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Appendix C Biodiversity Development Assessment Report

Snowy 2.0 Transmission Connection Project

(August 2022)

Snowy 2.0 Transmission Connection Project

Biodiversity Development Assessment Report

Rev 7

Transgrid

August 2022

Snowy 2.0 Transmission Connection Project

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Jacobs Group (Australia) Pty Limited
ABN 37 001 024 095
Level 4, 12 Stewart Avenue
Newcastle West NSW 2302 Australia
PO Box 2147 Dangar NSW 2309 Australia
T +61 2 4979 2600
F +61 2 4979 2666
www.jacobs.com

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Certification under Section 6.15 of the Biodiversity Conservation Act 2016

I, Chris Thomson (BAAS18058) certify that this Biodiversity Development Assessment Report and the accompanying finalised credit reports dated 8 August 2022 has been prepared in accordance with the requirements of (and information provided under) the Biodiversity Assessment Method.

Chris Thomson – BAAS18058

8 August 2022

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Glossary of terms

Term	Definition
Biodiversity Assessment Method (BAM)	The Biodiversity Assessment Method (BAM) is the assessment manual that outlines how an accredited person assesses impacts on biodiversity at project area. It is a scientific document that provides: ▪ A consistent method for the assessment of biodiversity on a proposed development or major project, or clearing site ▪ Guidance on how a proponent can avoid and minimise potential biodiversity impacts ▪ The number and class of biodiversity credits that need to be offset to achieve a standard of 'no net loss' of biodiversity.
Biodiversity credits	Ecosystem credits or species credits
Biodiversity credit report	The report produced by the Biodiversity Assessment Method Calculator that sets out the number and class of biodiversity credits required to offset the remaining adverse impacts on biodiversity values at a project area.
Biodiversity offsets	Management actions that are undertaken to achieve a gain in biodiversity values on areas of land in order to compensate for losses to biodiversity values from the impacts of development.
Biodiversity Offsets Scheme	A NSW government framework which creates a transparent, consistent and scientifically based approach to biodiversity assessment and offsetting for development that is likely to have a significant impact on biodiversity.
Biodiversity Offset Strategy	A strategy for offsetting residual impacts associated with a development.
Biodiversity Assessment Method Calculator (BAM-C)	The computer program that provides decision support to assessors and proponents by applying the BAM, and which calculates the number and class of biodiversity credits required to offset the impacts of a development.
Bioregion	Bioregions are relatively large land areas characterised by broad, landscape-scale natural features and environmental processes that influence the functions of entire ecosystems. They capture the large-scale geophysical patterns across Australia. These patterns in the landscape are linked to fauna and flora assemblages and processes at the ecosystem scale.
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 the project SEARs for cumulative impact assessment requirements.
Direct impact	An impact on biodiversity values that is a direct result of vegetation clearance and loss of habitat for a development. It is predictable, usually occurs at or near to the disturbance area and can be readily identified during the planning, design, construction, and operational phases of a development.
Disturbance area	The disturbance area encompasses the maximum extent of physical disturbance likely to be required to accommodate construction activities and infrastructure needed to build the project (see **Figure 2-1** and **Figure 2-2**). The exact location of the disturbance area will be situated within the extent of the project area (as described below) following detailed design. The disturbance area is also the vegetation clearing limit that Transgrid is seeking project approval for under Part 5, Division 5.2 of the *Environmental Planning and Assessment Act 1979*. The

Term	Definition
	disturbance area has been used for direct impact and offset calculations, excluding areas within the approved Snowy 2.0 main works disturbance footprint (05.02.2020).
Ecosystem credit	As defined by the BAM, a measurement of the value of EECs, CEECs and threatened species habitat for species that can be reliably predicted to occur with a PCT. Ecosystem credits measure the loss in biodiversity values at a disturbance area and the gain in biodiversity values at a biodiversity stewardship site.
Ecosystem credit species	A measurement of the value of threatened species habitat for species that can be reliably predicted to occur by vegetation surrogates (i.e. PCTs) and landscape features, or for which targeted survey has a low probability of detection.
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	An impact on biodiversity values that occurs when development related activities affect threatened species, threatened species habitat, or ecological communities in a manner other than direct impact. Compared to direct impacts, indirect impacts often: ▪ occur over a wider area than just in the study area ▪ have a lower intensity of impact in the extent to which they occur compared to direct impacts ▪ occur off site ▪ have a lower predictability of when the impact occurs ▪ have unclear boundaries of responsibility.
Local population	As defined by the BAM, the population that occurs in the study area. In cases where multiple populations occur in the study area and/or a population occupies part of the study area, impacts on the entirety of each population must be assessed separately.
Matter of national environmental significance (MNES)	A matter of national environmental significance (MNES) protected by a provision of Part 3 of the EPBC Act.
Mitigation measure	An action implemented before, during and after construction to avoid and minimise the potential severity of an impact of a project. Where there is uncertainty on the timing or extent of the impact Each mitigation measure is defined: ▪ the type of action ▪ the detailed method to implement the action ▪ schedule for implementation (location, timing and frequency) ▪ the person/organisation responsible for undertaking the action ▪ ecological measures for working out if the mitigation has been successful that adhere to SMART (Specific, Measurable, Achievable, Realistic, Timebound) principles ▪ reporting requirements (timing and frequency) ▪ how to determine when the action is complete (ecologically-based completion criteria) ▪ triggers for remedial actions leading to adaptive management by explicit techniques, timing, frequency, and responsibility.

Term	Definition
NSW (Mitchell) landscape	Landscapes with relatively homogeneous geomorphology, soils and broad vegetation types, mapped at a scale of 1: 250,000.
Patch	A patch is defined in the BAM as an area of intact native vegetation that occurs on the subject land, in this case the project area. The patch may extend onto adjoining land beyond the disturbance area of the project area, and for woody ecosystems, includes native vegetation separated by ≤100 m from the next area of intact native vegetation. For non-woody vegetation, this gap is reduced to ≤30 m.
Plant community type (PCT)	A NSW plant community type identified using the plant community type (PCT) classification system. The PCT classification was created in 2011 by consolidating two existing community-level classifications: the NSW Vegetation Classification and Assessment database; and the BioMetric Vegetation Types database used in NSW regulatory programs. The PCT classification is now maintained in the BioNet Vegetation Classification application. It is a way to classify vegetation types.
Population	As defined by the BAM, a group of organisms, all of the same species, occupying a particular area.
Prescribed Impacts	A prescribed impact(s) describes the native vegetation and loss of habitat, other than additional biodiversity impacts under Clause 6.1 of *the Biodiversity Conservation Regulation 2017*.Prescribed Impacts are those impacts on biodiversity values of the following actions that are prescribed by clause 6.1 of the *Biodiversity Conservation Regulation 2017* (as referred to in Chapter 6 of the BAM) as requiring assessment under the Biodiversity Offsets Scheme: a. impacts of development on the following kinds of habitat of threatened species or ecological communities: i. karst, caves, crevices, cliffs, and other geological features of significance, or ii. rocks, or iii. human made structures, or iv. non-native vegetation; b. impacts on connectivity of threatened species habitat; c. impacts on movement of threatened species that maintains their lifestyle; d. impacts of development on water quality, water bodies and hydrological processes that sustain threatened species and ecological communities (including from subsidence or upsidence resulting from underground mining or other development); e. wind turbine strikes on protected animals; f. impacts of vehicle strikes on threatened species of animals or on animals that are part of a threatened ecological community.
Project Area	The 'project area' represents the limits within which the disturbance area may occur during construction to allow for flexibility for the final siting of project infrastructure. Final siting of the infrastructure (i.e. the disturbance area) can move within the assessed project area subject to recommended environmental management measures and provided it does not exceed the limits defined by the project area. The total project area is about 205.92 ha, this includes 56.88 ha in Bago State Forest and 157.18 ha in KNP.
Snowy 2.0	Snowy 2.0' is the pumped hydro-electric expansion of the Snowy Scheme

Term	Definition
Snowy 2.0 disturbance footprint:	The extent of physical disturbance likely to be required to accommodate construction activities and infrastructure needed to build Snowy 2.0
Species credits	As defined by the BAM, the class of biodiversity credits created or required for the impact on threatened species that cannot be reliably predicted to use an area of land based on habitat surrogates. Species that require species credits are listed in the Threatened Biodiversity Data Collection.
Species credit species	Threatened species that are assessed according to Section 6.4 of the BAM
Study area	Study area: The study area is consistent with the term 'subject land' referred to in the BAM. The study area is the area of land that includes the project area and a 200 metre buffer to capture the biodiversity values outside of the project area (see **Figure 2-1** and **Figure 2-2).** The boundary of the study area shown in the figures of the BDAR includes a 200 m buffer from the edge of the project area, plus land (i.e. gullies) that will be spanned by transmission lines.
Target species	A species that is the focus of a study or intended beneficiary of a conservation action or connectivity measure.
Threatened Biodiversity Data Collection	Part of the BioNet database, published by EESG and accessible from the BioNet website at www.bionet.nsw.gov.au.
Threatened species	A species listed under the BC Act, *Fisheries Management Act 1994* (FM Act) or *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).
Threatened Ecological Community	A community of different species associated with one another and sharing the same habitat, that is listed under the BC Act, FM Act and Commonwealth EPBC Act. Threatened Ecological Communities (TECs) are listed as endangered or critically endangered under the BC Act, or may be listed as vulnerable, endangered or critically endangered under the Commonwealth EPBC Act.
1,500-m landscape buffer	The 1,500m landscape buffer is equivalent to an assessment area defined in the BAM, and describes an area of land that includes a 1,500m buffer around the project area identified as per section 3.1.2 of the BAM. The landscape buffer is an assessment area used to identify landscape features surrounding the project area to provide site context and to inform the likely habitat suitability of the project area.

Abbreviations	
asl	Above sea level
BAM	Biodiversity Assessment Method
BAM-C	Biodiversity Assessment Method Calculator
BC Act	*Biodiversity Conservation Act 2016* (NSW)
BCD	Biodiversity Conservation Division (part of the Environment, Energy and Science (ESS) Group within the Department of Planning, industry and Environment)
BCS	Biodiversity Conservation & Science (formerly BCD)
BDAR	Biodiversity Development Assessment Report
BOS	Biodiversity Offset Strategy
CEMP	Construction Environmental Management Plan
DAWE	Commonwealth Department of Agriculture, Water and the Environment
DPIE	Department of Planning, Industry and Environment (NSW)
DPI	Department of Primary Industries (NSW)
EEC	Endangered ecological community
EESG	Environment, Energy and Science Group (NSW DPIE)
EIS	Environmental Impact Statement
EP&A Act	*Environmental Planning and Assessment Act 1979* (NSW)
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth)
FCNSW	Forestry Corporation New South Wales
FM Act	*Fisheries Management Act 1994* (NSW)
GDE	Groundwater Dependent Ecosystem
IBRA	Interim Biogeographic Regionalisation for Australia
KNP	Kosciuszko national park
MNES	Matters of National Environmental Significance
NPWS	National Parks and Wildlife Service
OEH	Office of Environment and Heritage (replaced by BCD)
PCT	Plant Community Type
PMST	Protected Matters Search Tool
SEARs	Secretary's Environmental Assessment Requirements
SEPP	State Environmental Planning Policy
SSI	State Significant Infrastructure
TECs	Threatened Ecological Communities
TBDC	Threatened Biodiversity Data Collection (BioNet)

Executive Summary

Transgrid is seeking approval under Part 5 Division 5.2 of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act) for the construction and operation of an overhead transmission line connection and substation (the project) to enable the grid connection of the Snowy 2.0 pumped hydro generation project (Snowy 2.0). The project has been declared critical State Significant Infrastructure (SSI) under State Environmental Planning Policy (State and Regional Development) 2011.

The NSW Biodiversity Offsets Scheme applies to SSI projects unless the Secretary of the Department of Planning, Industry and Environment (DPIE) and the Chief Executive of Environment, Energy and Science Group (EESG) determine that the project is not likely to have a significant impact. This document is the Biodiversity Development Assessment Report (BDAR) for the project as required under the Biodiversity Assessment Method (BAM). This BDAR documents the methods and results of the biodiversity assessment undertaken for the project in line with the relevant State and Commonwealth environmental and threatened species legislation and policy. This BDAR addresses Stage 1 and Stage 2 of the BAM (DPIE, 2020a).

The eastern extent of the project is defined by the location of Snowy 2.0 cable yard at Lobs Hole in Kosciuszko National Park (KNP). The project then spans west across Talbingo Reservoir to Transgrid's existing Transmission Line 64 (330 kilovolt overhead transmission line between Upper Tumut and Lower Tumut switching stations) in Bago State Forest. Line 64 is the point of connection of the project to the National Electricity Market (NEM).

The total length of the overhead transmission line connection is approximately nine kilometres (km) with the project having a total worst-case disturbance area of approximately 119.6 hectares (ha), comprising 118.35 of native vegetation and 1.26 ha of cleared land. The disturbance area will be located within the project area of 205.92 ha. The project area represents the limits of where disturbance may occur during construction. Project direct impacts on biodiversity values have been calculated using the disturbance area.

Landscape

The project is located within a predominately natural landscape containing a diversity of habitats with high biodiversity value. The project area traverses two IBRA bioregions which approximately correspond to national park and state forest boundaries; the Australian Alps Bioregion and the South Eastern Highlands Bioregion.

Areas of geological significance have been identified within the 1,500 metre (m) landscape buffer, however none will be directly impacted by the project. No areas of land that the Minister for Energy and Environment has declared as an area of outstanding biodiversity value in accordance with Section 3.1 of the *Biodiversity Conservation Act 2016* (BC Act) will be affected.

There is approximately 3,931 ha of native vegetation (woody and non-woody vegetation) within a 1,500 m landscape buffer (total area of 4,052 ha) surrounding the project area, equating to a percent native vegetation cover in the landscape of 97%.

Assessment Methods

Extensive ecological surveys have been undertaken for this BDAR between October 2018 and August 2021 in accordance with the BAM including:

- Preliminary site visits and mapping
- Identification and detailed mapping of plant community types (PCTs) involving:
  - Stratification of PCTs in survey units (vegetation zones)
  - Plot based floristic vegetation survey and vegetation integrity assessment
- Threatened species habitat assessment
- Targeted threatened species surveys, including:
  - Parallel transects undertaken across suitable habitats within the project area for threatened flora species within prescribed survey periods (seasons)
  - Targeted fauna survey methods were employed including live trapping, baited remote sensor camera traps, call broadcasting, ultrasonic call recording (bats), spotlighting, timed area searches, nest tree survey and stagwatching.

Native vegetation and habitats

Seven PCTs were identified within the disturbance area, each containing up to four vegetation zones as follows:

- PCT 285: Broad-leaved Sally grass – sedge woodland on valley flats and swamps in the NSW South Western Slopes Bioregion and adjoining South Eastern Highlands Bioregion, with just one vegetation zone (moderate condition – Blackberry infestation)
- PCT 296: Brittle Gum – peppermint open forest of the Woomargama to Tumut region, NSW South Western Slopes Bioregion, with four vegetation zones including native grassland, good condition – drier *Eucalyptus nortonii* dominant slope, good condition – wetter sheltered slopes and moderate condition – Blackberry infestation
- PCT 300: Ribbon Gum – Narrow-leaved (Robertsons) Peppermint montane fern - grass tall open forest on deep clay loam soils in the upper NSW South Western Slopes Bioregion and western Kosciuszko escarpment, with just one vegetation zone (good condition)
- PCT 302: Riparian Blakely's Red Gum – Broad-leaved Sally woodland - tea-tree - bottlebrush - wattle shrubland wetland of the NSW South Western Slopes Bioregion and South Eastern Highlands Bioregion, with two vegetation zones including native grassland and moderate condition
- PCT 729: Broad-leaved Peppermint – Candlebark shrubby open forest of montane areas, southern South Eastern Highlands Bioregion and South East Corner Bioregion, with four vegetation zones including native grassland, regrowth shrubland, good condition (dry slopes) and good condition wetter sheltered slopes
- PCT 999: Norton's Box – Broad-leaved Peppermint open forest on footslopes, central and southern South Eastern Highlands Bioregion, with two vegetation zones including regrowth shrubland, and good condition – drier *Calytrix tetragona*
- PCT 1196: Snow Gum – Mountain Gum shrubby open forest of montane areas, South Eastern Highlands Bioregion and Australian Alps Bioregion, with two vegetation zones including native grassland and good condition.

None of this vegetation corresponds with a threatened ecological community listed under the NSW BC Act or Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*. (EPBC Act).

The above listed PCTs correspond with four vegetation classes (Keith 2004) that represent different broad habitat types used to stratify fauna survey, including:

- Upper Riverina Dry Sclerophyll Forests
- Southern Tableland Dry Sclerophyll Forests
- Southern Tableland Wet Sclerophyll Forests
- Subalpine Woodlands.

Groundwater Dependent Ecosystems

The level of groundwater dependence of vegetation communities in the disturbance area and broader study area was identified using the *Atlas of Groundwater Dependent Ecosystems* (GDEs) (Bureau of Meteorology, 2017) and the *Risk Assessment Guidelines for Groundwater Dependent Ecosystems* released by the NSW DPI (Kuginis *et al.*, 2012). Within the disturbance area:

- PCT 285 and PCT 296 are likely to be opportunistic facultative GDEs (i.e. partial dependence on the subsurface presence of groundwater when available)
- PCT 302 is likely to be a proportional facultative GDE (i.e partial dependence on the subsurface presence of groundwater from a consistent source).

The project is considered unlikely to affect groundwater to an extent that facultative GDEs will be detrimentally impacted.

Threatened species

One threatened plant species, *Caladenia montana*, was identified from the targeted surveys. An expert report was commissioned by Transgrid for Black-hooded Sun Orchid (*Thelymitra atronitida*) (Pellow, 2019), which determined that this species is unlikely to occur. No additional threatened flora species are assumed to be present.

Fauna surveys identified the following threatened species:

- Birds: Gang-gang Cockatoo (*Callocephalon fimbriatum*), Masked Owl (*Tyto novaehollandiae*), Diamond Firetail (*Stagonopleura guttata*), Varied Sittella (*Daphoenositta chrysoptera*), Flame Robin (*Petroica phoenicea*), Scarlet Robin (*Petroica boodang*) and Dusky Woodswallow (*Artamus cyanopterus cyanopterus*)
- Non-flying mammals: Yellow-bellied Glider (*Petaurus australis*) populations on the Bago Plateau, and Eastern Pygmy Possum (*Cercartetus nanus*)
- Flying mammals: Eastern False Pipistrelle (*Falsistrellius tasmaniensis*), Large Bent-winged Bat (*Miniopterus orianae oceanensis*), and Yellow-bellied Sheathtail-bat (*Saccolaimus flaviventris*) were positively identified from call analysis, and a fourth species, Greater Broad-nosed Bat (*Scoteanax rueppellii*) was recorded as possible identification from call analysis.

Other species credit fauna assumed to occur and included in the impact assessment include:

- Booroolong Frog (*Litoria booroolongensis,* listed endangered under the BC Act and EPBC Act).

Biodiversity Impacts

Impact calculations have been split between the two IBRA bioregions over which the project is situated (Australian Alps Bioregion and South Eastern Highlands Bioregion) for the purpose of determining separate offsetting requirements in the Biodiversity Assessment Method BAM-C (BAM-C). Impact calculations do not account for areas within the approved Snowy 2.0 disturbance footprint (05.02.2020).

The project will result in direct clearing of 118.35 ha of native vegetation within the disturbance area to allow the construction of, and ongoing operational maintenance of the asset for the life of the project. Full clearing will be required in areas that have been identified for future infrastructure, which includes the substation, individual twin transmission structures, and the development of construction and formed access tracks. Partial clearing will occur in areas that are safe to retain low growing vegetation within the operational limits of the asset. This includes large sections of the easement and hazard tree zone. The resulting modified vegetation will be maintained in this state for the life of the project, thereby retaining some of the original biodiversity values in the lower stratum and preserving the surface soil structure.

The project will remove areas of seven PCTs as described in **Table ES.1-1**.

None of this vegetation corresponds to a threatened ecological community listed under the BC Act or EPBC Act.

Table ES.1-1: Direct impacts to native vegetation from the project (SEH = Southern Eastern Highlands Bioregion, AA = Australian Alps Bioregion)

PCT ID No.	PCT name	Vegetation formation (Keith 2004)	Vegetation class (Keith 2004)	TEC+	Percent Cleared in NSW (%)	Area (ha) in disturbance area*		Area (ha) in project area	
						SEH	AA	SEH	AA
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	Dry Sclerophyll Forests (Shrub/grass sub-formation)	Upper Riverina Dry Sclerophyll Forests	No	75	-	2.20	-	2.74
296	Brittle Gum – peppermint open forest of the Woomargama to Tumut region, NSW South Western Slopes Bioregion	Dry Sclerophyll Forests (shrubby sub-formation)	Southern Tableland Dry Sclerophyll Forests	No	40	19.02	-	28.0	-
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	Wet Sclerophyll Forests (Grassy sub-formation)	Southern Tableland Wet Sclerophyll Forests	No	20	23.19	8.82	33.55	11.36

	Bioregion and western Kosciuszko escarpment								
302	Riparian Blakely's Red Gum – Broad-leaved Sally woodland – tea-tree – bottlebrush – wattle shrubland wetland of the NSW South Western Slopes Bioregion and South Eastern Highlands Bioregion	Dry Sclerophyll Forests (Shrub/grass sub-formation)	Upper Riverina Dry Sclerophyll Forests	No	50	2.34	-	6.78	-
729	Broad-leaved Peppermint – Candlebark shrubby open forest of montane areas, southern South Eastern Highlands Bioregion and South East Corner Bioregion	Dry Sclerophyll Forests (shrubby sub-formation)	Southern Tableland Dry Sclerophyll Forests	No	35	26.94	-	67.12	-
999	Norton's Box – Broad-leaved Peppermint open forest on footslopes, central and southern South Eastern Highlands Bioregion	Dry Sclerophyll Forests (shrubby sub-formation)	Southern Tableland Dry Sclerophyll Forests	No	15	8.60	-	14.48	-

1196	Snow Gum – Mountain Gum shrubby open forest of montane areas, South Eastern Highlands Bioregion and Australian Alps Bioregion	Grassy Woodlands	Subalpine Woodlands	No	5	-	27.24	-	35.84
TOTAL						**80.09**	**38.26**	**149.93**	**49.94**
GRAND TOTAL						**118.35**		**199.87**	

+Note no Threatened Ecological Communities were recorded in the project area.

*Note 1.26 ha comprised existing cleared land in the disturbance area.

The project will involve the loss of habitat within the disturbance area for the following species credit species:

- *Caladenia montana* - Surveys identified 166 plant clusters covered by a disturbance area of 9.35 ha (confined to South Eastern Highlands Bioregion)
- Gang-gang Cockatoo – 89.06 ha of breeding habitat (over both bioregions)
- Masked Owl – 10.86 ha of breeding habitat (over both bioregions)
- Booroolong Frog – 1.67 ha (confined to South Eastern Highlands Bioregion)
- Eastern Pygmy-possum – 117.29 ha (over both bioregions)
- Yellow-bellied Glider population on the Bago Plateau – 59.03 ha (over both bioregions).

The disturbance area also provides habitat features for a range of ecosystem credit fauna species and foraging habitat only for several dual-credit fauna species.

Twenty-nine waterways or unnamed drainage lines are crossed by the project area (not all will be directly impacted). Six of these are stream order three or greater and have also been mapped as Key Fish Habitat. The project will only directly impact three of these waterways: Sheep Station Creek, Cave Gully and Wallaces Creek. There is potential for indirect impacts to surrounding aquatic habitats from unmitigated erosion and contaminated (e.g. hydraulic fluids, oils, drilling fluids) run-off from construction and operation. The implementation of mitigation measures (i.e. track design, erosion and sediment control, spill control) will be implemented to control sediment and pollutants from any runoff events.

The project has potential to result in prescribed biodiversity impacts, namely impacts to connectivity and movement for gliding mammals (i.e. fragmentation by clearing along the transmission line corridor and collision with razor wire fences around the substation) and impacts on water quality for aquatic species including Booroolong Frog. Measures to minimise and mitigate these potential impacts have been discussed in this BDAR.

Due to the creation of new edges through remnant vegetation, there is also expected to be indirect impacts. While direct impacts are easily quantified and controlled by managing the extent of clearing within the disturbance area, the indirect impacts are subject to the efficacy of implemented environmental controls. As such, direct impacts are defined during project design, whereas indirect impacts are mitigated through effective environmental management during construction and associated with an adaptive management strategy.

Other potential indirect impacts that may occur due to the project include collision and electrocution of fauna with transmission lines, increased fire risk and increases in noise, vibration, dust, light and contaminants. The measures provided in this BDAR are likely to suitably mitigate these potential impacts.

Mitigation and monitoring

The impacts described are addressed in a mitigation strategy to be formalised into a Construction Environmental Management Plan (CEMP) and applied during the construction and operational phases.

Mitigation measures form the basis and framework for development of project specific Biodiversity Management Plan (BMP) that will include a biodiversity monitoring program to be developed post-approval of the project. The measures outlined in this section are intended to provide a framework for developing the BMP. The BMP will expand on, and provide more specific detail on the biodiversity mitigation measures.

The monitoring program will be designed to verify the extent of indirect impacts, identify where additional mitigation of indirect impacts is required. The BMP will include a program to evaluate and publicly report on the outcomes of such monitoring.

Offset requirements

A credit requirement has been generated by the BAM-C for the two bioregions assessed:

- South Eastern Highlands:
  - 1,733 ecosystem credits
  - 4,745 species credits
- Australian Alps Bioregion:
  - 1,156 ecosystem credits
  - 4,955 species credits.

This BDAR has assessed the project area for its biodiversity values so that if the disturbance area may need to shift slightly during detailed design, this can be achieved without the need to modify the project subject to recommended environmental management measures and provided it does not exceed the limits defined by the project area, noting the calculation of impact area has been restricted to the disturbance area for this stage of the development assessment. Once detailed design is complete further analysis of vegetation impact will be recalculated and where applicable the adjusted biodiversity offset liability updated post-approval.

A Biodiversity Offset Strategy (BOS) has been prepared by Snowy Hydro Limited for the project.

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 it is possible that our observations and conclusions as expressed in this report may change. Jacobs derived the data in this report from information sourced from Transgrid 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 project 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.

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1. Introduction

1.1 Project background

Transgrid is the manager and operator of the major high-voltage electricity transmission network in New South Wales (NSW) and the Australian Capital Territory (ACT).

Transgrid is seeking approval under Part 5 Division 5.2 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) for the construction and operation of an overhead transmission connection and substation to enable the grid connection of the Snowy 2.0 pumped hydro generation project (Snowy 2.0).

The Snowy 2.0 Transmission Connection Project (the project) has been declared critical State Significant Infrastructure (SSI) under the State Environmental Planning Policy (State and Regional Development) 2011 and is subject to assessment and determination by the Minister for Planning. This Biodiversity Development Assessment Report (BDAR) has been developed as a component of the Environmental Impact Statement (EIS) for the project.

1.2 Purpose of this technical report

This BDAR has been prepared to address the Secretary's Environmental Assessment Requirements (SEARs) issued for the project on 1 November 2019 by the Planning Secretary of the NSW Department of Planning, Industry and Environment (DIPE). The BDAR is consistent with the requirements of the Biodiversity Assessment Method [BAM] (DPIE 2020a).

The SEARs relevant to this BDAR are presented in **Table 1-1.**

Table 1-1: Secretary's environmental assessment requirements – Biodiversity

SEARs	Section addressed
An assessment of the biodiversity impacts of the project on terrestrial, aquatic and groundwater-dependent ecosystems, including listed Commonwealth and State threatened species and communities and listed Commonwealth migratory species	The BDAR has identified the following biodiversity values that may be impacted by the project: ▪ Terrestrial **– Chapter 6** and **Chapter 7** ▪ Aquatic **– Section 8** ▪ Groundwater dependent ecosystems **– Section 6.5** The BDAR has identified biodiversity values listed under the EPBC Act (Commonwealth) that may be impacted by the project in **Chapter 9**. An assessment of the biodiversity impacts of the project are detailed in **Chapter 11**.
A strategy to offset any residual impacts of the project focusing on enhancing the biodiversity values of the Kosciuszko National Park (KNP) in the medium to long term	Residual impacts of the project that require offsets are described in **Chapter 13** and **Chapter 14** A Biodiversity Offset Strategy (BOS) is provided in **Chapter 15**.

1.3 Minimum information requirements of this BDAR

This BDAR is compliant with the BAM (DPIE 2020a) and documents the first two stages of the BAM:

- Stage 1 – Biodiversity assessment
- Stage 2 – Impact assessment (biodiversity values and prescribed impacts).

The minimum information requirements in Table 24 of Appendix K of the BAM are addressed in this BDAR and section summarised in **Table 1-2**.

Table 1-2: Minimum information requirements of the BAM are addressed in this BDAR

BAM minimum information requirements (BAM, 2020a)	Report section addressed
Introduction Introduction to the biodiversity assessment including: ▪ brief description of the proposal ▪ identification of subject land1 boundary, including: ▪ operational footprint (if BDAR) ▪ construction footprint indicating clearing associated with temporary/ancillary construction facilities ▪ infrastructure (if BDAR) ▪ general description of the subject land ▪ sources of information used in the assessment, including reports and spatial data.	Information on the introduction for the biodiversity assessment are detailed in: ▪ Introduction – **Chapter 1 -** Page 1: - Project background - Page 1 - Purpose of this technical report Page 1 - Checklist of the minimum information requirements of this BDAR - Page 2 - Personnel Page - Page 11 - Agency Consultation - Page 12 - Sources of Information used in the assessment - Page 12 ▪ Description of project – **Chapter 2 -** Page13: - Project components - Page 13 - Project location - Page 13 - Construction - Page 17 - Operation - Page 27 ▪ Legislation and policy – **Chapter 3** Page 29.
Landscape context Identification of site context components and landscape features, including:	Information on the landscape context for the biodiversity assessment are detailed in:

▪ general description of subject land topographic and hydrological setting, geology and soils ▪ percent native vegetation cover in the assessment area (as described in BAM Section 3.2) ▪ IBRA bioregions and subregions (as described in BAM Subsection 3.1.3(2.)) ▪ rivers and streams classified according to stream order (as described in BAM Subsection 3.1.3(3.) and Appendix E) ▪ wetlands within, adjacent to and downstream of the site (as described in BAM Subsection 3.1.3(3.)) ▪ connectivity of different areas of habitat (as described in BAM Subsection 3.1.3(5–6.)) ▪ karst, caves, crevices, cliffs, rocks and other geological features of significance and for vegetation clearing ▪ proposals, soil hazard features (as described in BAM Subsections 3.1.3(7.) and 3.1.3(12.) ▪ areas of outstanding biodiversity value occurring on the subject land and assessment area (as described in BAM ▪ Subsection 3.1.3(8–9.)) any additional landscape features identified in any SEARs for the proposal.	▪ Landscape features **– Chapter 4 -** Page 30: - IBRA bioregions and sub-regions - Page 30 - BioNet NSW Landscapes (Mitchell landscapes) 30 - Rivers, streams and estuaries - Page 31 - Wetlands - Page 31 - Connectivity of habitat - Page 31 - Areas of geological significance and soil hazard features - Page 32 - Areas of outstanding biodiversity value - Page 32 - Native vegetation extent - Page 33 - 42019/2020 Dunns Road bushfire - Page 33.
Native Vegetation Identify native vegetation extent within the subject land, including cleared areas and evidence to support differences. between mapped vegetation extent and aerial imagery (as described in BAM Section 4.1(1–3.) and Subsection 4.1.1). Provide justification for all parts of the subject land that do not contain native vegetation (as described in BAM Subsection 4.1.2). Review of existing information on native vegetation including references to previous vegetation maps of the subject land and assessment area (described in BAM Section 4.1(3.) and Subsection 4.1.1). Describe the systematic field-based floristic vegetation survey undertaken in accordance with BAM Section 4.2. Where relevant, describe the use of more appropriate local data, provide reasons that support the use of more appropriate local data and include the written confirmation from the decision-maker that they support the use of more appropriate local data (as described in BAM Subsection 1.4.2 and Appendix A). For each PCT within the subject land, describe: ▪ vegetation class	Information on the native vegetation for the biodiversity assessment are detailed in: ▪ Native vegetation and vegetation integrity **– Chapter 5** - Page 43: - Background research and data sources - Page 43 - Preliminary site visits and scoping - Page 44 - Mapping extent of native vegetation - Page 44 - Plant community type identification - Page 45 - Vegetation zones and vegetation integrity score - Page 91 - Patch size - Page 92 - Threatened ecological communities - Page 92 - Groundwater dependent ecosystems - Page 94.

▪ extent (ha) within subject land ▪ evidence used to identify a PCT including any analyses undertaken, references/sources, existing vegetation maps (BAM Section 4.2(1–3.)) ▪ plant species relied upon for identification of the PCT and relative abundance of each species ▪ if relevant, TEC status including evidence used to determine vegetation is the TEC (BAM Subsection 4.2.2(1–2.)) ▪ estimate of percent cleared value of PCT (BAM Subsection 4.2.1(5.)). Describe the vegetation integrity assessment of the subject land, including: ▪ identification and mapping of vegetation zones (as described in BAM Subsection 4.3.1) ▪ assessment of patch size (as described in BAM Subsection 4.3.2) ▪ survey effort (i.e. number of vegetation integrity survey plots) as described in BAM Subsection 4.3.4(1–2.) ▪ use of relevant benchmark data from BioNet Vegetation Classification (as described in BAM Subsection 4.3.3(5.)). Where use of more appropriate local benchmark data is proposed (as described in BAM Subsection 1.4.2, BAM Subsection 4.3.3(5.) and BAM Appendix A): ▪ identify the PCT or vegetation class for which local benchmark data will be applied ▪ identify published sources of local benchmark data (if benchmarks obtained from published sources) ▪ describe methods of local benchmark data collection (if reference plots used to determine local benchmark data) ▪ provide justification for use of local data rather than BioNet Vegetation Classification benchmark values ▪ provide written confirmation from the decision-maker that they support the use of local benchmark data.	
Threatened species Identify ecosystem credit species likely to occur on the subject land, including: ▪ list of ecosystem credit species derived from the BAM-C (as described in BAM Subsection 5.1.1 and Section 5.2(1.)) ▪ justification and supporting evidence for exclusion of any ecosystem credit species based on geographic	Information on the threatened species for the biodiversity assessment are detailed in: ▪ Threatened species – **Chapter 6 -** Page 99: - Threatened species habitat assessment - Page 99 - Habitat types - Page 100

▪ limitations, habitat constraints or vagrancy (as described in BAM Subsections 5.2.1 and 5.2.2) ▪ justification for addition of any ecosystem credit species to the list. Identify species credit species likely to occur on the subject land, including: ▪ list of species credit species derived from the BAM-C (as described in BAM Subsection 5.1.1) ▪ justification and supporting evidence for exclusions based on geographic limitations, habitat constraints or vagrancy (as described in BAM Subsections 5.2.1 and 5.2.2) ▪ justification and supporting evidence for exclusions based on degraded habitat constraints and/or microhabitats on which the species depends (as described in BAM Subsection 5.2.2) ▪ justification for addition of any species credit species to the list. From the list of candidate species credit species, identify: ▪ species assumed present within the subject land (if relevant) (as described in BAM Subsection 5.2.4(2.a.)) ▪ species present within the subject land on the basis of being identified on an important habitat map for a species (as described in BAM Subsection 5.2.4(2.d.)) ▪ species for which targeted surveys are to be completed to determine species presence (Subsection 5.2.4(2.b.)) ▪ species for which an expert report is to be used to determine species presence (Subsection 5.2.4(2.c.)). Present the outcomes of species credit species assessments from: ▪ threatened species survey (as described in BAM Section 5.2.4) ▪ expert reports (if relevant) including justification for presence of the species and information used to make this determination (as described in BAM Section 5.2.4 and 5.3, Box 3). Where survey has been undertaken include detailed information on: ▪ survey method and effort, (as described in BAM Section 5.3) ▪ justification of survey method and effort (e.g. citation of peer-reviewed literature) if approach differs from the Department's taxa-specific survey guides or where no relevant guideline has been published ▪ timing of survey in relation to requirements in the TBDC or the Department's taxa-specific survey guides. Where survey was undertaken outside these guides include justification for the timing of surveys ▪ survey personnel and relevant experience	- Habitat suitability for species that can be predicted by habitat surrogates (ecosystem credit species) - Page 107 - Habitat suitability for species that cannot be predicted by habitat surrogates (species credit species) - Page 109 - Identifying geographic and habitat constraints - Page 111 - Candidate species removed from the assessment - Page 114 - Candidate species added to the assessment - Page 115 - Targeted threatened species surveys - Page 117 - Survey limitations - Page 149 - Threatened species survey results - Page 151 - Serious and irreversible impact entities - Page 164 ▪ Aquatic assessment **– Chapter 7 -** 175 ▪ Matters of National Environmental Significance **– Chapter 8 -** Page 187

▪ describe any limitations to surveys and how these were addressed/overcome. Where an expert report has been used in place of survey (as described in BAM Section 5.3, Box 3), include: ▪ justification of the use of an expert report ▪ identify the expert, provide evidence of their expert credentials and Departmental approval of expert status ▪ all requirements of Box 3 have been addressed in the expert report. Where use of local data is proposed (BAM Subsection 1.4.2): ▪ identify relevant species ▪ identify data to be amended ▪ identify source of information for local data, e.g. published literature, additional survey data, etc. ▪ justify use of local data in preference to VIS Classification or TBDC data ▪ provide written confirmation from the decision-maker that they support the use of local data. Species polygon completed for species credit species present within the subject land (assumed present or determined on the basis of survey, expert report or important habitat map) ensuring that: ▪ the unit of measure for each species is documented ▪ for species assessed by area: - the polygon includes the extent of suitable habitat for the target species within the subject land (as described in BAM Subsection 5.2.5) - a description of, and evidence-based justification for, the habitat constraints, features or microhabitats used to - map the species polygon including reference to information in the TBDC for that species and any buffers applied ▪ for species assessed by counts of individuals: - the number of individual plants present on the subject land (as described in BAM Subsection 5.2.5(3.)) - the method used to derive this number (i.e. threatened species survey or expert report) and evidence-based justification for the approach taken - the polygon includes all individuals located on the subject land with a buffer of 30 m around the individuals or groups of individuals on the subject land.	

Identify the biodiversity risk weighting for each species credit species identified as present within the subject land (as described in BAM Section 5.4).	
Prescribed impacts Identify potential prescribed biodiversity impacts on threatened entities, including: ▪ karst, caves, crevices, cliffs, rocks and other geological features of significance (as described in BAM Subsection 6.1.1) ▪ occurrences of human-made structures and non-native vegetation (as described in BAM Subsection 6.1.2) ▪ corridors or other areas of connectivity linking habitat for threatened entities (as described in BAM Subsection 6.1.3) ▪ water bodies or any hydrological processes that sustain threatened entities (as described in BAM Subsection 6.1.4) ▪ protected animals that may use the proposed wind farm development site as a flyway or migration route (as described in BAM Subsection 6.1.5) ▪ where the proposed development may result in vehicle strike on threatened fauna or on animals that are part of a threatened ecological community (as described in BAM Subsection 6.1.6). Identify a list of threatened entities that may be dependent upon or may use habitat features associated with any of the prescribed impacts. Describe the importance of habitat features to the species including, where relevant, impacts on life-cycle or movement patterns (e.g. Subsection 6.1.3). Where the proposed development is for a wind farm: ▪ identify a candidate list of protected animals that may use the development site as a flyway or migration route, including: resident threatened aerial species, resident raptor species and nomadic and migratory species that are ▪ likely to fly over the proposal area (as described in BAM Subsection 6.1.5) ▪ provide details of targeted survey for candidate species of wind farm developments undertaken in accordance with BAM Subsection 6.1.5(2–3.) ▪ predict the habitual flight paths for nomadic and migratory species likely to fly over the subject land and map the ▪ likely habitat for resident threatened aerial and raptor species (BAM Subsection 6.1.5(4.)).	Information on prescribed impacts for the biodiversity assessment are detailed in: ▪ Assessment of impacts **– Chapter 10 -** Page 205: - Prescribed biodiversity impacts - Karst, caves, crevices, cliffs, rocks and other geological features of significance - Human-made structures or non-native vegetation - Habitat connectivity - Water bodies, water quality and hydrological processes - Wind turbine strikes - Vehicle strike.

Avoid and minimise impacts Demonstration of efforts to avoid and minimise impacts on biodiversity values (including prescribed impacts) associated with the proposal location in accordance with Chapter 7, including an analysis of alternative: ▪ modes or technologies that would avoid or minimise impacts on biodiversity values and justification for selecting the proposed mode or technology ▪ routes that would avoid or minimise impacts on biodiversity values and justification for selecting the proposed route ▪ alternative locations that would avoid or minimise impacts on biodiversity values and justification for selecting the proposed location ▪ alternative sites within a property on which the proposal is located that would avoid or minimise impacts on biodiversity values and justification for selecting the proposed site. Describe efforts to avoid and minimise impacts (including prescribed impacts) to biodiversity values through proposal design (as described in BAM Sections 7.1 and 7.2). Identification of any other site constraints that the proponent has considered in determining the location and design of the proposal (as described in BAM Section 7.2.1(3.)).	Information on the avoid and minimise impacts for the biodiversity assessment are detailed in: ▪ Impact avoidance and minimisation **– Chapter 9**: - Locating the project to avoid and minimising direct and indirect impacts on biodiversity values - Designing the project to avoiding and minimise direct and indirect impacts on biodiversity values - Locating and designing the proposal to avoid and minimise prescribed impacts.
Assessment of impacts Determine the impacts on native vegetation and threatened species habitat, including a description of direct impacts of clearing of native vegetation, threatened ecological communities and threatened species habitat (as described in BAM Section 8.1). Assessment of indirect impacts on vegetation and threatened species and their habitat including (as described in BAM Section 8.2): ▪ description of the nature, extent, frequency, duration and timing of indirect impacts of the proposal ▪ documenting the consequences to vegetation and threatened species and their habitat including evidence-based justifications ▪ reporting any limitations or assumptions, etc. made during the assessment ▪ identification of the threatened entities and their habitat likely to be affected.	Information on the assessment of impacts for the biodiversity assessment are detailed in: ▪ Assessment of impacts **– Chapter 10**: - Direct impact - Indirect impacts - Prescribed biodiversity impacts - Summary of uncertain impacts - Cumulative impacts.

Assessment of prescribed biodiversity impacts (as described in BAM Section 8.3) including assessment of the nature, extent and duration of impacts on the habitat of threatened species or ecological communities associated with: ▪ karst, caves, crevices, cliffs, rocks and other features of geological significance ▪ human-made structures ▪ non-native vegetation ▪ connectivity of different areas of habitat of threatened species that facilitates the movement of those species across their range ▪ movement of threatened species that maintains their life cycle ▪ water quality, water bodies and hydrological processes that sustain threatened species and threatened ecological communities ▪ assessment of the impacts of wind turbine strikes on protected animals ▪ assessment of the impacts of vehicle strikes on threatened species of animals or on animals that are part of a TEC.	
Mitigation and management of impacts Identification of measures to mitigate or manage impacts in accordance with the recommendations in BAM Sections 8.4 and 8.5 including: ▪ techniques, timing, frequency and responsibility ▪ identify measures for which there is risk of failure ▪ evaluate the risk and consequence of any residual impacts ▪ document any adaptive management strategy proposed. Identification of measures for mitigating impacts related to: ▪ displacement of resident fauna (as described in BAM Subsection 8.4.1(2.)) ▪ indirect impacts on native vegetation and habitat (as described in BAM Subsection 8.4.1(3.)) ▪ mitigating prescribed biodiversity impacts (as described in BAM Subsection 8.4.2). Details of the adaptive management strategy proposed to monitor and respond to impacts on biodiversity values that are uncertain (BAM Section 8.5).	Information on the mitigation and management of impacts for the biodiversity assessment are detailed in: ▪ Mitigating and managing impacts on biodiversity values – **Chapter 11**: - Mitigation measures - Monitoring and adaptive management.
Impact Summary	Information on the impact summary for the biodiversity assessment are detailed in:

Identification and assessment of impacts on TECs and threatened species that are at risk of a serious and irreversible impacts (SAII, in accordance with BAM Section 9.1) including: ▪ addressing all criteria in Subsection 9.1.1 for each TEC listed as at risk of an SAII present on the subject land ▪ addressing all criteria in Subsection 9.1.2 for each threatened species at risk of an SAII present on the subject land ▪ documenting assumptions made and/or limitations to information ▪ documenting all sources of data, information, references used or consulted clearly justifying why any criteria could not be addressed. Identification of impacts requiring offset in accordance with BAM Section 9.2. Identification of impacts not requiring offset in accordance with BAM Subsection 9.2.1(3.). Identification of areas not requiring assessment in accordance with BAM Section 9.3. Ecosystem credits and species credits that measure the impact of the development on biodiversity values, including: ▪ future vegetation integrity score for each vegetation zone within the subject land (Equation 25 and Equation 26 in BAM Appendix H) ▪ change in vegetation integrity score (BAM Subsection 8.1.1) ▪ number of required ecosystem credits for the direct impacts of the proposal on each vegetation zone within the subject land (BAM Subsection 9) ▪ number of required species credits for each candidate threatened species that is directly impacted on by the proposal (BAM Subsection 10.1.3).	▪ Thresholds for the assessment and offsetting of impacts of the project **– Chapter 12**: - Impacts on a potential entity that are serious and irreversible impacts - Impacts for which the assessor is required to determine an offset requirement - Impacts for which the assessor is not required to determine an offset requirement - Impacts that do not require further assessment by the assessor ▪ Conclusion **- Chapter 15**.
Biodiversity credit report Description of credit classes for ecosystem credits and species credits at the development or clearing site or land to be biodiversity certified (BAM Section 10.2). Biodiversity Assessment Method Calculator (BAM-C) case numbers: ▪ 00033469/BAAS18009/22/00033471 for the South East Highlands Bioregion ▪ 00033469/BAAS18009/22/00033472 for the Australian Alps Bioregion	Information on the biodiversity credit report for the biodiversity assessment are detailed in: ▪ Biodiversity credit requirements **– Chapter 13** ▪ Biodiversity offset strategy **– Chapter 14**.

1.4 Personnel

The work to prepare this BDAR was undertaken by appropriately qualified and experienced ecologists, the project personnel, role and qualifications as outlined in **Table 1-3.**

Table 1-3: Personnel, role and qualifications

Name	Role	Qualifications
Chris Thomson	Principal Ecologist – Fauna surveys, report and technical review of BDAR.	Graduate Certificate in Natural Resources Bachelor of Applied Science Accredited under Section 6.10 of the BC ACT as a Biodiversity Assessment Method Assessor (No. BAAS18058)
Jon Carr	Senior Ecologist – Vegetation Integrity Surveys and targeted plant searches, fauna surveys, reporting and mapping	Bachelor of Environmental Science and Management Accredited under Section 6.10 of the BC ACT as a Biodiversity Assessment Method Assessor (No. BAAS18009)
Lukas Clews	Associate Ecologist – Plant community survey and mapping, vegetation integrity surveys and targeted plant searches, reporting, GIS	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 BC ACT as a Biodiversity Assessment Method Assessor (No. BAAS17060)
Brenton Hays	Senior Ecologist – Vegetation Integrity Surveys, fauna surveys, reporting and GIS	Bachelor of Environmental Science and Management (Hons) Accredited under Section 6.10 of the BC ACT as a Biodiversity Assessment Method Assessor (No. BAAS19068)
Tim Maher	Ecologist – Vegetation Integrity Surveys and targeted plant searches, fauna surveys, reporting	Master of Research (Plant Ecology) Bachelor of Advanced Science (Biology)
Matt Consterdine	Ecologist – Vegetation Integrity Surveys and targeted plant searches, fauna surveys	Bachelor of Environmental Science and Management Accredited under Section 6.10 of the BC ACT as a Biodiversity Assessment Method Assessor (No. BAAS20027)
Emma Weatherstone	Ecologist – targeted flora and fauna surveys	Bachelor of Wildlife Conservation
Paul Rossington	Senior Ecologist – Vegetation Integrity Surveys and targeted plant searches	Master of Wildlife Management Bachelor of Science (Biology) Accredited under Section 6.10 of the BC ACT as a Biodiversity Assessment Method Assessor (No. BAAS18065)

Name	Role	Qualifications
Lauren Ascah	Ecologist – Vegetation Integrity Surveys and fauna surveys	Bachelor of Science (First Class Hons) Bachelor of Science, Ecology (University of Calgary)

1.5 Agency Consultation

The NSW Biodiversity, Conservation & Science (BCS) (formerly Biodiversity Conservation Division), NSW National Parks and Wildlife Service (NPWS), and Commonwealth Department of Agriculture, Water and Environment (DAWE) were consulted throughout the development of this BDAR. This included meetings and advice prior to commencement of each phase of survey work, and general correspondence, review and guidance throughout the preparation of the BDAR. A number of briefings and discussions have been undertaken between the project team and BCS following exhibition of the EIS. The threatened species survey plan was also developed in consultation with the then Office of Environment and Heritage (OEH) in November 2018 prior to the commencement of surveys. Consultation included a review of proposed survey design by Miles Boak, Miranda Kerr and Glenn Stroud from the then OEH (who also consulted internally with OEH threatened species experts). Formal briefings were also held on 14 May 2021, 16 June 2021 and 21 July 2021 to discuss matters raised in their submission, project amendments and further biodiversity survey requirements. In addition, numerous technical meetings were held with specialists to discuss specific aspects such as threatened species and survey methodologies.

1.6 Sources of Information used in the assessment

The following databases were searched:

- BioNet - the website for the Atlas of NSW Wildlife and Threatened Species Profile Database – last searched 2 October 2020
- NSW Department of Primary Industries (DPI) freshwater threatened species distribution maps – last reviewed 29 September 2020
- DAWE's Protected Matters Search Tool – last searched 2 October 2020
- NSW BioNet Vegetation Classification database – last reviewed 2 October 2020
- Bureau of Meteorology's Atlas of Groundwater Dependent Ecosystems (GDE) – last searched 2 October 2020
- Department of Environment's Directory of Important Wetlands Tool – last reviewed 2 October 2020.

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)
- *Plant Communities of the South Eastern Highlands and Australian Alps within the Murrumbidgee Catchment of New South Wales Version 1.1* (Office of Environment and Heritage, 2011)
- *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, 2016b)
- *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).

2. Description of the project

2.1 Project components

The project involves construction and operation of an overhead transmission line and substation to connect the Snowy 2.0 main works project to the National Electricity Market (NEM). Key elements include:

- A new substation located within Bago State Forest and adjacent to TransGrid's existing Line 64, which forms a 330 kV connection between Upper Tumut and Lower Tumut switching stations. The substation will occupy a footprint of about 230 metres (m) wide by 530 m long, surrounded by an approximate 80 metre to 100 m wide cleared APZ
- Upgrade and widening of an existing access road off Elliott Way to the substation including the construction of new driveways into the 330 kV and 500 kV switchyards
- Two new 330 kV overhead double-circuit transmission lines from the Snowy 2.0 cable yard to the new substation:
  - Total length of each line is approximately nine kilometres (km)
  - Located in a transmission corridor ranging in width from approximately 120 m to 150 m, inclusive of the hazard tree zone
  - Each line will comprise approximately 21 steel lattice structures up to 75 metres in height
- Short overhead 330 kV transmission line connection (approximately 300 m in length) comprising both steel lattice structures and pole structures as required between the substation and Line 64
- Construction of approximately 7.5 km of new access tracks to the transmission structures, and upgrade to existing access tracks where required. The access tracks will remain following the completion of construction to service ongoing maintenance activities along the transmission lines. A new waterway crossing will be required at Sheep Station Creek for the access track in this location. This crossing is expected to be either a small bridge or a large culvert.
- Ancillary construction activities, including the establishment of tensioning and pulling sites for conductor and earth wire stringing, crane pads, site compounds and equipment laydown areas, water extraction and the transport and haulage of equipment and waste to and from the project area.

The accommodation of approximately 20 construction workers at the Snowy 2.0 works accommodation at Lobs Hole with the remainder of the construction workforce being accommodated as required in the nearby townships of Tumbarumba, Talbingo, Tumut, Adaminaby, Providence Portal and Cooma.

The project location and key components of the project are shown in **Figure 2-1** and **Figure 2-2** respectively. A detailed updated description of the project is provided in Appendix A of the Amendment Report (Transgrid 2021a).

2.2 Project location

The eastern extent of the project is defined by the location of the Snowy 2.0 cable yard at Lobs Hole in Kosciuszko National Park (KNP). The cable yard serves as the transition point between the underground cables carrying electricity generated by Snowy 2.0 to the overhead transmission connection. The cable yard forms part of the Snowy 2.0 Main Works.

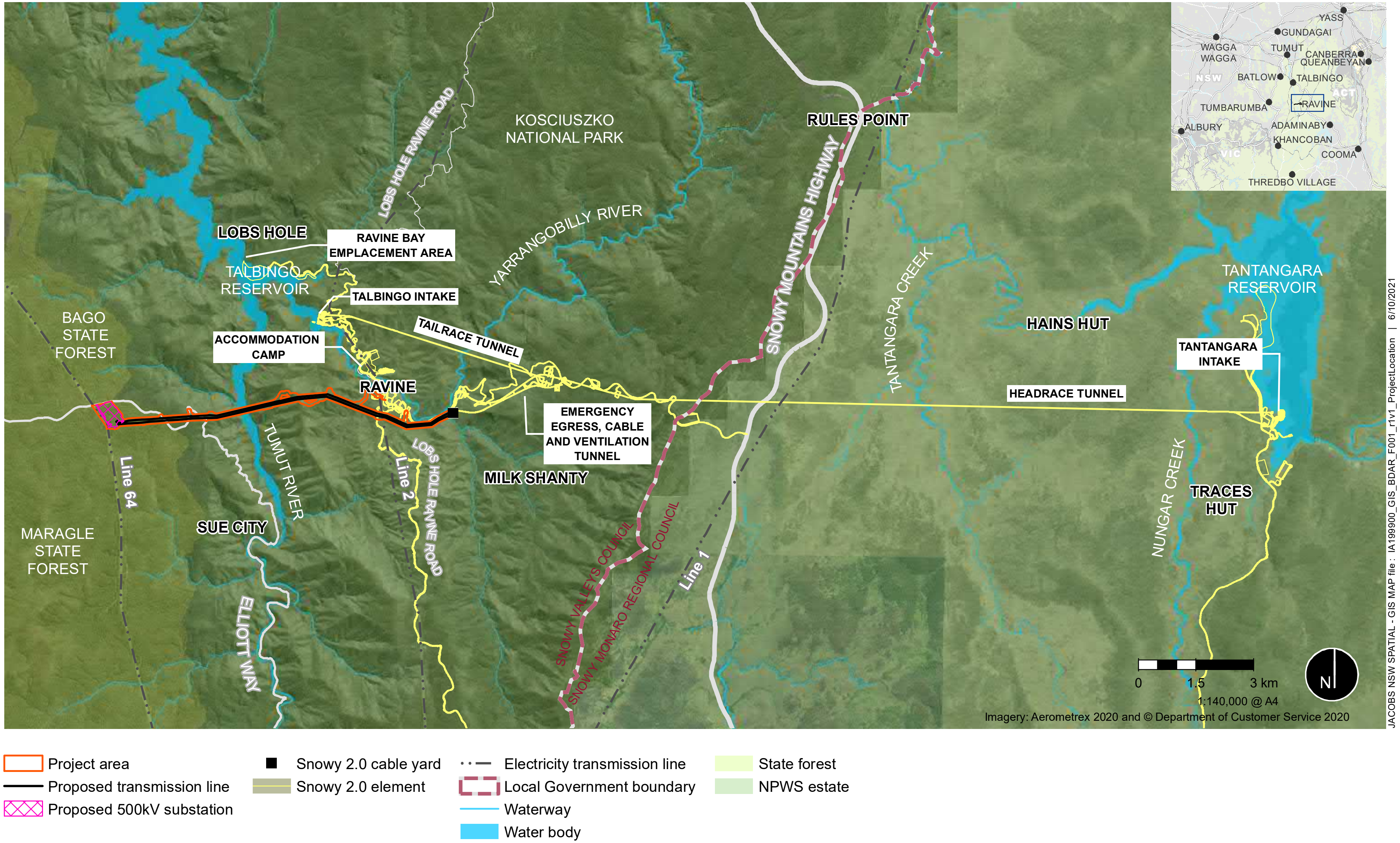
From the cable yard, the transmission connection extends west through KNP and Sheep Station Ridge, which is characterised by steep, mountainous terrain before an aerial crossing over Talbingo Reservoir. The transmission easement then continues into the western extent, passing over Elliott Way at three locations before entering Bago State Forest to the substation site, refer to **Figure 2-2**.

The existing landscape character of much of the project area consists of a mix of undisturbed and managed forestry land, and traverses mountainous and hilly terrain, and forested valleys. This landscape contains limited human disturbance, particularly at the eastern extent, however existing transmission line easements, minor access tracks, and infrastructure associated with the Talbingo Reservoir are located within and surrounding the project area, particularly at the Bago State Forest extent.

2.2.1 Definitions

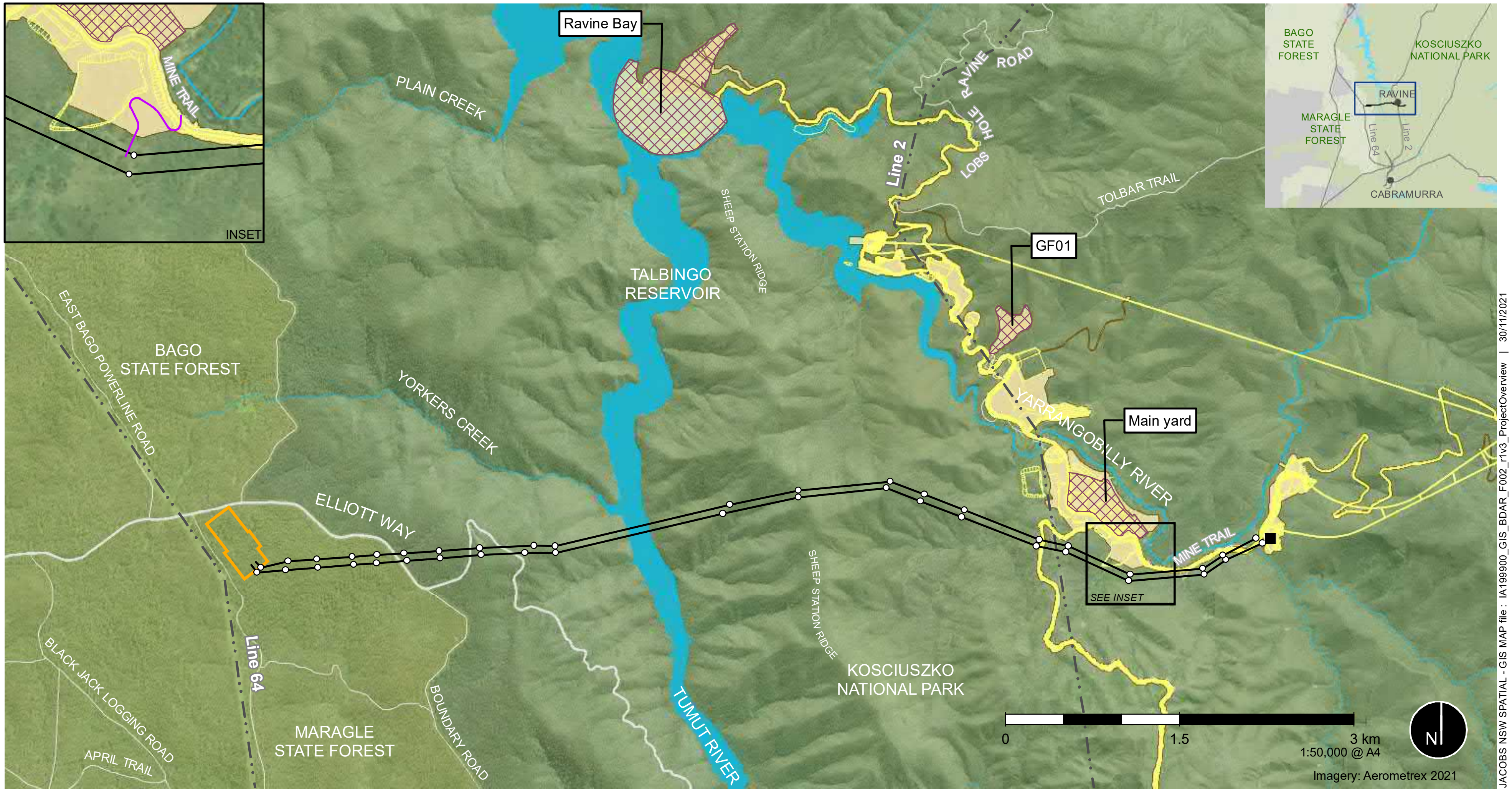
The following areas are discussed throughout the report and are defined as:

- The project: Refers to the concept design for the Snowy 2.0 Transmission Connection project, which includes two double circuit 330 kV transmission lines, substation, access tracks and ancillary infrastructure.
- Disturbance area: The disturbance area encompasses the maximum extent of physical disturbance likely to be required to accommodate construction and operational activities including minor adjustment to design and temporary and permanent infrastructure needed to build the project (see **Figure 2-1** and **Figure 2-2**).
- The exact location of the disturbance area will be situated within the extent of the project area (as described below). The disturbance area is also the vegetation clearing limit that Transgrid is seeking project approval for under Part 5, Division 5.2 of the EP&A Act. The disturbance area has been used for direct impact calculations.
- Snowy 2.0 Main Works disturbance footprint: encompasses the extent of physical disturbance occupied by the approved Snowy 2.0 project, and is not used to calculate direct impact calculations for the transmission connection.
- Project area: The project area in this BDAR is consistent with the term 'subject land' defined in the BAM. It is land that is subject to development, activity, and/or clearing (see **Figure 2-1** and **Figure 2-2**). The project area represents the limits of where disturbance may occur during construction. Project direct impacts on biodiversity values have been calculated using the disturbance area.
- Study area: The study area includes the project area and a 200 m buffer used to capture the biodiversity values outside of the project area (see **Figure 2-1** and **Figure 2-2**). The boundary of the study area shown in the figures of the BDAR includes a 200 m buffer from the edge of the project area, plus land that will be spanned by transmission lines.
- 1,500-metre landscape buffer: An assessment area that comprises a 1,500-metre buffer of land surrounding the project area. The project area and study area are situated within the 1,500-metre landscape buffer. The landscape buffer is equivalent to the assessment area required by the BAM to identify landscape features (see **Chapter 4**) surrounding the project area to provide site context and to inform the likely habitat suitability of the project area (see **Figure 4-1** and **Figure 4-3**)
- Bioregions: The study area is located across two IBRA bioregions: namely The South Eastern 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 Eastern Highlands Bioregion. For consistency with the requirements of the BAM, this assessment has been divided by the boundary of the two bioregions, with impacts assessed and reported separately for each bioregion
- Locality: This is defined as the bioregion sub-regions in which the project is located; that is, the Bondo sub-region of the South Eastern Highlands Bioregion and the Snowy Mountains sub-region of the Australian Alps Bioregion.



Data source:
Jacobs 2021, TransGrid, EMM 2021
© Department Finance, Services and Innovation 2018

Figure 2-1 | Project location



Proposed 500kV substation
Proposed structure
Proposed transmission line
Snowy 2.0 cable yard
Snowy 2.0 element
Emplacement area
Snowy 2.0 Disturbance footprint
Electricity transmission line
Waterway
Water body
State forest
NPWS estate

Figure 2-2 | Project overview

Data source:
Jacobs 2021, TransGrid, EMM 2021,

2.3 Construction

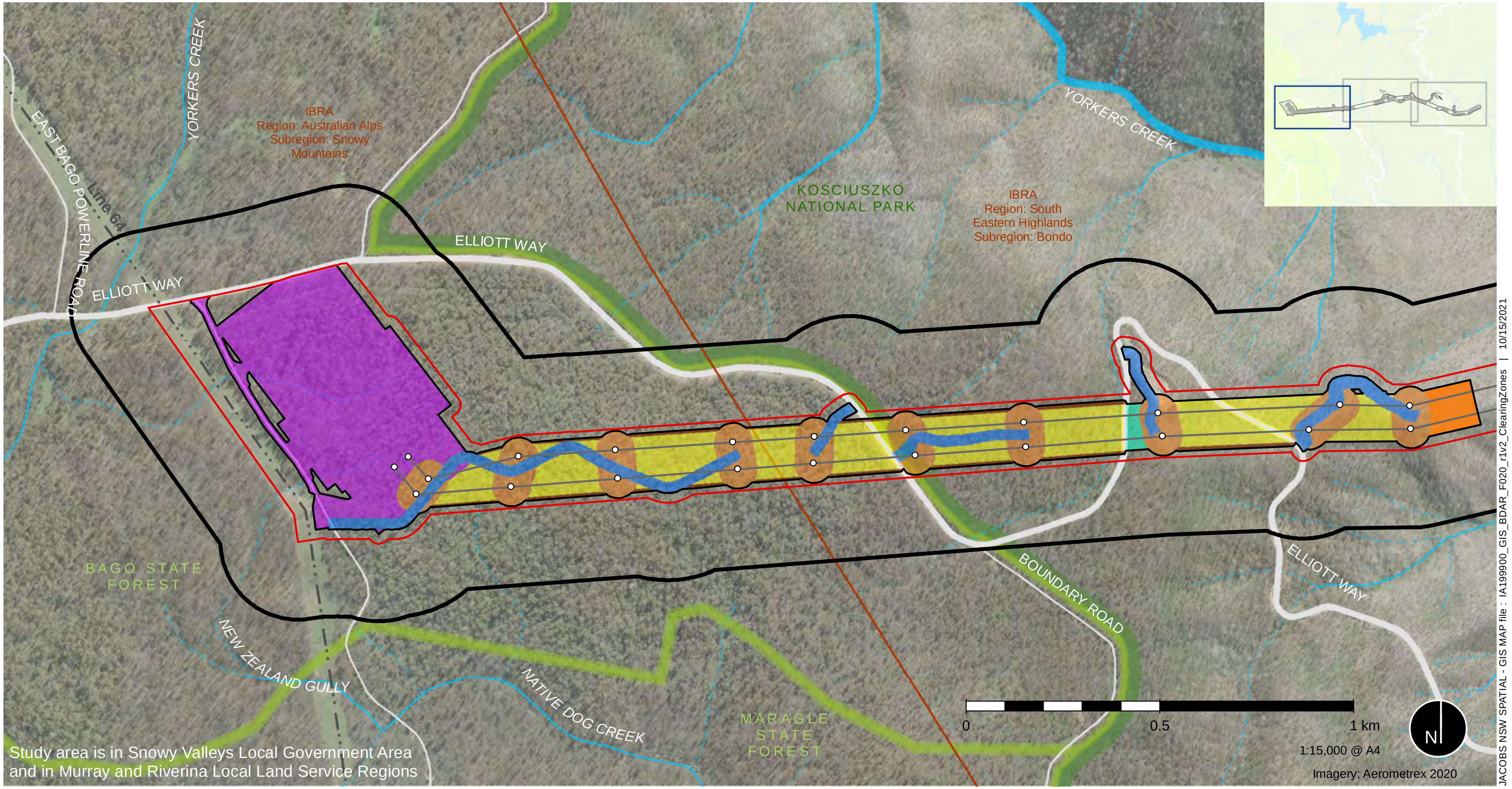
2.3.1 Vegetation clearing areas

The project will involve the removal of vegetation to allow the construction of, and ongoing operational maintenance of the asset for the life of the project. Full clearing will be required in areas that have been identified for future infrastructure, which includes the substation, transmission structures, tension and pulling pads and the access tracks. Partial clearing will occur in areas that are safe to retain low growing vegetation within the operational limits of the asset. This includes large sections of the project area (see **Figure 2-3**). The resulting modified vegetation will be maintained in this state for the life of the project, thereby retaining some of the original biodiversity values in the lower stratum and preserving the surface soil structure (the operational requirements are discussed in **Section 2.4**). Details of the proposed full and partial clearing activities required for construction are summarised in **Table 2-1** and a Vegetation Clearing Method document is provided in **Appendix K .**

Table 2-1: Summary of the vegetation clearing method proposed for construction

General impact	Disturbance zones	Vegetation clearing methods (construction)
Full vegetation clearing areas	Substation Transmission structures Access tracks Tension and pulling pads	Mechanical vegetation clearing methods will be employed to completely remove vegetation. In areas subject to civil works (such as construction benches, structure footings, access track surface, substation bench), complete removal of the root balls will be required. As such, a tree pusher will typically be used in these areas. Removed trees will be passed through a tub grinder with the material then re-used for erosion and sediment control and stabilisation of disturbed areas during and in post construction rehabilitation. Mulched material will only be stored within the cleared footprint. In the areas where civil works is not required, a forest harvester or excavator-mulcher will be used. Mulched material will be evenly spread on bare, disturbed or exposed areas within the full clearing area to assist in protection of the soil. Where low growing vegetation, grasses or ground cover exists, care will be taken to avoid excess debris build up/smothering as to promote regeneration of the grass layer.
Partial vegetation clearing areas	**Easement Clearing Zone (ECZ):** defined as the vegetation zone along the transmission line easement which will require the clearing and ongoing maintenance of tall growing vegetation which may intrude on the operational line operating conditions	During construction, machinery (including tracked machinery) will be used to clear the ECZ. In areas safely accessible to a machine, smaller trees (or other tall growing vegetation) <200 mm DBH will be removed using an excavator-mulcher. As such, ground cover species and low growth shrubs will be affected (particularly by trampling) during the mechanical clearing process as part of the movement of the machinery throughout the ECZ. Vegetation > 200 mm DBH will be removed using a forest harvester, noting that tree branches/canopy may be mulched in-situ. The tree barrels will either be: ▪ Tub ground to provide material for erosion/sediment control and rehabilitation for use outside of the ECZ; ▪ Relocated to the edge of the easement and retained as habitat where applicable

General impact	Disturbance zones	Vegetation clearing methods (construction)
		▪ The mulching of vegetation debris will also be dispersed as much as possible throughout the zone during clearing, and designed to minimise heaped mulch that will limit the rehabilitation/emergence of ground cover species following construction.
	Hand-clearing Zone (HCZ) – defined sections of the ECZ not suitable for machine access	In areas of the ECZ that are not safely or practicably accessible for machine clearing during construction, removal/management of vegetation will be undertaken by hand clearing/felling. Felled trees will remain in-situ with the crowns/heads being cut/docked and laid flat.
	Hazard Tree Zone (HTZ): the off-easement HTZ is defined as the areas external to the ECZ which contain trees of a sufficient height which, if they were to fall, will strike the overhead conductors or the transmission structures (known as Hazard Trees)	LiDAR (Light Detection and Ranging) analysis was performed on the transmission connection concept design modelled under Maximum Line Operating conditions to identify Hazard Trees. The outer boundary of the mapped trees was then buffered with consideration of potential future tree height within the PCTs assessed. This resulted in identifying a HTZ that varies in width adjacent to the project from between 6 to 40 m, depending on tree canopy height. The total area comprising the mapped hazard trees is 2.46 ha which contains an estimated 164 trees to be trimmed, lopped or removed. Individual hand felling of trees will be the preferred method where terrain (or other constraints) preclude management by machine. The broader HTZ which incorporates the necessary buffer area to account for potential future hazard trees is approximately 5.8 hectares (ha).



Project area
Disturbance area
Study area
Proposed structure
Proposed transmission line

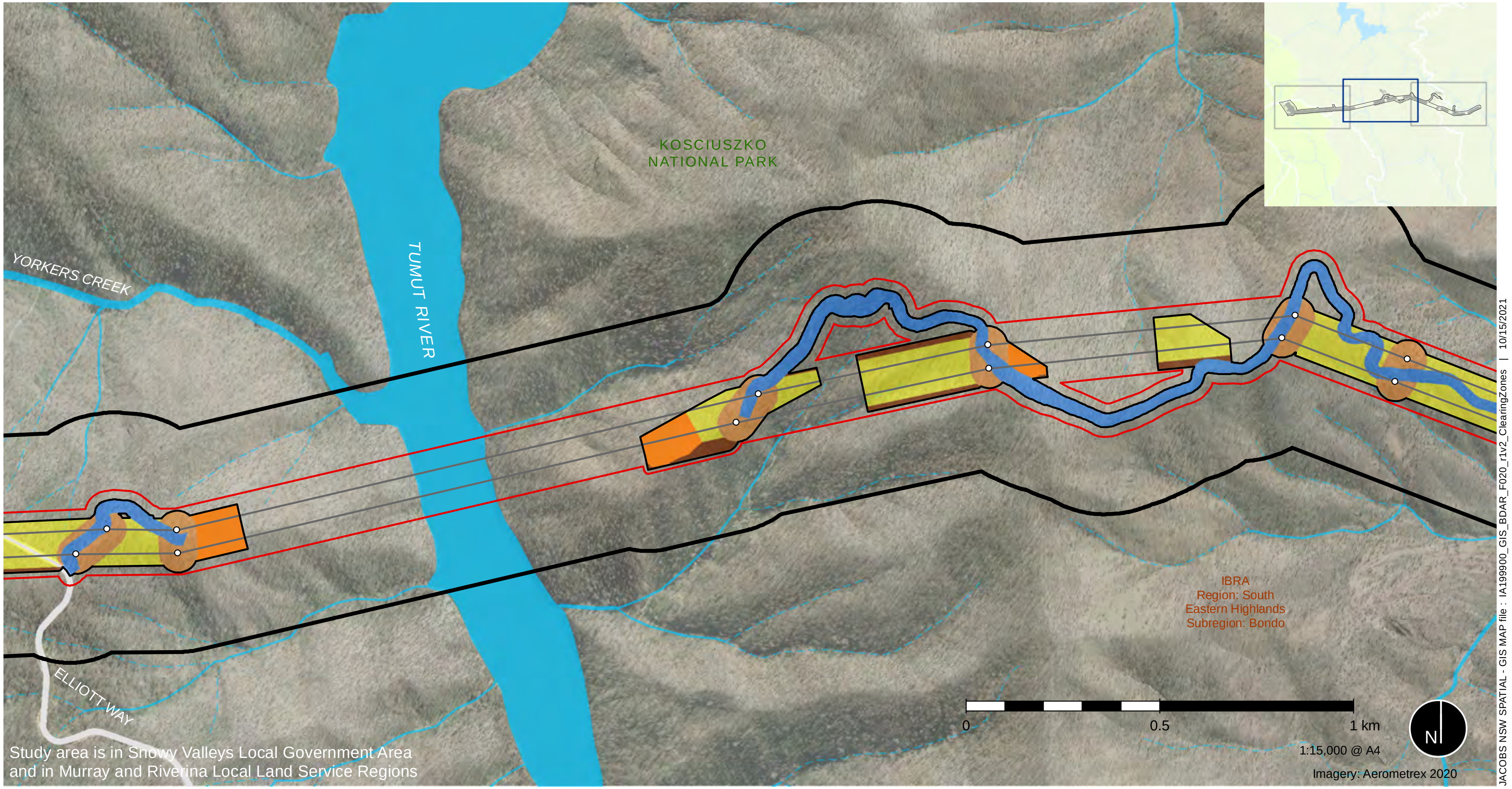
Total Clearing Zones:
Transmission Structure Zone (TSZ)
Access Track Zone (ATZ)
Substation Zone (SZ)
Tension and Pulling Zone (TPZ)

Partial Clearing Zones:
Easement Clearing Zone (ECZ)
Hand Clearing Zone (HCZ)
Hazard Tree Zone (HTZ)

Electricity transmission line
Minor road
Major road
Waterway
IBRA
NPWS estate
State Forest

Data sources:
Jacobs 2021, TransGrid 2021
© Department Finance, Services and Innovation 2018

Figure 2-3 | Vegetation clearing zones



Project area
Disturbance area
Study area
Proposed structure
Proposed transmission line

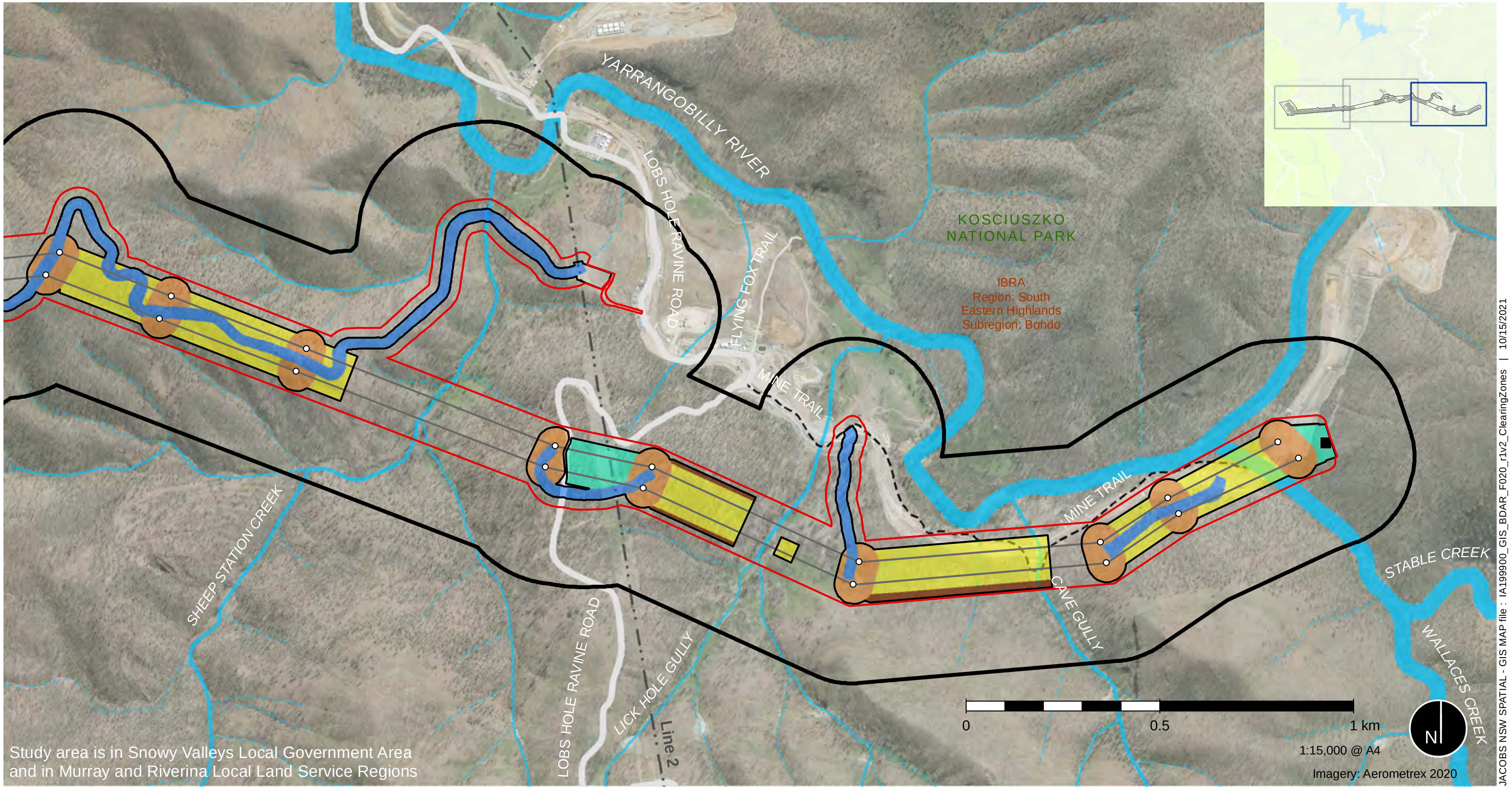
Total Clearing Zones:
Transmission Structure Zone (TSZ)
Access Track Zone (ATZ)
Substation Zone (SZ)
Tension and Pulling Zone (TPZ)

Partial Clearing Zones:
Easement Clearing Zone (ECZ)
Hand Clearing Zone (HCZ)
Hazard Tree Zone (HTZ)

Major road
Waterway
NPWS estate

Data sources:
Jacobs 2021, TransGrid 2021
© Department Finance, Services and Innovation 2018

Figure 2-3 | Vegetation clearing zones



Project area
Disturbance area
Study area
Proposed structure
Proposed transmission line

Total Clearing Zones:
Transmission Structure Zone (TSZ)
Access Track Zone (ATZ)
Substation Zone (SZ)
Tension and Pulling Zone (TPZ)

Partial Clearing Zones:
Easement Clearing Zone (ECZ)
Hand Clearing Zone (HCZ)
Hazard Tree Zone (HTZ)

Snowy 2.0 cable yard

Electricity transmission line
Minor road
Major road
Trail
Waterway
NPWS estate

Data sources:
Jacobs 2021, TransGrid 2021

Figure 2-3 | Vegetation clearing zones

2.3.2 Construction activities

The construction works will commence with the construction of the access tracks to the substation and structure locations. Once suitable access has been established, construction of the substation and transmission line will commence and occur concurrently.

