heritage assessment has been prepared as part of the PEA. The PEA is intended to inform the preparation of the Secretary's Environmental Assessment Requirements (SEARs) for an Environmental Impact Statement (EIS) for the Project. This Preliminary Heritage Assessment also aims to fulfil the requirements of the NSW Office of Environment and Heritage's (OEH) *Due Diligence Code of Practice for the Protection of Aboriginal Objects in NSW* (DECCW, 2009) (the due diligence code) and the Australia ICOMOS *Burra Charter (The Australia ICOMOS Charter for Places of Cultural Significance)* (Australia ICOMOS, 2013).

1.4 Location and study area

The Project is located in the Snowy Valleys local government area (LGA) and within Kosciusko National Parks and Bago State Forests as shown on **Figure 1-1**.

The extent of the site and route selection study area was constrained by the location of the Snowy 2.0 cable yard in the east, and Line 64 in the west. An area between the Snowy 2.0 cable yard and potential substation locations near the existing Line 64 was investigated at a desktop level and site field surveys during preparation of the PEA.

The following areas are discussed throughout the report and are defined as:

- Study area: The study area includes the likely Project impact area base on the preferred option with a 500 metres buffer. This area includes the potential locations of a new 330/500kV substation, 120 metres-wide easement for the 330kV double-circuit transmission lines from the Snowy 2.0 cable yard to the new substation (see **Figure 1.2**). All of the ancillary activities including brake and winch sites, crane pads, helicopter landing pad, site compounds and equipment laydown areas would be within the 500 metre buffer. This will be the study area that will be assessed in the EIS.
- Survey area: The survey area is a much larger area that was investigated for the route selection process and field investigation during the preparation of the PEA. The survey area includes the study area.
- Locality: This is defined as the area within a 10 kilometre (km) radius surrounding the Project footprint.

1.5 Limitations

As noted above, this Project is proposed to be submitted as Critical State Significant Infrastructure under the EPA Act. Consequently, there is no information presented regarding potential permits required under the State heritage regimes, such as the *Heritage Act 1977* (NSW) (Heritage Act) and/or *National Parks & Wildlife Act 1974* (NSW) (NPW Act). In addition, it is noted that Aboriginal heritage legislation in NSW is undergoing reform. It is noted further that this legislation may be enacted prior to the completion of this Project.

It should also be noted that while every effort has been made to quantify and assess the recorded and potential heritage within the study area, the alpine terrain is notoriously difficult to access. Some sites may therefore not be identified until construction has commenced. It is therefore recommended that a thorough Unexpected Finds Protocol is developed for this stage of the Project to manage the heritage values within the construction zone.

1.6 Aboriginal consultation

Aboriginal consultation was not undertaken at this stage of the investigation. It is anticipated that Aboriginal consultation will be carried out in the preferred route corridor during investigations for the EIS.

1.7 Authorship

This report was prepared by Deborah Farina (Senior Heritage Consultant, Jacobs). Fieldwork was undertaken by Deborah Farina and Ildike Piercy (Senior Heritage Consultant, Jacobs). Technical reviews were undertaken by Andrew Costello (Senior Heritage Consultant, Aboriginal heritage, Jacobs) and Dr Karen Murphy (Technical Leader, Historical Heritage, Jacobs).

2. Legislative context

This legislative context contains a brief overview of applicable heritage law as relevant in New South Wales. It is intended to be general in nature and for information purposes only. Any specific questions regarding the legislation, including its operation specific to a project and any potential legal ramifications to the client as a result of this general overview, should be addressed to a qualified legal practitioner.

The protection and administration of heritage in Australia is mainly legislated by the States. There is, however, a national heritage scheme as per the *Environment Protection and Biodiversity Act 1999* (EPBC Act) which governs World, National and Commonwealth heritage. This applies to both Aboriginal and non-Aboriginal heritage.

In New South Wales, Aboriginal and non-Aboriginal heritage is administered by separate Acts. The Heritage Act administers non-Aboriginal heritage of State and/or local heritage significance. Aboriginal heritage is currently administered by the NPW Act, however new standalone legislation is currently being drafted, and is likely to be introduced to Parliament in 2019.

Other Acts also contain some heritage administrative functions, and these are outlined below.

2.1 Commonwealth Heritage Legislation

2.1.1 Native Title Act 1993

A result of the *Mabo* decision, the *Native Title Act 1993* recognises and protects native title and provides that native title cannot be extinguished contrary to the Act. The National Native Title Tribunal is a Commonwealth Government agency set up under this Act, and mediates native title claims under the direction of the Federal Court of Australia.

The National Native Title Tribunal maintains the following registers:

- National Native Title Register
- Register of Native Title Claim
- Unregistered claimant applications.

In areas where Native Title has been recognised, consultation with the Native Title holder under State legislation, such as the NPW Act, is mandatory.

No known native title claims are active within the study area.

2.1.2 *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) includes 'national heritage' as a Matter of National Environmental Significance and protects listed places to the fullest extent under the Constitution. It also establishes the National Heritage List (NHL) and the Commonwealth Heritage List (CHL).

The following is a description of each of the heritage lists and the protection afforded places listed on them.

2.1.2.1 Commonwealth Heritage List

The Commonwealth Heritage List (CHL) is established under the EPBC Act. The CHL is a list of properties owned by the Commonwealth that have been assessed as having significant heritage value. Any proposed actions on CHL places must be assessed for their impact on the heritage values of the place in accordance with *Actions on, or impacting upon, Commonwealth land, and actions by Commonwealth agencies (Significant Impact Guidelines 1.2).* The guidelines require the proponent to undertake a self-assessment process to decide whether or not the action is likely to have a significant impact on the environment, including the heritage value of places. If an action is likely to have a significant impact an EPBC Act referral must be prepared and submitted to the Minister for approval.

2.1.2.2 National Heritage List

The National Heritage List (NHL) is a list of places with outstanding heritage value to Australia, including places overseas. Any proposed actions on NHL places must be assessed for their impact on the heritage values of the place in accordance with *Matters of National Environmental Significance (Significant Impact Guidelines 1.1).* The guidelines require the proponent to undertake a self-assessment process to decide whether or not the action is likely to have a significant impact on a matter of National Environmental Significance, including the national heritage value of places. If an action is likely to have a significant impact an EPBC Act referral must be prepared and submitted to the Minister for approval.

2.1.2.3 Register of the National Estate

The Register of the National Estate (RNE) was formerly compiled as a record of Australia's natural, cultural and Aboriginal heritage places worth keeping for the future. The RNE was frozen on 19 February 2007, which means that no new places have been added or removed since that time. From February 2012 all references to the RNE were removed from the EPBC Act. The RNE is maintained on a non-statutory basis as a publicly available archive.

2.2 New South Wales Heritage Legislation

2.2.1 National Parks and Wildlife Act 1974

The NPW Act is the primary Act governing Aboriginal heritage in NSW. The operative section of this Act is Part 6 (sections 81-90) and lists a number of offences regarding Aboriginal heritage. It also has grades of offences, with penalties dependent upon whether the offender is an individual or a company, with companies facing much heavier penalties.

Section (s) 86 of the Act makes it an offence to harm or desecrate Aboriginal objects and places. Unlike earlier Aboriginal heritage legislation, s86 is a strict liability offence, meaning that the prosecution does not need to prove intent or knowledge that the object or place was an Aboriginal object or place. Penalties for contravention of s86 for an individual is 2,500 penalty units (currently $275,000) or imprisonment for a year, or both (maximum sentence), while a corporation is fined 10,000 penalty units ($1.1 million). In the case of an individual, if circumstances of aggravation are proved then the fine and/or custodial sentence is doubled. Circumstances of aggravation are interpreted as the offence being committed in the course of carrying out a commercial activity or if the offence was the second or subsequent occasion on which the offender was convicted under s86.

Defences to s86 are provided in s87. One defence is if the harm was authorised by an Aboriginal Heritage Impact Permit (AHIP) (s90) and that all conditions were not contravened. If the offender can prove that they exercised due diligence, then this is another listed defence, as is the compliance with regulations (clauses. 80A-80B, National Parks & Wildlife Regulation 2009).

In addition, the *National Parks and Wildlife Regulation 2009* contains two standard defences to s86. Clause 80A can be invoked if the offender prepared an Aboriginal Heritage Due Diligence Assessment (*Due Diligence Code of Practice for the Protection of Aboriginal Objects in NSW* published by OEH (as the Department of Environment, Climate Change and Water, 2010) that concluded there was little to no potential for an Aboriginal object to be harmed by the proposed works. Such a due diligence assessment must be prepared in satisfaction of the Due Diligence Code of Practice as a minimum standard. If an industry Code of Practice has been prepared which exceeds the requirements of the Due Diligence Code of Practice, then that Code must be preferred. Clause 80B also provides a number of "low impact activities" that are deemed to not be activities requiring a due diligence assessment. Most of these activities must be conducted on disturbed ground to be triggered. Under both clauses 80A and 80B, proof that these investigations have been carried out must be produced to successfully invoke these standard defences.

If the due diligence assessment finds that there is a real risk that the proposed works will impact on an Aboriginal object or place, an AHIP under s90 of the NPW Act would normally be required. An AHIP is not required for approved State Significant Infrastructure or any investigative or other activities that are required to be carried out for the purpose of complying with any environmental assessment requirements in connection with an application for approval to carry out the State Significant Infrastructure.

The State Government is currently drafting standalone legislation for Aboriginal heritage. It is currently expected to be operational by 2019.

2.2.2 Environmental Planning and Assessment Act 1979

The EP&A Act requires that environmental impacts are considered in land-use planning, including impacts on Aboriginal and non-Aboriginal heritage. Division 5.2 of the EP&A Act applies for projects designated as State Significant Infrastructure and critical State Significant Infrastructure. This influences the way in which other legislation, including the Heritage Act and NPW Act is applied.

2.2.3 Heritage Act (NSW) 1977

The Heritage Act provides a number of mechanisms by which items and places of heritage significance may be protected. The Act is designed to protect both listed heritage items, such as standing structures and potential archaeological remains or relics. Different parts of the Act deal with these different situations.

Approvals under Part 4 or an excavation permit under s139 of the Heritage Act are not required for an approved project under Division 5.2 of the EP&A Act, however, this assessment follows the intent of the Heritage Act and the conditions of the approval which are based upon the Heritage Act requirements.

2.2.4 State Heritage Register

The Heritage Council of NSW maintains the State Heritage Register (SHR). Only those items which are of state-level heritage significance in NSW are listed on the SHR. Listing on the SHR controls activities such as alteration, damage, demolition and development.

Approved projects to which Division 5.2 of the EP7A Act applies do not require approval under Part 4 of the Heritage Act (e.g. a Section 60 approval) for items on the SHR. However, Division 5.2 projects must outline proposed heritage management and mitigation measures.

2.2.5 Archaeological relics

Part 6 Division 9 of the Heritage Act protects archaeological 'relics' from being 'exposed, moved, damaged or destroyed' by the disturbance or excavation of land. This protection extends to the situation where a person has 'reasonable cause to suspect' that archaeological remains may be affected by the disturbance or

excavation of the land. It applies to all land in NSW that is not included in the SHR. A 'relic' is defined by the Heritage Act as:

> *"Any deposit, object of material evidence which relates to the settlement of the area that comprises NSW, not being Aboriginal settlement, and has local or state significance".*

Section 139 of the Heritage Act requires any person who knows or has reasonable cause to suspect that their proposed works will expose or disturb a 'relic' to first obtain an Excavation Permit from the Heritage Council of NSW (pursuant to Section 140), unless there is an applicable exception (pursuant to Section 139(4)). In cases where a Section 139 permit is not required for projects assessed under Division 5.2 of the EP&A Act, works would need to be conducted in accordance with the intent of the Heritage Act.

Section 146 of the Heritage Act requires that any person who is aware or believes that they have discovered or located a relic must notify the Heritage Council of NSW, providing details of the location and other information required.

2.3 Other considerations

2.3.1 Kosciuszko National Park Plan of Management 2006

Although holding legislative force, this Plan of Management was prepared by OEH (then known as the Department of Environment & Conservation (DEC)), as part of its legislative obligations to National Parks in New South Wales under the NPW Act. The Plan of Management sets out the park's known environmental values and sets out strategies to manage foreseeable and potential impacts on its unique environment. One of the acknowledged values is Aboriginal heritage. In addition, separate requirements are set out for the Snowy Hydro scheme as well as the standards required for surveys and assessments within the Kosciuszko National Park.

Management Objective 7.01 states its aim as:

> *The cultural heritage values of the park are protected and managed in a strategic, comprehensive and integrated way*.

In protecting and managing these heritage values, the following policies and actions are listed:

- Conserve the cultural values of the park in accordance with the Australian ICOMOS Charter (2013)
- Ensure the relative levels of significance are the overriding consideration in management of particular cultural landscapes, places or objects
- Acknowledge the inseparability of natural and cultural values
- Lessees to be responsible for the assessment, management and maintenance of the cultural values located within their lease areas in accordance with the management strategies prescribed elsewhere in the plan (the Snowy Mountain Management Plan for the Snowy Mountain Hydro).

Under this Plan of Management, the following expectations are made of the Snowy Hydro Ltd:

- All Snowy Hydro Limited operations will be consistent with the objectives, policies and actions contained in this plan. This plan includes the Snowy Management Plan as set out in Schedule 1 of the Snowy Management Plan Procedures Agreement dated 30 June 2002
- The development and implementation of a Snowy Environmental Management Plan for areas occupied by Snowy Hydro Limited will be in accordance with the objectives outlined in the Snowy Management

Plan Procedures Agreement. (The Environmental Management Plan will fulfil the company's obligation under this plan to prepare an environmental management system – this appears to have been done)

- Any proposed amendments to the Snowy Management Plan or related documents will be consistent with this plan
- Permit the use of over-snow vehicles for essential management operations
- Permit the landing of aircraft for approved management purposes.

3. Heritage context

3.1 Environmental context

3.1.1 Geomorphology

The Australian Alps Bioregion is the highest part of the Great Dividing Range and contains Australia's highest mountain, Mount Kosciuszko. The topography of the locality is best described as steep to very steep (>18°) hills and mountains, interspersed with sharply incised valleys.

The Australian Alps seem to be the only region in mainland Australia affected by the Pleistocene glaciation and therefore contains a number of glacial and periglacial landforms above 1,100 m, including karsts. Volcanic activity in the Tertiary period produced basalts in the Cabramurra-Kiandra region (Office of Environment & Heritage, 2016).

West of the Tumut River the landscape is described as a west-tilted plateau (Kiandra Tableland) with marginal drainage dissection (Abell, 1998). East of the Tumut River is the Snowy Mountains National Park, also known as the Kosciuszko National Park.