A summary of the construction activities is provided in **Table 2-2.**

Table 2-2: Summary of proposed construction activities

Construction activity	Description
Pre-construction, site establishment and vegetation clearance	▪ Site mobilisation once relevant approvals have been granted, property acquisitions have been finalised Forestry Corporation of NSW (FCNSW) and National Parks and Wildlife Service (NPWS) and agreements with construction contractors has been achieved ▪ Surveying and marking out the approved disturbance area and any environmental avoidance areas ▪ Installation of appropriate stormwater and diversion drainage and erosion and sedimentation control works prior to ground disturbance and vegetation clearing until such time as completion criteria are met. ▪ Inform recreational users of KNP, Bago State Forest and Talbingo Reservoir of the construction activities, the extent of work areas and the locations of environmental exclusion areas with project notifications, including warning signs of construction activities and notifications of access restrictions ▪ Establishment of the construction compound and equipment laydown areas at the substation site and at Lobs Hole*.
Access tracks	▪ Vegetation clearing within the approved corridor (as described in **Table 2-1**). ▪ Grubbing and bulk earthworks (cut and fill) using an excavator ▪ Installation of suitable drainage structures and sediment retention basins where required. The project area and footprint assessed for track development includes space for localised drainage and sediment retention basins as required ▪ Laying and compaction of a suitable rock aggregate/road base ▪ Grading and/or reshaping of existing tracks where required, within the existing access track width (no road widening) ▪ Minor excavations followed by laying and compaction of crushed rock or gravel, to improve the track surface and drainage ▪ A new waterway crossing will be required at Sheep Station Creek for the access track in this location. This crossing is expected to be either a small bridge or a large culvert.
Substation	▪ Vegetation clearing across the substation site and surrounding asset protection zone (APZ). This will involve the stripping and stockpiling of topsoil for later use within the disturbance footprint ▪ Establishment of a site compound and laydown area within the cleared APZ. The site compound will be in place throughout the construction period and is expected to contain a demountable office, meal room, and toilet/shower facilities, equipment laydown areas, vehicle and equipment storage, maintenance sheds, chemical/fuel stores and stockpile areas ▪ Minor earthworks to establish the site amenities, which will include cut and fill to establish a level area for the site facilities and temporary storage areas and establishment of the permanent site access road

Construction activity	Description
	▪ Earthworks: - Excavation works to remove excess material, provide a level surface, and create the required trenches for drainage, earthing, and electrical conduits. Some spoil from the excavation may be reused on site for filling and compaction (including benching areas in the study area where required) and this will occur within the assessed project area. Excavation works will be carried out using equipment such as excavators, dozers and crushing plant. Furthermore, depending on the underlying geology, blasting may be required to facilitate the break-up of rock, should it be present - Bulk earthworks to establish the level surface for the substation bench - Approximately 11,300 cubic metres of excess spoil will be generated from the levelling of the substation site and construction of the access road. Any soil which cannot be reused onsite as fill material, landscaping or other means will be disposed of off-site at a suitably licenced facility and/or at a location(s) onsite approved by FCNSW. If this occurred, the disposal will be on existing cleared land only and not require vegetation clearing or any impact on biodiversity values - Where excavated spoil is not appropriate for reuse on site, additional spoil will be imported to site. Where this is required, this will be sourced from suitably licenced quarry and certified as pathogen and weed free Excavated Natural Material (ENM) or Virgin Excavated Natural Material (VENM). ▪ Civil and building works: - Civil works involving the establishment of concrete footings for the high voltage equipment and buildings, construction of stormwater drainage and oil containment infrastructure and cable trenches and subsurface cables. ▪ Construction of onsite buildings (e.g. control room) and services installed including general lighting, power and ventilation ▪ Installation of security fencing on all sides of the substation. The security fence will be about 3 m high and be comprised of a galvanised steel (or similar) material and topped with barbed or razor wire.
Transmission line	▪ Vegetation clearing within the approved disturbance area where the overhead conductors will not meet safe clearance heights above the underlying vegetation. Clearing will be conducted as per methods in Table **2-1** and **Appendix K**. ▪ Grading and/or reshaping of existing access tracks where required ▪ Establishment of the transmission structure work sites involving: - Clearing of an approximate 50 m area around each transmission structure location to allow for the laydown of materials and equipment and facilitate access for vehicles, plant and machinery during structure construction - Bulk earthworks (cut and fill) to establish level construction benches within the worksite to allow for the safe operation of plant and equipment (namely elevated works platforms and cranes) during structure construction - Geotechnical investigation works using a mobile drill rig at each structure location to determine the most appropriate footing design

Construction activity	Description
	- Bulk earthworks and excavations to establish the structure footings involving the installation of steel framework and backfilling with concrete or pile type footings involving boring four boreholes at each structure leg location and backfilling with concrete - Steel lattice structures will be transported to each structure location via heavy vehicle in parts and assembled on site using mobile cranes. ▪ Stringing of conductor and overhead earth wire which will involve: - Establishment of tensioning and pulling sites within the 50 m area around the structure and at suitable locations within the tensioning and pulling zone (TPZ) where tensioning and pulling equipment needs to occur outside of the transmission structure areas. - Attachment of sheaves (or pulleys) to the top of the structures in readiness for stringing work using an elevated work platform - Pulling out a lightweight draw wire across the section of line being strung using a drone, vehicle/machine (such as dozer) or helicopter, followed by the placement of the draw wire through the sheaves - Attachment of the draw wire to the earth wire or conductor drum (depending on which is being strung) and pulling it through the sheaves under tension using specialised tensioning and pulling equipment - Termination of the conductor/earth wire at each end clipping it into position followed by the removal of the sheaves.
Commissioning	▪ Testing of all high voltage equipment at the substation and ensuring all protection, control and metering equipment is operating correctly ▪ Completion of all necessary cut-in works to Line 64 and relevant testing undertaken ▪ Placement of the new transmission lines and substation into standby in readiness for Snowy 2.0 to be completed ▪ Once Snowy 2.0 becomes operational, energisation of the high voltage equipment and the project placed into service.
Rehabilitation and demobilisation	▪ Removal of all non-permanent infrastructure and equipment from the work sites and site compounds ▪ Decommissioning and dismantling of the site compounds at the substation and Lobs Hole ▪ Site stabilisation and landscaping involving: - Stabilisation and rehabilitation of exposed areas and slopes - Installation and maintenance of erosion and sediment controls at the work sites to manage impacts post-construction - Seeding soil slopes to assist stabilisation - Planting vegetation on any higher risk slopes - Mulching of stabilised and revegetated areas where required.

*The site compound at Lobs Hole will be partially located within the Snowy 2.0 disturbance footprint (05.02.2020).

2.3.3 Construction staging and timing

Construction of the project is anticipated to commence in mid-2022 and take approximately 55 months to complete. Notwithstanding, the commissioning of the grid connection of Snowy 2.0 is expected to occur approximately 30 months from the commencement of construction with the balance of the project staging (approximately 25 months) being associated with the construction and commissioning of the 500 kV switchyard to support the future HumeLink connection. Estimated timing for the main construction activities is set out in **Figure 2-4**. Further details on the estimated timing and staging of the main project activities is described in Appendix A of the Amendment Report (Transgrid 2021a)

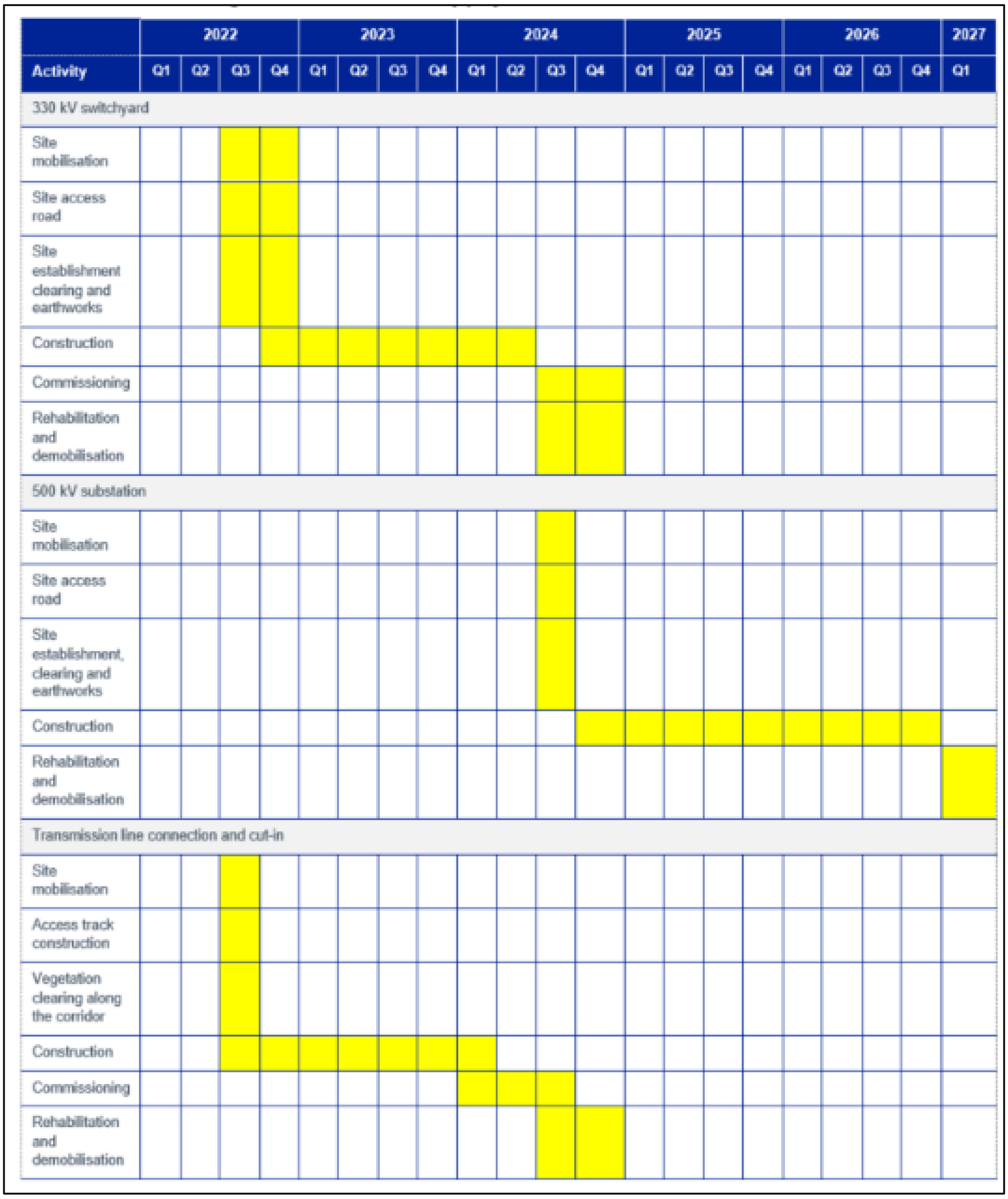


Figure 2-4: Indicative timing for the construction of key project components

2.3.4 Construction working hours

Given the isolated location of the project with no residential dwellings potentially affected by noise generating works and the construction of Snowy 2.0 occurring in parallel, construction works are expected to be carried out 12 hours per day, seven days per week between the hours of 6 am and 6 pm. Traffic movements to and from the project area will occur approximately one hour either side of the construction working hours and will continue throughout the hours of construction (i.e. traffic movements will occur between the hours of 5 am to 7 pm).

2.3.5 Rehabilitation and demobilisation

Following construction, all non-permanent infrastructure such as equipment laydown areas and site compounds will be decommissioned and removed from site. The rehabilitation activities will consider the overarching phases with key activities to be carried out both during and post construction as outlined in the Rehabilitation Strategy provided in **Table 2-3**. The Rehabilitation Strategy will form the basis of the Rehabilitation Plan which will be prepared to guide the long-term rehabilitation of applicable parts of the project area where permanent infrastructure and management (i.e. clearing under transmission lines) is not required. The Rehabilitation Plan will be developed in consultation with NPWS and the FC NSW. The Rehabilitation Plan will be consistent with the approved Snowy 2.0 Rehabilitation Plan prepared for Snowy Hydro for work within the Snowy 2.0 disturbance footprint.

All rehabilitation activities will be in accordance with the project Rehabilitation Plan which will be developed for the project.

Table 2-3: Framework for proposed Rehabilitation Strategy

Project phase	Proposed rehabilitation activities
Site preparation	During the preparation of the worksites including the substation, access tracks and transmission structure sites, the following activities will be carried out: ▪ Collection and stockpiling of organic matter from removal of vegetation during construction, including topsoil, woodchip and organic matter for use in rehabilitation.
Site stabilisation and landscaping	Site stabilisation activities will be carried out both during and post construction and will include the following: ▪ Stabilisation of exposed areas and slopes and prepare the sites for revegetation ▪ Installation of erosion and sediment controls at the work sites to manage impacts both during and post construction ▪ Seeding soil slopes to assist in stabilisation ▪ Planting vegetation on any higher risk slopes ▪ Mulching of stabilised and revegetated areas where required.
Maintenance and monitoring	Ongoing maintenance and monitoring of rehabilitation works will include: ▪ Monitoring of stabilised slopes and revegetated areas ▪ Monitoring on the performance of erosion and sediment controls ▪ Weed control and monitoring ▪ Maintaining any fencing placed around rehabilitation areas ▪ Re-mulching of stabilised and revegetated areas where required.
Demobilisation	Following the completion of construction, demobilisation activities will be carried out and will likely include: ▪ Removal of any temporary fencing around the works sites and site compound areas ▪ Disassembling and removal on any temporary on-site infrastructure including site offices, amenities, equipment storage, and maintenance sheds within the site compound areas ▪ Removal of all construction equipment and machinery from the site compound areas and work sites ▪ Removal and disposal of any remaining stockpiles and other waste materials from the site compounds and other laydown areas ▪ Removal of any temporary environmental controls (e.g. erosion and sediment controls) which are no longer required. The rehabilitation phases described above will coincide with the work site demobilisation activities.

2.4 Operation

The substation and transmission connection will be inspected by field staff on a regular basis. Key activities undertaken during operation will include:

- Regular inspection and maintenance of electrical equipment at the substation including structural integrity of all footings and support structures
- General inspection and maintenance of other components within the substation including the stormwater management system, fire detection system, onsite buildings and drainage infrastructure
- Regular inspection and maintenance of the transmission structures, footings, fittings, conductors and overhead earth wires.

It is expected that only light vehicles and small to medium plant will need to access the substation site and the transmission line easement for routine operational activities. The new substation will not accommodate full-time staff or contractors, and the regular collection of waste will therefore not be required during the operational phase. Any waste generated during operation of the substation and transmission easement will be minimal and disposed of on an 'as needs' basis, this includes contractors and plant involved in ongoing maintenance on the operational easement

2.4.1 Vegetation maintenance

Key activities associated with ongoing vegetation maintenance within the easement during operation will include:

- Vegetation removal and trimming within transmission easement clearing zone and substation APZ to maintain appropriate clearances between ground vegetation and the overhead transmission lines and around the substation to manage bushfire risk
- Ongoing identification and periodic removal of tall growing trees within the easement which have the potential to breach the safe clearance area beneath the conductors and trees external to the easement (hazard trees), which if were to fail, will strike the overhead conductors or the transmission structures.

Figure 2-5 shows a conceptual diagram of the operating easement, the easement clearing zone (ECZ) and hazard tree zone. Detail of the vegetation maintenance activities in each partial clearing zone are described in **Table 2-4.**

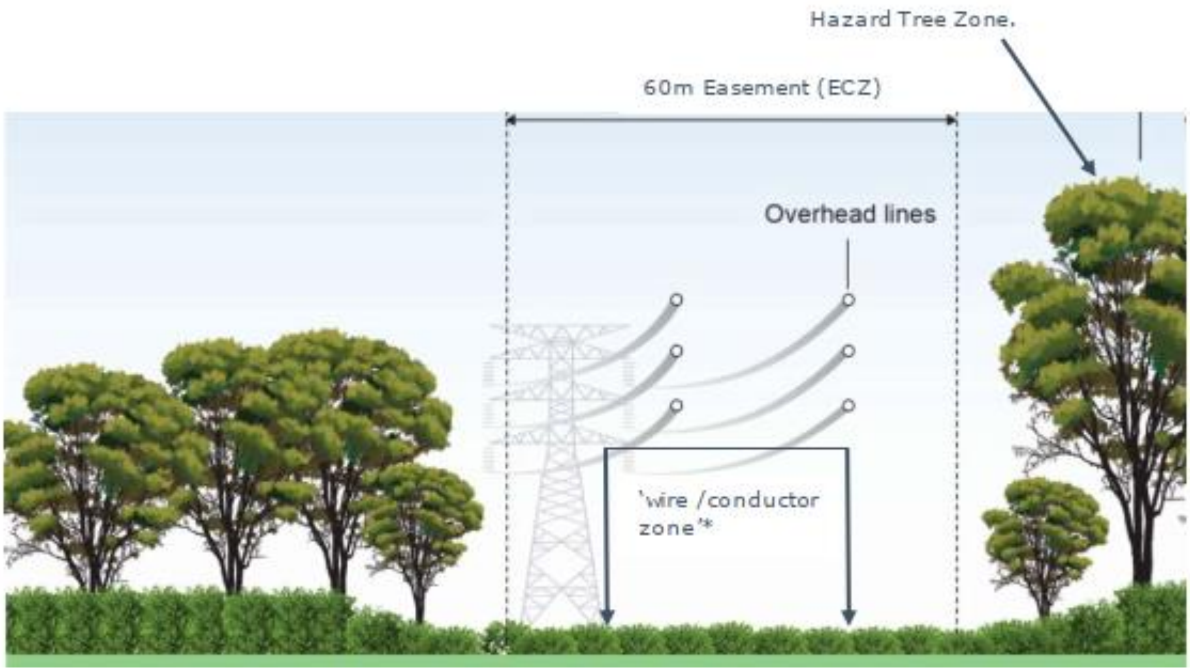


Figure 2-5: Operational vegetation maintenance of a typical easement

Table 2-4: Summary of proposed operational maintenance of vegetation

General impact	Disturbance zones	Vegetation maintenance methods (operation)
Full vegetation clearing areas	Substation, transmission structures, access tracks, tension and pulling pads	For the purposes of the biodiversity assessment, it is assumed that these disturbance zones will be subject to complete vegetation loss.
Partial vegetation clearing areas	Easement Clearing Zone (ECZ):	During operation, potential future slashing and mulching of the ECZ may be required to manage flashover and bushfire risks posed by tall and/or dense growing and mid-storey vegetation. A range of mechanical and manual vegetation management methods will be employed including: > Removal and/or herbicidal application of any regrowth with potential to infringe on safe electrical clearances > Selective hand clearing and/or application of a herbicide to control growth > Selective slashing and/or mulching with slasher/mulcher set to 200 mm above the ground level across the easement, particularly below the conductors or to establish safe access during maintenance.
	Hand-clearing Zone (HCZ)	Ongoing selective tree removal as required. This will be informed by period inspection and assessment. Felled trees to remain in-situ with the crowns/heads being cut/docked and laid flat.
	Hazard Tree Zone (HTZ):	A LiDAR inspection will be carried out annually for the life of the asset. Any off-easement hazard trees identified will be individually assessed by a qualified arborist to assess the health of the tree and important habitat features (i.e. nests, hollows). Trees in poor health or that contain defects will be removed or pruned. Hazard trees may be felled and left in-situ, or where potential to damage significant habitat trees to be retained, the tree will be removed sensitively from the top down.

3. Legislation and policy

In accordance with Part 7.9 of the *Biodiversity Conservation Act 2016* (BC Act), an application for approval under Division 5.2 of the EP&A Act to carry out State Significant Infrastructure must be accompanied by a BDAR unless the Planning Agency Head and the Environment Agency Head determine that the project is not likely to have any significant impact on biodiversity values. The SEARs issued for the project (**Section 1.2** of this report) have determined the need for a BDAR in accordance with Section 5.16 of the EP&A Act.

The Biodiversity Offsets Scheme applies to SSI projects unless the Secretary of DPIE and the Chief Executive of the Environment, Energy and Science Group (EESG) determine that the project is not likely to have a significant impact. This document is the BDAR for the project as required under the Biodiversity Assessment Method (BAM). This BDAR documents the results of the biodiversity assessment undertaken for the project in line with the relevant State and Commonwealth environmental and threatened species legislation and policy. This BDAR has been prepared by the accredited assessors identified in **Table 1-3**, who are accredited under Section 6.10 of the BC Act to apply the Biodiversity Assessment Method (BAM) in connection with the BDAR pursuant to Part 6 of the BC Act.

The BDAR has been prepared in compliance with the BAM (DPIE 2020a) and is structured around two primary stages:

- Stage 1 – Biodiversity assessment
- Stage 2 – Impact assessment (biodiversity values and prescribed impacts).

Biodiversity Assessment Method Calculator (BAM-C) case numbers 00033469/BAAS18009/22/00033471 for the South East Highlands Bioregion and 00033469/BAAS18009/22/00033472 for the Australian Alps Bioregion are associated with this BDAR.

This BDAR also addresses potential impacts to biodiversity listed under the *Fisheries Management Act 1994* (FM Act) and Matters of National Environmental Significance (MNES) identified in the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

An EPBC Act referral (2018 / 8363) was made to the Department of Agriculture, Water and the Environment (DAWE) on 28 February 2019 to assess whether the project will be considered to be a controlled action. On 5 April 2019, the department determined the project to be a 'controlled' action (referral reference number 2018/8363) on the basis of potential impacts to the following MNES:

- Listed threatened species and communities (section 18 & section 18A)
- Listed migratory species (section 20 & section 20A); and
- The heritage values of a National Heritage place (section 15B & section 15C).

The NSW Government confirmed the action will be assessed via the "Bilateral agreement made under section 45 of the EPBC Act relating to environmental assessment between Commonwealth of Australia and the State of New South Wales" (Bilateral Agreement) (2015). This agreement accredits the assessment process under Division 5.2 of the EP&A Act. As the project is considered a controlled action, the Australian Minister for the Environment will need to issue a separate approval for the project to DPIE.

4. Landscape features

4.1 IBRA bioregions and sub-regions

The project is located across two bioregions: the South Eastern Highlands (SEH) Bioregion in the eastern portion and the Australian Alps (AA) Bioregion in the western portion (Thackway and Cresswell, 1995), and within the Bondo and Snowy Mountains sub-regions respectively (refer **Figure 4-3**). There is approximately 118.35 ha of native vegetation within the disturbance area, including 38.26 ha in the Australian Alps Bioregion and 80.09 ha in the South Eastern Highlands Bioregion.

The majority of the project is located in the Bondo sub-region of the South Eastern 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.

Given this linear project crosses two bioregions and the differences in vegetation and habitat from each bioregion, a precautionary approach has been taken for this assessment, and two separate BAM-C case assessments have been created: one for the Australian Alps Bioregion and one for the South Eastern Highlands Bioregion. The boundaries of the IBRA regions case assessments were established using the spatial dataset 'Interim Biogeographic Regionalisation for Australia (IBRA), Version 7 (Regions)' (Department of the Environment and Energy, 2016).

4.2 BioNet NSW Landscapes (Mitchell landscapes)

The project crosses a diversity of landscapes mapped by the NPWS (2002) and described by the NSW Department of Environment and Climate Change (2001) as follows from east to west (refer to **Figure 4-1**):

- Pinbeyan – Ravine Ranges (approximately 48 per cent of the project) - 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 (approximately five per cent of the project) - 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
- Tooma Granite Ranges (approximately 43 per cent of the project) – 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.

The broader study area, outside of the project area, also includes a small area of the Cabramurra - Kiandra Basalt Caps and Sands. This landscape is represented by 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.

4.3 Rivers, streams and estuaries

The project area is located within the Murrumbidgee catchment. The broader study area contains the second order streams of Yorkers Creek, Native Dog Gully and New Zealand Gully that are fed by 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 substation site, 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.

East of the Talbingo Reservoir, the project will be built on ridges that are drained by unnamed first and second order ephemeral drainage lines. These unnamed drainage lines 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 ephemeral drainage lines that join the third order ephemeral stream of Sheep Station Creek. East of Lobs Hole Ravine Road the landscape is drained by first and second order drainage lines that flow into Lick Hole Gully and further east Cave Gully which are second and third order streams respectively. 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 crosses more first and second order streams and the larger fifth order stream of Wallaces Creek that flows north into the Yarrangobilly River.

West of the Talbingo Reservoir, the structures will 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. All waterways are displayed in **Figure 7-1**.

4.4 Wetlands

There are no naturally occurring wetlands in the project area. The transmission lines will span across the Talbingo Reservoir, which is not a naturally occurring wetland, however, does offer wetland habitat features.

4.5 Connectivity of habitat

According to the BAM, for project area, the assessor must identify the connectivity of different areas of habitat that may facilitate the movement of threatened species across their range. The habitat within the project area has a high degree of connectivity to other large areas of habitat within the KNP and Bago State Forest. The project is predominantly located within the KNP with the western end situated in the Bago State Forest. KNP is largely vegetated across its 690,000 ha extent and intact remnant vegetation extends across the Australian Alps and into the South Eastern Highlands. The Talbingo Reservoir provides a barrier to east west movement for some fauna groups.

South from the project area, there is habitat connectivity south into Victoria in national parks, state forests and on private land from the Snowy Mountains and Monaro, to the Victorian Highlands, Victorian Alps, South East Coastal Ranges, Kybean-Gaurock subregion, and into the East Gippsland Lowlands subregion to the coast on the south east corner. Connectivity to the north exists through the Bondo subregion extending through to the Inland Slopes and Murrumbateman subregions where agricultural land becomes dominant and habitats are largely cleared or fragmented. From the project area within the Snowy Mountains in the west, vegetation stretches into the Bondo and Inland Slopes subregions where the habitats become fragmented by agricultural development. Eastern connectivity exists through the Bondo subregion, Snowy Mountains, and into the Monaro where habitats become fragmented by agricultural development. There are high levels of physical, and functional, habitat connectivity surrounding the project area. However, some species will not be adapted to all environments and restricted environments do exist within this larger connected landscape.

4.6 Areas of geological significance and soil hazard features

Areas of geological significance generally include karst, caves, crevices and cliffs. Many of these geological features occur within proximity to the project area and there are some areas of rock outcrop with crevices. Areas of rock outcrop within the study area, including granite tors, are shown in **Figure 4-1**.

The KNP contains well-known periglacial features including terracing, solifluction lobes, sliding and shattered boulders and block streams (also known as scree slopes or boulder streams). The block streams are recognised as a significant natural feature of the KNP and are listed under 'Rocks and Landforms' in Schedule 1 (Significant Natural and Cultural Features) of the Kosciuszko Plan of Management (KNP PoM) (Department of Environment and Conservation, 2006). Block streams occur to the south of the project area along Lobs Hole Ravine Road but will not be impacted by the project area.

The Devonian shallow-water sediments in the Ravine Basin, within which the eastern portion of the project area is situated, are listed under 'Rocks and Landforms' in Schedule 1 (Significant Natural and Cultural Features) of the KNP PoM. There is an outcropping of the Devonian age Lick Hole Formation located along the lower section of Lobs Hole Ravine Road to the south of the project area. The strata consist of grey friable shale with a high density of calcareous, rounded nodules. Some nodules appear to display the remains of branching structure and are assumed to be corals. Fossils of trilobites, brachiopods and molluscs are also present (EMM Consulting, 2018a).

In terms of Karst areas, the tufa deposits and fossil sequence at Ravine are recognised in the KNP PoM as a significant natural feature. Karst features are considered to be rare within the Lick Hole Formation as there is a general lack of massive limestone (EMM Consulting, 2018a). The tufa deposits occur between 300 to 750 m downslope of the project area within two main areas, Cave Gully and Lick Hole Gully (refer to **Figure 4-1**). The Cave Gully deposit is located in Cave Gully approximately 1 km upstream of the Lobs Hole Copper Mine. The Lick Hole Gully Tufa is deposited near the headwaters of Lick Hole Gully and are visible from Lobs Hole Ravine Road. The Ravine Copper Mine (Lobs Hole Mine) is recognised as a geoheritage site in the KNP PoM. These tufa deposits are considered to be too far away from the project area to be impacted by vibrations during construction and mitigation provided in **Section 11** will minimise the likelihood of indirect project impacts.

The red and yellow earths formed from deeply weathered granodiorite in the western portion of the project area are subject to localised sheet, gully and wind erosion following vegetation disturbance. Hydrogeological mapping to the west of the disturbance area in the alpine areas of the upper Murray Catchment show that the Tumbarumba Hydrogeological Unit (which the western extent of the disturbance area on granodiorite geology is likely to cover) has a low salt store that has moderate availability. The overall salinity hazard in this area is low. There is no acid sulfate soil risk mapping available. The soil assessments undertaken for the Snowy 2.0 Exploratory Works and Main Works EIS (EMM Consulting, 2018 and EMM Consulting 2019) indicate that east of Lobs Hole Ravine Road, shallow Tenosols occur on the mid to upper slopes and crests of the undulating hills and have low to moderate erosion potential and are moderately dispersive throughout the profile. Deeper Kandosols are found on the gentler mid to upper slopes and these have a low to moderate erosion potential and are moderately dispersive in the B horizon. Dermosols are also present along Lobs Hole Ravine Road (reddish pink colour soils) and these have low to moderate erosion potential with the bottom 30 cm of the profile being moderately dispersive (EMM Consulting, 2018b and Cardno, 2018). Some smaller areas of Haplic Epipedal Black Vertosol soils occur along the Yarrangobilly River floodplain (EMM Consulting, 2018b).

4.7 Areas of outstanding biodiversity value

The project area does not contain any areas of outstanding biodiversity value listed on the register of declared areas of outstanding biodiversity value.

4.8 Native vegetation extent

To assess the percentage of the current extent of native vegetation, a buffer of 1,500 m was placed around the boundary of the project area. While the transmission line is a linear feature, the project area contains a mix of linear features such as the easement and access tracks, and individual site-based features including structure locations and the substation site. As such, a 500 m buffer of the centre line will not be appropriate to capture all the project features. Therefore, the 1,500 m buffer (landscape buffer) around all features was chosen.

Native over storey vegetation was digitised off an aerial photograph to determine the extent of native vegetation cover within the 1,500 m landscape buffer (see **Figure 4-1**). Obviously cleared areas were excluded from the mapping. However, the calculations are subject to a degree of error as the mapping is desktop based and subject to limited ground truthing. The extent of native vegetation cover within the 1,500 m landscape buffer was then calculated in ArcGIS Desktop (10.7.1).

The 1,500 m landscape buffer is approximately 4,052 ha in size. There is approximately 3,931 ha of native vegetation (woody and non-woody vegetation including native grasslands) within the 1,500 m landscape buffer. This results in a percent native vegetation cover in the landscape of 97.01 per cent. Native vegetation cover in the landscape is very high in the >70 per cent cover class. These calculations are an approximation only and there are dirt roads that exist throughout the 1,500 m buffer that are not mapped as they have canopy cover. The purpose of the percentage vegetation cover calculation is to create a figure of native vegetation cover that is used in the BAM-C to predict threatened species likely to occur or use habitat on a site. Minor adjustments to polygon boundaries will not affect the >70 per cent cover class present within the landscape buffer particularly given the high quantification of vegetation cover.

4.9 2019/2020 Dunns Road bushfire

The Dunns Road bushfire that impacted the project study area started on 27 December 2019 from a lightning strike in a private pine plantation near Adelong. The fire covered a total area of 333,980 ha (NPWS 2020). The severity of this fire across the project study area is shown in **Figure 4-2** and **Figure 4-4**, which displays the spatial dataset 'Fire Extent and Severity Mapping' (FESM, Department of Planning, Industry and Environment, 2020b) that identifies four burn area classes. Much of the study area has been mapped as the top two classes: "Extreme – full canopy consumption'' and 'High – full canopy scorch /partial consumption''. In the study area and broader locality, lower fire intensity is mapped in Bago and Maragle State Forests compared to KNP, the area between the proposed substation and east to Elliott Way is mapped as 'Low - burnt understorey with unburnt canopy'

The NSW government developed the 'Guideline for applying the Biodiversity Assessment Method at severely burnt sites' (Department of Planning, Industry and Environment, 2020c) following the 2019-2020 bushfires. The aim of the Guideline is to provide assessors with a reasonable, evidence-based and transparent process for identifying severely burnt native vegetation and provides a range of approaches for applying the BAM on land impacted by severe or catastrophic bushfire, i.e. bushfire of high to extreme intensity resulting in significant modification of vegetation structure and composition such that the original vegetation type and condition is no longer identifiable. The Guideline states that the 'Fire Extent and Severity Mapping' can be used to assess a site. Based on this mapping, most of the study area affected by the Dunns Road bushfire will meet the definition or severely burnt.

The majority of the fieldwork undertaken for this BDAR required to identify and assess native vegetation integrity and threatened species habitat was completed prior to the 2019-2020 fires, so the Guideline (Department of Planning, Industry and Environment, 2020c) largely does not apply to this assessment. Targeted surveys for *Caladenia montana* were undertaken after the Dunns Road bushfire (October 2020) as were targeted nest searches for large forest owls , and these did not require the implementation of the Guideline. However, in line with the Guideline, **Figure 4-4** shows recent aerial imagery from after the Dunns Road fire (imagery date April 2020) and likely sites of resource flows and sinks as recognised by the Guideline (i.e. potential locations where moisture and nutrients are likely to accumulate and support more rapid regeneration of vegetation and a higher carrying capacity). Within the project area and study area, likely sites of resource flows and sinks are assumed to be:

- Low lying areas containing swampy and riparian vegetation. These are mapped in **Figure 4-4** using the distribution of Broad-leaved Sally grass - sedge woodland on valley flats and swamps in the NSW South Western Slopes Bioregion and adjoining South Eastern Highlands Bioregion (PCT 285) and Riparian Blakely's Red Gum - Broad-leaved Sally woodland - tea-tree - bottlebrush - wattle shrubland wetland of the NSW South Western Slopes Bioregion and South Eastern Highlands Bioregion (PCT 302) identified during surveys
- Mapped waterways, as these are likely to transport and accumulate nutrients.

These possible sites of resource flows and sinks are therefore likely to be important for the recovery of all bushfire affected vegetation in the locality. Clearing of these areas for the project may threatened the natural process of post-fire recovery over a broader area. The impacts of the Dunns Road bushfire may also increase the potential for indirect impacts to resource flow/sink sites which are downslope from the project area and should be monitored during construction (see **Section 11**). Severely burnt areas will likely take many years to return to a similar state prior to the Dunns Road bushfire, and during this period are susceptible to impacts from weed invasion and soil erosion. These impacts have been discussed further in **Section 10.2**.

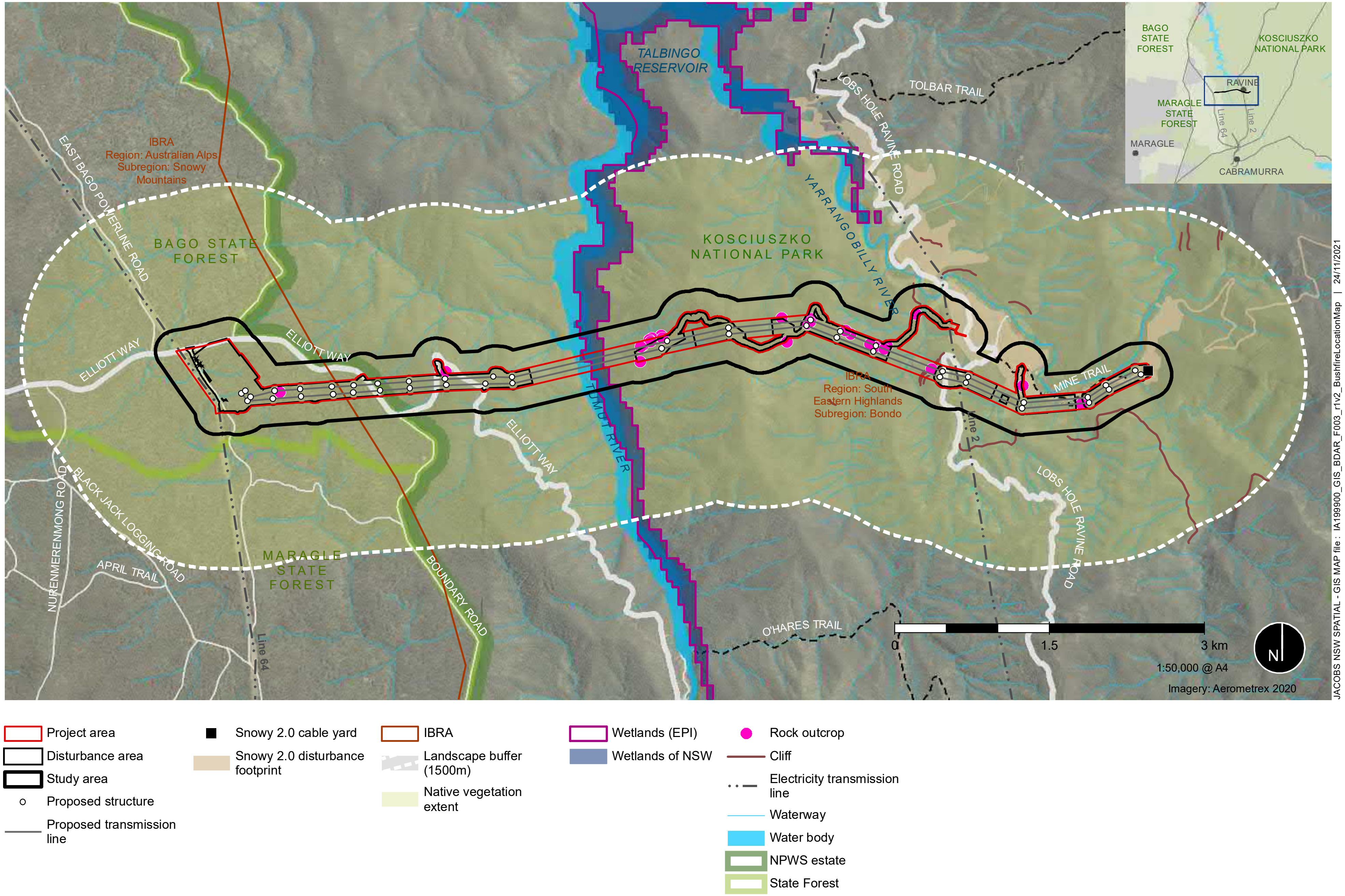


Figure 4-1 | Location map showing pre 2019/2020 bushfires

Data source:
Jacobs 2021, TransGrid 2021, EMM 2021, DPE 2018,
© Department Finance, Services and Innovation 2018

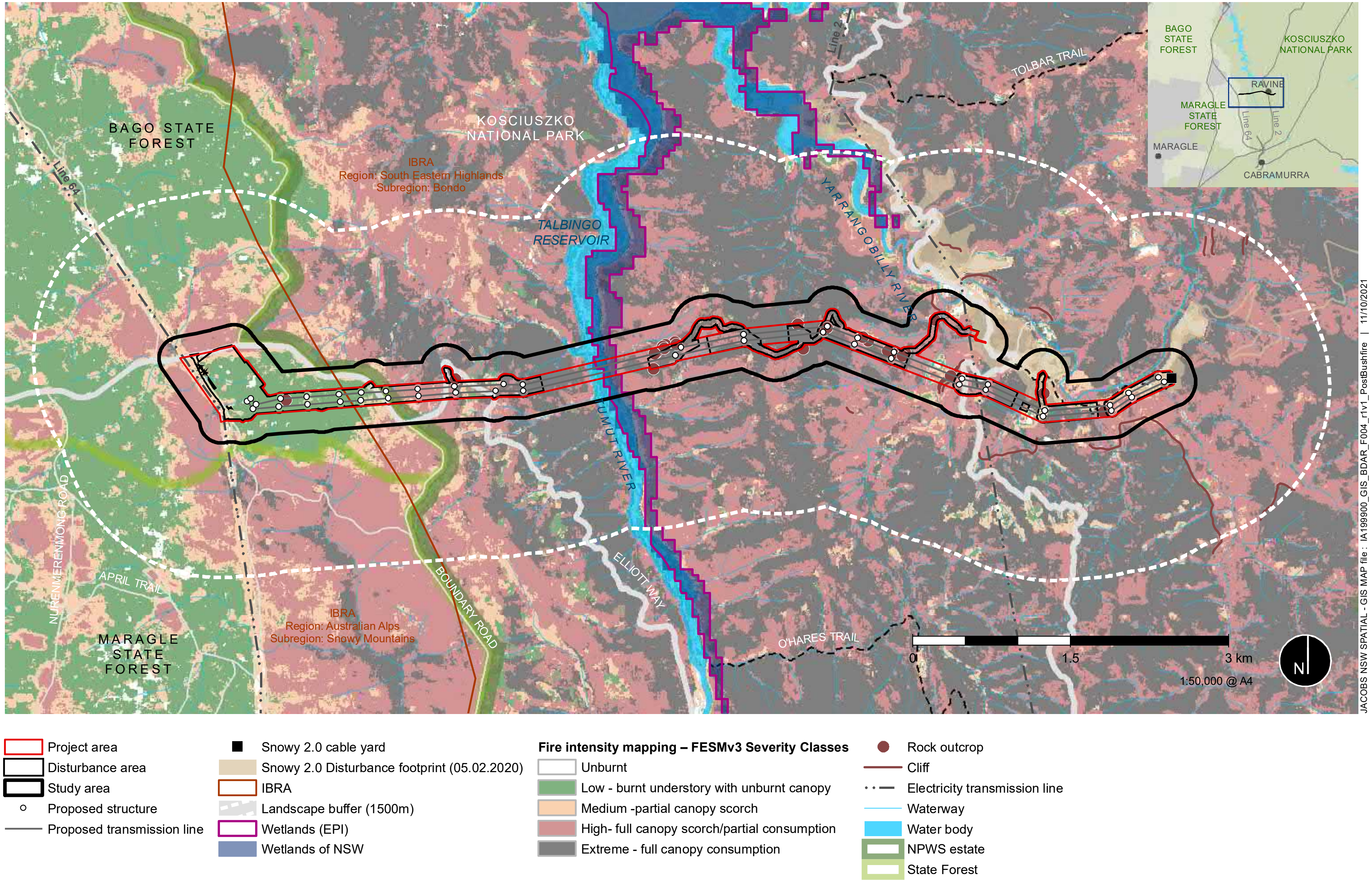
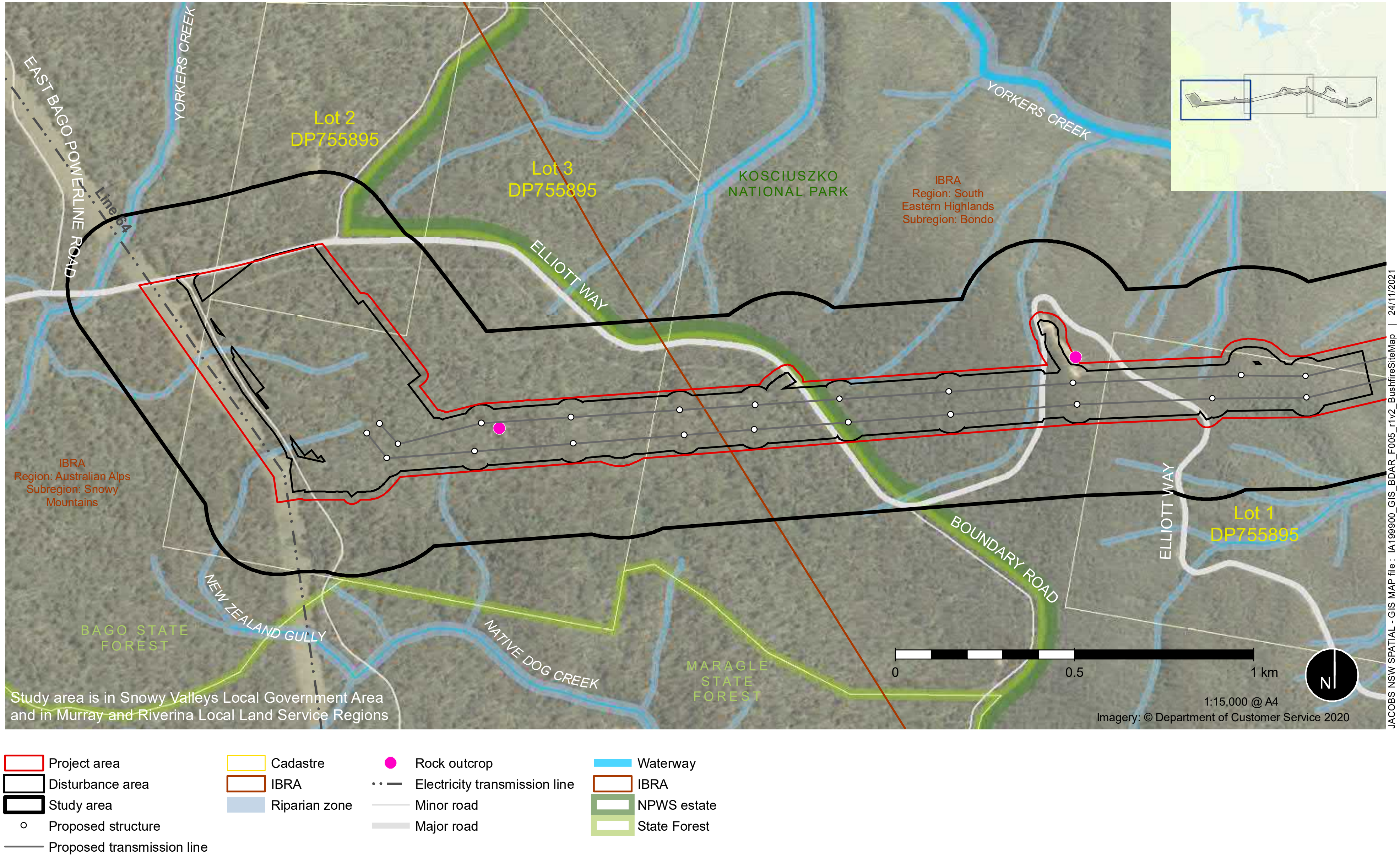


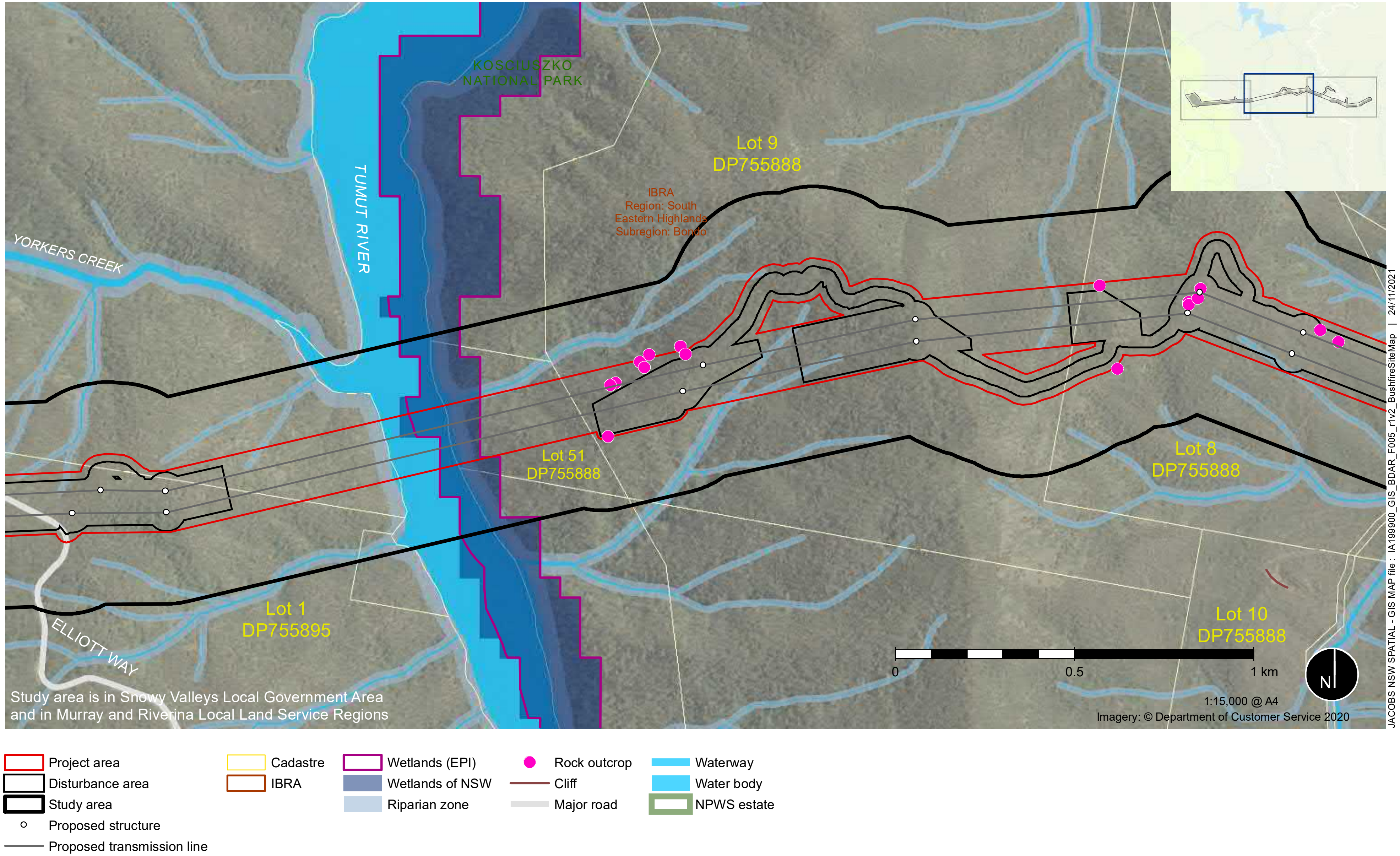
Figure 4-2 | Location map showing post 2019/2020 bushfire

Data source:
Jacobs 2021, TransGrid 2021, EMM 2021, DPE 2018, FESM DPIE 2018, © Department Finance, Services and Innovation 2018



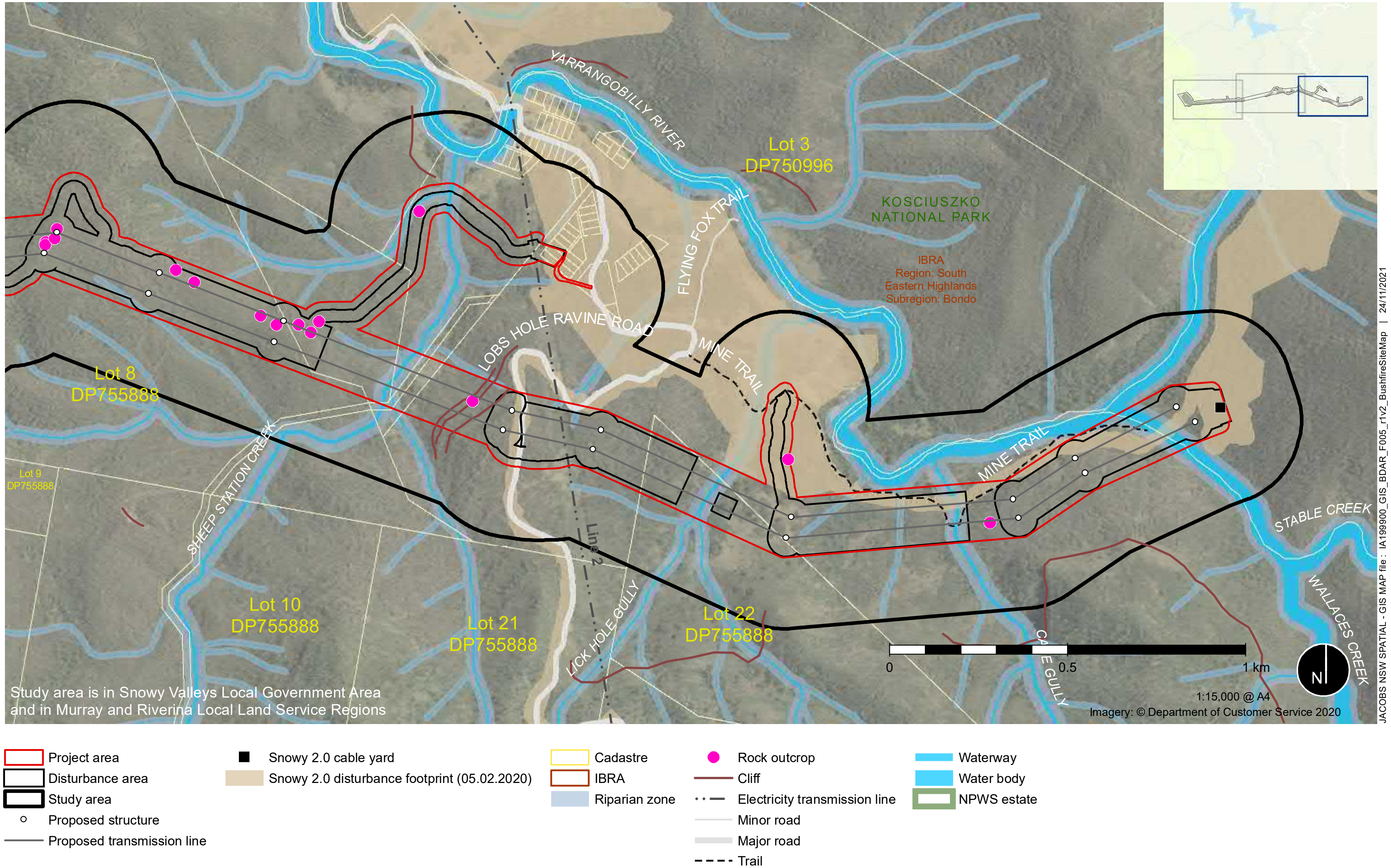
Data sources:
Jacobs 2021, TransGrid 2021, DPE 2018,
© Department Finance, Services and Innovation 2018

Figure 4-3 | Site map showing pre 2019/2020 bushfires



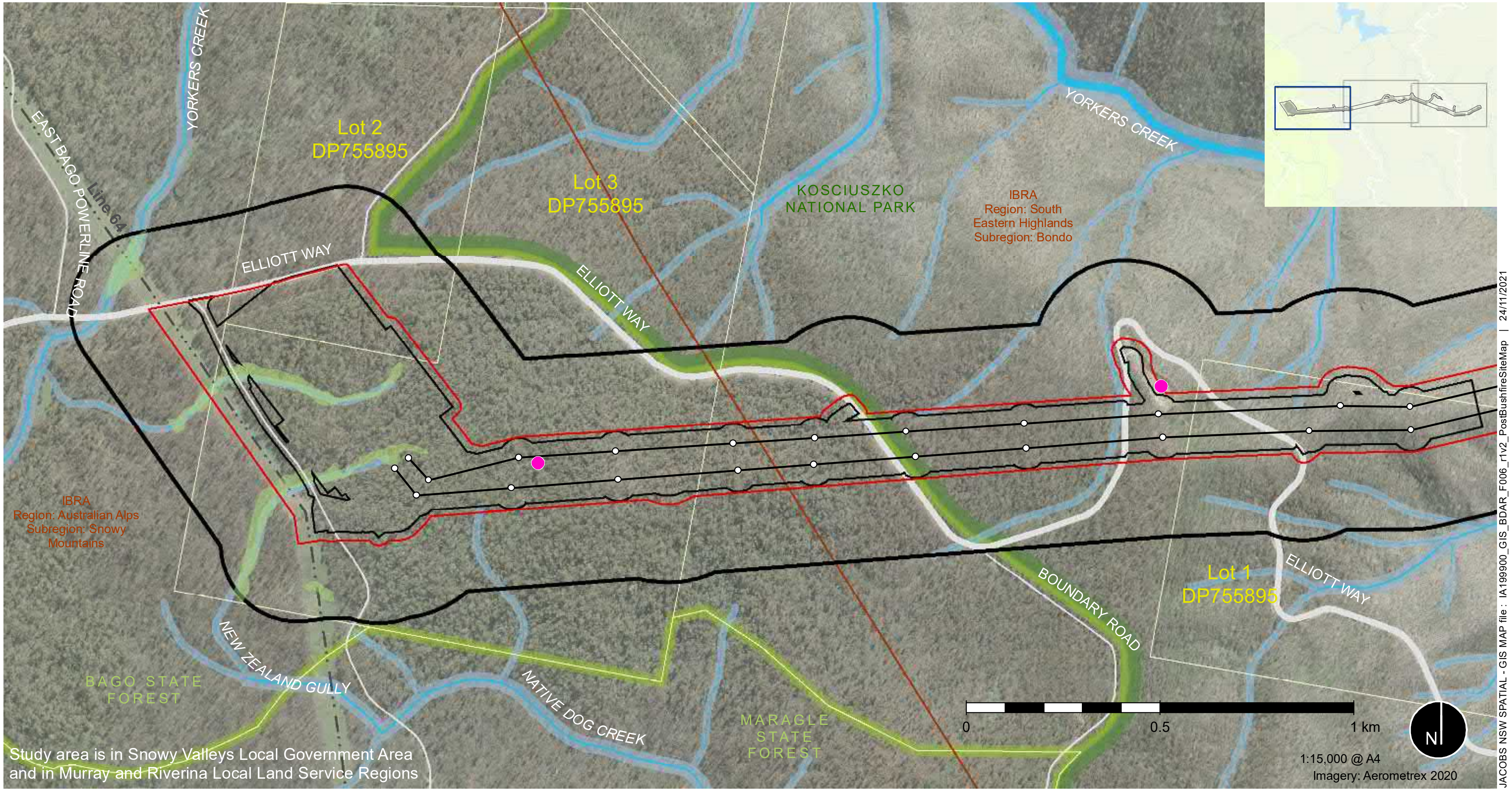
Data sources:
Jacobs 2021, TransGrid 2021, DPE 2018,
© Department Finance, Services and Innovation 2018

Figure 4-3 | Site map showing pre 2019/2020 bushfires



Data sources:
Jacobs 2021, TransGrid 2021, DPE 2018,
© Department Finance, Services and Innovation 2018

Figure 4-3 | Site map showing pre 2019/2020 bushfires



Project area
Disturbance area
Study area
Proposed structure
Proposed transmission line

Rock outcrop
Electricity transmission line
Minor road
Major road
Waterway
Cadastre
IBRA
NPWS estate
State Forest

Likely sites of resource flows and sinks

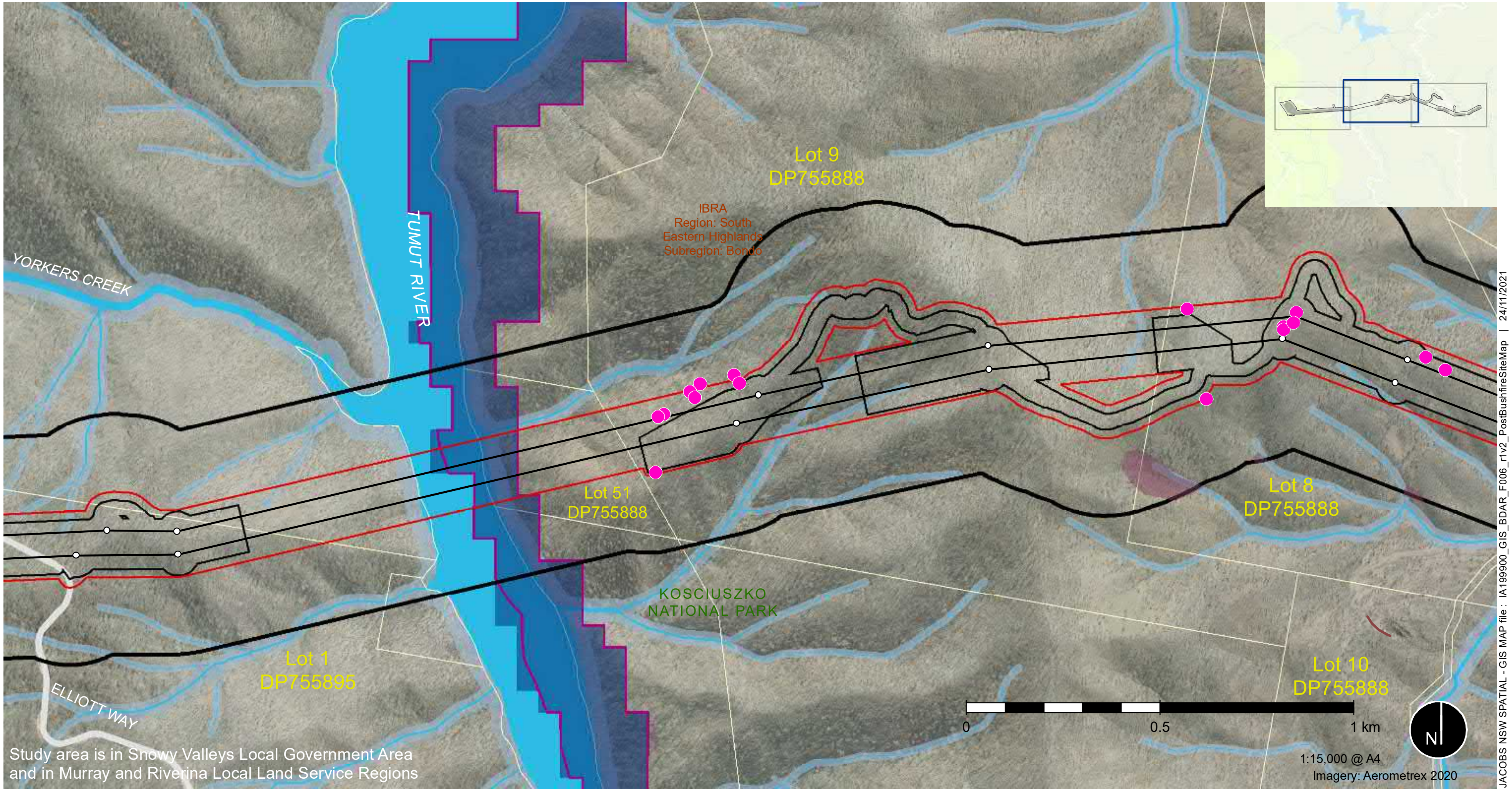
PCT 285: Broad-leaved Sally grass - sedge woodland on valley flats and swamps in the NSW South Western Slopes Bioregion and adjoining South Eastern Highlands Bioregion

Riparian zone

Data sources:

Jacobs 2021, TransGrid 2021, DPE 2018,
© Department Finance, Services and Innovation 2018

Figure 4-4 | Site map showing post 2019/2020 bushfires



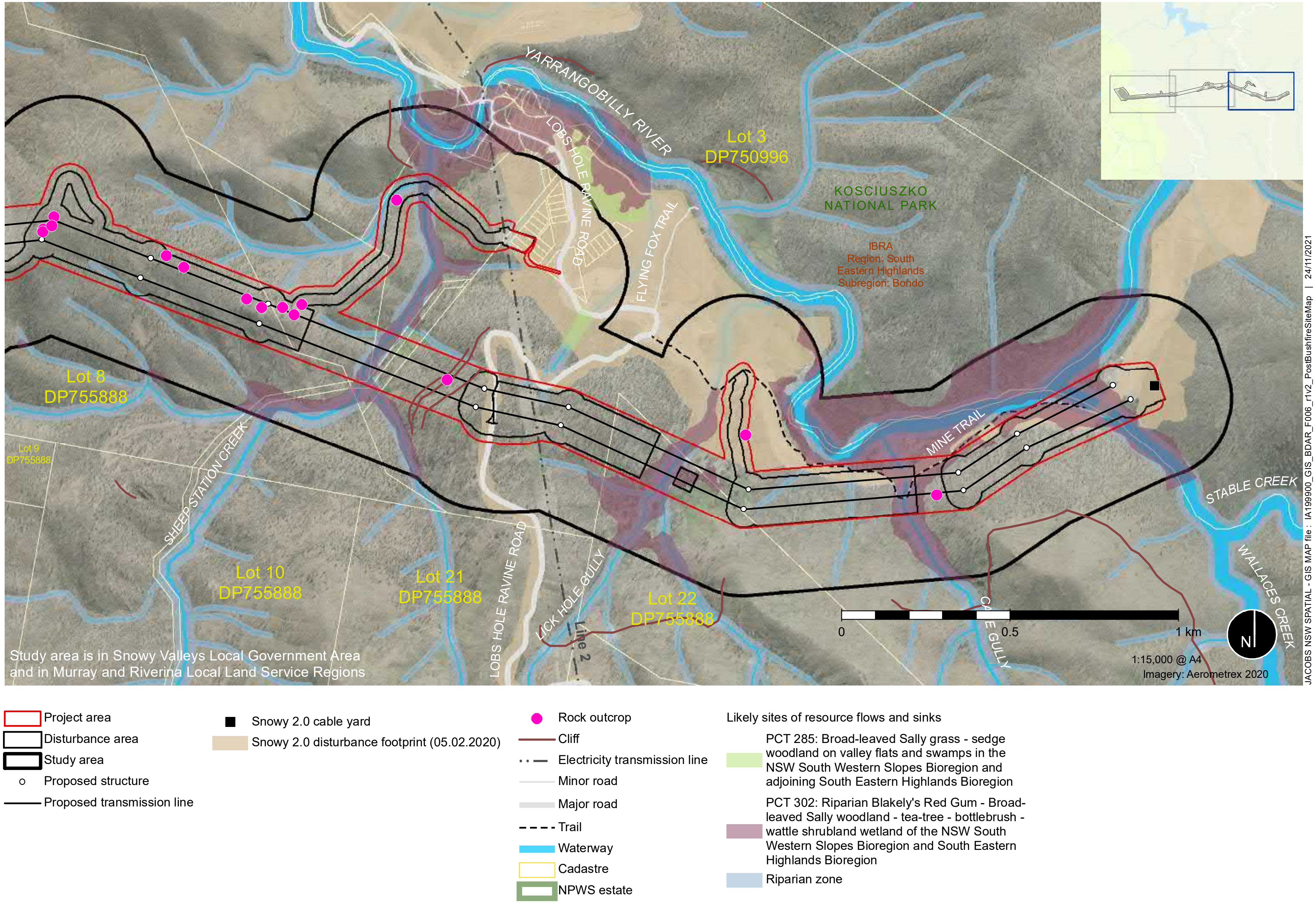
- Project area
- Disturbance area
- Study area
- Proposed structure
- Proposed transmission line
- Rock outcrop
- Cliff
- Major road
- Waterway
- Wetlands (EPI)
- Wetlands of NSW
- Cadastre
- NPWS estate

Likely sites of resource flows and sinks

- PCT 302: Riparian Blakely's Red Gum - Broad-leaved Sally woodland - tea-tree - bottlebrush - wattle shrubland wetland of the NSW South Western Slopes Bioregion and South Eastern Highlands Bioregion
- Riparian zone

Data sources:
Jacobs 2021, TransGrid 2021, DPE 2018,
© Department Finance, Services and Innovation 2018

Figure 4-4 | Site map showing post 2019/2020 bushfires



Data sources:
Jacobs 2021, TransGrid 2021, DPE 2018,
© Department Finance, Services and Innovation 2018

Figure 4-4 | Site map showing post 2019/2020 bushfires

5. Native vegetation and vegetation integrity

5.1 Background research and data sources

A background review of existing information was undertaken to identify the existing environment within a nominal search area of 10 km and the broader locality including relevant bioregion subregions. 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), and assess the likelihood of occurrence of threatened species, populations and communities as well as important habitat for migratory species in the survey area and locality. The searches were also undertaken to identify any Areas of Outstanding Biodiversity Value in the study area.

The following databases were searched:

- BioNet - the website for the Atlas of NSW Wildlife and Threatened Species Profile Database – last searched 2 October 2020
- NSW Department of Primary Industries (DPI) freshwater threatened species distribution maps – last reviewed 29 September 2020
- DAWE's Protected Matters Search Tool – last searched 2 October 2020
- NSW BioNet Vegetation Classification database – last reviewed 2 October 2020
- Bureau of Meteorology's Atlas of Groundwater Dependent Ecosystems (GDE) – last searched 2 October 2020
- Department of Environment's Directory of Important Wetlands Tool – last reviewed 2 October 2020.

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)
- *Plant Communities of the South Eastern Highlands and Australian Alps within the Murrumbidgee Catchment of New South Wales Version 1.1* (Office of Environment and Heritage, 2011)
- *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, 2016b)
- *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).

The mapping provided in the *Riverina Regional Native Vegetation Map Version v1.0 - VIS_ID 4469* (Office of Environment and Heritage, 2016b) was found to be unreliable in terms of polygon boundaries and PCT identification so this dataset was not used extensively during the field work but was referred to as a resource of potential PCTs that could be present in the broader area.

Preliminary and provisional determinations to list species and ecological communities as threatened under the BC Act were viewed on the EESG 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 EPBC Act was last reviewed in September 2020.

A meeting with EESG Senior Threatened Species Officer Geoff Robertson in October 2018 also provided valuable information on the threatened species of concern from the region which helped target the field work and assessment.

5.1.1 Snowy 2.0 Main Works

The BDARs completed for the Snowy 2.0 Exploratory Works (EMM Consulting, 2017) and Snowy 2.0 Main Works EIS (EMM Consulting, 2019) were reviewed and the results were used to inform the preparation of this BDAR. The vegetation mapping, data from vegetation integrity plots, and threatened species data were gathered and used to inform the field survey program. Three vegetation integrity plots from the Snowy 2.0 Exploratory Works BDAR (EMM Consulting, 2017) and Snowy 2.0 Main Works BDAR (EMM Consulting, 2017) have been used to supplement the work undertaken for this BDAR as the disturbance area for this project overlaps with approximately 6.9 ha of approved Snowy 2.0 disturbance area. These shared project areas have been surveyed and mapped in this BDAR, however since they already form part of the Snowy 2.0 Main Works development application and the impacts subsequently already assessed and offset, these areas have been removed from the impact calculations for the Transmission Connection assessment.

5.2 Preliminary site visits and scoping

An initial site visit was undertaken within the study area over two days in March 2018 to ground-truth the results of the background research and undertake an initial rapid high-level habitat assessment. This site visit involved a drive through the study area on accessible roads and tracks. Areas visited included Lobs Hole Ravine Road, Link Road, Goat Ridge Road and Elliott Way in KNP. 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 KNP was undertaken over four days in April 2018 with designers and engineers from Transgrid. This visit included walking through sections of the Bago State Forest and to the top of Sheep Station Ridge in the KNP to plan potential helipad locations and access tracks.

During the initial site visits in March and April 2018, notes were made on PCTs and boundaries between PCTs, and incidental observations of fauna were made. These initial site visits undertaken for preliminary assessments allowed for the scoping of field surveys.

5.3 Mapping extent of native vegetation

The extent of native vegetation in the project area was mapped using aerial imagery. Polygons were digitised in a GIS (ArcGIS 10.7) at a scale of between 1:1,000 and 1:5,000. The vegetation extent within the project area has been mapped in detail although some boundary errors may still exist.

5.3.1 Definition of native vegetation

Under the BAM and BOS, native vegetation has the same meaning as in section 1.6 of the BC Act which states that native vegetation and clearing native vegetation have the same meanings as in Part 5A of the *Local Land Services Act 2013* (LLS Act). Part 5A 60B of the LLS Act defines the meaning of native vegetation as any of the following types of plants native to New South Wales:

a) Trees (including any sapling or shrub or any scrub)

b) Understorey plants

c) Groundcover (being any type of herbaceous vegetation)

d) Plants occurring in a wetland.

A plant is native to NSW if it was established in NSW before European settlement.

Some cleared areas within the project area do contain native trees, understorey plants, and groundcover species. Regrowth native grasslands and shrublands are common in the project area. While these areas are heavily disturbed, they do contain native vegetation. As such, these areas have been assigned to the most likely original PCT, which can be determined with reasonable confidence based on adjacent PCTs and position in the landscape.

5.4 Plant community type identification

The types and distributions of PCTs within the project area were identified and mapped progressively during the field surveys. The identification of PCTs presented here is in accordance with the NSW PCT classification as described in the BioNet Vegetation Classification. Each PCT was assigned to the relevant corresponding Threatened Ecological Community (TEC) where applicable. A plot-based floristic vegetation survey as described in Section 5.2 of the BAM was undertaken across the project area, supplemented with rapid vegetation assessments of dominant species in accessible areas of the broader study area, to identify the PCTs or most likely PCTs. The plot-based floristic vegetation surveys were undertaken over the period of 14 November 2018 to February 2019. An additional two-day survey was undertaken within the proposed substation site in October 2018 (see **Table 5-1** for a summary of survey timing).

Table 5-1: Summary of survey timing

Survey date	Number of survey days
Preliminary site visit, PCT identification, mapping and scoping surveys	
22nd – 23rd March 2018	2
16th – 18th April 2018	3
4th – 5th October 2018	2
Main survey period (PCT mapping and VI surveys)	
13th – 16th November 2018	4
10th – 12th December 2018	3
30th – 31st January 2019	2
1st – 5th February 2019	5

Some PCTs in the study area are currently poorly described in the BioNet Vegetation Classification, with few species identified in each structural layer. Other described PCTs provide a single broad definition of several seemingly distinct vegetation types. In many cases there is no distinct linear boundary to assist in determining the distribution of different PCTs within the project area. To aid in the identification of PCTs, existing vegetation mapping and classification relevant to the study area was reviewed. The detailed descriptions of vegetation units provided in the *Native Vegetation of the Southern Forests: South-east Highlands, Australian Alps, South-west Slopes, and SE Corner Bioregions* (Gellie, 2005) and the *Plant Communities of the South Eastern Highlands and Australian Alps within the Murrumbidgee Catchment of New South Wales Version 1.1* (Office of Environment and Heritage, 2011) appears to be the most accurate and was used to aid PCT identification and mapping. The PCTs and mapping provided in the BDAR for the Snowy 2.0 Exploratory Works and Main Works EISs (EMM Consulting, 2017 and 2019) also provided valuable information on determining the PCTs most likely to be present. To supplement available vegetation mapping, a digital terrain model was created in the GIS based on contour data. This assisted in differentiating between the hill tops, hill slopes of varying steepness and aspect, lower lying flat areas, and drainage lines. This review of information informed the stratification of native vegetation for the survey design.

5.4.1 Stratification of native vegetation into survey units

Using existing vegetation mapping, prior to the fieldwork commencing, survey plots were randomly located within each area of mapped vegetation to provide a representative assessment of the vegetation. Plots were also positioned to provide a wide spatial coverage of the project area. Once the identification of PCTs had been finalised, each PCT was then divided into vegetation zones; each comprising an area of native vegetation in the project area that is the same PCT and has a similar broad condition state. The PCTs identified within the project area are described in detail in Section 5.5.

The field survey was able to provide good spatial coverage and survey effort for each PCT present in the project area, meeting the requirements of the BAM. The vegetation within the project area has been assigned to a PCT as listed in the BioNet Vegetation Classification database based on the observed species composition, vegetation structure, landscape position, and underlying geology and soils. In most cases, the vegetation on site does not perfectly align with any PCT listed in the BioNet Vegetation Classification database so the vegetation has been allocated to the PCT with which it most closely aligns.

There is approximately 118.35 ha of native vegetation within the disturbance area, including 38.26 ha in the Australian Alps Bioregion and 80.09 ha in the South Eastern Highlands Bioregion. A summary of the PCTs identified in each bioregion is provided in **Table 5-3**.

5.4.2 Plot-based floristic vegetation survey and vegetation integrity assessment

A plot-based full floristic survey and vegetation integrity assessment was undertaken in accordance with the BAM using a series of 20 x 20 m plots (or 400 m^2 equivalent area), each nested inside a 20 x 50 m plot (or equivalent 1,000 m^2 area). In some situations, along narrow PCT patches, 10 x 40 m floristic plots were used. The location of each plot/mid-line completed during the survey is illustrated in **Figure 5-1**. Plots/mid-lines were established to provide a representative assessment of the vegetation integrity of the vegetation zone, accounting for the level of variation in the broad condition state of the vegetation zone. The emphasis was on identifying broad condition states within each PCT and no attempt was made at fine scale mapping in areas of variable vegetation density.

A summary of the survey effort completed in each vegetation zone in each bioregion is provided in **Table 5-2**.

Vegetation zones and plot assessment have been divided by bioregion because there are two BAM-Cs associated with this BDAR (refer to **Section 4.1** for more information). The minimum survey requirements was met for all vegetation zones and exceeded for zones with larger areas so that the variation within each zone could be adequately sampled. The plot based floristic survey was designed to build upon the survey work already completed in the east of the project area for the Snowy 2.0 Exploratory Works and Main Works BDARs (EMM Consulting, 2017 and 2020a) and replication of survey sites was avoided. Data from the Snowy 2.0 Exploratory Works and Main Works EISs (EMM Consulting, 2018 and 2019) has been used in this BDAR where it was applicable to the project area.

Separate vegetation zones have been created to assess indirect impacts on areas of retained vegetation where new edges are being created (refer to **Section 10.2.1**) for more details). Considering these zones are contiguous with the areas that will be directly impacted, relevant plot data collected for the direct impact zones has been used to calculate vegetation integrity scores for indirect impact zones in the BAM-C.

Data from eighty-one plots has been used to determine vegetation integrity as shown in **Table 5-2**. Data from one plot (Plot 35) has been used twice for two vegetation zones of the same PCT and condition recorded in the two bioregions. Three vegetation integrity assessment plots from the Snowy 2.0 Exploratory Works and Main Works BDARs (EMM Consulting, 2017 and 2020a) were used to supplement the survey effort where the study areas overlapped.

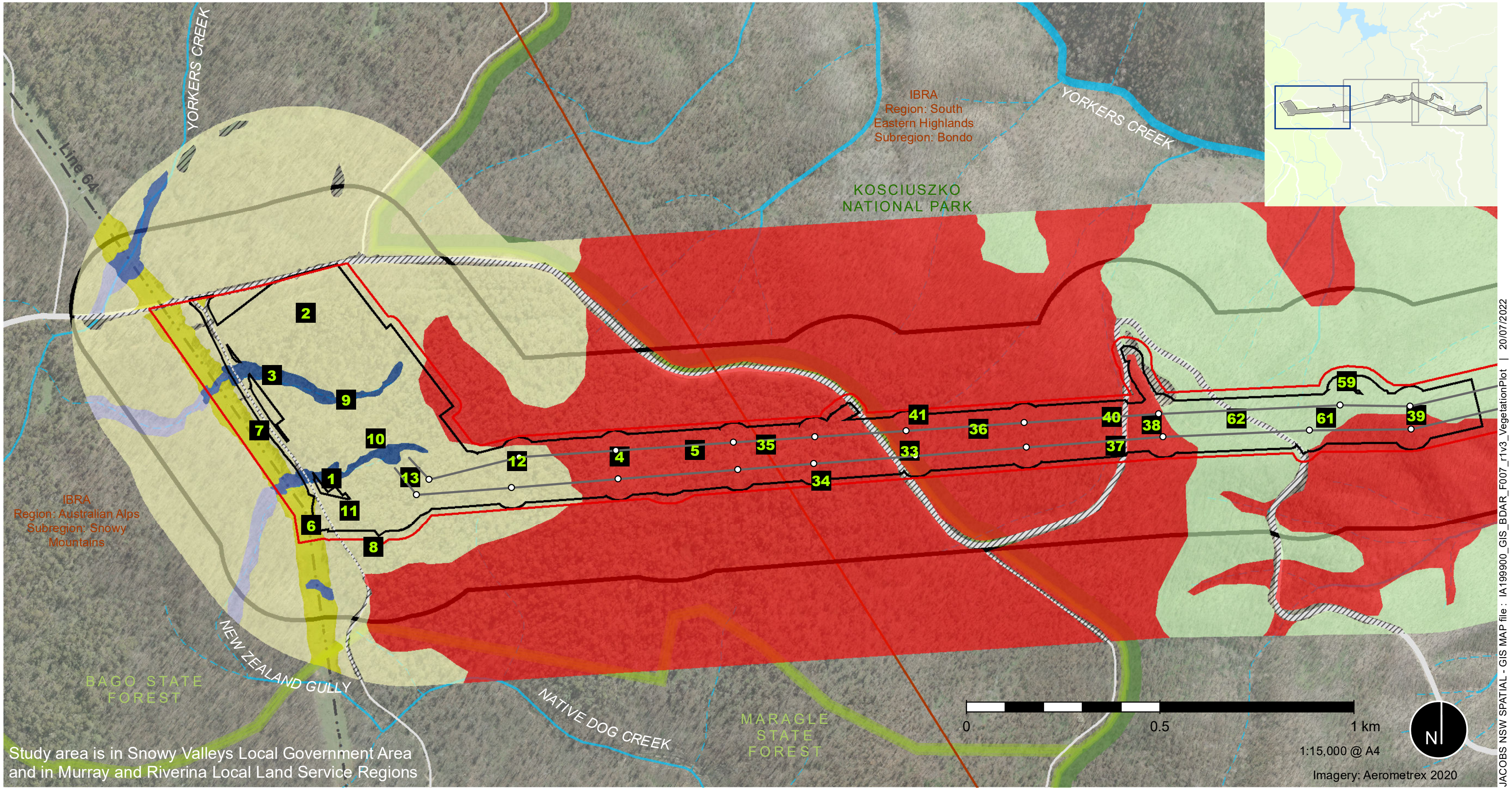
Table 5-2: PCT and vegetation zones identified in the project area

Vegetation Zone	PCT name	Broad condition class	Extent in disturbance area (ha)	Min no. of plots required (Table 3 BAM)	No. plots completed	VI plot identifier
Australian Alps Bioregion						
AA-1 285_Moderate Blackberry	PCT 285 - Broad-leaved Sally grass - sedge woodland on valley flats and swamps in the NSW South Western Slopes Bioregion and adjoining South Eastern Highlands Bioregion	Moderate - Blackberry infestation	2.2	2	3	1, 2, 3
AA-2 300_Good	PCT300 - 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	Good	8.82	3	3	4, 5, 35*
AA-3 1196_DNG	PCT1196 - Snow Gum - Mountain Gum shrubby open forest of montane areas, South Eastern Highlands Bioregion and Australian Alps Bioregion	Native Grassland	0.09	1	2	6, 7
AA-4 1196_Good		Good	27.16	4	6	8, 9, 10, 11, 12, 13
South Eastern Highlands Bioregion						
SEH-1 296_DNG	PCT296 - Brittle Gum - peppermint open forest of the Woomargama to Tumut region, NSW South Western Slopes Bioregion	Native Grassland	0.1	1	1	14
SEH-2 296_Good_dry slopes		Good condition – drier *Eucalyptus nortonii* dominant slope	4.07	2	3	15, 16, 17
SEH-3 296_Good_wet_slopes		Good condition – wetter sheltered slopes	13.56	3	12	18, 19, 20, 21, 22, 23, 24, 25, 26^, 27, 28, 29
SEH-4 296_Moderate_Blackberry		Moderate – Blackberry infestation	1.29	1	1	30

Vegetation Zone	PCT name	Broad condition class	Extent in disturbance area (ha)	Min no. of plots required (Table 3 BAM)	No. plots completed	VI plot identifier
SEH-5 300_Good	PCT300 - 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	Good	23.19	4	12	31, 32, 33, 34, 35*, 36, 37, 38, 39, 40, 41, 42
SEH-6 302_DNG	PCT302 - Riparian Blakely's Red Gum - Broad-leaved Sally woodland - tea-tree - bottlebrush - wattle shrubland wetland of the NSW South Western Slopes Bioregion and South Eastern Highlands Bioregion	Native Grassland	0.22	1	1	43
SEH-7 302_Moderate		Moderate	2.12	2	5	44, 45, 46, 47, 48
SEH-8 729_DNG	PCT729 - Broad-leaved Peppermint - Candlebark shrubby open forest of montane areas, southern South Eastern Highlands Bioregion and South East Corner Bioregion	Native Grassland	0.72	1	3	49, 50, 51
SEH-9 729_Derived Shrubland		Shrubland - regrowth	0.61	1	4	52, 53, 54, 55
SEH-10 729_Good_dry_slopes		Good - dry open slopes & ridgetops	12.82	3	8	56, 57, 58, 59, 60, 61, 62, 63
SEH-11 729_Good_wet_slopes		Good - wetter sheltered slopes	12.79	3	8	64, 65, 66, 67, 68, 69, 70, 71
SEH-12 999_Derived_shrubland	PCT999 - Norton's Box - Broad-leaved Peppermint open forest on footslopes, central and southern South Eastern Highlands Bioregion	Shrubland - regrowth	1.34	1	2	72, 73
SEH-13 999_Good_dry_Calytrix		Good - drier Calytrix tetragona	7.26	3	8	74, 75, 76, 77, 78, 79, 80, 81

*Plot 35 is within the SEH Bioregion though in the same contiguous patch of PCT300 and therefore the same vegetation zone and has been replicated in both BAM-C cases for the purposes of identifying VI

^ Plot 26 is equivalent plot 1025 from Main Works BDAR, Plot 46 is equivalent to Plot 1018, and Plot 47 is equivalent to Plot 1048



Project area
Disturbance area
Study area
Proposed structure
Proposed transmission line
Electricity transmission line
Minor road
Major road

Waterway
3 Vegetation integrity plots
IBRA
NPWS estate
State Forest

Plant community type and vegetation zones

PCT 1196: Snow Gum - Mountain Gum shrubby open forest:

Good

Native grassland

PCT 285: Broad-leaved Sally grass - sedge woodland:

Good

Moderate

Shrubland - regrowth

Moderate - Blackberry infestation

PCT 300: Ribbon Gum - Narrow-leaved (Robertsons) Peppermint montane fern - grass tall open forest:

Good

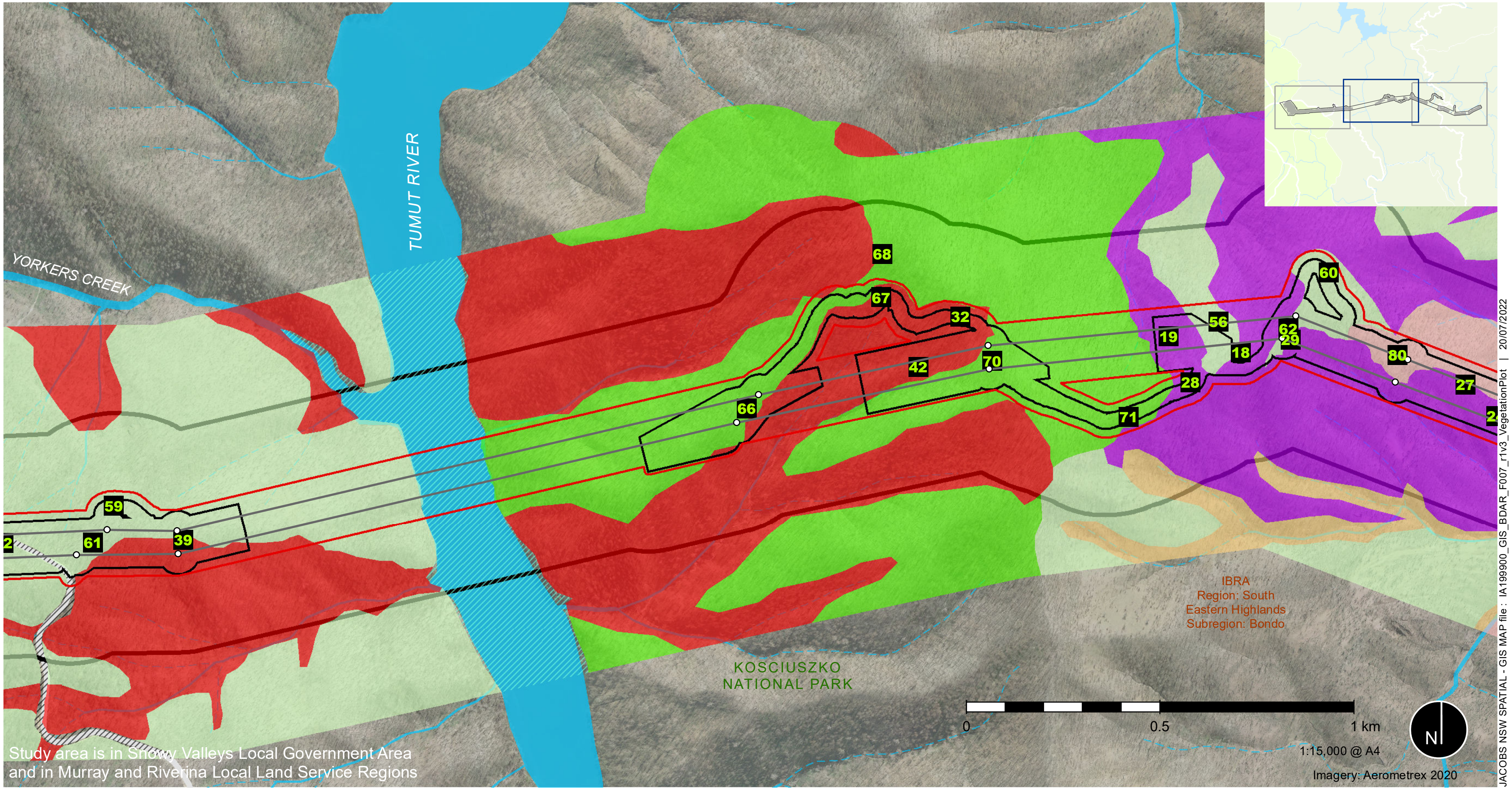
PCT 729: Broad-leaved Peppermint - Candlebark shrubby open forest:

Good - dry open slopes & ridgetops

Cleared

Data sources:
Jacobs 2021, TransGrid 2021

Figure 5-1 | Location of plot based floristic vegetation survey and vegetation Integrity assessments



- Project area
- Disturbance area
- Study area
- Proposed structure
- Proposed transmission line
- Major road
- Waterway
- 3 Vegetation integrity plots
- IBRA
- NPWS estate

Plant community type and vegetation zones

PCT 296: Brittle Gum - peppermint open forest:

- Good - wetter sheltered slopes

PCT 300: Ribbon Gum - Narrow-leaved (Robertsons) Peppermint montane fern - grass tall open forest:

- Good

PCT 302: Riparian Blakely's Red Gum - Broad-leaved Sally woodland - tea-tree - bottlebrush - wattle shrubland wetland:

- Moderate

PCT 729: Broad-leaved Peppermint - Candlebark shrubby open forest:

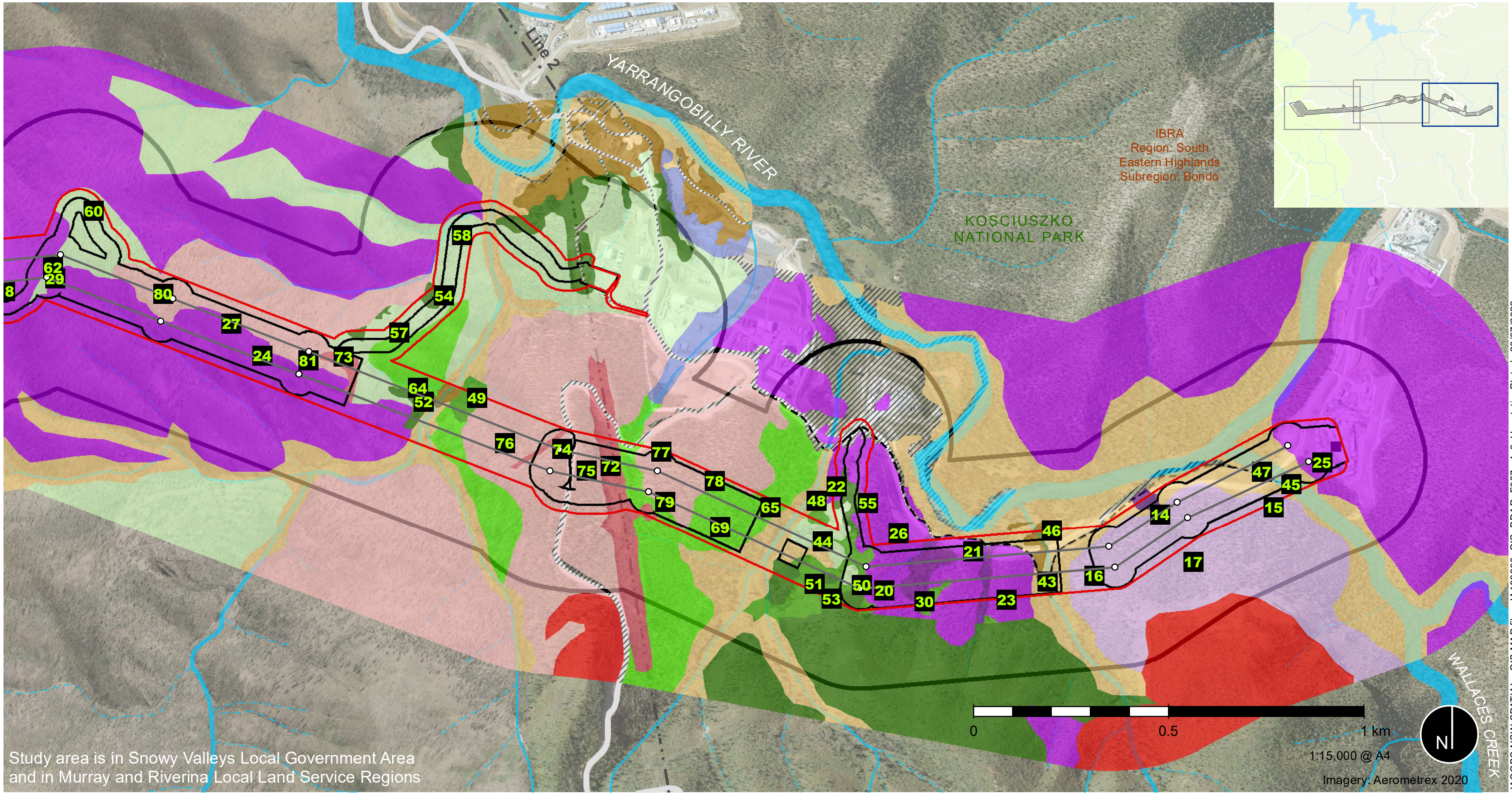
- Good - dry open slopes & ridgetops
- Good - wetter sheltered slopes

PCT 999: Norton's Box - Broad-leaved Peppermint open forest:

- Good - drier Calytrix tetragona
- Water
- Cleared

Data sources:
Jacobs 2021, TransGrid 2021

Figure 5-1 | Location of plot based floristic vegetation survey and vegetation Integrity assessments



Project area
Disturbance area
Study area
Proposed structure
Proposed transmission line
Snowy 2.0 cable yard
Electricity transmission line
Minor road
Major road
Trail

Waterway
3 Vegetation integrity plots
IBRA
NPWS estate

Plant community type and vegetation zones

PCT 285: Broad-leaved Sally grass - sedge woodland:
Moderate

PCT 296: Brittle Gum - peppermint open forest:
Good - drier E. nortonii dominant slope
Good - wetter sheltered slopes
Moderate - Blackberry infestation
Native grassland

PCT 300: Ribbon Gum - Narrow-leaved (Robertsons) Peppermint montane fern - grass tall open forest:
Good

PCT 302: Riparian Blakely's Red Gum - Broad-leaved Sally woodland - tea-tree - bottlebrush - wattle shrubland wetland:
Moderate
Native grassland

PCT 729: Broad-leaved Peppermint - Candlebark shrubby open forest:
Good - dry open slopes & ridgetops
Good - wetter sheltered slopes
Native grassland
Shrubland - regrowth

PCT 999: Norton's Box - Broad-leaved Peppermint open forest:
Good - drier Calytrix tetragona
Shrubland - regrowth
Water
Cleared

Data sources:
Jacobs 2021, TransGrid 2021

Figure 5-1 | Location of plot based floristic vegetation survey and vegetation Integrity assessments

5.5 Plant community types

This BDAR describes PCTs in terms of their floristic composition, geological substrate and relevant regional vegetation classification. The PCTs identified within the disturbance area and broader project area are listed in **Table 5-3** and their distribution is outlined in **Figure 5-2**. The mapping of PCTs has also been extended to the larger study area to provide context. Descriptions of the vegetation that occurs in the disturbance area and broader project area are provided in the following sections matched to the most likely PCT as described in the BioNet Vegetation Classification database. In most cases, the vegetation on site does not perfectly align with any PCT listed in the BioNet Vegetation Classification database so the vegetation has been allocated to the PCT with which it most closely aligns. Vegetation integrity plot data is provided in **Appendix B** and **Appendix C**.

Table 5-3: PCTs types identified within the project area, split over two bioregions (SEH = Southern Eastern Highlands Bioregion, AA = Australian Alps Bioregion)

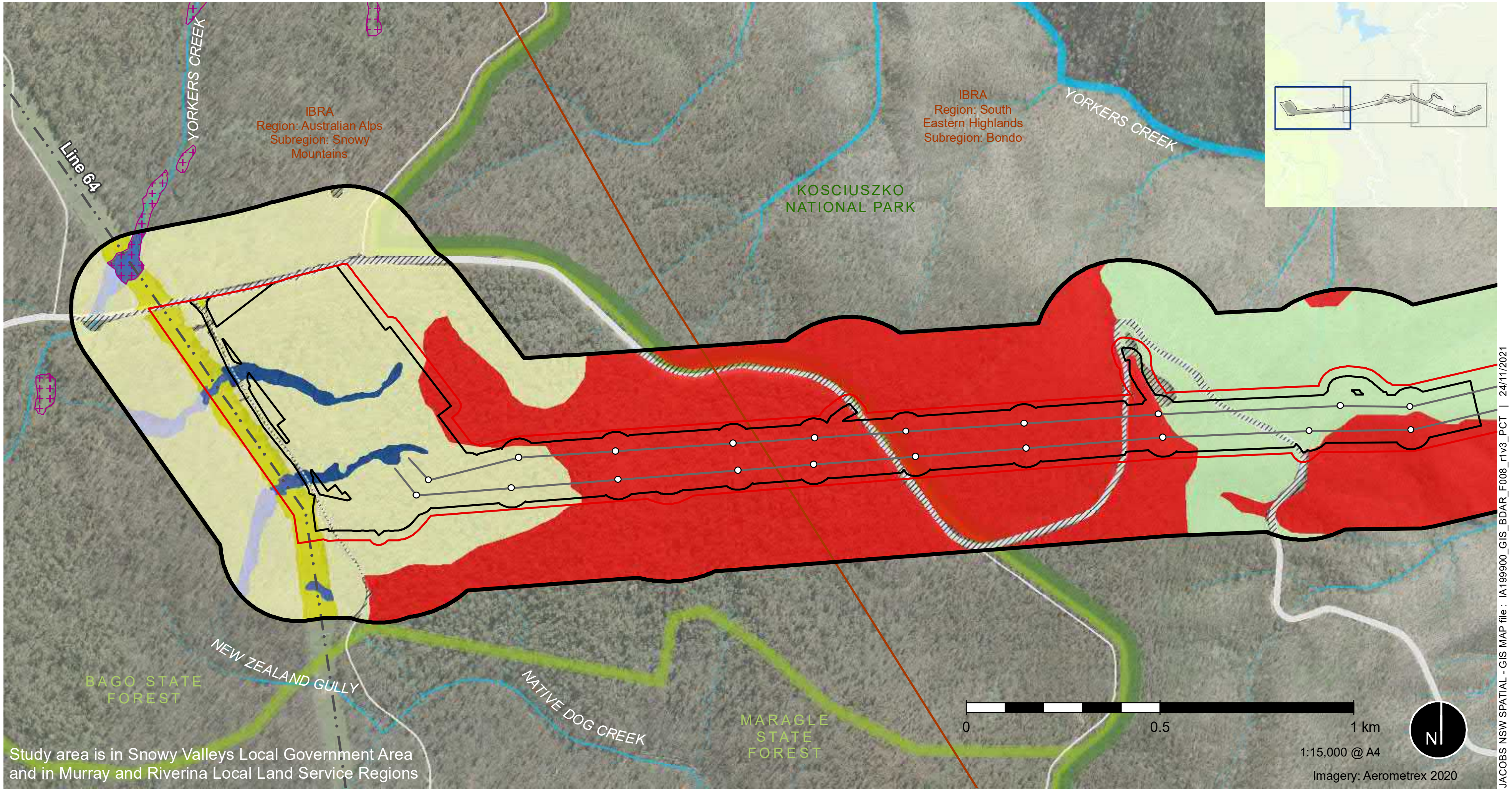
PCT ID No.	PCT name	Vegetation formation (Keith 2004)	Vegetation class (Keith 2004)	TEC+	Percent Cleared in NSW (%)	Area (ha) in disturbance area*		Area (ha) in project area	
						SEH	AA	SEH	AA
285	Broad-leaved Sally grass – sedge woodland on valley flats and swamps in the NSW South Western Slopes Bioregion and adjoining South Eastern Highlands Bioregion	Dry Sclerophyll Forests (Shrub/grass sub-formation)	Upper Riverina Dry Sclerophyll Forests	No	75	-	2.20	-	2.74
296	Brittle Gum – peppermint open forest of the Woomargama to Tumut region, NSW South Western Slopes Bioregion	Dry Sclerophyll Forests (shrubby sub-formation)	Southern Tableland Dry Sclerophyll Forests	No	40	19.02	-	28.0	-
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	Wet Sclerophyll Forests (Grassy sub-formation)	Southern Tableland Wet Sclerophyll Forests	No	20	23.19	8.82	33.55	11.36

	Bioregion and western Kosciuszko escarpment								
302	Riparian Blakely's Red Gum – Broad-leaved Sally woodland – tea-tree – bottlebrush – wattle shrubland wetland of the NSW South Western Slopes Bioregion and South Eastern Highlands Bioregion	Dry Sclerophyll Forests (Shrub/grass sub-formation)	Upper Riverina Dry Sclerophyll Forests	No	50	2.34	-	6.78	-
729	Broad-leaved Peppermint – Candlebark shrubby open forest of montane areas, southern South Eastern Highlands Bioregion and South East Corner Bioregion	Dry Sclerophyll Forests (shrubby sub-formation)	Southern Tableland Dry Sclerophyll Forests	No	35	26.94	-	67.12	-
999	Norton's Box – Broad-leaved Peppermint open forest on footslopes, central and southern South Eastern Highlands Bioregion	Dry Sclerophyll Forests (shrubby sub-formation)	Southern Tableland Dry Sclerophyll Forests	No	15	8.60	-	14.48	-

1196	Snow Gum – Mountain Gum shrubby open forest of montane areas, South Eastern Highlands Bioregion and Australian Alps Bioregion	Grassy Woodlands	Subalpine Woodlands	No	5	-	27.24	-	35.84
TOTAL						**80.09**	**38.26**	**149.93**	**49.94**
GRAND TOTAL						**118.35**		**199.87**	

+Note no Threatened Ecological Communities were recorded in the project area.

*Note 1.26 ha comprised existing cleared land in the disturbance area.



- Project area (1)
- Disturbance area
- Study area
- Proposed structure
- Proposed transmission line
- Electricity transmission line
- Minor road
- Major road
- Waterway
- IBRA
- NPWS estate
- State Forest
- Montane Peatlands and Swamps Threatened Ecological Community (Environmental Protection Authority 2016)

Plant community type and vegetation zones

PCT 1196: Snow Gum - Mountain Gum shrubby open forest:

- Good
- Native grassland

PCT 285: Broad-leaved Sally grass - sedge woodland:

- Good
- Moderate
- Shrubland - regrowth
- Moderate - Blackberry infestation

PCT 300: Ribbon Gum - Narrow-leaved (Robertsons) Peppermint montane fern - grass tall open forest:

- Good

PCT 729: Broad-leaved Peppermint - Candlebark shrubby open forest:

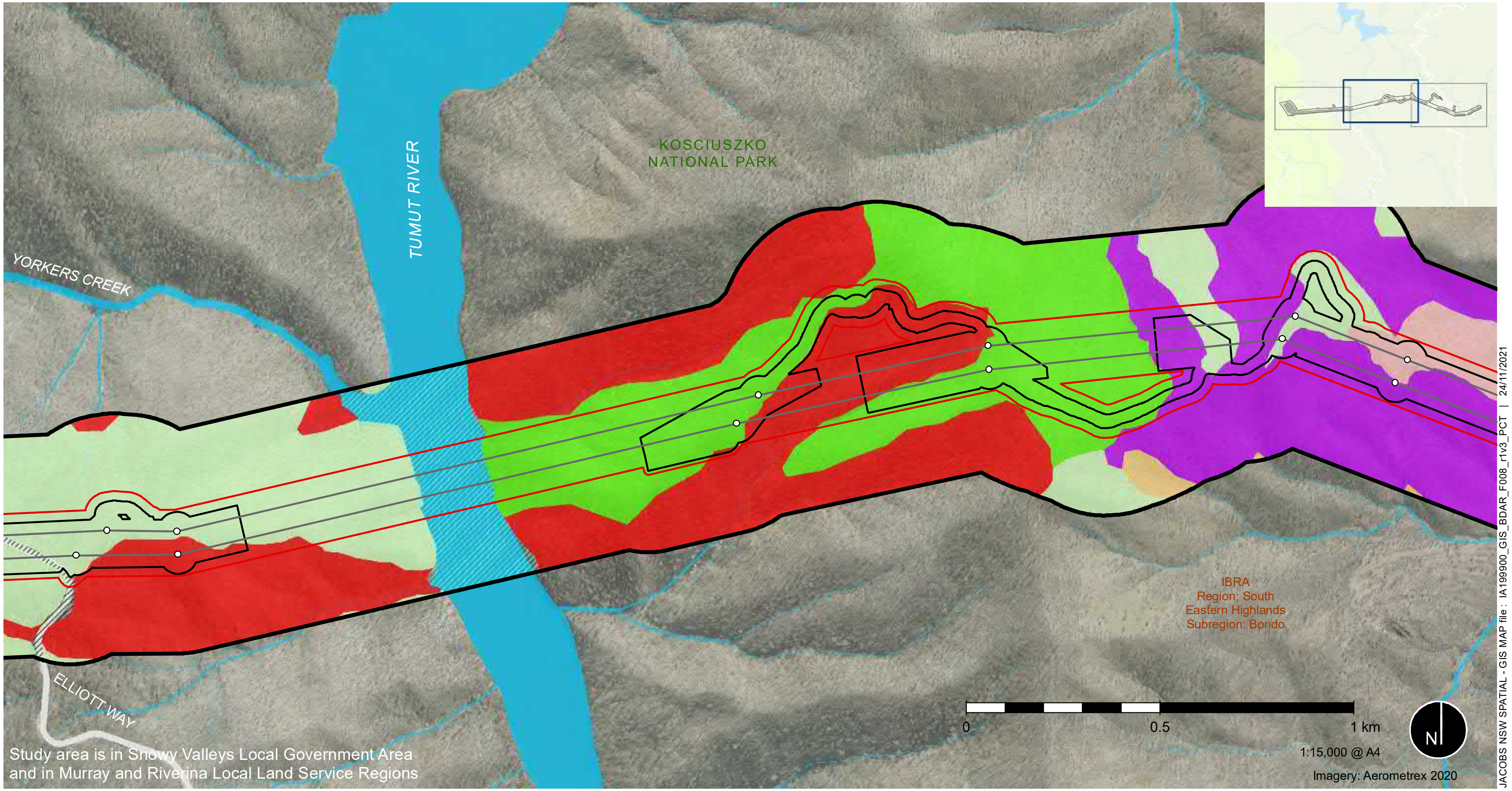
- Good - dry open slopes & ridgetops

Other:

- Cleared

Data sources:
Jacobs 2021, TransGrid 2021, DPE 2018,
© Department Finance, Services and Innovation 2018

Figure 5-2 | Plant community types and vegetation zones



Project area (1)

Disturbance area

Study area

Proposed structure

Proposed transmission line

Electricity transmission line

Major road

Waterway

NPWS estate

Montane Peatlands and Swamps Threatened Ecological Community (Environmental Protection Authority 2016)

Plant community type and vegetation zones

PCT 296: Brittle Gum - peppermint open forest:

Good - wetter sheltered slopes

PCT 300: Ribbon Gum - Narrow-leaved (Robertsons) Peppermint montane fern - grass tall open forest:

Good

PCT 302: Riparian Blakely's Red Gum - Broad-leaved Sally woodland - tea-tree - bottlebrush - wattle shrubland wetland:

Moderate

PCT 729: Broad-leaved Peppermint - Candlebark shrubby open forest:

Good - dry open slopes & ridgetops

Good - wetter sheltered slopes

PCT 999: Norton's Box - Broad-leaved Peppermint open forest:

Good - drier Calytrix tetragona

Other:

Water

Cleared

Data sources:

Jacobs 2021, TransGrid 2021, DPE 2018,
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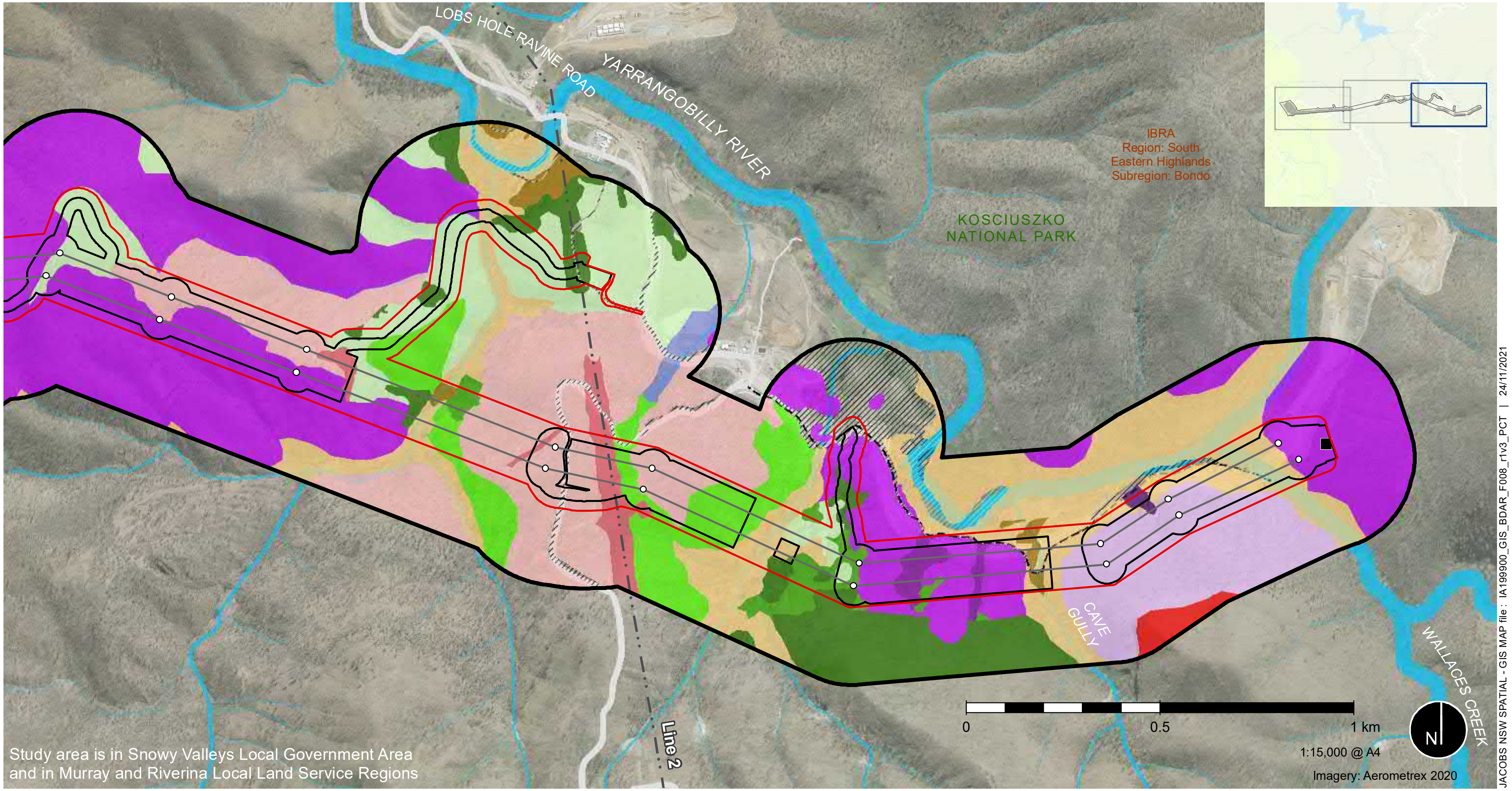
Figure 5-2 | Plant community types and vegetation zones



Project area (1)
Disturbance area
Study area
Proposed structure
Proposed transmission line
Snowy 2.0 cable yard

Electricity transmission line
Minor road
Major road
Trail
Waterway
NPWS estate

Montane Peatlands and Swamps Threatened Ecological Community (Environmental Protection Authority 2016)

Plant community type and vegetation zones

PCT 285: Broad-leaved Sally grass - sedge woodland:

Moderate

PCT 296: Brittle Gum - peppermint open forest:

Good - drier E. nortonii dominant slope
Good - wetter sheltered slopes
Moderate - Blackberry infestation
Native grassland

PCT 300: Ribbon Gum - Narrow-leaved (Robertsons) Peppermint montane fern - grass tall open forest:

Good

PCT 302: Riparian Blakely's Red Gum - Broad-leaved Sally woodland - tea-tree - bottlebrush - wattle shrubland wetland:

Moderate
Native grassland

PCT 729: Broad-leaved Peppermint - Candlebark shrubby open forest:

Good - dry open slopes & ridgetops
Good - wetter sheltered slopes
Native grassland
Shrubland - regrowth

PCT 999: Norton's Box - Broad-leaved Peppermint open forest:

Good - drier Calytrix tetragona
Shrubland - regrowth

Other:

Water
Cleared

Data sources:
Jacobs 2021, TransGrid 2021, DPE 2018,

Figure 5-2 | Plant community types and vegetation zones

5.5.1 Broad-leaved Sally grass – sedge woodland on valley flats and swamps in the NSW South Western Slopes Bioregion and adjoining South Eastern Highlands Bioregion

Vegetation formation: Dry Sclerophyll Forests (Shrub/grass sub-formation)

Vegetation class: Upper Riverina Dry Sclerophyll Forests **PCT ID:** 285

Threatened ecological community (BC Act and EPBC Act): Not a TEC

Vegetation zones (condition) and plots:

Moderate – Blackberry infestation: Plots 1, 2, 3.

PCT 285 percent cleared in NSW: 75%

Project Impact: 2.2 ha

The Broad-leaved Sally grass – sedge woodland on valley flats and swamps in the NSW South Western Slopes Bioregion and adjoining South Eastern Highlands Bioregion PCT is described in the BioNet Vegetation Classification database as a mid-high woodland dominated by Broad-leaved Sally (*Eucalyptus camphora* subsp. *humeana*) sometimes with Black Sally (*Eucalyptus stellulata*) grading into open forest dominated by Robertson's Peppermint (*Eucalyptus robertsonii* subsp. *robertsonii*), Blakely's Red Gum (*Eucalyptus blakelyi*) or Apple Box (*Eucalyptus bridgesiana*). The shrub layer is usually sparse and includes the tall shrubs *Acacia dealbata, Acacia melanoxylon, Acacia kettlewelliae, Leptospermum continentale* and the low shrubs *Mirbelia oxylobioides, Hibbertia obtusifolia, Hovea linearis, Cassinia aculeata, Epacris breviflora* and rarely *Bossiaea foliosa*. The tall tree fern *Dicksonia antarctica* occurs in some narrow creeks and *Pteridium esculentum* may occur. The ground cover is usually dense being dominated by grasses such as *Poa labillardierei* var. *labillardierei*, Micr*olaena stipoides* var. *stipoides* and *Echinopogon ovatus*. The sedge *Carex appressa* is most often present and in some wetter sites *Eleocharis sphacelata* and *Carex fascicularis* occur, along with *Phragmites australis*. Rushes including *Juncus holoschoenus* and *Juncus sarophorus* also occur at wet sites. Forbs include *Senecio bathurstianus, Hydrocotyle laxiflora, Ranunculus lappaceus, Geranium neglectum* and *Acaena novae-zelandiae* are common. The Broad-leaved Sally grass – sedge woodland on valley flats and swamps in the NSW South Western Slopes Bioregion and adjoining South Eastern Highlands Bioregion PCT occurs on alluvial or colluvial organic grey to brown podzolic clay loam soils, on poorly drained valley flats, surrounding swamps or lining creeks in hill or mountain landscapes generally above 600 m altitude in the southern section of the NSW South Western Slopes and adjoining South Eastern Highlands Bioregions. The underlying lithology is mainly granite or granodiorite. In the case of the examples in the west of the project area, this PCT also occurs in the Australian Alps.

Within the project area, and broader study area (refer to **Figure 5-2**), this vegetation matches the description of the Western Montane/Sub-alpine Wet Heath/Herb Grass Woodland (Vegetation Group 124) as described by Gellie (2005). This vegetation also aligns with the description for the Small-fruited Hakea - Drumstick Heath - Swamp Heath subalpine wet heathland of the Australian Alps and western South Eastern Highlands Bioregions (map unit u193) as described by the Office of Environment and Heritage (2011). Within the project area, vegetation considered most likely to be representative of the Broad-leaved Sally grass - sedge woodland on valley flats and swamps in the NSW South Western Slopes Bioregion and adjoining South Eastern Highlands Bioregion PCT occurs in two narrow drainage lines (New Zealand Gully and the unnamed drainage line to the north that flows into Yorkers Creek) at the western extent in the Bago State Forest at the location of the substation (**Photo 5-1** to **Photo 5-4**). Shrublands also exist in the easement of the existing Line 64 (**Photo 5-3** and **Photo 5-4**). This PCT is also present in other drainage lines in the broader study area including unnamed drainage lines that flow into Yorkers Creek, sections of Yorkers Creek, and parts of the Sheep Station Creek and Yarrangobilly River floodplains in the east.

This vegetation is most likely to be representative of PCT 285 for the following reasons:

- This canopy is characterised by *Eucalyptus camphora* subsp. *humeana* with a range of other eucalypts depending on location including *Eucalyptus pauciflora, Eucalyptus robertsonii* subsp. *robertsonii, Eucalyptus dalrympleana, Eucalyptus stellulata,* and *Eucalyptus viminalis*. Some areas of canopy are sparse, and trees appear as emergent or trees may absent (such as in the Line 64 easement, refer **Photo 5-3** and **Photo 5-4**) due to management
- The shrub layer is sparse to dense depending on level of disturbance and is characterised by the presence of *Leptospermum lanigerum* (**Photo 5-2** and **Photo 5-3**), *Leptospermum continentale, Baeckea utilis, Bossiaea foliosa, Coprosma hirtella, Daviesia latifolia, Epacris breviflora, Olearia erubescens, Platylobium formosum, Hakea microcarpa, Rubus parvifolius* and small individuals of *Acacia melanoxylon*. The midstorey of this PCT in the project area is largely dominated by the exotic species *Rubus fruticosus* sp. agg
- The ground cover is outcompeted by *Rubus fruticosus* sp. agg. in many locations (**Photo 5-1**). However, the characteristic species *Carex appressa* is common along with *Juncus australis, Juncus sarophorus, Lepidosperma laterale, Lomandra longifolia, Acaena novae-zealandiae, Geranium solanderi, Stellaria pungens, Themeda australis, Ranunculus lappaceus,* and *Asperula conferta*.

Other PCTs that have *Eucalyptus camphora* as a part of the canopy include Riparian Blakely's Red Gum - Broad-leaved Sally woodland - tea-tree - bottlebrush - wattle shrubland wetland of the NSW South Western Slopes Bioregion and South Eastern Highlands Bioregion (PCT 302) and Carex - Juncus sedgeland/wet grassland of the South Eastern Highlands Bioregion (PCT 765). The assemblage of vegetation dominated by *Eucalyptus camphora* in the project area lacks most of the canopy or midstorey species typically found in PCT 302. The vegetation could fit the description of PCT 765 based on species complement, however the vegetation in the project area has more of a woodland structure. A summary of the vegetation structure and floristics of PCT 285 is given below in **Table 5-4**. This list of species reflects the local variation gathered from multiple floristic plots undertaken within the project area and also includes incidental observations while moving through the vegetation in the broader study area.

Table 5-4: Floristic and structural summary of PCT 285 within the project area

Vegetation layer	Dominant species
Tree canopy (upper stratum)	*Eucalyptus camphora, Eucalyptus dalrympleana, Eucalyptus pauciflora, Eucalyptus robertsonii, Eucalyptus viminalis, Acacia melanoxylon* present in the canopy in varying combinations.
Midstorey (mid-stratum)	Characterised by shrubs including *Leptospermum lanigerum, Leptospermum continentale, Astroloma humifusum, Baeckea utilis, Bossiaea foliosa, Coprosma hirtella, Daviesia latifolia, Epacris breviflora, Olearia erubescens, Persoonia chamaepeuce, Pimelea curviflora, Platylobium formosum, Hakea microcarpa, Rubus parvifolius.*
Groundcovers (ground stratum)	Grass and grass like species including *Poa sieberiana, Juncus sarophorus, Juncus australis, Carex appressa, Luzula flaccida, Rytidosperma penicillatum, Themeda triandra, Austrostipa pubescens, Lomandra longifolia, Lepidosperma laterale, Lachnagrostis filiformis, Dichelachne crinita, Poa helmsii. Empodisma minus* was observed in other examples in the broader study area. Forbs including *Hydrocotyle sibthorpioides*, *Coronidium monticola, Veronica* sp. A, *Gonocarpus micranthus, Viola betonicifolia, Cotula* sp., *Gratiola peruviana, Acaena novae-zelandiae, Isotoma fluviatilis, Geranium solanderi, Euchiton* sp., *Stylidium graminifolium, Cymbonotus lawsonianus, Senecio prenanthoides, Pterostylis decurva, Pterostylis monticola, Asperula conferta, Wahlenbergia stricta, Solenogyne gunnii, Lagenifera stipitata, Centipeda* sp., *Brachyscome spathulata, Hypericum gramineum, Dichondra repens, Tricoryne elatior, Oreomyrrhis eriopoda, Ranunculus lappaceus, Stellaria pungens, Arthropodium milleflorum.* Ferns including *Doodia aspera* can dominate the ground layer under dense patches of *Leptospermum* spp. *Blechnum nudum* is also present. Species in the 'other' growth forms include *Glycine clandestina*. *Sphagnum cristatum* is present in wetter situations.
Exotic species	*Centaurium erythraea, Erythranthe moschata, Prunella vulgaris, Trifolium repens, Hypochaeris radicata, Medicago polymorpha.*

Vegetation layer	Dominant species
High Threat Weeds	*Rubus fruticosus* sp. agg., *Rosa rubiginosa, Holcus lanatus, Hypericum perforatum, Acetosella vulgaris, Leucanthemum vulgare.*

Photo 5-1: PCT 285 (AA-1) with canopy of *Eucalyptus camphora* and *Eucalyptus pauciflora* and dense infestation of *Rubus fruticosus*

Photo 5-2: PCT 285 (AA-1) in the western portion of the project area showing canopy of *Eucalyptus camphora* and dense shrub layer of *Leptospermum lanigerum*.

Photo 5-3: PCT 285 (AA-1) beneath Line 64 showing dense layer of *Leptospermum lanigerum* with canopy species removed.

Photo 5-4: PCT 285(AA-1) in the western portion of the project area in the Line 64 easement showing young regrowth of *Leptospermum* spp. and *Epacris brevifolia* with a dense groundcover of *Hydrocotyle sibthorpioides*.

5.5.2 Brittle Gum – peppermint open forest of the Woomargama to Tumut region, NSW South Western Slopes Bioregion

Vegetation formation: Dry Sclerophyll Forests (shrubby sub-formation)

Vegetation class: Southern Tableland Dry Sclerophyll Forests **PCT:** 296

Threatened ecological community (BC Act and EPBC Act): Not a TEC

Vegetation zones (condition) and plots:

- Native Grassland: Plot 14
- Good – drier *Eucalyptus nortonii* dominant slope: Plots 15, 16, 17
- Good – wetter sheltered slopes: Plots 18, 19, 20, 21, 22, 23, 24, 25, 26 (EMM 1025), 27, 28, 29
- Moderate – Blackberry infestation: Plot 30.

PCT 296 percent cleared in NSW: 40%

Project Impact: 19.03 ha.

The Brittle Gum – peppermint open forest of the Woomargama to Tumut region, NSW South Western Slopes Bioregion PCT is described in the BioNet Vegetation Classification database as a mid-high to tall open forest dominated by Brittle Gum (*Eucalyptus mannifera* subsp. *mannifera*) with Broad-leaved Peppermint (*Eucalyptus dives*) and Red Stringybark (*Eucalyptus macrorhyncha*). Robertson's Peppermint (*Eucalyptus robertsonii*) may also be present in protected areas. Shrubs are sparse to mid-dense and may be diverse. They include *Hibbertia obtusifolia, Monotoca scoparia, Platylobium formosum* subsp. *formosum, Acacia dealbata, Acacia rubida* and *Melichrus urceolatus*. The ground cover is sparse to mid-dense with grasses such as *Joycea pallida* and *Poa sieberiana* and forbs such as *Senecio tenuiflorus, Dianella revoluta* var. *revoluta, Gonocarpus* *tetragynus, Pomax umbellata, Dichopogon strictus* and *Poranthera microphylla*. Climbers such as *Hardenbergia violacea* and *Billardiera scandens* may be present. Occurs at altitudes over 500 m on light grey to brown podzolic loam or clay soils derived from granite or metasediments on steep hillslopes in hill or mountain landform patterns in the Woomargama to Tumut regions in the upper slopes sub-region of the NSW South-western Slopes Bioregion and adjacent South Eastern Highlands Bioregion.

Within the project are, and broader study area (refer to **Figure 5-2**), this vegetation somewhat matches the description of the Tablelands Dry Shrub/Grass Forest (Vegetation Group 110) as described by Gellie (2005). This vegetation also aligns with the description for the Broad-leaved Peppermint - Brittle Gum - Red Stringybark tall shrub-grass dry sclerophyll open forest of lower ranges of the western South Eastern Highlands and upper South Western Slopes Bioregions (map unit u105) as described by the Office of Environment and Heritage (2011), but *Eucalyptus macrorhyncha* is not present. *Eucalyptus dives* is the dominant species. *Eucalyptus nortonii* also occurs and is occasionally dominant. *Eucalyptus mannifera* is present in isolated patches and is generally not a dominant part of the canopy, except in some areas (**Photo 5-7**). Within the project area, vegetation considered most likely to be representative of the Brittle Gum – peppermint open forest of the Woomargama to Tumut region, NSW South Western Slopes Bioregion PCT occurs in the South Eastern Highlands Bioregion on the slopes to the Tumut River, the slopes of Sheep Station Ridge (**Photo 5-5** and **Photo 5-6**), and the slopes off Lobs Hole Ravine Road and Mine Trail (**Photo 5-7** to **Photo 5-9**). PCT 296 intergrades extensively with PCT 729, PCT 302 and PCT 999 and the boundaries between these PCTs are not distinct.

This vegetation is most likely to be representative of PCT 296 for the following reasons:

- This canopy is largely dominated by *Eucalyptus dives* (**Photo 5-5** and **Photo 5-6**). However, on some slopes *Eucalyptus nortonii* dominates (**Photo 5-8**). *Eucalyptus mannifera* is present in isolated patches (**Photo 5-7**). Other eucalypts including *Eucalyptus rubida, Eucalyptus robertsonii* and *Eucalyptus viminalis* also occur occasionally
- The midstorey of the vegetation matches the description of PCT 296 well with *Hibbertia obtusifolia, Monotoca scoparia, Platylobium formosum, Melichrus urceolatus, Acacia dealbata, Dillwynia phylicoides, Boronia nana, Hovea linearis, Daviesia latifolia, Cassinia aculeata, Acacia buxifolia* subsp. *buxifolia, Acacia pravissima, Indigofera australis, Persoonia chamaepeuce, Cassinia longifolia, Grevillea polybractea,* and *Bursaria spinosa*
- The ground cover contains species characteristic of PCT 296 including *Poa sieberiana*, *Lomandra filiformis*, *Gonocarpus tetragynus*, *Wahlenbergia stricta*, and *Dianella revoluta*.

Other candidate PCTs for this vegetation that have *Eucalyptus dives* as a part of the canopy include the 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 (PCT 297). Some parts of the vegetation within the project area fit the descriptions of PCT 297 and PCT 296 equally well.

Four condition variants of PCT 296 were identified within the project area including:

- Good – drier *Eucalyptus nortonii* dominant slope (**Photo 5-8**)
- Good – wetter sheltered slopes (**Photo 5-5** and **Photo 5-6**)
- Moderate – Blackberry infestation
- Native Grassland (**Photo 5-9**).

A summary of the vegetation structure and floristics of PCT 296 is given below in **Table 5-5**. This list of species reflects the local variation gathered from multiple floristic plots undertaken within the project area and also includes incidental observations while moving through the vegetation in the broader study area.

Table 5-5: Floristic and structural summary of PCT 296 within the project area

Vegetation layer	Dominant species
Tree canopy (upper stratum)	*Eucalyptus dives* is the dominant canopy species within this PCT on the project area and in the broader study area. Other species of eucalypt present in varying combinations include *Eucalyptus nortonii* which can become dominant, *Eucalyptus rubida, Eucalyptus robertsonii* and *Eucalyptus viminalis. Eucalyptus mannifera* is not a dominant species within the project area but occurs in small scattered patches. *Acacia dealbata* is a common tree species throughout the PCT.
Midstorey (mid-stratum)	Characterised by shrubs including *Acacia pravissima, Astroloma humifusum, Banksia canei, Brachyloma daphnoides, Bursaria spinosa, Cassinia aculeata, Cassinia longifolia, Choretrum pauciflorum, Coprosma hirtella, Daviesia latifolia, Grevillea rosmarinifolia, Leucopogon fletcheri, Mirbelia oxylobioides, Monotoca scoparia, Pimelea linifolia, Platylobium formosum, Tetratheca bauerifolia, Calytrix tetragona.*
Groundcovers (ground stratum)	Grass and grass like species including *Poa sieberiana, Lomandra glauca, Lomandra multiflora, Lomandra longifolia, Lomandra filiformis, Lepidosperma laterale, Themeda triandra.* Forbs including *Diuris sulphurea, Geranium solanderi, Gonocarpus tetragynus, Patersonia* sp., *Wahlenbergia stricta, Asperula scoparia, Dianella revoluta, Euphrasia collina sub*sp. *paludosa, Geranium obtusisepalum, Picris angustifolia, Ranunculus lappaceus, Stackhousia monogyna, Stylidium graminifolium, Thelymitra megcalyptra, Veronica cinerea, Veronica derwentiana, Viola betonicifolia.* Ferns including *Pteridium esculentum* and *Cheilanthes sieberi* are occasional. Species in the 'other' growth forms include *Hardenbergia violacea, Glycine clandestina* and *Cassytha glabella*.
Exotic species	*Centaurium erythraea, Hypochaeris radicata.*
High Threat Weeds	*Rubus fruticosus* sp. agg., *Rosa rubiginosa, Hypericum perforatum.*

Photo 5-5: PCT 296 (SEH-2) on the eastern slope of Sheep Station Ridge showing a patch dominated by *Eucalyptus dives* with *Eucalyptus mannifera* occasional

Photo 5-6: PCT 296 (SEH-2) on the eastern slope of Sheep Station Ridge showing a typical patch dominated by *Eucalyptus dives*.

Photo 5-7: PCT 296 (SEH-3) to the south of Mine Trail showing dominance of *Eucalyptus mannifera*.

Photo 5-8: PCT 296 (SEH-2) to the south of Mine Trail showing dominance of *Eucalyptus nortonii* in the canopy.

Photo 5-9: PCT 296 (SEH-1) to the south of Mine Trail in Lobs Hole ravine showing a small disturbed area now dominated by shrubs and grasses.

5.5.3 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

Vegetation formation: Wet Sclerophyll Forests (Grassy sub-formation)

Vegetation class: Southern Tableland Wet Sclerophyll Forests **PCT:** 300

Threatened ecological community (BC Act and EPBC Act): Not a TEC

Vegetation zones (condition) and plots:

- Good condition: Plots 4, 5, 31, 32, 33, 34, 35, 36, 37, 38, 38, 40, 41, 42, 67.

PCT 300 percent cleared in NSW: 20%

Project Impact: 32.01 ha.

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 is described in the BioNet Vegetation Classification database as a tall to very tall open forest dominated by Ribbon Gum (*Eucalyptus viminalis*) with Robertson's Peppermint (*Eucalyptus robertsonii*) and occasionally Broad-leaved Peppermint (*Eucalyptus dives*). The shrub layer may be very sparse after fire or mid-dense if not burnt for decades. It includes *Acacia dealbata, Cassinia aculeata, Lomatia myricoides, Platylobium formosum subs*p. *formosum, Acrotriche serrulata, Senecio velleioides, Coprosma quadrifida, Coprosma hirtella* and *Acacia melanoxylon*. Ferns may be abundant and *Polystichum proliferum* may be common. Bracken Fern (*Pteridium esculentum*) may be abundant in regularly burnt sites. The ground cover includes grasses such as *Poa meionectes, Microlaena stipoides* var. *stipoides, Austrofestuca eriopoda* and *Elymus scaber* var. *scaber*. Forbs include *Stellaria pungens, Lagenifera stipitata, Senecio* sp. E, *Plantago varia, Acaena novae-zelandiae, Viola betonicifolia, Dianella revoluta* var. *revoluta*, *Dianella tasmanica, Hydrocotyle laxiflora* and *Dichondra repens*. The rushes *Luzula densiflora* or *Luzula flaccida* may be common. The climbers *Glycine clandestina* and *Clematis aristata* may be present. Occurs on deep red-brown loam soils derived from granite and sedimentary substrates on sheltered hillslopes in a mountain landform pattern in elevations between 700 and 1150 m on the south-western edge of the South Eastern Highlands Bioregion including in KNP and in the southern Upper Slopes sub-region of the NSW South-western Slopes Bioregion.

Within the project area, and broader study area (refer to **Figure 5-2)**, this vegetation matches the description of the Tableland Acacia/Fern/Grass Forest (Vegetation Group 1-4) as described by Gellie (2005). This vegetation also aligns with the description for the Ribbon Gum - Robertson's Peppermint very tall wet sclerophyll open forest primarily of the Bondo Subregion of the South Eastern Highlands and the northern Australian Alps Bioregions (map unit u52) as described by the Office of Environment and Heritage (2011). Within the project area, vegetation considered most likely to be representative of 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 occurs in the west of the project area in the Bago State Forest and on east facing slopes to the Talbingo Reservoir in the KNP (**Photo 5-10** to **Photo 5-15**). On the eastern side of the Talbingo Reservoir PCT 300 occurs on Sheep Station Ridge and the west facing slope to the Talbingo Reservoir. In the broader study area, PCT 300 likely occurs over many of the disturbed slopes off Lobs Hole Ravine Road to the south of the project area as evidenced by the widespread presence of *Eucalyptus viminalis*. PCT 300 intergrades extensively with PCT 1196 in the western portion of the project area in the Bago State Forest. There is also considerable overlap in species with PCT 296 and PCT 729 and the boundaries between these PCTs are not distinct.

This vegetation is most likely to be representative of PCT 300 for the following reasons:

- This canopy is variable being dominated by *Eucalyptus robertsonii* with *Eucalyptus viminalis, Eucalyptus dalrympleana, Eucalyptus rubida, Eucalyptus mannifera* and *Eucalyptus dives* occurring infrequently to being codominant in areas
- The midstorey of the vegetation matches the description of PCT 300 well with *Acacia dealbata, Cassinia aculeata, Lomatia myricoides, Platylobium formosum, Tetratheca ciliata, Coprosma quadrifida, Coprosma hirtella,* and *Acacia melanoxylon*
- The ground cover contains species characteristic of PCT 300 including *Pteridium esculentum, Acaena novae-zealandiae, Stellaria pungens, Polystichum proliferum, Lagenifera stipitata, Rubus parvifolius. Luzula flaccida, Viola betonicifolia, Dianella revoluta, Dianella tasmanica, Stackhousia monogyna, Wahlenbergia stricta, Microlaena stipoides, Elymus scaber, Hypericum gramineum, Glycine clandestina, Oxalis perennans, Geranium solanderi, Hydrocotyle laxiflora, Asperula scoparia, Clematis aristata,* and *Gonocarpus tetragynus*.

Other candidate PCTs for this vegetation that have *Eucalyptus robertsonii* as a part of the canopy include 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 295). However, the lack of *Eucalyptus macrorhyncha, Eucalyptus nortonii* and *Eucalyptus bicostata* indicates that PCT 295 does not fit the description of the vegetation within the project area.

A summary of the vegetation structure and floristics of PCT 300 is given below in **Table 5-6**. This list of species reflects the local variation gathered from multiple floristic plots undertaken within the project area and also includes incidental observations while moving through the vegetation in the broader study area.

Table 5-6: Floristic and structural summary of PCT 300 within the project area

Vegetation layer	Dominant species
Tree canopy (upper stratum)	*Eucalyptus robertsonii* is the dominant canopy species within this PCT on the project area and in the broader study area. Other species of eucalypt present in varying combinations include *Eucalyptus viminalis* which can become dominant, *Eucalyptus dalrympleana, Eucalyptus pauciflora, Eucalyptus dives, Eucalyptus mannifera, Eucalyptus rubida. Acacia dealbata* and *Acacia melanoxylon* are a common tree species throughout the PCT.
Midstorey (mid-stratum)	Characterised by shrubs including *Acacia pravissima, Astroloma humifusum, Bossiaea foliosa., Brachyloma daphnoides, Bursaria spinosa, Cassinia aculeata, Cassinia longifolia, Choretrum pauciflorum, Coprosma hirtella, Daviesia latifolia, Daviesia ulicifolia, Dodonaea viscosa, Exocarpos strictus, Gompholobium* sp., *Grevillea arenaria* subsp. *Canescens, Grevillea rosmarinifolia, Hibbertia obtusifolia, Indigofera australis, Leucopogon fletcheri, Leucopogon lanceolatus, Leucopogon virgatus, Lomatia myricoides, Melichrus urceolatus, Platylobium formosum, Tetratheca ciliata.*
Groundcovers (ground stratum)	Grass and grass like species including *Carex gaudichaudiana, Dichelachne* sp., *Echinopogon ovatus, Lepidosperma curtisiae, Lomandra filiformis, Lomandra longifolia, Lomandra multiflora, Luzula alpestris, Luzula flaccida, Microlaena stipoides, Poa helmsii, Poa sieberiana, Themeda triandra.* Forbs including *Acaena novae-zelandiae, Acaena ovina, Ajuga australis, Arthropodium milleflorum, Asperula conferta, Asperula scoparia, Brunoniella australis, Caladenia gracilis, Cardamine paucijuga, Chiloglottis valida, Chrysocephalum semipapposum, Dianella revoluta, Dianella tasmanica, Dichondra repens, Epilobium billardierianum, Euchiton sphaericus, Euphrasia collina* subsp. *paludosa, Geranium obtusisepalum, Geranium solanderi, Gonocarpus tetragynus, Gratiola peruviana, Hydrocotyle laxiflora, Hypericum gramineum, Mentha laxiflora, Oxalis exilis, Picris angustifolia, Plantago* sp., *Pterostylis longifolia, Ranunculus lappaceus, Ranunculus pimpinellifolius, Ranunculus pumilio, Rumex brownii, Senecio gunnii, Senecio prenanthoides, Stackhousia monogyna, Stellaria pungens, Stylidium graminifolium, Thelymitra* spp., *Veronica derwentiana, Viola betonicifolia, Viola eminens, Wahlenbergia stricta.* Ferns including *Pteridium esculentum* and *Polystichum proliferum* are common. Species in the 'other' growth forms include *Hardenbergia violacea, Glycine clandestina, Cassytha* sp. and *Clematis aristata*.
Exotic species	*Centaurium erythraea, Hypochaeris radicata.*

Vegetation layer	Dominant species
High Threat Weeds	*Rubus fruticosus* sp. agg., *Rosa rubiginosa, Hypericum perforatum.*

Photo 5-10: PCT 300 (AA-2) to the south of Elliott Way in the Bago State Forest showing dominance of *Eucalyptus robertsonii* with *Eucalyptus dalrympleana* and *Eucalyptus viminalis*

Photo 5-11: PCT 300 (SEH-5) on the western slope of Sheep Station Ridge showing dominance of *Eucalyptus robertsonii*

Photo 5-12: PCT 300 (SEH-5) south of Elliott Way in Bago State Forest showing dominance of *Eucalyptus robertsonii* and open midstorey

Photo 5-13: PCT 300 (SEH-5) south of Elliott Way in the Bago State Forest showing dominance of *Eucalyptus robertsonii* with *Eucalyptus dalrympleana* and *Eucalyptus viminalis* and a denser shrub layer

Photo 5-14: PCT 300 (SEH-5) north of Elliott Way showing dominance of *Eucalyptus viminalis* in the drainage line

Photo 5-15: PCT 300 (SEH-5) along Elliott Way in the broader study area showing dominance of *Eucalyptus viminalis* in a drainage line

5.5.4 Riparian Blakely's Red Gum – Broad-leaved Sally woodland - tea-tree - bottlebrush - wattle shrubland wetland of the NSW South Western Slopes Bioregion and South Eastern Highlands Bioregion

Vegetation formation: Dry Sclerophyll Forests (Shrub/grass sub-formation)

Vegetation class: Upper Riverina Dry Sclerophyll Forests **PCT:** 302

Threatened ecological community (BC Act and EPBC Act): Not a TEC

Vegetation zones (condition) and plots:

- Native Grassland: Plot 43
- Moderate condition: Plots 44, 45, 46 (EMM 1018), 47 (EMM 1048), 48.

PCT 302 percent cleared in NSW: 50%

Project Impact: 2.34 ha

The Riparian Blakely's Red Gum - Broad-leaved Sally woodland - tea-tree - bottlebrush - wattle shrubland wetland of the NSW South Western Slopes Bioregion and South Eastern Highlands Bioregion PCT is described in the BioNet Vegetation Classification database as a riparian woodland containing Blakely's Red Gum (*Eucalyptus blakelyi*), Broad-leaved Sally (*Eucalyptus camphora* subsp. *humeana*), Apple Box (*Eucalyptus* bridgesiana) or Ribbon Gum (*Eucalyptus viminalis*) with a closed or mid-dense tall shrubland understorey along creeks that is dominated by species of tea tree including *Leptospermum obovatum, Leptospermum brevipes* and occasionally *Leptospermum grandifolium* and *Bursaria spinosa, Callistemon sieberi, Acacia melanoxylon, Melicytus dentatus, Acacia dealbata* and in some locations *Acacia kettlewelliae* and *Pomaderris angustifolia*. The ground cover on the banks and adjoining flats of the watercourses may be dense or mid-dense and includes the mat-rush *Lomandra longifolia* with the rush *Juncus usitatus*, the grasses *Microlaena stipoides* var. *stipoides*, *Poa labillardierei* var. *labillardierei, Poa ensiformis* and *Lachnagrostis filiformis* and the sedges *Carex appressa, Carex gaudichaudiana, Carex fascicularis* and *Isolepis subtilissima*. The wetland forbs *Gratiola peruviana* and *Ludwigia peploides* subsp. *montevidensis* occur along creeks along with the tall Common Reed (*Phragmites australis*). Forbs include *Viola caleyana, Mentha australis, Alternanthera denticulata, Hydrocotyle peduncularis* and *Persicaria* spp. Occurs on shallow, brown to grey podsolic loamy clays or humic gleys over gravel often derived from granite or granodiorite substrates lining creeks and on adjoining flats in the southern part of the Upper Slopes sub-region of the NSW South-western Slopes Bioregion extending into the South Eastern Highlands Bioregion. Mainly confined to the Tumut - Tumbarumba districts. The species composition varies with altitude and grazing history as grazing reduces shrub layer. Often heavily infested with weeds including Blackberry (*Rubus discolor*) and Willow (*Salix* spp.).

Within the project area, and broader study area (refer to **Figure 5-2**), this vegetation does not have a matching vegetation group as described by Gellie (2005). This vegetation aligns well with the description for the Ribbon Gum very tall woodland on sandy alluvial soils along drainage lines of the eastern South Eastern Highlands Bioregion (map unit p520) as described by the Office of Environment and Heritage (2011); however, this map unit is described as having a sparse to absent shrub layer while the vegetation in the project area has a dense shrub layer.

Within the project area, PCT 302 occurs in the east in the KNP along the major waterway of the Yarrangobilly River (**Photo 5-19**) and the smaller waterways of Wallaces Creek, Lick Hole Gully, Cave Gully (**Photo 5-16** to **Photo 5-18**) and Sheep Station Creek. PCT 302 extends out of the project area into the broader study area along these waterways. PCT 302 intergrades extensively with PCT 285 where a broader floodplain is present such as along areas of Sheep Station Creek and on the Yarrangobilly River floodplain, and PCT 729 and PCT 296 where the drainage lines become narrow bands within steeper terrain in areas to the south of Mine Trail and the upper reaches of Sheep Station Creek away from the confluence with the Yarrangobilly River. In most cases the boundaries between these PCTs are not distinct and there is considerable overlap in species with *Eucalyptus viminalis* growing up slope from the adjacent drainage line.

This vegetation is most likely to be representative of PCT 302 for the following reasons:

- This canopy is dominated by *Eucalyptus viminalis* with *Eucalyptus camphora* also common. Other eucalypts including *Eucalyptus stellulata, Eucalyptus rubida,* and *Eucalyptus robertsonii* are occasional

  The midstorey of the vegetation matches the description of PCT 302 well with characteristic species *Acacia melanoxylon, Bursaria spinosa, Callistemon sieberi, Pomaderris angustifolia, Pomaderris aspera, Melicytus dentatus, Acacia dealbata, Dodonaea viscosa,* and *Acacia pravissima* all present. The shrub layer is dense
- The ground cover contains species characteristic of PCT 302 including *Lachnagrostis filiformis, Carex gaudichaudiana, Juncus usitatus, Carex appressa, Carex fascicularis, Lomandra longifolia, Microlaena stipoides, Phragmites australis, Pteridium esculentum, Themeda triandra, Dichelachne micrantha, Alternanthera denticulata, Persicaria prostrata, Mentha australis, Ranunculus lappaceus, Epilobium billardierianum, Gratiola peruviana,* and *Lythrum salicaria*.

Other candidate PCTs for this vegetation that have *Eucalyptus viminalis* as a part of the canopy include 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 299). The *Riverina Regional Native Vegetation Map Version v1.0 - VIS_ID 4469* (Office of Environment and Heritage, 2016b) indicates that the vegetation along the Yarrangobilly River is likely to be PCT 299. However, within the project area, and broader study area, this vegetation more closely matches the description of PCT 302 due to the dense and species rich shrub layer. PCT 302 appears to be a very variable community and the PCT name is misleading in the context of the riparian vegetation in the project area and broader study area.

Two condition variants of PCT 302 were identified within the project area including:

- Moderate (**Photo 5-16**, **Photo 5-17** and **Photo 5-19**)
- Native Grassland (**Photo 5-18**).

A summary of the vegetation structure and floristics of PCT 302 is given below in **Table 5-7**. This list of species reflects the local variation gathered from multiple floristic plots undertaken within the project area and also includes incidental observations while moving through the vegetation in the broader study area.

Table 5-7: Floristic and structural summary of PCT 302 within the project area

Vegetation layer	Dominant species
Tree canopy (upper stratum)	*Eucalyptus viminalis* is the dominant canopy species within this PCT on the project area and in the broader study area. *Eucalyptus camphora* is also common. Other eucalypts including *Eucalyptus stellulata, Eucalyptus rubida*, and *Eucalyptus robertsonii* are occasional. *Acacia dealbata* and *Acacia melanoxylon* are also common tree species throughout the PCT.
Midstorey (mid-stratum)	Characterised by shrubs including *Acacia pravissima, Bursaria spinosa, Cassinia aculeata, Cassinia longifolia, Dodonaea viscosa, Acacia pruinosa, Gynatrix pulchella, Pimelea pauciflora, Rhytidosporum* sp., *Callistemon sieberi, Pomaderris angustifolia, Pomaderris aspera, Melicytus dentatus, Exocarpos strictus, Banksia canei, Leptospermum lanigerum.*
Groundcovers (ground stratum)	Grass and grass like species including *Poa helmsii, Lachnagrostis filiformis, Carex gaudichaudiana, Juncus usitatus, Carex appressa, Carex fascicularis, Lomandra longifolia, Microlaena stipoides, Phragmites australis, Themeda triandra, Dichelachne micrantha, Rytidosperma penicillatum, Anthosachne scabra, Echinopogon ovatus, Poa sieberiana, Hemarthria uncinata, Poa labillardierei.* Forbs including *Alternanthera denticulata, Persicaria prostrata, Mentha australis, Ranunculus lappaceus, Ranunculus pimpinellifolius, Epilobium billardierianum, Gratiola peruviana, Lythrum salicaria, Acaena novae-zelandiae, Ajuga australis, Rumex brownii, Chrysocephalum semipapposum, Geranium solanderi, Poranthera microphylla, Oxalis perennans, Myosotis australis, Dichondra repens, Galium gaudichaudii, Hydrocotyle laxiflora, Stellaria pungens.* Ferns including *Pteridium esculentum* and *Blechnum* spp. are common. Species in the 'other' growth forms include *Glycine clandestina, Cassytha* sp. and *Clematis aristata*.
Exotic species	*Centaurium erythraea, Hypochaeris radicata, Prunella vulgaris, Erythranthe moschata, Aira elegantissima, Cirsium vulgare.*
High Threat Weeds	*Rubus fruticosus* sp. agg., *Rosa rubiginosa, Hypericum perforatum, Holcus lanatus.*

Photo 5-16: PCT 302 (SEH-7) along Cave Gully showing dominance of *Eucalyptus viminalis* with *Rubus fruticosus* sp. agg.

Photo 5-17: PCT 302 (SEH-7) along Cave Gully showing dense *Rubus fruticosus* sp. agg. infestation along the drainage line and dense native shrub layer in the background

Photo 5-18: PCT 302 (SEH-6) along Cave Gully opposite Mine Trail showing absent canopy and dense ground cover of *Poa helmsii*

Photo 5-19: PCT 302 (SEH-7) along the Yarrangobilly River north of Sheep Station Creek showing canopy of *Eucalyptus viminalis* and dense shrub layer

5.5.5 Broad-leaved Peppermint – Candlebark shrubby open forest of montane areas, southern South Eastern Highlands Bioregion and South East Corner Bioregion

Vegetation formation: Dry Sclerophyll Forests (Shrubby sub-formation)

Vegetation class: Southern Tableland Dry Sclerophyll Forests **PCT:** 729

Threatened ecological community (BC Act and EPBC Act): Not a TEC

Vegetation zones (condition) and plots:

- Native Grassland: Plots 49, 50, 51
- Shrubland - regrowth: Plots 52, 53, 54, 55
- Good - dry open slopes & ridgetops: Plots 56, 57, 58, 59, 60, 61, 62, 63, 70, 71.

PCT 729 percent cleared in NSW: 35%

Project Impact: 26.94 ha

Good - wetter sheltered slopes: Plots 64, 65, 66, 68, 69The Broad-leaved Peppermint - Candlebark shrubby open forest of montane areas, southern South Eastern Highlands Bioregion and South East Corner Bioregion PCT is not currently described well in the BioNet Vegetation Classification database. This PCT is identified with a very low classification confidence level and no detailed description of the vegetation is provided.