Cabramurra, the highest settlement in Australia, is also the nearest settlement to the Project and is located at an elevation of 1482 m above sea level.

3.1.2 Geology and soils

The geology of the locality is varied. The eastern study area, in the area of the Snowy Hydro Ravine site, is chiefly made up of conglomerate, with sandstone and siltstone, laid down in the Silurian Period (443 – 416 million years ago). There are small lenses of later Devonian Lick Hole Limestone (limestone and shale; 419-358 million years ago). The western study area is mainly granite (Silurian I-S trans-type granite) with quartz, feldspar muscovite and biotite inclusions (Adamson, 1966).

As with the geology, the soils of the locality are varied dependent on landform. Silurian geology generally had the Cabramurra soil profile, comprising red earths with sandy and clay loam textures that occur on upper slopes and red/yellow earths on lower slopes. These soils usually occur on elevated, undulating to rolling low hills and rises in the eastern highlands, with slopes of <20% gradient and elevations of 700-1253 m. Also present was Cabramurra variant A, a colluvial soil found on elevated, moist, steep hills on granite and grandoriorite on slopes with a greater than 30% gradient and an elevation of 700-1286 m. Rock outcrops are rare and generally deep. The soils are generally red and brown earths/structured red earths, with sandy loam and clay loan textures. Erosion was noted on poor constructed or maintained forest tracks (Office of Environment & Heritage, undated).

The soils and geology of the area indicate that there was sufficient raw material for exploitation by past Aboriginal communities. The depth of soils also indicates that there is potential for subsurface archaeological deposits to be present.

3.1.3 Flora and fauna

Due to the diversity of landscapes within the locality, the native vegetation is also variable. The study area is highly vegetated being within the Kosciuszko National park and the Maragle and Bago State Forests. While the locality is highly vegetated, it is not without disturbance. There is a long history of human use in the area, and disturbance in the form of logging, farming, habitation, tourism, and infrastructure development and maintenance can be found.

Due to the large extent, variability and generally high quality of the habitats in the Kosciuszko National Park, Maragle State Forest and Bago State Forest, many threated fauna and flora species are known to occur or are considered likely to occur. This includes species listed under both the *Biodiversity Conservation Act 2016* (BC Act) and EPBC Act. The unique biodiversity of this region indicates a favourable habitat supporting plant and animal species for hunting and gathering by past Aboriginal communities.

3.1.4 Hydrology

The corridor is watered by a number of natural watercourses, both permanent and ephemeral. Major water sources include Tumut River, and tributary creeks that feed into Yarrangobilly River in the Snowy Ravine portion of the corridor. The preferred route crosses the Tumut River portion of the Talbingo Reservoir, refer to **Figure 1 1**. The hydrology of the area indicates that there were sufficient sources of water to support Aboriginal habitation.

3.1.5 Climate

The mean monthly minimum and maximum temperatures at the nearest representative weather station at Cabramurra range from -0.9°C – 3.8°C (July) to 11.5°- 21.5°C (January). Mean monthly rainfall is heaviest in August, at 129.5 mm, and lightest in January at 59.3 mm (Bureau of Meteorology, 2018).

These monthly climate statistics indicate a very cold winter with precipitation either in the form of rainfall or snow, with mild, moderately wet summers. Whilst the winters may have made habitation uncomfortable, the summer months indicate comfortable temperatures for habitation. This seasonal use of the area by Aboriginal people is borne out by historical ethnographic data (see **Section 3.2.1** below).

3.1.6 Existing environment

The Project is located in a remote mountainous region mostly within the Snowy Mountains National Park, characterised by dense vegetation and rocky outcrops.

The nearest settlement to the study area is Cabramurra, located approximately 20 kilometres to the south. The rugged landscape and paucity of facilities means that it is accessed mostly by campers, hikers and other such outdoor enthusiasts.

Other disturbances have resulted from the construction associated with the original Snowy Mountains Scheme, including the damming of the Talbingo River. High voltage power lines are also present within the landscape. It is possible that other sites exist within the study area associated with the Snowy Mountains Scheme such as temporary camp sites for workers and/or compounds for construction equipment.

Overall, owing to access and the topography, the areas of greater disturbances are located in the valleys and lower slopes, with the ridges and upper slopes subjected to less disturbance.

3.1.7 Australian Historic Themes

In 2001 a framework of historic themes was developed by the Australian Heritage Commission, grouping historic sites into themes and sub-themes. It was envisaged that these themes would allow historians and other professionals to fully explore the history of an area or place and to identify historical processes, events, activities and people associated with that area or place (Australian Heritage Commission, 2001:6).

As can be seen from the identified themes presented in **Table 3.1**, much of the non-Aboriginal history of the locality is related to the natural landscape as well as the Snowy Mountains Scheme.

Table 3.1 : Australian Historic Themes for the corridor

Theme	Sub-Theme	Sub-sub-themes/Notes
1. Tracing the evolution of the Australian environment	1.1 Tracing climatic and topographical change	The Snowy Mountains Region has a unique place in mainland Australia's landscape and was the only area to be affected by the Pleistocene glaciation.
	1.3 Assessing scientifically diverse environments	The diversity of the Snowy Mountains landscape is directly correlated with its abundance of unique flora and fauna; some species are only found in this part of mainland Australia.
	1.4 Appreciating the natural wonders of Australia	This diversity of landscape and environment has led to its popularity with visitors, particularly in winter.
2. Peopling Australia	2.1 Living as Australia's earliest inhabitants	The Snowy Mountains were within the traditional lands of the Ngarigo people, who lived in or near the lower slopes and/or nearby tablelands all year round. The alpine country is an important area for many southern Aboriginal countries because of the Bogong moth festivals held here every year.
	2.2 Adapting to diverse environments	Because of the often-harsh climate and low resources, both Aboriginal and non-Aboriginal people needed to adapt to their surroundings to survive.
	2.4 Migrating	2.4.4 Migration through organized colonization
	2.5 Promoting settlement	
	2.6 Fighting for land	2.6.1 Resisting the advent of Europeans and their animals
		2.6.2 Displacing indigenous people
3. Developing Local, Regional and National Economies	3.3 Surveying the continent	3.3.2 Looking for overland stock routes
		3.3.3 Prospecting for precious metals
		3.3.4 Looking for land with agricultural potential
	3.4 Utilising natural resources	3.4.1 Hunting
		3.4.2 Mining
		3.4.4 Making forests into a saleable resource
		3.4.5 Tapping natural energy sources
	3.5 Developing primary production	3.5.1 Grazing stock
	3.6 Recruiting labour	
	3.7 Establishing communications	3.7.1 Establishing postal services
		3.7.2 Developing electric means of communication
	3.8 Moving goods and people	3.8.7 Building and maintaining roads
		3.11.1 Regulating waterways

Theme	Sub-Theme	Sub-sub-themes/Notes
	3.11 Altering the environment	3.11.2 Reclaiming land
		3.11.5 Establishing water supplies
	3.12 Feeding people	3.12.1 Using indigenous foodstuffs
	3.14 Developing an Australian engineering and construction industry	3.14.1 Building to suit Australian conditions
		3.14.2 Using Australian materials to construction
	3.16 Struggling with remoteness, hardship and failure	3.16.1 Dealing with hazards and disasters
	3.22 Lodging people	
	3.23 Catering for tourists	
4. Building Settlements, Towns and Cities	4.1 Planning urban settlements	4.1.1 Selecting township sites
	4.2 Supplying urban services (power, transport, fire prevention, roads, water, light and sewerage)	
	4.5 Remembering significant phases in the development of settlements, towns and cities	
5. Working	5.1 Working in harsh conditions	5.1.2 Coping with dangerous jobs and workplaces
8 Developing Australia's Cultural Life	8.14 Living in the country and rural settlements	

3.2 Aboriginal heritage context

This investigation has been designed to conform with the NSW Due Diligence Code, which aims to assess the extent and potential of Aboriginal heritage within an area, and the level of harm that is posed by any proposed works which will require an AHIP. Given that this investigation is to inform a PEA, the assessment of harm is confined to foreseeable but presumed impacts, which will be assessed further in future stages of the Project.

3.2.1 Cultural context

As with all information regarding pre-contact Aboriginal culture, accounts were mostly written by European settlers with a varied level of understanding of Aboriginal people. Their observations, and our current understanding of Aboriginal culture, must therefore be viewed through that prism.

Language groups identified within the Snowy Mountain region included Walgal and Ngarigo (Tindale 1974). The Project is believed to be within the country of the Walgal people, whose lands occupied the northern

part of the Australian Alps, near Kiandra. The Ngarigo, on the other hand, ranged over the Monaro Tableland region, from around Queanbeyan in the north and extending south just past the modern Victorian border, east to Nimmitabel and west to the Australian Alps. Known as the mountain people, during the winter months both the Walgal and Ngarigo people would forage in the lower montane forests and on the tableland, although the harsh and unpredictable weather meant that food sources were scarce. Some fauna, such as wombats and possums, were sometimes available, as were some edible tubers and rhizomes, however these were not as palatable at this time of year. (Mulvaney and Kamminga 1999). In particular, the daisy yam (*Microseris lanceolata*) would have constituted a primary reliable staple collected as part of the women's food gathering activities. Moreover, honey from the hives of stingless bees and mana (sugary exudate) from the Manna Gum, Red Spotted Gums and Candlebark also provided subsistence and medicinal resources (Mulvaney and Kamminga 1999).

The toolkit of the Walgal people was described by Flood as containing several types of spears, including a 'death spear' tipped with stone barbs (Flood, 1980:51). Johnson and Paton include wooden clubs, grinding stones, scrapers, bone points and sharp-edged cutting tools (Johnson and Paton, 2000:6)

Cultural group division appears to be somewhat mediated according to relative seasonality in the Mountain region. During the summer months, several bands joined together for ceremonial and initiation purposes. The Ngarigo people would be joined in October by their neighbours to the north, the Ngnunawal and the Jaitmatang, as well as the Yuin people from the coast. These annual ceremonies provided opportunity to solidify political, social and religious connections between the tribes. There were two ceremonial grounds, one at Jindabyne and another at Wollondibby Valley, where disputes were settled, marriages made and young men initiated (Mulvaney and Kamminga 1999).

To facilitate the annual convergence of these tribes several routes to and from the mountains are evidenced by archaeological material. Prehistoric camps are littered across the expanse of the Thredbo Valley. In particular, excavations of the flats above the river uncovered thousands of artefacts (Mulvaney and Kamminga 1999). The groups would then disband to favoured campsites in the high country for the highlight of this gathering - the Bogong moth (*Agrotis infusa*) feasts. These protein-rich insects migrate every year in the spring from northern New South Wales and settle in the caves of the Snowy Mountains, where they would be harvested and roasted (Mulvaney and Kamminga, 1999:298). Considered a delicacy by early Aboriginal people, the migration of the moths during the summer led to intensified harvesting for the preparation of cakes composed from the insects. This was an exclusive male-related activity and strongly suggests correlation to the ceremonial practices as a 'communal food' (Bowdler 1981). Despite early settlers' exaggeration of the contribution of the moths to the diet, the Bogong moths most likely only party contributed to wide range seasonally mediated subsistence strategy utilised by the Aboriginal groups of the Mountains.

Accounts also indicate that fire was used for resource management by Aboriginal people in the Snowy Mountain region. An account by surveyor by the name of Thomas Townsend in 1846 recounts how many of the areas he surveyed in the Snowy Mountain region were burnt. Researchers have also postulated that fire management was utilised to smoke out the Bogong Moths as part of the summer ceremonial activities (Independant Scientific Committee 2004).

3.2.2 Post-contact history

In the subsequent years following European settlement, the already sparse food supplies during the winter months diminished substantially. The effects of this were compounded by isolation from some of the most resource abundant grassland and the disbandment of many inter-tribal ceremonial and social networks. By 1835, Lhotsky said of the Ngarigo:

> *Of the tribes of the natives, which visit this hut sometimes to the number of sixty and seventy, I heard the following: the Menero* (Monaro) *tribe is very weak, consisting of about fifty men* (Sneddon, 1994:124).

Charles Sturt, however, visited the Tumut Valley ("the Dumot river") in 1828 and found it "better peopled" than the Murrumbidgee Valley, and considered it being "little inferior to the (Morumbidgee) either in size or in the rapidity of its current" and that it watered "a finer country, the principal rock-formation upon it being of limestone and whinstone" (Sturt, 1834:25).

By the 1850 European commodities superimposed most of the traditional Aboriginal economy of the area and the only sustainable option to many Aboriginal people was to be to adapt to European practices (Officer 1989). From 1823, Aboriginal men acted as guides to Pastoralists through the mountains and later engaged as stockmen an brumby runners (Context Pty Ltd 2015). However, this alongside European introduction of diseases slowly diminished much of the local Aboriginal population of this area.

3.2.3 Aboriginal Heritage Information Management System (AHIMS)

An extensive search of the AHIMS database maintained by OEH was undertaken on 18 January 2018 and updated searches were carried out in July and October 2018. The search yielded 39 sites within the survey area. A breakdown of these previously recorded sites within the survey are is provide in **Table 3.2** and shown on **Figure 3-1**.

Table 3.2 : AHIMS results

Site types	Number	Percentage
Non-specified artefact scatters (unknown number of artefacts)	31	79.5
Potential archaeological deposits (PAD)	6	15.4
Resource gathering site	2	5.1
TOTALS	**39**	**100%**

The above AHIMS results show that the most dominant site type is overwhelmingly artefact sites, either in isolation or together with other artefacts (n=31, 79.5%). Potential archaeological deposits indicate areas of undisturbed terrain and/or intact soil profiles that are sufficiently close to water and food resources that have the potential to yield archaeological items, such as stone artefacts. There is a relatively high number of PADs in the searched area (n=6; 15.4%), reflecting the relatively undisturbed nature of the landscape.

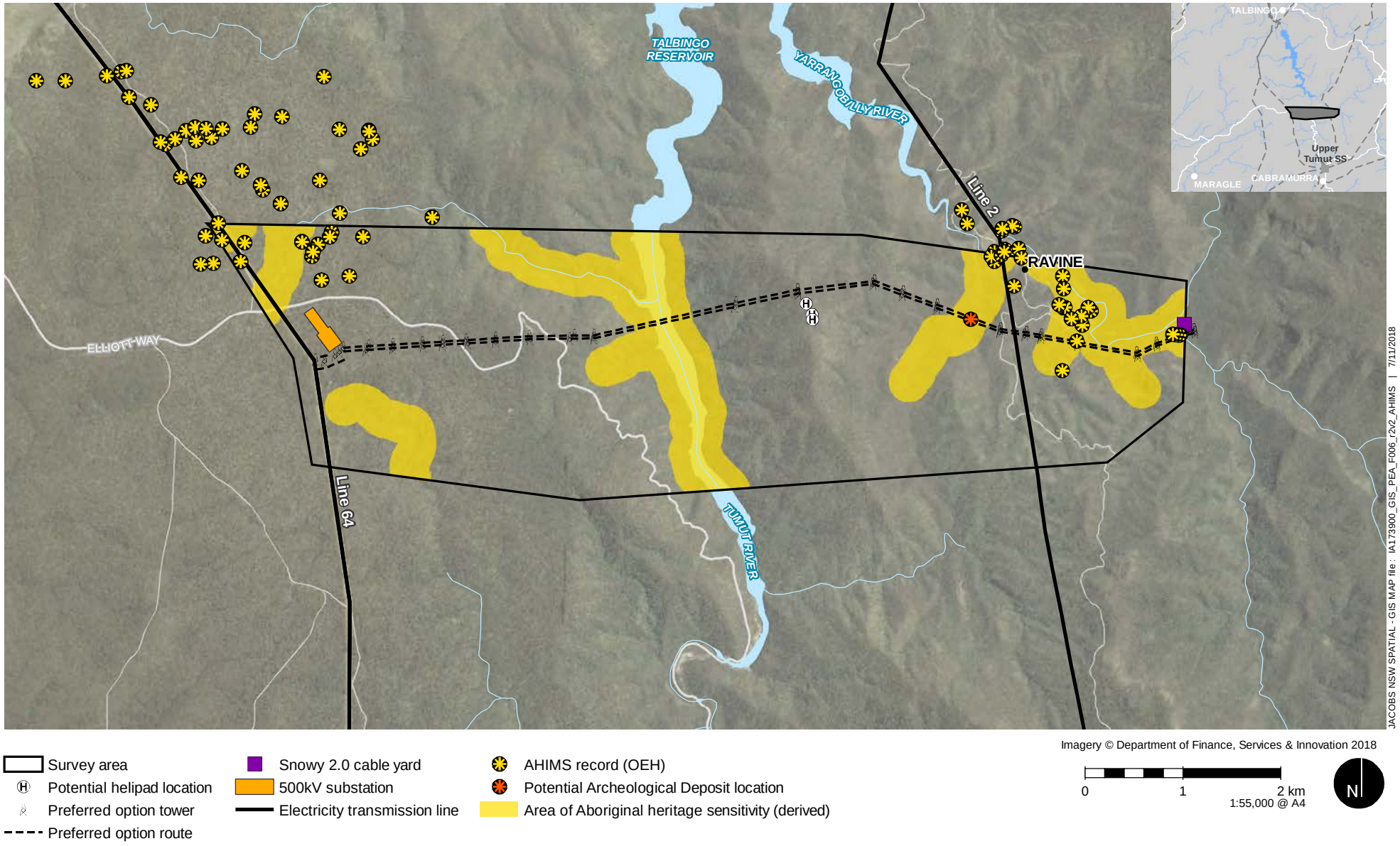


Figure 3-1 | AHIMS records and areas of Aboriginal sensitivity

3.2.4 Literature review

Johnson, 1991, Kosciuszko Baseline Assessment

This extensive baseline heritage study was prepared on behalf of the National Parks & Wildlife Service (NPWS) in order to systemize existing knowledge and to provide recommendations for its management of archaeological resources. The investigation included a desktop assessment, designation of archaeographic zones, an assessment of the "Moth Hunter" hypothesis, and recommendations for its future management.

Following a desktop assessment incorporating several weeks of background research, eight "archaeographic" zones were identified: Northern woodland/dry forests, Northwest woodland/forests, Western wet forests, Alpine, southern forests, frost hollows/coolamon, Eastern forests and Byadbo. Sampling programs were based on the geographic characteristics of the archaeographic zones.

According to Johnson's investigation, the current Project is broadly within the north west woodland/forest, with the eastern margins within the zone described as "frost hollows". The descriptions for these zones are:

North west woodland/forest: steep valleys draining into the Tumut region. The western side has generally low altitudes, ranging from 400-1000 m, with the elevation increasing towards the east and south, reaching alpine levels in the far south of the zone. The topography is described as "very rugged" with slopes exceeding 10°. The geology in the zone is varied owing to the meeting of the Gilmour and Long Plain fault zones in the area, as are the soils. Vegetation also varies, with some areas totally cleared, to some areas in the south of the zone only suitable for subalpine stands and grasslands with the occasional tall forest in protected gullies. The climate is described as having only light winter snows, with an annual precipitation of 483-660 mm per year. Lobs Hole, however, was described as having a "very warm microclimate". Water is available at most times, even in creeks at higher altitudes, however the steep slopes with cliff lines and dense forest restricts accessibility away from the major creeks. In 1991 there were only a few sites recorded near Talbingo Reservoir. There is a basalt quarry known in the Fiery Range area (Yarrangobilly). River cobbles provide a variety of stone resources, and the range of environments in the zone provides a corresponding variety of animal and vegetable resources (p.58).

"Frost Hollows": The topography in this zone is described as "gentle, although between 1000 m and 1400 m above sea level. Slopes are moderate and are generally less than 6°. The geology contains limestone karst, overlaid by sandy, well-drained soils. Valleys in these areas mostly comprise grasslands and bogs owing to the extreme cold. Ridge tops and upper hill slopes, above the cold are and severe frosts, are generally open woodland or dry sclerophyll forests. Although there are a number of recorded sites in this zone, owing to the climate they are expected to be sparse and located along the tree line. The bogs prevalent in the area provide numerous sources of water, and the grasslands provide easy access to both the Tumut Valley to the north west and east to the Monaro.

The topography, climate and vegetation observations for the relevant archaeographic zones in Johnson's 1991 study conforms with the results of independent searches performed as part of this study. Fieldwork for Johnson's investigation comprised a three-week program of survey that targeted all eight archaeographic zones. A total of 80 artefact scatters were identified during that time, with 1,400 artefacts recorded. In all cases these artefacts were confined to areas of ground visibility and exposure – tracks and fire trails, sheet erosion and areas subjected to burning. Raw materials showed strong spatial patterns, with black chert prevalent in the northwest section of Kosciuszko National Park and Silcrete more prevalent in the Jindabyne and Lower Snowy River areas. Johnson suggests that further studies regarding distribution, metrical and technological variations may give insights to routes of communication in past Aboriginal communities.

However, Johnson concludes that his methodology of comparing their assemblages to those conducted previously was "a mistake" owing to the various standards previously used in the classification of some artefact types. Johnson recommended that NPWS should develop and publish standards for survey

coverage and artefact attributes to standardize the recording of Aboriginal artefacts in order to provide more meaningful outcomes when comparing datasets from different studies. Johnson also recommended that detailed recording and sourcing studies should also be conducted in the Ravine area. It is unknown whether this recommendation was ever followed by NPWS, however no such report was identified during searches of their reports database during this investigation.

Overall, in his testing of the results of previous archaeological investigations in the Kosciuszko National Park, Johnson concluded that these had largely been "optimistic in the interpretation of sketchy and biased data" (p 5). Johnson further states that previous site interpretations had been based on social/cultural information rather than archaeological evidence (*ibid*).

Johnson and Paton, 2000, An Archaeological Investigation of Access Tracks to Transmission Towers on the Cabramurra to Goobarragandra 02 Feeder Line

This investigation was undertaken on behalf of TransGrid ahead of the proposed upgrading of access tracks to transmission towers in Kosciuszko National Park. The study area for this investigation ran from Cabramurra in the south to Goobarragandra in the north, with Section 1 of this study area passing through the Lobs Hole/Ravine area.

There were 17 tower sites within this investigation with their associated tracks to be upgraded, with four being located within Section 1. It was noted that the terrain was steep and rugged, with Aboriginal archaeological sensitivity designated as low. Soils within the vicinity of the four towers in this section were noted to be gravelly, with minimal erosion. The assessment noted further that the tracks themselves were highly disturbed having been cut directly into steep slopes, reducing the probability of artefacts being encountered.

This investigation noted that there were eight previously recorded sites within the Cabramurra-Yarrangobilly (Section 1). It notes that these sites are clustered on relatively flat ground along the Yarrangobilly River. This broadly reflects the results of the AHIMS search conducted as part of this investigation (refer to **Figure 3-1)**. Johnson and Paton also note that the sites correlated with the terrain, in that steep terrain had few sites, whilst level terrain, such as along rivers and creeks, and on plateaus on the tops of ridges and spurs, contained the greatest number of sites. No new sites were identified during survey.

It was concluded that as the areas of impact were along previously disturbed tracks and transmission towers in rugged terrain, it was unlikely that any archaeological deposits would be disturbed as a part of these works.

Alpin, K, Ford, F, and Hiscock P, 2010, Early Holocene Human Occupation in the Southeast Australian Alps: New Evidence from the Yarrangobilly Plateau, New South Wales

This investigation was an academic reporting of the results of a set of archaeological excavations in the caves at Yarrangobilly, approximately 15 kilometres north east of the Project, within the Kosciuszko National Park. The authors note that although the natural history of the Alps region is well established, at least since the last glaciation (c.16,000 years BP), the archaeological record is less clear. Archaeological investigations show that human activity in the area above 1000 m elevation mainly dates back to the late Holocene (c.4,000 years BP). In the 1970s, Flood found only sparse artefact scatters above 1,200 m. This was viewed as an enigma given the ethnographic information relating to the exploitation of the Bogong moths.

However, excavations undertaken in a cave at Yarrangobilly (Site Y259), located at 1,100 m above sea level (asl) near the Yarrangobilly cave complex, appears to contradict existing archaeological evidence. The remains of Bogong moths were noted during the excavations, indicating this cave as one of the areas the moths would congregate during their summers in the high country, although the moths generally preferred

shelters above 1,400 m asl. Y259 was first excavated by Drummond in 1963, who reported “many thousands of bones”, which were collected. Analysis showed the bones to derive from mammalian fauna.

Alpin et al excavated a 1m² pit in the area that appeared to contain the most number of bones, at the south of the cave, in arbitrary two centimetre spits owing to the homogenous sediment. This homogeneity was consistent throughout the trench, with the exception of a layer of brecciated deposit in spit 6. All sediment was bagged and transported to a laboratory for analysis, together with a subsample of the brecciated deposit, retrieved for separate analysis.

The assemblage contained a group of faunal remains belonging to those deposited by owls, who were known to roost in the higher levels of the cave. These comprised small, nocturnal animals and made up the bulk of the total assemblage. However, at units II and III were bones interpreted as being prey deposited by humans. These were mainly larger animals such as wallabies, not hunted by owls, with some evidence of heat treatment such as cooking or post-discard burning. Other potential causes of the presence of the burnt bone, such as bones burn by bushfire being washed into the cave, were discarded as a likely scenario because the bones lacked rounding of edges usually present in such overland transport, and because the heat that the bones were subjected to exceeded that normally expected of bushfire, evidenced by the calcination of the bones. A more likely cause is that of being burnt in or near a hearth. The team concluded that the faunal and charcoal remains indicate habitation of the cave from around 9,700-9,120 years cal. BP, placing it in the early Holocene period rather than the late.

3.3 Non-Aboriginal Heritage

This section outlines the non-Aboriginal (historic) heritage items and values present within and near to the survey area. See **Figure 3-16** for locations of listed items of non-Aboriginal heritage significance.

3.3.1 Heritage register searches

There are a number of databases which catalogue significant heritage items. At the National level, the Department of Environment and Energy administers the Australian Heritage Database (AHD) for World, National and Commonwealth Heritage. A search was undertaken of the Australian Heritage Database, administered by the Federal Department of Environment and Energy, on 19 January 2018 for items of world heritage significance. No heritage items of world significance were identified.

3.3.1.1 National/Commonwealth Heritage

A search was undertaken of the Australian National Heritage database on 19 January 2018 for items of National and/or Commonwealth heritage significance. Two items of National significance were identified (**Table 3.3**) with in the study area.

Table 3.3 : Items of National or Commonwealth significance

Item Name	Address	Listing	Within study area
Australian Alps National Parks and Reserves	The Alpine Way, Thredbo	NHL – listed place	Partially
Snowy Mountains Scheme	-	NHL – listed place	Partially

3.3.1.2 Register of National Estate

A search of the Australian Heritage Database was undertaken on 19 January 2018 for items on the former RNE, with two results. It should be noted that unless registered on other lists/databases, there is no legislative protection for these items under the RNE.

Table 3.4 : Items on the RNE

Item Name	Location	Item type
Four Mile Hut	Kiandra Road, Cabramurra	Historic hut (c.1937)
Kosciuszko National Park (1981 boundary)	Snowy Mountains Highway, Tumut	Registered in 1981.

3.3.1.3 State Heritage Register

A search of the State Heritage Register (SHR) (NSW) was undertaken on 19 January 2018 for items of State Heritage significance within the locality. Two items were identified, as summarized in **Table 3.5**. They will not be impacted by the Project.

Table 3.5 : State Heritage items

Item Name	Address	Listing	Within study area
Matthews Cottage	Kiandra, Kosciusko National Park	SHR00998	No – approx. 10 km east of Tumut switching station
Kiandra Courthouse/Chalet	Kinadra, Kosciuszko National Park	SHR00994	No – approx. 10 km east of Tumut switching station

3.3.1.4 Local heritage searches

A search of Schedule 5 of the *Snowy River Local Environmental Plan 2013* was undertaken on 19 January 2018 for items of local heritage significance within or near the survey area. There were no items of local heritage significance listed within or near study area.

3.3.1.5 Summary

The listed non-Aboriginal heritage items are largely connected with the Kosciuszko National Park/Australian Alps National Parks and Reserves and the Snowy Hydro (formerly the Snowy Mountains Hydro-Electric) Scheme. The other major items relate to the goldfields at Kiandra, with both of the items of State heritage being in that area.

3.3.2 Historical context

There have been four main phases of non-Aboriginal settlement in the locality. These are set out in the chronology in **Table 3.6**. Each of these phases have contributed in varying degrees to the current heritage values of the locality.

Table 3.6 : Chronology of non-Aboriginal heritage

Date(s)	Event(s)
1820s	European exploration and sporadic settlement begins. Settlement at this time is outside the limits of the recognised “Colony” of New South Wales.
1830s	Intensification of European settlement and grazing
1851	Gold is discovered in Kiandra
1874	Discovery of copper in Lobs Hole
1880s	Decline of Kiandra
1891	Construction of copper smelt at Ravine
1910	Proclamation of the village of Ravine (Lobs Hole)
1921	Abandonment of village of Ravine
1949-1974	Snowy Mountains Scheme constructed
1986	Ravine included in Kosciusko National Park

3.3.2.1 Early European settlement

While the Wangal and Ngarigo occupied the high plains during the summer months for the Bogong moths, and the lower slopes for small game year-round, from around the 1830s European pastoralists began

arriving on the grassy plains. According to Seddon, these treeless plains were not much used, except where ochre or stone was required (Seddon, 1994:112-113). One of the first explorers in the Snowy Mountains/Monaro area was Captain Currie, who in 1823 speaks of “a tribe of natives, who fled at our approach, never having seen Europeans before” (Seddon, 1994:112-113).