Within the project area, and broader study area (refer to **Figure 5-2**), this vegetation matches the Tablelands Shrub/Tussock Grass Forest (Vegetation Group 75) as described by Gellie (2005). This vegetation aligns well with the description for the Broad-leaved Peppermint - Candlebark tall dry sclerophyll open forest of quartz-rich ranges of the upper South East Highlands and lower Australian Alps Bioregions (map unit u21) as described by the Office of Environment and Heritage (2011). However, the vegetation in the project area does not have *Eucalyptus bridgesiana*.

Within the project area, PCT 729 occurs in the west in the KNP on the steep east facing slopes to the Talbingo Reservoir, and in the east on the western and eastern slopes of Sheep Station Ridge, and slopes to the south of Mine Trail and east of Lobs Hole Ravine Road (**Photo 5-20** to **Photo 5-24**). PCT 729 intergrades extensively with PCT 296 and the boundaries between these two PCTs is very indistinct. Some areas dominated by *Eucalyptus dives* could be assigned to either PCT. This PCT also intergrades with PCT 302 where drainage lines are present and there are areas where *Eucalyptus rubida* and *Eucalyptus viminalis* intermix in the canopy. There is a more abrupt ecotone where PCT 729 occurs next to PCT 999 with a distinct canopy species change and change in midstorey structure. Where this PCT occurs on more sheltered slopes the midstorey is dominated by a dense cover of *Banksia canei* (**Photo 5-21**). Elsewhere in drier ridge tops and slopes the midstorey is more open and dominated by *Calytrix tetragona* and *Brachyloma daphnoides* (**Photo 5-24)**.

While the Broad-leaved Peppermint - Candlebark shrubby open forest of montane areas, southern South Eastern Highlands Bioregion and South East Corner Bioregion PCT is not currently described well in the BioNet Vegetation Classification database, the vegetation within the project area is considered to be most likely representative of PCT 729 for the following reasons:

- This canopy is dominated by *Eucalyptus dives* with *Eucalyptus rubida* occurring variably as occasional, co-dominant or as the dominant canopy species. Other eucalypts including *Eucalyptus viminalis, Eucalyptus robertsonii, Eucalyptus nortonii,* and *Eucalyptus mannifera* also occur at ecotones
- The midstorey of the vegetation matches the description of PCT 729 well with characteristic species *Acacia dealbata, Brachyloma daphnoides,* and *Cassinia longifolia*
- The ground cover contains species characteristic of PCT 729 including *Dianella revoluta, Dichelachne rara, Hovea linearis, Lomandra longifolia, Poa sieberiana,* and *Stackhousia monogyna*.

The other candidate PCT for this vegetation is the Brittle Gum – peppermint open forest of the Woomargama to Tumut region, NSW South Western Slopes Bioregion (PCT 296). However, *Eucalyptus rubida* is conspicuous in the vegetation and can be dominant. *Brachyloma daphnoides* is conspicuous in the shrub layer and this species is not noted for PCT 729 in the BioNet Vegetation Classification database.

Four condition variants of PCT 729 were identified within the project area including:

- Good – dry open slopes and ridgetops (**Photo 5-24**)
- Good – wetter sheltered slopes (**Photo 5-21**)
- Shrubland regrowth (**Photo 5-22**)
- Native Grassland (**Photo 5-23**).

A summary of the vegetation structure and floristics of PCT 729 is given below in **Table 5-8**. This list of species reflects the local variation gathered from multiple floristic plots undertaken within the project area and also includes incidental observations while moving through the vegetation in the broader study area.

Table 5-8: Floristic and structural summary of PCT 729 within the project area

Vegetation layer	Dominant species
Tree canopy (upper stratum)	*Eucalyptus dives* is the dominant canopy species within this PCT on the project area and in the broader study area. *Eucalyptus rubida* occurs variably as occasional, co-dominant or as the dominant canopy species. Other eucalypts including *Eucalyptus viminalis, Eucalyptus robertsonii, Eucalyptus nortonii*, and *Eucalyptus mannifera* also occur at ecotones. *Acacia dealbata* is prominent and *Callitris endlicheri* is occasional.
Midstorey (mid-stratum)	Characterised by shrubs including *Astroloma humifusum, Banksia canei* (can be very dense), *Bossiaea foliosa, Brachyloma daphnoides, Bursaria spinosa, Calytrix tetragona, Cassinia aculeata, Cassinia longifolia, Choretrum pauciflorum, Chorizema parviflorum, Coprosma hirtella, Daviesia latifolia, Daviesia mimosoides, Dillwynia crispii, Dillwynia phylicoides, Exocarpos cupressiformis, Exocarpos strictus, Gompholobium huegelii, Grevillea arenaria* subsp. *canescens, Grevillea rosmarinifolia, Hibbertia obtusifolia, Hovea lanceolata, Indigofera australis, Leucopogon fletcheri, Leucopogon virgatus, Mirbelia oxylobioides, Monotoca scoparia, Omphacomeria acerba, Persoonia chamaepeuce, Pimelea curviflora, Pimelea linifolia, Platylobium formosum, Rhytidosporum* sp., *Tetratheca bauerifolia.*
Groundcovers (ground stratum)	Grass and grass like species including *Dichelachne* sp., *Lepidosperma laterale, Lomandra filiformis, Lomandra longifolia, Lomandra multiflora, Luzula* sp., *Microlaena stipoides, Poa labillardierei, Poa sieberiana, Rytidosperma* sp., *Themeda triandra.* Forbs including *Ajuga australis, Asperula conferta, Asperula scoparia, Brachyscome scapigera, Caladenia congesta, Caladenia gracilis, Chrysocephalum apiculatum, Crassula sieberiana, Daucus glochidiatus, Dianella revoluta, Diuris sulphurea, Euchiton involucratus, Euphrasia collina* subsp. *paludosa, Geranium obtusisepalum, Gonocarpus tetragynus, Hovea heterophylla, Hydrocotyle laxiflora, Hypericum gramineum, Oxalis perennans, Picris angustifolia, Plantago gaudichaudii, Poranthera microphylla, Prasophyllum brevilabre, Pterostylis longifolia, Pterostylis nutans, Ranunculus lappaceus, Senecio quadridentatus, Senecio prenanthoides, Stackhousia monogyna, Stellaria pungens, Stylidium graminifolium, Thelymitra megcalyptra, Veronica derwentiana, Viola betonicifolia, Wahlenbergia stricta, Xerochrysum bracteatum.* Ferns including *Pteridium esculentum* and *Cheilanthes sieberi* are common. Species in the 'other' growth forms include *Glycine clandestina, Amyema pendula, Hardenbergia violacea*, and *Cassytha* spp.
Exotic species	*Centaurium erythraea, Hypochaeris radicata, Prunella vulgaris, Aira elegantissima.*
High Threat Weeds	*Rubus fruticosus* sp. agg., *Rosa rubiginosa, Hypericum perforatum, Holcus lanatus.*

Photo 5-20: PCT 729 (SEH-11) south of Mine Trail showing the canopy of *Eucalyptus rubida*

Photo 5-21: PCT 729 SEH-10) to the west of Sheep Station Creek showing the canopy dominated by *Eucalyptus dives* and a dense shrub layer of *Banksia canei*

Photo 5-22: PCT 729 (SEH-9) to the south of Mine Trail showing an area of regenerating shrubland

Photo 5-23: PCT 729 (SEH-8) to the south of Mine Trail showing an area of native grassland dominated by *Themeda triandra*

Photo 5-24: PCT 729 (SEH-10) to the west of Sheep Station Creek showing dominance of *Eucalyptus dives* in the canopy and shrub layer dominated by *Brachyloma daphnoides*

5.5.6 Nortons Box - Broad-leaved Peppermint open forest on footslopes, central and southern South Eastern Highlands Bioregion

Vegetation formation: Dry Sclerophyll Forests (Shrub/grass sub-formation)

Vegetation class: Upper Riverina Dry Sclerophyll Forests **PCT:** 999

Threatened ecological community (BC Act and EPBC Act): Not a TEC

Vegetation zones (condition) and plots:

- Shrubland - regrowth: Plots 72, 73
- Good - drier *Calytrix tetragona*: Plots 74, 75, 76, 77, 78, 79, 80, 81.

PCT 999 percent cleared in NSW: 15%

Project Impact: 8.60 ha.

The Nortons Box – Broad - leaved Peppermint open forest on footslopes, central and southern South Eastern Highlands Bioregion PCT is not currently described well in the BioNet Vegetation Classification database. This PCT is identified with a very low classification confidence level and no detailed description of the vegetation is provided.

Within the project area, and broader study area (refer to **Figure 5-2**), this vegetation matches the Montane Dry Shrub/Tussock Grass Forest (Vegetation Group 79) as described by Gellie (2005). This vegetation aligns well with the description for the Norton's Box - Broad-leaved Peppermint shrubby mid-high open forest on granite substrates primarily in the Namadgi Region (map unit u18) as described by the Office of Environment and Heritage (2011).

Within the project area, PCT 999 occurs in the east in the KNP on the steep dry north and west facing slopes and ridgetops to the east and west of Sheep Station Creek and East of Lobs Hole Ravine Road. PCT 999 intergrades with PCT 729 and PCT 296 but the boundary between these vegetation types is relatively distinct with an obvious change in dominant canopy species and change in midstorey structure evident.

While the Nortons Box – Broad - leaved Peppermint open forest on footslopes, central and southern South Eastern Highlands Bioregion PCT is not currently described well in the BioNet Vegetation Classification database, the vegetation within the project area is considered to be most likely representative of PCT 999 for the following reasons:

- This canopy is dominated by *Eucalyptus nortonii* with *Eucalyptus dives* occurring occasionally. *Eucalyptus rubida* and *Eucalyptus robertsonii* occur at ecotones. *Callitris endlicheri* occurs in scattered patches being most abundant on the steep slopes west of Sheep Station Creek
- The midstorey of the vegetation matches the description of PCT 999 well with characteristic species *Calytrix tetragona, Cassinia longifolia* present. *Calytrix tetragona* dominates the shrub layer
- The ground cover contains species characteristic of PCT 999 including *Austrostipa scabra, Desmodium varians, Dianella revoluta, Dichelachne micrantha, Elymus scaber, Geranium solanderi, Poa sieberiana,* and *Themeda triandra*.

The other candidate PCT for this vegetation is the Red Stringybark - Broad-leaved Peppermint - Nortons Box heath open forest of the upper slopes subregion in the NSW South Western Slopes Bioregion and adjoining South Eastern Highlands Bioregion (PCT 311). However, due to the absence of *Eucalyptus macrorhyncha* from the project area and broader study area, and absence of midstorey species such as *Xanthorrhoea glauca*, combined with the dominance of *Calytrix tetragona* in the midstorey, the vegetation is considered most likely to be representative of PCT 999.

Two condition variants of PCT 999 were identified within the project area including:

- Good – drier *Calytrix tetragona* (**Photo 5-25** to **Photo 5-27** and **Photo 5-30**)
- Shrubland - regrowth (**Photo 5-28**).

A summary of the vegetation structure and floristics of PCT 999 is given below in **Table 5-9**. This list of species reflects the local variation gathered from multiple floristic plots undertaken within the project area and also includes incidental observations while moving through the vegetation in the broader study area.

Table 5-9: Floristic and structural summary of PCT 729 within the project area

Vegetation layer	Dominant species
Tree canopy (upper stratum)	*Eucalyptus nortonii* is the dominant canopy species within this PCT on the project area and in the broader study area. *Eucalyptus dives* can be co-dominant in areas. *Eucalyptus rubida* and *Eucalyptus robertsonii* occur at ecotones. Callitris endlicheri occurs in scattered patches.
Midstorey (mid-stratum)	Characterised by shrubs including *Acacia buxifolia, Acacia gunnii, Acacia pravissima, Banksia canei, Brachyloma daphnoides, Calytrix tetragona* (dominant), *Cassinia aculeata, Cassinia longifolia, Dillwynia phylicoides, Hibbertia obtusifolia, Leucopogon virgatus, Leucopogon fletcheri, Monotoca scoparia, Pimelea linifolia, Platylobium formosum, Rhytidosporum* sp., *Tetratheca bauerifolia.*
Groundcovers (ground stratum)	Grass and grass like species including *Austrostipa scabra, Dichelachne micrantha, Elymus scaber, Poa sieberiana*, *Themeda triandra, Lomandra filiformis, Lomandra glauca, Lomandra gracilis, Lomandra longifolia, Luzula* sp. Forbs including *Boronia nana, Caladenia congesta, Caladenia gracilis, Gonocarpus tetragynus, Hovea* sp., *Hypericum gramineum, Prasophyllum brevilabre, Wahlenbergia stricta, Dianella revoluta, Geranium solanderi.* Ferns including *Cheilanthes sieberi* are occasional. Species in the 'other' growth forms include *Desmodium varians, Glycine clandestina, Hardenbergia violacea,* and *Cassytha* spp.
Exotic species	*Centaurium erythraea, Aira elegantissima.*

High Threat Weeds	*Hypericum perforatum*

Photo 5-25: PCT 999 (SEH-13) adjacent to Lobs Hole Ravine Road showing dominance of *Eucalyptus nortonii* in the canopy and shrub layer dominated by *Calytrix tetragona*

Photo 5-26: PCT 999 (SEH-13) on the steep slope to the west of Lobs Hole Ravine Road showing dominance of *Eucalyptus nortonii* in the canopy and shrub layer dominated by *Calytrix tetragona*

Photo 5-27: PCT 999 (SEH-13) on the steep slope to the west of Lobs Hole Ravine Road showing dominance of *Eucalyptus nortonii* in the canopy and exposed rocky outcrop

Photo 5-28: PCT 999 (SEH-13) on the steep slope to the west of Lobs Hole Ravine Road showing an area with cleared canopy dominated by a dense shrub layer of *Calytrix tetragona*

Photo 5-29: PCT 999 (SEH-13) on the ridge to the west of Sheep Station Creek dominated by *Eucalyptus nortonii*

5.5.7 Snow Gum – Mountain Gum shrubby open forest of montane areas, South Eastern Highlands Bioregion and Australian Alps Bioregion

Vegetation formation: Grassy Woodlands

Vegetation class: Subalpine Woodlands **PCT:** 1196

Threatened ecological community (BC Act and EPBC Act): Not a TEC

Vegetation zones (condition) and plots:

- Native Grassland: Plots 6, 7
- Good - drier *Calytrix tetragona*: Plots 8, 9, 10, 11, 12, 13.

PCT 1196 percent cleared in NSW: 5%

Project impact: 27.24 ha

The Snow Gum - Mountain Gum shrubby open forest of montane areas, South Eastern Highlands Bioregion and Australian Alps Bioregion PCT is described in the BioNet Vegetation Classification database as an open to tall open forest with an open shrubby understorey and grassy ground layer, widespread on montane to sub alpine slopes and ridges. This PCT is not currently described well in the BioNet Vegetation Classification database and is identified with a very low classification confidence level and no detailed description of the vegetation is provided.

Within the project area, and broader study area (refer to **Figure 5-2)**, this vegetation matches the description of the Tablelands Acacia/Grass/Herb Dry Forest (Vegetation Group 101) as described by Gellie (2005) but may also fit the description of the Tablelands Acacia Moist Herb Forest (Vegetation Group 95), Montane Acacia/Dry Shrub/Herb/Grass Forest (Vegetation Group 97), Western Montane Moist Shrub Forest (Vegetation Group 98). This vegetation also aligns with the description for the Mountain Gum - Snow Gum ± Robertson's Peppermint grass-forb very tall woodland to open forest of the Australian Alps and South Eastern Highlands Bioregions (map unit u22) as described by the Office of Environment and Heritage (2011).

Within the project area, vegetation considered most likely to be representative of the Snow Gum - Mountain Gum shrubby open forest of montane areas, South Eastern Highlands Bioregion and Australian Alps Bioregion PCT occurs in the west within the Bago State Forest at the location of the substation. Native Grasslands also exist in the easement of the existing Line 64 (refer **Photo 5-33**). This PCT is present in the broader study area to the north, west and south of the project area.

This vegetation is most likely to be representative of PCT 1196 for the following reasons:

- This canopy is characterised by *Eucalyptus pauciflora* with *Eucalyptus dalrympleana* and *Eucalyptus robertsonii*
- The shrub layer is sparse to dense depending on level of disturbance and is characterised by the presence of *Acacia dealbata, Coprosma hirtella, Daviesia latifolia, Daviesia ulicifolia, Olearia erubescens,* and *Platylobium formosum*
- The ground cover contains the characteristic species *Acaena novae-zelandiae, Acaena ovina, Asperula scoparia, Dianella tasmanica, Lomandra longifolia, Luzula flaccida, Microlaena stipoides, Poa sieberiana, Stellaria pungens, Stylidium graminifolium, Brachyscome spathulata, Lagenifera stipitata,* and *Viola betonicifolia*.

Other PCTs that have *Eucalyptus pauciflora* as a part of the canopy are either known from higher altitude alpine areas, other bioregions (e.g. New England Tablelands) or have *Eucalyptus rubida, Eucalyptus viminalis* or *Eucalyptus delegatensis* as a conspicuous component of the canopy. The vegetation in the project area could also match the description for the Mountain Gum – Snow Gum - Broad-leaved Peppermint shrubby open forest of montane ranges, South Eastern Highlands Bioregion and Australian Alps Bioregion (PCT 953). However, PCT 953 is more of a shrubby dry sclerophyll forest as opposed to the subalpine vegetation in the project area and PCT 953 contains several shrub species that are absent from this vegetation. Furthermore, the vegetation in the project area is characterised by several ground cover species that are not found in PCT 953.

Two condition variants of PCT 1196 were identified within the project area including:

- Good (**Photo 5-30** to **Photo 5-32**)
- Native Grassland (**Photo 5-33**).

A summary of the vegetation structure and floristics of PCT 1196 is given below in **Table 5-10**. This list of species reflects the local variation gathered from multiple floristic plots undertaken within the project area and also includes incidental observations while moving through the vegetation in the broader study area.

Table 5-10: Floristic and structural summary of PCT 1196 within the project area

Vegetation layer	Dominant species
Tree canopy (upper stratum)	*Eucalyptus pauciflora, Eucalyptus dalrympleana, Eucalyptus robertsonii, Acacia melanoxylon, Acacia dealbata*.
Midstorey (mid-stratum)	Characterised by shrubs including *Acacia pravissima, Astroloma humifusum, Bossiaea foliosa, Cassinia aculeata, Cassinia longifolia, Coprosma hirtella, Daviesia latifolia, Daviesia ulicifolia, Exocarpos cupressiformis, Lomatia myricoides, Olearia erubescens, Persoonia chamaepeuce, Platylobium formosum, Tetratheca bauerifolia, Tetratheca ciliata.*
Groundcovers (ground stratum)	Grass and grass like species including *Austrodanthonia pilosa, Lachnagrostis filiformis, Lomandra filiformis, Lomandra laxa, Lomandra longifolia, Luzula flaccida, Microlaena stipoides, Poa sieberiana, Poa labillardierei, Themeda triandra, Cymbopogon refractus, Dichelachne* sp., *Deyeuxia* sp., *Elymus scaber,* Forbs including *Acaena novae-zelandiae, Acaena ovina, Ajuga australis, Arthropodium* sp., *Asperula scoparia, Brachyscome scapigera, Calotis scabiosifolia, Caladenia gracilis, Caladenia alpina, Chiloglottis valida, Chrysocephalum apiculatum, Coronidium scorpioides, Corybas* sp., *Cotula australis, Craspedia* sp., *Cymbonotus lawsonianus, Dianella revoluta, Dianella tasmanica, Dichondra repens, Euchiton involucratus, Euphrasia collina* subsp. *paludosa, Galium gaudichaudii, Gastrodia sesamoides, Geranium obtusisepalum, Geranium solanderi, Geranium* sp. 2, *Gonocarpus tetragynus, Herpolirion novae-zelandiae, Hydrocotyle laxiflora, Hydrocotyle pedicellosa, Hydrocotyle tripartita, Hypericum gramineum, Lagenifera stipitata, Lobelia purpurascens, Microseris lanceolata, Oxalis perennans, Picris angustifolia, Plantago debilis, Poranthera microphylla, Pterostylis decurva, Pterostylis longifolia, Pterostylis monticola, Diuris monticola, Ranunculus lappaceus, Senecio quadridentatus, Senecio prenanthoides, Solenogyne bellioides, Stackhousia monogyna, Stellaria pungens, Stylidium graminifolium, Veronica calycina, Veronica derwentiana, Viola betonicifolia, Viola hederacea, Wahlenbergia stricta*. Ferns including *Pteridium esculentum* are occasionally present. Species in the 'other' growth forms include *Clematis aristata, Glycine clandestina, Glycine microphylla, Glycine tabacina, Cullen* sp.
Exotic species	*Centaurium erythraea, Erythranthe moschata, Prunella vulgaris, Trifolium repens, Hypochaeris radicata, Medicago polymorpha.*
High Threat Weeds	*Rubus fruticosus* sp. agg., *Rosa rubiginosa, Holcus lanatus, Hypericum perforatum, Acetosella vulgaris, Leucanthemum vulgare.*

Photo 5-30: PCT 1196 (AA-4) within the Bago State Forest at the substation site showing dominance of *Eucalyptus pauciflora* with few large trees and abundant regeneration of younger trees

Photo 5-31: PCT 1196 (AA-4) within the Bago State Forest showing dominance of *Eucalyptus pauciflora* with shrubby midstorey

Photo 5-32: PCT 1196 (AA-4) within the Bago State Forest showing *Eucalyptus pauciflora* with *Eucalyptus dalrympleana*

Photo 5-33: PCT 1196 (AA-3) beneath Line 64 showing the native grassland

5.6 Vegetation zones and vegetation integrity score

A summary of the vegetation zones identified within the project disturbance area, including the corresponding vegetation integrity (VI) score developed from the VI plot data is presented in **Table 5-11** for vegetation zones in the South Eastern Highlands Bioregion and **Table 5-12** for vegetation zones in the Australian Alps Bioregion. The VI survey plot data is provided in **Appendix B** and **Appendix C**.

Table 5-11: Vegetation zones and vegetation integrity scores for the South Eastern Highlands Bioregion

Veg Zone	PCT ID	PCT name	Vegetation Zone	Condition class	Area (ha)	VI score*
SEH-1	296	Brittle Gum - peppermint open forest of the Woomargama to Tumut region, NSW South Western Slopes Bioregion	296_DNG	Derived Native Grassland	0.1	39.5
SEH-2			296_Good, dry slopes	Good – drier *Eucalyptus nortonii* dominant slope	4.07	88.7
SEH-3			296_Good, wet slopes	Good – wetter sheltered slopes	13.56	75.3
SEH-4			296_Moderate Blackberry	Moderate – Blackberry infestation	1.29	49.1
SEH-5	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	300_Good	Good	23.19	81.1
SEH-6	302	Riparian Blakely's Red Gum - Broad-leaved Sally woodland - tea-tree - bottlebrush - wattle shrubland wetland of the NSW South Western Slopes Bioregion and South Eastern Highlands Bioregion	302_DNG	Derived Native Grassland	0.22	14.6
SEH-7			302_Moderate	Moderate	2.12	61.3
SEH-8	729	Broad-leaved Peppermint - Candlebark shrubby open forest of montane areas, southern South Eastern Highlands Bioregion and South East Corner Bioregion	729_DNG	Derived Native Grassland	0.72	23.4
SEH-9			729_Derived shrubland	Shrubland - regrowth	0.61	36.6
SEH-10			729_Good dry slopes	Good - dry open slopes & ridgetops	12.82	81.5
SEH-11			729_Good wetter slopes	Good - wetter sheltered slopes	12.79	76
SEH-12	999	Norton's Box - Broad-leaved Peppermint open forest on footslopes, central and southern South Eastern Highlands Bioregion	999_Derived shrubland	Shrubland - regrowth	1.34	31.5
SEH-13			999_Good dry Calytrix	Good - drier *Calytrix tetragona*	7.26	58.9

Table 5-12: Vegetation zones and vegetation integrity scores for the Australian Alps Bioregion

Veg Zone	PCT ID	PCT name	Vegetation Zone	Condition class	Area (ha)	VI score*
AA-1	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	285_Moderate Blackberry	Moderate - Blackberry infestation	2.2	78.7

Veg Zone	PCT ID	PCT name	Vegetation Zone	Condition class	Area (ha)	VI score*
AA-2	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	300_Good	Good	8.82	83.5
AA-3	1196	Snow Gum - Mountain Gum shrubby open forest of montane areas, South Eastern Highlands Bioregion and Australian Alps Bioregion	1196_DNG	Derived Native Grassland	0.09	38.6
AA-4			1196_Good	Good	27.16	84.9

5.7 Patch size

A patch is defined in the BAM as an area of intact native vegetation that occurs on the subject land (project area). The patch may extend onto adjoining land beyond the project area, and for woody ecosystems, includes native vegetation separated by ≤100 m from the next area of intact native vegetation. For non-woody vegetation, this gap is reduced to ≤30 m. Patch size for each vegetation zone located on the project area was mapped in accordance with Subsection 5.3.2 of the BAM using the following steps:

1) Identify vegetation zones that will be included in the same patch.
2) Identify the boundary of any adjoining intact native vegetation which extends beyond the limit of the project area.
3) Digitise each patch in a GIS using separate polygons where multiple patches exist.
4) Calculate the area of each patch in ha in a GIS.

The patch was then allocated to a patch size class (<5 ha, 5–24 ha, 25–100ha or >100 ha). Patch size class is used as a filter in the BAM-C to predict threatened species likely to occur or use habitat on project area.

The main barrier that breaks apart vegetation within the project area is the existing Talbingo Reservoir which is approximately 180 m wide underneath the transmission line connection corridor. The Talbingo Reservoir divides the vegetation into two patches that are each more than 100 ha in size. As such, the two patches received the maximum patch size class of >100 ha.

The Elliott Way road corridor is not wide enough to constitute a break in a patch and vegetation on either side of Elliott Way is classed as part of the same patch. This also applies to vegetation either side of Lobs Hole Ravine Road. Importantly, the native grassland in the Line 64 easement contains all structural layers (strata) characteristic of PCT 1196. There is regeneration of tree and shrub species so the easement does not constitute a break in the patch for the purposes of patch size calculation under the BAM.

5.8 Threatened ecological communities

There are five threatened ecological communities (TECs) as listed under the BC Act that could occur in the broader study area based on the database searches and the regional PCT mapping (see **Section 8.3** for discussion on EPBC Act TECs). These TECs are 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 assessment concludes that none of these TECs occurs in the disturbance area or project area. Discussion and justification for this conclusion is provided below.

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

This TEC corresponds directly to the Drooping Sheoak - *Ricinocarpos bowmannii* - grasstree tall open shrubland of the Coolac - Tumut Serpentinite Belt PCT. This TEC is mapped as occurring in the east of the broader study area north of Roundtop Mountain and adjacent to Lobs Hole Ravine Road which is on limestone and shale geology. 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, Eucalyptus viminalis, Acacia dealbata, Dodonaea viscosa, Bursaria spinosa, Calytrix tetragona,* and *Exocarpos strictus*. The characteristic species *Allocasuarina verticillata*, *Acacia implexa*, *Xanthorrhoea glauca* and *Ricinocarpos bowmanii* were not present in the areas visited. Based on visits to the study area the mapping of this TEC is considered inaccurate. This TEC does not occur in the project area and is unlikely to occur in the broader study area.

5.8.2 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. This TEC is mapped as occurring in the higher altitude alpine areas in the west of the broader survey area near Yorkers Creek on the Bago plateau in the Bago State Forest. This TEC is mapped more extensively in that area (refer to **Figure 5-2**) by the Montane Peatlands and Swamps layer (Environmental Protection Authority, 2016) 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 patch of creek line vegetation along Yorkers Creek to the north of the project area in the Line 64 easement (refer to **Figure 5-2**) was visited during the surveys and it was found to contain species characteristic of the Montane Peatlands and Swamps of the New England Tableland, NSW North Coast, Sydney Basin, South East Corner, South Eastern Highlands and Australian Alps Bioregions TEC. Mature *Eucalyptus camphora* and *Eucalyptus pauciflora* trees are present at the edges of the vegetation and also as scattered seedlings throughout. A characteristic dense shrub layer consisting of *Leptospermum lanigerum, Epacris breviflora, Baeckea utilis, Hakea microcarpa* is present in a band along the drainage line. Groundcover species including *Empodisma minus,* and *Juncus* spp. occur with *Carex* spp., *Poa* spp., and a range of herbs and wildflowers typical of the TEC including the key indicator species *Gonocarpus micranthus* and *Sphagnum cristatum*. The vegetation and the portion of Yorkers Creek in this area is quite damaged from horses and the ground layer vegetation is heavily grazed. As the vegetation is in an altered state from the creation and maintenance of the Line 64 easement it cannot be definitively stated whether this vegetation along Yorkers Creek is part of the TEC or whether it has been derived from the Broad-leaved Sally grass - sedge woodland on valley flats and swamps in the NSW South Western Slopes Bioregion and adjoining South Eastern Highlands Bioregion PCT (PCT 285).

This patch is upstream and north of Elliott Way so is unlikely to be affected by surface water flow from the project. However, there is another smaller mapped patch on Yorkers Creek around 500 m downstream of the second order stream that flows from the substation site. This mapped area was not verified from surveys but has the potential to be indirectly impacted by surface water flow from the project. The potential for indirect impacts to this potential TEC will be managed by standard erosion control measures and drainage design around the substation site.

The regrowth shrubland representative of PCT 285 along New Zealand Gully within the project area in the Line 64 easement shares many of the same species as the vegetation along Yorkers Creek. However, the vegetation along New Zealand Gully is clearly derived from PCT 285 as evidenced by the adjacent vegetation along New Zealand Gully either side of the easement and the evidence of cut trees lying in the creek under the dense shrub layer. The vegetation within the easement was originally a sclerophyll forest lining a narrow drainage line and was not a peatland or swamp. As such, the Montane Peatlands and Swamps of the New England Tableland, NSW North Coast, Sydney Basin, South East Corner, South Eastern Highlands and Australian Alps Bioregions TEC does not occur in the project area.

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

The western portion of the broader study area in the Maragle and Bago State Forests have mapped areas of Olivine Basalt geology. However, these areas are within the Australian Alps Bioregion so the vegetation in these areas of basalt will not be considered part of the Tableland Basalt Forest in the Sydney Basin and South Eastern Highlands Bioregions TEC. Furthermore, the vegetation in this western portion of the project area is located on Biotite Granodiorite geology. The portion of the project area that lies within the South Eastern Highlands Bioregion is located on a mix of shale, limestone, quartzite and siltstone geology. 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.

The vegetation within the South Eastern Highlands Bioregion portion of the project area does not match well with the descriptions for this TEC and none of the PCTs mapped in or near the project area correspond with this TEC.

5.8.4 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

The 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 TEC is mapped in the western portion of the broader study area in the Maragle and Bago State Forests associated with the drainage of Yorkers Creek and tributaries. Extensive areas of vegetation in the KNP in the east of the survey area are also mapped by regional mapping projects as PCTs that correspond to parts of this TEC.

While *Eucalyptus rubida, Eucalyptus pauciflora,* and *Eucalyptus viminalis* are common species within the PCTs in the project area, the vegetation types present within the project area do not match well with the description for this TEC. Furthermore, the TEC falls within the structural formation of Grassy Woodlands and the vegetation classes of Subalpine Woodlands and Tableland Clay Grassy Woodlands. The PCTs within the project area that are dominated by *Eucalyptus rubida* and *Eucalyptus viminalis* are dry and wet sclerophyll forests and not part of the Subalpine Woodlands or Tableland Clay Grassy Woodlands vegetation classes. The vegetation dominated by *Eucalyptus pauciflora* within the project area and broader study area is within the Australian Alps Bioregion so is therefore not considered to be part of this TEC.

5.8.5 White Box Yellow Box Blakely's Red Gum Woodland

This TEC corresponds directly to the Blakely's 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 by the available regional mapping projects.

The project area does not contain any PCTs dominated by *Eucalyptus albens, Eucalyptus melliodora*, or *Eucalyptus blakelyi*. These tree species were not recorded within the project area or broader study area during the vegetation surveys. Therefore, the White Box Yellow Box Blakely's Red Gum Woodland does not occur in or around the project area.

5.9 Groundwater dependent ecosystems

The level of groundwater dependence of vegetation communities in the project area and broader study area has been identified using the *Atlas of Groundwater Dependent Ecosystems* (GDEs) (Bureau of Meteorology,

2017) and the *Risk Assessment Guidelines for Groundwater Dependent Ecosystems* released by the NSW DPI (Kuginis *et al.*, 2012).

Extensive groundwater and GDE assessments have recently been undertaken as part of the Snowy 2.0 Main Works BDAR (EMM Consulting, 2020a), including a stygofauna assessment undertaken by Macquarie University. Information collected in those assessments for PCTs relevant to this project has been discussed here.

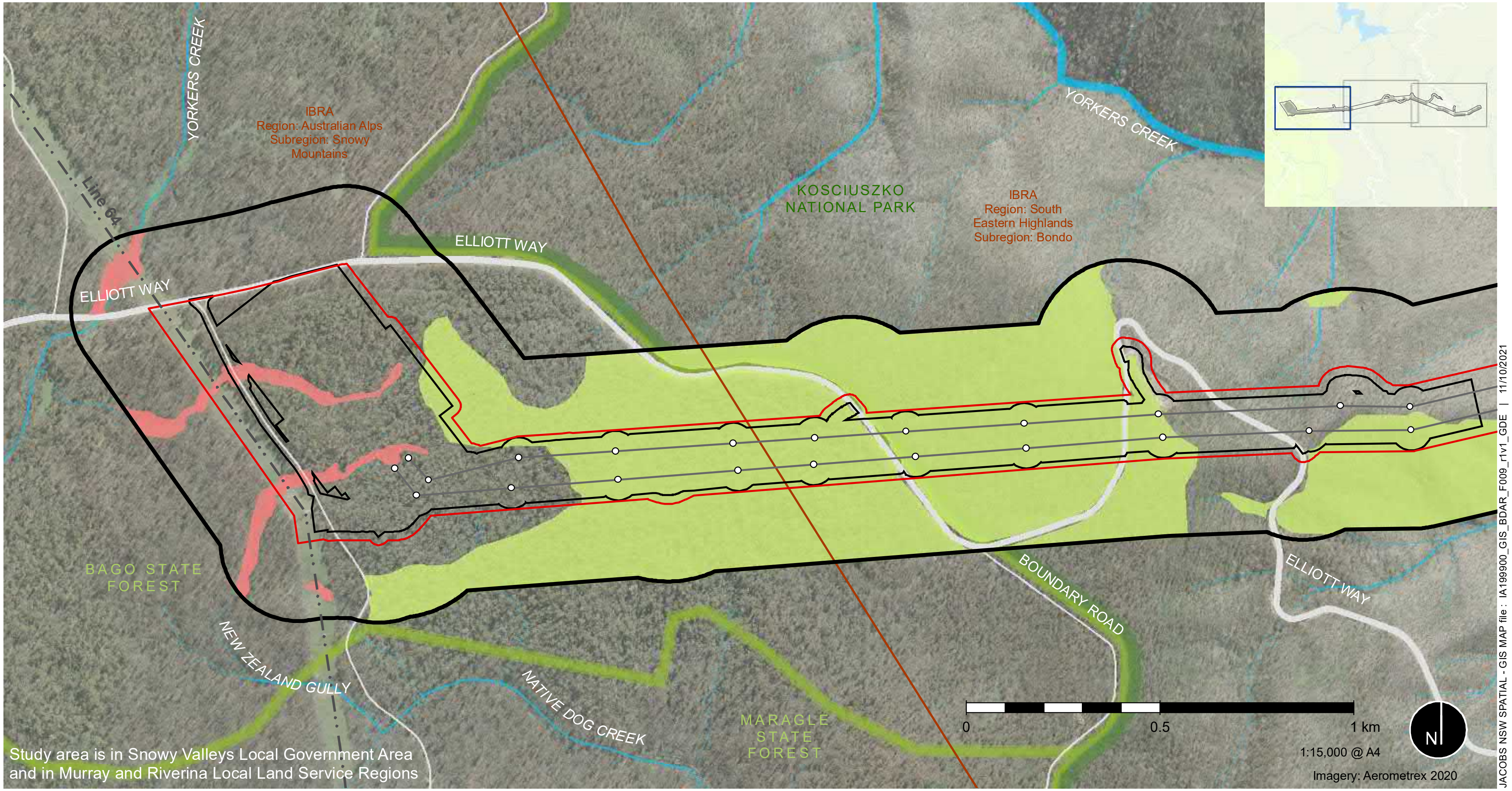
There are a number of high and moderate potential aquatic GDEs and terrestrial GDEs mapped within the study area and broader surrounds by the Atlas of GDEs (Bureau of Meteorology, 2017). The mapped aquatic GDEs are generally situated along the larger named water courses. Within and near the project area, the mapped aquatic GDEs include vegetation along Yorkers Creek, Native Dog Gully, New Zealand Gully and Appletree Gully to the west of the Talbingo Reservoir and vegetation along the Tumut River, 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 project 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, 2016b) which has been shown to be inaccurate. However, the project area and the broader study area does contain some areas of moderate to high potential terrestrial GDEs including areas of:

- Broad-leaved Sally grass - sedge woodland on valley flats and swamps in the NSW South Western Slopes Bioregion and adjoining South Eastern Highlands Bioregion (PCT 285)
- Brittle Gum - peppermint open forest of the Woomargama to Tumut region, NSW South Western Slopes Bioregion PCT (PCT 296)
- Riparian Blakely's Red Gum - Broad-leaved Sally woodland - tea-tree - bottlebrush - wattle shrubland wetland of the NSW South Western Slopes Bioregion and South Eastern Highlands Bioregion (PCT 302).

The Snowy 2.0 Main Works BDAR (EMM Consulting, 2020a) identified potential groundwater dependence of vegetation by intersecting PCT mapping with groundwater depth mapping to put PCTs. For PCTs relevant to this project the assessment identified two likely types of GDEs:

- Proportional facultative – PCT 285 and PCT 302
- Opportunistic facultative – PCT 300
- PCT 296, PCT 729, PCT 999 and PCT 1196 were found to be non-dependent.

However, the assessment (EMM Consulting, 2020a) also found some groundwater associations from non-dependent PCTs, therefore the method may not be entirely accurate. Based on this assessment and the data provided in the GDE Atlas (Bureau of Meteorology, 2017), none of the PCTs are likely to have a total reliance on groundwater. However, PCT 285, PCT 296, PCT 300 and PCT 302 are likely to be 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 may use groundwater during periods of low flow or drought. The level of groundwater dependency will likely change between the PCTs in different areas, i.e. proportional to opportunistic depending on the current groundwater level. Within the study area, PCT 285 and PCT 302 are likely to have the highest groundwater dependency as they are located on alluvial and colluvial soils along the Yarrangobilly River and tributaries. Base flow (that part of stream flow derived from groundwater discharge and bank storage) may contribute year-round to flows in the Yarrangobilly River that supports the riparian vegetation, but it is likely that this vegetation can also exist without the input of groundwater, as long as there is no prolonged drought.



Project area

Disturbance area

Study area

Proposed structure

Proposed transmission line

Likely facultative GDEs

PCT 285: Broad-leaved Sally grass - sedge woodland on valley flats and swamps in the NSW South Western Slopes Bioregion and adjoining South Eastern Highlands Bioregion

PCT 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

Electricity transmission line

Minor road

Major road

Waterway

IBRA

NPWS estate

State Forest

Data sources:
Jacobs 2021, TransGrid 2021, DPE 2018,
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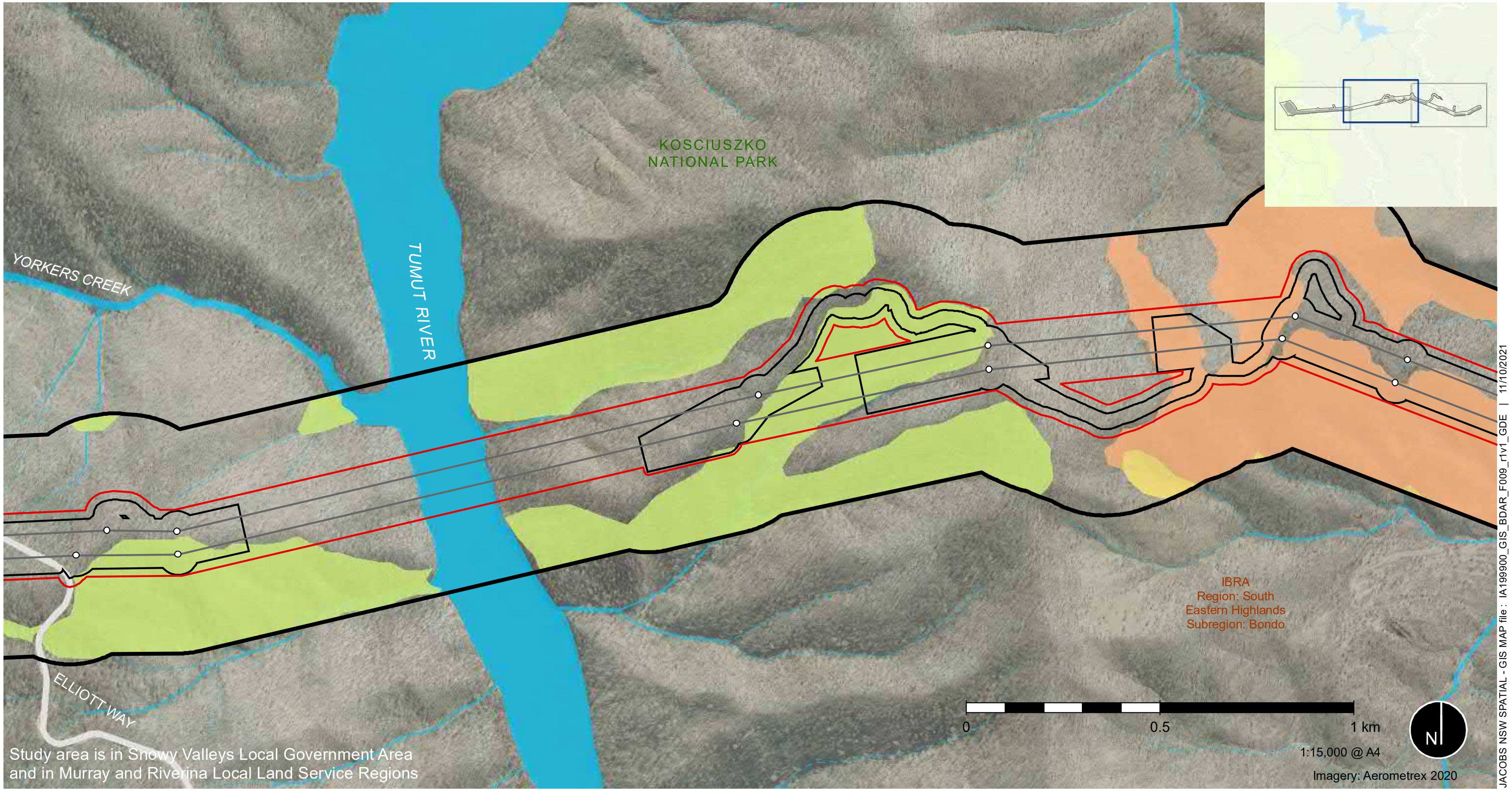
Figure 5-3 | Groundwater Dependent Ecosystems



Project area
Disturbance area
Study area
Proposed structure
Proposed transmission line

Likely facultative GDEs
PCT 296: Brittle Gum - peppermint open forest of the Woomargama to Tumut region, NSW South Western Slopes Bioregion
PCT 300: Ribbon Gum - Narrow-leaved (Robertsons) Peppermint montane fern - grass tall open forest on deep clay loam soils in the upper NSW South Western Slopes Bioregion and western Kosciuszko escarpment
PCT 302: Riparian Blakely's Red Gum - Broad-leaved Sally woodland - tea-tree - bottlebrush - wattle shrubland wetland of the NSW South Western Slopes Bioregion and South Eastern Highlands Bioregion

Electricity transmission line
Major road
Waterway
NPWS estate

Data sources:
Jacobs 2021, TransGrid 2021, DPE 2018,
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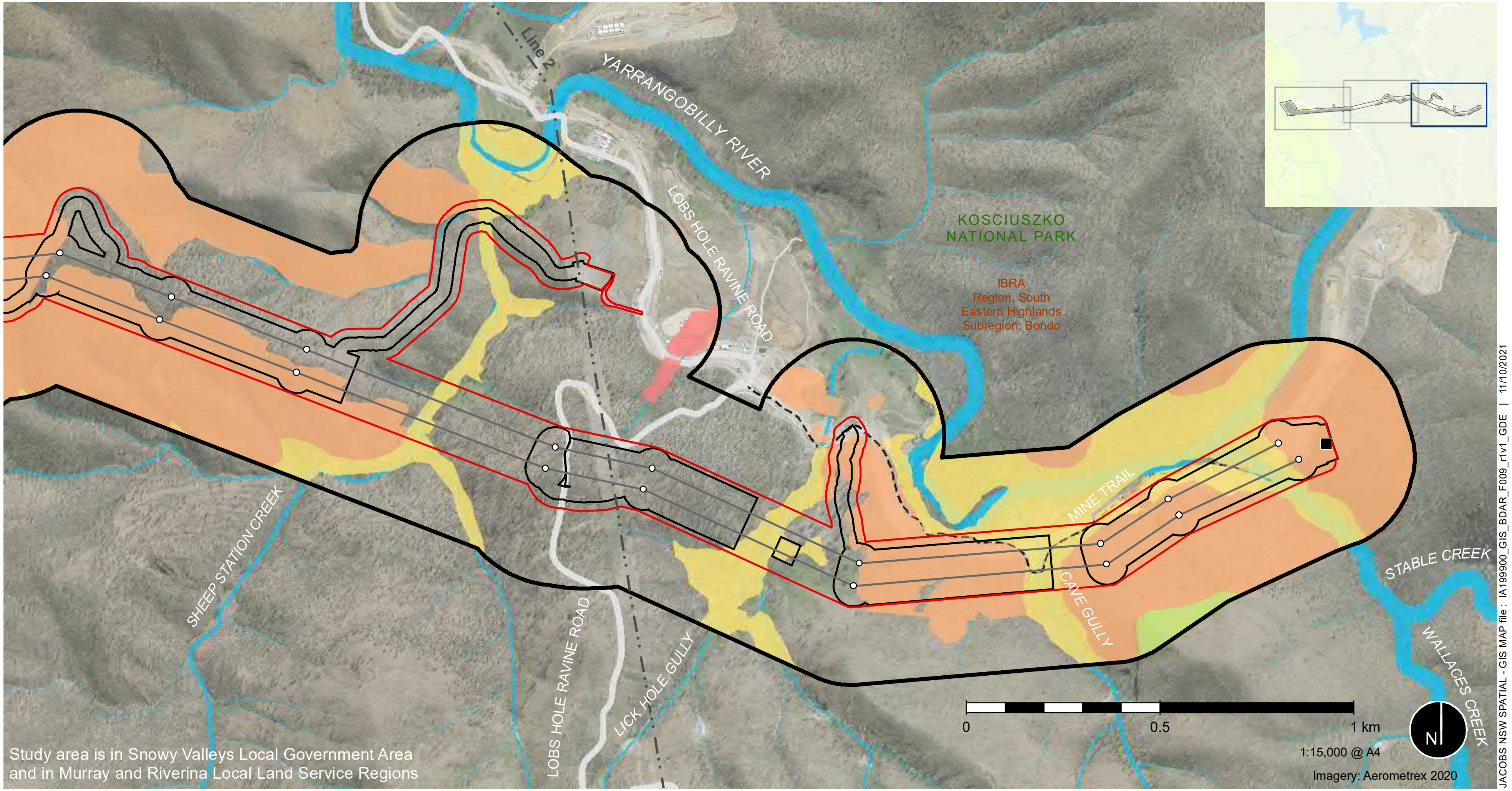
Figure 5-3 | Groundwater Dependent Ecosystems



Project area

Disturbance area

Study area

Proposed structure

Proposed transmission line

Snowy 2.0 cable yard

Likely facultative GDEs

PCT 285: Broad-leaved Sally grass - sedge woodland on valley flats and swamps in the NSW South Western Slopes Bioregion and adjoining South Eastern Highlands Bioregion

PCT 296: Brittle Gum - peppermint open forest of the Woomargama to Tumut region, NSW South Western Slopes Bioregion

PCT 300: Ribbon Gum - Narrow-leaved (Robertsons) Peppermint montane fern - grass tall open forest on deep clay loam soils in the upper NSW South Western Slopes Bioregion and western Kosciuszko escarpment

PCT 302: Riparian Blakely's Red Gum - Broad-leaved Sally woodland - tea-tree - bottlebrush - wattle shrubland wetland of the NSW South Western Slopes Bioregion and South Eastern Highlands Bioregion

Electricity transmission line

Minor road

Major road

Trail

Waterway

NPWS estate

Data sources:
Jacobs 2021, TransGrid 2021, DPE 2018,

Figure 5-3 | Groundwater Dependent Ecosystems

6. Threatened species

The BAM-C was used to derive the list of candidate species for this assessment, and the results were also supplemented with database searches, including a review of the Threatened Biodiversity Data Collection, to identify the threatened species that have been recorded by previous surveys or are considered likely to occur in the broader study area and project area. The initial site visits undertaken in March and April 2018 also provided an opportunity to rapidly observe the types of habitats and the quality of the broad habitat types within the broader study area and surrounds.

This section provides a description of the habitat types within the project area and broader study area and provides the results of the habitat suitability assessment for threatened species as outlined in Section 6 of the BAM. As the project is largely a linear type project (although some components such as the substation are better described as site based) that crosses two IBRA bioregions (South Eastern Highlands and the Australian Alps), separate habitat suitability assessments have been completed for each IBRA bioregion.

6.1 Threatened species habitat assessment

Once the study area had been assessed for landscape context, and the PCTs present and vegetation integrity were known, the list of candidate threatened species for assessment was developed. As outlined in Section 5.2.1 of the BAM, the following criteria (a – f) were used to predict the threatened species that require assessment:

a) the distribution of the species includes the IBRA subregion which the project area is, in the opinion of the assessor, mostly located within, and
b) the project area is within any geographic constraints of the distribution of the species within the IBRA subregion, and
c) the species is associated with any of the PCTs identified by the assessor under Chapter 5 as occurring within the project area, and
d) the native vegetation cover within the 1,500 m landscape buffer as determined by the assessor in accordance with Subsection 4.3.2 of the BAM is equal to or greater than the minimum class that is required for the species (unless the development is, or is part of, a linear shaped development), and
e) the patch size which the vegetation zone is part of, as identified in Subsection 5.3.2 of the BAM is equal to or greater than the minimum specified for that species, and
f) the species is identified as an ecosystem or species credit species in the Threatened Biodiversity Data Collection.

A threatened species was predicted as requiring assessment if that species meets all the criteria a) to f) that are relevant to the species. The BAM-C was used to derive the list of candidate species based on criteria a) to f). If any one of the criteria a) to f) relevant to a species was not met, the project area was considered not to be suitable habitat for the threatened species and no further assessment was undertaken for that species.

In addition to the output from the BAM-C, data from the surveys undertaken for the Snowy 2.0 Exploratory Works and Main Works BDARs (EMM Consulting, 2017 and 2020a) was reviewed and the results were used to inform the candidate species list. The surveys undertaken for the Snowy 2.0 Exploratory Works and Main Works BDARs provide a more up to date view of the species that are known to be present in the project area and which species are likely to occur. The results of the BioNet search and the Commonwealth Department of Agriculture, Water and the Environment's Protected Matters Search Tool (PMST) search were also used to inform development of the candidate species list to ensure those species that are only listed under the EPBC Act (i.e. Greater Glider) were considered appropriately.

As the project is a linear shaped project that crosses two bioregions, a separate habitat suitability assessment was undertaken for each IBRA subregion that the project area crossed, i.e. one habitat suitability assessment for the Bondo subregion and one habitat suitability assessment for the Snowy Mountains subregion. There is approximately 118.3 ha of native vegetation within the disturbance area, including 38.3 ha in the Australian Alps Bioregion and 80.0 ha in the South Eastern Highlands Bioregion.

Some species returned from the database searches (i.e. BioNet and the Protected Matters Search Tool – see **Appendix A** for the full list) were removed from the assessment due to the absence of suitable habitat in the project area. The study area lacks high alpine plains, so species restricted to these areas were removed from the assessment based on the lack of these habitat types on the project area. Conversely, some species were added to the assessment based on consultation with EESG (refer **Section 1.4)**, review of recent database records, and the presence of potential habitat.

The threatened species habitat suitability assessment is provided in the following sections and **Appendix A**. The candidate list of threatened species for assessment is provided in **Section 6.5**.

6.2 Habitat types

The broad habitat types identified within the project area, along with the corresponding PCT, are outlined in **Table 6-1**. The area of these broad habitat types within the South Eastern Highlands and Australian Alps are identified individually. There were four broad habitat types identified within the project area including:

- Upper Riverina Dry Sclerophyll Forests (see **Photo 6-1**) – this habitat is typically an open dry sclerophyll forest (shrub/grass sub-formation) with an open sclerophyllous shrub stratum and a patchy groundcover of grasses. This habitat occurs on the drier areas of undulating terrain or steep rocky slopes on soils of moderate fertility. The riparian vegetation along the Yarrangobilly River and tributaries also falls into this habitat type.
- Southern Tableland Dry Sclerophyll Forests (see **Photo 6-2**) – this habitat is an open dry sclerophyll forest (shrubby sub-formation) with a forest or woodland structure and an open to sparse sclerophyll shrub stratum and open groundcover of grasses. The forests are stunted on exposed stony hills and taller on deeper soils in undulating terrain. This habitat occurs on stony ridges and exposed slopes on infertile soils.
- Southern Tableland Wet Sclerophyll Forests (see **Photo 6-3**) – this habitat type is a wet sclerophyll forest (grassy sub-formation) with a tall open canopy and a variable density of shrubs (a mixture of sclerophyllous and mesophyllous species). There is a diverse, relatively continuous herbaceous-grassy groundcover. It occurs on sloping hills and valleys, and occasionally on the steeper slopes of gorges and scarps.
- Subalpine Woodlands (see **Photo 6-4**) – this habitat type is a grassy woodland with an open canopy. The understorey includes a variable sclerophyll shrub stratum and ground cover dominated by tussock grasses and a variety of herbs. This habitat type occurs at the higher elevations of 1000-1800 m in frost-hollows on the tablelands. This habitat receives moderate rainfall, frequent frosts and occasional snow.

Figure 6-1 shows the location of the habitat types within the project area and broader study area.

Table 6-1: Summary of broad habitat types within the project area

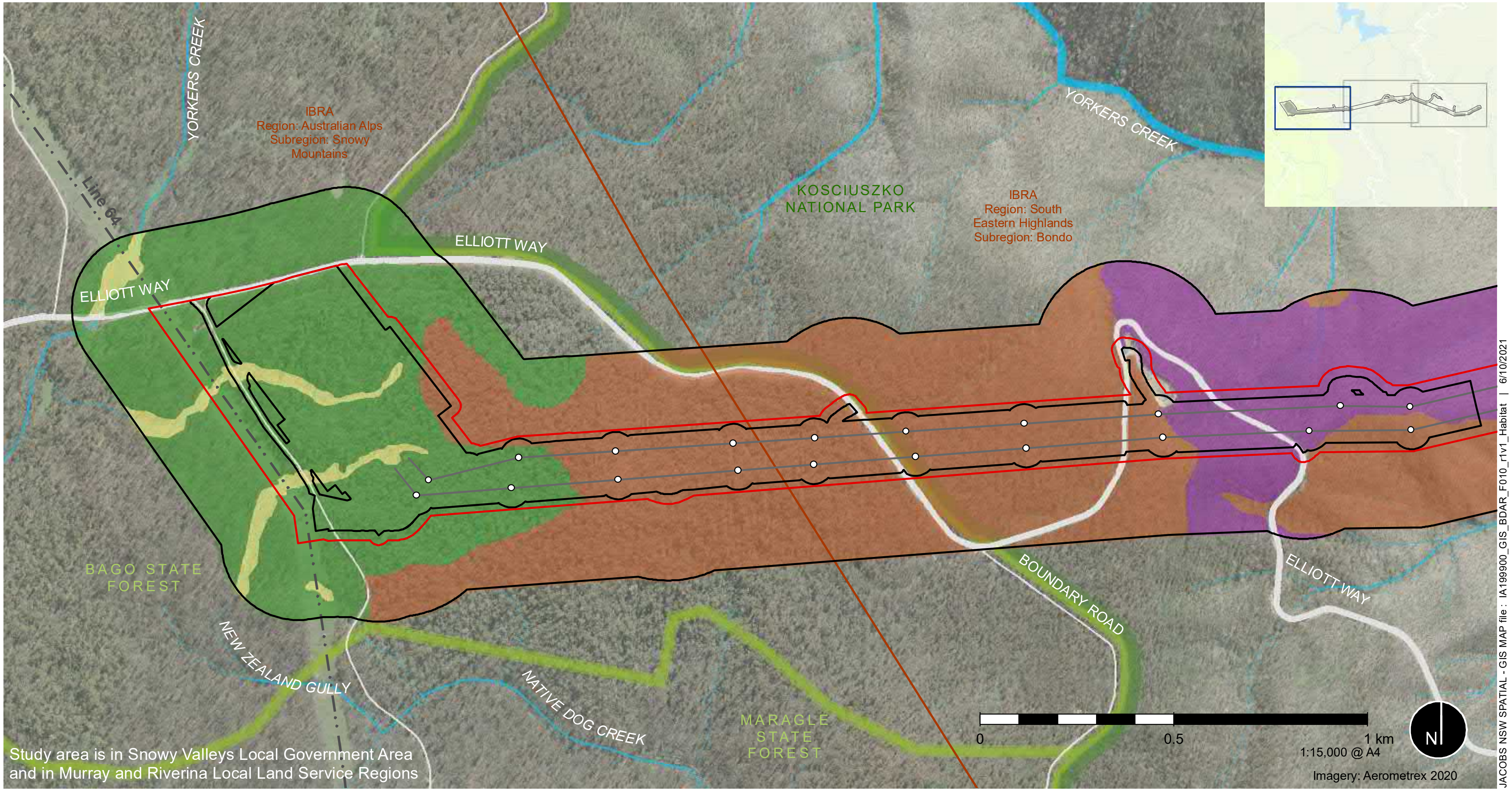
PCT IDs	Vegetation formation (Keith 2004)	Vegetation class (Keith 2004) / habitat type	Area (ha) in project area	
			South Eastern Highlands (Bondo SR)	Australian Alps (Snowy SR)
285 302	Dry Sclerophyll Forests (Shrub/grass sub-formation)	Upper Riverina Dry Sclerophyll Forests	6.57	2.24
729 296 999	Dry Sclerophyll Forests (Shrubby sub-formation)	Southern Tableland Dry Sclerophyll Forests	102.24	None
300	Wet Sclerophyll Forests (Grassy sub-formation)	Southern Tableland Wet Sclerophyll Forests	47.63	15.14
1196	Grassy Woodlands	Subalpine Woodlands	None	31.23

Photo 6-1: An example of the Upper Riverina Dry Sclerophyll Forest habitat type within the broader study area along the Yarrangobilly River

Photo 6-2: An example of the Southern Tableland Dry Sclerophyll Forest habitat type within the project area

Photo 6-3: An example of the Southern Tableland Wet Sclerophyll Forest habitat type within the project area

Photo 6-4: An example of the Subalpine Woodland habitat type within the project area in the Bago State Forest



Project area
Disturbance area
Study area
Proposed structure
Proposed transmission line

Habitat type
Southern Tableland Dry Sclerophyll Forests
Southern Tableland Wet Sclerophyll Forests
Subalpine Woodlands
Upper Riverina Dry Sclerophyll Forests

Electricity transmission line
Minor road
Major road
Waterway
IBRA
NPWS estate
State Forest

Data sources:
Jacobs 2021, TransGrid 2021, DPE 2018,
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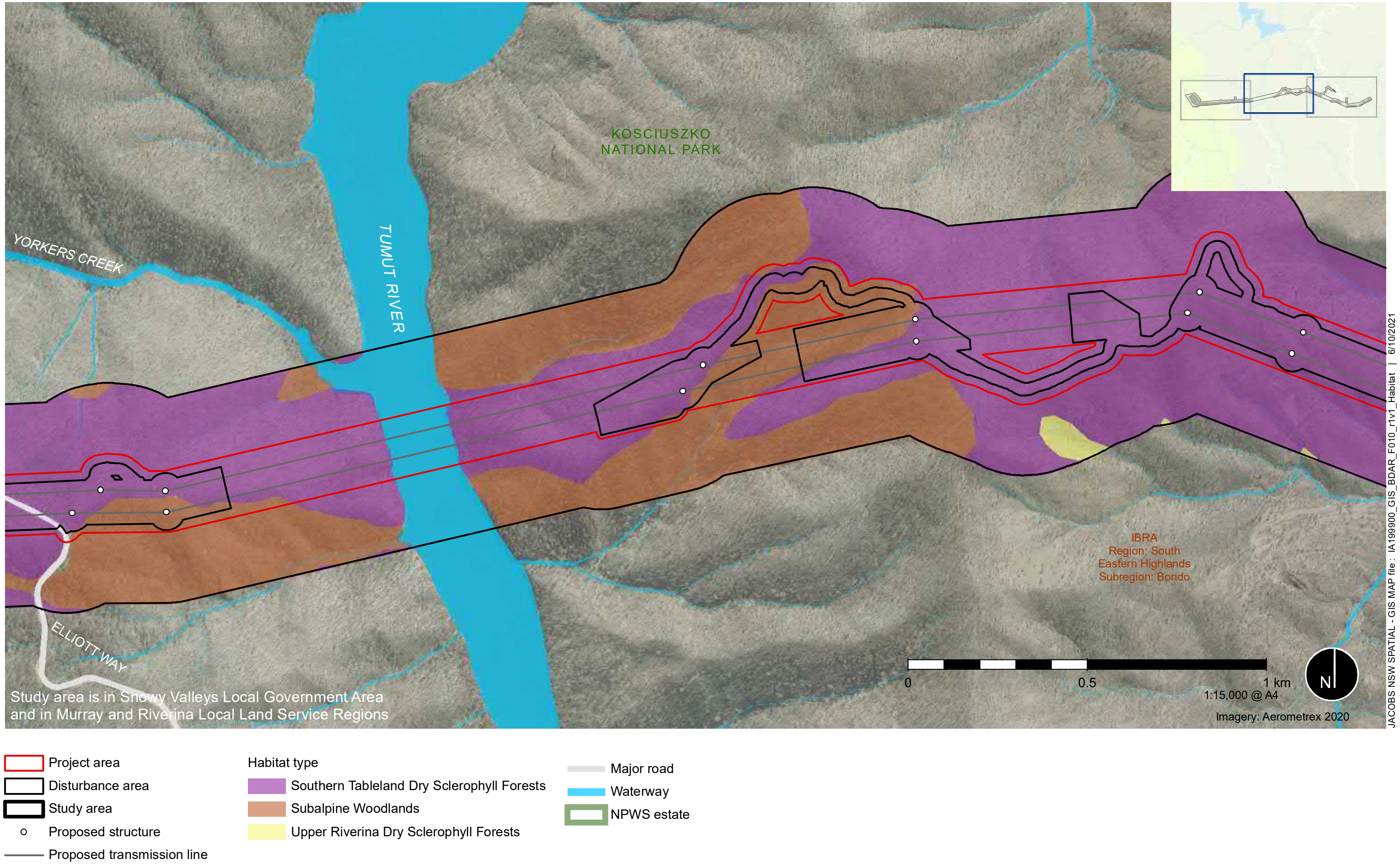
Figure 6-1 | Habitat types



Data sources:
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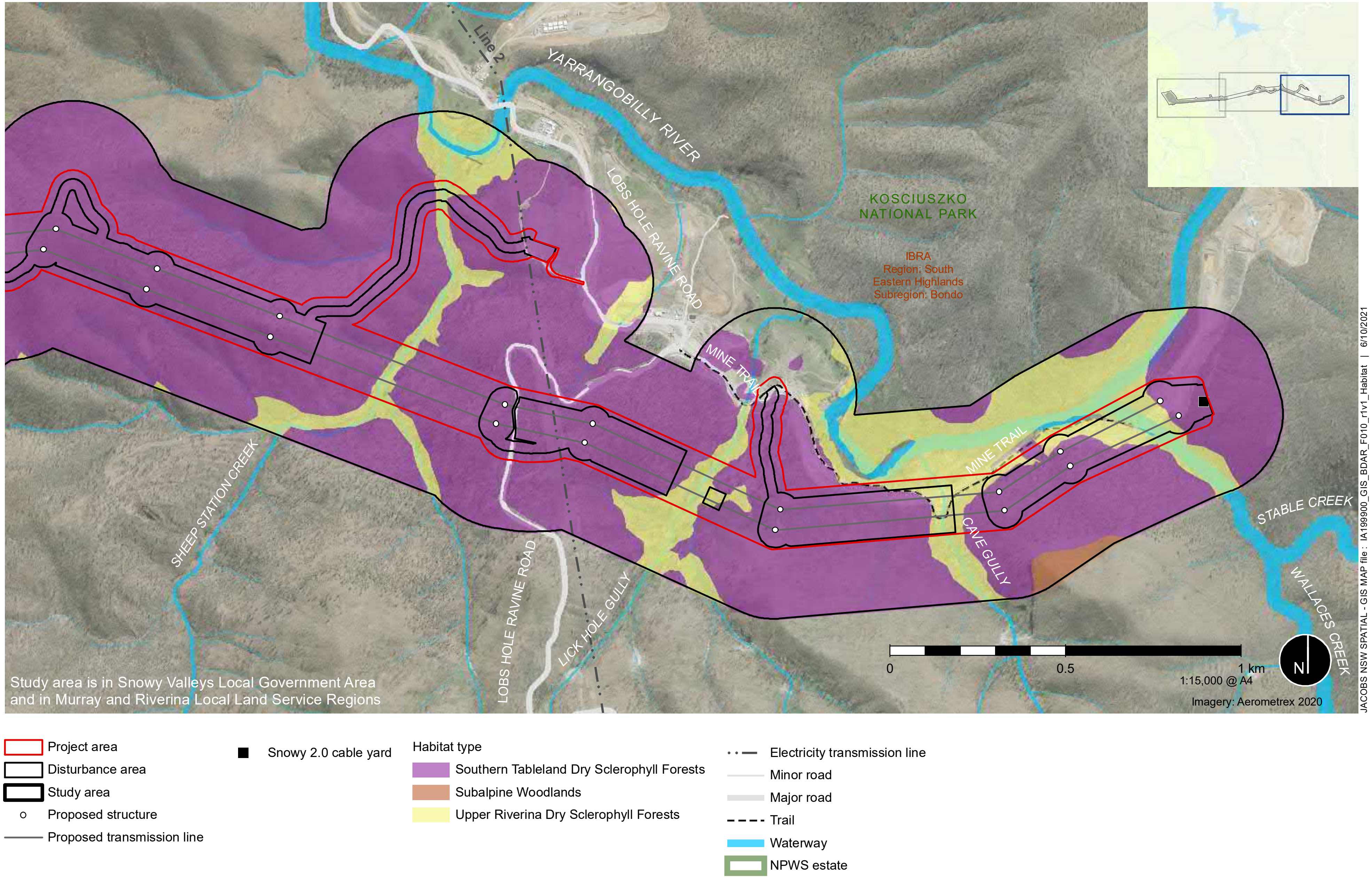
Figure 6-1 | Habitat types



Data sources:
Jacobs 2021, TransGrid 2021, DPE 2018,

Figure 6-1 | Habitat types

6.3 Habitat suitability for species that can be predicted by habitat surrogates (ecosystem credit species)

Ecosystem credit species are those threatened species where the likelihood of occurrence of a 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. Ecosystem credit threatened species have been assessed in conjunction with information about site context (Section 1 and Chapter 3 of the BAM), PCTs and vegetation integrity attributes (Chapter 4 of the BAM), and data from the Threatened Biodiversity Data Collection (TBDC).

The BAM-C was used to generate a list of the predicted threatened species that met the criteria outlined in Section 5.2.1 of the BAM. Two BAM-Cs were used, one for the South Eastern Highlands Bioregion and for the Australian Alps Bioregion to ensure all species were captured and filtered appropriately in the assessment. In addition to the output from the BAM-C, data from the surveys undertaken for the Snowy 2.0 Exploratory Works and Main Works BDARs (EMM Consulting, 2017 and 2020a) was reviewed and the results were used to inform the candidate species list. The surveys undertaken for the Snowy 2.0 Exploratory Works and Main Works BDARs provide a more up to date view of the species that are known to be present in the study area and which species are likely to occur. The results of the BioNet search and the Commonwealth Department of Environment's Protected Matters Search Tool (PMST) search were also used to inform development of the species list.

The initial list of predicted ecosystem credit species is provided in **Table 6-2**. The full threatened species habitat suitability assessment is provided in **Appendix A**. Once the initial list of predicted ecosystem credit species was generated, the geographic limitations of each species (where applicable) were examined to see if they were met. Geographic limitations usually relate to altitude or topographic features and different geographic limitations can be described for different IBRA bioregion and subregions across a species' distribution (hence the importance of running two BAM-C case studies for this BDAR). Where the project area is not within the geographic limitation described for a species, the species was removed from the predicted list of threatened species and no further assessment was undertaken.

In accordance with Section 5.2.2 (Step 2) of the BAM, an onsite assessment was undertaken to determine the presence of any habitat constraints or microhabitats for the threatened species predicted to occur in the project area. Some species do not have any identified habitat constraints, in which case this step was not undertaken. The only ecosystem credit species with a habitat constraint applicable to this assessment is the Yellow-bellied Glider. The Yellow-bellied Glider requires the habitat to contain hollow bearing trees, and the hollows need to be >25cm in diameter. The habitats within the project area in the South Eastern Highlands and Australian Alps Bioregions contain these features so the Yellow-bellied Glider required assessment as an ecosystem credit species except in zones that lack hollow bearing trees.

The justification for including or excluding ecosystem credit species from the assessment is provided in **Table 6-2**.

Under the BAM, targeted survey is not required for ecosystem credit species. However, 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). Therefore, some species are listed in both **Table 6-2** and **Table 6-3** as an ecosystem credit species and a species credit species.

Table 6-2: Summary of predicted ecosystem credit species that were assessed

Species name	Common name	EPBC Act	BC & FM Act	South Eastern Highlands	Australian Alps	Justification for inclusion / exclusion	Sensitivity to gain class
Birds							
Artamus cyanopterus cyanopterus	Dusky Woodswallow	-	V	✓	✓	Included in all zones	Moderate
Callocephalon fimbriatum	Gang-gang Cockatoo (foraging)	-	V	✓	✓	Included in all zones and recorded in the study area	Moderate
Chthonicola sagittate	Speckled Warbler	-	V	✓	x	Included in all zones	High
Climacteris picumnus victoriae	Brown Treecreeper (eastern subspecies)	-	V	✓	x	Included in all zones	High
Daphoenositta chrysoptera	Varied Sittella	-	V	✓	✓	Included in all zones	Moderate
Haliaeetus leucogaster	White-bellied Sea-Eagle (foraging)	M	V	✓	✓	Excluded from all zones except those associated with PCT 302 along the Yarrangobilly River.	High
Hieraaetus morphnoides	Little Eagle (foraging)	-	V	✓	✓	Included in all zones	Moderate
Hirundapus caudacutus	White-throated Needletail	-	V	✓	✓	Included in all zones	High
Lophoictinia isura	Square-tailed Kite (foraging)	-	V	✓	x	Included in all zones	Moderate
Melanodryas cucullata cucullata	Hooded Robin (south-eastern form)	-	V	✓	x	Included in all zones	Moderate
Ninox connivens	Barking Owl (foraging)	-	V	✓	x	Included in all zones	High
Ninox strenua	Powerful Owl (foraging)	-	V	✓	✓	Included in all zones	High
Pachycephala olivacea	Olive Whistler	-	V	✓	✓	Included in all zones.	Moderate
Petroica boodang	Scarlet Robin	-	V	✓	✓	Included in all zones	Moderate
Petroica phoenicea	Flame Robin	-	V	✓	✓	Included in all zones	Moderate
Stagonopleura guttata	Diamond Firetail	-	V	✓	✓	Included in all zones	Moderate
Tyto novaehollandiae	Masked Owl (foraging)	-	V	✓	x	Included in all zones and recorded in the study area	High

Species name	Common name	EPBC Act	BC & FM Act	South Eastern Highlands	Australian Alps	Justification for inclusion / exclusion	Sensitivity to gain class
Mammals							
Dasyurus maculatus	Spotted-tailed Quoll	E	V	✓	✓	Included in all zones	High
Falsistrellus tasmaniensis	Eastern False Pipistrelle	-	V	✓	✓	Included in all zones and recorded in the study area	High
Miniopterus orianae oceanensis	Large Bent-winged Bat (foraging)	-	V	✓	✓	Included in all zones and recorded in the study area	High
Petaurus australis	Yellow-bellied Glider	-	V	✓	✓	Excluded from native grassland and regrowth shrubland zones as this species will not occur in this habitat in its current condition	High
Reptiles							
Varanus rosenbergi	Rosenberg's Goanna, Heath Monitor	-	V	✓	✓	Included in all zones	High

Key: E = endangered, V = vulnerable, M = migratory

6.4 Habitat suitability for species that cannot be predicted by habitat surrogates (species credit species)

Habitat suitability is identified as the degree to which the habitat needs of threatened species are present at a particular site. Species credit species have been assessed in conjunction with information collected about the site context of the project area (Section 3 of the BAM), on PCTs and vegetation integrity attributes in (Section 4 of the BAM), and data obtained from the Threatened Biodiversity Data Collection (Section 5.2 of the BAM).

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 assessment of habitat in the project area, and review of databases, published information, and work undertaken for the Snowy 2.0 Exploratory Works and Main Works BDARs (EMM Consulting, 2017 and 2020a), the following species credit species as outlined in **Table 6-3** are considered 'candidate species' for the assessment. The full threatened species habitat suitability assessment is provided in **Appendix A**.

Table 6-3: Summary of candidate species credit species returned by the BAM-C

Species name	Common name	EPBC Act	BC & FM Act	South Eastern Highlands	Australian Alps	Sensitivity to gain class
Plants						
Caladenia montana	Caladenia montana	-	V	✓	✓	Moderate
Calotis glandulosa	Mauve Burr Daisy	V	V	x	✓	High
Leucochrysum albicans var. *tricolor*	Hoary Sunray	E	-	✓	✓	Moderate
Pomaderris cotoneaster	Cotoneaster Pomaderris	E	E	✓	x	High
Prasophyllum bagoense	Prasophyllum bagoense	CE	CE	x	✓	Very High
Prasophyllum keltonii	Kelton's Leek Orchid	CE	CE	x	✓	Very High
Pterostylis alpina	Pterostylis alpina	-	V	x	✓	High
Pterostylis foliata	Slender Greenhood	-	V	x	✓	High
Thelymitra atronitida	Black-hooded Sun Orchid	-	CE	x	✓	N/A
Thesium australe	Austral Toadflax	V	V	x	✓	Moderate
Birds						
Callocephalon fimbriatum	Gang-gang Cockatoo (breeding)	-	V	✓	✓	High
Haliaeetus leucogaster	White-bellied Sea-Eagle (breeding)	M	V	✓	✓	High
Hieraaetus morphnoides	Little Eagle (breeding)	-	V	✓	✓	Moderate
Lophoictinia isura	Square-tailed Kite (breeding)	-	V	✓	x	Moderate
Ninox connivens	Barking Owl (breeding)	-	V	✓	x	High
Ninox strenua	Powerful Owl (breeding)	-	V	✓	✓	High
Petroica rodinogaster	Pink Robin	-	V	✓	✓	High
Tyto novaehollandiae	Masked Owl (breeding)	-	V	✓	x	High
Frogs						
Litoria booroolongensis	Booroolong Frog	E	E	✓	x	High
Litoria spenceri	Spotted Tree Frog	E	CE	✓	✓	Very High
Litoria verreauxii alpina	Alpine Tree Frog	V	E	x	✓	High
Pseudophryne corroboree	Southern Corroboree Frog	CE	CE	x	✓	Very High
Pseudophryne pengilleyi	Northern Corroboree Frog	CE	CE	x	✓	Very High

Species name	Common name	EPBC Act	BC & FM Act	South Eastern Highlands	Australian Alps	Sensitivity to gain class
Mammals						
Cercartetus nanus	Eastern Pygmy-possum	-	V	✓	✓	High
Miniopterus orianae oceanensis	Large Bent-winged Bat (breeding)	-	V	✓	✓	Very High
Petaurus norfolcensis	Squirrel Glider	-	V	✓	✓	High
Phascogale tapoatafa	Brush-tailed Phascogale	-	V	✓	x	High
Phascolarctos cinereus	Koala	V	V	✓	✓	High
Pseudomys fumeus	Smoky Mouse	E	CE	x	✓	High
volans	Greater Glider	V	-			
Reptiles						
Cyclodomorphus praealtus	Alpine She-oak Skink	E	E	x	✓	High
Liopholis guthega	Guthega Skink	E	E	x	✓	High

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

6.4.1 Identifying geographic and habitat constraints

Once the initial list of predicted candidate species credit species was generated, the geographic limitations of each species (where applicable) were examined to see if they were met. Where the project area is not within the geographic limitation described for a species, the species was removed from the predicted list of threatened species and no further assessment was undertaken. In accordance with Section 5.2.2 (Step 2) of the BAM, an onsite assessment was undertaken to determine the presence of any habitat constraints or microhabitats for the threatened species predicted to occur on the project area. Some species do not have any identified habitat constraints, in which case this step was not undertaken. The species included or excluded based on geographic or habitat constraints listed in the BAM-C are outlined below in **Table 6-4.** Justification for exclusion of these species based on this information is provided in **Section 6.4.2**.

Table 6-4: Summary of candidate species credit species with geographic or habitat constraints

Species name	Common name	EPBC Act*	BC Act*	South Eastern Highlands	Australian Alps	Sensitivity to gain class	Habitat constraint	Geographic limitation*	Included or excluded?
Plants									
Calotis glandulosa	Mauve Burr Daisy	V	V	x	✓	High	-	North of Eucumbene – Yes	Included
Pomaderris cotoneaster	Cotoneaster Pomaderris	E	E	✓	x	High	-	South of the northern Kosciuszko NP boundary – Yes	Included

Species name	Common name	EPBC Act*	BC Act*	South Eastern Highlands	Australian Alps	Sensitivity to gain class	Habitat constraint	Geographic limitation*	Included or excluded?
Birds									
Callocephalon fimbriatum	Gang-gang Cockatoo (breeding)	-	V	X	✓	High	Hollow bearing trees - yes Eucalypt tree species with hollows greater than 9 cm diameter – Yes	-	Included
Haliaeetus leucogaster	White-bellied Sea-Eagle (breeding)	M	V	✓	✓	High	Living or dead mature trees within suitable vegetation within 1km of a rivers, lakes, large dams or creeks, wetlands and coastlines – Yes	-	Included
Hieraaetus morphnoides	Little Eagle (breeding)	-	V	✓	✓	Moderate	Nest trees - live (occasionally dead) large old trees within vegetation) – Yes	-	Included
Ninox strenua	Powerful Owl (breeding)	-	V	✓	✓	High	Hollow bearing trees - yes Living or dead trees with hollow greater than 20cm diameter – Yes	-	Included
Frogs									
Litoria spenceri	Spotted Tree Frog	CE	CE	✓	✓	Very High	Waterbodies - yes River environment with rocky habitat or within 500 m of a rocky river – Yes	-	Excluded – refer to **Section 6.4.2**
Litoria verreauxii alpina	Alpine Tree Frog	V	E	x	✓	High	-	Above 1,000 m asl – Yes	Included

Species name	Common name	EPBC Act*	BC Act*	South Eastern Highlands	Australian Alps	Sensitivity to gain class	Habitat constraint	Geographic limitation*	Included or excluded?
Pseudophryne corroboree	Southern Corroboree Frog	CE	CE	x	✓	Very High	Swamps - no Within 200 m of high montane sub-alpine bog or ephemeral pool environments – No	Above 1,000 m asl – Yes	Excluded – refer to **Section 6.4.2**
Pseudophryne pengilleyi	Northern Corroboree Frog	CE	CE	x	✓	Very High	-	Above 700 m asl – Yes	Excluded – refer to **Section 6.4.2**
Mammals									
Miniopterus orianae oceanensis	Large Bent-winged Bat (breeding)	-	V	✓	✓	Very High	Caves - no Cave, tunnel, mine, culvert or other structure known or suspected to be used for breeding including species records with microhabitat code "IC - in cave – no Observation type code "E nest-roost – No With numbers of individuals >500 - no	-	Included
Phascogale tapoatafa	Brush-tailed Phascogale	-	V	✓	x	High	Hollow bearing trees – Yes	-	Included
Phascolarctos cinereus	Koala (breeding)	V	V	✓	✓	High	Areas identified via survey as important habitat (see comments) – No	-	Included
Petauroides volans	Greater Glider	V	-	✓	✓		Hollow-bearing trees - Yes	-	Included

Species name	Common name	EPBC Act*	BC Act*	South Eastern Highlands	Australian Alps	Sensitivity to gain class	Habitat constraint	Geographic limitation*	Included or excluded?
Reptiles									
Liopholis guthega	Guthega Skink	E	E	x	✓	High	Granite substrate and decomposing granite soils - yes Rocky areas including sub-surface boulders – Yes	-	Excluded – refer to **Section 6.4.2**

*Key: CE = critically endangered, E = endangered, EP = endangered population, V = vulnerable, asl = above sea level

6.4.2 Candidate species removed from the assessment

According to Section 5.2.3 (Step 3) of the BAM, a candidate species credit species is considered unlikely to occur on the project area if one of the following applies

a. After carrying out a field assessment:
   i. the assessor determines that microhabitats required by a species are absent from the project area (or specific vegetation zone). This must be based on evidence such as published literature, or
   ii. the assessor determines that the habitat constraints or microhabitats are degraded to the point that the species is unlikely to use the project area (or specific vegetation zones).
b. An expert report states that the species is unlikely to be present on the project area or specific vegetation zones.

The species that this rationale applies to and the reason for removing from the assessment is described below.

6.4.2.1 *Prasophyllum bagoense* and *Prasophyllum keltonii*

Prasophyllum bagoense and *Prasophyllum keltonii* were removed from the assessment as the project area does not provide suitable habitat for these two species. These orchid species are only known from the McPhersons Plain area to the west of the project area. Reference sites in the Bago State Forest where known populations of *Prasophyllum bagoense* and *Prasophyllum keltonii* exist were visited during the December 2018 survey period with Geoff Robertson, EESG Senior Threatened Species Officer, to gain a better understanding of the habitats of these species. *Prasophyllum bagoense* and *Prasophyllum keltonii* were flowering during the December 2018 survey period. These two species have a highly restricted distribution and specific habitat preferences and no alpine or sub-alpine peatlands, damp herbfields and fens, or alpine grassland/herbfield and open heathlands are present in the project area. The project area is covered in dense forest habitat, so these two species were removed from the assessment.

6.4.2.2 Spotted Tree Frog

The Spotted Tree Frog (*Litoria spenceri*) has two identified habitat constraints: waterbodies, and river environment with rocky habitat or within 500 m of a rocky river. These habitat constraints are met in the South Eastern Highlands portion of the project area due to the presence of the Yarrangobilly River nearby. However, there are no suitable waterbodies or rocky river environments in the Australian Alps portion of the project area, so the Spotted Tree Frog was not included as a candidate species in this portion of the project area. Only two populations of the Spotted Tree Frog have been identified in New South Wales and these populations are located at Bogong Creek and in the upper Murray River, both within KNP and there is no evidence to suggest that the Spotted Tree Frog was more widely distributed in the past (NSW National Parks & Wildlife Service, 2001). These populations are not within or near the project area and will not be impacted by the project. As such, the Spotted Tree Frog was removed from consideration as a species credit species and the Spotted Tree Frog has not been assessed.

6.4.2.3 Southern Corroboree Frog and Northern Corroboree Frog

Two other threatened frog species returned by the BAM-C for the Australian Alps portion of the project area were the Southern Corroboree Frog (*Pseudophryne corroboree*) and the Northern Corroboree Frog (*Pseudophryne pengilleyi*). The Southern Corroboree Frog has a habitat constraint of swamps and being within 200 m of high montane sub-alpine bog or ephemeral pool environments. Both habitat constraints are not met in the project area. The Southern Corroboree Frog also has the geographic limitation of above 1,000 m asl and the Northern Corroboree Frog has the geographic limitation of above 700 m asl which are met in the Australian Alps portion of the project area. However, the remaining habitats of the Southern Corroboree Frog and the Northern Corroboree Frog are very well known, and the project area is not located near the habitats of either species. As such, the Southern Corroboree Frog and the Northern Corroboree Frog was removed from consideration as species credit species and they have not been assessed.

6.4.2.4 Alpine She-oak Skink

The Alpine She-oak Skink (*Cyclodomorphus praealtus*) is restricted to sub-alpine and alpine grasslands and in NSW it has only been observed within KNP between Smiggin Holes and Kiandra. The Alpine She-oak Skink has very specific habitat requirements, preferring tree-less or very lightly treed areas that contain tussock grasses, low heath or a combination of both (i.e. alpine to sub-alpine grasslands or heath). The project area does not contain any alpine to sub-alpine grasslands or heath and therefore is not considered to provide suitable habitat for the Alpine She-oak Skink. This species was removed from the assessment based on the absence of suitable habitat from the project area.

6.4.2.5 Guthega Skink

The Guthega Skink (*Liopholis guthega*) has the habitat constraint of granite substrate and decomposing granite soils, and rocky areas including sub-surface boulders. The Australian Alps portion of the project area contains granodiorite substrate and some rocky areas including sub-surface boulders. However, the Guthega Skink is restricted to locations above 1,600 m asl in the Australian Alps, near Mt Kosciuszko, NSW, and the Bogong High Plains, Victoria. The project area is well below this altitude with the highest point in the Australian Alps portion of the project area being 1,190 m asl. The habitat for the Guthega Skink within NSW appears to be very restricted and not present in the project area so this species was removed from the assessment.

6.4.3 Candidate species added to the assessment

6.4.3.1 Yellow-bellied Glider population on the Bago Plateau

The *Petaurus australis* – endangered population (Yellow-bellied Glider population on the Bago Plateau) was not returned from the BAM-C despite the western portion of the project area being in the Bago State Forest. The Yellow-bellied Glider population on the Bago Plateau was added to the assessment for candidate species for the Australian Alps portion of the project area.

6.4.3.2 Southern Myotis

Southern Myotis was included in the assessment as there are records of this species from the Tumut River (2010 and 2014) and the Yarrangobilly River and surrounding vegetation may provide suitable habitat for this species. The absence of other Southern Myotis records in the locality is more than likely due to lack of survey effort rather than actual absence. The Southern Myotis was added to the assessment for the South Eastern Highlands portion of the project area. Suitable habitat for the Southern Myotis is identified as the range of PCTs associated with the species (as per the TBDC) within 200 m of any medium to large permanent creeks, rivers, lakes or other waterways (i.e. with pools/ stretches 3 m or wider) (Office of Environment and Heritage, 2018). There are no waterways that fit this description within the Australian Alps portion of the project area and this species was not added to the BAM-C for the Australian Alps.

6.4.3.3 Thelymitra alpicola

In the Threatened Species Profile Database, *Thelymitra alpicola* (Alpine Sun Orchid) is identified as associated with the Montane wet heath and bog of the eastern tablelands, South Eastern Highlands Bioregion (PCT 939). There are no areas of PCT 939 within the project area. However, there are areas of potentially suitable habitat at the ecotone of PCT 285 and PCT 1196 within the Australian Alps portion of the project area. There is no suitable habitat for this species in the South Eastern Highlands portion of the project area.

A reference site for *Thelymitra alpicola* in the Bago State Forest was visited with Geoff Robertson, EESG Senior Threatened Species Officer, in December 2018 and the habitat in this location is similar to that which occurs along New Zealand Gully and the other unnamed watercourse in the west of the project area. Potential habitat for this species is also present along Yorkers Creek to the north of the project area. As the range of habitat types for *Thelymitra alpicola* is not fully known, this species has been included in the Australian Alps assessment as a precautionary measure.

6.4.3.4 Pterostylis oreophila

In New South Wales, the *Pterostylis oreophila* (Blue-tongued Greenhood) is known from a few small populations within KNP and a population of about 40 plants (possibly now extinct) in Bago State Forest and adjoining Crown Leases south of Tumut. This species grows along sub-alpine watercourses under more open thickets of Mountain Tea-tree in muddy ground very close to water and less commonly grows in peaty soils and sphagnum mounds.

Pterostylis oreophila is associated with Alpine and sub-alpine peatlands, damp herbfields and fens, South Eastern Highlands Bioregion and Australian Alps Bioregion (PCT 637), Montane wet heath and bog of the eastern tablelands, South Eastern Highlands Bioregion (PCT 939) and water bodies, rivers, lakes, streams (not wetlands). There may be potential habitat for this species in the western sub-alpine parts of the project area near watercourses where thickets of Tea-tree occur such as along New Zealand Gully where PCT 285 is present. This species was raised as a candidate species during consultation with EESG Senior Threatened Species Officer Geoff Robertson and has been included as a candidate species for assessment as a precautionary measure. However, this species was not able to be added to the Australian Alps Bioregion BAM-C case as it does not appear in the search list. For the purpose of assessment, this species was initially targeted during field surveys.

6.4.3.5 Masked Owl

Masked Owl was identified in the BAM-C for the South Eastern Highlands but not for the Australian Alps bioregion. While the species is not associated with the three PCTs represented in the Australian Alps, there are three records of the species from Bago State Forest and the habitat is considered suitable for breeding. The species was added to both assessment cases.

6.4.4 Other species of special consideration

6.4.4.1 Thelymitra atronitida

Thelymitra atronitida (Black-hooded Sun Orchid) is known to occur in the Snow Gum - Mountain Gum shrubby open forest of montane areas, South Eastern Highlands Bioregion and Australian Alps Bioregion (PCT 1196). PCT 1196 occurs in the western Australian Alps portion of the project area. There is some taxonomic confusion surrounding *Thelymitra atronitida* within NSW. The Bago State Forest population falls within the circumscription of *Thelymitra atronitida* in a critical revision of the *Thelymitra pauciflora* complex by Jeanes (2004) but there is a possibility that the Bago State Forest population may on further research be found to be taxonomically distinct (NSW Threatened Species Scientific Committee, 2011) and the plants collected within the Bago State Forest may have been misidentified. The determination to list *Thelymitra atronitida* as a critically endangered species is made on the basis of the Cape Solander and Bago State Forest populations being conspecific (belonging to the same species) (NSW Threatened Species Scientific Committee, 2011). An expert report has been commissioned for this species (see **Appendix F**). The report by Belinda Pellow (AMBS Ecology) concludes that the Bago population of *Thelymitra atronitida* may be an incorrect identification (and may be common species *Thelymitra pauciflora*).

6.5 Targeted threatened species surveys

After the candidate species list had been developed (see **Section 6.4**), these species were targeted by survey using the methods described in the following section.

6.5.1 Threatened plant surveys

After the PCTs and finer scale habitats within the project area had been identified, and the threatened species habitat assessment had been undertaken, threatened plant surveys were undertaken targeted to the following candidate species:

- *Caladenia montana*
- *Calotis glandulosa*
- *Pomaderris cotoneaster*
- *Pterostylis alpina*
- *Pterostylis foliata*
- *Pterostylis oreophila*
- *Thelymitra alpicola*
- *Thelymitra atronitida*
- *Thesium australe*
- *Leucochrysum albicans* var. *tricolor.*

The threatened flora surveys were guided by the methodology and effort described in the *Surveying threatened plants and their habitats - NSW survey guide for the Biodiversity Assessment Method* (Department of Planning, Industry and Environment, 2020a) and the *Draft Survey Guidelines for Australia's Threatened Orchids* (Department of the Environment, 2013). The application of the described guidelines is not mandatory, but they provide an indication of the effort that is likely required. The main method adopted was walking parallel search transects (approximately 5-10 m spacing between observers) and with reference to the species prescribed survey timing in the Threatened Biodiversity Data Collection (TBDC). This approach was used to adequately cover the large areas of potential habitat for the above listed species.

To identify habitats that were potentially suitable for terrestrial orchids and other target species including *Pomaderris cotoneaster, Calotis glandulosa* and *Thesium australe*, transects were walked through all PCTs within the project area. Where an orchid was encountered, the specimen was identified to species or genus level if possible and a waypoint taken to enable a map to be made of areas that appear suitable for orchid species.

Pomaderris cotoneaster is known from a variety of habitats and no distinct habitat association for this species has been determined, however the only associated PCT within the project area listed on the TBDC is PCT 300. As such, searches for plants from the genus *Pomaderris* were undertaken during all transects and floristic plot surveys.

Thesium australe is known to occur in the region and a reference population on Larry's Ridge north of Cabramurra was visited in February 2019. Plants were found during this survey, indicating that *Thesium australe* was detectable during the survey of the project area. Transects were walked through grassy woodlands and dry sclerophyll forests in the project area with searches undertaken in grassy areas, areas of native grassland, and in easements, particularly in areas where *Themeda triandra* (a species with which *Thesium australe* is often found in association) was dominant.

Calotis glandulosa was targeted along roadsides and in bare areas while walking through PCT 1196 and driving along the roads. *Calotis glandulosa* was flowering during the survey period and reference populations were visited along the Snowy Mountains Highway at Providence Portal to confirm flowering.

Comprehensive surveys for threatened orchids targeted PCT 1196, PCT 300, PCT 285, PCT 729 and PCT 296 (each identified as suitable habitat types for the species listed above in the TBDC. Targeted surveys for orchids were conducted during 2018 (October, November, December), 2019 (January, February, October, November and December) and 2020 (October) to adequately cover the seasonal survey requirements for each of the above species.

It is acknowledged that the 2018/2019 summer was exceptionally dry and conditions for orchid surveys were not considered to be optimal. Subsequent follow-up surveys were conducted under more optimum conditions during October, November and December 2019. These supplementary surveys were considered to be appropriate for orchid growth, given the high numbers of common orchid species encountered and very high counts of individual orchid plants identified throughout the surveyed areas (refer **Section 6.7.1**). Additionally, a large portion of the study area was also resurveyed again in October 2020 to target newly identified habitat for *Caladenia montana*. Conditions were ideal for both orchid growth and detection during this survey, due to favourable disturbance caused by the Dunns Road bushfire in January (see **Section 4.9**) and the following above average rainfall in most months of 2020 (recorded at Cabramurra SMHEA AWS).

Searches for *Pterostylis oreophila* and *Thelymitra alpicola* were carried out in potentially suitable habitats within areas of PCT 1196 Snow Gum and PCT 285 Broad-leaved Sally and along Sub-alpine watercourses (containing thickets of Mountain Tea-tree) in the Australian Alps Bioregion portion of the project area. Such habitats exist along New Zealand Gully and various unnamed watercourses in Bago State Forest and KNP.

Various reference sites for *Thelymitra alpicola, Thelymitra atronitida, Pterostylis foliata* and *Pterostylis alpina* were examined in Bago State Forest to determine if these species were flowering, although the target species were unable to be located at these sites. No reference sites for *Caladenia montana* were available to check for this species near the substation site during surveys in 2019 or 2020.

Approximately 702 km was walked during the flora surveys over 2018, 2019 and 2020 by teams of two to six ecologists. A summary of the distance covered on foot and approximate number of hours expended during each field survey event is provided in **Table 6-5**Error! Reference source not found.. A summary of the survey effort based on the area of habitat for each target plant species is provided in **Table 6-6**.

The location of tracks walked during the threatened plant surveys and specific search areas for orchids and *Thesium australe* are illustrated in **Figure 6-2**.

Table 6-5: Summary of flora survey - walked transect lengths, survey effort and conditions

Survey timing	Transect length	Approx. search time	No. people	Person hours	Weather station	Monthly rainfall prior to survey (mm)	Average daily temp during survey week (ºC)
4-5 Oct 2018	3 km	3	2	6	Tumbarumba	49.2	19.5
					Cabramurra	86.2	8.8
13-16 Nov 2018	99 km	32	4	128	Tumbarumba	33.8	24.3
					Cabramurra	58.0	15.8
10-12 Dec 2018	66 km	24	2	48	Tumbarumba	126.6	29.5
					Cabramurra	269.2	20.5
30-31 Jan 2019	29 km	16	2	32	Tumbarumba	64.2	33.5
					Cabramurra	70.8	24.3
1-5 Feb 2019	37 km	40	2	80	Tumbarumba	69.0	30.5
					Cabramurra	66.6	22.3
10-15 Oct 2019	82 km	40	2	80	Tumbarumba	44.0	20.5
					Cabramurra	95.4	11.7

4-10 Nov 2019	45 km	48	2	96	Tumbarumba	26.0	16.8
					Cabramurra	35.0	7.3
4-8 Dec 2019	30 km	32	2	64	Tumbarumba	49.8	25.7
					Cabramurra	92.8	16.7
27-31 Oct 2020	310 km	40	8	320	Tumbarumba	78.2	20.6
					Cabramurra	103.8	11.7

Note: Transect length rounded to the nearest km and estimated from tracks made on hand-held GPS units so is subject to error due to normal issues such as quality of satellite reception and any device malfunction. Actual distance covered is greater as not all observers were always carrying a GPS unit.

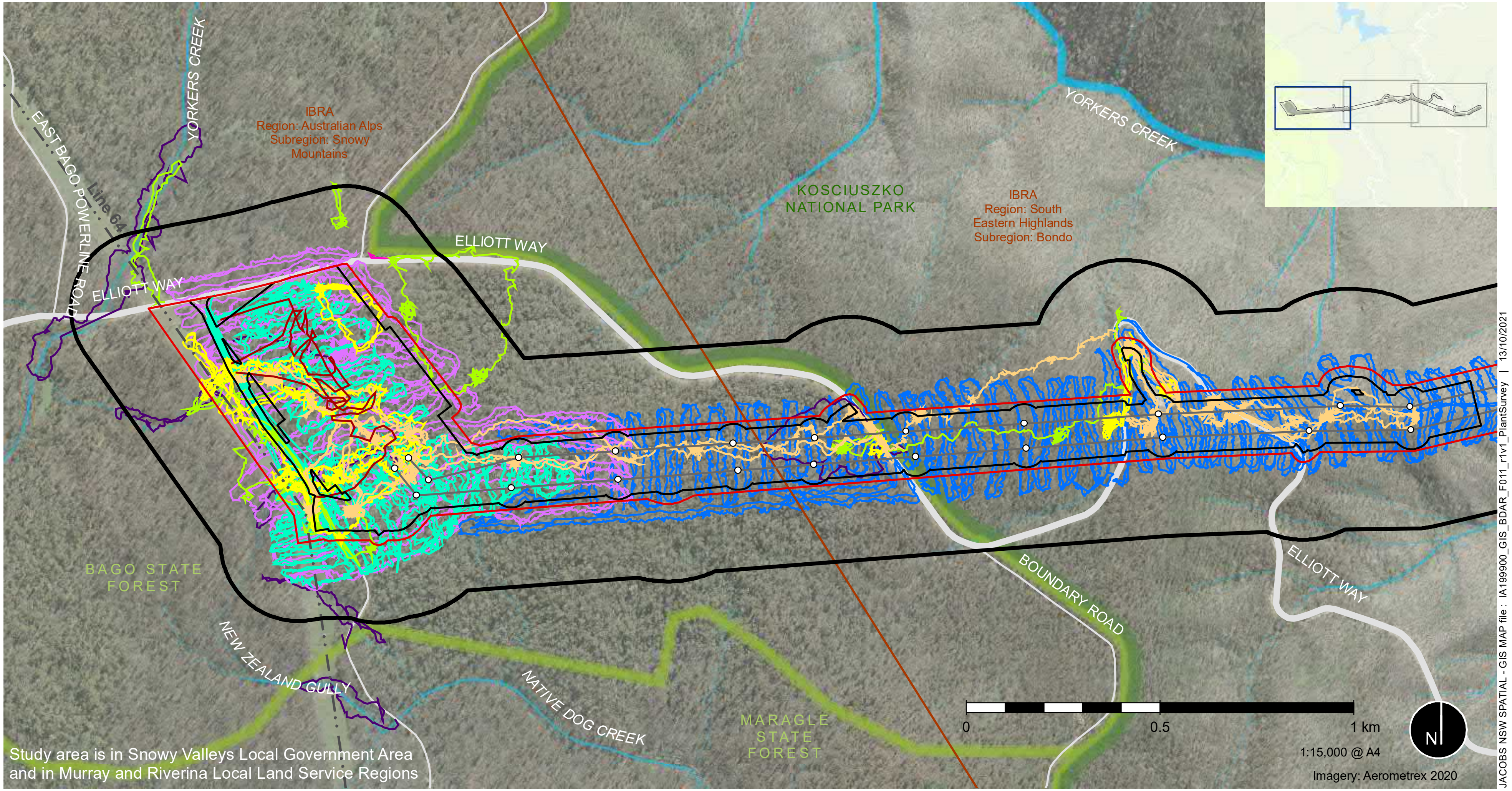
Table 6-6: Summary of survey effort for threatened plant species

Species	Common name	EPBC Act	BC Act	Required survey period (TBDC)	Habitat area (ha) in project area	Survey guideline*	Approx. effort
Caladenia montana	-	-	V	October – November	31.22 (PCT 1196) 62.77 (PCT 300) 57.53 (PCT 729) 12.79 (PCT 999) 31.44 (PCT 296)	Potential total length of field traverse based on 10-metre spaced transects: 25-50 km (PCT 1196) ~50 km (PCT 300) ~50 km (PCT 729) 10-25 km (PCT 999) 25-50 km (PCT 296)	November 2018: 8.9 km in PCT 1196 9.5 km in PCT 300 November 2019: 6.5 km in PCT 300 35.8 km in PCT 1196 October 2020: 54.8 km in PCT 296 81.5 km in PCT 300 130 km in PCT 729 42.77 km in PCT 999 1.6 km in PCT 1196
Calotis glandulosa	Mauve Burr-daisy	V	V	October – March	31.22 (PCT 1196)	Potential total length of field traverse based on 10-metre spaced transects: 25-50 km (PCT 1196)	November 2018: 32 km in PCT 1196 October 2020: 1.6 km in PCT 1196
Pomaderris cotoneaster	Cotoneaster Pomaderris	E	E	October – November	62.77 (PCT 300)	Potential total length of field traverse based on 20-metre spaced transects: ~25 km (PCT 300)	November 2018: 9.5 km in PCT 300 224.5 km across study area in other potential habitats during entire survey period October 2020: 81.5 km in PCT 300
Pterostylis alpina	Alpine Greenhood	-	V	August, September and November (the TBDC does not list October though this is likely an error)	31.22 (PCT 1196)	Potential total length of field traverse based on 10-metre spaced transects: 25-50 km (PCT 1196)	October and November 2018: 8.9 km in PCT 1196 9.5 km in PCT 300 October 2019: 5.8 km in PCT 285 0.66 km in PCT 300 75 km in PCT 1196

Species	Common name	EPBC Act	BC Act	Required survey period (TBDC)	Habitat area (ha) in project area	Survey guideline*	Approx. effort
							November 2019: 2.4 km in PCT 285 6.5 km in PCT 300 35.8 km in PCT 1196 October 2020: 54.8 km in PCT 296 81.5 km in PCT 300 130 km in PCT 729 42.77 km in PCT 999 1.6 km in PCT 1196
Pterostylis foliata	*Slender Greenhood*	-	V	October – November	31.22 (PCT 1196)	Potential total length of field traverse based on 10-metre spaced transects: 25-50 km (PCT 1196)	October and November 2018: 11.9 km in PCT 1196 9.5 km in PCT 300 October 2019: 5.8 km in PCT 285 0.66 km in PCT 300 75 km in PCT 1196 November 2019: 2.4 km in PCT 285 6.5 km in PCT 300 35.8 km in PCT 1196 October 2020: 54.8 km in PCT 296 81.5 km in PCT 300 130 km in PCT 729 42.77 km in PCT 999 1.6 km in PCT 1196
Pterostylis oreophila	Blue-tongued Greenhood	CE	CE	December – January	2.23 (PCT 285)	Potential total length of field traverse based on 10-metre spaced transects: 2-10 km (PCT 285)	December 2018 to January 2019: 6.1 km in PCT 285 from

Species	Common name	EPBC Act	BC Act	Required survey period (TBDC)	Habitat area (ha) in project area	Survey guideline*	Approx. effort
Thelymitra alpicola	Alpine Sun Orchid	-	V	November – January	2.23 (PCT 285)	Potential total length of field traverse based on 10-metre spaced transects: 2-10 km (PCT 285)	November 2018 to January 2019: 10 km in PCT 285 from <u>November 2019:</u> 2.4 km in PCT 285 6.5 km in PCT 300 35.8 km in PCT 1196 <u>December 2019:</u> 2.4 km in PCT 285 1.5 km in PCT 296 3.5 km in PCT 300 5.1 km in PCT 729 15.4 km in PCT 999 2.4 km in PCT 1196
Thelymitra atronitida	Black-hooded Sun Orchid	-	CE	November – December	31.22 (PCT 1196)	Potential total length of field traverse based on 10-metre spaced transects: 25-50 km (PCT 1196)	<u>November and December 2018:</u> 22.6 km in PCT 1196 9.5 km in PCT 300 <u>November 2019:</u> 2.4 km in PCT 285 6.5 km in PCT 300 35.8 km in PCT 1196 <u>December 2019:</u> 2.4 km in PCT 285 1.5 km in PCT 296 3.5 km in PCT 300 5.1 km in PCT 729 15.4 km in PCT 999 2.4 km in PCT 1196
Thesium australe	Austral Toadflax	V	V	November – February	31.22 (PCT 1196)	Potential total length of field traverse based on 10-metre spaced transects: 25-50 km (PCT 1196)	<u>November 2018 to January 2019:</u> 26 km in PCT 1196 202 km across study area in other potential habitats

Note: * = The number of required survey kms is taken from the *Surveying threatened plants and their habitats - NSW survey guide for the Biodiversity Assessment Method* (Department of Planning Industry and Environment, 2020). *Pomaderris cotoneaster* and *Thesium australe* were searched for throughout the project area and the searches were not restricted to specific PCTs. PCTs adjacent to known associated habitat types were also searched for the target species.



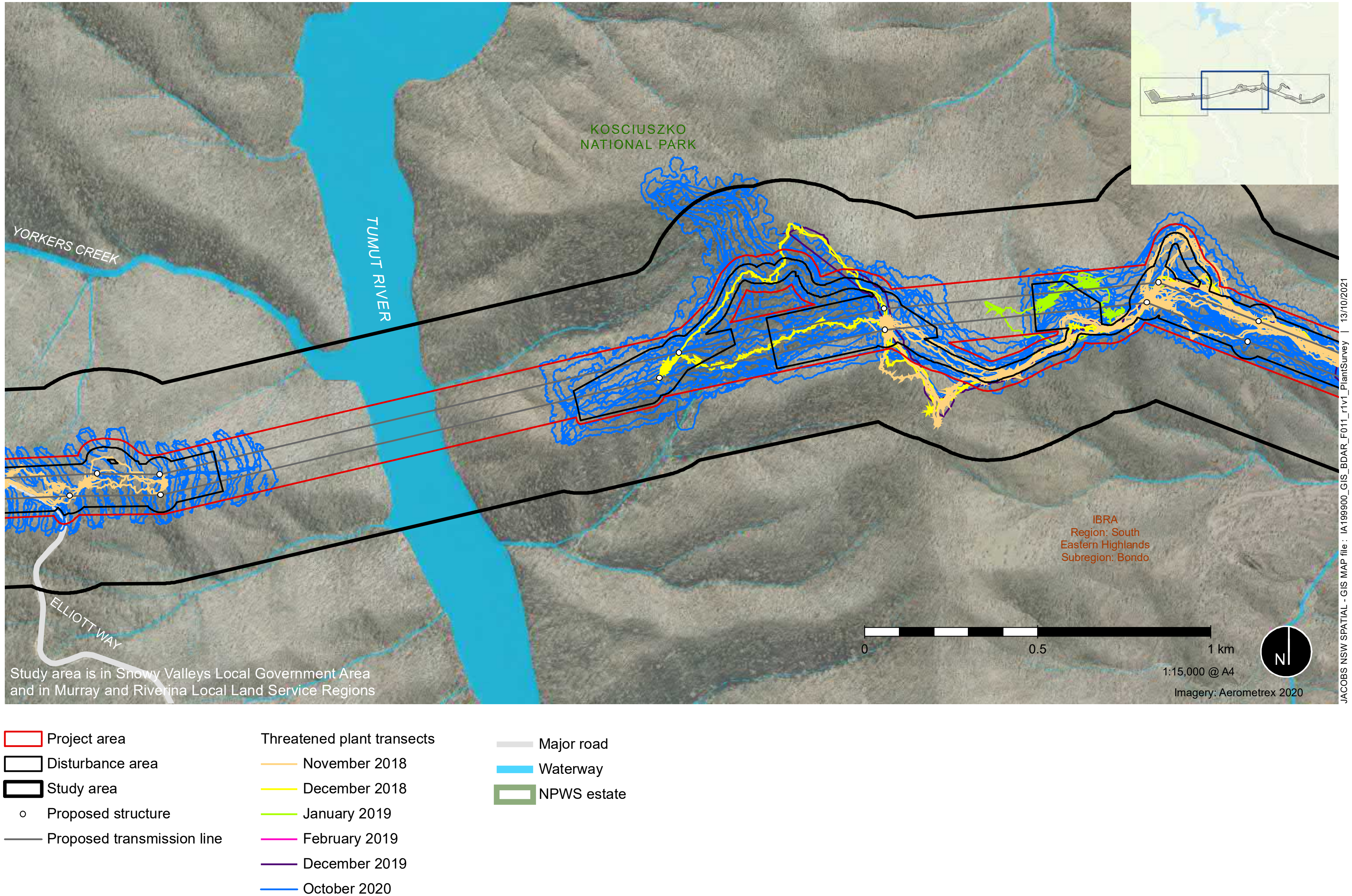
Project area
Disturbance area
Study area
Proposed structure
Proposed transmission line

Threatened plant transects
October 2018
November 2018
December 2018
January 2019
February 2019
October 2019
November 2019
December 2019
October 2020

Electricity transmission line
Minor road
Major road
Waterway
IBRA
NPWS estate
State Forest

Data sources:
Jacobs 2021, TransGrid 2021

Figure 6-2 | Location of targeted threatened plant surveys



Data sources:
Jacobs 2021, TransGrid 2021
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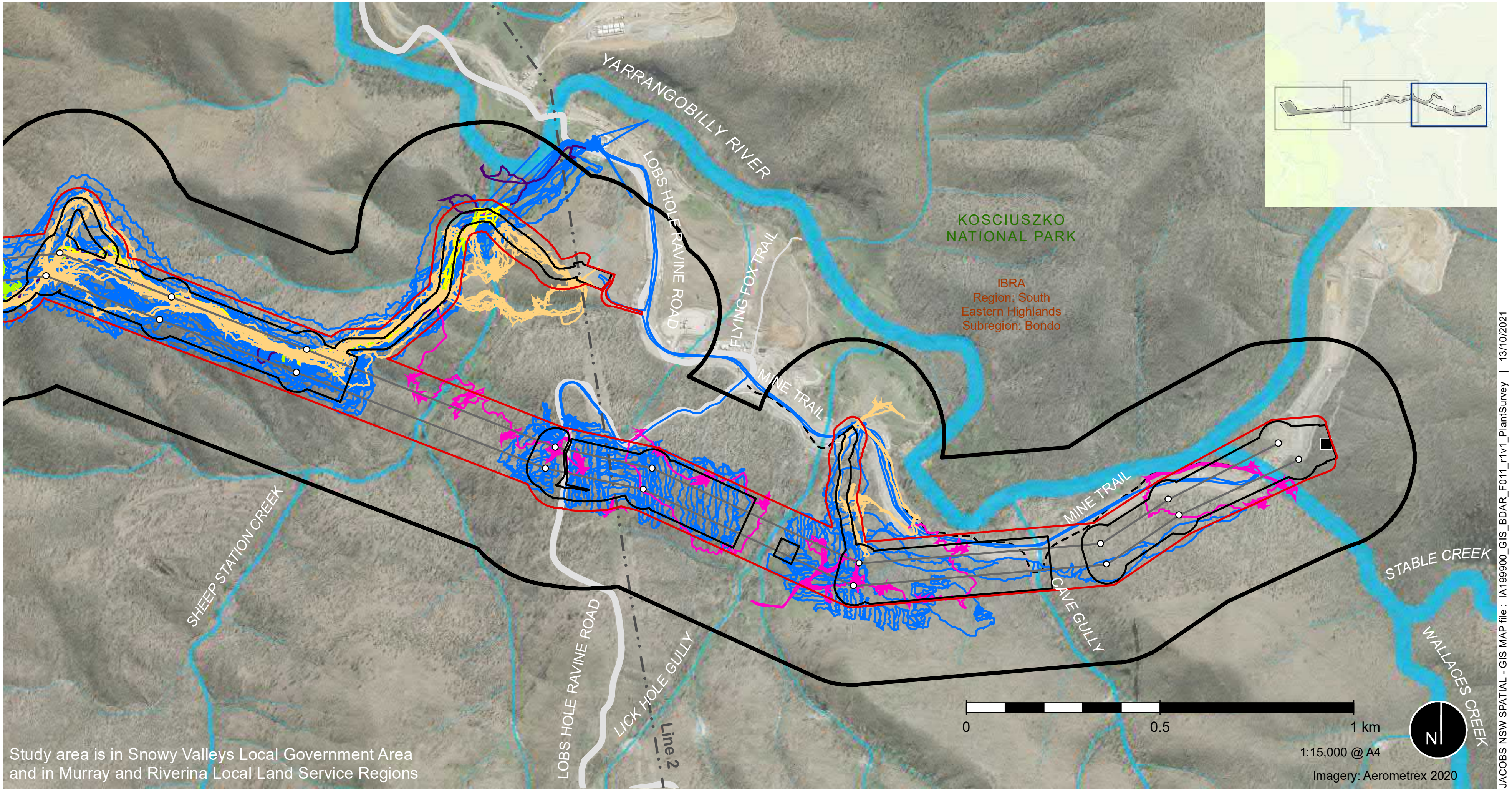
Figure 6-2 | Location of targeted threatened plant surveys



Project area
Disturbance area
Study area
Proposed structure
Proposed transmission line

Snowy 2.0 cable yard

Threatened plant transects
November 2018
December 2018
January 2019
February 2019
December 2019
October 2020

Electricity transmission line
Minor road
Major road
Trail
Waterway
NPWS estate

Data sources:
Jacobs 2021, TransGrid 2021
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Figure 6-2 | Location of targeted threatened plant surveys

6.5.2 Threatened animals

The list of threatened species-credit animal species targeted during surveys was developed with information collected about the site context of the project area (Section 3 of the BAM), on PCTs and vegetation integrity attributes in (Section 4 of the BAM), and data obtained from the Threatened Biodiversity Data Collection. The details of this process are provided in **Section 6.4** of this BDAR. The threatened animal survey plan was also developed in consultation with the then Office of Environment and Heritage (OEH) in November 2018 prior to the commencement of surveys. Consultation included a review of proposed survey design by Miles Boak, Miranda Kerr and Glenn Stroud from the then OEH (who also consulted internally with OEH threatened species experts). Further consultation with the BCS (formerly BCD & OEH), and a meeting with threatened owl experts was undertaken in June-August 2021 for advice on supplementary methods to survey for nest trees suitable for Masked Owl, Powerful Owl and Gang-gang Cockatoo. The following animal species were targeted in surveys (see **Figure 6-3** and **Figure 6-4**).

- Diurnal birds: Pink Robin, Painted Honeyeater, Gang-gang Cockatoo, Little Eagle, Square-tailed Kite, White-bellied Sea-Eagle
- Nocturnal birds: Barking Owl, Powerful Owl, Masked Owl
- Small terrestrial mammals: Eastern Pygmy-possum, Smoky Mouse
- Large terrestrial mammals: Spotted-tailed Quoll
- Arboreal mammals: Yellow-bellied Glider, Greater Glider, Squirrel Glider, Brush-tailed Phascogale, Koala
- Bats: Large Bent-winged Bat, and Southern Myotis
- Amphibians: Alpine Tree Frog.

Surveys for terrestrial fauna included a range of techniques aimed at identifying the type and distribution of fauna habitats within the project area, and the presence and distribution of threatened species. The focus was on targeting the threatened species identified as candidate species credit species, however survey data was collected for all species observed. Surveys included diurnal and nocturnal effort using a stratified sampling approach that aimed to sample the range of habitats present. Opportunistic observations of threatened species were also recorded during survey activities while present in the study area. Surveys were focussed on areas within the project area and where possible also occurred in adjacent habitats that extended beyond the disturbance area which may be indirectly impacted. Nest trees were searched within the study area at 100m and/or 200m beyond the project area to account for possible disturbance buffers and to determine possible species polygons for forest owls or Gang-gang Cockatoo if necessary.

Surveys were conducted during the summer season of 2018-19 and winter season of 2021 using a combination of sampling techniques based on the methodology and effort as outlined in the TBDC and relevant survey guidelines including:

- Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities (Department of Environment and Conservation, 2004)
- T*hreatened species survey and assessment guidelines: field survey methods for fauna – Amphibians* (Department of Environment and Climate Change, 2009)
- '*Species credit' threatened bats and their habitats NSW survey guide for the Biodiversity Assessment Method* (Office of Environment and Heritage, 2018)
- *Survey Guidelines for Australia's Threatened Bats* (Department of the Environment Water Heritage and the Arts, 2010a)
- *Survey Guidelines for Australia's Threatened Birds* (Department of the Environment Water Heritage and the Arts, 2010b)
- *Survey Guidelines for Australia's Threatened Frogs* (Department of the Environment Water Heritage and the Arts, 2010c)
- *Survey Guidelines for Australia's Threatened Mammals* (Department of the Environment Water Heritage and the Arts, 2011a)

- *Survey Guidelines for Australia's Threatened Reptiles* (Department of the Environment Water Heritage and the Arts, 2011b).

Details of the specific survey techniques and effort applied is outlined in this section of the BDAR and described in relation to the location and habitat types sampled and the target species.

6.5.2.1 Habitat stratification and site selection

The extent of the fauna survey area was initially identified from an overlay of the project area onto an aerial photograph and consideration of the footprint of the substation and location of transmission structures, access tracks and ancillary areas and appropriate buffers on infrastructure as discussed. Following definition of the study area, habitat stratification was applied to ensure that fauna surveys sampled the full range of habitats types within the study area. The approach focused on identifying the vegetation formation and class (Keith 2004) of all the PCTs present and then biophysical attributes, in this regard elevation, as well as slope and aspect.

The eucalypt-dominated sclerophyll forests are the most widespread fauna habitat across the study area and occupy a range of different slope gradients and aspects. Stratification of habitats into survey units relied on vegetation formation, aspect and slope, and PCT. Wet or moist habitats are mostly restricted to sheltered slopes and gullies and represented special areas in conjunction with rocky cliffs and potential cave sites. The stream environments associated with creeks and wet depressions were also sampled.

The survey approach focused firstly on establishing twelve primary survey sites sampling each of the stratification units. Survey sites included a live-trapping grid approximately 1.5 ha in area, from which terrestrial and arboreal mammals were targeted. Bird and reptile census, spotlighting, call playback and koala scat search techniques were also conducted at each primary site. In addition to the primary sites, a high density of camera traps was deployed along the project alignment, focusing in remote areas near structure sites and access tracks not easily accessible daily. A range of supplementary measures were then used generally, and across the project alignment; this included microbat trapping, spotlighting, koala scat searches and time-based bird and reptile survey sites. A summary of the habitat types sampled, approximate area of each habitat type and survey techniques applied is provided in **Table 6-7**.

Table 6-7: Summary of broad habitat types within the project area and summary of survey methods applied

Vegetation formation (Keith 2004)	Vegetation Class (Keith 2004)	Description, extent	Disturbance area – direct impact (ha)	A	B	C	D	E	F	G
Dry Sclerophyll Forests (Shrub/grass sub-formation)	Upper Riverina Dry Sclerophyll Forest	Predominantly occurs in the eastern portion of the study area on moist flats with elevation ranging from 1040-1070 m, typically ephemeral drainage lines, with limited standing water, includes PCT285, PCT302 and PCT999	13.1 ha	√	√	√	√	√	√	√
Dry Sclerophyll Forests (Shrubby sub-formation)	Southern Tableland Dry Sclerophyll Forests	Includes PCT 296, and 729	60.7 ha	√	√	√	√	√	√	√
Wet Sclerophyll Forests (Grassy sub-formation)	Southern Tableland Wet Sclerophyll Forests	Includes PCT 300	32.0 ha	√	√	√	√	√	√	√
Grassy Woodlands	Subalpine Woodlands	Includes PCT 1196	27.25	√	√	√	√	–	√	√

Vegetation formation (Keith 2004)	Vegetation Class (Keith 2004)	Description, extent	Disturbance area – direct impact (ha)	A	B	C	D	E	F	G
A - Tree-based Elliott traps (small to medium arboreal mammals) B - Ground-based Elliott traps (small terrestrial mammals) C - Camera traps (set on ground and in low trees and shrubs) D - Harp traps (microchiropteran–bats) E - Call playback (nocturnal mammals and large forest–owls) F - Diurnal bird census G - Timed nocturnal searches (nocturnal birds, frogs and mammals)										

6.5.2.2 Timing, season and weather conditions

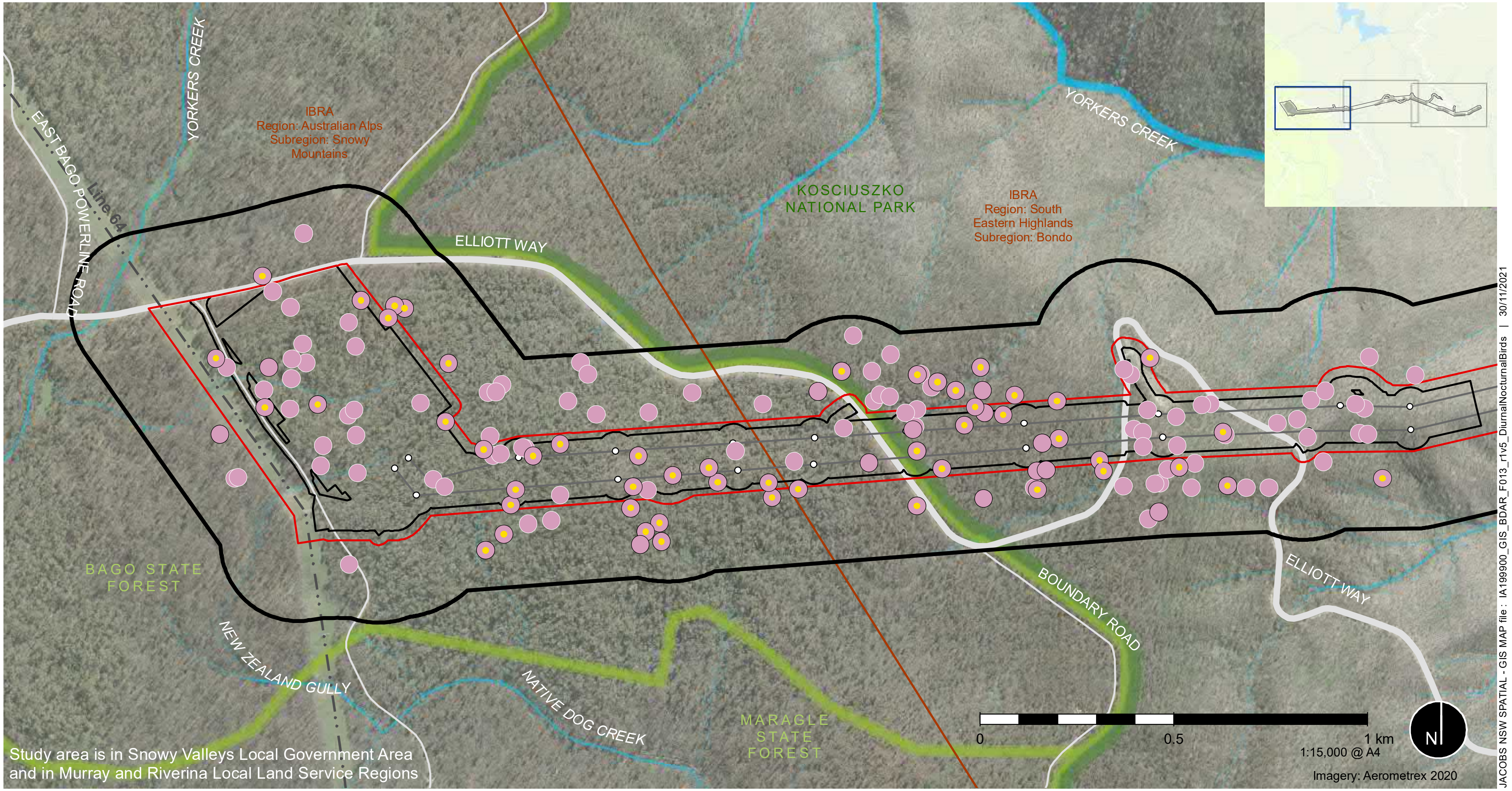
Fauna surveys were conducted over a total of 37 days sampling in the summer season of 2018-19 over the months of December-February and in the winter season of 2021 over the months of July and August. A summary of the field survey times, average temperature during the survey period and total rainfall conditions experienced during each period are provided in **Table 6-8**.

Weather conditions during the December 2018 survey were warm to hot with rainfall experienced on two of the days. Conditions during the January / February 2019 survey were hot with temperatures in the Ravine area exceeding 40˚C with storms and rainfall occurring on several nights. Conditions in July 2021 were mostly cold and dry, with only one day of rainfall. All surveys in August 2021 were undertaken at dusk and were generally cold and clear with 4 days of rainfall. Field survey during the 12-19 August 2021 period was only undertaken at the western end of the study area between the quarry on Elliot Way and the substation.

Weather information for the survey periods was used from the Tumbarumba Post Office (072043) and Cabramurra (072161) weather stations. It should be noted that there is about a 500m difference in elevation between the Cabramurra weather station and the Lobs Hole valley. This change in topography and landform greatly affects weather conditions. For example, there was blizzard conditions and heavy snow fall at the Link Road gate entry to Lobs Hole Road on the night of 3 August 2021, however in the study area at Lobs Hole, only sporadic rain, light winds and about a 6^0C difference in temperature was observed. For this reason, local site conditions are also noted in **Table 6-8**.

Table 6-8: Summary of timing, weather and rainfall conditions for fauna surveys

Survey period	Duration	Weather station	Min - Max Daily Temp (^{0}C)	Min - Max Average Temp (^{0}C)	Total rainfall during survey period (mm)	Local notes
4-14 December 2018	10 days	Tumbarumba Post Office	7.4–33.6	12–29	60.2	Warm to hot, 2 days of rain
		Cabramurra	4.3–23.5	11–20	49.4	
22 January to 2 February 2019	11 days	Tumbarumba Post Office	12–39.5	17–33	26.2	Hot, several days of rain
		Cabramurra	7.5–30.6	15–24	25.8	
9-14 July 2021	6 days	Tumbarumba Post Office	-4.0–14.0	-1.4–14	0.8	Cold, 1 day of rain, light wind
		Cabramurra	-0.5–7.1	0.5–5.5	2.4	
2-9 August 2021	8 days	Tumbarumba Post Office	-4.0–15.5	1.0–12	21.8	Cold, 3 days of rain, light winds
		Cabramurra	-2.7-7.0	-1.0–3	42.5	
12-19 August 2021	8 days	Tumbarumba Post Office	-2.5–15.5	0–14	7.2	Cold & calm, 1 day of rain, light wind



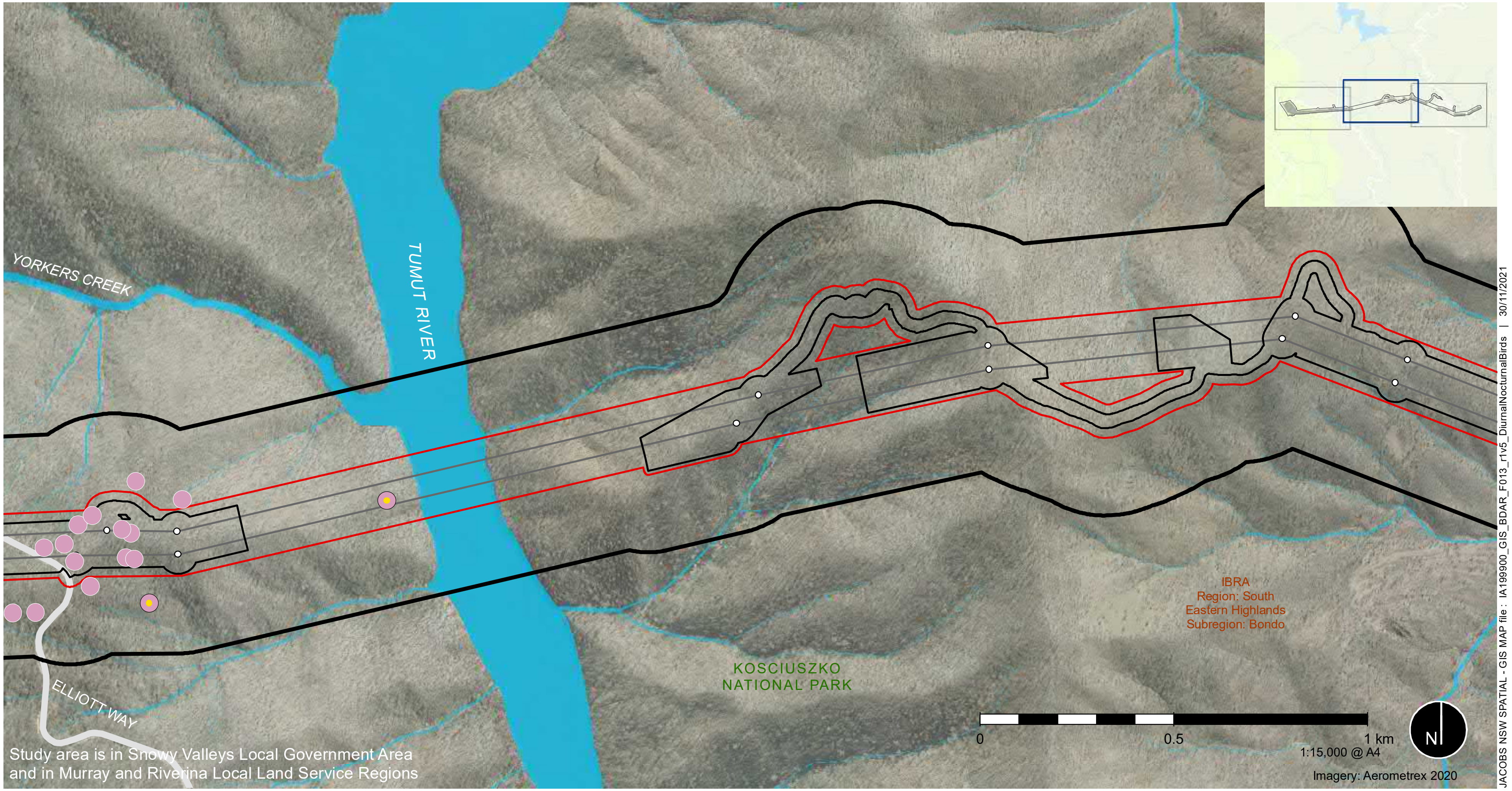
Project area
Disturbance area
Study area
Proposed structure
Proposed transmission line

Tree stagwatched
Potential nest trees for Gang-gang Cockatoos
Potential nest trees for Masked Owl

Electricity transmission line
Minor road
Major road
Waterway
IBRA
NPWS estate
State Forest

Data sources:
Jacobs 2021, TransGrid 2021, DPE 2018,
© Department Finance, Services and Innovation 2018

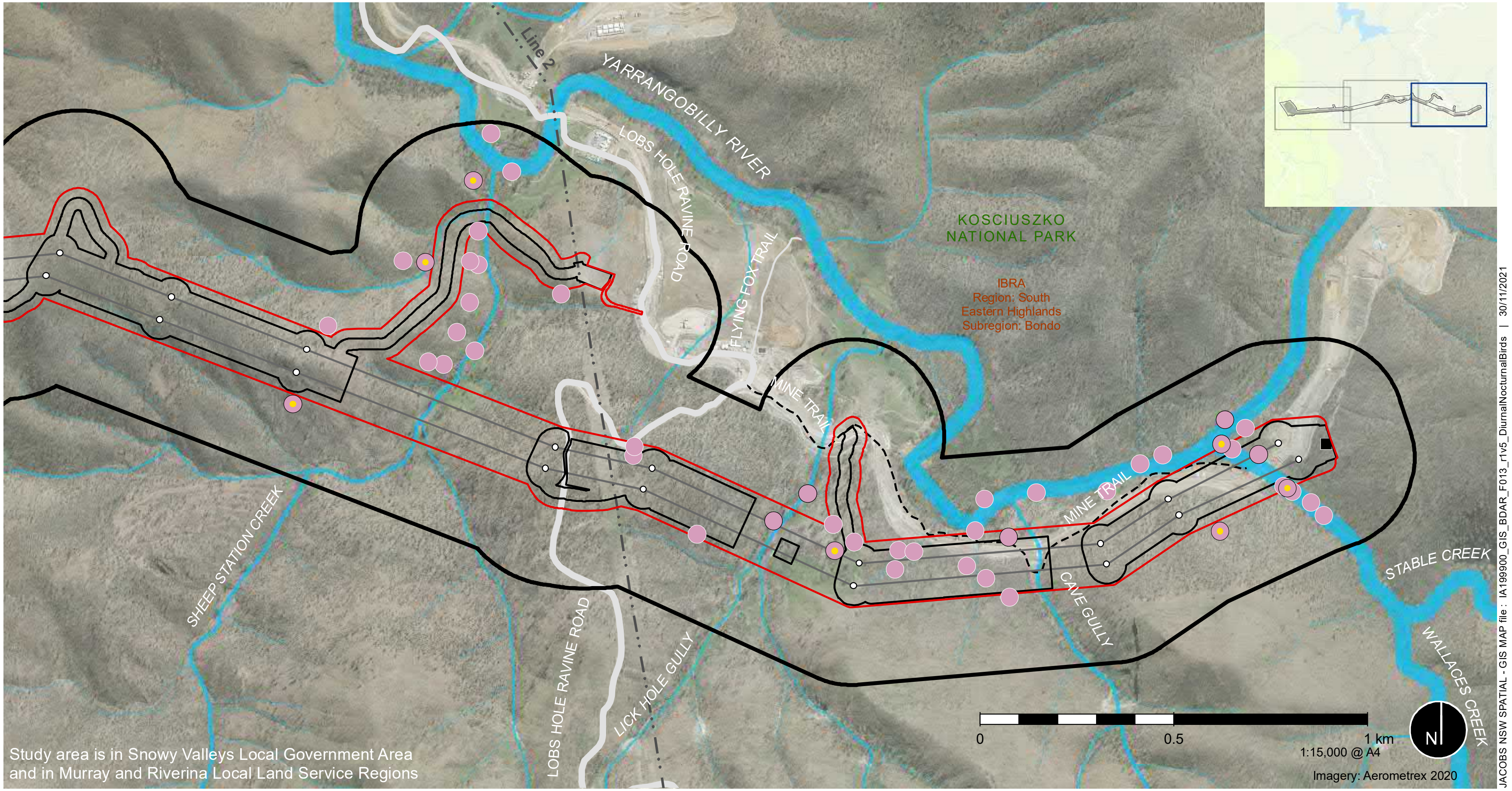
Figure 6-3 | Targeted nest tree survey and trees stagwatched



Project area
Disturbance area
Study area
Proposed structure
Proposed transmission line
Tree stagwatched
Potential nest trees for Gang-gang Cockatoos
Potential nest trees for Masked Owl
Electricity transmission line
Major road
Waterway
NPWS estate

Data sources:
Jacobs 2021, TransGrid 2021, DPE 2018,

Figure 6-3 | Targeted nest tree survey and trees stagwatched



Project area
Disturbance area
Study area
Proposed structure
Proposed transmission line
Snowy 2.0 cable yard
Tree stagwatched
Potential nest trees for Gang-gang Cockatoos
Potential nest trees for Masked Owl
Electricity transmission line
Minor road
Major road
Trail
Waterway
NPWS estate

Data sources:
Jacobs 2021, TransGrid 2021, DPE 2018,
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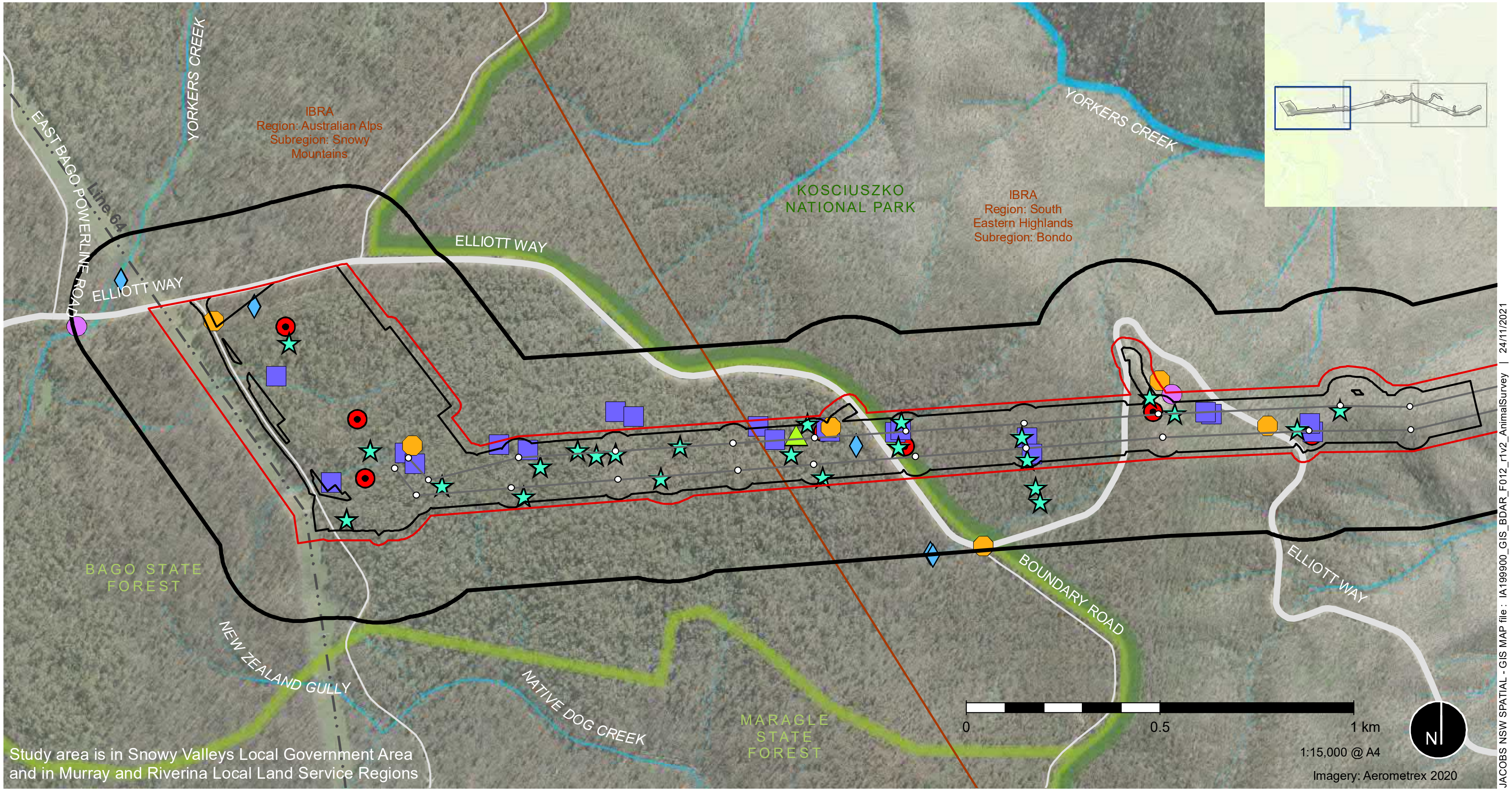
Figure 6-3 | Targeted nest tree survey and trees stagwatched



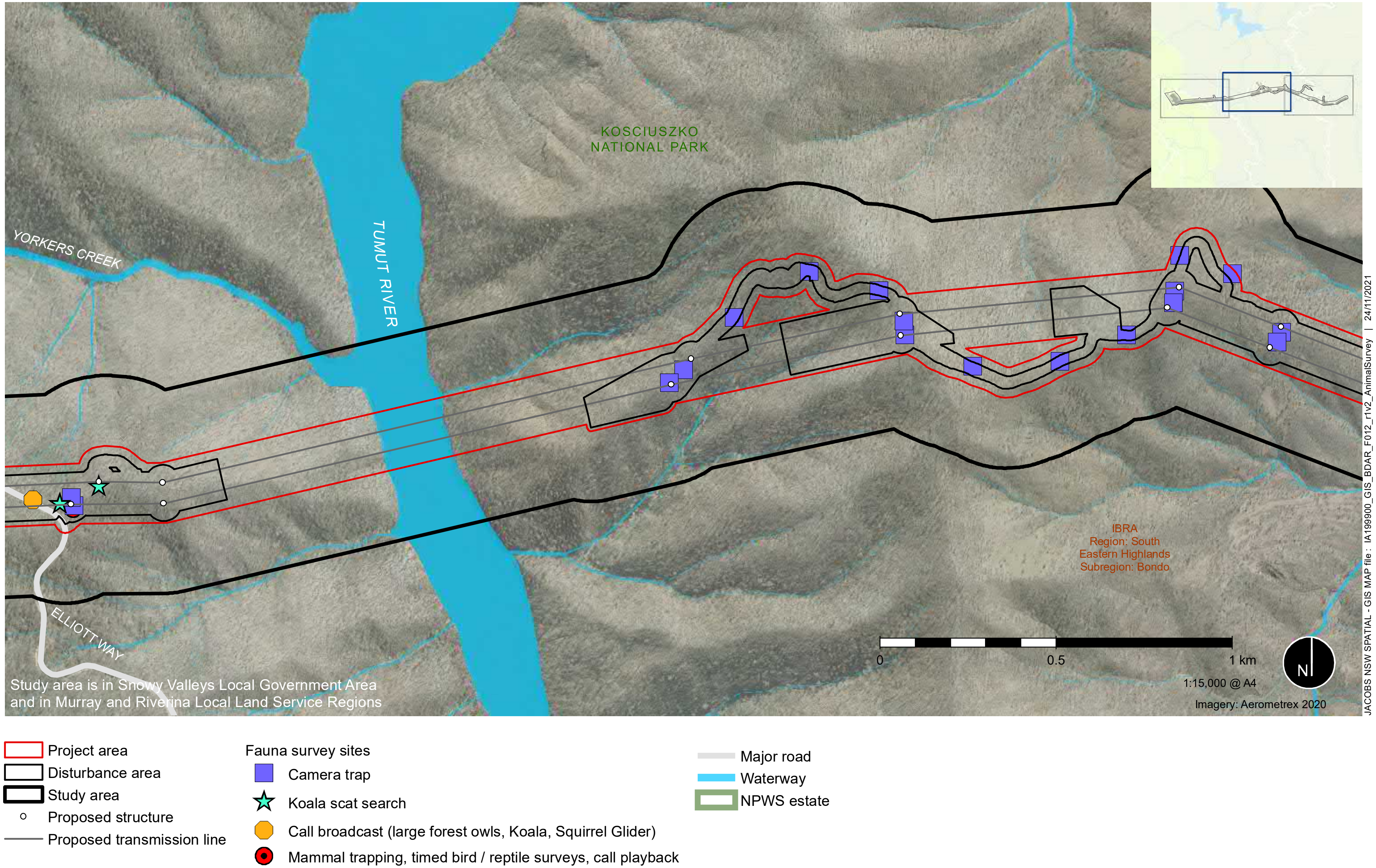
Project area
Disturbance area
Study area
Proposed structure
Proposed transmission line

Fauna survey sites
Bat call detector
Camera trap
Harp trap
Koala scat search
Timed reptile search
Call broadcast (large forest owls, Koala, Squirrel Glider)
Mammal trapping, timed bird / reptile surveys, call playback

Electricity transmission line
Minor road
Major road
Waterway
IBRA
NPWS estate
State Forest

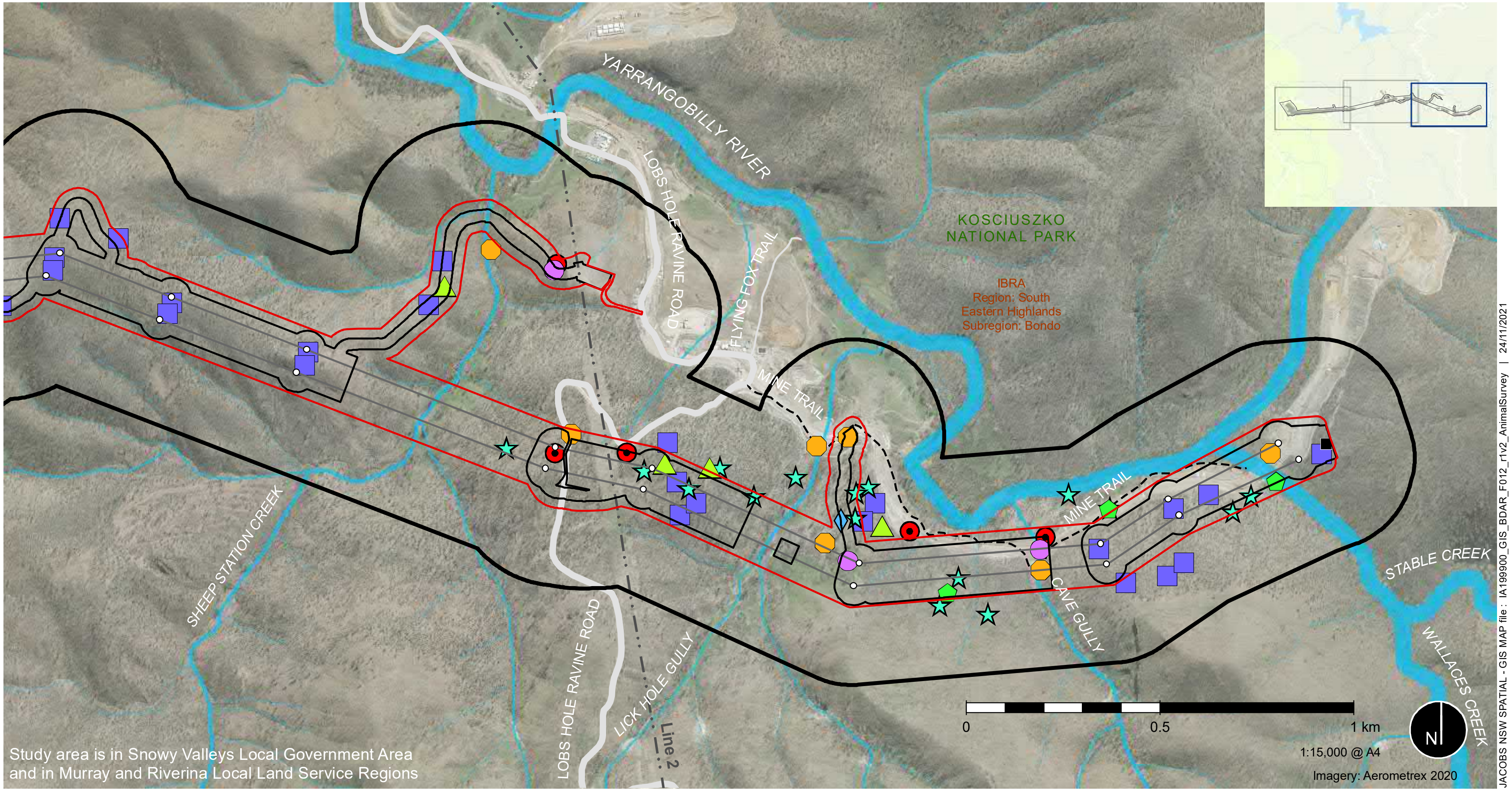
Data sources:
Jacobs 2021, TransGrid 2021
© Department Finance, Services and Innovation 2018

Figure 6-4 | Location of targeted threatened animal surveys



Data sources:
Jacobs 2021, TransGrid 2021

Figure 6-4 | Location of targeted threatened animal surveys



Project area
Disturbance area
Study area
Proposed structure
Proposed transmission line

Snowy 2.0 cable yard

Fauna survey sites
- Bat call detector
- Camera trap
- Harp trap
- Koala scat search
- Timed bird survey
- Timed reptile search
- Call broadcast (large forest owls, Koala, Squirrel Glider)
- Mammal trapping, timed bird / reptile surveys, call playback

Electricity transmission line
Minor road
Major road
Trail
Waterway
NPWS estate

Data sources:
Jacobs 2021, TransGrid 2021
© Department Finance, Services and Innovation 2018

Figure 6-4 | Location of targeted threatened animal surveys

6.5.2.3 Diurnal birds

The survey for diurnal birds focused on the Gang-gang Cockatoo (breeding habitat) and Pink Robin. The Painted Honeyeater was also included as it was identified from the PMST search. Other threatened bird species listed as ecosystem credit species were also noted when encountered and their locations mapped. The surveys were largely undertaken outside of the breeding habitat survey period for the White-bellied Sea-Eagle and Little Eagle. However, the survey period was appropriate to detect any breeding habitat for the Square-tailed Kite.

The diurnal bird surveys were undertaken by using the standard technique of timed-based area searches. All birds observed or heard were recorded in areas of 1 ha over a 20-minute period. Twenty timed-based search areas were completed, each one in the hour period of dawn and dusk. Opportunistic observations of target bird species and location were also noted while moving through habitat undertaking other field activities.

Potential signs of breeding habitat for raptors including the White-bellied Sea-Eagle, Little Eagle and Square-tailed Kite were searched for while moving through the habitats across the entire project area. Observers searched for any large stick nests in the top of the canopy of large trees.

Commonwealth survey guidelines for other threatened bird species suggest a survey requirement for 10 hours of bird surveys over five days (two hours per day) for sites less than 50 ha in size. Commonwealth survey guidelines for raptor nest searches suggest 8 hours over 4 days (2 hours per day) for sites less than 50 ha. The survey undertaken for this BDAR exceeds the recommended survey effort with 10 days of survey undertaken in December 2018 and 11 days of survey undertaken in January and February 2019. Nest searches were undertaken throughout the entire survey period.

A targeted survey of potential nest sites for the Gang-gang Cockatoo was conducted by two ecologists over 6 days (9-14 July 2021) and comprised a search and mapping of suitable hollow bearing trees within the disturbance area, and additional 200m search buffer of the project area to account for possible disturbance buffers and to determine possible species polygons. It also included searches of potential nest trees for forest owls within a 100m search buffer of the project area (See section 6.5.2.3). All locations with suitable breeding habitat were searched in the study area, except slopes associated with Sheep Station Ridge. Parts of the non-searched areas were assumed to have breeding habitat based on PCT associations with the species. If numerous potential nest trees were recorded inside the project area at any given location, nest tree searches did not expand beyond the 200m buffer areas and tree density plots (50x100m) were undertaken to estimate the number of potential nest trees and demonstrate the potential breeding habitat value per PCT.

The TBDC was initially reviewed to determine the most accepted habitat constraints criteria for assessing potential nest trees likely to be used by Gang-gang Cockatoo. Further consultation with BCS, including meetings on the 16 June 2021 and 21 July 2021 aided in determining the most up to date, standardised and accepted survey method for assessing potential nest trees.

The targeted nest tree survey for Gang-gang Cockatoo was undertaken outside of the species breeding period. The likelihood of breeding habitat being present was therefore determined by the number of potential nest trees identified as meeting the habitat constraints criteria: Gang-gang Cockatoo - trees containing ≥ 10cm (diameter of entrance) tree hollows at a height ≥ 9m.

Observers recorded tree species, diameter at breast height, hollow types, sizes and heights and captured photos of each potential nest tree. Other nests in the study area were also noted, especially any large stick nests, if present.

A summary of the survey effort undertaken for threatened birds is provided in **Table 6-9**.

Table 6-9: Summary of survey effort for threatened diurnal birds

Common name	Species name	EPBC Act	BC Act	Survey period limitation	Survey timing	No. survey sites	No. people	Survey effort
Pink Robin	*Petroica rodinogaster*	-	V	All year	4th-14th Dec 2018 (10 days) 22nd–Jan - 2nd Feb 2019 (11 days) 9-14 July 2021	20 timed searches Opportunistic observation throughout survey period Observation to locate large stick nests undertaken throughout survey period Targeted tree hollow survey and mapping of potential nest trees	Varied from 1 to 2 observers at each site	Timed searches = approximately 13.2 person hours Approximately 61 km of ground was covered during the survey, walking and driving, during which time all large trees with stick nests were surveyed
Painted Honeyeater	*Grantiella picta*	V	V	Sept – Jan				
Gang-gang Cockatoo	*Callocephalon fimbriatum*	-	V	Oct – Jan				
Little Eagle	*Hieraaetus morphnoides*	-	V	Aug – Oct (breeding habitat survey)				
Square-tailed Kite	*Lophoictinia isura*	-	V	Sept – Jan (breeding habitat survey)				
White-bellied Sea-Eagle	*Haliaeetus leucogaster*	M	V	July – Dec (breeding habitat survey)				

Note: The main fauna survey period was conducted outside of the breeding survey period for the Little Eagle and White-bellied Sea-Eagle so the survey for these species focused on locating large stick nests in the top of tree canopies.

6.5.2.4 Nocturnal birds

The survey for nocturnal birds focused on the Barking Owl, Powerful Owl, Masked Owl and Sooty Owl. The assessment for Barking Owl was limited to the South Eastern Highlands portion of the project area while the Powerful Owl and Masked Owl may occur in both the South Eastern Highlands and the Australian Alps. The Sooty Owl is not associated with any of the PCTs within the study area, however, calls for this species were broadcast during the call playback survey at all locations.

Field surveys were undertaken both inside and outside of the breeding period for these three owl species. The targeted survey outside the breeding season was carried out with two survey events comprising call playback and spotlighting over 20 nights between 4-11 December 2018 and 22 January to 2 February 2019. Targeted surveys in the breeding season were conducted in two stages with three survey events comprising targeted tree hollow survey and mapping over 6 days between 9-14 July 2021 and two nocturnal stag watching events over 16 nights between 2-9 August 2021 and 12-19 August 2021 to target mapped potential nest trees.