In 1834, when Polish explorer John Lhotsky travelled to the Monaro, it was outside of what was termed “the Colony” of New South Wales, with the “Moneroo (Monaro) Squattage District” added in 1840 (**Figure 3-2**). However, the census of 1828 showed 20 people on the Monaro, all servants working in the Canberra area, perhaps as far down as the Monaro. In addition, a letter from Richard Brooks stated that he had been working with stock and men at Berridale since 1827 (Plowman, 2007:10). Lhotsky included information regarding squatters he had encountered in 1834, along with the times they had been present in the area (**Table 3.7**). There were also a number of other squatters who had only been established for a few months. Lhotsky also noted still more stations around the Snowy and McLaughlin Rivers (Plowman, 2007:10).

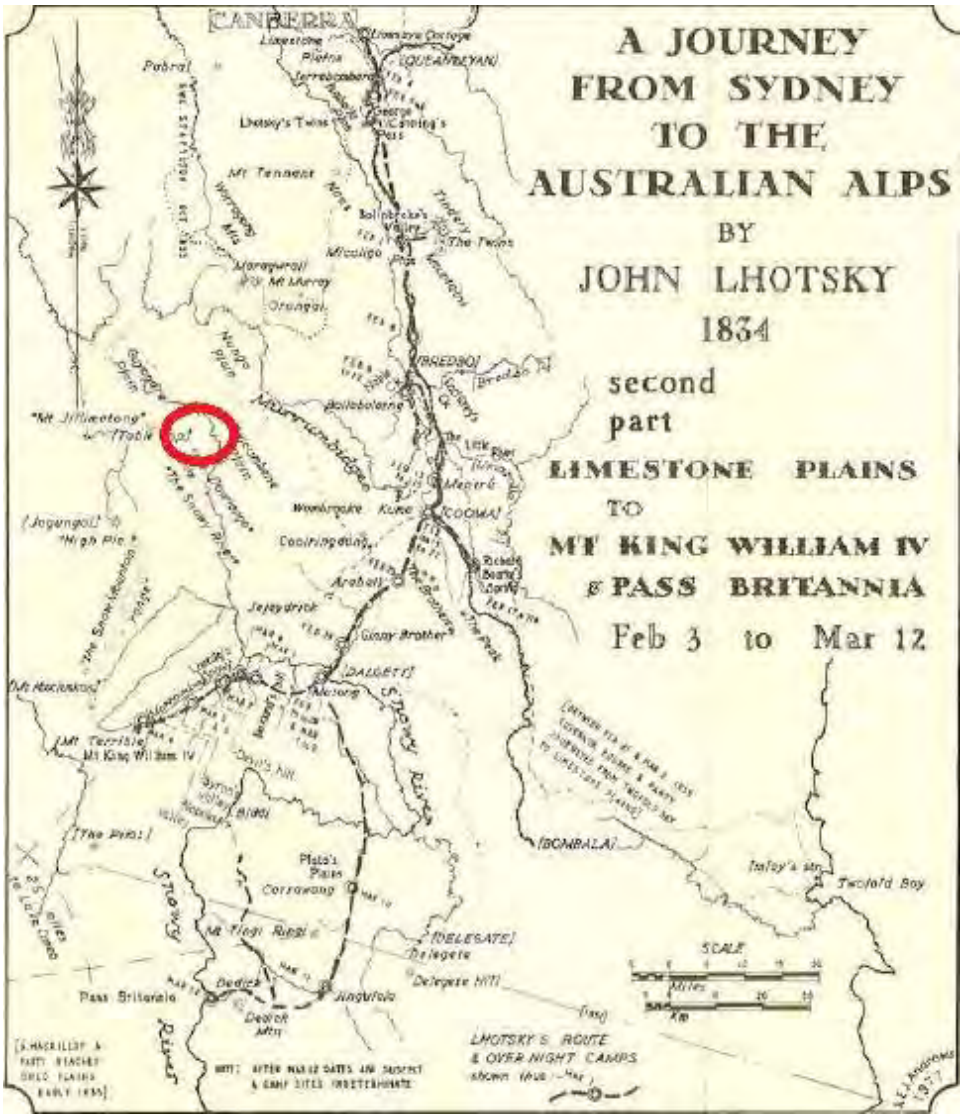


Figure 3-2 : Lhotsky’s route in 1834 showing approximate location of the Project (Per Andrews in Plowman, 2007:11)

Table 3.7 : Squatters in the Monaro before 1834 (Plowman, 2007:10)

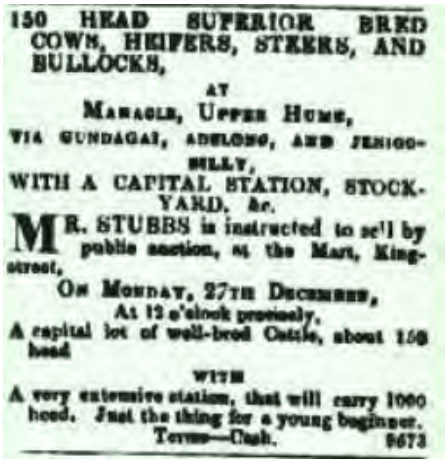
Squatter	Property	Time in Monaro (ex 1834)
R Campbell	Waterholes (north of Machelago)	7 years
Cooper & Levy	Kuma (Cooma)	5 years
Bunyan	Pindjera	4-5 years
R Brooks	Jijedery (Gegedzerick)	6 years
Sherwin	Yinibrothers	2 years
White	Tomgrogin (near Nimmitabel)	4 years
York	Benilingra (Billilingera)	5 years
Bradley	Blulungewaing (south of Bredbo)	2 years

To the west of the Snowy Mountains, Hume and Hovell passed within 20 kilometres of the western end of the study area in 1824, when exploring for a track between Hume's Cooma Cottage and the Albury area. Spennerman describes the pastoral development in the Maragle/Bago area as falling into three main phases (Spennerman, 2016:2), shown in **Table 3.8**.

Table 3.8 : Pastoralism in the Snowy Mountains

Date(s)	Event(s)
1840-1875	Establishment of squatting runs
1875-1945	Intensification of agricultural via small to medium acreage farms
1945-present	Consolidation of larger holdings as part of the Soldier Settlement Scheme

The effect of these explorations and the resultant publishing of accounts of the expeditions resulted in an influx of squatters to the region. Still outside of the colony, the land was not subject to payment of any duties, however it was likewise outside of the jurisdictions of courts and policing. The Maragle run, located near modern day Tumbarumba to the west of the Project, was first taken up by Dr Thomas Bell in 1839 (Spennerman, 2016:2). Bell lived at Braidwood and hired managers to work the run. By 1847 the land was offered for sale, with an advertisement appearing in the Sydney Morning Herald (**Figure 3-3**).



150 HEAD SUPERIOR BRED COWS, HEIFERS, STEERS, AND BULLOCKS,

AT

MANAGLE, UPPER HUME,

VIA GUNDAGAI, ADELONG, AND JENIGO-BELLY,

WITH A CAPITAL STATION, STOCK-YARD, &c.

MR. STUBBS is instructed to sell by public auction, at the Mart, King-street,

ON MONDAY, 27TH DECEMBER,

At 12 o'clock precisely,

A capital lot of well-bred Cattle, about 150 head

WITH

A very extensive station, that will carry 1000 head. Just the thing for a young beginner.

Terms—Cash. 9673

Figure 3-3 : Advertisement in the *Sydney Morning Herald*, 16 December 1847, page 4 (Courtesy: National Library of Australia).

Of note in the advertisement is that it is the cattle headlining the sale, "with a very extensive station" as by the 1850s the practice of grazing stock within the Snowy Mountains in the summer became common. A stock route ran across the range from New Maragle to Kiandra (**Figure 3-6**). Pastures in the alpine and subalpine regions were particularly verdant at this time of year, following the burning of native vegetation, thus establishing the "green pick" (Crabb, 2003:12). It is believed that Banjo Paterson's composite "Man from Snowy River" and "Clancy of the Overflow" characters came from this time period.

The land comprising the Lobs Hole/Ravine end of the survey area was part of the Yarrangobilly Run in the land district of Tumut (**Figure 3-7**). In 1885 the southern portion of the run was resumed to be made available for selection (Australian Town and Country Journal, 1885:1). Following resumption, the land was selected by Frank William Yan, who farmed the area from around the 1880s. His son, George, became postmaster at Lobs Hole (also known as Ravine) (**Figure 3-4**).

Figure 3-4 : Lobs Hole (Ravine) Post Office, c.1920. George Yan is pictured at right (Courtesy: Trove, National Library of Australia).

The presence of pastoral runs and the movement of stock in the area is evidenced by the presence of a travelling stock reserve (TSR) in/near the survey area. TSRs are Crown Land reserves used for the droving, watering and grazing of livestock along specific routes to allow movement of stock between properties or to market. The TSR shown in **Figure 3-6** below is TSR 265. It is of note that the map is from c.1888, evidence that the stock route was in use at that time. A search of the NSW Government Sharing and Enabling Environment Data (SEED) showed an additional TSR located on the north of Elliott Way, to the east of Powerline Road (see **Figure 3-5**). This is located outside of the current study area.

Figure 3-5 : Travelling Stock Reserve (in orange). The prefer route is outside of this frame, to the east (Courtesy: SEED).

Figure 3-6 : Map showing TSR265 (in red) c.1888. Approximate location of the Project is shown in green (Courtesy: National Library of Australia).

Figure 3-7 : Pastoral Map c.1860 showing pastoral runs and approximate location of the Project (Courtesy: Reuss & Browne, National Library of Australia).

The TSRs are the subject of recent interest in terms of conservation. In their submission to the NSW Travelling Stock Reserves Draft State Planning Framework 2016-2019 Committee, Landcare New South Wales noted that the TSRs had high heritage values as a result of the large number of communities and landholders who have a strong history and connection to the TSRs. According to Landcare, TSRs are:

> *…valuable assets for stock movement, seed collection, apiary, stock watering points, recreational activities and numerous other activities. A number of significant Aboriginal cultural sites are also located in TSRs and TSRs are vital for biodiversity connectivity and wildlife refuge.* (Landcare NSW, 2015:2).

However recent mapping, including SEED, does not list TSR265 as an item of potential conservation. One of the reasons that TSRs are of conservation interest is because they are a rapidly diminishing item; it would appear that TSR 265 shown in **Figure 3-6** above is no longer extant.

3.3.2.2 Village of Ravine

With the commencement of mining for copper (see **Section 3.3.2.3** below) in 1874, a settlement began to support both the miners and the facilities required by them. By 1908, the village of Ravine contained a number of temporary buildings, but a school, butcher's shop, blacksmiths' shop and a boarding house was also built. The village of Ravine was proclaimed in 1910, the same year that Julius Forsstrom took over the Lobs Hole Central Mine (Boot, 2001:3).

In 1912 copper prices plummeted, leading to the abandonment of the Lobs Hole Central Mine. The following year, Forsstrom bought out the Lobs Hole Copper Mining Company and employed six men to mine it, however the outbreak of the First World War in 1914 led to a shortage of workers. Forsstrom, a Finnish national, also faced sabotage from his workers who mistakenly thought he was German.

From 1915, the village of Ravine began its decline. The lease for the Washington Hotel ceased and was not renewed (**Figure 3-9**). The building continued to be used for traveller's accommodation. By 1917, Forsstrom concentrated his mining enterprises elsewhere, and Ravine began to decline. At its height, 500 people lived there. In 1919 Forsstrom wound up all Lobs Hole operations, the Washington Hotel became a private residence and the police station closed. The school closed the following year and burnt down in 1928. The postal service also closed in 1921, and the Forsstrom family left the area for good (Boot, 2001:4).

The village of Ravine was added to the Kosciuszko National Park on 19 February 1986 (NSW Government Gazette, 1986:886). The ruins associated with the former village are not listed separately on known heritage databases, however they are part of the nationally listed Australian Alps National Parks and Reserves item and are therefore protected by the heritage provisions of the EPBC Act.

Figure 3-8 : Layout of Ravine township, undated (Courtesy: Historical Land Records Viewer).

Figure 3-9 : Washington Hotel, c. 1920 (Courtesy: Town and Country Magazine).

3.3.2.3 Mining

With the influx of settlers to their pastoral runs, exploration of their environment for sufficient feed for their livestock led to the discovery of gold. The first in the area were in Omeo and Beechworth in Victoria in 1851 and 1852 respectively. The rush of miners to the district spearheaded a rush to find new goldfields, which were eventually discovered at Tumbarumba in 1855 and Adelong in 1857 (LRGM Services, 2002:9).

The importance of mining in the Australian Alps is well-established. Mining in the Alps was primarily for gold, which brought large numbers of people to settle in the Alps in towns like Kiandra, approximately 13 kilometres from Ravine (the easterly end of the study area) (**Figure 3-10**). Kiandra was the epicentre of mining in Kosciuszko National Park, and was dominated by alluvial gold mining (LRGM Services, 2002:v).

The area surrounding Kiandra was settled by the Pollock brothers, who brought sheep to the high country in the summer for grazing. While there, they undertook prospecting and discovered rich deposits at Kiandra. Already a magnet for miners, the Pollocks reported their find at Tumbarumba and so began the biggest gold rush in the Australian Alps. By 1860 anywhere between 5,000 and 15,000 people descended on Kiandra hoping to “strike it rich” in the gold rush, but numbers are generally agreed at 10,000. The winter drew many of the miners away, and while the government began planning for around 150,000 people to rejoin the Kiandra gold rush in the spring, it never happened. The gold disappeared quickly and in 1861 when gold was discovered at Lambing Flat (Young), the diggers left for good (LRGM Services 2002:9-10).