Owl call playback was completed at 16 sites which included each of the primary survey sites and four additional sites. Call broadcast was repeated twice at each site on separate nights, for a total of 32 survey nights. Where possible call playback sites were established near suitable habitat features (i.e. large hollow bearing trees) and included forest and riparian ecotones. Calls were played intermittently for each target species followed by a 10-minute listening period. Spotlights were turned off during call broadcast to encourage owls to call or approach. The call playback session was followed by a 10-minute spotlight of the canopy in the vicinity of the call playback site in an attempt to detect any owls attracted to the calls. All birds observed or heard were recorded. Calls of each species were alternated on different nights to not disturb owls that might be present.

A targeted nest tree survey was conducted over 6 days (9-14 July 2021) and comprised a search and mapping of suitable hollow bearing trees during the winter breeding period for forest owls, and included a 100m search buffer of the project area to account for possible disturbances and to determine possible species polygons. All locations with suitable breeding habitat were searched in the study area, with the exception of the steep slopes associated with Sheep Station Ridge which was not considered to have suitable breeding habitat for forest owls based on previous survey observations and mapping of tree hollows during flora searches.

The TBDC and the Large Forest Owl Recovery Plan (DEC 2006) were initially reviewed to determine the most accepted habitat constraints criteria for assessing potential owl nest trees and conducting stagwatch surveys to identify actual nest trees used by forest owls. Further consultation with BCD, including meetings on the 16 June 2021 and 21 July 2021 aided in determining the most up to date, standardised and accepted survey method for assessing potential nest trees and survey techniques of forest owls. The likelihood of forest owl breeding habitat being present was determined by identified habitat trees meeting the following habitat constraints criteria:

- Masked Owl - trees containing ≥ 20cm (diameter of entrance) tree hollows at a height ≥ 3m
- Powerful Owl - trees containing ≥ 20cm (diameter of entrance) tree hollows at a height ≥ 6m.

Opportunistic mapping of large hollow bearing trees (noted as ecologists walked through the study area) was undertaken during various diurnal surveys in 2018-2020. These trees were revisited in the targeted nest tree search in July 2021 to determine suitability for forest owl breeding habitat. Observers recorded tree species, diameter at breast height, hollow types, sizes and heights and captured photos of each potential nest tree. Evidence of previous inhabitancy (owl pellets, scat whitewash, animal carcasses, etc) was searched for beneath each tree. All hollow bearing trees and candidate nest trees are mapped in Error! Reference source n ot found..

To support the efficacy of the subsequent stagwatch survey, all candidate nest trees were categorised into the following nest tree classes:

- Poor - hollows with high exposure to the elements, highly burnt stags (usually isolated and exposed), large (tall hollow stumps) chimney hollows at 3m in height with no branches for perching or small trees with small hollows at 20cm in size.
- Good – hollows protected or semi-exposed in large trees with foliage or regrowth foliage, hollows on large boughs or trunk, hollows >6m height at 20-40cm in size.
- Very Good – hollows protected in very large trees with foliage or regrowth foliage, sometimes multiple hollows meeting criteria on large boughs or trunk, hollows >6m height at 20-50cm or greater if not too exposed to elements, and particularly trees in drainage lines.

Candidate nest trees with a ‘good’ or ‘very good’ class were allocated to a follow-up stagwatch watch survey and were considered to provide the most suitable nesting habitat for forest owls.

The nocturnal stagwatch survey was conducted by five ecologists over 16 nights spilt between two survey events in 2-9 August 2021 and 12-19 August 2021 to target the winter breeding period. Each candidate nest tree was stagwatched once by one observer for 90 minutes, 30 minutes before sunset and 60 minutes following sunset. Observers recorded any animal activity associated with target trees, including nearby nocturnal fauna calls and local weather conditions. Some locations were re-visited on a second night if potential owl calls were heard nearby in order to locate a potential nest tree. The second survey event (12-19 August 2021) was supplemented with drone surveys conducted by EMM consulting to aid in the detection of forest owl nest trees.

Only habitat trees meeting the nesting suitability criteria were stagwatched in locations that were safely accessible during the night. Two candidate nest trees located on steep slopes and a long distance from tracks and roads were not stagwatched and were assumed as actual nest trees that met the criteria for Masked Owl.

The survey effort is considered adequate for detecting breeding behaviour and nest trees of target forest owls in the study area (see Error! Reference source not found.). The survey was undertaken in accordance with the s tandard guidelines and was an accepted survey method in consultation with BCS. While a minimum of two nights watching a single candidate nest tree for Powerful Owl wasn't achieved (as per TBDC), the survey timing only allowed for 1 night of stagwatching due to the high number of candidate nest trees and large study area. A high number of stagwatch survey nights (16), and using multiple observers was intended to address this limitation by increasing the opportunity to detect calling birds and confirm species presence in the study area. This accounted for a total of 36 nights in the study area across the full survey program (2018-2021).

All rocky outcrops and overhangs were also surveyed for within the project area during the 2018-2019 surveys. Larger caves and cliffs outside of the project area were identified from aerial imagery and also inspected. Evidence of previous inhabitancy was searched at cave-like habitat, when encountered in the project area.

Existing breeding habitat for the Masked Owl was identified during the recent surveys undertaken for the Snowy 2.0 Exploratory Works and Main Works BDARs (EMM Consulting, 2017 and 2020a). As such, this same breeding habitat has also been identified in this BDAR. Due to the positive identification of the Masked Owl within the Lobs Holes Ravine area (EMM Consulting, 2017 and 2020a), calls of the Masked Owl were purposefully not played to avoid disturbing resident owls.

A summary of survey effort for threatened owls is provided in **Table 6-10**.

Table 6-10: Summary of survey effort for threatened nocturnal birds

Common name	Species name	EPBC Act	BC Act	Survey period limitation	Survey timing	No. survey sites / technique	No. nights	Survey effort
Barking Owl	*Ninox connivens*	-	V	May – Dec (breeding habitat survey)	4th-11th Dec 2018 22nd Jan - 2nd Feb 2019 2-9 Aug 2021 12-19 Aug 2021	16 call playback survey sites repeated twice 16 Spotlighting transect sites Search and mapping candidate nest hollow Owl pellets searched for beneath large trees Stagwatch survey of 60 candidate nest trees Study area examined for cliff lines and caves	40 survey nights spotlighting 16 nights stag watching	32 nights of call playback Approximately 109 person hours spotlighting Approximately 80 person hours stag watching Approximately 90 km of ground was covered during the surveys, walking and driving, during which time large hollow-bearing trees and any caves or cliff lines were surveyed
Powerful Owl	*Ninox strenua*	-	V	May – Aug (breeding habitat survey)				
Masked Owl	*Tyto novaehollandiae*	-	V	May – Aug (breeding habitat survey)				
Sooty Owl	*Tyto tenebricosa*	-	V	April – Aug (breeding habitat survey)				

6.5.2.5 Small terrestrial mammals

The targeted survey for threatened small mammal species focused on the Smoky Mouse and Eastern Pygmy Possum. The Broad-toothed Rat was also targeted during the trapping program although the habitat within the project area was considered unsuitable for this species. EMM (2020) had reported a small area of potential habitat for Broad-toothed Rat, along Mines Trail at the junction of the Caves Creek, which is also within the current study area. Subsequent trapping did not confirm presence of the species, and the habitat is an isolated native grassland, not suited to the species.

The trapping program for small terrestrial mammals involved the integrated approach of ground-based live-trapping (Elliott type A, 33 x 10 x 9 cm) at each of the 12 primary sites and remote cameras (n=66) across the remainder of the study area. Tree mounted Elliott type B traps (15 x 16 x 45 cm) were also used at each site to target arboreal mammals and these were considered a potential incidental technique for Eastern Pygmy-possum (effort for arboreal mammals is discussed in **Section 6.5.2.7).** A summary of the overall survey effort is provided in **Table 6-11**.

Ground traps were set along two parallel lines consisting of between 12 and 13 traps (25 in total at each site) separated by at least 100 m. Traps were placed 10-15 m apart along each trap line, providing a trapping grid of 1.0-1.5 ha. Due to the likely low density of the target species and higher densities of more common species such as Agile Antechinus within the habitats, trapping intensity was increased above the recommended 100 trap nights per stratification unit. Traps were baited with a standard bait mix of peanut butter, rolled oats and honey and rebaited when necessary. The Elliott traps were left open for a maximum period of four nights and checked every morning within two hours of sunrise. This was an important consideration given the high temperatures experienced during the summer trapping period. Traps were packed with materials such as leaf litter to allow any trapped animals to keep warm overnight.

Camera traps were placed in the remaining habitats away from the primary sites, with a concentrated effort near proposed structure sites and access tracks where direct clearing is proposed. Bait stations were attached to a wooden stake located approximately 1.5 m away from the camera that was positioned approximately 30 cm above the ground mounted on a tree. Cameras were set on a timer to operate between 8 pm to 6 am. The cameras were left operational for a minimum of 10 nights which was deemed sufficient to record the species present, this was based on previous targeted camera trap surveys for the Smoky Mouse reported in Nelson *et al* (2009). To maximise the chance of detecting the Smoky Mouse, cameras were set on maximum sensitivity, with two photos taken per trigger, and a two-second delay between triggers. Camera traps were the main form of mammal survey undertaken in the more remote parts of the project area such as Sheep Station Ridge where live trapping was not practicable.

Predator scats were collected opportunistically throughout the survey and sent to Georgeanna Story at Scats About for hair analysis.

The recommended survey effort for small terrestrial mammals is 100 Elliott trap nights per stratification unit up to 50 ha in size (plus additional effort for every additional 100 ha) (Department of Environment and Conservation, 2004) and two remote cameras placed out for one week in areas up to 5 ha in size (with this effort repeated for every additional 5 ha of habitat present), as described for Smoky Mouse by Department of the Environment Water Heritage and the Arts (2011a).

A summary of the survey effort undertaken for small mammals is provided in **Table 6-11**. The survey effort is also further described below separated into bioregions.

Table 6-11: Summary of survey effort for small terrestrial mammals

Common name	Species name	EPBC Act	BC Act	Survey period limitation	Survey timing	No. survey sites	No. nights	Survey effort
Eastern Pygmy-possum	*Cercartetus nanus*	-	V	October – March	4th-11th December 2018 (west side of Tumut River) 22nd January - 2nd February 2019 (east side of Tumut River)	12 live trap sites (25 ground and 6 tree mounted traps at each site) 53 camera trap sites (43 ground and 10 tree mounted) 16 spotlighting sites (2 people)	Each Elliott trap site operated for 4 nights 57 nights of camera trapping (47 nights on west side of Tumut River and 10 nights on east side) 34 person nights spotlighting	100 ground and 24 tree mounted trap nights at each site (1,200 ground trap nights, 288 tree trap nights across the study area) 1,266 camera trap nights across the study area Approximately 74 person hours spotlighting
Smoky Mouse	*Pseudomys fumeus*	E	CE	All year				

There is approximately 27.2 ha of Sub-alpine Woodland (PCT 1196) identified as potential habitat for the Smoky Mouse and Eastern Pygmy Possum. There is also approximately 32.0 ha of Southern Tableland Wet Sclerophyll Forests (PCT 300), and 2.2 ha of Upper Riverina Dry Sclerophyll Forest (PCT 285) that may be suitable as habitat for the Smoky Mouse and the Eastern Pygmy Possum. A summary of the survey effort is provided in **Table 6-12**.

Based on work undertaken for the Snowy 2.0 Exploratory Works and Main Works BDARs (EMM Consulting, 2017 and 2020a), the Smoky Mouse was not found in habitats below 1,100 m above sea level (asl). The South Eastern Highlands portion of the project area is below 1,000 m asl and the Smoky Mouse is not considered to be a candidate species for assessment in this portion of the project area.

Within the Sub-alpine Woodland (PCT 1196) habitat, three primary trap sites were established, each consisting of 25 Elliott A type traps. The trap lines also ran through the narrow drainage lines of Upper Riverina Dry Sclerophyll Forest (PCT 285) sampling this habitat. Two trap sites were operational for four nights while one was operational for three nights. This resulted in a total effort of 275 ground trap nights targeting small terrestrial mammals in the Sub-alpine Woodland and narrow bands of Upper Riverina Dry Sclerophyll Forest habitat. Three remote cameras were stationed within the Sub-alpine Woodland habitat and one remote camera was stationed in the narrow drainage lines of Upper Riverina Dry Sclerophyll Forest and left operational for 47 nights. This resulted in 188 camera trap nights in Sub-alpine Woodland habitat and 47 camera trap nights in the narrow drainage lines of Upper Riverina Dry Sclerophyll Forest.

Within the Southern Tableland Dry Sclerophyll Forests (PCT 296, 729 and 999) habitat, five ground trap sites were established, each consisting of 25 traps. Trap sites were operational for four nights. This resulted in a total effort of 500 ground trap nights targeting small terrestrial mammals in the Southern Tableland Dry Sclerophyll Forests habitat type. Thirty-five cameras were stationed within the Southern Tableland Dry Sclerophyll Forest habitat type (four cameras on the west of the Talbingo Reservoir, 31 cameras to the east of the Talbingo Reservoir). The four cameras to the west of the Talbingo Reservoir were operational for 46 nights while the 31 cameras on the east of the Talbingo Reservoir were operational for 10 nights.

One trap site was established in the Upper Riverina Dry Sclerophyll Forests (PCT 302) habitat type, consisting of 25 traps. The trap site was operational for four nights resulting in a total effort of 100 ground trap nights targeting small terrestrial mammals in the Upper Riverina Dry Sclerophyll Forests habitat type. No cameras were established in this habitat types, however this is supplemented by two cameras placed on the margin of Southern Tableland Wet Sclerophyll Forests.

Three ground trap sites established in the Southern Tableland Wet Sclerophyll Forests (PCT 300) habitat type on the west side of the Talbingo Reservoir resulted in 300 trap nights. No live traps were established in the Southern Tableland Wet Sclerophyll Forests (PCT 300) habitat type on the east side of the Talbingo Reservoir. The impracticalities of checking the traps each morning and setting traps each night in this remote area on the crest and the western slopes of Sheep Station Ridge meant that a live-trapping program could not be undertaken safely or according to animal ethics regulations. As such, remote camera traps were stationed along the project area in this area of habitat and relied on for the survey. Two cameras were established in this habitat, and five on the margins of the PCT boundary, and were operational for 10 nights.

Table 6-12: Summary of survey effort for small mammals

Vegetation formation	Vegetation class / habitat type	Disturbance area (ha)	Required survey effort*	Survey completed
Dry Sclerophyll Forests (Shrub/grass sub-formation)	Upper Riverina Dry Sclerophyll Forests (PCT 302)	2.3 ha	100 ground trap nights 28 camera trap nights	100 ground trap nights 67 camera trap nights
Dry Sclerophyll Forests (Shrubby sub-formation)	Southern Tableland Dry Sclerophyll Forests (PCT 296, 729, 999)	56.6 ha	200 ground trap nights 280 camera trap nights	500 ground trap nights 494 camera trap nights
Wet Sclerophyll Forests (Grassy sub-formation)	Southern Tableland Wet Sclerophyll Forests (PCT 300)	32.0 ha	200 ground trap nights 182 camera trap nights	300 ground trap nights 517 camera trap nights
Grassy Woodlands	Subalpine Woodlands	27.3 ha	100 trap nights 98 camera trap nights	275 ground trap nights 188 camera trap nights

Note: * = survey effort rounded up to nearest 50 ha for trapping and nearest 5 ha for camera trapping

6.5.2.6 Large terrestrial mammals

The targeted survey for large terrestrial mammals focused on the Spotted-tailed Quoll. The Spotted-tailed Quoll is an ecosystem credit species for the purpose of this BDAR but is also listed as a vulnerable species under the EPBC Act so survey was undertaken for this species. The Spotted-tailed Quoll is considered likely to inhabit all of the habitats within the project area. Suitable den sites may be present within the Sub-alpine Woodland (PCT 1196) habitat and Southern Tableland Wet Sclerophyll Forest habitat (PCT 300) as these areas contain a large number of fallen hollow bearing trees and large woody debris on the ground. The rocky areas within the Southern Tableland Dry Sclerophyll Forests (PCT 296, 729 and 999) habitat type may also be suitable for den sites.

The 43 ground-based camera traps as described in **Section 6.5.2.5** were also used to detect the Spotted-tailed Quoll, by including an additional meat bait (sardines). Spotlighting transects were also undertaken in 16 locations throughout the project area. The survey effort undertaken for the Spotted-tailed Quoll is outlined in **Table 6-13.**

Table 6-13: Summary of survey effort for larger terrestrial mammals

Common name	Species name	EPBC Act	BC Act	Survey period limitation	Survey timing	No. survey sites	No. nights	Survey effort
Spotted-tailed Quoll	*Dasyurus maculatus*	E	V	September - February	4th-11th December 2018 22nd January - 2nd February 2019	43 ground camera trap sites 16 spotlighting sites (2 people)	57 nights of camera trapping (47 nights on west side, 10 nights on east side of study area) 32 person nights spotlighting	981 ground camera trap nights across the study area Approximately 74 person hours spotlighting

6.5.2.7 Arboreal mammals

The targeted survey for threatened arboreal mammal species focused on the Yellow-bellied Glider, Greater Glider, Squirrel Glider, Brush-tailed Phascogale and Koala. The Eastern Pygmy-possum was also targeted and is described in **Section 6.5.2.5**. Several techniques were utilised for these species in an integrated approach to maximise the chances of detection within the project area.

The trapping program targeting the Yellow-bellied Glider, Greater Glider, Squirrel Glider, and Brush-tailed Phascogale (also the Eastern Pygmy Possum) involved tree mounted Elliott B traps and remote cameras placed on the ground and on trees and flowering shrubs. Spotlighting and call playback were also utilised.

Each trapping grid consisted of 6 tree mounted traps set on brackets 3-4 m above ground along two parallel lines separated by at least 100 m. Traps were placed 50 m apart along each trap line forming a one ha trapping grid centred over the ground-based trap grid. Traps were baited with a standard bait mix of peanut butter, rolled oats and honey and rebaited when necessary. A honey-water mix was sprayed on the tree trunk above the trap each morning. Traps were left open for four nights and checked every morning within two-hours of sunrise. The tree traps were packed with materials such as leaf litter to allow any trapped animals to keep warm overnight.

Camera traps were placed in the remaining habitats away from the primary sites, with a concentrated effort near structure sites and access tracks likely to be disturbed from the project. Tree mounted cameras were placed between 1.5 and 1.7 m above the ground and bait stations were attached to the tree trunk or branch approximately 1.5 m away from the camera. Ground based cameras were set 30 cm from ground level with baits placed on stakes 1.5 m from the camera. The cameras were set on a timer to operate between 8 pm to 6 am and left operational for a minimum of 10 nights. Camera traps were the main form of mammal survey undertaken in the more remote parts of the project area such as Sheep Station Ridge where live trapping was not practicable.

Koala surveys consisted of scat searches underneath suitable food tree species (i.e. *Eucalyptus viminalis* and *Eucalyptus rubida*). A rapid assessment method was used as described in Woosnam-Merchez *et al.* (2012) whereby sites were pre-selected to sample the range of habitat types and biophysical attributes within the study area. The observers tracked to each waypoint and completed a dedicated scat search up to 5 m around the base of the nearest tree and continued searching trees radiating out from the waypoint until a minimum of 20 trees were searched at each site. Koalas were also targeted by call playback and spotlighting.

A summary of the overall survey effort is provided in **Table 6-14**.

Table 6-14: Summary of survey effort for arboreal mammals

Common name	Species name	EPBC Act	BC Act	Survey period limitation	Survey timing	No. survey sites	No. nights / people	Survey effort
Yellow-bellied Glider	*Petaurus australis*	-	V, EP	All year	4th-11th December 2018 22nd January - 2nd February 2019 2-9 Aug 2021 12-19 Aug 2021	12 trap sites (6 tree mounted Elliott B traps at each site) 10 tree mounted camera trap sites 16 call playback survey sites 16 spotlighting sites Stag watch 60 hollow-bearing trees	Each trap site operated for 4 nights (except Site 7 which was 3 nights) 57 nights of camera trapping (47 nights on west side, 10 nights on east side of Talbingo Reservoir) 16 nights of call playback 16 nights spotlighting 16 dusk stag watch events	24 tree mounted trap nights at each site (210 tree mounted Elliott trap nights) 285 tree mounted camera trap nights 16 nights of call playback Approximately 74 person hours spotlighting and a further 80 hours stag watching Stag watch of 60 hollow-bearing trees
Greater Glider	*Petauroides volans*	V	-	All year				
Squirrel Glider	*Petaurus norfolcensis*	-	V	All year				
Brush-tailed Phascogale	*Phascogale tapoatafa*	-	V	All year				
Koala	*Phascolarctos cinereus*	V	V	All year		40 Koala scat search sites 16 call playback survey sites 16 spotlighting sites	2 people conducting each Koala scat survey 32 call playback events 16 nights spotlighting	800 trees inspected for Koala scats throughout the study area (20 trees at each site). 16 nights of call playback 74 person hours spotlighting

The recommended survey effort for arboreal mammals is 24 Elliott trap nights over 3 to 4 consecutive nights per stratification unit up to 50 ha in size (plus additional effort for every additional 100 ha) (Department of Environment and Conservation, 2004). No guidelines are provided for the use of remote cameras for these species. Spotlight transects were undertaken by two observers over a total of 16 nights. Each night involved a dedicated 2-person hour search at one of the primary trap grids followed by an additional 2-3 person hours walking spotlight transects located either in proximity to the trapping grid, or selecting vehicle and walking tracks located in other part of the project area, these varied in length from 1-5 km. The total search effort equated to 74-person hours.

At minimum, two call playback sites were conducted each night (16 sites in total) and these were positioned at the trapping grid, with an additional site selected at least 2 km from the trapping grid. Each site was sampled twice over the survey period resulting in 32 survey events.

Spotlighting was supplemented with call playback for arboreal mammals such as Squirrel Glider, Yellow-bellied Glider, and Koala that respond to vocalisations.

Within the project area, there is approximately 27.3 ha of Sub-alpine Woodland (PCT 1196) identified as potential habitat for the Squirrel Glider, Yellow-bellied Glider, Greater Glider and potentially Koala. There is also approximately 32.0 ha of Southern Tableland Wet Sclerophyll Forests (PCT 300), and 13.1 ha of Upper Riverina Dry Sclerophyll Forest (PCTs 285, 302 and 999) within the Australian Alps portion of the project area that may be suitable as habitat for these species. These habitats are also likely to be suitable for the Eastern Pygmy Possum. A summary of the survey effort is provided in **Table 6-15**.

Within the Southern Tableland Dry Sclerophyll Forests habitat, four tree mounted trap sites were established, each consisting of six traps. The trap sites were operational for four nights. One trap site (24 tree trap nights) was also established within this habitat on the west side of the Talbingo Reservoir. Thirty-three cameras were stationed within the Southern Tableland Dry Sclerophyll Forest habitat type (four cameras on the west of the Talbingo Reservoir, 29 cameras to the east of the Talbingo Reservoir). The two cameras to the west of the Talbingo Reservoir were operational for 46 nights while the 25 cameras on the east of the Talbingo Reservoir were operational for 10 nights.

Within the Sub-alpine Woodland habitat, three tree mounted Elliott trap sites were established, each consisting of six type traps. The trap lines also ran through the narrow drainage lines of Upper Riverina Dry Sclerophyll Forest sampling this habitat. Two trap sites were operational for four nights while one was operational for three nights. This resulted in a total effort of 66 tree-trap nights targeting arboreal mammals in the Sub-alpine Woodland and narrow bands of Upper Riverina Dry Sclerophyll Forest habitat. Three remote cameras were stationed within the Sub-alpine Woodland habitat and one remote camera was stationed in the narrow drainage lines of Upper Riverina Dry Sclerophyll Forest and left operational for 47 nights. This resulted in 188 camera trap nights in Sub-alpine Woodland habitat and 47 camera trap nights in the narrow drainage lines of Upper Riverina Dry Sclerophyll Forest. Another Elliott trap site was established in a broader area of Upper Riverina Dry Sclerophyll Forests habitat type, consisting of six tree mounted traps. This trap site was operational for four nights. This resulted in a total effort of 24 tree trap nights targeting arboreal mammals in the Upper Riverina Dry Sclerophyll Forests habitat type.

Three tree trap sites established in the Southern Tableland Wet Sclerophyll Forests habitat type on the west side of the Talbingo Reservoir resulted in 72 trap nights. No live traps were established in the Southern Tableland Wet Sclerophyll Forests habitat type on the east side of the Talbingo Reservoir. The impracticalities of checking the traps each morning and setting traps each night in this remote area on the crest and the western slopes of Sheep Station Ridge meant that a live-trapping program could not be undertaken safely or according to animal ethics regulations. As such, remote camera traps were stationed along the project area in this area of habitat and relied on for the survey. Thirteen remote cameras were stationed within this habitat. This resulted in 517 camera trap nights in contiguous Southern Tableland Wet Sclerophyll Forests habitat type.

Table 6-15: Summary of trapping survey effort for arboreal mammals

Vegetation formation	Vegetation class / habitat type	Disturbance Area (ha)	Required survey effort	Survey completed
Dry Sclerophyll Forests (Shrub/grass sub-formation)	Upper Riverina Dry Sclerophyll Forests (PCT 285 and PCT 302)	5.54 ha	24 tree trap nights	Elliot trap lines were part of the Subalpine woodland sites 47 camera trap nights
Dry Sclerophyll Forests (Shrubby sub-formation)	Southern Tableland Dry Sclerophyll Forests (PCT 296, 729 and 999)	54.57 ha	48 trap nights	96 tree trap nights 494 camera trap nights
Wet Sclerophyll Forests (Grassy sub-formation)	Southern Tableland Wet Sclerophyll Forests (PCT 300)	31.99 ha	24 tree trap nights	72 trap nights 517 camera trap nights (3 cameras in Australian Alps and 10 within contiguous habitat in South Eastern Highlands Bioregion)
Grassy Woodlands	Subalpine Woodlands (PCT 1196)	27.24 ha	24 tree trap nights	66 trap nights 188 camera trap nights

Spotlight transects were undertaken by two observers over a total of nine nights. Each night involved a dedicated 2-person hour search at one of the primary trap grids followed by an additional 2-3 person hours walking spotlight transects located either in proximity to the trapping grid, or selecting vehicle and waking tracks located in other part of the project footprint, these varied in length from 1-5 km. The total search effort is summarised in **Table 6-16** and equated to 36-person hours. An additional 80 hours was accumulated by 5 observers conducting stag watch surveys of hollow-bearing trees in the disturbance area as part of the large forest owl nesting survey.

Three call playback sites were conducted and these were positioned at the trapping grid, with an additional two site around drainage lines in Upper Riverina Dry Sclerophyll Forests. An additional seven call playback sites were undertaken in contiguous habitat on the west side of the Talbingo Reservoir.

Due to the confirmed presence of Yellow-bellied Glider at the substation site, the position of hollow-bearing trees was marked within the project area and were searched on two separate nights, including stag watching habitat trees to determine if the species was denning in this location. An additional 16 nights of stag watching was conducted in August 2021 for all mapped hollow-bearing trees in the disturbance area.

Table 6-16: Summary of spotlighting and call playback survey effort for arboreal mammals

Vegetation formation	Vegetation class / habitat type	Disturbance area (ha)	Required survey effort	Survey completed
Dry Sclerophyll Forests (Shrub/grass sub-formation)	Upper Riverina Dry Sclerophyll Forests	5.54 ha	2 x 1 hour and 1 km up to 200 ha stratification unit on two separate nights	6-person hours over two separate nights
Wet Sclerophyll Forests (Grassy sub-formation)	Southern Tableland Wet Sclerophyll Forests	31.99 ha	2 x 1 hour and 1km up to 200 ha stratification unit on two separate nights	14-person hours over three sperate nights
Grassy Woodlands	Subalpine Woodlands	27.24 ha	2 x 1 hour and 1 km up to 200 ha stratification unit on two separate nights	16-person hours over four separate nights

Spotlight transects were undertaken by two observers over a total of nine nights. Each night involved a dedicated 2-person hour search at one of the primary trap grids followed by an additional 2-3 person hours walking spotlight transects located either in proximity to the trapping grid, or selecting vehicle and waking tracks located in other part of the project area; these varied in length from 1-5 km. The total search effort equated to 36-person hours.

At total of 20 call playback sites (12 on the east side and eight on the west side of the Talbingo Reservoir) were conducted and these were positioned at the trapping grids, with an additional site selected in between.

6.5.2.8 Micro-Bats

The target species for the threatened bat surveys was the Large Bent-winged Bat and Southern Myotis. Before the survey commenced, literature including *A bat survey in State Forests on the south-west slopes region of New South Wales with suggestions of improvements for future surveys* (Law *et al.*, 1998), and databases, were reviewed to determine the likely bat species that will be encountered during the survey.

The *'Species credit' threatened bats and their habitats NSW survey guide for the Biodiversity Assessment Method* (Office of Environment and Heritage, 2018) outlines the required survey methods and effort required for the Southern Myotis. The survey requirements include using harp traps or mist nets placed in areas of potential habitat set beside or preferably over pools of water along creeks or rivers, particularly in flat or areas of low relief if present. A roost search should be undertaken including searching any bridges, tunnels, culverts or other structures identified as potential breeding habitat for bats or signs of bats (guano etc). The survey undertaken for this BDAR used the combined approach of capture via harp traps supplemented with ultrasonic call recording with acoustic detectors (Anabat). Harp traps and acoustic recorders were set up along watercourses (i.e. Wallaces Creek) and corridors expected to be flight routes for the target species. Traps were set in the late afternoon and checked early the following morning. Any bats caught were removed in the early morning, biometric data taken and then bats placed in a cool shaded location and released at dusk. Mist nests were not used. However, a harp trap was set over Wallaces Creek to capture any Southern Myotis that may be foraging along the creek. The harp trap appropriately covered most of the creek width. Echolocation calls were sent to Greg Ford from Balance! Environmental for analysis.

The Large Bent-winged Bat is an ecosystem credit species for foraging habitat and is a species credit species where breeding habitat will be impacted. The 'Species credit' threatened bats and their habitats NSW survey guide for the Biodiversity Assessment Method (Office of Environment and Heritage, 2018) indicates that the focus of the survey should be to determine whether any breeding habitat for the Large Bent-winged Bat is present and whether it will be impacted. For the purpose of the BAM, breeding habitat is specific habitat features that are used, or presumed likely to be used, by threatened bat species as maternity sites. Breeding habitat is considered present if there is:

- Potential breeding habitat
- Breeding individuals of the target species in the project area

Potential breeding habitat for the Large Bent-winged Bat is identified as caves, tunnels, mines or other structures known or suspected to be used by the Large Bent-winged Bat including species records in the NSW BioNet Atlas with microhabitat code 'IC – in cave'; observation type code 'E nest-roost'; with numbers of individuals greater than 500; or identified from the scientific literature. Within the broader region, the Yarrangobilly Caves and perhaps the Tumut 2 Surge Shaft may be breeding habitats for the Large Bent-winged Bat, but the project will not impact these areas. The literature indicates that the area around Bago State Forest is generally lacking in caves as evidenced by the low occurrence of the Large Bent-winged Bat (see Law *et al.*, 1998). There were no rock crevices, holes or caves suitable as breeding habitat for the Large Bent-winged Bat identified within the project area during the survey. However, in the broader study area, the cliff line to the south of Mine Trail has potential for caves and was searched for roost site potential. There were no caves identified as potential breeding habitat so targeted survey of the cave was not undertaken and harp traps were not placed at the cave exit.

The surveys were undertaken within the optimal survey period for the Large Bent-winged Bat and Southern Myotis as outlined in the BAM-C and Threatened Species Profile Database. The surveys were undertaken during favourable weather conditions with hot calm conditions experienced during the survey period. The survey undertaken for these species is summarised in **Table 6-17**.

Table 6-17: Summary of survey effort for bats

Common name	Species name	EPBC Act	BC Act	Survey period limitation	Survey timing	No. survey sites	No. nights	Survey effort
Large Bent-winged Bat	*Miniopterus orianae oceanensis*	-	V	November – February	4th-11th December 2018 22nd January - 2nd February 2019	5 Anabat sites 8 harp trap sites	18 Anabat nights Harp traps set for 2 nights at each site	18 Anabat nights (approx. 215 hours of continuous recording) 16 harp trap nights
Southern Myotis	*Myotis macropus*	-	V	October – March				

6.5.2.9 Amphibians

The target species for the threatened frog surveys were the Booroolong Frog (*Litoria booroolongensis*) and the Alpine Tree Frog (*Litoria verreauxii alpina*). The survey used the combined approach of visual encounter surveys (spotlighting) and call playback techniques. However, due to the dry environmental conditions at the time of survey, a lack of suitable habitat along most of the project area, and existing data on the confirmed Booroolong Frog habitat in the Yarrangobilly River, Wallaces Creek and Sheep Station Creek from the Snowy 2.0 Exploratory Works and Main Works BDARs (EMM Consulting, 2017 and 2020a), detailed frog surveys according to accepted best practice guidelines were not undertaken.

<u>Booroolong Frog surveys for Snowy 2.0 Exploratory Works and Main Works</u>

This BDAR relies on the recent high-quality data for Booroolong Frog collected for the BDAR for the Snowy 2.0 Exploratory Works and Main Works EISs (EMM Consulting, 2017 and 2020a). This project overlaps the same habitats in the east of the study area around the Yarrangobilly River, Sheep Station Creek, Lick Hole Gully and Cave Gully. The Booroolong Frog is known from the study area being recorded in Yarrangobilly River, and so has been assumed present in this waterway and not the focus of these targeted surveys. Further to this, the survey effort for the Main Works covered the same tributaries impacted by the current project (i.e. Yarrangobilly River, Wallaces Creek and Sheep Station Creek, Lick Hoe Gully and Cave Gully) and the species polygon generated for the Main Works EIS is based on the results of comprehensive surveys and this same habitat polygon has been adopted for the current project.

According to the Snowy 2.0 Exploratory Works and Main Works EISs (EMM Consulting, 2017 and 2020a), Booroolong Frog surveys between December 2017 to January 2019 covered 'all permanent and intermittent watercourses which provided optimal to marginal habitat' within the Snowy 2.0 survey area. Habitat suitability was measured during dedicated habitat assessments and the lengths of five waterways (Yarrangobilly Creek and tributaries) were deemed suitable (totalling 8,095 m). According to EMM, the methods and survey effort 'were developed in accordance with DECC (2009) and DSEWPaC (2010) guidelines'. Nocturnal searches involved visual encounter surveys (VES), undertaken in accordance with the following;

- Surveys undertaken in temperatures of greater than 10°C, and not during rain.
- Two observers walked a 200 m transect along a stream.
- Using a spotlight and head torch, searches were completed for surrounding vegetation, rocks and other microhabitats.
- All frogs observed or heard were recorded.

- Hygiene protocols were followed to prevent the spread of chytrid fungus, with full wash down between streams.

Egg mass and tadpole sampling were undertaken in accordance with the following:

- Egg mass detected during VES listed above.
- Tadpole sampling undertaken using a dip net, with the net dragged along a transect for 1-2 minutes.
- Samples keyed out using Anstis (2013).

Based on the five streams within the survey area this will equate to five x 200 m transects repeated on four nights, equating to 4,000 m of transect survey. Overall, 19 transects within the Main Works disturbance footprint were completed, equating to 118, 080 m of transect survey. An additional three transects with 35, 692 m of transect survey were completed adjacent to the disturbance footprint. The minimum survey effort was exceeded (EMM, 2020).

Alpine Tree Frog surveys

The *Survey Guidelines for Australia's Threatened Frogs* (Department of the Environment Water Heritage and the Arts, 2010c) indicates that the optimal survey conditions for Alpine Tree Frog is following summer rains (one week after heavy rainfall – generally accepted as >50 millimetres (mm) in seven days) at the time of peak activity for the species. Rainfall in the seven days prior to and during the December 2018 survey was well below optimal for surveying for the Alpine Tree Frog. The Commonwealth survey guidelines stipulate that the survey should be a minimum of two nights under ideal conditions, repeated on at least four separate occasions during the activity period. Due to the overall dry environmental conditions, the required survey for Alpine Tree Frog could not be met and this was largely due to an absence of any aquatic habitat, soaks and wet depressions within the disturbance area during the survey periods. Additionally, the habitat within the project area was sub-optimal for this species so extensive survey effort was not planned. Despite the poor conditions, dedicated survey effort for this species was undertaken as described below and **Table 6-18**.

The targeted survey focused on the habitats to the west of the Talbingo Reservoir and were undertaken in December 2018. The survey focused on the higher altitude Subalpine Woodlands habitat and specifically 5 ephemeral drainage lines in Bago SF and alongside Elliott Way in the KNP. These streams are ephemeral and no permanent breeding habitat was present. The drainage lines were dry apart from some very small wet depressions, likely created by horse damage in the Line 64 easement, and these ranged from 1-2 square metres. A total of 50 m of each drainage line was walked on four separate nights, focusing on any wet soaks present. The chance of encountering calling frogs was considered limited. The threatened Alpine Tree Frog (*Litoria verreauxii alpina*) appears to grade into the nominate race *Litoria verreauxii* and intermediate forms occur between 1,000 m and 1,300 m in elevation. The surveys therefore focused on locating any frogs resembling *Litoria verreauxii* in the broader sense both from calls and visually.

Table 6-18: Summary of survey effort for amphibians

Common name	Species name	EPBC Act	BC Act	Survey period	Survey timing	No. survey sites	No. nights	Survey effort
Alpine Tree Frog	*Litoria verreauxii alpina*	V	E	Nov - Dec	4th-11th Dec 2018	5 ephemeral drainage lines in Bago SF visual encounter surveys (spotlighting) and call playback conducted along approximately 50 m of each habitat and repeated on 4 separate nights	4 separate nights with headtorch and spotlight by two observers (10 hours)	2 hours call playback

6.6 Survey limitations

6.6.1 General

The desktop assessment and field survey undertaken for this BDAR provide a limited view into the ecological values of the whole study area. The diversity of flora and fauna species recorded from this study should not be seen to be comprehensive. It is unlikely that every species present within the project area has been recorded. The field survey aimed to sample the project area and a comprehensive inventory of species was not made. 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 are indicative of the environmental condition of the project area 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. All surveys have been conducted in accordance with the BAM and best practice guidelines listed in **Section 6.5**.

The spring and summer 2018 / 2019 survey period occurred at a time of relatively widespread dry environmental conditions across NSW. Below average rainfall was recorded in 2018 at the Tumbarumba Post Office, Tooma (Eudlo), and Yarrangobilly Caves weather stations with 295.4 mm, 136.4 mm, and 240.8 mm below average rainfall recorded at each station respectively. As such, no attempt at a targeted orchid survey was made during this period and supplementary surveys targeted more optimum conditions.

There were also some limitations to the survey techniques able to be used on site arising from the remoteness of some of the habitats. Elliott trap sites were not established on the crest and slopes of Sheep Station Ridge as it was not practical to check the traps each morning and set the traps each night in this remote area. For work health and safety reasons and animal ethics reasons, remote camera traps were stationed along the project area in this area of habitat and relied on for the survey.

During the survey period, a hunting exclusion zone was established in the Bago State Forest around the survey area. However, the hunting exclusion zone was incorrectly mapped and did not show the full extent of our survey area as an exclusion zone. This could not be altered before the survey commenced and consequently, the distribution of Elliott Trap sites and other survey methods within the Bago State Forest were somewhat restricted. Spotlighting within the Bago State Forest was also somewhat restricted on two nights in December 2018 due to active hunting that was occurring within the study area. During the survey period, ecologists heard nearby gunshots and observed blood trails from wounded animals within the survey area while spotlighting. Consequently, the nocturnal survey work within the Bago State Forest was limited for work health and safety reasons, however the required survey effort was still achieved.

6.6.2 Vegetation survey

Many of the PCTs identified within the project area and surrounds are not currently described well in the BioNet Vegetation Classification database and have been identified with a very low classification confidence level. As such, the vegetation within the project area has been assigned to the most likely PCT as they are described in the BioNet Vegetation Classification database. PCT 300 appears to be a very broad PCT that captures a significant proportion of the vegetation in the project area. The dominance of *Eucalyptus rubida* and *Eucalyptus nortonii* in the canopy of the vegetation east of the Tumut River with a shrubby midstorey makes assignment to a PCT difficult and there is no clear matching PCT in the BioNet Vegetation Classification database. In many cases, there are no clear lines defining the transition between PCTs, so the mapping provided in this BDAR is supported by on ground floristic surveys and observations of potential ecotones. Plant communities are naturally variable and the boundaries between different PCTs on this site overlap considerably with a gradual transition from one community to another. However, a choice must be made to map and assign a PCT to an area in the study area. As mapping necessitates that a hard boundary is drawn to separate PCTs, boundaries of PCTs and vegetation zones have been mapped as best as possible based on observations made during the field survey and based on patterns observed on aerial photography. It is likely that the boundaries of PCTs and vegetation zones will change with time and in response to long-term variation in biophysical conditions in the study area such as rainfall and surface drainage patterns.

6.6.3 Post fire limitations

The severe bushfires in early January 2020 impacted a large proportion of the landscape, with the most intense burns occurring in the east of the project area near Sheep Station Ridge. The large majority of flora and fauna surveys for this project were completed in 2019 and well before the fires occurred (no surveys were interrupted by bushfire). However, the findings of a small number of remaining surveys such as targeted threatened orchid searches (late 2020) and hollow-bearing tree survey (mid 2021) may have been influenced by structural vegetation change to the landscape as a result of fire. Nonetheless, results of orchid surveys show that the fires likely encouraged germination and growth of many species (including threatened *Caladenia montana).*

Sometimes disturbance events such as fire simulate fauna breeding activity as a result of displaced prey species and better foraging opportunities in areas with open understorey or regrowth surplus of food resources. In July 2021, observations of post-fire conditions showed a full recovery of vegetation and potential foraging habitat on the west side of the study area at Maragle and Bago State Forests. While most of the large hollow-bearing trees had been affected by fire primarily in this area, the fire had not impacted on tree health or damaged tree hollows, and little evidence of fallen trees caused by fire was observed as a result of lower intensity burns. The east side of the study area (Lobs Hole Ravine) experienced high intensity burns and the recovery of vegetation and habitat has been slow to recover, in most places the ground cover had fully regenerated, and many *Eucalyptus* species had coppice regrowth. Some fallen trees with hollows, mainly *Eucalyptus nortonii* were observed in PCT999 on steep slopes. See **Photo 6-5** and **Photo 6-6** of vegetation post-fire recovery at locations heavily affected by fire. No suitable nest trees for threatened forest owls were observed in PCT999. Given that surveys of large tree hollows for fauna occurred almost 18 months post-fire, it is unlikely that utilisation of hollows by fauna during this survey was affected.

Photo 6-5: PCT729 post-fire vegetation recovery (west of Tumut River) July 2021

Photo 6-6: PCT302 post-fire vegetation recovery Yarrangobilly River July 2021

6.7 Threatened species survey results

6.7.1 Threatened plant species

One threatened plant species, *Caladenia montana*, was recorded from targeted surveys, namely *Caladenia montana*. A brief description on the result of other target species is discussed below.

6.7.1.1 Caladenia montana

Surveys for *Caladenia montana* in October 2020 identified several club spider orchid species of the genus *Caladenia* (see **Photo 6-7** and **Photo 6-8**). Samples were sent to Mark Clements at the Australian National Botanical Gardens in Canberra during the surveys. Only verbal communication has occurred with Mark Clements (personal communication 15 January 2021), who advised that the samples sent to him consisted of at least two species:

- *Caladenia orestes*, and
- *Caladenia montana/fitzgeraldii*

These species are difficult to distinguish from one another by morphology alone and both *Caladenia orestes* and *Caladenia montana* are currently not included in the *Caladenia* identification key on Plantnet. Mark Clements advised that *Caladenia montana* and *Caladenia fitzgeraldii* cannot be distinguished on morphology alone, and only DNA analysis can separate them. Due to the financial and staffing constraints, the Australian National Botanical Gardens could not service this request. Additionally, as *Caladenia orestes* has no description in PlantNet, field staff had no ability to distinguish this species. Due to these factors, a conservative approach assumes that the plants identified in the disturbance area and surrounds are all *Caladenia montana*.

Surveys identified 166 plant clusters, varying from 1 to 12 plants (clusters were recorded when plants were within one metre of one another). A species polygon was developed for *Caladenia montana* in accordance with Subsection 5.2.5 (Step 5) of the BAM, for species where area is the unit of measure. However, the BAM is not clear on how to determine what is considered “suitable habitat”. Most terrestrial orchids are constrained by the presence of a particular mycorrhizal fungi species in the soil. Therefore, the creation of a species polygon based on PCT and vegetation zone alone is inappropriate. Therefore, to develop the species polygon for *Caladenia montana*, a 30 m buffer has been placed around each point. This is consistent with the approach taken for orchid species polygon creation in the Main Works BDAR (EMM 2020a). This resulted in a species polygon that is approximately 18.6 ha, as shown in **Figure 6-8**. The biodiversity risk weighting for *Caladenia montana* is 1.5.

Photo 6-7: Caladenia montana with dark red sepals identified in the disturbance area

Photo 6-8: Caladenia montana with greenish sepals identified in the disturbance area

6.7.1.2 Other terrestrial orchids

Surveys for the candidate threatened terrestrial orchid species were undertaken in suitable habitats throughout the 2018, 2019 and 2020 survey periods and targeted *Pterostylis alpine, Pterostylis foliate, Pterostylis oreophila, Thelymitra alpicola,* and *Thelymitra atronitida.* None of these species were identified within the project area from a series of systematic targeted surveys undertaken for this BDAR.

The spring and summer 2018 / 2019 survey period occurred at a time of relatively widespread dry environmental conditions across NSW. Below average rainfall was recorded throughout the region in 2018 and many terrestrial orchid species flowered poorly in dry years. The below average rainfall in the region likely had a negative influence on the detectability of terrestrial orchids during the survey period. As such, comprehensive orchid surveys were not conducted. However, areas of broadly suitable habitat were identified based on the presence of more common congeneric orchid species. *Caladenia carnea, Caladenia alpina, Caladenia gracilis* and *Caladenia congesta* were recorded throughout PCT 1196 and PCT 300 during the November 2018 surveys, suggesting that the habitat is broadly suitable for species of *Caladenia*. Species of *Pterostylis* orchids including *Pterostylis monticola, Pterostylis longifolia, Pterostylis nutans* and *Pterostylis decurva* were found to be common throughout PCT 1196, PCT 285 and PCT 300 during this survey period. *Pterostylis alpina* and *Pterostylis foliata* were not recorded.

Thelymitra megcalyptra and *Thelymitra alpina* (common species) were frequently recorded throughout PCT 1196, PCT 300, PCT 729 and PCT 296 during November 2018. Samples were taken and confirmation of identification for these species was provided by botanists at the Royal Botanic Gardens. *Thelymitra juncifolia* (also a common species) was recorded at the edge of PCT 285 within the Line 64 easement. No evidence of threatened *Thelymitra atronitida* was observed. There is taxonomic uncertainty surrounding the plants identified as *Thelymitra atronitida* in the Bago State Forest and an expert report has been commissioned for this species (see attachment at **Appendix F**). The report by Belinda Pellow (AMBS Ecology) concludes that the Bago population of *Thelymitra atronitida* may be an incorrect identification (and may be common species *Thelymitra pauciflora*). Overall, Thelymitra atronitida is no longer predicted to occur in the project area and does not require assessment.

To address sub-optimal conditions in the 2018 surveys, further systematic surveys were targeted in the 2019 flowering period (October, November and December). These covered large areas of the project area targeting suitable habitats outlined above. Conditions were favourable for the target species for the 2019 survey, with preceding rainfall events, as determined by the presence of high numbers and a wide diversity of common orchid species in flower at the time. Common species recorded included *Chiloglottis valida, Corybas* sp., *Diuris sulphurea, Thelymitra alpina*, *Caladenia alpina, Caladenia carnea, Pterostylis nutans, Pterostylis longifolia and Pterostylis monticola.* Ecologists recorded a large number of orchid plants and over 600 locations containing orchid colonies or individual orchid plants were mapped in the project area (suggesting conditions for orchid germination were sufficient during surveys).

Flowering *Pterostylis* orchids which closely resembled the threatened species *Pterostylis alpina* were found within PCT 1196, within the project area. A sample was taken to the National Herbarium in Canberra. The herbarium identified this species to be *Pterostylis monticola* (common species). Again, *Pterostylis foliata* was not recorded.

Pterostylis oreophila and *Thelymitra alpicola* were not recorded despite targeted surveys within suitable habitats (within areas of PCT 1196 Snow Gum and PCT 285 Broad-leaved Sally). Sub-alpine watercourses (containing thickets of Mountain Tea-tree) along New Zealand Gully and various unnamed watercourses in Bago State Forest and KNP were thoroughly searched (**Figure 6-2).**

Reference sites for *Pterostylis foliata* and *Pterostylis alpina,* in Bago State Forest, were also checked, with no successful recordings (despite coinciding with flowering seasons).

The absence of these candidate threatened species from the project area (and adjacent areas), despite comprehensive survey, means each has been excluded from the impact calculations in both the South East Highlands Bioregion BAM-C and the Australian Alps Bioregion BAM-C associated with this BDAR (in accordance with paragraphs 6.4.1.17 – 6.4.1.19 (Step 3) of the BAM).

6.7.1.3 Calotis glandulosa

Calotis glandulosa was not recorded within the project area during the surveys. *Calotis glandulosa* was also not recorded during survey work undertaken for the Snowy 2.0 Exploratory Works and Main Works BDARs (EMM Consulting, 2017 and 2020a). *Calotis glandulosa* was flowering during the survey period and conspicuous suggesting that if this species were present in the area, it will have been found during surveys. There are no existing records of *Calotis glandulosa* from the Bago State Forest and the project area is located to the west of the known distribution of this species. Therefore, there is a high level of confidence that *Calotis glandulosa* does not occur in the project area.

6.7.1.4 Pomaderris cotoneaster

There is a high level of confidence that *Pomaderris cotoneaster* does not occur within the project area. *Pomaderris cotoneaster* was not recorded within the project area during the surveys undertaken for this BDAR and it was also not recorded during the survey work undertaken for the Snowy 2.0 Exploratory Works and Main Works BDARs (EMM Consulting, 2017 and 2020a). A congener, *Pomaderris velutina* which is superficially like *Pomaderris cotoneaster,* was recorded outside of the project area in the broader study area along the Yarrangobilly River with other species of *Pomaderris* including *Pomaderris aspera* and *Pomaderris angustifolia*. The habitats, particularly PCT 302 and to a lesser extent PCT 300, appear suitable for species of *Pomaderris* but *Pomaderris cotoneaster* was not recorded in the project area during the surveys.

6.7.1.5 Thesium australe

Thesium australe was not recorded within the project area during the survey period despite targeted searches in areas of potentially suitable habitat. *Thesium australe* was also not recorded during survey work undertaken for the Snowy 2.0 Exploratory Works and Main Works BDARs (EMM Consulting, 2017 and 2020a). *Thesium australe* is known to occur in the region and the population on Larry's Ridge north of Cabramurra was visited and plants found in February 2019 indicating that *Thesium australe* was detectable during the survey. Transects were walked through grassy woodlands and dry sclerophyll forests in the project area with searches undertaken in grassy areas, areas of native grassland, and in easements, particularly in areas where *Themeda triandra* (a species with which *Thesium australe* is often found in association) was dominant. The grassy canopy gaps in PCT 729 and PCT 296 and the native grassland in the easement under Line 64 and the easements off Lobs Hole Ravine Road were searched without finding *Thesium australe*.

6.7.1.6 Leucochrysum albicans var. tricolor

Leucochrysum albicans var. *tricolor* was not recorded within the project area during the survey period despite targeted searches in areas of potentially suitable habitat. *Leucochrysum albicans* var. *tricolor* was also not recorded during survey work undertaken for the Snowy 2.0 Exploratory Works and Main Works BDARs (EMM Consulting, 2017 and 2020a). Known from the highway near the Providence Portal and Adaminaby areas. Habitat association with PCT 999.

6.7.2 Threatened animal species

A consolidated list of all threatened fauna species recorded from targeted surveys is shown in **Table 6-19** and discussed further below. The Booroolong Frog was not targeted although is included in the assessment as this species assumed present based on the results of the Snowy 2.0 Main Works EIS, and confirmed within the same study area as the current assessment for the Transmission Connection.

Table 6-19: Threatened fauna species confirmed present from targeted surveys (E = endangered species; V – vulnerable species; EP = endangered population)

Species	Credit type		Status		Biodiversity risk weighting*
	Ecosystem	Species	EPBC Act	BC Act	
Litoria booroolongensis (Booroolong Frog)		√	E	E	2
Cercartetus nanus (Eastern Pygmy-possum)		√		V	2
Petaurus australis (Yellow-bellied Glider)		√		EP	2
Tyto novaehollandiae (Masked Owl)	√ *(foraging)*	√ *(breeding)*		V	2
Callocephalon fimbriatum (Gang-gang Cockatoo)	√ *(foraging)*	√ *(breeding)*		V	2
Miniopterus orianae oceanensis (Large Bent-winged Bat)	√ *(foraging)*	*breeding*		V	N/A
Stagonopleura guttata (Diamond Firetail)	√			V	N/A
Daphoenositta chrysoptera (Varied Sittella)	√			V	N/A
Petroica phoenicea (Flame Robin)	√			V	N/A
Petroica boodang (Scarlet Robin)	√			V	N/A

Artamus cyanopterus (Dusky Woodswallow)	√			V	N/A
Falsistrellus tasmaniensis (Eastern False Pipistrelle)	√			V	N/A
Saccolaimus flaviventris (Yellow-bellied Sheathtail-bat)	√			V	N/A
Scoteanax rueppellii (Greater Broad-nosed Bat)	√			V	N/A

*Applies to all species credit species. This is auto populated based on the level of biodiversity concern.

6.7.2.1 Gang-gang Cockatoo (breeding)

The survey for Gang-gang Cockatoo focused on locating potential breeding habitats. Breeding habitat for the Gang-gang Cockatoo is identified by the presence of suitable habitat (i.e. PCTs) and the presence of a nest or observations of a pair of birds on site.

Gang-gang Cockatoos were commonly observed along the length of the project area with most records made in the Australian Alps portion of the project area and in areas to the east of Lobs Hole Ravine Road in the South Eastern Highlands portion of the project area. The Gang-gang Cockatoo was regularly observed foraging in small family groups along roadsides in the alpine areas of the broader locality. Birds were commonly seen flying over the project area in pairs or family groups that suggests some habitats are preferred within the project area as breeding habitat for the Gang-gang Cockatoo. During surveys for the Snowy 2.0 Exploratory Works and Main Works BDARs (EMM Consulting, 2017 and 2020a), Gang-gang Cockatoo pairs were also observed investigating tree hollows in PCT 1196 and PCT 302.

A total of 212 potential nest/roost trees suitable for Gang-gang Cockatoo were recorded during the targeted nest tree survey in July 2021. Many of these hollow bearing trees with suitable nesting habitat were observed in PCT 300, PCT 1196 and PCT 302. Hollow tree density plots (50x100 m) were completed in PCTs on the west side of Lake Talbingo. This data determined an average of 5 hollow trees/ha in PCT300 and PCT1196 combined and 2.4 hollow trees/ha for PCT729. This demonstrates a high availability of important breeding habitat in the study area, particularly in portions of the Australian Alps bioregion throughout Bago State Forest.

While the targeted nest tree survey was undertaken outside of the breeding period, all suitable hollow trees recorded have been assumed as actual nest trees for the purposes of determining a species polygon. A 200 m buffer was applied to each hollow tree to calculate the species polygon (breeding habitat) for Gang-gang Cockatoo. No nest tree survey was completed between Lake Talbingo and the lower eastern slopes of Sheep Station Ridge. Given the high abundance of suitable hollow trees identified throughout the study area, it has been assumed that breeding habitat is likely to occur in the PCTs associated with Gang-gang Cockatoo at this location. This includes a vegetation patch comprising PCT300 which was added to the total species polygon area. The species polygon for the Gang-gang Cockatoo breeding habitat equates to around 51.03 ha and is illustrated in **Figure 6-5.**

6.7.2.2 White-bellied Sea-Eagle (breeding)

Breeding habitat for the White-bellied Sea-Eagle is indicated by live large old trees within 1 km of rivers, lakes, large dams or creeks, wetlands and coastlines that contain a large stick nest within the tree canopy. Breeding habitat for this species can also be indicated by an adult with nest material, or adults observed duetting within the breeding period. The survey for the White-bellied Sea-Eagle focused on locating potential nest sites.

The White-bellied Sea-Eagle is known to occur in the locality and has been recorded around the Tumut River, Tantangara Reservoir, and the Jounama Pondage at Talbingo. While foraging habitat is present, the White-bellied Sea-Eagle was not recorded in the project area during the surveys and no large trees containing large stick nests were located within the project area. This suggests that breeding habitat for the White-bellied Sea-Eagle is not present in the project area at the time of the assessment. These results are consistent with the results from the Snowy 2.0 Exploratory Works and Main Works BDARs (EMM Consulting, 2017 and 2020a).

6.7.2.3 Little Eagle (breeding)

Breeding habitat for the Little Eagle is indicated by live (occasionally dead) large old trees within suitable vegetation and the presence of a male and female; or female with nesting material; or an individual on a large stick nest in the top half of the tree canopy. The survey for the Little Eagle focused on locating potential nest sites.

The Little Eagle is known to occur in the locality having been recorded along the Tumut River and the Jounama Pondage at Talbingo, the McPherson's Plains area and areas within the KNP. While foraging habitat is present, the Little Eagle was not recorded in the project area during the surveys and no large trees containing large stick nests were located within the project area. This suggests that breeding habitat for the Little Eagle is not present in the project area at the time of the assessment. These results are consistent with the results from the Snowy 2.0 Exploratory Works and Main Works BDARs (EMM Consulting, 2017 and 2020a).

6.7.2.4 Square-tailed Kite (breeding)

To identify breeding habitat for the Square-tailed Kite, it is necessary to locate a Square-tailed Kite sitting on a stick nest or in attendance of a stick nest. The survey for the Square-tailed Kite focused on locating potential nest sites.

There are no records of the Square-tailed Kite near the project area and this species was not recorded during the surveys. No large trees containing large stick nests were located within the project area. This suggests that breeding habitat for the Square-tailed Kite is not present in the project area at the time of the assessment. These results are consistent with the results from the Snowy 2.0 Exploratory Works and Main Works BDARs (EMM Consulting, 2017 and 2020a).

6.7.2.5 Barking Owl (breeding)

Breeding habitat for the Barking Owl is indicated by the presence of suitable habitat (i.e. PCTs) and:

1) the presence of male and female or
2) calling to each other (duetting) or
3) find nest or
4) existing breeding habitat has been identified.

Despite the presence of seemingly suitable habitat within the South Eastern Highlands portion of the project area, the Barking Owl was not recorded during the surveys. These results are consistent with the results from the Snowy 2.0 Exploratory Works and Main Works BDARs (EMM Consulting, 2017 and 2020a) where the Barking Owl was not found despite targeted call playback surveys in areas of seemingly suitable habitat. Given the extent of recent survey for the Barking Owl around Lobs Hole Ravine Road and the failure to detect this species, it is considered unlikely to occur in the project area and breeding habitat is not present.

6.7.2.6 Powerful Owl (breeding)

Breeding habitat for the Powerful Owl is indicated by the presence of suitable habitat (i.e. PCTs) and:

1) the presence of male and female or
2) calling to each other (duetting) or
3) find nest or

4) existing breeding habitat has been identified.

Despite the presence of suitable habitat and extensive targeted survey within the project area, the Powerful Owl was not recorded during the call playback, spotlighting or stag watch surveys conducted over multiple seasons. These results are consistent with the surveys from the Snowy 2.0 Exploratory Works and Main Works BDARs (EMM Consulting, 2017 and 2020a) where the Powerful Owl was not recorded. Given the extent of survey for the Powerful Owl and the species absence, breeding habitat has not been recorded in the assessment.

Survey work undertaken in the Bago and Maragle State Forests in the late 1990s (see Kavanagh and Stanton, 1998) suggests that the Powerful Owl is present in these large areas of contiguous forest but at low density. The authors suggest that the Powerful Owl is less likely to be found in higher elevation forests with a clear preference shown for sites below 900 m asl (Kavanagh and Stanton, 1998). The results also suggested vegetation preferences for the Powerful Owl with an apparent preference for 'wet peppermint type' forests (likely equating to PCT 300) over the 'alpine gum' type forests (likely equating to PCT 1196) (Kavanagh and Stanton, 1998).

The nest tree survey and mapping identified 60 hollow bearing trees considered suitable for forest owl breeding based on the nest tree classes, this included Powerful Owl. Four trees were classed as very good, and 54 trees classed as good. Most of the suitable forest owl trees were concentrated between the quarry at Elliot's Way and the substation (in Bago and Maragle State Forests), with only six suitable trees at Lobs Hole Ravine mostly located on watercourses. No owl pellets, evidence of whitewash or other signs of animal activity was observed at any of the trees during diurnal tree mapping or stag watch surveys and the Powerful Owl was not detected during stag watch surveys in the breeding season nor during call playback and spotlighting surveys in the non-breeding season. As a result, no species polygons were generated for this species.

6.7.2.7 Masked Owl (breeding)

The presence of Masked Owl and breeding habitat was identified for the Snowy 2.0 Exploratory Works and Main Works BDARs (EMM Consulting, 2017 and 2020a) at Lobs Hole Ravine. Masked Owl was then recorded for the current project on two occasions also near Cave Gully (at Lob Hole Ravine) calling just after dusk in the January 2019 nocturnal survey. These observations were during non-breeding periods although suggest there is a resident breeding pair occupying part of the study area near the Lobs Hole Ravine.

Masked Owl was recorded calling in the hour after sunset on three separate occasions during the August 2021 stag watch survey, within the central and western end of the project, within Bago State Forest and in proximity to the proposed substation. The nest tree survey recorded and mapped 60 hollow bearing trees considered suitable as forest owl breeding habitat based on the hollow dimensions and classes. Four trees were classed as very good, and 54 trees classed as good. Most of the suitable forest owl trees were concentrated between the quarry at Elliott Way, wet to the substation, within State Forest, with only six suitable trees at Lobs Hole Ravine mostly located on watercourses, with only six suitable trees at Lobs Hole Ravine mostly located on watercourses.

No owl pellets, evidence of whitewash or other signs of animal activity was observed at any of the trees during diurnal tree mapping or stag watch surveys. A Masked Owl was heard calling on two occasions an hour after dusk, and on the road edge of Elliott Way, and the edge of the Line 64 cleared easement. On both these occasions it was believed the animal was perch hunting along a cleared forest edge and calling to mate or parent outside the study area. On the third occasion an owl was heard calling with 15 minutes of sunset from an area with high density of large hollows in the study area. A subsequent inspection of tree and stag watch survey at this location the following day and night by five ecologists did not locate the bird or a nest site, and it is considered likely that the bird was roosting at this location. Given the high density of tree hollows near the roost location, a 500-metre radius was positioned around the call site, and all mapped hollow-bearing trees in this location have been identified as candidate nest trees. This resulted in placing a 100-metre buffer around 16 candidate trees. A further two candidate nest trees were mapped on the steep western slopes of

Lake Talbingo but due to unsafe access at night, these trees were not able to be stag watched. These trees meet the habitat constraints criteria for Masked Owl and are therefore have been assumed actual nest trees for the purpose of determining species polygons. A Masked Owl species polygons has been generated with a 100m buffer around a total of 18 trees in accordance with the TBDC.

The species polygon for the Masked Owl breeding habitat is provided in **Figure 6-4**.

6.7.2.8 Pink Robin

The Pink Robin has been sporadically recorded in the locality in the past but was not recorded within the project area during the bird surveys undertaken for this BDAR. Likewise, the Pink Robin was not recorded during the surveys undertaken for the Snowy 2.0 Exploratory Works and Main Works BDARs (EMM Consulting, 2017 and 2020a). As this species has not been recorded during these two surveys, it is considered unlikely to occur in the project area.

6.7.2.9 Booroolong Frog

The Booroolong Frog is known to inhabit the Yarrangobilly River, Wallaces Creek and the lower section of Sheep Station Creek where these meet Yarrangobilly River. This is based on confirmed records reported in the Snowy 2.0 Exploratory Works and Main Works BDARs (EMM Consulting, 2017 and 2020a). The Yarrangobilly River was identified as providing optimal breeding habitat for the Booroolong Frog, with a series of cobble banks and bedrock structures along stream margins, with slow flowing water connected by larger, slow flowing pools (EMM Consulting, 2017 and 2020a). The breeding habitat in Wallaces Creek is considered to be more limited, with only small sections providing suitable breeding habitat and it is likely this area provides sub-optimal breeding habitat as well as connective and dispersal habitat (EMM Consulting, 2017 and 2020a). Sheep Station Creek is also likely to be sub-optimal as breeding habitat for the Booroolong Frog and may only be used during peak flow events, as this drainage line is dry the remainder of time.

During targeted surveys undertaken for the Snowy 2.0 Exploratory Works and Main Works BDARs (EMM Consulting, 2017 and 2020a), the Booroolong Frog was observed up to 130 m from the Yarrangobilly River during a high rainfall event that saw key breeding habitat flooded. During this period, most frogs were observed within the riparian zone (i.e. within 50 m of the River (EMM Consulting, 2017 and 2020a). Based on that information, the Yarrangobilly River and lower end of Wallaces Creek and Sheep Station Creek have been identified as Booroolong Frog breeding habitat, while areas within 50 m of this breeding habitat has been identified as potential dispersal and refuge habitat. These criteria were used to develop the species polygon for the Main Works BDAR, and this same species polygon has been adopted for the connecting Transmission Line project, given the proximity of the habitat for the current project. The species polygon for the Booroolong Frog equates to around 0.82 ha and is illustrated on **Figure 6-6**.

6.7.2.10 Alpine Tree Frog

The survey for Alpine Tree Frog was not undertaken during optimal conditions for detecting the species due to the dry environmental conditions. However, despite this, there is a general lack of suitable habitat to target surveys for the Alpine Tree Frog within the project area. The ephemeral streams within the project area including New Zealand Gully, the unnamed watercourse in the Bago State Forest, and the unnamed watercourse alongside Elliott Way in the KNP do not contain suitable breeding habitats such as pools. The drainage lines were relatively dry apart from some small turbid pools created by horse damage in the Line 64 easement. Therefore, the chance of encountering calling frogs during the survey was limited.

The higher altitude areas of PCT 1196 peak at 1,190 m asl with PCT 300 present on the eastern slope to the edge of the Australian Alps Bioregion at 1,000 m asl near the quarry along Elliott Way. The threatened Alpine Tree Frog (*Litoria verreauxii alpina*) appears to grade into the nominate race *Litoria verreauxii* and intermediate forms occur between 1,000 m and 1,300 m in elevation, so the surveys focused on finding any frogs resembling *Litoria verreauxii* in the broader sense. However, the surveys did not find any frogs resembling *Litoria verreauxii* within the project area.

The project area is at the very edge of the altitudinal range for the Alpine Tree Frog as this species is generally found in alpine and sub-alpine areas above 1,100 m asl. As the project area does not support stream habitats that contain streamside pools, or other still waterbodies suitable for the species, the Alpine Tree Frog is considered unlikely to occur.

6.7.2.11 Eastern Pygmy-possum

The Eastern Pygmy-possum was recorded during the recent surveys undertaken for the Snowy 2.0 Exploratory Works and Main Works BDARs (EMM Consulting, 2017 and 2020a) so the presence of the Eastern Pygmy-possum in the eastern portion of the project area to the east of Lobs Hole Ravine Road was known before work on this BDAR began. During the surveys for the Snowy 2.0 Exploratory Works and Main Works BDARs (EMM Consulting, 2017 and 2020a), the Eastern Pygmy-possum was found widely within PCT 296, PCT 300, PCT 302, PCT 729 and PCT 1196.

During the surveys undertaken for this BDAR, the Eastern Pygmy-possum was found in three locations east of the Talbingo Reservoir, around Lobs Hole Ravine Road and north of Wallaces Creek, found in PCT 296 and PCT 999 (**Photo 6-10**). The Eastern Pygmy-possum was also found in PCT 729 to the west of the Talbingo Reservoir caught on camera traps set in the habitats off Elliott Way (**Photo 6-9**). Areas with a dense midstorey of *Banksia canei* appeared to be the preferred habitat for the Eastern Pygmy-possum. Based on the distribution of suitable habitat within the project area, it is likely that the Eastern Pygmy-possum also occupies the slopes of Sheep Station Ridge although the remote cameras did not record this species in that area. The Eastern Pygmy-possum was not found within the Australian Alps portion of the project area during the surveys, with Bago State Forest. However, one Eastern Pygmy-possum was found on the side of the road on Bradleys Drive to the north of Elliott Way within vegetation dominated by *Eucalyptus pauciflora*. This is an interesting record for this species as records from the Bago State Forest are limited despite the number of surveys that have been undertaken on the area by State Forests (see Kavanagh and Stanton, 1998). Despite the lack of Eastern Pygmy-possum captures within PCT 1196 or PCT 300 in the Australian Alps portion of the project area, the capture of an Eastern Pygmy-possum to the west of the broader study area in the locality suggests that a low-density population of the Eastern Pygmy-possum is likely to be present within the Australian Alps portion of the project area. The species polygon for the Eastern Pygmy-possum is provided in **Figure 6-5**.

Photo 6-9: The Eastern Pygmy-possum was recorded during the survey on a camera trap

Photo 6-10: The Eastern Pygmy-possum was recorded during spotlighting

6.7.2.12 Yellow-bellied Glider population on the Bago Plateau

The *Petaurus australis* - endangered population (Yellow-bellied Glider population on the Bago Plateau) was recorded during the surveys within the Bago State Forest in the Australian Alps portion of the project area. Yellow-bellied Gliders were found within PCT 1196 and PCT 300.

The Yellow-bellied Glider population on the Bago Plateau is disjunct owing to the steep valleys and unsuitable habitat surrounding the Bago Plateau and, in addition, because of cleared agricultural land to the west and the Tumut River and Talbingo Reservoir to the east. For the purposes of the Endangered population listing, the Bago Plateau population is defined to occur above the 900 m asl elevation contour and north of a line coinciding with the southern boundary of Maragle State Forest. The western portion of the project area where the Yellow-bellied Glider was recorded during the surveys is located at the south eastern edge of this Endangered population distribution. Yellow-bellied Gliders live in small social groups (2–6 individuals) that occupy exclusive territories of 25 to 84 ha in New South Wales. As such, it is likely that the project area crosses through the territories of several social groups from the population. The species polygon for the Yellow-bellied Glider population on the Bago Plateau is provided in **Figure 6-6**.

6.7.2.13 Squirrel Glider

Despite extensive survey effort comprising live-trapping, camera trapping, spotlighting and stag watching, the Squirrel Glider was not recorded. However the common Sugar Glider (*Petaurus breviceps*) was observed on several occasions and captured on camera.

An image of a *Petaurus* sp. was captured by remote camera, feeding on the flowers of *Banksia canei* in the habitats off Lobs Hole Ravine Road. This individual was identified by Dr Damien Michael (Charles Sturt University) as a large Sugar Glider (*P. breviceps*). The Squirrel Glider also has not been recorded from extensive surveys undertaken during Exploratory Works and Main Works investigations (EMM Consulting, 2017 and 2020a) within the same habitats, although Sugar Glider was apparently captured (N. Garvey EMM, *pers comm*). Sugar Gliders were observed on three occasions within Bago State Forest during the August 2021 hollow stag watching survey. Considering these multiple observations of the similar Sugar Glider, the Squirrel Glider is recorded as absent from the project area and a species polygon is not required.

6.7.2.14 Greater Glider

Despite extensive survey effort comprising live-trapping, camera trapping, spotlighting and stag watching, the Greater Glider was not recorded within the project area during the targeted surveys between 2018 and 2021 undertaken for this BDAR. Likewise, the Greater Glider was not recorded during the surveys undertaken for the Snowy 2.0 Exploratory Works and Main Works BDARs (EMM Consulting, 2017 and 2020a) which involved extensive nocturnal survey work. The arboreal mammal fauna is dominated by Common Brushtail Possum, Yellow-bellied Glider, Sugar Glider and Eastern Pygmy-possum all of which were commonly reported. The Greater Glider is reported as absent from the project area and species polygon is not required.

Despite the absence of records from these surveys, the Greater Glider has potential to occur in the taller wetter forests (i.e. PCT 300) and sub-alpine woodland (PCT 1196) habitats. These habitats appear to provide suitable forging resources for the Greater Glider in the form of eucalypts species *Eucalyptus dalrympleana, Eucalyptus viminalis,* and *Eucalyptus robertsonii* and trees large enough to contain hollows of suitable size for the Greater Glider. As a precautionary approach, an assessment of significance under in accordance with the EPBC Act Assessment of Significance Guidelines (2013) has been undertaken and is reported in Appendix G. This species has been further assessed in **Section 10**.

6.7.2.15 Brush-tailed Phascogale

Despite extensive survey effort comprising live-trapping, camera trapping, spotlighting and stag watching, the Brush-tailed Phascogale was not recorded. Based on the surveys undertaken for the Snowy 2.0 Exploratory Works and Main Works BDARs (EMM Consulting, 2017 and 2020a) and the surveys undertaken for this BDAR, the Brush-tailed Phascogale is considered unlikely to occur in the project area. Records of the Brush-tailed Phascogale within the KNP are very scarce, and this species was not recorded during the surveys for this BDAR or for the Snowy 2.0 Exploratory Works and Main Works BDARs.

6.7.2.16 Koala (breeding)

Records of the Koala are very scarce within the locality. Isolated Koala records exist from Batlow (1940), Tumbarumba (1970), Lake Eucumbene (1962) and some spatially inaccurate records from Maragle State Forest (2004) and Talbingo (2006). The project area and locality are not recognised as a major Koala population centre. A Koala was observed crossing the Snowy Mountains Highway near Blowering Dam in 2016.

No Koalas or signs were found within the project area from the targeted survey. Surveys targeted the primary Koala food tree species for the Central and Southern Tablelands which is *Eucalyptus viminalis*. The secondary food tree species *Eucalyptus rubida* was also searched. *Eucalyptus viminalis* and *Eucalyptus rubida* are dominant tree species in the South Eastern Highlands portion of the project area (PCT 302 and PCT 729). These species are also found in PCT 300 within the South Eastern Highlands and Australian Alps portions of the project area. Potential Koala habitat therefore appears to be widespread within the project area and broader locality, and there is potential for dispersing Koalas to move through the project area and broader study area. However, the results of the survey indicate the absence of the Koala and thus breeding habitat is not present. Likewise no Koalas or scats were found during the surveys undertaken for the Snowy 2.0 Exploratory Works and Main Works BDARs (EMM Consulting, 2017 and 2020a).

6.7.2.17 Smoky Mouse

Prior to the surveys undertaken for the Snowy 2.0 Exploratory Works and Main Works BDARs (EMM Consulting, 2017 and 2020a), the Smoky Mouse was not known from the locality. During surveys for the Snowy 2.0 Exploratory Works and Main Works BDARs, the Smoky Mouse was captured in 13 locations in the higher elevation habitats above 1,100 m along Lobs Hole Ravine Road (EMM Consulting, 2017 and 2020a). The Smoky Mouse was only captured in the sub-alpine woodland habitat of PCT 1196 and was not found in the drier habitats below 1,100 m in elevation.

PCT 1196 is present in the western portion of the project area within the Bago State Forest in the Australian Alps Bioregion. This area of habitat within the project area was considered likely to be suitable for the Smoky Mouse based off the recent work undertaken for the Snowy 2.0 Exploratory Works and Main Works BDARs (see EMM Consulting, 2017 and 2020a). PCT 285 and PCT 300 may also be suitable based off the information in the EESG Threatened Biodiversity Data Collection. Despite a trapping program targeting PCT 1196, PCT 285 and PCT 300 using remote cameras and ground based Elliott traps, the Smoky Mouse was not recorded within the project area during the surveys undertaken for this BDAR. Species captured in the Elliott traps in the habitats included Bush Rat and Agile Antechinus. The camera traps recorded Bush Rat, Agile Antechinus, Brushtail Possum, Wombat, macropods, Superb Lyrebirds, and pests including deer, pigs, and cats (see Appendix D for all trapping results). Two trap sites were placed in PCT 1196 in an attempt to capture the Smoky Mouse and its absence within the trapping grids is considered to be associated with the comparatively lower condition of the habitat in this location compared to Lobs Hole Ravine and Kosciusko National Park, associated with the presence and abundance of feral horses and weeds.

6.7.2.18 Spotted-tailed Quoll

The Spotted-tailed Quoll was not recorded within the project area during the surveys undertaken for this BDAR. Likewise, the Spotted-tailed Quoll was not recorded during the surveys undertaken for the Snowy 2.0 Exploratory Works and Main Works BDARs (EMM Consulting, 2017 and 2020a).

Despite the lack of records from recent surveys, there are a number of Spotted-tailed Quoll records to the north of the project area within the Bago State Forest Brandy Marys Crown Lease area and McPhersons Plain (from 2001 to 2004). The Spotted-tailed Quoll occurs at low densities and individuals have a large home range, so it is likely that the project area lies within the home range of one or more Spotted-tailed Quolls. The habitats contain suitable habitat including potential den sites in areas with boulders, rocky outcrops, small caves (particularly the South Eastern Highlands portion), and large woody debris and hollow-bearing trees (large hollow logs and hollow-bearing trees are abundant in the Australian Alps portion).

6.7.2.19 Large Bent-winged Bat (breeding)

The Large Bent-winged Bat is an ecosystem credit species for foraging habitat and is a species credit species where breeding habitat will be impacted. Following the *'Species credit' threatened bats and their habitats NSW survey guide for the Biodiversity Assessment Method* (Office of Environment and Heritage, 2018) the focus of the survey was on finding any breeding habitat for the Large Bent-winged Bat within or adjacent to the project area.