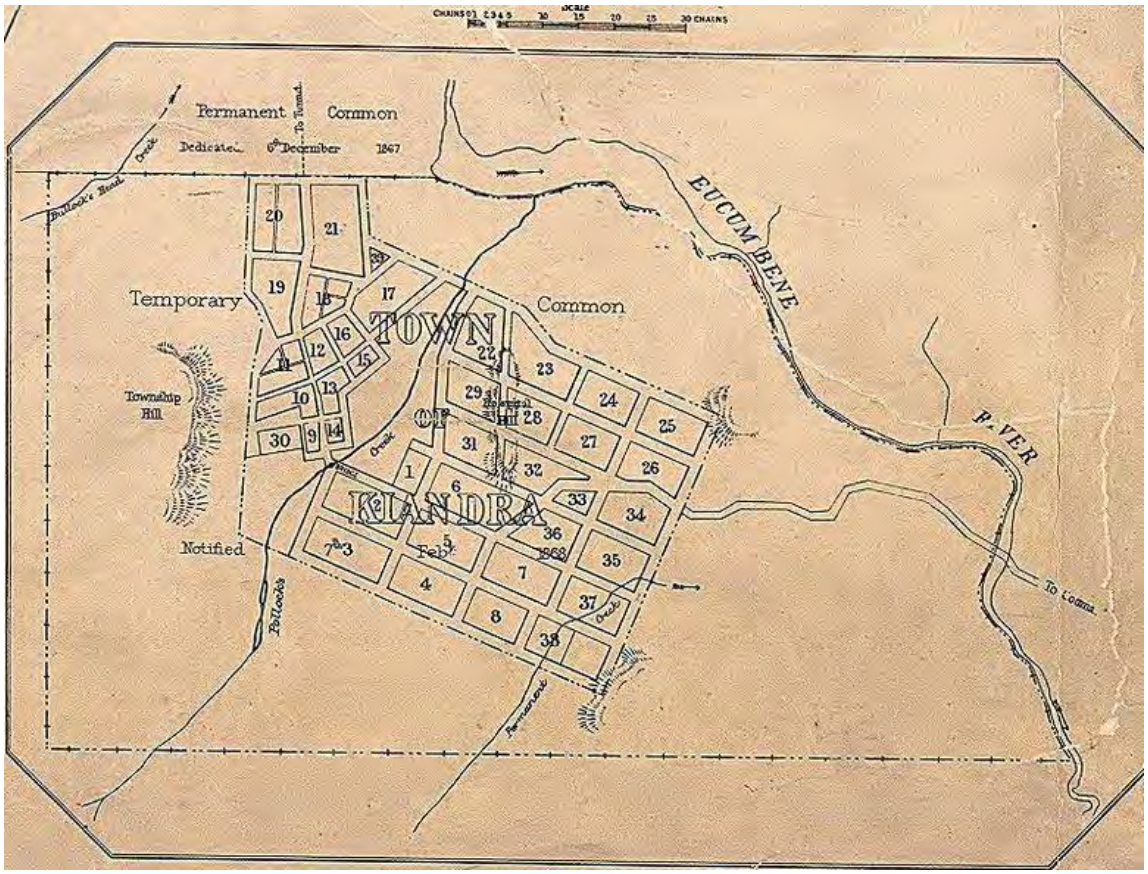


Figure 3-10 : Township of Kiandra (c. 1900) (Courtesy: Historical Land Records Viewer).

In 1874, two new areas for mining were opened: the Lobs Hole copper lode and the New Maragle goldfield, both within the survey area (**Figure 3-11**). Lobs Hole was originally a resting place on the road between Tumut and the Kiandra diggings. Located in a deep valley along the Yarrangobilly River, the Lobs Hole and village of Ravine area is spared the harsh winters experienced by the surrounding mountains. A correspondent wrote of the copper at Lobs Hole in 1872:

> *The copper is turning out rich here, and active work will be gone into before long. A tin mine has been discovered not far from the river… Native dogs are flocking to the hole in swarms this winter. Poison baits are destroying them in large numbers.* (Anon., 1872:2).

Further shafts were opened up in 1891, 1892 and 1897. In the 1890s, the equipment from Kiandra was purchased and moved to Lobs Hole, and by 1899 six men were employed at the mine (Boot, 2001:2).

A contemporary mining report states that while the Lobs Hole (Ravine) workings were successful, they were not aided by the topography of the land:

> *Lobs Hole is awkwardly situated with respect to the outside world. Kiandra, a few miles away, is 3,000 feet above the mine, and a gorge 3,300 feet deep has to be ascended before reaching the town.*
>
> *The ore at present is packed by horses up a track reaching an altitude of 2,400 feet some 2½ miles from the mine. Thence bullock teams convey the copper over rough mountains through Talbingo to Gundagai.* (Anonymous, 1901).

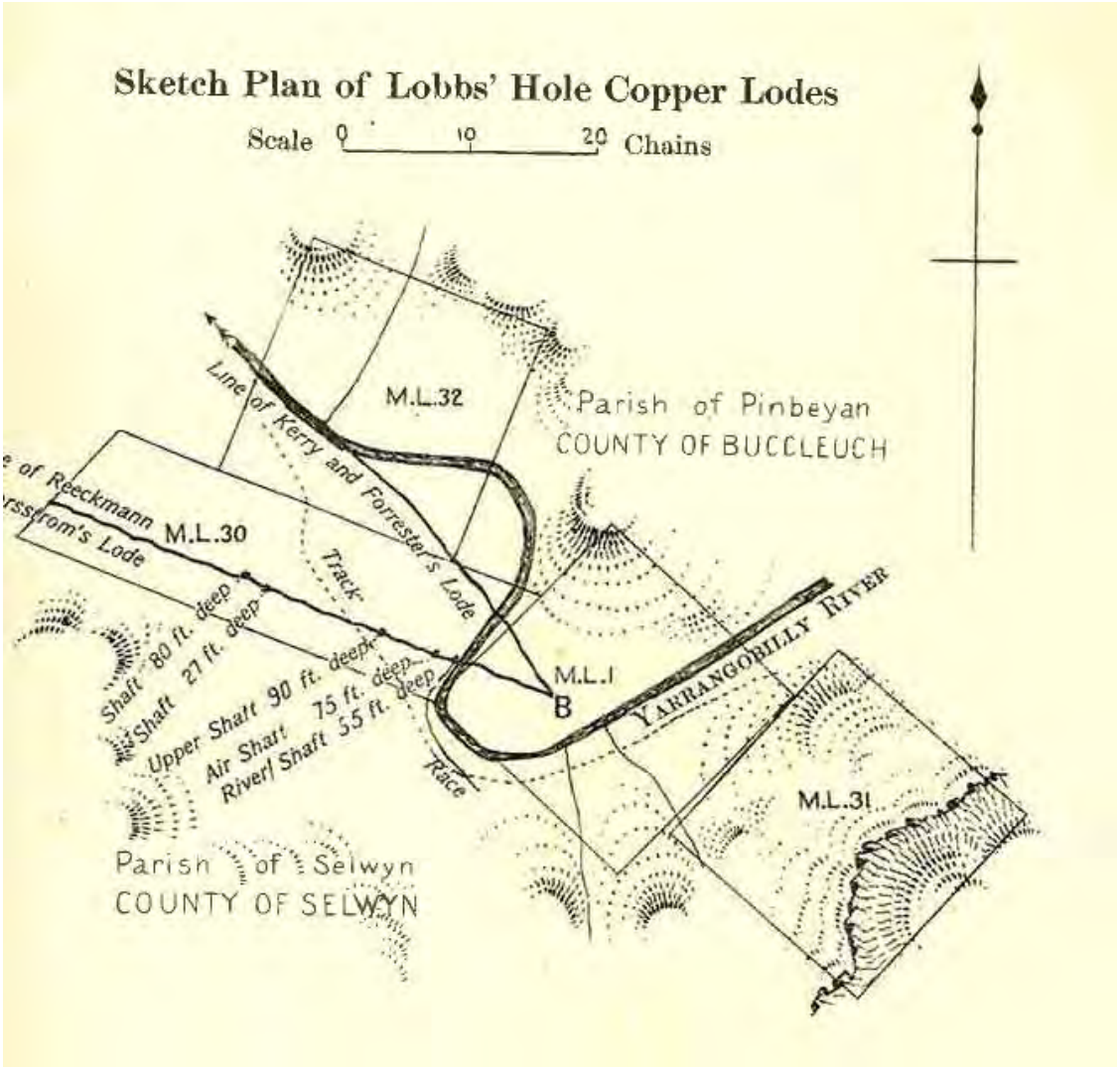


Figure 3-11 : Plan of Lobs Hole/Ravine mining activities (c.1901) (NSW Planning & Environment, nd).

The New Maragle goldfields also opened in 1874, however no town grew up around them (**Figure 3-12**). Originally part of the Maragle pastoral run, the goldfields were worked intermittently from then until around 1900.

In 1876, the following report on the "New Maragle Creek" goldfield stated:

> *The only quartz line of reef in this locality is the Pilot Reef, on which a number of leases have been surveyed but little or no work done to develop the ground. No. 1 on the line was prospected some years ago, and a considerable amount of work done. Two tunnels driven from the base of the hill to cut the supposed Reef, but from want of funds and other difficulties work was discontinued for two years. About six months ago the Pilot Reef Company commenced work again and have been successful in cutting a gold-bearing leader below the line of the Pilot Reef…*
>
> *Machinery to the value of £3,500 has been placed on the ground consisting of pumping, winding and crushing plant, race and large dam for saving water and conveying it to the mill for pumping purposes…*

The company employs ten to twelve men, besides contractors for the delivery of firewood.

The roads between this and Tumbarumba are very bad, and of course all the materials made use of for the mine and consumption are very expensive. £500 laid out judiciously would improve this road, and induce a larger population to settle down. (Langford, 1876, in NSW Planning & Environment, nd).

By 1891, the Warden of the Tumbarumba Mining District, J FMakinson, reported that Mr Richard Cook, the lessee of the Maragle lease, yielded the most gold in the district at £7 per week per man. The gold yielded from that lease was also described as the coarsest, and of the highest value. By 1894, thirty men are listed as working the New Maragle lease (NSW Planning and Environment, ud). No mention of the New Maragle diggings were mentioned after this date. A delegation from the Department of Mines toured the gold mines in the Snowy Mountains in 1911; the New Maragle diggings were not mentioned.

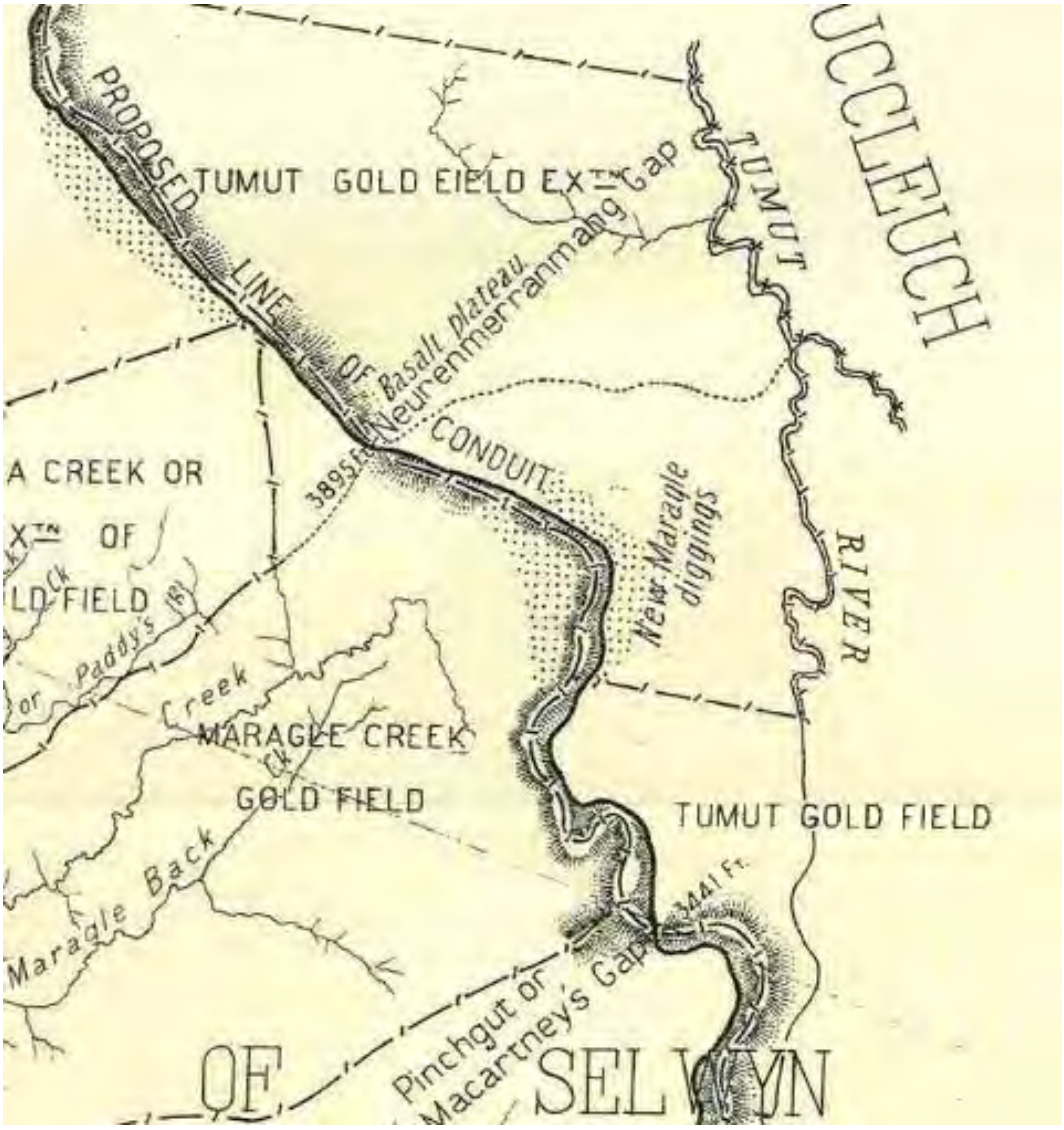


Figure 3-12 : Location of New Maragle diggings, c. 1894 (NSW Planning and Environment, ud).

3.3.2.4 Snowy Mountains Scheme

In 1949, a grand, bold scheme was developed to create electricity for Australia from the rushing rivers in the Snowy Mountains area. According to newspapers of the time, however, the Snowy Mountains Scheme had been in the planning since 1884 (The Murrumbidgee Irrigator, 1949:2). It involved the damming of several of the rivers to power turbines to provide electricity and to simultaneously provide drought-prone areas with additional water (**Figure 3-13**). According to Snowy Hydro:

> *The Scheme diverts the headwaters of the Snowy, Eucumbene and Murrumbidgee Rivers westward through the Great Dividing Range, releasing waters into the Murray and Murrumbidgee Rivers.* (Snowy Hydro, ud).

The passage of the *Snowy Mountains Hydro-Electric Power Act 1949* (Cth) established the Snowy Mountains Hydro-Electric Authority. Construction of the scheme commenced shortly thereafter.

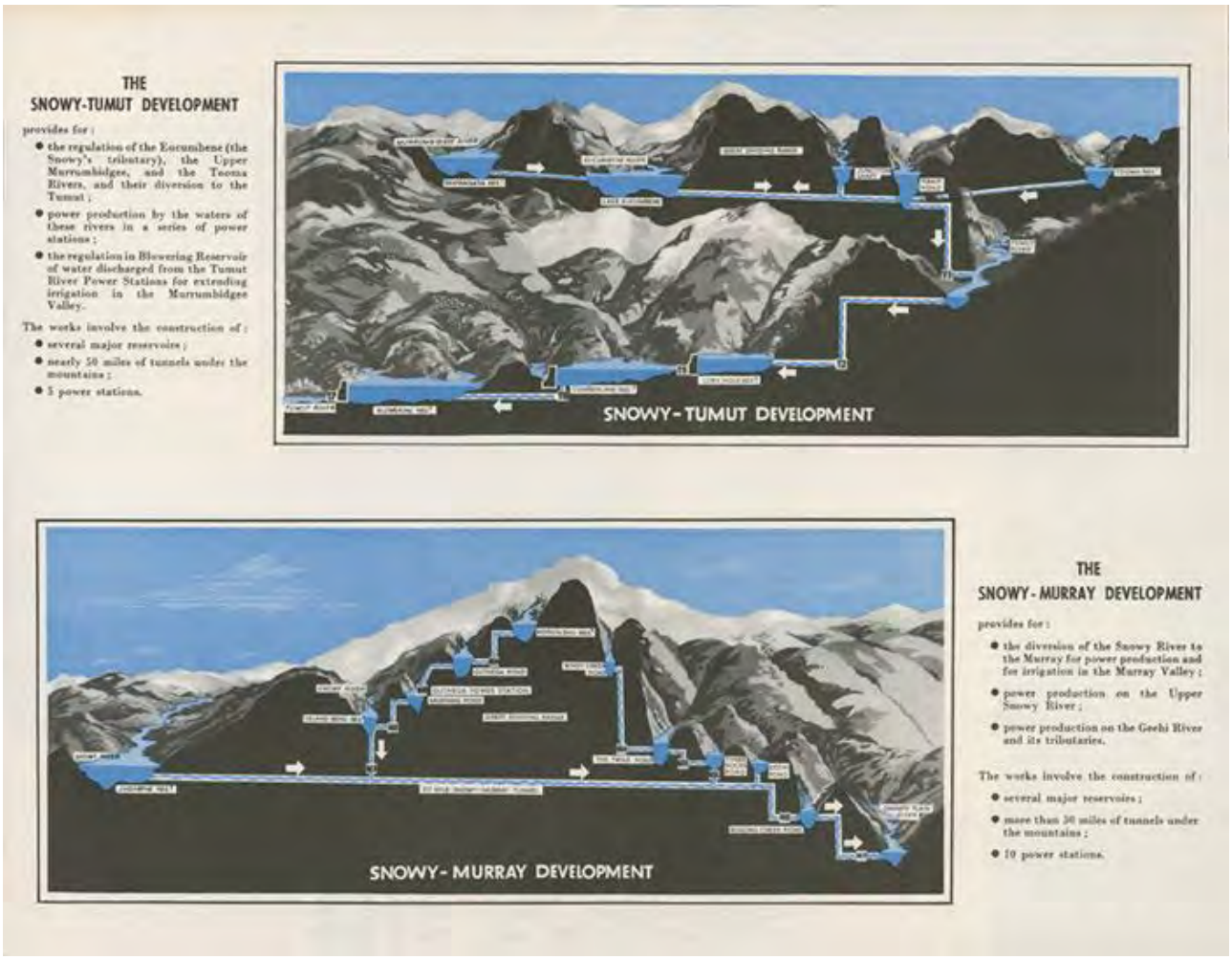


Figure 3-13 : Two development works as part of the Snowy Hydro scheme (Courtesy: National Archives of Australia).

Figure 3-14 : Snowy Hydro Electric Scheme – Lobs Hole Survey Camp, c.1952 (Courtesy: National Archives of Australia).

By the time of its completion in 1974, a total of seven power stations, 16 dams and 225 kilometres of tunnels, pipelines and aqueducts had been constructed. The town of Adaminaby was drowned under Lake Eucumbene, with the new town relocated above its high waterline. The relocation included moving the town's church stone-by-stone to its new location (National Archives of Australia, Series A2618, p4).

The construction workforce was made up of local and overseas workers. Many post-war European migrants were enticed to Australia based on the promise of steady work, and the Snowy Mountains Scheme was one of the largest employers of new migrants.

Most areas within Kosciuszko National Park were subject to some form of works, including the transmission towers to be supplemented by this Project. A survey camp was erected at Lobs Hole (Ravine) in the early 1950s in order to house surveyors working with on the Snowy Hydro scheme, headed by Major Hugh Clews of the Snowy Mountains Authority (formerly of the Royal Australian Surveying Corps) **(Figure 3-14** and **Figure 3-15).**

Lobs Hole drawing Office, 1951.
Building clad with "Malthoid" paper, using transparent drawing paper as glass windows.
SMA Photo

Figure 3-15 : From the Lobs Hole Survey Camp, 1951 (Gough (ed.), 2004:66)

3.3.3 Literature review

Boot, P, 2001, An archaeological assessment of mining relics at Lobs Hole/Ravine, Kosciusko National Park

This assessment was prepared by the National Parks and Wildlife Service to monitor the condition of mining relics. Boot provides a useful chronology of the development of the mining town and draws on the work of two previous assessments undertaken by the NPWS. Part of the wider area of this investigation is within the survey.

As described in its title, this assessment was focused on the mining relics rather than the town of Lobs Hole/Ravine. Most of the discussion centred on the remaining relics, in particular the former mining and air shafts still extant. Boot recommended that interpretation was required of the site, as well as the installation of interpretative signage, however the most important work required was the covering of uncovered pits and the construction of a safe public walking track.

Spennerman, D H R, 2016, The Junction of Maragle Back Creek and Reedy Creek, Maragle: European Context and Land Use History

This report was prepared as an historical investigation of the Maragle pastoral run and the surrounding area, part of which falls within the western end of the survey area. Spennerman reviews historical newspapers, mapping and secondary historical sources to illustrate the history of the run. Spennerman also provides details on the alienation of the Maragle run, and the development of the gold mining industry and other industries in the area. As an historical investigation, no field inspections were undertaken as part of this study.

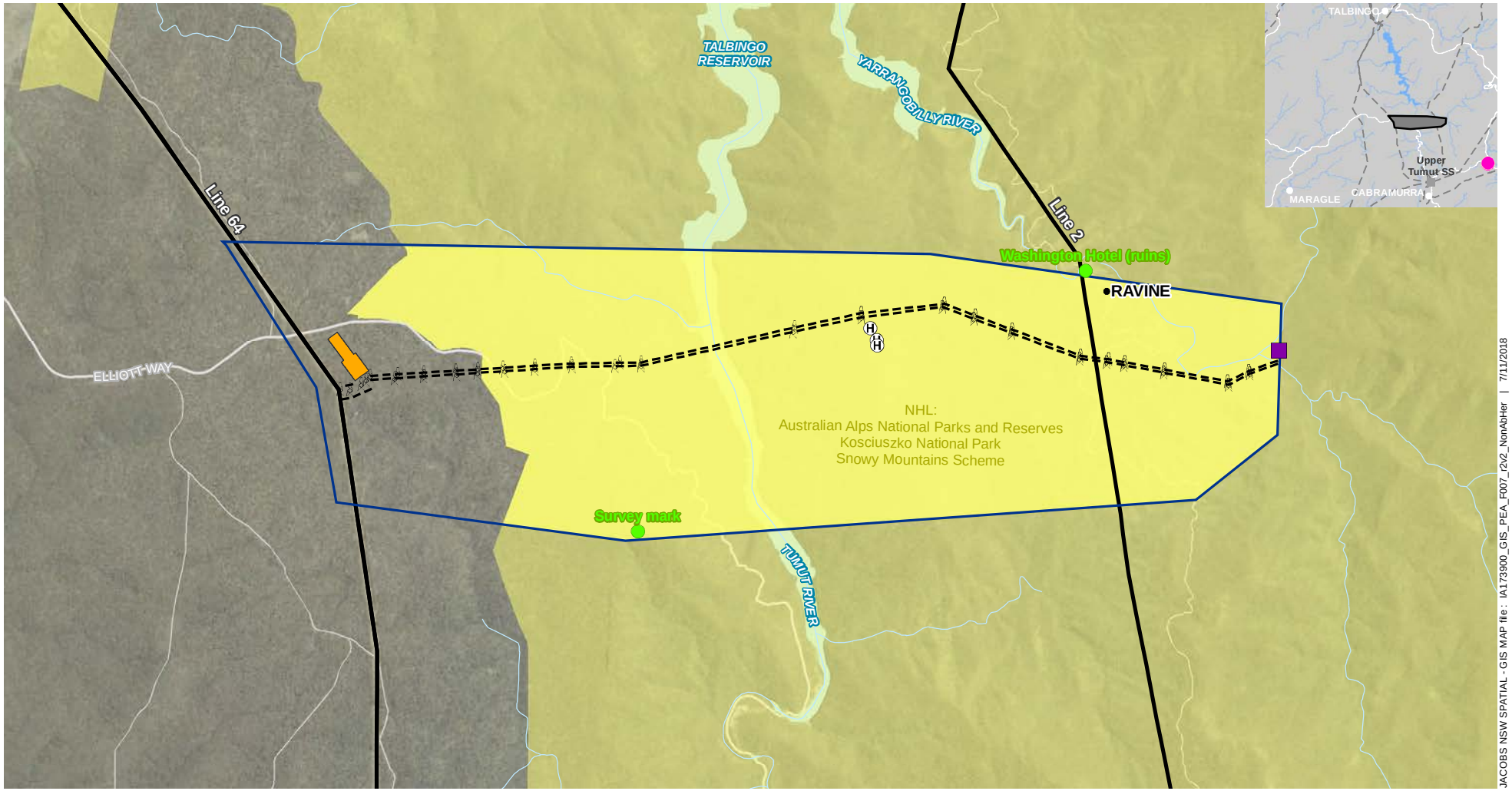


Figure 3-16 | Non-Aboriginal heritage items

3.4 Significance assessment of National heritage places

As noted in **Table 3.3**, there are two nationally significant heritage items within the study area, being the Australian Alps National Parks and Reserves, and the Snowy Mountains Scheme. An assessment of the impact of the Project on these items will be undertaken as part of the EIS for the Project.

In order to establish whether any future alignments will have a significant impact on the National heritage values, the following tables (sets out the values of both of these items. The criteria are based on the National Heritage Significance Criteria. The significance assessments are summarised using the National heritage significance criteria. These values must be taken into account when assessing the impact of the Project on these items.

Table 3.9 : Australian Alps National Parks and Reserves significance assessment

Criterion	Values
Criterion A - Events, processes	The values listed under this criterion largely relate to the natural environment, such as glacial/periglacial features, fossils, karst and biological heritage. However, cultural events such as the moth feasts, transhumant grazing, scientific research and water harvesting.
Criterion B - Rarity	The item satisfies this criterion based on the unique natural environment.
Criterion D - Principal characteristics of a class	The item is nationally significant because of the use of the mountains for grazing during the pastoral phase of post-contact human occupation. The north east of Kosciuszko National Park was especially noted for its importance.
Criterion E - Aesthetic characteristics	The item satisfies this criterion mostly because of its natural beauty, however the landscapes of huts and the effect on human artistic output is also mentioned.
Criterion G - Social value	The item satisfies this criterion based on its importance to the Australian people as the only alpine region in the country. It has also been the setting for many favourite Australian poems and novels, such as Banjo Paterson's *Man from Snowy River*, and Elyne Mitchell's *Silver Brumby* series. The mountain huts are also assessed as being of high social value.
Criterion H - Significant people	There are a number of significant people attached to the item, such as Baron Ferdinand von Mueller (botany), Eugen von Guerard (art), Banjo Paterson (author) and Elyne Mitchell (author).

Table 3.10 : Snowy Mountains Scheme significance assessment

Criterion	Values
Criterion A - Events, processes	This item was one of the biggest post-war infrastructure projects in the country. It has become regarded as a symbol of Australia's place as a multicultural, independent and resourceful country.
Criterion B - Rarity	The item fulfils this criterion because of the size and scale of the engineering involved in the planning and delivery of the project. It incorporated a number of innovative features, such as underground power stations, enormous earth-filled dams, and two examples of pumped storage capacity, using off-peak power, which are the only two examples in Australia.

Criterion	Values
Criterion D - Principal characteristics of a class	The item is nationally significant as it is a continuously operating, intact hydro-electric scheme. It is also the largest and most complex of its kind in the country.
Criterion F - Creative or technical achievement	The item is considered one of the engineering wonders of the world, featuring technical achievement and innovation. It therefore satisfies this criterion.
Criterion G - Social value	The item satisfies this criterion based on its importance to the construction, surveying, hydrology, electrical and civil engineering industries.
Criterion H - Significant people	There are a number of significant people attached to the item, such as Sir William Hudson, called the “father of the Snowy” and Olav Olsen, the Chief Investigating Engineer for the project.

3.5 Summary

3.5.1 Aboriginal heritage

The environmental context of the locality indicates favourable habitation for past Aboriginal communities. Abundant food, water, shelter and other resources are located in or near the study area, although it is likely that the climate would have been more conducive to Aboriginal habitation only at lower levels all year round, with the higher ground visited only during the summer months.

Ethnographic information relating to Aboriginal habitation of the survey area is centred on the Bogong moth festival and ceremonies. Habitation of the survey area outside of this is sporadic and recorded sites have been identified in connection with infrastructure projects undertaken within the nearby State Forests. This limited information conforms with known habitation patterns in other areas of south-east Australia, i.e., sites are within 300 m of permanent water on elevated, level land.

3.5.2 Non-Aboriginal heritage

Although historical resources indicate an early settlement of the Snowy Mountains area, remaining evidence is confined to the lower elevations such as Lobs Hole/Ravine within the Kosciuszko National Park and Kiandra to the east of the Project. Kosciuszko National Park, as part of the Australian Alps National Parks and Reserves, is also in itself a national heritage item.

Other unregistered heritage items relate to the early pastoral and mining pursuits within the vicinity of the survey area, in particular remnant mining infrastructure and perhaps portions of and infrastructure relating to the TSR 265. Pastoral maps in the area note a number of huts, sheds and other structures that were in use for pastoralism; the terrain, remote location and minimal disturbances may have conserved some of these items. It is also likely that some heritage items relating to the construction of the Snowy Mountains Scheme in the 1950s still remains in some areas within the survey area. However, the construction of the Snowy Mountain Scheme, implementation and maintenance of the infrastructure and recreational users may have destroyed some or all of these items. The harsh climate may also have aided in deterioration and/or destruction of any organic or metal items. Overall, whilst some items of non-Aboriginal heritage may remain, it is considered of low likelihood.