For the purpose of the BAM, breeding habitat is specific habitat features that are used, or presumed likely to be used, by threatened bat species as maternity sites. Breeding habitat is considered present if there is:

1) potential breeding habitat, and
2) breeding individuals of the target species in the project area.

The Large Bent-winged Bat was not caught in the harp traps during the surveys. However, the Large Bent-winged Bat was recorded (definite and possible call identification) in December 2018 on the Anabats placed in PCT 1196 and PCT 729. In January 2019, the Large Bent-winged Bat was recorded (definite and possible call identification) on Anabats placed in PCT 729 and PCT 302. It is likely that the Large Bent-winged Bat forages widely throughout the habitats in the project area.

There were no caves, tunnels, mines or other structures known or suspected to be used by the Large Bent-winged Bat found within or adjacent to the project area during the surveys. The literature indicates that the area around Bago State Forest is generally lacking in caves as evidenced by the low occurrence of the Large Bent-winged Bat (see Law *et al.*, 1998). Any crevices, holes and small 'caves' found in the project area during the survey (and Photo 6-12Error! Reference source not found.) were examined for the presence of bats (i.e. urine stains, fresh guano, remains) however no evidence of bat roosting was found. As such, there were no rock crevices, holes or caves suitable as breeding habitat for the Large Bent-winged Bat identified within the project area during the survey.

In the broader study area, the cliff line to the south of Mine Trail (Photo 6-11and Photo 6-12) and Cave Gully have potential for caves and this area was examined for roost site potential. There were no caves identified as potential breeding habitat so targeted survey of the cave was not undertaken and harp traps were not placed at any cave exits.

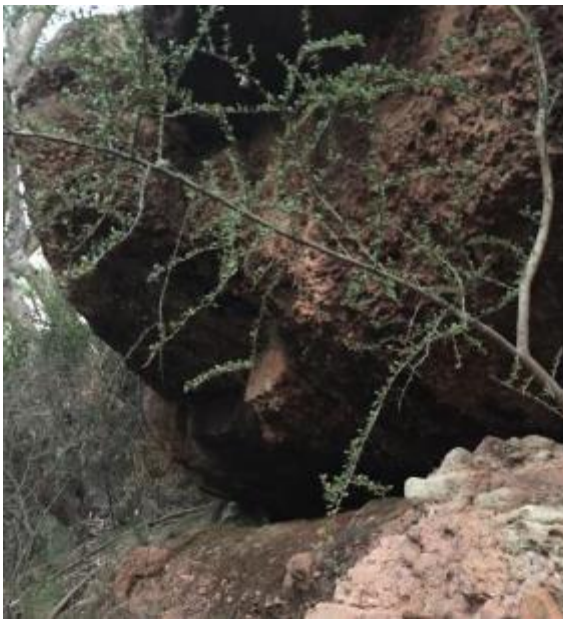


Photo 6-11: The small overhang and crevices / cave off Mine Trail were examined for evidence of bats during the survey

Photo 6-12: The small overhang and crevices / cave off Mine Trail were examined for evidence of bats during the survey

6.7.2.20 Southern Myotis

The Southern Myotis is a species credit species. Following the *'Species credit' threatened bats and their habitats NSW survey guide for the Biodiversity Assessment Method* (Office of Environment and Heritage, 2018) the focus of the survey was firstly to identify any suitable habitats (i.e. the range of PCTs associated with the species (as per the TBDC) within 200 m of any medium to large permanent creeks, rivers, lakes or other waterways (i.e. with pools/ stretches 3 m or wider). While PCT 302 is not listed as a PCT association for the Southern Myotis on the TBDC, we assumed that the habitat ay be suitable due to the habitat characteristics and records of Southern Myotis from similar habitats in the locality along the Tumut River.

There are no bridges, tunnels, culverts or other structures present in the project area that will be suitable as potential breeding habitat for the Southern Myotis. However, in the broader study area the cliff line to the south of Mine Trail has potential for caves and was examined for roost site potential including the limestone cave south of Mine Trail. There were no caves identified as potential breeding habitat so targeted survey of the cave was not undertaken and harp traps were not placed at the cave exit.

A harp trap was placed over Wallaces Creek during the survey in an attempt to capture the Southern Myotis. An Anabat was also placed on Wallaces Creek with the harp trap. The Southern Myotis was not caught in the harp traps during the surveys. Likewise, there were no calls recorded on the Anabats that may have been from the Southern Myotis. The absence of records during this survey, and the survey undertaken for the Snowy 2.0 Exploratory Works and Main Works BDARs (EMM Consulting, 2017 and 2020a), combined with general lack of Southern Myotis records from the locality indicates that this species may be unlikely to occur in the project area.

6.7.2.21 Predator Scat Analysis

Predator scats were collected on an opportunistic basis and retained for analysis to gain further evidence of threatened species presence. Whilst exact locations of scats were not recorded, the corresponding PCT was noted. Analysis was carried out by Georgeanna Story from Scats About. Results are shown below in **Table 6.20** and in **Appendix D**.

No evidence of threatened fauna species was identified within predator scats.

Table 6-20: Results of predator scat analysis

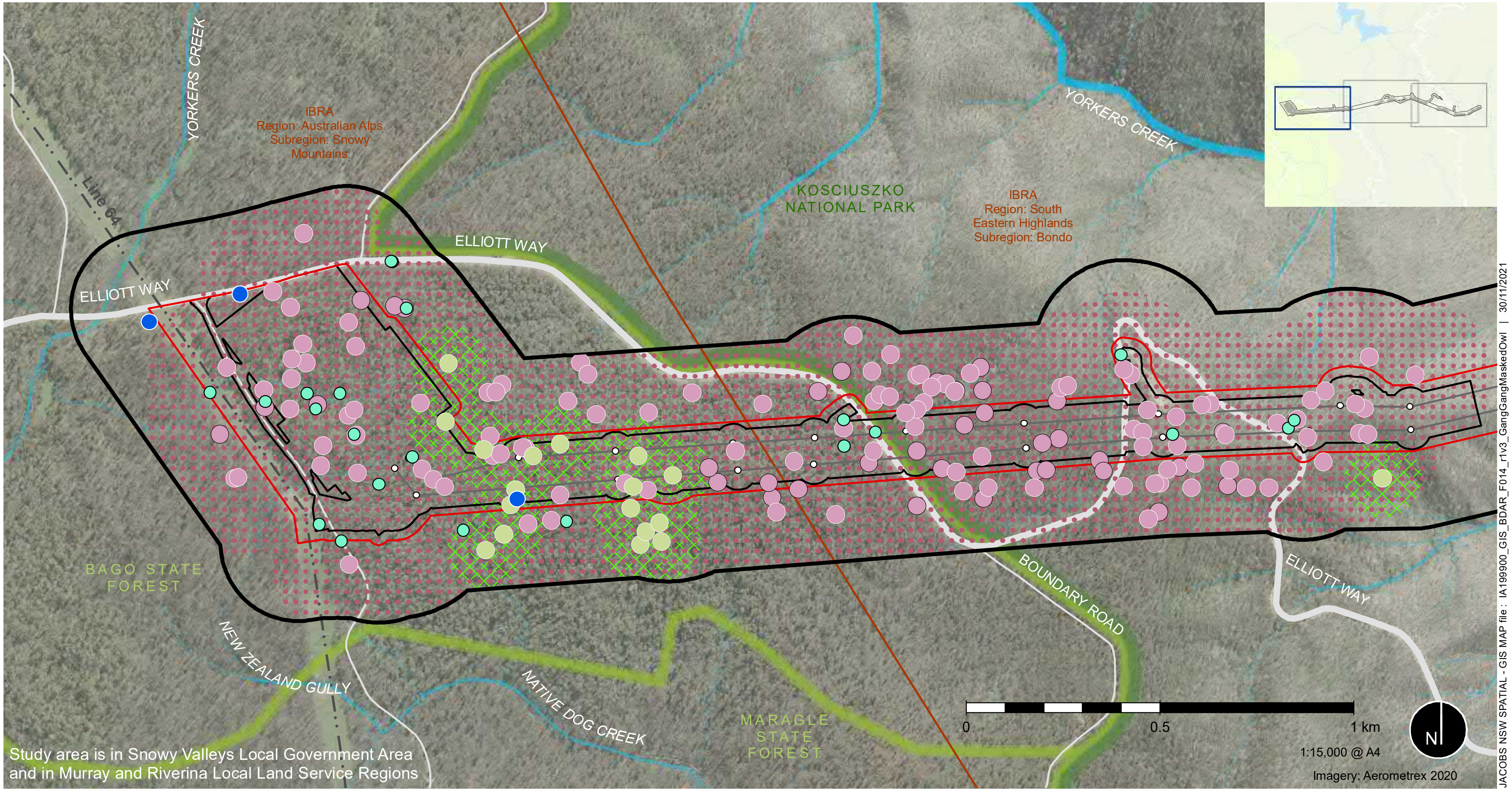
Scat No.	PCT / Vegetation formation	Species identified from the scat
Sample 1	PCT 300 Wet Sclerophyll Forests (Grassy sub-formation) Southern Tableland Wet Sclerophyll Forests	Fox scat containing Platypus and Beetle
Sample 2	PCT 300 Wet Sclerophyll Forests (Grassy sub-formation) Southern Tableland Wet Sclerophyll Forests	Dog scat containing Eastern Grey Kangaroo
Sample 3	PCT 729 Dry Sclerophyll Forests (Shrubby sub-formation) Southern Tableland Dry Sclerophyll Forests	Dog scat containing Horse and seed

6.8 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 projects. 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 project 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. 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 EESG.

Of the threatened species identified and assessed as present within the study area and project area, none are listed in the TBDC or BAM-C as being SAII entities or are considered to meet the SAII principles. On this basis, the project is unlikely to result in serious and irreversible impacts.



Project area
Disturbance area
Study area
Proposed structure
Proposed transmission line

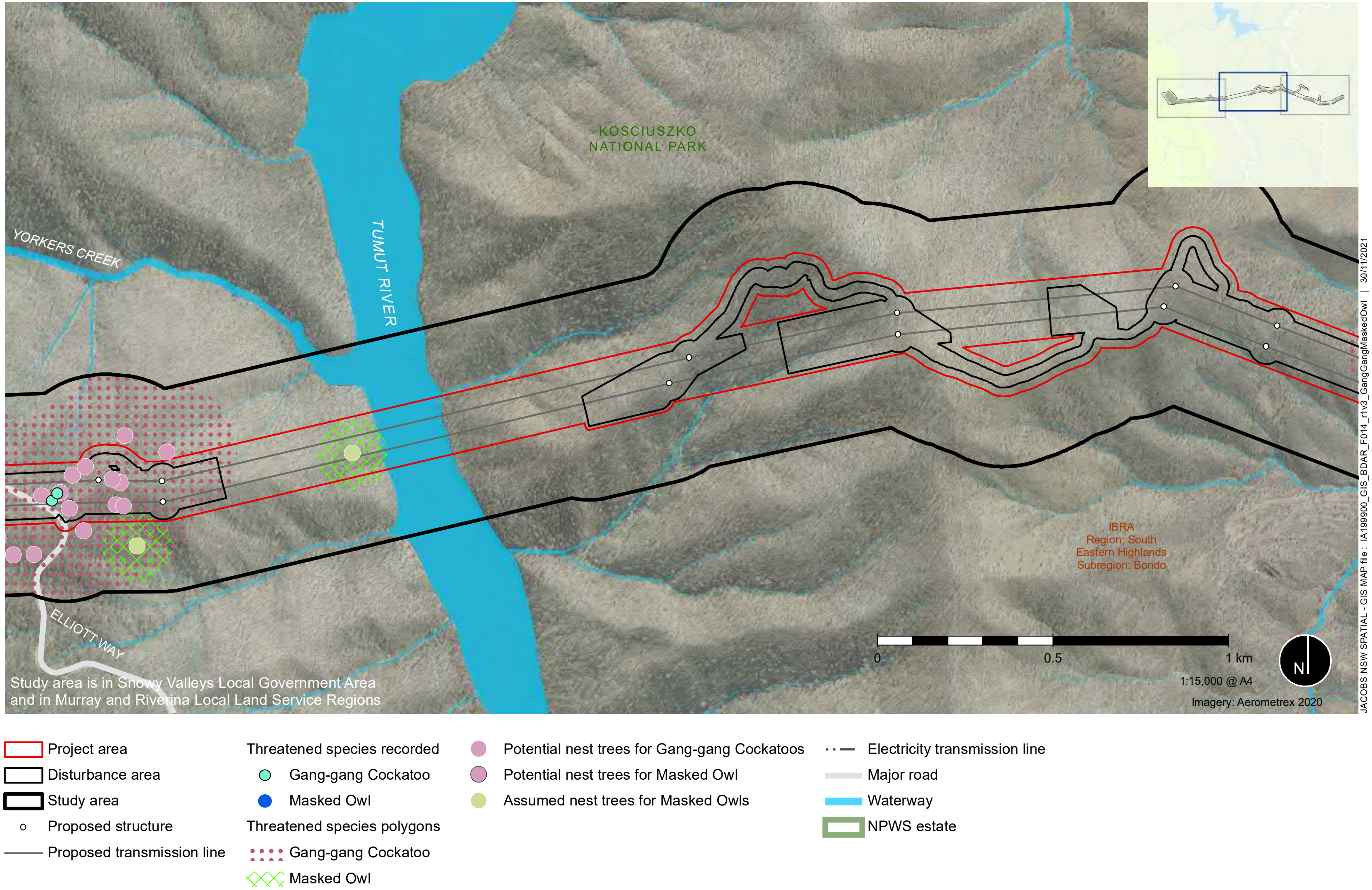
Threatened species recorded
Gang-gang Cockatoo
Masked Owl
Threatened species polygons
Gang-gang Cockatoo
Masked Owl

Potential nest trees for Gang-gang Cockatoos
Potential nest trees for Masked Owl
Assumed nest trees for Masked Owls

Electricity transmission line
Minor road
Major road
Waterway
IBRA
NPWS estate
State Forest

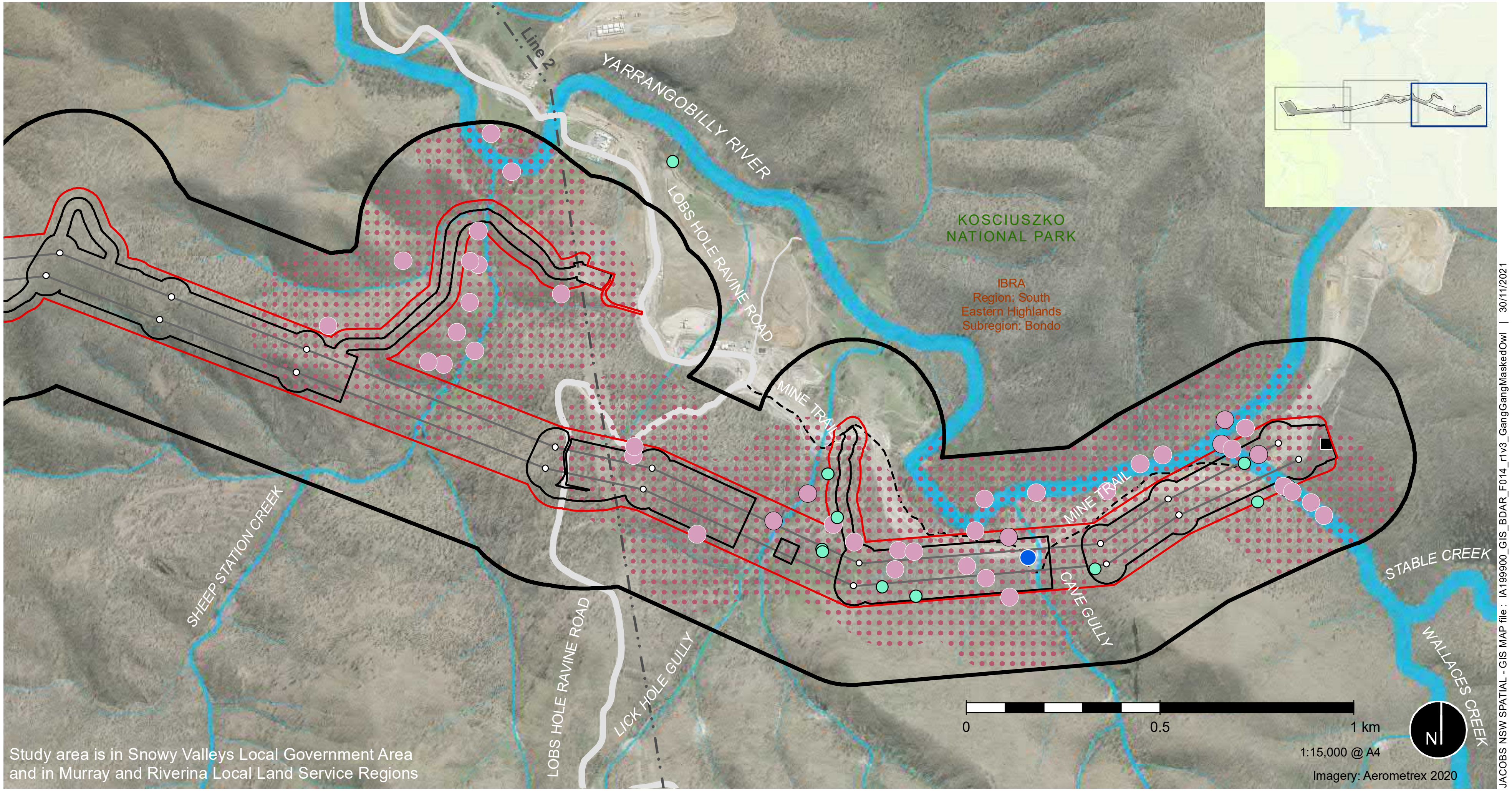
Data sources:
Jacobs 2021, TransGrid 2021, DPE 2018,

Figure 6-5 | Threatened species polygons for Gang-gang Cockatoo and Masked Owl



Data sources:
Jacobs 2021, TransGrid 2021, DPE 2018,

Figure 6-5 | Threatened species polygons for Gang-gang Cockatoo and Masked Owl



Project area
Disturbance area
Study area
Proposed structure
Proposed transmission line
Snowy 2.0 cable yard

Threatened species recorded
Gang-gang Cockatoo
Masked Owl

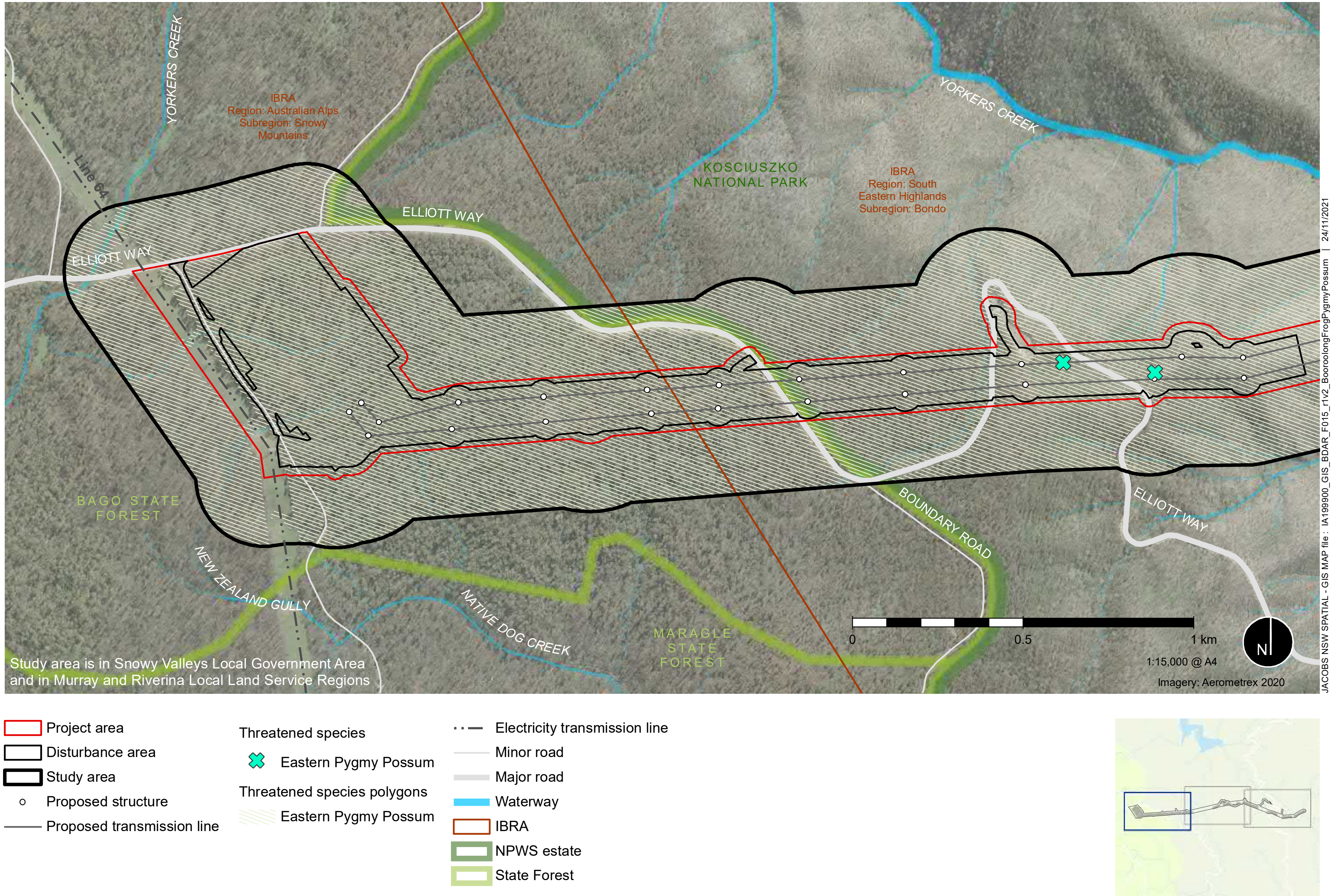
Threatened species polygons
Gang-gang Cockatoo
Masked Owl

Potential nest trees for Gang-gang Cockatoos
Potential nest trees for Masked Owl
Assumed nest trees for Masked Owls

Electricity transmission line
Minor road
Major road
Trail
Waterway
NPWS estate

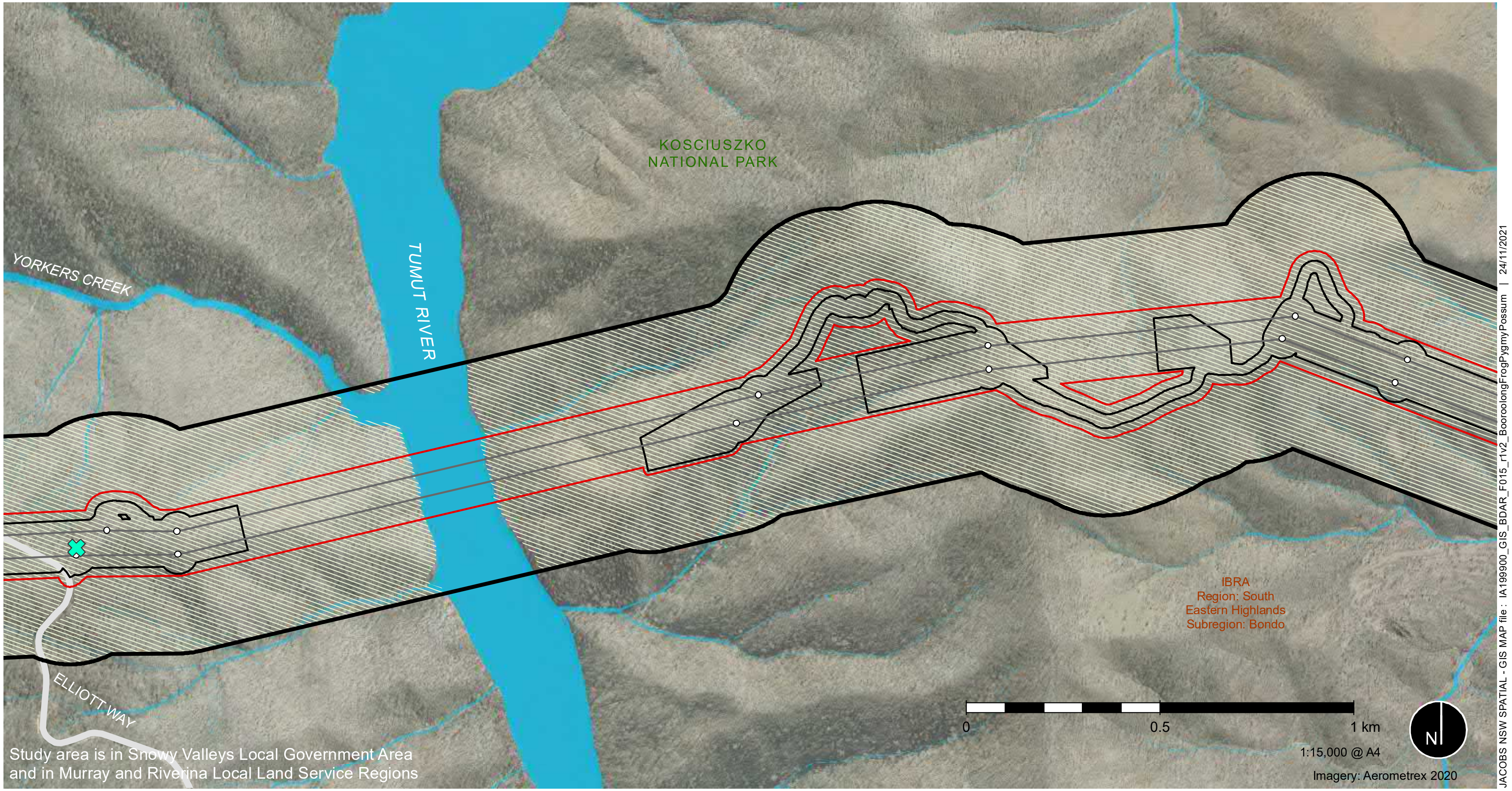
Data sources:
Jacobs 2021, TransGrid 2021, DPE 2018,
© Department Finance, Services and Innovation 2018

Figure 6-5 | Threatened species polygons for Gang-gang Cockatoo and Masked Owl



Data sources:
Jacobs 2021, TransGrid 2021, EMM Consulting 2020,
© Department Finance, Services and Innovation 2018

Figure 6-6 | Threatened species polygon for Booroolong Frog and Eastern Pygmy Possum



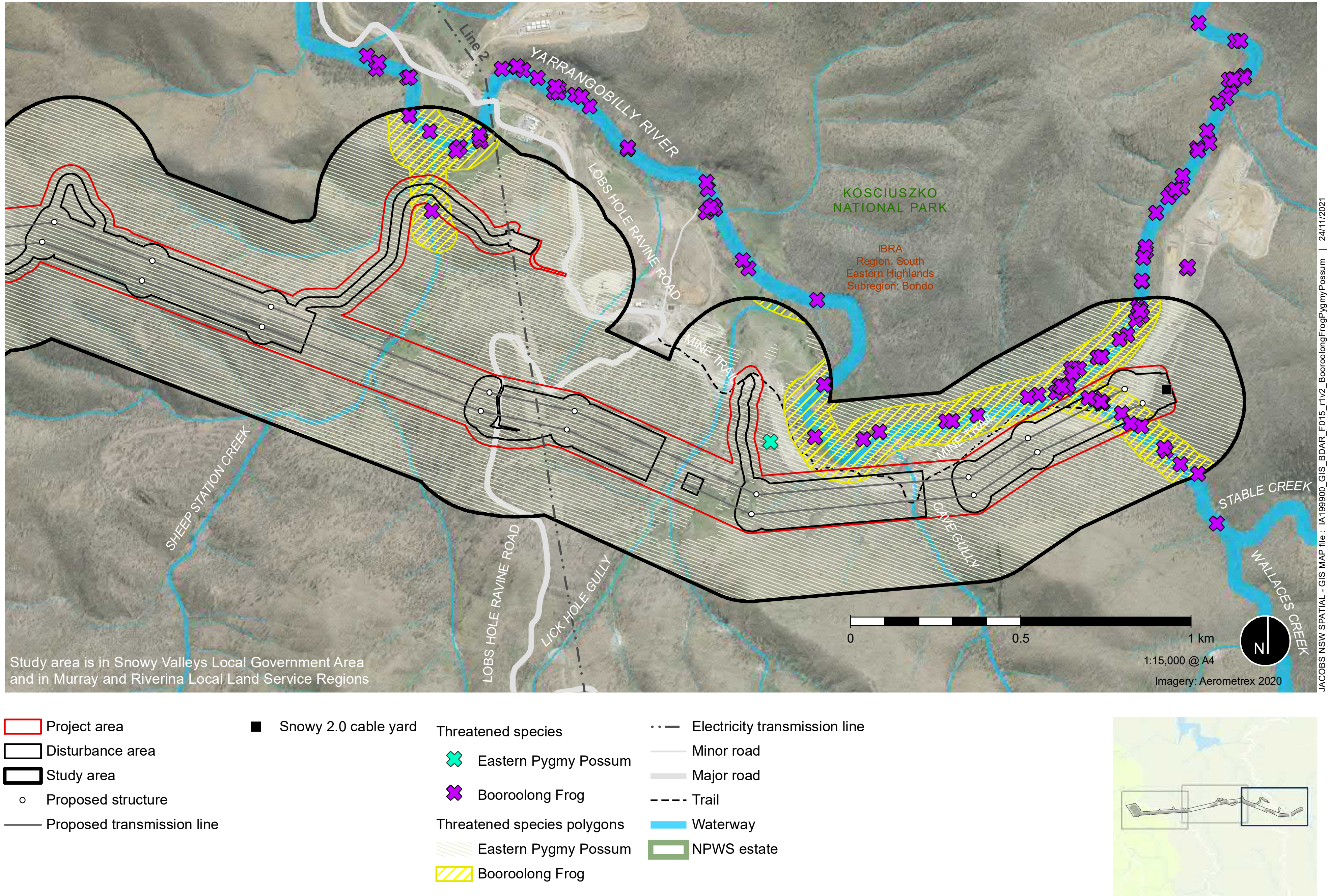
Project area
Disturbance area
Study area
Proposed structure
Proposed transmission line

Threatened species
Eastern Pygmy Possum
Threatened species polygons
Eastern Pygmy Possum

Electricity transmission line
Major road
Waterway
NPWS estate

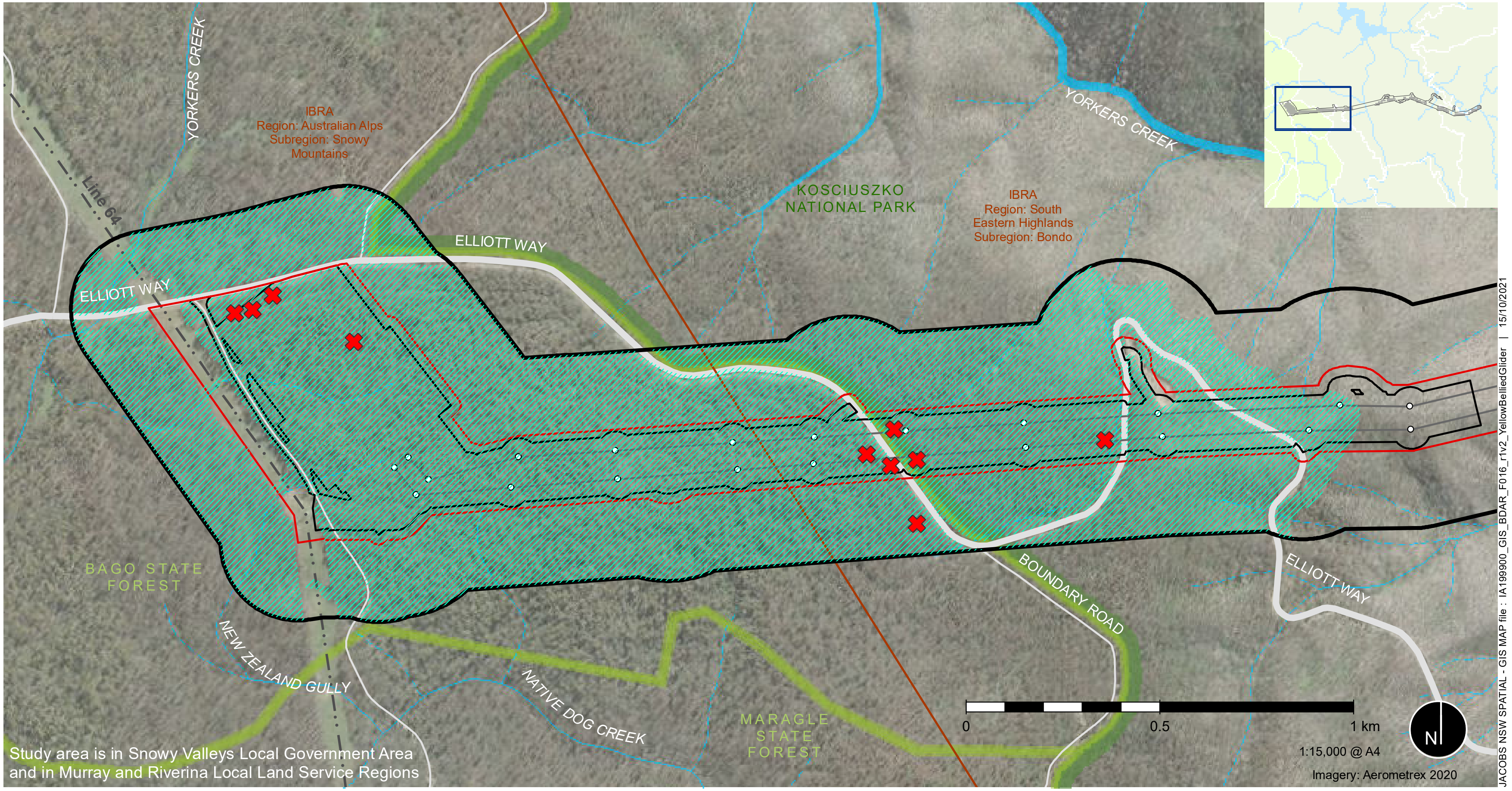
Data sources:
Jacobs 2021, TransGrid 2021, EMM Consulting 2020,
© Department Finance, Services and Innovation 2018

Figure 6-6 | Threatened species polygon for Booroolong Frog and Eastern Pygmy Possum



Data sources:
Jacobs 2021, TransGrid 2021, EMM Consulting 2020,
© Department Finance, Services and Innovation 2018

Figure 6-6 | Threatened species polygon for Booroolong Frog and Eastern Pygmy Possum



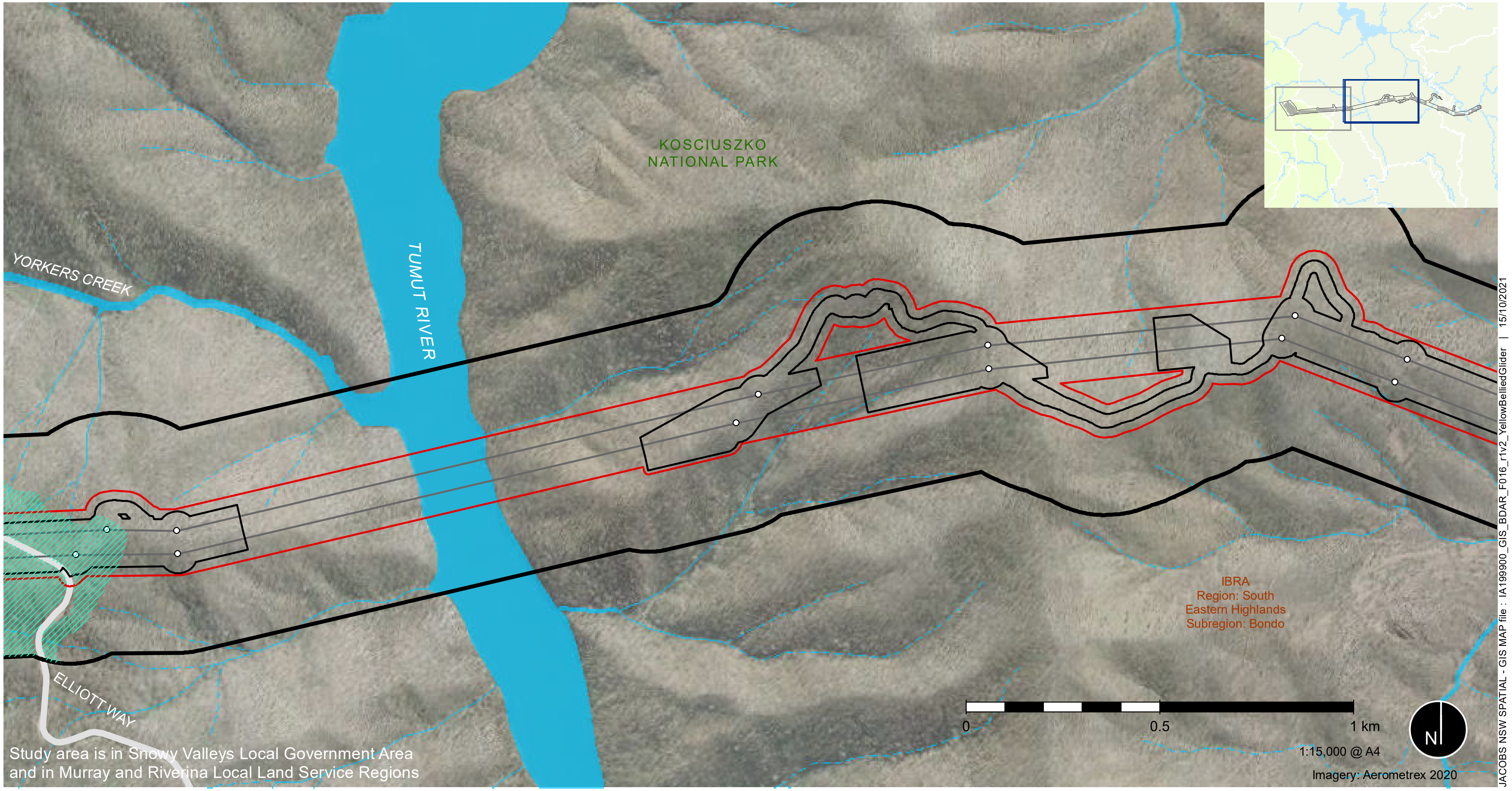
Project area
Disturbance area
Study area
Proposed structure
Proposed transmission line

Threatened species
Yellow-bellied Glider

Electricity transmission line
Minor road
Major road
Waterway
IBRA
NPWS estate
State Forest
Yellow-bellied Glider species polygon

Data sources:
Jacobs 2021, TransGrid 2021
© Department Finance, Services and Innovation 2018

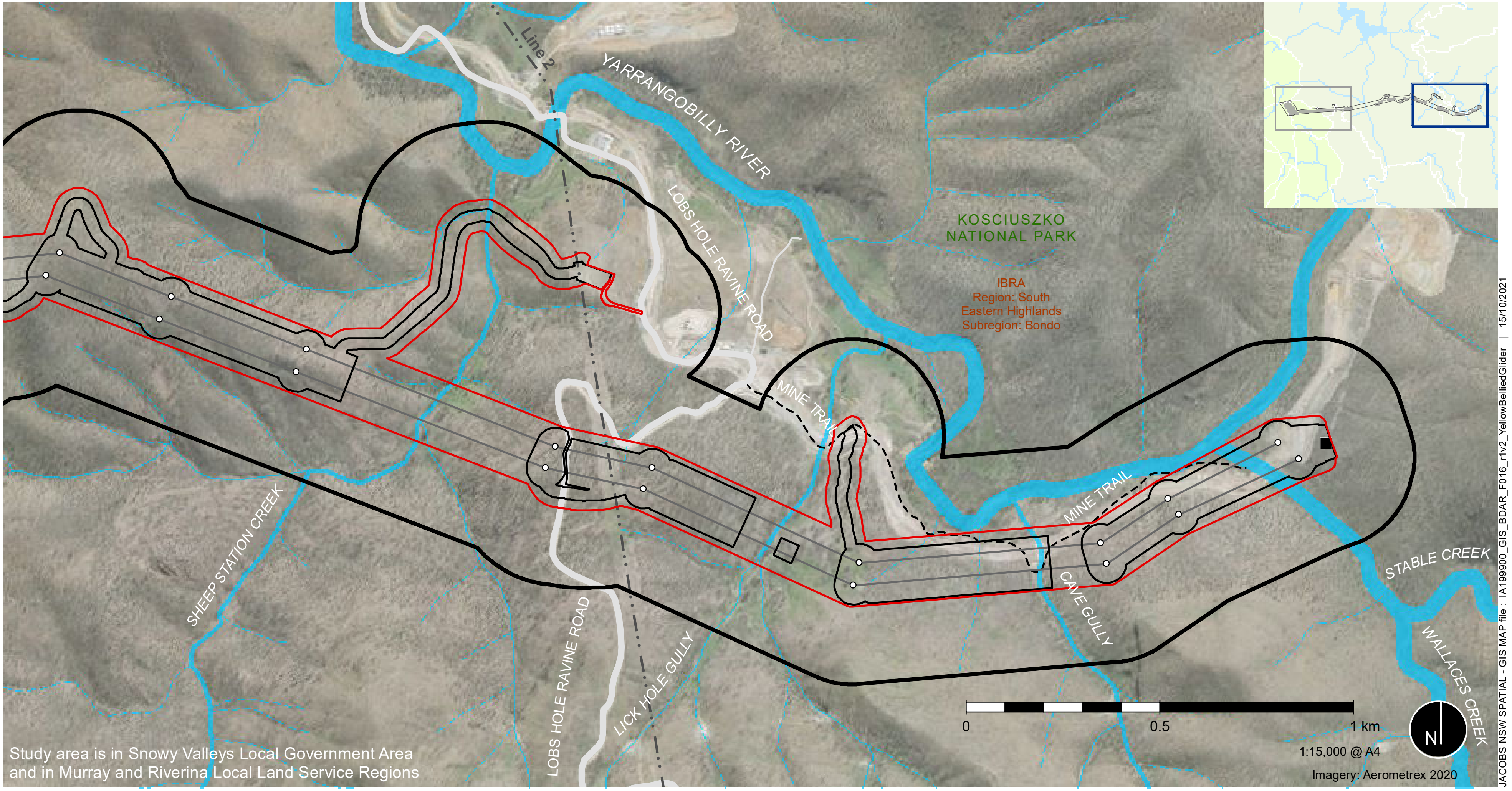
Figure 6-7 | Threatened species polygon for Yellow-bellied Glider population on the Bago Plateau



Project area
Disturbance area
Study area
Proposed structure
Proposed transmission line
Electricity transmission line
Major road
Waterway
NPWS estate
Yellow-bellied Glider species polygon

Data sources:
Jacobs 2021, TransGrid 2021
© Department Finance, Services and Innovation 2018

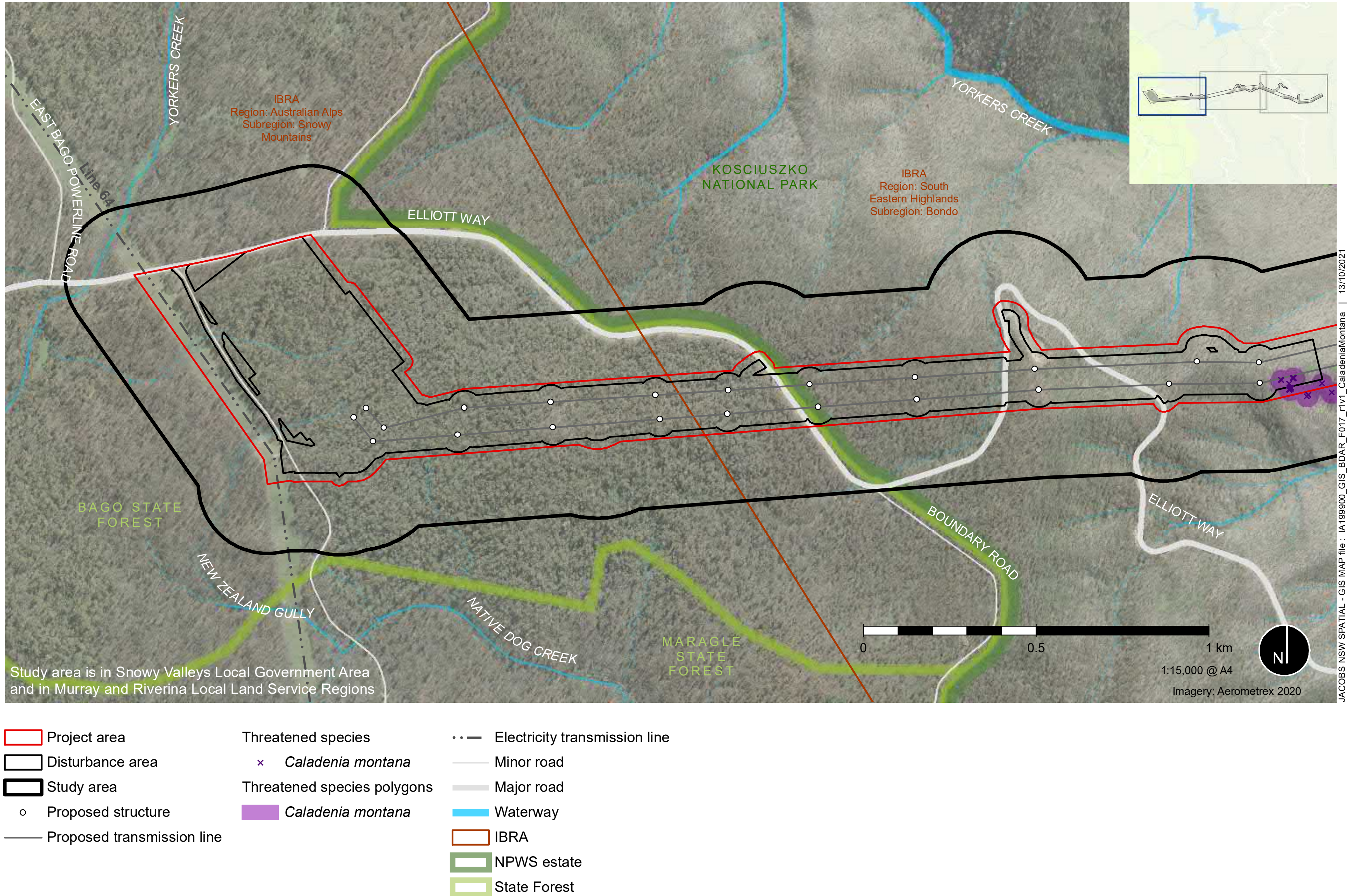
Figure 6-7 | Threatened species polygon for Yellow-bellied Glider population on the Bago Plateau



Project area
Disturbance area
Study area
Proposed structure
Proposed transmission line
Snowy 2.0 cable yard
Electricity transmission line
Minor road
Major road
Trail
Waterway
NPWS estate

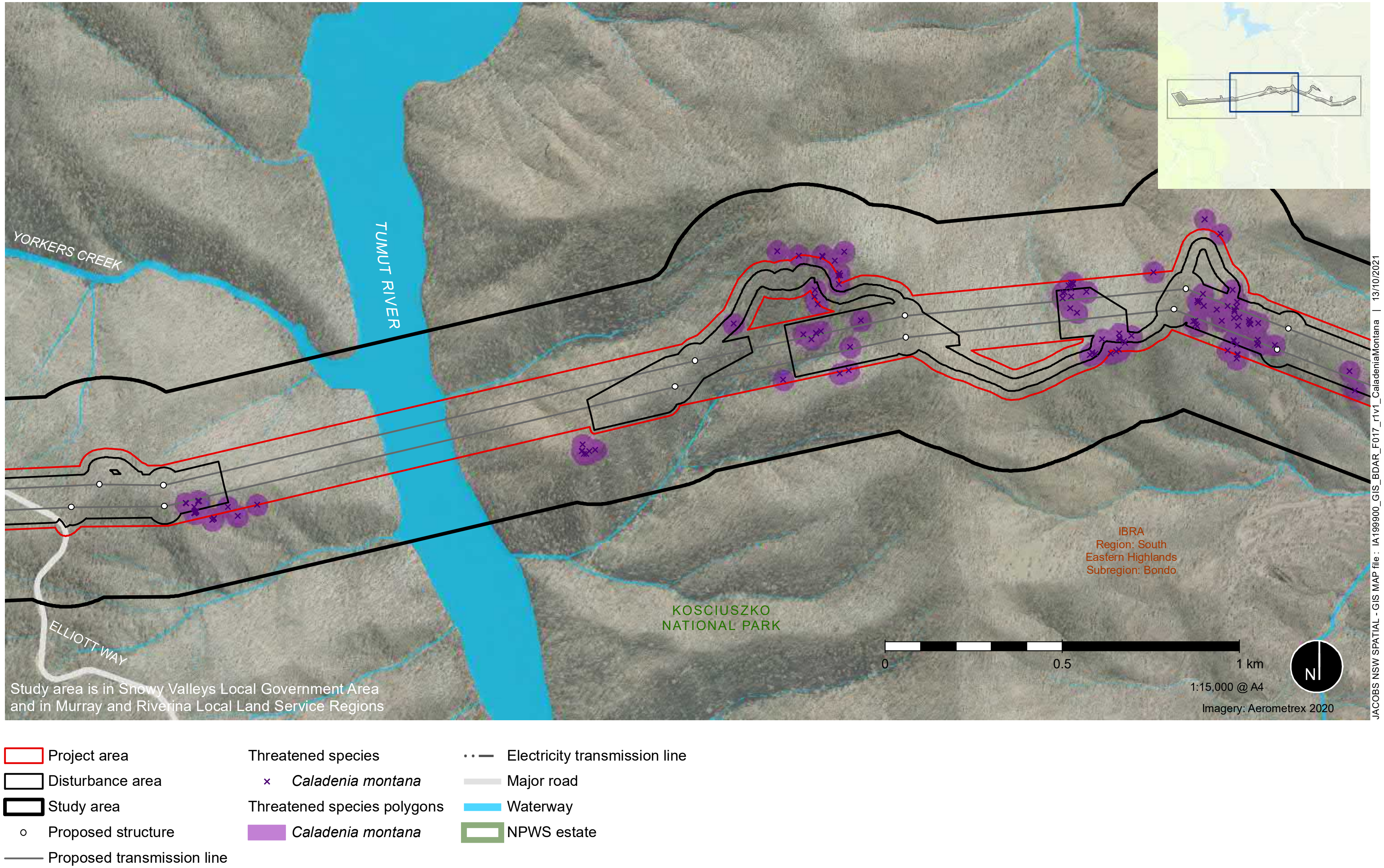
Data sources:
Jacobs 2021, TransGrid 2021
© Department Finance, Services and Innovation 2018

Figure 6-7 | Threatened species polygon for Yellow-bellied Glider population on the Bago Plateau



Data sources:
Jacobs 2021, TransGrid 2021, DPE 2018,
© Department Finance, Services and Innovation 2018

Figure 6-8 | Threatened species polygon for *Caladenia montana*



Data sources:
Jacobs 2021, TransGrid 2021, DPE 2018,
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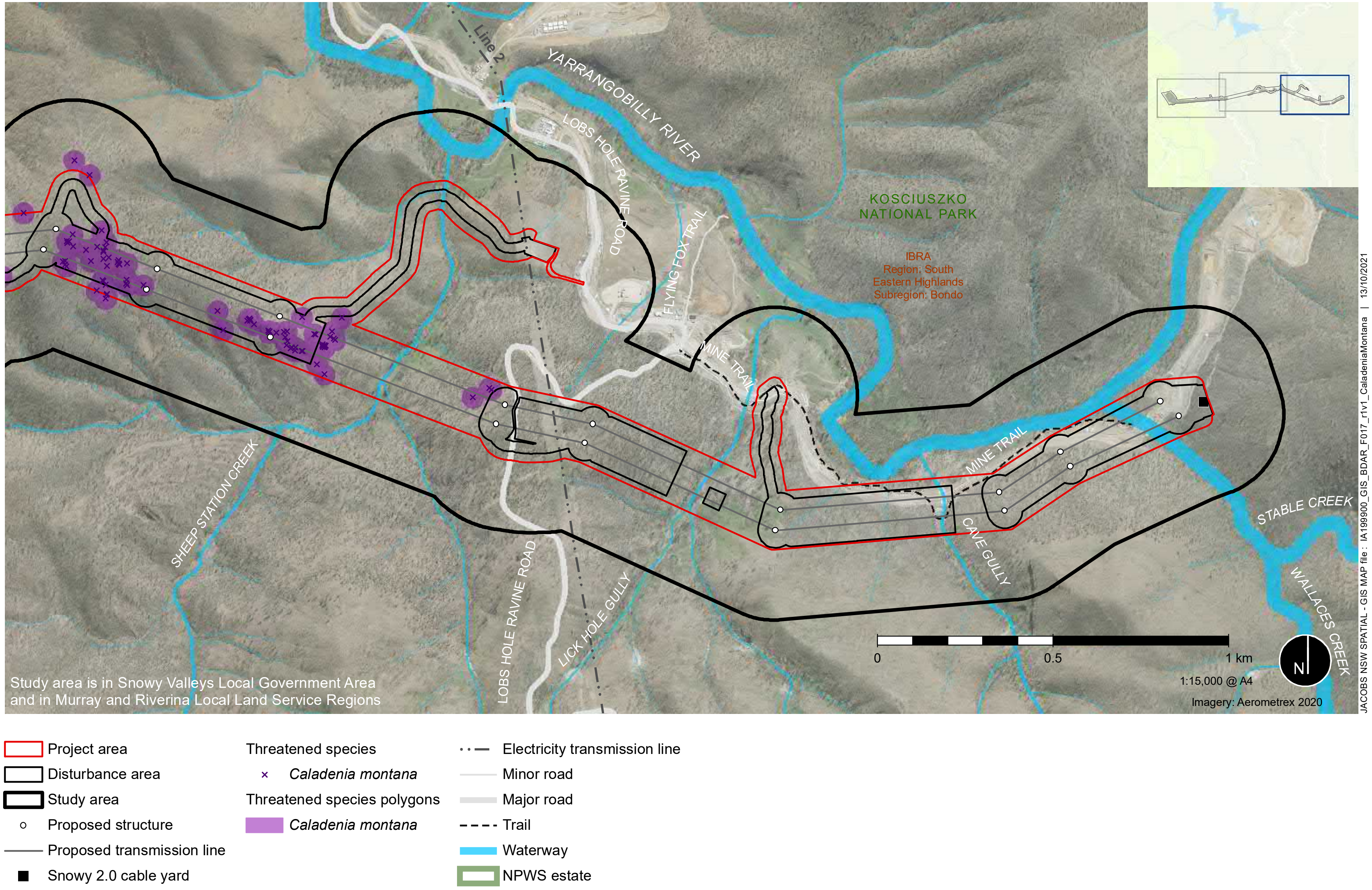
Figure 6-8 | Threatened species polygon for *Caladenia montana*



Data sources:
Jacobs 2021, TransGrid 2021, DPE 2018,
© Department Finance, Services and Innovation 2018

Figure 6-8 | Threatened species polygon for *Caladenia montana*

7. Aquatic assessment

The project area is located within the Murrumbidgee catchment. The western portion of the project area in the Australian Alps Bioregion contains the second order streams of Yorkers Creek, Native Dog Gully and New Zealand Gully that are fed by smaller ephemeral first order streams (SIX maps). 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 substation site, 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 new structures will 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 will 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 both 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 area crosses more first and second order streams and the larger fifth order stream of Wallaces Creek that flows north into the Yarrangobilly River.

Aquatic habitats within the project area and broader study area were assessed against the DPI's *Policy and Guidelines for Fish Habitat Conservation and Management* (NSW Department of Primary Industries, 2013) and *Why Do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings* (Fairfull and Witheridge, 2003). Sensitive receiving environments were identified based on proximity to the following considerations:

- The presence of Key Fish Habitat (NSW DPI, 2013)
- Waterway classification (Fairfull and Witheridge, 2003)
- Habitat for threatened aquatic species listed under the FM Act and EPBC Act.

Searches of databases, existing mapping and other literature was used to identify the locations of these sensitive receptors. Sources included:

- Fisheries Spatial Data Portal
- Protected Matters Search Tool
- Snowy 2.0 Exploratory Works Aquatic Ecology Assessment (Cardno, 2018).

Twenty-nine waterways or unnamed drainage lines are crossed by the project area (i.e. not all will be directly impacted). Six of these waterways are stream order three or greater. Wallaces Creek, Tumut River and Yarrangobilly River are major waterways. These waterways have also been mapped as Key Fish Habitat including:

- Tumut River (and Talbingo Reservoir) – 6th order
- Sheep Station Creek – 3rd order
- Lick Hole Gully – 3rd order
- Cave Gully – 3rd order
- Yarrangobilly River – 7th order
- Wallaces Creek – 6th order.

Eighteen generally unnamed gullies/drainage lines also occur within the study area, these gullies are first order, ephemeral and most have little to no channel definition. Site inspections were not undertaken at the majority of these locations, as they are not considered key fish habitat and are ephemeral streams only likely to contain water for brief periods following high rainfall events. Yarrangobilly River is included in this assessment as it occurs close to the project area at the eastern edge and several tributaries that may be impacted by the project drain to it. 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 of aquatic habitats in the broader study area is provided in **Figure 8-1**. The aquatic habitat assessment is provided below.

7.1 Aquatic habitat assessment

An assessment of the habitat within each of the named waterways and a selection of representative unnamed waterways located in the project area is provided. All waterways mapped are displayed in **Figure 7-1.**

7.1.1 New Zealand Gully

New Zealand gully is an ephemeral first order stream which drains to Native Dog Creek in the southwestern edge of the study area (see **Figure 7-1**). New Zealand Gully is densely overgrown with minimal channel definition (**Photo 7-1** and **Photo 7-2**). The gully appears to be absent of surface water flows for a significant period. The stream is not mapped as key fish habitat and threatened fish are not predicted to occur. New Zealand Gully is not considered key fish habitat and has not been identified as a sensitive receiving environment.

Photo 7-1: New Zealand Gully showing dense vegetation cover and lack of water

Photo 7-2: New Zealand Gully showing dense vegetation cover and lack of water

7.1.2 Unnamed tributary of Yorkers Creek

The tributary of Yorkers Creek is a moderately disturbed first order tributary of the Tumut River which flows adjacent to the project (see **Figure 7-1**). Access by hooved animals (horses, pigs) have created bank erosion and affected water quality at this site (**Photo 7-3** and **Photo 7-4**). The creek contains unstable mud substrate and aquatic habitat including refuge pools and large instream woody snags. The creek is mapped as key fish habitat. Threatened fish are not predicted to occur, however Murray Crayfish are likely to be present downstream approximately 4 km in the Tumut River. Yorkers Creek is assessed as Type 3 moderately sensitive key fish habitat due to the variety of habitat present. With respect to fish passage, the creek is identified as Class 3, minimal key fish habitat. Yorkers Creek has not been identified as a sensitive receiving environment.

Photo 7-3: The unnamed tributary of Yorkers Creek and Yorkers Creek showing horse damage

Photo 7-4: The unnamed tributary of Yorkers Creek and Yorkers Creek showing horse damage

7.1.3 Talbingo Reservoir and Tumut River

Talbingo Reservoir (**Photo 7-5**) is a large waterbody which connects Tumut River and Yarrangobilly River approximately 2.5 km downstream of the project (see **Figure 7-1**). A variety of aquatic habitat was present including gravel beds, undercut banks, aquatic macrophytes and overhanging vegetation. Two threatened fish are predicted to occur in the Talbingo Reservoir including Murray Crayfish and Macquarie Perch. Threatened Trout Cod have also been stocked in the reservoir as recently as 2016 (Cardno, 2018). Talbingo reservoir has been assessed as Type 1, highly sensitive key fish habitat due to the likelihood of containing threatened fish. With respect to fish passage, the reservoir has been classified Class 1, major key fish habitat. The Talbingo Reservoir has been identified as a sensitive receiving environment.

Tumut River is a permanently flowing, sixth order stream which drains to Talbingo reservoir. The waterway contains fish habitat including dense overhanging vegetation, instream riffles and undercut banks (**Photo 7-6**). The river is mapped as key fish habitat. Murray Crayfish are predicted to occur within this section of the Tumut River. Tumut River is assessed as Type 1, highly sensitive key fish habitat due to the likelihood of containing threatened fish. With respect to fish passage, it is classified Class 1, major key fish habitat. Tumut River has been identified as a sensitive receiving environment.

Photo 7-5: Talbingo Reservoir upstream of the project area

Photo 7-6: Tumut River upstream of the project area

7.1.4 Sheep Station Creek

Sheep Station Creek is an ephemeral third order stream which flows under a section of the project area not directly impacted, then under a proposed access track and drains to the Yarrangobilly River (see **Figure 7-1**). Sheep Station Creek was dry during site inspections (**Photo 7-7** and **Photo 7-8**), however when flowing, the aquatic habitat includes gravel beds and undercut banks. The creek is mapped as key fish habitat. Threatened fish are likely to occur in the Yarrangobilly River which is located approximately 100 m downstream. Threatened species include Murray Crayfish and Macquarie Perch. Sheep Station Creek is assessed as Type 3, minimally sensitive key fish habitat. While it contains important habitat characteristics such as instream gravel beds and is connected to nearby threatened fish distributions, it is ephemeral. With respect to fish passage, the creek has been assessed as Class 3, minimal key fish habitat due to its ephemeral nature and sporadic refuge. Sheep Station Creek has been identified as a sensitive receiving environment.

Photo 7-7: Sheep Station Creek within the project area

Photo 7-8: Sheep Station Creek within the project area

7.1.5 Lick Hole Gully

Lick Hole Gully **(Photo 7-9**) is an ephemeral third order tributary of Yarrangobilly River which flows under the project area and is parallel to a proposed access track (see **Figure 7-1**). The tributary is mapped as key fish habitat. Threatened fish are not predicted to occur however, Macquarie Perch are predicted to occur approximately 450 m downstream in the Yarrangobilly River. In the absence of field surveys and visible fish habitat (**Photo 7-9**), the tributary is assessed as Type 3, minimal key fish habitat. With respect to fish passage, the tributary is considered Class 3, minimally sensitive key fish habitat. Lick Hole Gully is not considered a sensitive receiving environment.

Photo 7-9: Lick Hole Gully showing the dense vegetation cover and crossing of Mine Trail

Photo 7-10: Lick Hole Gully waterway contained minor fish habitat features

7.1.6 Cave Gully

Cave Gully is an ephemeral third order tributary of the Yarrangobilly River which flows under a portion of the disturbance area near Mine Trail (see **Figure 7-1**). It was dry at the time of inspection (**Photo 7-11** and **Photo 7-12**). When the tributary is flowing, aquatic habitat including gravel beds and undercut banks are present. The tributary is mapped as key fish habitat. Threatened fish are not predicted to occur in the creek however, Macquarie Perch are predicted to occur approximately 100 m downstream in the Yarrangobilly River. Cave Gully is assessed as Type 3, minimally sensitive key fish habitat due to apparently ephemeral flow and absence of aquatic macrophytes in the study area inspected. With respect to fish passage, the tributary is considered Class 3, minimally sensitive key fish habitat. Cave Gully is not considered a sensitive receiving environment.

Photo 7-11: Cave Gully showing the densely vegetated area south of Mine Trail and cleared area north of Mine Trail

Photo 7-12: Cave Gully showing the densely vegetated area south of Mine Trail and cleared area north of Mine Trail

7.1.7 Yarrangobilly River

Yarrangobilly River is a permanently flowing sixth order stream that runs parallel to the northern boundary of the project in Lobs Hole (see **Figure 7-1**). The Yarrangobilly River has a number of tributaries that occur within the project area including Lick Hole Gully, Cave Gully, Wallaces Creek and Sheep Station Creek. A variety of aquatic habitat was present including woody debris, gravel beds, riffle-pool sequences, and overhanging vegetation (**Photo 7-13** and **Photo 7-14**). Macquarie Perch are predicated to occur within this section of the river. The waterway is also mapped as key fish habitat. Vulnerable Murray Crayfish have also been observed in Yarrangobilly River during field assessments (Cardno, 2018). Yarrangobilly River has been assessed as Type 1, highly sensitive key fish habitat (DPI, 2013). With respect to fish passage, it is identified as Class 1, major key habitat. Yarrangobilly River has been identified as a sensitive receiving environment.

Photo 7-13: Yarrangobilly River showing a pool and riffle sequence

Photo 7-14: Yarrangobilly River showing a pool and riffle sequence

7.1.8 Wallaces Creek

Wallaces Creek is a sixth order tributary of the Yarrangobilly River that flows under the most eastern end of the project area near the Snowy 2.0 cable yard (see **Figure 7-1**). A variety of aquatic habitat was present including gravel beds, rocks greater than 500 mm in size, woody debris, instream macrophytes and overhanging vegetation (**Photo 7-15** and **Photo 7-16**). Wallaces Creek is mapped as key fish habitat and is within 500 m of predicted threatened fish occurrence - Macquarie Perch. Additionally, vulnerable Murray Crayfish have been observed in Wallaces Creek during field assessments (Cardno, 2018). The waterway has been assessed as Type 1, highly sensitive key fish habitat with respect to fish passage. Wallaces Creek has been identified as Class 1, major key fish habitat. Wallaces Creek is considered a sensitive receiving environment.

Photo 7-15: Wallaces Creek within the project area showing in stream boulders and woody debris

Photo 7-16: Wallaces Creek within the project area showing in stream boulders and woody debris

7.1.9 Unnamed creek lines on Sheep Station Ridge

There are a number of mapped first and second order steep creek lines that occur across the remainder of the project area (see **Figure 7-1**). These are highly ephemeral rocky drainage gullies on steep slopes (**Photo 7-17** and **Photo 7-18**) that do not hold water for long periods of time. These creeks are mostly located on Sheep Station Ridge and consist of small and shallow rocky pools that likely fill after rain and dry out quickly (**Photo 7-17**). The creeks are not mapped as key fish habitat. Threatened fish are likely to occur in the Tumut River which is located approximately 500 m downstream from the project area on Sheep Station Ridge. Threatened species known to occur in the Tumut River include Murray Crayfish and Trout Cod. These unnamed creeks are assessed as Type 3, minimally sensitive key fish habitat. While they contain important habitat characteristics such as instream gravel beds and is connected to nearby threatened fish distributions, they are highly ephemeral. With respect to fish passage, the creek has been assessed as Class 4, unlikely key fish habitat due to the it's steep and ephemeral nature and sporadic refuge. These creeks have been identified as sensitive receiving environments due to their connectivity to the Tumut River.

Photo 7-17: Unnamed second order creek on Sheep Station Ridge that flows into the Tumut River

Photo 7-18: Steep terrain on which these unnamed creeks are located

7.2 Threatened fish

The Aquatic Ecology Assessments prepared for the Snowy 2.0 Main Works (Cardno, 2018; 2019) indicate that the dominant fish species in the Yarrangobilly River and Wallaces Creek are the non-native Brown Trout, Rainbow Trout and Red Fin Perch. Juvenile Galaxias sp. were caught in the Yarrangobilly River. The Murray Crayfish (*Euastacus armatus*), a threatened species listed under the FM Act, was caught in the Yarrangobilly River and Wallaces Creek. Gambusia and Goldfish were also caught (Cardno, 2018).

This assessment has relied on the data from the recent surveys and assessment undertaken for Snowy 2.0 Exploratory Works (Cardno, 2018, 2019). No targeted fish surveys have been undertaken. The desktop searches, including a review of work undertaken for the Snowy 2.0 Exploratory Works Aquatic Ecology Assessment (Cardno, 2018) identified the following threatened fish species that have been recorded by previous surveys and are known to occur in the Tumut River / Talbingo Reservoir (or have been previously stocked) and Yarrangobilly River:

- Macquarie Perch (*Macquaria australasica*)
- Silver Perch (*Bidyanus bidyanus*)
- Trout Cod (*Maccullochella macquariensis*)
- Murray Cod (*Maccullochella peelii*)
- Murray Crayfish (*Euastacus armatus*).

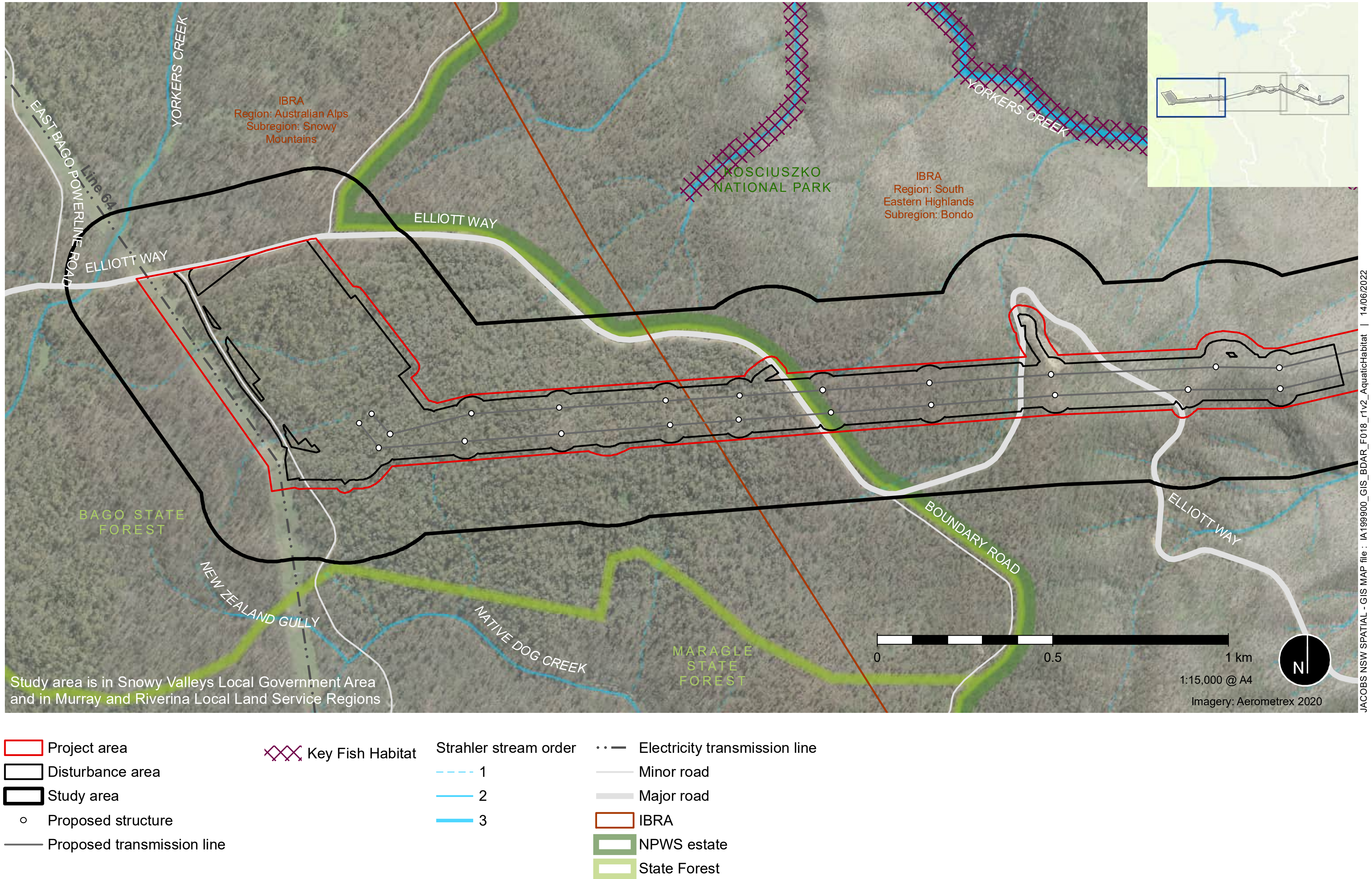
Despite fish stocking of threatened Trout Cod and Macquarie Perch within the Talbingo Reservoir, these species were not located during the Cardno (2018) surveys and it is unknown if self-sustaining populations occur within the study area. The Trout Cod is considered unlikely to be found outside of the Talbingo Reservoir while the Macquarie Perch may also occur in the Yarrangobilly River (Cardno, 2018). As the Murray Cod and Silver Perch have been stocked in Blowering Dam, there is a low chance that these two species may have also been introduced to the Talbingo Reservoir. The Murray Crayfish is known to occur in the Yarrangobilly River and Wallaces Creek. Signage at the Talbingo Reservoir indicates the presence, or potential presence of these species (**Photo 7-19** and **Photo 7-20**).

Based on the assessment and review of the work undertaken for the Snowy 2.0 Exploratory Works and Main Works EISs (Cardno, 2018), only the Murray Crayfish and Macquarie Perch are likely to occur in the habitats that may be affected by works in the project area. The potential impacts to these two species have been assessed using the criteria outlined in the FM Act (see **Appendix H**).

The project is considered unlikely to significantly affect threatened species, populations or ecological communities listed under the FM Act or EPBC Act (see **Appendix G** and **Appendix H**). Mitigation measures will be sufficient to prevent a significant impact (see **Section 11**).