The Australian Alps National Parks and Reserves and the Snowy Mountain Scheme are both items listed on the National heritage list, which recognises heritage items of national importance. Impact on these two items will need to be assessed regardless of the option chosen.

4. Site visits

Two site visits were undertaken as part of this investigation; the first preliminary visit was undertaken on 21-22 March 2018 by Deborah Farina in conjunction with Lukas Clews (Senior Ecologist, Jacobs) ("preliminary site visit"). A representative of the National Parks and Wildlife Service accompanied the Jacobs team on 21 March 2018 and provided an induction of the geology, landscapes and history of the Kosciusko National Park. The purpose of the site visit was to investigate the terrain and disturbance in the vicinity of the various corridor options and to gauge the Aboriginal and non-Aboriginal character within those survey areas.

The second visit was undertaken by Ildike Piercy on 16-19 April 2018 with Lukas Clews, and representatives from TransGrid ("second visit"). The purpose of this visit was to ground-truth and assess the constructability of various transmission alignment options in crossing Sheep's Station Ridge and the Tumut River. An inspection for Aboriginal and non-Aboriginal heritage was also undertaken during this visit.

The results of the site visits have been used to inform an assessment of the heritage risks for each corridor option.

4.1 Survey coverage

4.1.1 Observations during preliminary site visit

The preliminary site visit was first guided by a representative of the NPWS, who started at the east of the survey area, near Lobs Hole/Ravine, and worked westward. During the survey, Jacobs staff advised of where recorded sites and other areas of interest were and the representative of the NPWS calculated the easiest way to those locations. This part of the survey was centred around the transmission alignment corridor but was also focused on orientation and safe travel through the steep and heavily wooded terrain (**Figure 4-1**).

Figure 4-1 : View of eastern end of survey area from Wallace's lookout (Jacobs, 2018).

The study area is mainly located within the Kosciuszko National Park, with smaller sections on the west of the Tumut River within the Maragle (south of Elliott Way) and/or Bago State Forests (north of Elliott Way). East of the Tumut River and within the Kosciuszko National Park is the former village of Lobs Hole/Ravine, a former European settlement with a large copper mine and smelt (**Figure 4-2**).

Figure 4-2 : Ruins of the Washington Hotel, Ravine, looking north-east (Jacobs, 2018).

Ravine is located in a valley between Sheep Station Ridge and Toll Bar Ridge and is to the south of the southern-most arm of Talbingo Reservoir. It lies on the southern banks of the Yarrangobilly River (**Figure 4-3**).

Figure 4-3 : Yarrangobilly River near Ravine, looking south (Jacobs, 2018).

Soils in the Lobs Hole/Ravine area appear to be loamy sand **(Figure 4-4**). At the time of the preliminary visit, NSW Archaeology were conducting test excavations in connection with the Snowy 2.0; dry sieving was being successfully conducted, evidencing the friability of the soil. Granite outcrops were noted throughout the eastern side of the Tumut River. Although wildlife droppings were noted (deer, horse), none were sighted. It should be noted, however, that the eastern end of the survey area was subject to multiple geotechnical investigations and traffic protocols were implemented owing to the narrow tracks throughout the national park.

Figure 4-4 : Soils near Washington Hotel in track, looking west (Jacobs, 2018).

The Tumut River is at the bottom of a steeply incised valley. O'Hares Camping Ground is on a large, level river bank **(Figure 4-5**). Here the river becomes much wider, although a number of dead trees along the water line on the northern bank near the camping ground is evidence of the changing landscape since the river was dammed. The character of the river banks varied, with some areas elevated and level, and others boggy and rocky, level with the water (**Figure 4-6**).

Figure 4-5 : Tumut River, looking north, from O'Hares camping ground (Jacobs, 2018).

Figure 4-6 : Upper reaches of Tumut River, above O'Hares camping ground, looking north (Jacobs, 2018).

From the Tumut River heading west the immediate landscape was extremely steep (Figure 4-7). Once on the ridge, there were areas of a more undulating character, however steep slopes still occurred throughout (**Figure 4-8**). An area within the Bago State Forest was also investigated for a switching station **(Figure 4-9**). The planned area is much larger than is required for the switching station to allow for flexibility in the design process but was investigated during the preliminary visit as best as the terrain would allow. This portion of the preliminary site visit was conducted without the assistance of the representative of the NPWS.

Figure 4-7 : Western banks of Tumut River from eastern side (Jacobs, 2018).

Figure 4-8 : Example of landscape after scaling the western banks of the Tumut River (Jacobs, 2018).

Figure 4-9 : One of the areas within the proposed switching station site (Jacobs, 2018).

Soils throughout the western survey rea were variable dependent on landform. Tracks appeared to be sandy throughout, although there were areas of wetland noted adjacent to creeks and other drainage lines.

The western end of the corridor was at that stage subjected to less preparatory work, and the wildlife was likewise more abundant. Observed in the Maragle State Forest were brumby, deer and wild boar; brumbies and lyrebirds were observed in the Bago State Forest.

As noted above, existing recorded Aboriginal sites have been chiefly identified with previous infrastructure projects, such as Forestry NSW logging and TransGrid power upgrades. This has created a survey bias around specific areas within the locality, resulting in clustering of sites. In areas outside of previous investigations, there are no sites recorded. In these areas, it is stressed that this is not an indication of no sites, but a result of this survey bias. Given historical accounts and ethnographic data that the area was heavily exploited by past Aboriginal communities, it is likely that there are many Aboriginal sites still not identified.

Balanced against this potential are the obvious difficulties of access owing to steep terrain, and the previous disturbances caused by the Snowy Hydro program in the 1950s. The Tumut River was used in historical times as a navigable waterway, linking places such as Ravine, Talbingo and Tumut. It is therefore possible that the River and its banks were likewise pathways through the steep terrain used by former Aboriginal communities travelling east-west. The damming of the Tumut River in the 1950s means that many former camping and habitation sites are now likely to be underwater. The eastern side of the Tumut River is steep although some crevices that may have been used as a shelter were observed; the terrain prevented inspection. Given the changes to the landscape it is difficult to discern whether these crevices would have been as difficult or less difficult to access prior to the damming of the river.

4.1.2 Observations during second site visit

The second site visit was focused on walking the alignments of proposed transmission routes east from Lobs Hole to the western side of the Tumut River. Further to the field observations in the preliminary site visit, various routes were walked in order to assess the constructability of any of the transmission alignments, as well as any infrastructure such as access tracks.

It was noted that there were no suitable sources of stone material identified within the survey area (mainly mountain tops and their steep sides and ridges) (**Figure 4-10**), no water sources obviously and the same trees and natural resources observed on the mountain tops are available at the bottom in the valleys where they could be much more easily harvested.

Figure 4-10 : Example of geology within survey area (Jacobs, 2018).

Soils within the survey area appeared to be a relatively loose granular, silty loam with clay in some areas (**Figure 4-11**). Heavy bioturbation was observed as result of faunal activity including lyrebird scratchings, wombats and rabbits, soil turnover from wild pigs and movement of deer and brumbies across the area. Ground Surface Visibility was estimated to average less than five percent across the survey area (**Figure 4-12**). Heavy leaf litter and organic detritus was observed throughout the survey area, obscuring any potential heritage material.

Figure 4-11 : Soils characteristic across slopes within the survey area (Jacobs, 2018)

Figure 4-12 : Example of ground surface and visibility (Jacobs, 2018).

4.2 Results

4.2.1.1 Aboriginal heritage

Attempts were made to ground-truth the sites noted in **Table 5.1** below. Most sites in the Ravine cluster were not identified, however these were being investigated by NSW Archaeology (see **Section 5.1.1.1** below). Site #56-6-0048 was re-identified and located near the ruins of the Washington Hotel.

With regard to the Bago-Bago cluster, none of these sites were re-identified. It is noted that these sites were mostly located in or around tracks; it is likely that these artefacts have long since been destroyed or redeposited elsewhere by vehicle movement.

One area of Potential Archaeological Deposit (PAD) was identified in a valley near Lobs Hole/Ravine. This area was within one the transmission alignment options at the eastern end, refer to **Figure 3-1**. The PAD was a flat, relatively open area adjacent to a creek, with a variety of natural resources at hand. Its proximity to Lobs Hole/Ravine and the previously recorded Aboriginal sites increases its potential as a site of Aboriginal heritage. No other items of Aboriginal heritage were identified.

Figure 4-13 : Creek near area of PAD (Jacobs, 2018).

4.2.1.2 Non-Aboriginal heritage

No new items of non-Aboriginal heritage were identified. The ruins of the Washington Hotel are the only items of non-Aboriginal heritage within the survey area and was inspected. It comprised the remains of pist (mud) walls with scatters of brick and rusted metal surrounding it (**Figure 4-2**). A number of small mounds covered in blackberries were also noted nearby, potentially associated with the ruins. Aboriginal site #56-6-0048 was near this item.

From an archaeological perspective a hill was observed to the north-east of the Washington Hotel, with a large surface scatter of building material and other household detritus, some of modern deposition. Given that Lobs Hole/Ravine was a small township that had a large copper smelter and was a stopping point between Kiandra and Tumut, it is highly likely that archaeological deposits are within the former township area.

One survey marker dating from 1953 was identified on the western side of the Tumut River within the Kosciuszko National Park (**Figure 4-14**). The marker is of concrete construction with a copper plate inscribed with its details. No other items of non-Aboriginal heritage were identified.

Figure 4-14 : Historical survey marker noted in second site visit (Jacobs, 2018).

5. Options and Constraints Analysis

For the purposes of the PEA and this assessment, the survey area was a much larger area that was investigated for the route selection process. This area covers the development footprint, the proposed study area, and adjacent areas (that are unlikely to be impacted).

It is acknowledged that the terrain within the study area will present difficulties in constructing new transmission lines and that constructability will be a crucial factor in formulating a preferred option. In order to provide a flexible framework for heritage assessment at this stage, this assessment proposes to indicate areas of heritage sensitivity so as to inform TransGrid in the design phase. An impact assessment will be undertaken to support the EIS for the Project.

This analysis and assessment, therefore, aims to present the known heritage items within the study area and areas where potential heritage and/or archaeological deposits may be located. A brief discussion of potential further heritage work required is also included in this section.

5.1 Analysis of Options and Heritage constraints

As can be seen from **Figure 1-1**, the preferred transmission route begins in the vicinity of Lobs Hole/Ravine, and travel west across Sheep Station Ridge and the Tumut River to the proposed switching station in the Bago State Forest. The preferred route is close to a number of recorded Aboriginal heritage sites at Lobs Hole/Ravine, and the ruins of the village of Ravine.

5.1.1 Aboriginal heritage

As described in **Section 3** above, there are 39 recorded Aboriginal heritage sites within the survey area. Outside of this area Johnson and Paton note the presence of additional sites and site types, including bora grounds (ceremonial grounds), axe grinding grooves and culturally modified trees (Johnson & Paton, 2000:17). All of the ceremonial grounds appear to be connected with the Bogong moth festival, two being at Pillared Rock Ridge and one in the nearby Bogong Mountain Rang, approximately 10 kilometres north east of Talbingo and 27 kilometres north of the Ravine end of the study area.

The locations of these sites are geographically grouped into two areas at either end of the survey area, see **Figure 3-1**. The 21 sites at the eastern end of survey area are around Lobs Hole/Ravine and the Snowy 2.0 cable yard. While the western 18 sites are located around Line 64 in the Maragle and Bago State Forests. These two areas are considered separately according to these two geographic locations.

5.1.1.1 Eastern end around Lobs Hole/Ravine and the cable yard

This area is at the eastern end of the study area and within Kosciuszko National Park. The preferred route commences in Ravine area before crossing the Tumut River to the new substation. The Ravine area including the Snowy 2.0 cable yard comprises a group of 21 previously identified Aboriginal sites as described in **Table 5.1** and shown on **Figure 3-1**. At the time of the site survey only five (56-6-0041, 56-6-0042, 56-6-0046, 56-6-0047 and 56-6-0048) of the 21 sites were listed on the AHIMS.

Table 5.1 : Aboriginal heritage sites with the survey area around Lobs Hole/Ravine

AHIMS ID	Site name	Site type	Location xxx
56-6-0041	KNP91-21;Ravine;	Artefact: -	Outside study area
56-6-0043	KNP91-23;Ravine;	Artefact: -	Outside study area

AHIMS ID	Site name	Site type	Location xxx
56-6-0045	KNP91-60;	Artefact: -	Within in study area and about 270 m from transmission line
56-6-0046	KNP91-61;	Artefact: -	Outside study area
56-6-0048	KNP91-63;	Artefact: -	Within in study area and about 480 m from transmission line
56-6-0009	Ravine;Lob's Hole; KNP91-59	Artefact: -	Within in study area and about 70 m from transmission line
56-6-0476	Ravine SU18/L1	Artefact: -	Within in study area and about 220 m from transmission line
56-6-0477	Ravine SU17/L1	Artefact: -	Within in study area and about 100 m from transmission line
56-6-0486	Ravine SU10/L3	Artefact: -	Outside study area
56-6-0487	Ravine SU11/L1	Artefact: -	Outside study area
56-6-0489	Ravine SU6/L3	Artefact: -	Within in study area and about 400 m from transmission line
56-6-0490	Ravine SU6/L4	Artefact: -	Within in study area and about 400 m from transmission line
56-6-0491	Ravine SU6/L2	Artefact: -	Outside study area
56-6-0492	Ravine SU5/L1	Artefact: -	Within in study area and about 400 m from transmission line
56-6-0493	Ravine SU5/L2	Artefact: -	Within in study area and about 390 m from transmission line
56-6-0494	Ravine SU6/L1	Artefact: -	Within in study area and about 400 m from transmission line
56-6-0495	Ravine SU3/L1	Artefact: -	Within in study area and about 70 m from transmission line
56-6-0496	Ravine SU3/L2	Artefact: -	Within in study area and about 70 m from transmission line
56-6-0497	Ravine SU3/L3	Artefact: -	Within in study area and about 50 m from transmission line
56-6-0498	Ravine SU4/L1	Artefact: -	Within in study area and about 320 m from transmission line
56-6-0499	Ravine SU4/L2	Artefact: -	Within in study area and about 320 m from transmission line
-	PAD	Elevated, level ground in close proximity to Lobs Hole/Ravine cluster.	

As noted in **Section 3.2.3** above, the overwhelming majority of previously identified sites within the survey area are artefact sites, either singly or in an artefact scatter. In the Lobs Hole/Ravine area, all previously

recorded sites are artefact scatters and all but one were identified either along or near tracks or along the banks of the Yarrangobilly River. Site #56-6-0048 was located on higher ground in the vicinity of the non-Aboriginal ruins (see **Section 5.1.2**).

During the site visit on 22 March 2018 it was noted that test excavations were being undertaken by NSW Archaeology on behalf of the Snowy 2.0. A discussion on site with Andrew Pearce of NSW Archaeology indicated that during testing a reasonable number of artefacts were being uncovered, although numbers and significance would not be known until the completion of their Cultural Heritage Assessment Report (Andrew Pearce, pers. Comm, 22 March 2018). Many of these sites (16) have now been listed on the AHIMS. These preliminary observations highlight that landforms within 200 m of permanent water and on elevated, level ground are likely to contain subsurface archaeological material. One such PAD was observed during the second site visit in the vicinity of the Lobs Hole/Ravine cluster (see **Section 4** and **Table 5.1** above). Any ground disturbance in this or similar landforms may therefore harm subsurface material.

5.1.1.2 Bago State Forest/Maragle State Forest

This cluster of 18 sites was largely identified as part of investigations relating to track construction and maintenance by NSW Forestry in the Bago and Maragle State Forests. A new substation is proposed to be constructed as part of these works; within the Bago State Forest, to the south of Elliot Way and to the east of Line 64 (see **Figure 1-1**).

The previously identified sites which are located near the new substation are described in **Table 5.2** and shown on **Figure 3-1**.

Table 5.2 : Aboriginal heritage sites within the survey area near the substation

AHIMS ID	Site name	Site type	Location
56-6-0059	YC1 Yorkers Creek;	Artefact: -	Within study area and about 450 m from the substation footprint Outside study area
56-6-0300	LBC-IF-11/PAD (J191)	PAD: -	Outside study area
56-6-0301	LBC-IF-11 (J190)	Artefact: -	Outside study area
56-6-0302	LBC-IF-10 (J189)	Artefact: -	Outside study area
56-6-0308	YC-IF-8 (J183)	Artefact: -	Outside study area
56-6-0309	YC-IF-7/PAD (J182)	PAD: -	Outside study area
56-6-0310	YC-OS-8 J179	Artefact: 4	Outside study area
56-6-0311	YC-OS-10 PAD J178	PAD: 1	Within study area and about 300 m from the substation footprint
56-6-0312	YC-IF-7 (J181)	Artefact: -	Outside study area
56-6-0313	YC-OS-10 J177	Artefact: 1	Within study area and about 300 m from the substation footprint
56-6-0314	YC-OS-03 PAD J176	PAD: 1	Outside study area
56-6-0315	YC-OS-03 J175	PAD: 1	Outside study area
56-6-0316	YC-OS-8/PAD (J180)	PAD: -	Outside study area
56-6-0063	YC-OS-3 Bago State	Artefact: -	Outside study area

AHIMS ID	Site name	Site type	Location
56-6-0064	YC-ST-2 Yorker Creek	Artefact: -	Outside study area
56-6-0067	YC-ST-2	Aboriginal Resource and Gathering	Outside study area
56-6-0068	YC-05-3	Aboriginal Resource and Gathering	Outside study area
56-6-0180	Logbridge Ck-1F-3 - J46	Artefact: -	Outside study area

None of the sites within the survey area are within the substation footprint and the nearest sites are located about 300 metres to the north of Elliott Way.

5.1.2 Aboriginal archaeological predictive model

Based on AHIMS sites, ethnographic information and previous investigations it is possible to discern a pattern in the recorded sites and their location. This information allows the development of a predictive model in order to identify areas of archaeological sensitivity.

In her seminal work of the Australian high country, Josephine Flood (Flood, 1980) noted the following Aboriginal site types.

- Lowland base camps (below 900 m)
- Montane valley camps (between 745 m and 1160 m)
- High summer camps (between 1160 m and 1525 m)
- Camps above the snow line (above 1525 m).

Although there are a multitude of variables, Flood (1980) indicated the following determinants, based on previous investigations, for the presence and complexity of these camp sites:

- Proximity to permanent water (within 200 m, although Flood noted that most sites were within 100 m)
- Elevated, level ground to detect game and/or danger
- Shelter or materials to erect temporary shelter
- Access to food and other resources.

Based on the above, the following predictive model is made:

- The most likely sites to be encountered are artefact sites, either as single artefacts (isolated find) or a group of one or more artefacts (artefact scatters)
- Artefact sites can be found in any context, however they are more likely to be found on elevated, level ground within 200 m of permanent water
- As with many areas within the south-east of Australia, surface material is not likely to be an indication of the presence or absence of subsurface material
- The dominant raw material of artefacts is likely to be silcrete and/or mudstone with smaller quantities of quartz.

Figure 3-1 shows areas of archaeological sensitivity based on the above predictive model.

5.1.3 Summary

Most recorded Aboriginal heritage has been recorded as part of previous infrastructure and development projects and identified sites are therefore limited to the footprints of those projects. It is highly likely that additional sites exist within the study area. The predictive model above and **Figure 3-1** may aid in identifying further Aboriginal heritage sites in future assessments.

5.2 Non-Aboriginal Heritage

Although there is only sporadic evidence, the historical context above demonstrates that non-Aboriginal people have been living and working within the survey area since the early 19th century. The historical record shows that there have been phases of land use, commencing with pastoralism and subsumed by mining, of both copper and gold. The construction of the Snowy River Scheme brought another wave of habitation into the area, although it is likely that it also destroyed much of the earlier heritage.

Although some non-Aboriginal heritage may exist throughout the survey area, there are two main areas where the potential is higher.

5.2.1 Lobs Hole/Ravine

The types of remains to be found in this area are associated with both the mining and the township. Remains of buildings were noted on the surface near the ruins of the Washington Hotel; it is likely that there is some archaeological material remaining. Boot's (2001) assessment also notes that there are remains associated with the mining activities on both sides of the Yarrangobilly River.

The area has been opened to the public for many years. Accidental and willful damage has occurred since that time. In addition, being open to the harsh and variable climate of the area is likely to have caused deterioration to any remaining heritage; the Washington Hotel is an example of this. Owing to the limited intrusive development, subsurface remains are likely to be better protected.

5.2.2 Maragle State Forest

The area from the western banks of the Tumut River through to the Maragle State Forest was once the New Maragle goldfields. Descriptions of the mining activities describe installed machinery as well as the diggings. As with Ravine, it is possible that some evidence of these workings remain, particularly in more remote pockets of the area.

As a State Forest, this area has also been subject to extensive recreational use. Any equipment connected with the mine may still remain, although it was common at the time for equipment to be sold and reused at other mining sites, as Julius Forsstrom did in purchasing redundant equipment at Kiandra for use at Lobs Hole/Ravine (Boot, 2001:2).

The topography of the New Maragle diggings, however, was part of the deeply incised valley of the Tumut River (**Figure 3-12**). Being less accessible, it is possible that more heritage features and archaeological sites may have remained undisturbed. However, it is also more exposed than Ravine, and therefore more open to deterioration.

5.2.3 Summary

Although non-Aboriginal heritage may possibly exist throughout the study area, given the long history of its land use for mining and pastoralism pursuits, it is more likely to be at the two known centres within the locality, being Lobs Hole/Ravine in the east and the New Maragle diggings in the west. It is likely that many of the relics have either been removed or deteriorated, however there is nonetheless moderate potential for

some to remain. The preferred route commences in the vicinity of the mining activities and village of Ravine, and ends running through the area once forming the New Maragle diggings.

5.3 Conclusion

It is considered that the preferred route corridor has the potential to cause impact to both Aboriginal and non-Aboriginal heritage and/or archaeology. To avoid or minimise such impact, the following advice is given:

- Aboriginal and non-Aboriginal impact assessments should be undertaken in areas that may disturb the ground's surface along the route of the final option. This includes areas earmarked for helipads, tracks, campsites, laydown areas, etc. as well as the transmission towers.
- Targeted and intensive inspection of the areas proposed for all areas proposed for ground disturbance works should be undertaken as part of these impact assessments.

6. Conclusions and recommendations

Areas of both Aboriginal and non-Aboriginal heritage are present within the survey area. Previously identified areas of Aboriginal heritage are broadly clustered in two groups at the eastern and western ends of the survey area, and are generally on elevated, level ground in the vicinity of permanent water. These sites are all artefact sites; however, the preliminary site visit was unable to ground-truth all of these sites. In relation to non-Aboriginal heritage, there is a survey mark noted on the western side of the Tumut River, and the items associated with the copper mining activities and village at Ravine at the eastern end of the survey area. Given the dense vegetation, harsh winter climate and rugged terrain, it is probable that other items may still exist within the study area but have not yet been recorded.

The preferred route largely involves a transmission alignment commencing near Ravine, traversing Sheep's Station Ridge and the Tumut River, and terminating at a planned switching station within the Bago State Forest. The while the location for the ancillary activities, including brake and winch sites, crane pads, helicopter landing pad, site compounds and equipment laydown areas is still to be finalised, they would all be within be within the 500 metre buffer including in the study area.

Based on the assessment undertaken to date and presented above, the Project has the potential to impact on previously unrecorded Aboriginal and non- Aboriginal heritage items. The mechanisms by which these impacts could occur include surface disturbance and excavations associated with the construction of access tracks, work compounds, transmission line towers and the switchyard.

Further Aboriginal cultural heritage assessments including targeted and intensive archaeological surveys will be undertaken as part of the EIS, to ensure that Aboriginal cultural heritage values are properly identified, assessed and avoided where possible. An Aboriginal cultural heritage assessment (ACHA) will be required in accordance with the NSW OEH (2011) *Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW* and *Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales* (NSW DECCW 2010a).

Further non-Aboriginal heritage assessment will also be undertaken as part of the EIS and would include the consideration of potential impacts on the values, settings and integrity of heritage areas and items and archaeological resources in the study area. Historical heritage assessment would be undertaken as part of the EIS and be undertaken in accordance with principles of *The Australian International Council on Monuments and Sites, Charter for Places of Cultural Significance* (also known as the Burra Charter, Australian ICOMOS 2013) and the *NSW Heritage Manual* (Heritage Office 1996 and 2006).

References

Abell, R S, 1998, "*Special Regolith Landform Units of the Green Hills, Bago and Maragle State Forests, New South Wales*, (Map) Australian Geological Survey Organisation, Canberra.

Adamson, C L and Loudon, A G, 1966, *Wagga Wagga 1:250 000 Geological Sheet SI/55-15*, 1st ed., Geological Survey of New South Wales, Sydney.

Anonymous, 1872, *Lobs Hole*, The Manaro Mercury and Cooma and Bombala Advertiser, published on 3 August 1872, page 2.

Australian Heritage Commission, 2001, *Australian Heritage Themes,* Commonwealth of Australia, Canberra.

Australian Town & Country Journal, 1885, *Runs Divided for Selection.* Published 18 July 1885, page 1.

Boot, P, 2001, *An archaeological* assessment *of Mining relics at Lobs Hole/Ravine, Kosciuszko National Park*, Southern Aboriginal Heritage Unit, Cultural Heritage Division, National Parks & Wildlife Service.

Bowdler, S. 1981 Hunters in the Highlands: Aboriginal Adaptations in the Eastern Australian Uplands. *Archaeology in Oceania* 16(2):99-111.

Bureau of Meteorology, 2018, "*Climate Statistics for Australian Locations: Summary Statistics Cabramurra SMHEA AWS*", accessed 19 January 2018 from http://www.bom.gov.au/climate/averages/tables/cw_072161.shtml

Context Pty Ltd 2015 *NATIONAL CULTURAL HERITAGE VALUES ASSESSMENT & CONFLICTING VALUES REPORT The wild horse population Kosciuszko National Park*

Crabb, P, 2003, *Managing the Australian Alps:the History of Cooperative Management of the Australian Alps National Park*, Centre for Resource and Environmental Studies, Australian National University, Canberra.

Flood, J, 1980, *The Moth Hunters: Aboriginal Pre History of the Australian Alps*, Australian Institute of Aboriginal Studies, Canberra.

Gough, N R (ed.), 2004, *The Major: Lt. Col. Hugh Powell Gough Clews*, self published, Moonee Ponds, Vic.

Independant Scientific Committee 2004 *An assessment of the values of Kosciuszko National Park*.

Landcare NSW Inc., 2015, *Submission to the Draft NSW Travelling Stock Reserves State Planning Framework 2016-2019*, submission to NSW TSR Draft State Planning Framework 2016-2019 Committee. Accessed 22 May 2018 from http://landcarensw.org.au/wp-content/uploads/2016/02/NSW-Travelling-Stock-Reserves-4-Dec-2015.pdf.

Langford, H M, *Tumut and Adelong District - Tumbarumba Division,* 1876, in

LRGM - Services, 2002, *Australian Alps Mining Heritage Conservation & Presentation Strategy*, report to the Australian Alps Liaison Committee.

Mulvaney, D.J. and J. Kamminga 1999 *Prehistory of Australia*. St. Leonards: Allen & Unwin.

Murrumbidgee Irrigator, *Minister Explains Snowy River Scheme at Civil Welcome and Dinner*, published on 24 May 1949, page 2.

National Parks & Wildlife Service, 2003, *The Bioregions of New South Wales: their biodiversity, conservation and history*, NSW National Parks & Wildlife Service, Sydney.

New South Wales Government Gazette, *National Parks & Wildlife Act 1974, Proclamation*, published 28 February 1986, No. 36, p.886.

New South Wales Planning & Environment, Resources and Geoscience, undated, *MR06598 Mineral Commodoties in the Snowy Mountains Area: Extracts from Annual Reports 1880 to 1939*. Accessed 23 May 2018 from https://search.geoscience.nsw.gov.au/report/R00029754?q=Maragle&sort=score%20desc&t=all&a=true&p=false&s=false.

Office of Environment & Heritage, undated, *eSpade database*, Sydney.

Office of Environment & Heritage, 2016, *Australian Alps – Landform*, Bioregion overviews, accessed 18 January 2018 from http://www.environment.nsw.gov.au/bioregions/AustralianAlps-Landform.htm

Officer, K. 1989 *Namagadi Pictures The Aboriginal rock art site within the Namagadi National Park, ACT.*

Plowman, S, 2007, *Thematic History, 1823 - 1945: Cooma Monaro Shire, New South Wales*. Report to Cooma-Monara Shire Council.

Seddon, G, 1994 *Searching for the Snowy: An Environmental History*, Allen & Unwin, St Leonards.

Spennerman, D H R, 2016, *The Junction of Maragle Back Creek and Reedy Creek, Maragle: European Context and Land Use History*, Institute for Land, Water and Society, Charles Sturt University, Albury.

Sturt, Charles, 1834, *Two Expeditions into the Interior of Southern Australia During the Years 1828, 1829, 1830 and 1831: With Observations on the soil, climate and general resources of the colony of New South Wales*, Volume 2, 2nd ed., Smith Elder & Co., London.

Tindale, N.B. 1974 *Aboriginal tribes of Australia: Their terrain, environmental controls, distribution, limits and proper names*. Berkeley: University of California Press.