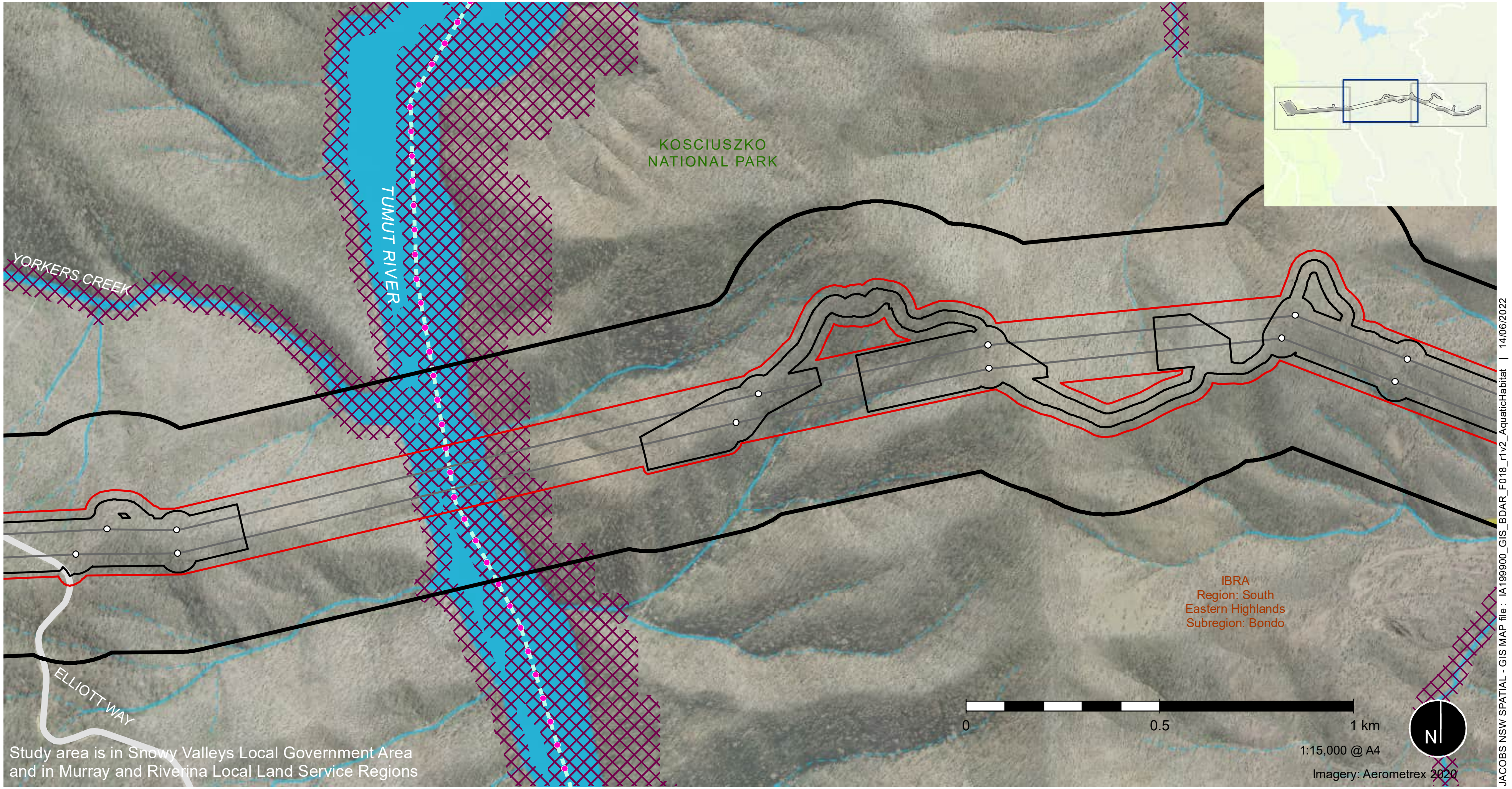
Photo 7-19: Murray Crayfish sign at the Talbingo Reservoir

Photo 7-20: Trout Cod sign at the Talbingo Reservoir



Data sources:
Jacobs 2021, TransGrid 2021, EMM 2020, DPI 2019, DPE 2018,
© Department Finance, Services and Innovation 2018

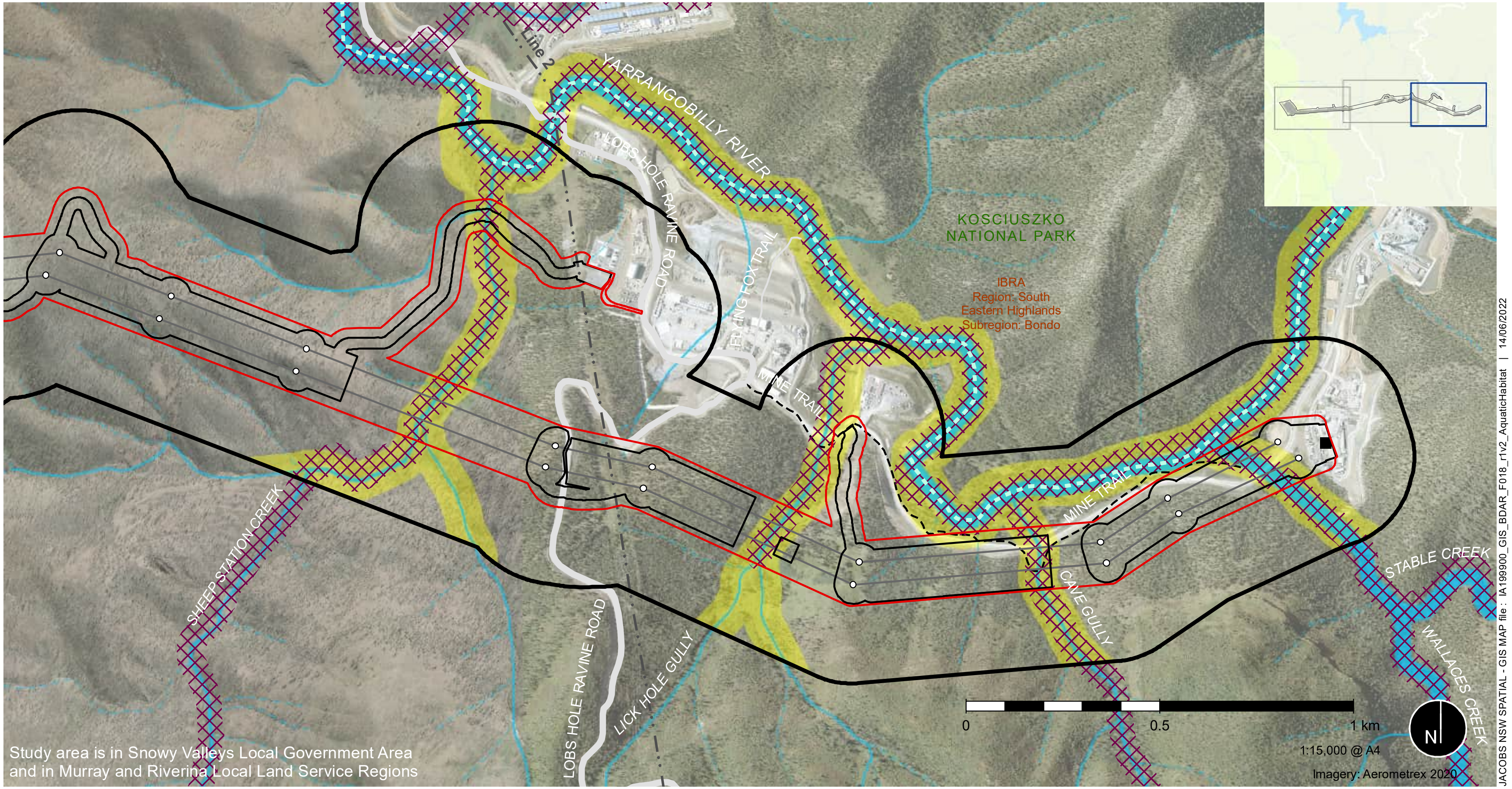
Figure 7-1 | Aquatic habitats



Project area
Disturbance area
Study area
Proposed structure
Proposed transmission line
Booroolong Frog 50m exclusion area
Murray Crayfish (Tumut River)
Macquarie Perch (Tumut River and Yarrangobilly River)
Key Fish Habitat
Strahler stream order
1
2
3
5-7
Electricity transmission line
Major road
NPWS estate

Data sources:
Jacobs 2021, TransGrid 2021, EMM 2020, DPI 2019, DPE 2018,
© Department Finance, Services and Innovation 2018

Figure 7-1 | Aquatic habitats



- Project area
- Disturbance area
- Study area
- Proposed structure
- Proposed transmission line
- Snowy 2.0 cable yard
- Booroolong Frog 50m exclusion area
- Macquarie Perch (Tumut River and Yarrangobilly River)
- Key Fish Habitat
- Strahler stream order
  - 1
  - 2
  - 3
  - 5-7
- Electricity transmission line
- Minor road
- Major road
- Trail
- NPWS estate

Data sources:
Jacobs 2021, TransGrid 2021, EMM 2020, DPI 2019, DPE 2018,
© Department Finance, Services and Innovation 2018

Figure 7-1 | Aquatic habitats

8. 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.

The project was referred under the EPBC Act to the Commonwealth Minister for the Environment and Energy. The Minister determined on 5 April 2019 that approval is required as the action has the potential to have a significant impact on:

- Listed threatened species and communities
- Listed migratory species
- The heritage values of a National Heritage place.

The NSW Government confirmed the action will be assessed under the "Bilateral agreement made under section 45 of the EPBC Act relating to environmental assessment between Commonwealth of Australia and the State of New South Wales" (Bilateral Agreement) (2015). This agreement accredits the assessment process under Division 5.2 of the EP&A Act. The agreement was also amended in March 2020 to include the Australian Government accreditation of the BC Act and endorsement of the NSW Biodiversity Offsets Scheme.

For threatened biodiversity listed under the EPBC Act identified in habitats within the study area or considered at east moderately likely to occur, significance assessments have been completed in accordance with the *EPBC Act Policy Statement 1.1 Significant Impact Guidelines* (Department of Environment, 2013) (see **Appendix G**) where these species have not already been assessed in accordance with the BC Act. Assessments have been included for some species where non-detection may not mean absence (e.g. Smoky Mouse). Whether or not an action is likely to have a significant impact depends upon the sensitivity, value, and quality of the environment that is affected, and upon the intensity, duration, magnitude and geographic extent of the impacts (Department of Environment, 2013). Importantly, for a 'significant impact' to be 'likely', it is not necessary for a significant impact to have a greater than 50 per cent chance of happening; it is sufficient if a significant impact on the environment is a real or not remote chance or possibility (Department of Environment, 2013). This advice has been considered while undertaking the assessments.

8.1 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. Impacts to heritage values are not addressed in this BDAR, though are provided in the Aboriginal Cultural Heritage assessment report (Appendix C of the EIS) and Non-Aboriginal heritage assessment report (Appendix G of the EIS).

8.2 Wetlands of international importance

The study area does not contain any wetlands of international importance. However, the Protected Matters Search Tool (PMST) returned several wetlands of international importance within 800 km of the project.

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

The distances from the project are provided in the PMST report. The report also states that all these wetlands are upstream, however the Banrock Station Wetland Complex, Hattah-kulkyne Lakes, Riverland and Coorong and Lakes Alexandrina and Albert are in fact downstream of the Tumut River (i.e. Tumut River – Murrumbidgee River – Murray River after the Boundary Bend confluence).

Due to the distance of these wetlands of international importance from the disturbance area, they are considered unlikely to be affected.

8.3 Threatened ecological communities

According to the PMST, the following EPBC Act listed TECs are known to occur, likely to occur, or may occur in the broader study area:

- Alpine Sphagnum Bogs and Associated Fens (Endangered) – known to occur 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.

The PCTs within the project area as outlined in **Section 5.5** do not correspond to any EPBC Act listed TECs. Some vegetation along Yorkers Creek to the north and outside of the project area around the substation (see **Figure 5-2**) is likely to correspond to the EPBC Act listed Alpine Sphagnum Bogs and Associated Fens TEC. This patch is upstream and north of Elliots Way so is unlikely to be affected by surface water flow from the project. However, there is another smaller mapped patch on Yorkers Creek around 500 m downstream of the second order stream that flows from the substation site. This mapped area was not verified from surveys but has the potential to be indirectly impacted by surface water flow from the project. The potential for indirect impacts to this potential TEC will be managed by standard erosion control measures and drainage design around the substation site.

8.4 Threatened plants

Due to the large extent, variability and generally high quality of the habitats present across the broader KNP and Bago State Forest, many EPBC Act listed threatened plant species are known to occur, may occur or are considered likely to occur in the locality. The PMST report identified thirteen plant species with potential to occur in the locality based on records and modelled habitat. Of these, only several species were considered for this assessment. This includes:

- *Calotis glandulosa* (Mauve Burr-daisy) – vulnerable under the EPBC Act
- *Pomaderris cotoneaster* (Cotoneaster Pomaderris) – endangered under the EPBC Act

- *Pterostylis oreophila* (Blue-tongued Greenhood) – critically endangered under the EPBC Act
- *Thesium australe* (Austral Toadflax) – vulnerable under the EPBC Act.

No EPBC Act listed threatened plant species were recorded during targeted surveys. Following comprehensive surveys, the EPBC Act listed *Prasophyllum* orchids that occur in the McPherson's Plain area are considered unlikely to occur in the heavily forested habitats that are present in the project area. *Pterostylis oreophila* is not known to occur in the project area, however, has been included as a precaution in this assessment on advice from Geoff Robertson, EESG Senior Threatened Species Officer. *Pterostylis oreophila* was not recorded during targeted surveys undertaken for this BDAR during the appropriate survey period. Considering the bilateral agreement, the survey and assessment undertaken in accordance with the BAM is considered adequate for assessing these species and no assessments of significance have been completed.

8.5 Threatened animals

The PMST identified 23 threatened fauna species listed under the EPBC Act with potential to occur in the locality based on records and modelled habitat. Targeted surveys have confirmed a population of one species, the Booroolong Frog, within Yarrangobilly River, that has potentially to be directly and indirectly impacted. The following is a brief discussion on the assessment results for this species and other national threatened species considered at least moderately likely to occur.

- **Booroolong Frog**: The rivers and streams in the eastern portion of the broader study area are suitable for the Booroolong Frog (recorded in many locations along the Yarrangobilly River and Wallaces Creek) as indicated in the Snowy 2.0 Exploratory Works and Main Works BDARs (EMM Consulting, 2017 and 2020a). Breeding and dispersal habitat for this species has been previously identified (see EMM Consulting, 2017 and 2020a). At the furthest eastern end of the project, the easement is located to the south of, and directly upslope of Yarrangobilly River. The project will directly impact on around 1.67 ha of habitat for the Booroolong Frog associated with the access road crossing of Sheep Station Creek, near the junction with the Yarrangobilly River, and the easement clearing associated with the crossing of Wallace Creek also neat the junction of the Yarrangobilly River. The BAM provides credits required to offset the direct impact and the quantum of credits is described in Section 13. Given the location of the project, upslope from the Booroolong Frog habitat, there is potential for indirect impacts on the habitat of the species associated with mobilisation of sediment during construction and operation. Further discussion of the potential impacts to this species is provided in Section 10.3.5 and details of proposed measures to mitigate the impact and monitoring performance of the measures is outlined in Section 11.
- The **Spotted-tailed Quoll is** known to occur throughout the habitats on the east and west of the Tumut River and breeding habitat is likely to be present. There is approximately 135.6 ha of potential habitat for the Spotted-tailed Quoll within the disturbance area, including around 39.26 ha of surrounding vegetation that will be indirectly impacted by edge effects
- The **Smoky Mouse** is known to occur in the locality as identified in the Snowy 2.0 Exploratory Works and Main Works BDARs (EMM Consulting, 2017 and 2020a) and may occur in the sub-alpine woodland habitats in the west of the project area. This species was not recorded during the trapping program undertaken for this BDAR despite an intensive targeted trapping survey and therefore is considered unlikely to be impacted. Although surveys were conducted in accordance with guidelines, there is potential this species is still present and was not identified. There is approximately 27.63 ha of potential sub-alpine woodland habitat for the Smoky Mouse within the disturbance area, including around 3.68 ha of surrounding vegetation that will be indirectly impacted by edge effects
- **Greater Glider**: Despite extensive survey effort comprising live-trapping, camera trapping, spotlighting and stag watching, the Greater Glider was not recorded within the project area during the targeted surveys between 2018 and 2021 undertaken for this BDAR. Likewise, the Greater Glider was not recorded during the surveys undertaken for the Snowy 2.0 Exploratory Works and Main Works BDARs (EMM Consulting, 2017 and 2020a) which involved extensive nocturnal survey work. The arboreal mammal fauna is dominated by Common Brushtail Possum, Yellow-bellied Glider, Sugar Glider and Eastern Pygmy-possum all of which were commonly reported. The Greater Glider is reported by other

studies (e.g., Kavanagh and Bamkin 1995; Kavanagh et al. 1995b) to be most abundant in forests occurring at high (>700m) elevations. A widespread study of the southwestern slopes found the Greater Glider to avoid the highest elevation forests sampled and to occupy more of the lower elevation forests than expected. This species was most frequently recorded by these authors in the low elevation Woomargama State Forest, however, only two records of the Greater Glider were made throughout Bago and Maragle State Forests. Despite the absence of records from the current surveys, the Greater Glider has a moderate potential to occur in the taller wetter forests (i.e. PCT 300) and sub-alpine woodland (PCT 1196) habitats, the direct impact on these two communities equates to around 32.1 ha. These habitats appear to provide suitable forging resources for the Greater Glider in the form of eucalypts species *Eucalyptus dalrympleana, Eucalyptus viminalis,* and *Eucalyptus robertsonii* and trees large enough to contain hollows of suitable size for the Greater Glider. Clearing the easement of trees and canopy may indirectly impact the broad-scale movements of this species. As a precautionary approach, an assessment of significance was undertaken in accordance with the EPBC Act Assessment of Significance Guidelines (2013) and is reported in Appendix G. This species has been further assessed in **Section 10**

- The **White-throated Needletail** is a migratory species and listed as vulnerable under the EPBC Act. This species is moderately likely to occur within the project area and may fly over the area during migration. The project area contains habitat that could potentially be used by the White-throated Needletail, however this species is predominantly aerial and is unlikely to significantly impact on this species. The project, however, is not classed as 'important habitat' and will not seriously disrupt the lifecycle of an ecologically significant proportion of the White-throated Needletail population
- A low-density **Koala** population may be present across the surrounding landscape as suitable food tree species including *Eucalyptus viminalis* and *Eucalyptus rubida* are common. However, surveys for the Koala were undertaken as part of this assessment in accordance with survey guidelines (refer to **Section 6.5.2**) and evidence of Koala presence was not identified (refer to **Section 6.7.2.16**), nor was the species identified from the Main Works EIS investigations. There is approximately 88.5 ha of potential habitat for the Koala within the disturbance area, however the potential for this species to occur is considered low, therefore no significance assessment has been undertaken.

Significance assessments have been completed for these species in accordance with the *EPBC Act Policy Statement 1.1 Significant Impact Guidelines* (Department of Environment, 2013) (see **Appendix G**).

8.6 Migratory species

Based on the PMST report and field surveys, twelve listed migratory species may occur in the broader locality (see **Table 8-1**). Surveys for birds were undertaken as part of the field surveys. The surveys included area surveys over 2 ha for 20 minutes each conducted in summer during which time most of the listed migratory species are present in eastern Australia. Surveys were undertaken across all PCTs and habitat variations.

'Important habitat' for a migratory species is defined as (DoE 2013):

- Habitat utilised by a migratory species occasionally or periodically within a region that supports an ecologically significant proportion of the population of the species
- Habitat that is of critical importance to the species at particular life-cycle stages
- Habitat utilised by a migratory species which is at the limit of the species range
- Habitat within an area where the species is declining.

An assessment of the likely occurrence of these species and the presence of important habitat is discussed in **Table 8-1**. An assessment of significance for migratory species has been completed in accordance with the *EPBC Act Policy Statement 1.1 Significant Impact Guidelines* (Department of Environment, 2013) and is provided in **Appendix G**. While some migratory bird species are likely to use the study area and locality, the study area will not be classed as 'important habitat'. A nationally significant proportion of a population will not be supported by the study area. Similar forest habitats are widespread in the locality and the habitat within the study area will be only a fraction of what is available for these species.

The project will not substantially modify, destroy, or isolate an area of important habitat for the migratory species and it will not seriously disrupt the lifecycle of an ecologically significant proportion of a population of migratory birds. Given the proposal is a linear project, the habitats within the disturbance area will only be a minor proportion of what is available (with large areas of forest flanking the proposed disturbance areas). Migratory species are all highly mobile and will be able to cross over the cleared alignment easily while dispersing through forest habitats. The forest habitats within the study area are not at the limit of the species range for Rufous Fantail, Satin Flycatcher, White-throated Needletail, Fork-tailed Swift or Latham's Snipe. The decline of these species within the alpine and sub-alpine forest environments is unknown although is unlikely to match decline rates in the lower-altitude coastal or agricultural regions of NSW where pressure from land clearing is higher, and where temperature increases as a result of climate change are more likely to be felt. It is unlikely that the habitats are within an area where these species are declining.

Table 8-1: Assessment of habitat and importance for EPBC Act listed migratory species

Species	Distribution and habitat preferences	Habitat present / records in the study area	Important habitat
Common Sandpiper (*Actitis hypoleucos)*	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.	None, wading bird habitat is not present.	No
Fork-tailed Swift (*Apus pacificus)*	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. The Fork-tailed Swift breeds in Asia but migrates to Australia from September to April. There is one record of the Fork-tailed Swift within 10 km of the project area.	Likely to fly over the disturbance area during migration, no records. Fork-tailed Swift breeds in Asia and return to Australia in summer. The species spend the majority of time foraging aerially, well above the forest canopy. These species could forage in the air space above the study area or temporarily perch within the study area and are therefore considered moderately likely to occur.	No
Sharp-tailed Sandpiper (*Calidris acuminata)*	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. Roosting occurs at the edges of wetlands, on wet open mud or sand or in sparse vegetation.	None, wading bird habitat is not present.	No
Pectoral Sandpiper (*Calidris melanotos)*	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,	None. wading bird habitat is present.	No

Species	Distribution and habitat preferences	Habitat present / records in the study area	Important habitat
	lakes, inundated grasslands, saltmarshes, river pools, creeks, floodplains and artificial wetlands.		
Latham's Snipe (*Gallinago hardwickii)i*	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. This species was recorded within the Main Works project area (in alpine bogs and fens and sub-alpine wet grasslands). Some areas of the Tumut River and Yarrangobilly River are likely to provide suitable habitat for this species. Included in migratory species assessment.	No
White-bellied Sea-Eagle (*Haliaeetus leucogaster)r*	Distributed along the coastline (including offshore islands) of mainland Australia and Tasmania. Found in coastal habitats (especially those close to the seashore) 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).	This species is likely to hunt and nest in the broader study area along the Yarrangobilly River and Talbingo Reservoir. Included as a candidate and predicted species for assessment.	No
White-throated Needletail (*Hirundapus caudacutus)*	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.	This species may fly over the disturbance area during migration, no current records in the study area. Likely to fly over the disturbance area during migration, no records. Fork-tailed Swift breeds in Asia and return to Australia in summer. The species spend the majority of time foraging aerially, well above the forest canopy. These species could forage in the air space above the study area or temporarily perch within the study area and are therefore considered moderately likely to occur.	No
Yellow Wagtail (*Motacilla flava)*	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.	Habitat unsuitable for this species.	No
Satin Flycatcher (*Myiagra cyanoleuca)*	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.	Suitable habitat is widespread, and this species has been frequently recorded in the locality. The Satin Flycatcher was also recorded in the study area on different occasions within a variety of Dry Sclerophyll Forest formations. This species occupies many tall forest habitats and will often	No

Species	Distribution and habitat preferences	Habitat present / records in the study area	Important habitat
		frequent the study area and surrounding forest areas.	
Eastern Curlew (*Numenius madagascariensis)*	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 disturbance area is not considered suitable for this species.	No
Rufous Fantail (*Rhipidura rufifrons)*	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.	This species has been recorded in the survey area and surrounds in the past and suitable habitat for this species is widespread. Rufous Fantails were recorded numerous times during diurnal bird surveys in PCT 1196 (Grassy Woodlands and Subalpine Woodlands), PCT 302 (Dry Sclerophyll Forests (Shrub/grass sub-formation) and Upper Riverina Dry Sclerophyll Forests) as well as PCT 296 (Southern Tableland Dry Sclerophyll Forests and Dry Sclerophyll Forests (Shrubby sub-formation). This species often inhabits wet sclerophyll forests and gullies dominated by Eucalypts which are present throughout much of the study area and surrounding forests.	No
Australian Painted Snipe (*Rostratula australis)*	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.	Low. Habitat in the disturbance area is not considered suitable for this species. Not included for assessment	

9. Impact avoidance and minimisation

This section of the BDAR outlines the efforts taken to avoid and minimise impacts on biodiversity in accordance with Section 7 of the BAM. A key part of management of biodiversity for this project is the application of the 'avoid, minimise and offset' hierarchy as follows:

3) Avoid and minimise impacts as the highest priority incorporating effective and feasible mitigation measures
4) Offset where residual, significant unavoidable impacts will occur (if required).

9.1 Locating the project to avoid and minimise direct and indirect impacts on biodiversity values

9.1.1 Options assessment

A detailed options assessment was carried out by EMM (2021) to identify and systematically assess potential transmission connection options to connect Snowy 2.0 to the NEM. The full options assessment report is provided in Appendix D of the Submissions Report.

A total of 12 potential connection options were identified and assessed against a suite of agreed evaluation criteria pertaining to technical requirements, environmental and planning considerations and safety. A key focus of the options assessment was also to consider potential future biodiversity impacts associated with the HumeLink project which is required to connect to the Snowy 2.0 connection point.

The 12 options are summarised in **Table 9-1** and shown in **Figure 9-1**. The evaluation criteria are shown in **Figure 9-2**.

Table 9-1: Transmission connection options

Connection Point	Method of connection				
	Overhead	Deep cable Tunnel	Trench	Horizontal Directional Drilling	Hybrid
Line 64 (located west of KNP)	Option 4	Option 5	Option 6	Option 7	Option 8 (trench and tunnel)
Line 1, Line 2, or Upper Tumut Switching Station (UTSS) (connection points located within KNP)	Options 1, 2, and 3	-	-	-	-
Lower Tumut Switching Stations (LTSS) (located to the north of KNP)	Option 11	Option 12	Option 10	-	Option 9 (trench and submarine cable)

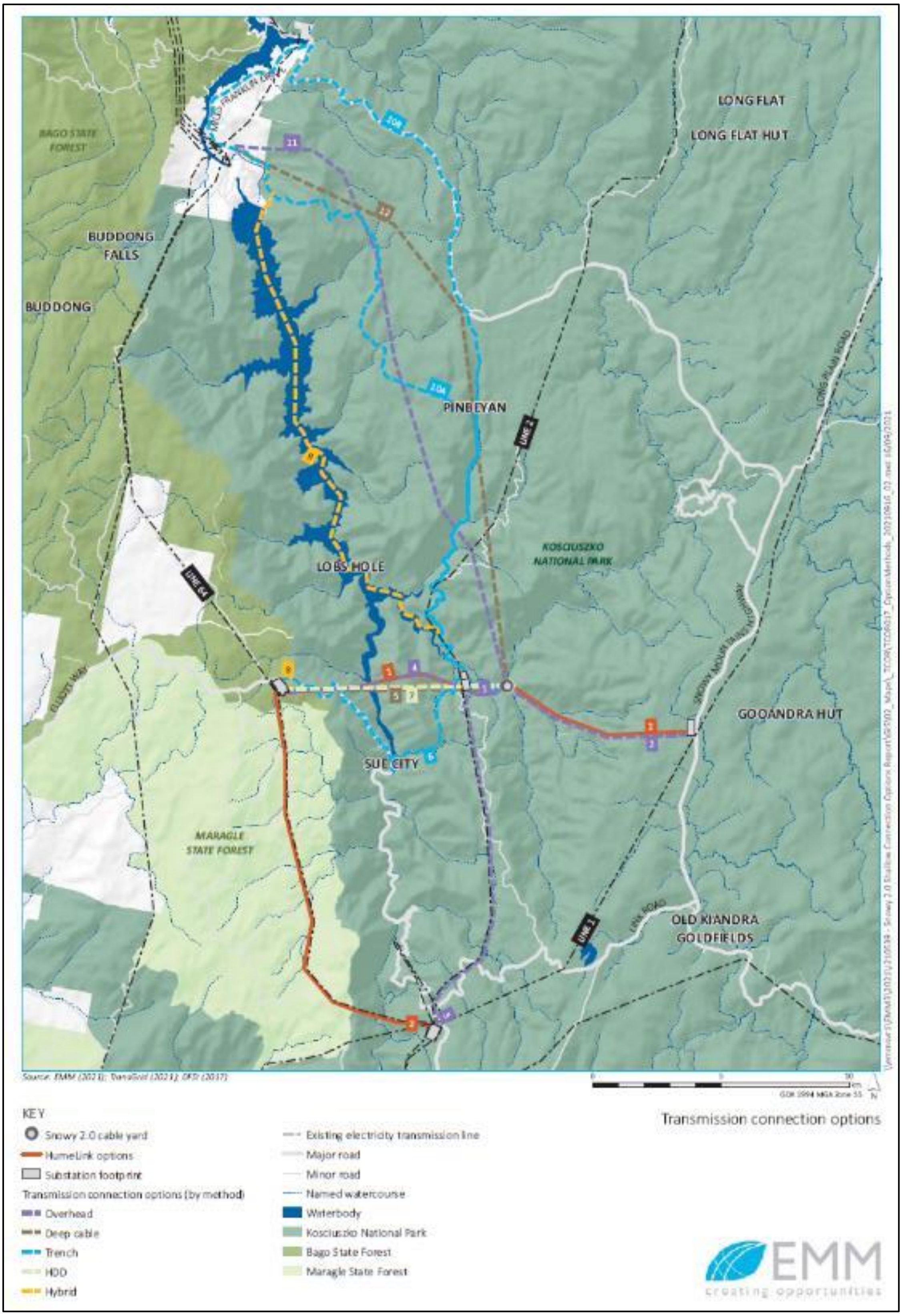


Figure 9-1: Transmission connection options

A screening assessment of the 12 options was carried out against the project objectives and evaluation criteria (Refer to **Figure 9-2**).

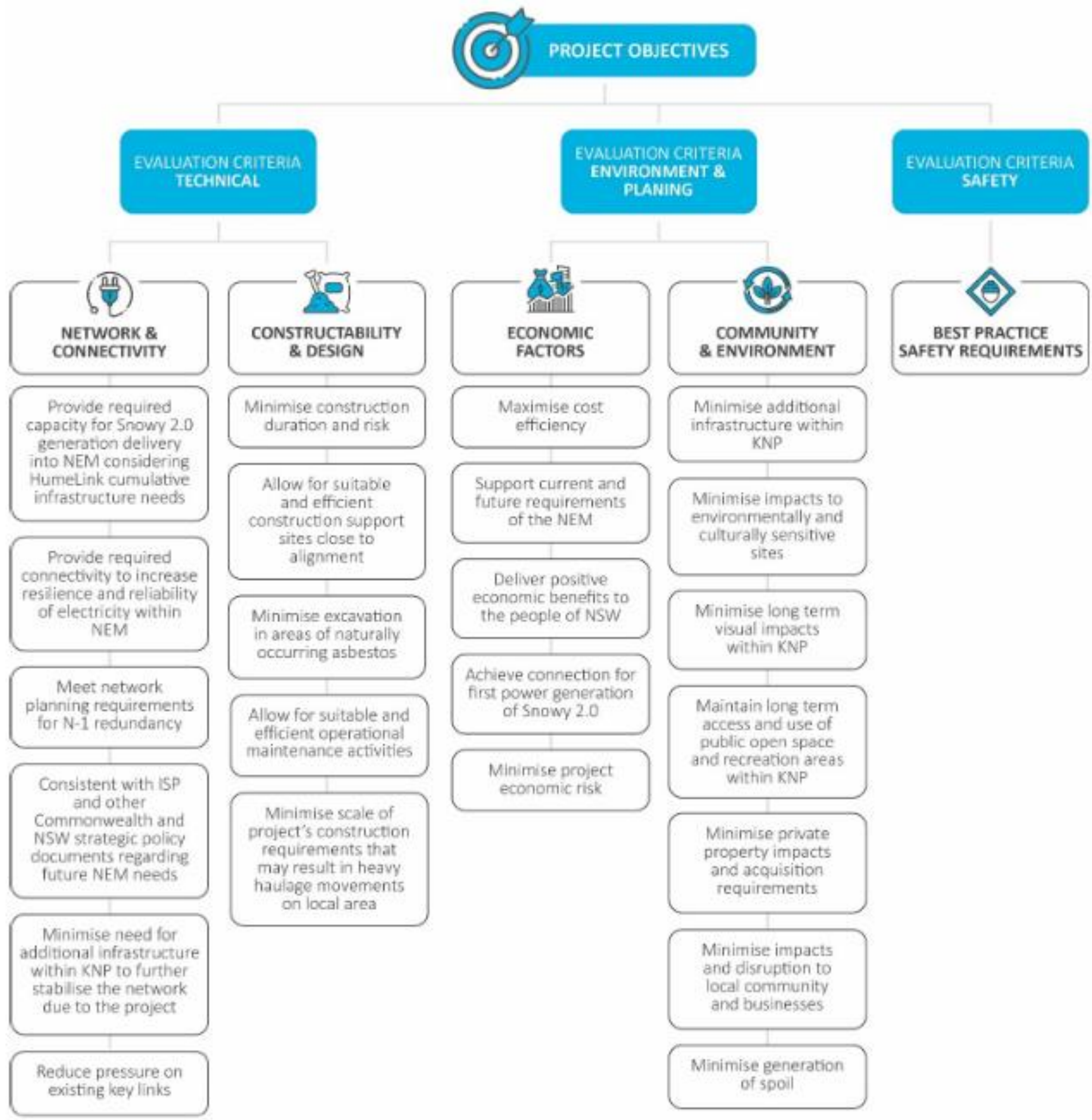


Figure 9-2 Project evaluation criteria (source: Snowy 2.0 Shallow Connection - Options Report (EMM, 2021))

Options screening

A screening assessment of the 12 options determined that eight options did not meet the set objectives and considered technically viable or unacceptable relating to the evaluation criteria including:

- Require significant additional assets to be constructed within KNP and will bring additional HumeLink infrastructure into KNP, including a new substation and 500 kV lines (Option 1, Option 2, Option 3)
- Are not technically viable (Option 7, Option 9)
- Do not ensure the resilience and reliability of the NEM in the context of dramatically increased intermittent generation from renewable sources (Option 10, Option 11 and Option 12).

Option 7 was deemed to be technically unviable because it is unsuitable for steep terrain, has a high probability of tunnel drift during drilling and also requires the transition to overhead transmission over Talbingo Reservoir.

Option 9 was deemed to be technically unviable because of the required construction methodology within Talbingo Reservoir and the construction schedule. It will not enhance the resilience and reliability of the NEM as it increases the concentration of transmission circuits within a single corridor north of LTSS, and it also will likely have significant environmental impacts associated with dredging within the reservoir.

Post screening assessment and agency engagement

The results of the screening assessment were presented to DPIE and NPWS. Further detailed information was requested and supplied to DPIE and NPWS to further understand the design considerations and significance of impacts associated with three of the four options that had been proposed to move forward to detailed analysis from the screening assessment (Options 5, 6 and 8) and to further consider Options 3 and 9. As a result the following six options were subject to further detailed analysis:

- Option 3 – Overhead to UTSS
- Option 4 – Overhead to Line 64
- Option 5 – Deep cable tunnel to Line 64
- Option 6 – Trench to Line 64
- Option 8 – Hybrid trench/deep cable tunnel to Line 64
- Option 9 – Hybrid trench/submarine cable to LTSS.

The comparison of the six options in relation key biodiversity, technical and cost parameters is provided in Table 9-2. The environmental considerations in this table (with the exception of Option 4) are very high level as detailed environmental assessments have not been carried out for these options.

Table 9-2: Summary table

Element	Option 3	Option 4	Option 5	Option 6	Option 8	Option 9
Area of vegetation clearance						
Within KNP (ha)	185	74 (37 has fully cleared and 37 ha partially cleared)	8	77	5	8
Outside KNP (ha)	Nil	44 (34 ha fully cleared and 10 ha partially cleared)	27	33	35	4
Maximum disturbance total (ha)	185 (not including HumeLink disturbance)	118 (71 ha fully cleared, 47 partially cleared)	35	110	40	12
Biodiversity considerations						
Biodiversity	Approximately 80 ha of Smoky Mouse (critically endangered species listed under NSW and Commonwealth legislation) habitat cleared with additional indirect impacts. This is a significant impact that is unlikely to be tolerable. Additional future network expansion impacts due to	Requires clearing of native vegetation which provides habitat for threatened species though no significant impacts are predicted.	Disturbance footprint has been largely surveyed. Significant impacts to biodiversity are unlikely.	Potential biodiversity impacts (disturbance area not surveyed).	Potential biodiversity impacts (disturbance area not surveyed for trench component).	Potential biodiversity impacts (disturbance area not surveyed). Potentially significant impacts on the threatened Murray crayfish from dredging.

Element	Option 3	Option 4	Option 5	Option 6	Option 8	Option 9
	HumeLink KNP connection.					
Other						
Cost* (million)	~ $450	$290	~ $1,393	~ $1,087	~ $1,304	Unable to quantify however likely to be >$1,000 million
Time (months)	57	45	82	74	78	N/A
Network resilience considerations including HumeLink connection	Worsens See Note 1	Improved See Note 2	Improved See Note 2	Improved See Note 2	Improved See Note 2	Worsens See Note 1

Note:

Additional assets and Snowy 2.0 connection at UTSS will lower system resilience when assessed using causal events (extreme weather and / or bushfire) due to worsened spatial and temporal factors in combination with the higher concentration of assets and localised power density. Threats at UTSS include loss of significant generation input capacity (2,660 MW and disruption of critical interconnection between Victoria and NSW (VNI1)). Threats with connection at LTSS are even higher with loss of extreme generation input capacity of 3,800 MW and similar disruption of critical interconnection between Victoria and NSW.

New assets and Snowy 2.0 connection at Maragle will increase system resilience when assessed using causal threats of extreme weather and / or bushfire due to improved spatial and temporal factors in combination with overall reduced concentration of assets and localised power density (relative to other proposed connection points at UTSS and LTSS). The choice of Maragle also creates a node on an alternative interconnection path to south-west NSW and Victoria relative to the existing single interconnection between Victoria and NSW. Threats at Maragle include loss of significant generation input capacity (2,000 MW) but avoids disruption of critical interconnection between Victoria and NSW.

A second meeting was held on 10 August 2021 with DPIE and NPWS to further discuss the options assessment. In consultation with DPIE and NPWS, it was agreed that Options 5, 6, 8 and 9 will not proceed to a detailed assessment as, primarily, they did not meet the evaluation criteria relating to economic factors; specifically they significantly increased the project's economic risk. Timeframes and disturbance areas were also key considerations.

It was resolved that options 3 and 4 will proceed to the detailed assessment stage for selection of a preferred option for the project.

Detailed assessment and selection of the preferred option

A detailed assessment of the remaining options (Option 3 and Option 4) was carried out against the evaluation criteria. A summary of the outcomes, particularly with regards to impact area and biodiversity impacts is outlined in **Table 9-3**.

Table 9-3: Detailed analysis of Option 3 and Option 4

Element	Option 3 – Overhead to UTSS	Option 4 – Overhead to Line 64
Vegetation disturbance		
Within KNP	185 ha plus HumeLink extension 25 ha	74 ha
Outside KNP	0 ha plus HumeLink extension 108 ha	44 ha
Total	185 ha plus HumeLink extension 133 ha	118ha
Biodiversity considerations		
Biodiversity	Approximately 80 ha of Smoky Mouse (critically endangered species listed under NSW and Commonwealth legislation) habitat cleared with additional indirect impacts. This is a significant impact that is unlikely to be tolerable. Additional future network expansion impacts due to HumeLink KNP connection.	Requires clearing of native vegetation which provides habitat for threatened species though no significant impacts are predicted.
Other		
Cost	~ $450 million	~ $290 million
Time	57 months	45 months
Network resilience considerations including HumeLink connection	Worsens. Additional assets and Snowy 2.0 connection at UTSS will lower system resilience when assessed using causal events (extreme weather and/or bushfire) due to worsened spatial and temporal factors in combination with the higher concentration of assets and localised power density. Threats at UTSS include loss of significant generation input capacity (2,660 MW and disruption of critical interconnection between Victoria and NSW.	Improved. New assets and Snowy 2.0 connection at Maragle would increase system resilience when assessed using causal threats of extreme weather and/or bushfire due to improved spatial and temporal factors in combination with overall reduced concentration of assets and localised power density (relative to the two proposed alternative connection point options). The choice of Maragle also creates a node on an alternative interconnection path to south-west NSW and Victoria relative to the existing single interconnection between Victoria and NSW. Threats at Maragle include loss of significant generation input capacity (2,000 MW) but avoids

Element	Option 3 – Overhead to UTSS	Option 4 – Overhead to Line 64
		disruption of critical interconnection between Victoria and NSW.

Among other aspects, option 4 was determined to be the preferred option due to the following:

- The estimated impact area is approximately 67 ha less that option 3
- Option 3 would involve the clearing of approximately80 ha of Smoky Mouse habitat cleared with additional indirect impacts. This is a significant impact that is unlikely to be tolerable.
- Option 3 would involve further impact within KNP (approximately 25 ha) whilst option 4 would avoid further impacts within KNP.

Option 4, as the preferred project option, consists of an overhead transmission connection connecting the Snowy 2.0 cable yard within KNP to Line 64 via a new substation within Bago State Forest. This option as 'the project' is the subject of the EIS, the Submissions Report and this BDAR.

9.2 Designing the project to avoid and minimise direct and indirect impacts on biodiversity values

The project, including the amendments identified in the Amendment Report (Transgrid 2021a), has been designed, to the greatest extent possible, to avoid and minimise impacts, and to respond to the issues raised by the community and stakeholders. The detailed design and construction methodology for the amended project will be further developed with the objective of further avoiding and minimising potential impacts on the local and regional environment, and the local community.

Further consideration of the amended project has identified additional opportunities to reduce impacts. In particular, the project has been refined to further avoid and minimise impacts on biodiversity where possible. This has included the reduction of the disturbance area and the inclusion of six distinct vegetation clearing management zones, of which each will be subject to specific clearing requirements (see **Section 2.3.1**). The disturbance area needed for construction has been reduced by 12.6% from 143 ha to approximately 125 ha. This has resulted in direct impacts to about 118.35 ha of native vegetation which is a reduction of about 17.3 ha from the project as assessed in the EIS. This reduction was achieved through refinement of the access tracks and transmission connection easement by reducing the width of the cleared easement and hazard tree areas using LiDAR analysis.

While the project will involve the removal of vegetation to allow the construction of, and ongoing operational maintenance of the asset for the life of the project, the design has allowed for total clearing only in areas identified for infrastructure and remaining areas of the project will, over the long-term result in partial clearing along the designated transmission easement. The resulting modified vegetation will be maintained in this state for the life of the project, thereby retaining some of the original biodiversity values in the lower stratum and preserving the surface soil structure. By achieving this, the loss of vegetation to accommodate the infrastructure has been reduced from the initial concept design plan with proposed clearing of 118.35 ha. This includes a full clearing area of 70.90 ha over the life of the project and further 47.45 hectare of partially cleared vegetation. The partial cleared zones to be maintained during operation include:

- **Easement Clearing Zone (ECZ):** defined as the vegetation zone along the transmission line easement which will require the clearing and ongoing maintenance of tall growing vegetation only which may intrude on the operational line operating conditions. Removal of regrowth vegetation including mid storey and understorey shrubs to 100-200 mm via slashing and mulching.
- **Hand-clearing Zone (HCZ)**: defined sections of the ECZ not suitable for machine access, where tall growing vegetation will be removed, but low shrubs and groundcovers will remain

- **Hazard Tree Zone (HTZ):** the off-easement HTZ is defined as the areas external to the ECZ which contain trees of a sufficient height which, if they were to fall, will strike the overhead conductors or the transmission structures (known as Hazard Trees). The hazard tree zone will retain much of the original habitat value and flora diversity, with the exception of tall hazard trees being removed.

This biodiversity assessment considers a worst case impact of slashing and mulching of vegetation in the ECZ. The future potential of slashing and mulching across all areas of the easement is likely, aside from those areas on steep slopes where hand clearing is designated. Due to these future management locations being unknown, a precautionary approach had to be adopted, but predicted a future vegetation integrity score based on Line 2 VI data near the project. As a worst case impact of future slashing across the whole ECZ has been adopted monitoring of VI scores will be required to measure the actual change in VI after construction.

9.3 Locating and designing the project to avoid and minimise prescribed impacts

Some types of projects may have impacts on biodiversity values in addition to, or instead of, impacts from clearing vegetation and/or loss of habitat. For many of these impacts, the biodiversity values may be difficult to quantify, replace or offset, making avoiding and minimising impacts critical.

Chapter 6 of the BAM (2020) identifies actions that are prescribed as impacts to be assessed under the biodiversity offsets scheme as per clause 6.1 of the *Biodiversity Conservation Regulation 2017*. Such prescribed impacts (including direct and indirect impacts) are impacts:

a) on the habitat of threatened species or ecological communities associated with:
    i. karst, caves, crevices, cliffs, and other geological features of significance, or
    ii. rocks, or
    iii. human made structures, or
    iv. non-native vegetation
b) on areas connecting threatened species habitat, such as movement corridors
c) that affect water quality, water bodies and hydrological processes that sustain threatened entities (including from subsidence or upsidence resulting from underground mining)
d) on threatened and protected animals from turbine strikes from a wind farm
e) on threatened species or fauna that are part of a TEC from vehicle strikes.

9.3.1 Habitat features other than vegetation

In relation to part a) impacts of the project have been focused away from a known karst area that occurs approximately 300 m to the south of the project (see discussion in **Section 4.6** and **Figure 4-1)**.

Human made structures and non-native vegetation are not a concern for this project.

It is noted that there are a number of exposed rock sites and outcrops of various sizes are identified and mapped in the disturbance area, and that cannot be avoided. There is scope to avoid sections of exposed rock through applying micro-siting of track footprints for the detailed survey and track design and this will be prioritised. Any proximal and downslope areas of geological significance that may have potential to be indirectly impacted during construction will be identified in the biodiversity management plan and included in the construction monitoring plan.

9.3.2 Habitat connectivity and fauna movement

Impacts to connectivity and species movement cannot be avoided in this landscape and given the proposed removal of vegetation along a linear transmission line corridor. As such there will be potential impacts to movement of fauna, in particular fauna species reliant on a continuous tree canopy and tall shrub layers for movement through the landscape. During the operational maintenance phase the low shrub and groundcover layers of the easement clearing zone (ECZ) will be allowed to regenerate, and taller shrubs and low trees will be retained in hand-clearings zones. This will effectively retain some cover, shelter and foraging resources for ground-dwelling fauna and birds adapted to low cover habitats and has been designed to avoid impacts to movement across the easement for these groups.

There is potential that security fencing associated with the substation may affect the ability of threatened non-flying species to move through the area. Transgrid standard substation security fencing will be installed on all sides of the substation, which is planned to be about 3 m-high galvanised steel topped with barbed or razor wire (more information is provided in Chapter 5 of the EIS). Barbed wire fencing is a well-documented hazard to wildlife, particularly gliding mammals (van der Ree 1999) and Yellow-bellied Gliders are common in this location. This potential impact has been discussed in more detail in **Section 10.3.2** and **Section 10.3.4**.

While this fencing in unlikely to affect the movements of arboreal fauna (because there will be no habitat remaining inside the fence) there is low potential for collision with the fence. Where barbed wire is required, measures may also be taken to improve the visibility of the hazard. Options may include adding visible objects to the fence, such as tape, plastic flags, and metal tags (Booth 2007). The potential for entanglement in barbed wire is likely to be greatest within 100 m of the substation fence corners where animals are within gliding distance of other trees. All measures proposed to minimise this impact are described in **Chapter 11**.

9.3.3 Water quality in habitat occupied by Booroolong Frog and Murray Crayfish

The project avoids direct impacts to known Booroolong Frog breeding habitat. As sections of the project are situated on slopes above and in proximity to the Yarrangobilly River consideration has been given during the project design to avoiding and minimising the direct impact on this habitat through ensuring that permanent structures have been placed outside of the habitat and floodplain. The potential for sediment to flow from the steep slopes either side of the Talbingo Reservoir is considered low, due to the fact that the transmission line has been designed to span these steep slopes and sediment and erosion controls around structure sites will effectively mitigate this issue.

Construction and operation of the project has potential to indirectly impact water quality of habitat occupied by Booroolong Frog and Murray Crayfish. The potential for short and long-term mobilisation of sediment downslope towards Yarrangobilly River has also been avoided during the operational maintenance phase, by allowing regeneration of groundcover vegetation in the partial clearing zones. To protect Booroolong Frog habitat, a 50 m exclusion zone (refer to **Figure 11 1**) will be adopted for the Main Works project on Yarrangobilly Creek and will be retained for construction of the transmission line around the tributaries that flow downhill into the Yarrangobilly Creek, this includes the limits of clearing on the lower end of Sheep Station Creek, Cave Gully, Lick Hole Gully and Wallace Creek that are crossed by the project to protect the downstream habitat of Booroolong Frog by clearly identifying exclusion zones. Parts of the 50 m exclusion zone along Lick Hole Gully and Cave Gully occur within the Easement Clearing Zone and will require clearing of trees and shrubs. However, the introduction of the partial clearing zones are likely to reduce the risk of erosion and sedimentation from the project to downstream waterways where parts of the groundcover in the ECZ, HCZ and HTZ will remain partially intact or intact, and reduce soil disturbance. There will be no use of heavy machinery in the riparian zones.

Due to the risk of indirect impacts from increased runoff at these locations, strict sediment control measures will be implemented and outlined in a Soil and Water Management Plan (SWMP). The plan will ensure protection of aquatic habitat in the tributaries crossed by the project, and particularly aimed at protecting the habitat for the Booroolong Frog associated with Yarrangobilly Creek. An adaptive management plan will be prepared to address the risk of increased sedimentation/run off to the identified breeding habitat and population extent downhill and downstream of the project area. This will require an estimation of the residual impact if sediment mitigation measures fail. The potential for downslope sediment mobilisation will also be monitored and managed in a water quality monitoring program. A adaptive management strategy has been developed to demonstrate how the stormwater, sediment and erosion controls will minimise and mitigate impacts to identified Booroolong Frog habitat and the Yarrangobilly River population as described in **Chapter 11**.

9.3.4 Turbine strike

The impacts of wind turbines are not applicable to this project.

9.3.5 Wildlife vehicle strike

There are no TECs in the disturbance area or project area, and therefore no threatened fauna that are part of the TEC. Increased vehicle movements during construction of the project have the potential to result in fauna mortality from vehicle strikes. These potential impacts can be avoided and managed and will be addressed in the biodiversity management plan, and include examples such as on-site education, identifying and reporting hazards as they occur during construction, and setting appropriate working hours and vehicle speed limits.

10. Assessment of impacts

10.1 Direct impact

10.1.1 Removal of native vegetation and habitat for threatened species

This BDAR has assessed the project area for its biodiversity values so that if the disturbance area may need to shift slightly during detailed design, this can be achieved without the need to modify the project, noting the calculation of impact area has been restricted to the disturbance area for this stage of the development assessment. Project impacts and offset obligations will be revised throughout the life of the project, further details of this are provided in Section 13. This approach is consistent with the approved Snowy 2.0 Main Works EIS (EMM Consulting, 2019).

The direct impact associated with vegetation clearing has been calculated using the 'disturbance area', for both full and partial clearing areas. The impact does not include land within the approved Snowy 2.0 disturbance footprint which partially overlaps the project. The impact assessed is based on vegetation clearing zones and comprise total clearing zones and partial clearing zones, where some vegetation retention is planned within the operational easement as explained in Section 2 and Section 9.

The project will comprise a full clearing area of 70.90 ha and a further 47.45 ha maintained as a partially cleared vegetation. The disturbance area with vegetation clearing zones is depicted in **Figure 2-3**. A comprehensive description of the vegetation clearing activities proposed for the full and partial clearing areas during both construction and operation is provided in Section 2 and is the basis for calculating vegetation integrity loss, and impact on threatened species.

Full clearing zones

While native vegetation and habitat clearing will be avoided and minimised along sections of the project area including at waterways and gullies, partial clearing areas and areas already cleared for the Snowy 2.0 Main Works construction, the project will result in the direct removal of native vegetation and habitat to bare ground in the full clearing areas (Substation, Transmission Structures, Access Tracks and Tension and Pulling area). There will be no direct impacts from clearing of a threatened ecological community. The estimated full clearing of vegetation in the disturbance area is approximately 70.90 ha consisting of the following PCTs:

- Broad-leaved Sally grass – sedge woodland on valley flats and swamps in the NSW South Western Slopes Bioregion and adjoining South Eastern Highlands Bioregion (PCT 285)
- Brittle Gum – peppermint open forest of the Woomargama to Tumut region, NSW South Western Slopes Bioregion (PCT 296)
- 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 300)
- Riparian Blakely's Red Gum – Broad-leaved Sally woodland - tea-tree - bottlebrush - wattle shrubland wetland of the NSW South Western Slopes Bioregion and South Eastern Highlands Bioregion (PCT 302)
- Broad-leaved Peppermint – Candlebark shrubby open forest of montane areas, southern South Eastern Highlands Bioregion and South East Corner Bioregion (PCT 729)
- Norton's Box – Broad-leaved Peppermint open forest on footslopes, central and southern South Eastern Highlands Bioregion (PCT 999)
- Snow Gum – Mountain Gum shrubby open forest of montane areas, South Eastern Highlands Bioregion and Australian Alps Bioregion (PCT 1196).

The estimated full clearing of native vegetation will result in the direct removal and permanent loss of habitat that was confirmed to occupied and utilised by the following threatened species:

- *Caladenia montana*
- Gang-gang Cockatoo (breeding habitat)
- Masked Owl (breeding habitat)
- Booroolong Frog
- Eastern Pygmy-possum
- Yellow-bellied Glider Population on the Bago Plateau.

The potential hollow bearing nest tree where the Masked Owl was observed roosting is located at a transmission structure and cannot be avoided. Of the 17 potential nest trees mapped at this location, eight occur outside the project area and will be avoided (see **Figure 6-5**). Others will be impacted by the project in both full clearing and partial clearing zones.

Partial clearing zones

The project will result in the partial removal of native vegetation and habitat within the operational easement and adjacent hazard tree zone located on the flanks of short sections of the easement. The estimated partial clearing of vegetation in these disturbance areas is approximately 47.45 ha consisting of the following PCTs:

- Brittle Gum – peppermint open forest of the Woomargama to Tumut region, NSW South Western Slopes Bioregion (PCT 296)
- 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 300)
- Riparian Blakely's Red Gum – Broad-leaved Sally woodland - tea-tree - bottlebrush - wattle shrubland wetland of the NSW South Western Slopes Bioregion and South Eastern Highlands Bioregion (PCT 302)
- Broad-leaved Peppermint – Candlebark shrubby open forest of montane areas, southern South Eastern Highlands Bioregion and South East Corner Bioregion (PCT 729)
- Norton's Box – Broad-leaved Peppermint open forest on footslopes, central and southern South Eastern Highlands Bioregion (PCT 999)
- Snow Gum – Mountain Gum shrubby open forest of montane areas, South Eastern Highlands Bioregion and Australian Alps Bioregion (PCT 1196).

Over the operational life of the project, it is expected that these PCTs will continue to exist in the easement and the hazard tree zone with a modified forest structure and flora and fauna diversity. Although the vegetation will retain some biodiversity value, in particular serving to protect and prevent soil degradation and erosion and provide shelter, food resources, cover and habitat connectivity for some fauna groups and species. The removal of habitat within the ECZ will largely be associated with the clearing and ongoing suppression of trees and vegetation over 200 mm in height. While there will be preservation of ground cover vegetation, it is assumed the loss will have a complete impact on threatened species. Similarly, the HTZ, which is small in area, will also remove larger trees above 50 cm diameter at breast height, and while this will be done sensitively involving hand removal, the resulting habitat will be modified in structure, likely removing old growth and hollow-bearing habitat trees. The change in the structure and floristics of the habitat is expected to directly remove the habitat of threatened species, including:

- *Caladenia montana* – a terrestrial orchid – through removal of plants, ground disturbance and loss of suitable habitat
- Gang-gang Cockatoo and Masked Owl (breeding habitat) – through removal of potential and actual hollow nest sites and human activity within the buffer of nesting trees adjacent to the easement
- Booroolong Frog – removal and disturbance of a small area of potential dispersal and sheltering habitat along Sheep Station Creek, Wallaces Creek and close to Yarrangobilly River

- Arboreal mammals Eastern Pygmy-possum, and Yellow-bellied Glider – through removal of the canopy and food and shelter resources.

10.1.2 Calculating the change in vegetation integrity score

As described in Section 2.2 of the Stage 2 BAM Operational Manual (DPIE 2019), management zones were applied in the BAM-C to assess impacts of vegetation loss. The 70.90 hectare area required for infrastructure will be subject to full clearing, and in these zones the future Vegetation Integrity (VI) score has been set at zero (i.e. full clearing to ground-level).

In the 47.45 hectare partial clearing area the future VI score has been determined by modifying the VI attributes using advice from the BAM operational manual (DPIE, 2019b) and reference plot data collected for another transmission easement, which traverses the same PCTs. An existing 330kV easement runs north-south through Lobs Hole (Transgrid's Line 2) and was sampled as part of the Main Works BDAR (See **Appendix M**). The corridor was constructed in the 1960s, likely using clear felling machinery, and the vegetation in the easement has been maintained for over 50 years. The Line 2 easement comprises the same PCTs as the assessed project, and vegetation integrity data collected by EMM Consulting (2020a) was used, comprising 18 VI plots for PCT1196 (9 plots), PCT 296 (2 plots), PCT 300 (2 plots), PCT 302 (2 plots), PCT 729 (2 plots), and PCT 999 (1 plot). No plots were completed for PCT 285, this PCT has the same vegetation class as PCT 302 (Upper Riverina Dry Sclerophyll Forests) and the mean reference data from plots completed in PCT 302 were used. The mean of each vegetation class was calculated and applied to the future value scores in the BAM-C relevant to each management zone. The vegetation class was used because each associated PCT represents the same benchmark. A summary on how this data was applied to set a future value of full and partial clearing is explained in **Table 10-1**. The treatment of each attribute in each partial impact management zone is detailed in **Table 10-2**.

The Line 2 reference data is not applied to the Hazard Tree Zone. The current mean values for plots in remnant vegetation zones were entered for each Hazard Tree Zone into the BAM-C.

Table 10-1: Summary of full and partial clearing within the disturbance area and associated loss in future vegetation integrity scores for relevant attributes

Clearing management zones	Attributes with total loss	Attributes with partial or no loss
Full Clearing Zones	Full clearing of trees, shrubs and groundcovers, BAM-C values set to zero for all attributes related to composition, structure, and function	N/A
Easement Clearing Zone (ECZ)	Trees / shrubs continually removed as part of long-term easement management – tree and shrub growth forms set to zero	Other growth forms (grass, forb, fern and other) remain in-situ with future value based on an average score using Line 2 reference data for each PCT
Hand Clearing Zone (HCZ)	Tree growth form set to zero	Other growth forms (shrub, grass, forb, fern and other) remain in-situ with future value based on an average score using Line 2 reference data for each PCT
Hazard Tree Zone (HTZ)	Set 'Stem Class' for 50-79 cm and 'Number of large trees (>50cm DBHOB)' to zero	All growth-forms remain in-situ, including non-hazard trees, shrubs, and ground growth forms will retain current VI condition

Table 10-2:Treatment of each attribute in each partial impact management zone applied in the BAM-C

Attribute	Application in BAM-C	Justification
Easement Clearing Zone (ECZ)		
Composition - tree	Set to '0'	Trees / shrubs continually removed as part of long-term easement management
Composition - shrub	Set to '0'	
Composition - grass, forb, fern, other	Line 2 data average for each management zone	There may be some disturbance to groundcover during construction but expected to regenerate in the long term and remain in a mature condition in-situ under the same/similar maintenance regime as Line 2
Structure - tree	Set to '0'	Trees / shrubs continually removed as part of long-term easement management
Structure - shrub	Set to '0'	
Structure - grass, forb, fern, other	Line 2 data average for each management	There may be some disturbance to groundcover during construction but expected to regenerate in the long term and remain in a mature condition in-situ under the same/similar maintenance regime as Line 2
Function – large trees	Line 2 data average for each management	Trees continually removed as part of long-term easement management, and it is anticipated that no large trees will occur. This is evident in the Line 2 data.
Function – litter cover		Litter cover may at first increase with the felling of trees and shrubs depending on level of ground disturbance. It is anticipated that over time litter will decay and not be replaced by debris from trees and shrubs. Low levels of litter are evident in the Line 2 data.
Function – length of fallen logs		The long term maintenance regime requires removal of most logs to improve access and operational maintenance within the easement. Limited log lengths are anticipated and this is evident in the Line 2 data.
Function – stem class		A stem size class with an average ≥0.1 derived from the Line 2 data was applied to a future stem size class. It is anticipated that most of the larger stem class sizes will be excluded (ie >30cm). Although tree structure and composition are assumed absent for ECZ, the largest stem size class in Line 2 data is 20-29cm for Southern Tableland Dry Sclerophyll Forests. Tree regeneration with <5cm diameter was assumed present if at least 1 plot showed presence.
Function – High threat Weed Cover		It will be anticipated that the cover of High Threat Weeds may reduce during construction but will persist in the long term and remain in-situ under the same/similar maintenance regime as Line 2.
Hand Clearing Zone (HCZ)		
Composition - tree	Set to '0'	Trees continually removed (via hand clearing) as part of long-term easement management
Composition - shrub	Line 2 data average for each management	There may be some disturbance to shrub and groundcover during construction but expected to regenerate in the long term and remain in mature condition in-situ under the same/similar maintenance regime as Line 2
Composition – grass, forb, fern, other		

Attribute	Application in BAM-C	Justification
Structure - tree	Set to '0'	Trees continually removed (via hand clearing) as part of long-term easement management
Structure - shrub	Line 2 data average for each management	There may be some disturbance to shrub and groundcover during construction but expected to regenerate in the long term and remain in mature condition in-situ under the same/similar maintenance regime as Line 2
Structure - grass, forb, fern, other		
Function – large trees	Line 2 data average for each management	Trees continually removed as part of long-term easement management, and it is anticipated that no large trees will occur. This is evident in the Line 2 data.
Function – litter cover		Litter cover may at first increase with the felling of trees and shrubs depending on level of ground disturbance. It is anticipated that over time litter will decay and not be replaced by debris from trees and shrubs. Low levels of litter are evident in the Line 2 data.
Function – length of fallen logs		The long term maintenance regime requires removal of most logs to improve maintenance within the easement. Limited log lengths are anticipated and is evident in the Line 2 data.
Function – stem class		A stem size class with an average ≥0.1 derived from the Line 2 data was applied to a future stem size class. It is anticipated that most of the larger stem class sizes will be excluded (ie >30cm). Although tree structure and composition are assumed absent for ECZ, the largest stem size class in Line 2 data is 20-29cm for Southern Tableland Dry Sclerophyll Forests. Tree regeneration with <5cm diameter was assumed present if at least 1 plot showed presence.
Function – High threat Weed Cover		It will be anticipated that the cover of High Threat Weeds may reduce during construction but will persist in the long term and remain in-situ under the same/similar maintenance regime as Line 2.
Hazard Tree Zone (HTZ)		
Composition - All	No change	All growth-forms remain in-situ, including non-hazard trees, shrubs, and ground growth forms will retain current VI condition
Structure - All	No change	
Function – large trees	'Number of large trees (>50cm DBHOB)' to zero	It is assumed that all trees in the large tree threshold for each vegetation zone will be considered a hazardous tree which will require removal.
Function – litter cover	No change	All growth-forms remain in-situ, including non-hazard trees, shrubs, and ground growth forms will retain litter cover condition.
Function – length of fallen logs	No change	Non-hazard trees and shrubs will retain current fallen logs. The length of logs may increase over time if any hazard trees are felled and retained in-situ, but it is difficult to estimate this future value score.
Function – stem class	Set 'Stem Class' for 50-79 cm to zero	It is assumed that all trees 50-79 cm stem class will be considered a hazardous tree which will require removal.

Attribute	Application in BAM-C	Justification
Function – High threat Weed Cover	No change	It will be anticipated that the cover of High Threat Weeds will persist in the long term and remain in-situ.

As a guide to the future outlook of transmission easement, Error! Not a valid bookmark self-reference. provides the mean condition score for each vegetation class from the Line 2 data applied to the treatments from **Table 10-2** for both the ECZ and HCZ management zones. This data was derived from **Appendix M**. The Southern Tableland Dry Sclerophyll Forests, Southern Tableland Wet Sclerophyll Forests and Upper Riverina Dry Sclerophyll Forests were applied to the benchmarks in the South Eastern Highlands Bioregion offset calculator and the Subalpine Woodlands applied to Australian Alps Bioregion offset calculator benchmark.

If the current observed mean of an attribute in a vegetation zone was below the reference data and benchmark, the observed mean was automatically kept as the future value in the BAM-C to ensure a conservative approach. Therefore, some future mean values will score lower than the Line 2 reference data. A stem size class with an average ≥0.1 derived from the reference data was applied to a future stem size class in the BAM-C. Tree regeneration with stems <5cm in diameter was assumed present if at least 1 plot showed presence. This sometimes resulted in an increase of the future function score where the current observed mean had a low score due to an absence of tree regeneration in most plots. It is reasonable to expect that with some disturbance tree regeneration becomes present in response to increased light and bare ground for tree germination. This is apparent for vegetation zone PCT 729_DNG.

Table 10-3 Line 2 vegetation integrity scores to represent future mean values for easement clearing zones and hand clearing zones (EMM consulting 2020a)

PCTs	Vegetation Class (PCTs)*	Management zones	Average condition scores applied			VI score
			Composition	Structure	Function	
296 729 999	Southern Tableland Dry Sclerophyll Forests	ECZ	50.2	26.4	33.9	**35.6**
		HCZ	80.7	45.4	33.9	**49.9**
300	Southern Tableland Wet Sclerophyll Forests	ECZ	36.6	26.9	2.6	**13.6**
		HCZ	47	32.3	2.6	**15.8**
285 302	Upper Riverina Dry Sclerophyll Forests	ECZ	42.4	34.8	20.2	**31.0**
		HCZ	61.9	54.3	20.2	**40.8**
1196	Subalpine Woodlands	ECZ	59.7	41.8	12.5	**31.5**
		HCZ	77.1	62.1	12.5	**39.1**

Table 10-4 provides a summary of type and condition of vegetation and area full and partial clearing for each management zone that is proposed to be impacted and is presented with the proposed future vegetation integrity score.

Table 10-4: Proposed full and partial loss of vegetation for each management zone and future vegetation integrity score (ECZ = Easement Clearing Zone, HCZ = Hand-clearing Zone, HTZ = Hazard Tree Zone)

PCT name	Vegetation zone / condition class	Clearing zones (ha)		Total impact (ha)	Current VI score	Change in VI	Future VI	Total VI loss
		Full loss	Partial loss					
SOUTH EASTERN HIGHLANDS BIOREGION								
PCT 296 Brittle Gum - peppermint open forest of the Woomargama to Tumut region, NSW South Western Slopes Bioregion	SEH-1 296_DNG	0.04	0.06 (ECZ)	0.10	39.5	-39.5 (full)	0 (full)	-26.4
						-17.8 (ECZ)	21.7 (ECZ)	
	SEH-2 296_Good, dry slopes	2.81	1.26 (ECZ)	4.07	88.7	-88.7 (full)	0 (full)	-72.2.1
						-48.1 (ECZ)	40.6 (ECZ)	
	SEH-3 296_Good, wet slopes	5.28	7.46 (ECZ)	13.56	75.3	-75.3 (full)	0 (full)	-50.4
						-38 (ECZ)	37.3 (ECZ)	
			0.82 (HTZ)			-2.8 (HTZ)	72.5 (HTZ)	
	SHE-4 296_Moderate Blackberry	-	1.17 (ECZ)	1.29	49.1	-43.3 (ECZ)	5.8 (ECZ)	-39.2
			0.12 (HTZ)			0 (HTZ)	49.1	
PCT 296 Total		**8.13**	**10.89**	**19.02**				
PCT 300 Ribbon Gum - Narrow-leaved (Robertsons) Peppermint montane fern - grass tall open forest on deep clay loam soils in the upper NSW South Western Slopes Bioregion and western Kosciuszko escarpment	SEH-5 300_Good	10.16	10.89 (ECZ)	23.19	81.1	-80.9 (full)	0 (full)	-69.6
						-68.5 (ECZ)	12.3 (ECZ)	
			0.37 (HCZ)			-66.3 (HCZ)	14.6 (HCZ)	
			1.76 (HTZ)			-11.9 (HTZ)	69 (HTZ)	
PCT 300 Total		**10.16**	**13.02**	**23.19**				
PCT 302 Riparian Blakely's Red Gum - Broad-leaved Sally woodland - tea-tree - bottlebrush - wattle shrubland wetland of the NSW South Western Slopes Bioregion and South Eastern Highlands Bioregion	SEH-6 302_DNG	-	0.18 (ECZ)	0.22	14.6	-7.7 (ECZ)	6.9 (ECZ)	-6.3
			0.04 (HTZ)			0 (HTZ)	14.6 (HTZ)	
	SEH-7 302_Moderate	0.58	1.42 (ECZ)	2.12	61.3	-61.3 (full)	0 (full)	-42.6
						-38.1 (ECZ)	23.2 (ECZ)	
			0.11 (HTZ)			-0.9 (HTZ)	60.4 (HTZ)	
PCT 302 Total		**0.58**	**1.75**	**2.34**				
PCT 729 Broad-leaved Peppermint -	SEH-8	0.52	0.14 (ECZ)	0.72	23.4	-23.4 (full)	0 (full)	-15.3

PCT name	Vegetation zone / condition class	Clearing zones (ha)		Total impact (ha)	Current VI score	Change in VI	Future VI	Total VI loss
		Full loss	Partial loss					
Candlebark shrubby open forest of montane areas, southern South Eastern Highlands Bioregion and South East Corner Bioregion	729_DNG		0.06 (HTZ)			+4.7 (ECZ)	28.1 (ECZ)	
						+8.9 (ECZ)	32.3 (ECZ)	
	SEH-9 729_Derived shrubland	0.61	-	0.61	36.6	-36.6	0	-36.6
	SEH-10 729_Good dry slopes	6.87	4.55 (ECZ)	12.82	81.5	-80.5 (full)	0 (full)	-61.3
						-43.9 (ECZ)	36.5 (ECZ)	
			1.09 (HCZ)			-28.6 (HCZ)	51.9 (HCZ)	
			0.32 (HTZ)			-5.8 (HTZ)	74.7 (HTC)	
	SEH-11 729_Good wetter slopes	6.06	3.72 (ECZ)	12.79	76	-72.2 (full)	0 (full)	-46.8
						-34.2 (ECZ)	38	
			1.49 (HCZ)			-19 (HCZ)	53.1	
			1.52 (HTZ)			-3.5 (HTZ)	68.7	
PCT 729 Total		**14.06**	**12.89**	**26.94**				
PCT 999 Norton's Box - Broad-leaved Peppermint open forest on footslopes, central and southern South Eastern Highlands Bioregion	SEH-12 999_Derived shrubland	1.14	0.20 (ECZ)	1.34	31.5	-31.5 (full)	0 (full)	-30.7
						-26.2 (ECZ)	5.2	
	SEH-13 999_Good dry Calytrix	4.99	2.09 (ECZ)	7.26	58.9	-58.9 (full)	0 (full)	-55.3
						-51.5 (ECZ)	7.4 (ECZ)	
			0.18 (HTZ)			-57.8 (HTC)	-1.1 (HTC)	
PCT 999 Total		**6.13**	**2.46**	**8.60**				
SUBTOTAL		**39.06**	**41.01**	**80.09**				
AUSTRALIAN ALPS BIOREGION								
PCT 285 Broad-leaved Sally grass - sedge woodland on valley flats and swamps in the NSW South Western Slopes Bioregion and adjoining South Eastern Highlands Bioregion	AA-1 285_Moderate Blackberry	2.20	-	2.2	78.7	-78.7 (full)	0 (full)	-78.7
PCT285 Total		**2.20**	-	**2.20**				

PCT name	Vegetation zone / condition class	Clearing zones (ha)		Total impact (ha)	Current VI score	Change in VI	Future VI	Total VI loss
		Full loss	Partial loss					
PCT 300 Ribbon Gum - Narrow-leaved (Robertsons) Peppermint montane fern - grass tall open forest on deep clay loam soils in the upper NSW South Western Slopes Bioregion and western Kosciuszko escarpment	AA-2 300_Good	4.70	3.55 (ECZ)	8.82	83.7	-83.7 (full)	0 (full)	-73.9
						-71.4 (ECZ)	12.3 (ECZ)	
			0.57 (HTZ)			-11.3 (HTZ)	72.2 (HTZ)	
PCT 300 Total		**4.70**	**4.12**	**8.82**				
PCT1196 Snow Gum - Mountain Gum shrubby open forest of montane areas, South Eastern Highlands Bioregion and Australian Alps Bioregion	AA-3 1196_DNG	0.09	-	0.09	38.6	-38.6 (full)	0 (full)	-38.6
	AA-4 1196_Good	24.85	2.04 (ECZ)	27.16	84.9	-84.9 (full)	0 (full)	-80.9
						-40.9 (ECZ)	44 (ECZ)	
			0.27 (HTZ)			-11.3 (HTZ)	73.6 (HTZ)	
PCT1196 Total		**24.93**	**2.31**	**27.24**				
SUBTOTAL		**31.83**	**6.42**	**38.26**				
GRAND TOTAL		**70.90**	**47.45**	**118.35**				

A summary of the direct impacts on threatened species habitat are outlined in **Table 10-5** for South Eastern Highlands and **Table 10-6** for the Australian Alps.

Table 10-5: Summary of direct impacts on threatened species habitat (species credit species) in the South Eastern Highlands

PCT name	Vegetation zone / Condition class	Clearing area (ha)					
		Caladenia montana	Gang-gang Cockatoo (breeding)	Masked Owl (breeding)	Eastern Pygmy-possum	Yellow-bellied Glider Population on the Bago Plateau	Booroolong Frog
PCT 296 Brittle Gum - peppermint open forest of the Woomargama to Tumut region, NSW South Western Slopes Bioregion	SEH-1 296_DNG	-	0.10	-	0.10	-	-
	SEH-2 296_Good, dry slopes	-	3.75	-	4.07	-	-
	SEH-3 296_Good, wet slopes	4.69	5.92	-	13.56	-	0.15
	SEH-4 296_Moderate Blackberry	-	1.29	-	1.29	-	-
PCT 296 Total		**4.69**	**11.06**	**-**	**19.02**	**-**	**0.15**

PCT name	Vegetation zone / Condition class	Clearing area (ha)					
		Caladenia montana	Gang-gang Cockatoo (breeding)	Masked Owl (breeding)	Eastern Pygmy-possum	Yellow-bellied Glider Population on the Bago Plateau	Booroolong Frog
PCT 300 Ribbon Gum - Narrow-leaved (Robertsons) Peppermint montane fern - grass tall open forest on deep clay loam soils in the upper NSW South Western Slopes Bioregion and western Kosciuszko escarpment	SEH -5 300_Good	1.56	17.33	0.04	23.19	15.49	-
PCT 300 Total		**1.56**	**17.33**	**0.04**	**23.19**	**15.49**	**-**
PCT 302 Riparian Blakely's Red Gum - Broad-leaved Sally woodland - tea-tree - bottlebrush - wattle shrubland wetland of the NSW South Western Slopes Bioregion and South Eastern Highlands Bioregion	SEH -6 302_DNG	-	0.22	-	-	-	-
	SEH-7 302_Moderate	-	2.12	-	2.12	-	1.26
PCT 302 Total*		**-**	**2.34**	**-**	**2.12**	**-**	**1.26**
PCT 729 Broad-leaved Peppermint - Candlebark shrubby open forest of montane areas, southern South Eastern Highlands Bioregion and South East Corner Bioregion	SEH-8 729_DNG	-	0.72	-	-	-	-
	SEH -9 729_Derived shrubland	-	0.61	-	0.61	-	0.08
	SEH-10 729_Good dry slopes	1.13	10.21	-	12.82	5.38	0.18
	SEH-11 729_Good wetter slopes	0.56	2.94	-	12.79	-	-
PCT 729 Total		**1.69**	**14.48**	**-**	**26.22**	**5.38**	**0.25**
PCT 999 Norton's Box - Broad-leaved Peppermint open forest on footslopes, central and southern South Eastern Highlands Bioregion	SEH-12 999_Derived shrubland	0.36	1.23	-	1.34	-	-
	SEH-13 999_Good dry Calytrix	1.05	4.59	-	7.26	-	-
PCT 999 Total		**1.41**	**5.82**	**-**	**8.60**	**-**	**-**
Total		**9.35**	**51.03**	**0.04**	**79.13**	**20.87**	**1.67**

Table 10-6: Summary of direct impacts on threatened species habitat (species credit species) in the Australian Alps

PCT name	Vegetation Zone	Clearing zones (ha)			
		Gang-gang Cockatoo (breeding)	Masked Owl (breeding)	Eastern Pygmy-possum	Yellow-bellied Glider Population on the Bago Plateau
PCT 285 Broad-leaved Sally grass - sedge woodland on valley flats and swamps in the NSW South Western Slopes Bioregion and adjoining South Eastern Highlands Bioregion	AA-1 285_Moderate Blackberry	2.20	0.03	2.20	2.20
PCT 285 Total		**2.20**	**0.03**	**2.20**	**2.20**
PCT 300 Ribbon Gum - Narrow-leaved (Robertsons) Peppermint montane fern - grass tall open forest on deep clay loam soils in the upper NSW South Western Slopes Bioregion and western Kosciuszko escarpment	AA-2 300_Good	8.82	5.82	8.82	8.82
PCT 300 Total		**8.82**	**5.82**	**8.82**	**8.82**
PCT 1196 Snow Gum - Mountain Gum shrubby open forest of montane areas, South Eastern Highlands Bioregion and Australian Alps Bioregion	AA-3 1196_DNG	0.09	-	-	-
	AA-4 1196_Good	27.16	4.97	27.16	27.16
PCT 1196 Total		**27.24**	**4.97**	**27.16**	**27.16**
Total		**38.26**	**10.82**	**38.18**	**38.16**

10.2 Indirect impacts

Section 1.2 of the BAM Stage 2 Manual (DPIE 2019b) defines indirect impacts as development related activities not associated with clearing for the development footprint. Paragraph 8.2 of the BAM lists potential indirect impacts that may result from construction and/or operation of a new development. The potential indirect impacts that are applicable to this project are discussed below. Note, there are no listed Threatened Ecological Communities in the disturbance area, although PCTs and habitat for threatened species is present and discussed previously. Though indirect impacts cannot be quantified, the potential for indirect impacts can be minimised through the application of stringent mitigation measures and monitoring the performance of these. The types of potential indirect impacts on native vegetation and threatened species (and their habitat) within a beyond the disturbance area are summarised in **Table 10-7** and described in more detail in the following sections. The discussion includes an assessment of the extent, duration and consequence of the impact.

The summary table below provides reference to the report section where each impact is assessed with the intent of providing a reference to follow the impact to the mitigation section of the BDAR (**Section 11**).

Table 10-7: Summary of potential indirect impacts on native vegetation and habitat for threatened species

Indirect impact (refers text following sections)	Impacted entities	Extent	Duration	Consequence
Clearing easement and access tracks: edge effect, displacement of fauna for life-cycle	Native vegetation associated with 7 PCTs and habitat for threatened species	The extent of the indirect disturbance buffer adjacent to the project is uncertain and subject to	Long-term	Negative changes to the structure and function of the adjoining vegetation

Indirect impact (refers text following sections)	Impacted entities	Extent	Duration	Consequence
activities (foraging, shelter, movement, breeding (**Section 10.2.1**)	adjoining the easement	monitoring and assessment		
Clearing easement and tracks: Increased sedimentation onto downstream habitat (**Section10.2.2**)	Booroolong frog habitat	Yarrangobilly River, Sheep Station Creek and Wallace Creek	Long-term	Loss of Booroolong frog (*Litoria booroolongensis*) habitat leading to decline in population
Weed Invasion and risk of pathogens (**Section 10.2.3**)	Native vegetation associated with seven PCTs and habitat for threatened species adjoining the easement. Indirect impacts of relocating spoil.	The extent of the indirect disturbance buffer adjacent to the project is uncertain and subject to monitoring and assessment	Potential long-term during construction and operation	Negative changes to the structure and function of the adjoining vegetation
Increase in predator and pest animal populations (**Section 10.2.4**)	Threatened fauna, and common fauna, particularly small mammal groups	Along the length of the transmission line	Potential short and long-term during construction and operation	Decline of threatened fauna populations
Collisions and electrocution of fauna with transmission lines (**Section 10.2.5**)	High risk species of birds and bats	Along the length of transmission line	Potential long-term during operation	Loss of resident pairs, particularly raptors and disturbance to breeding activity
Changed fire regimes during operation (**Section 10.2.6**)	Native vegetation and threatened species	Surrounding landscape including National Park and State Forest	Long-term during operation	Negative changes to the structure and function of the adjoining vegetation Direct mortality of fauna
Noise, vibration, and light pollution (**Section 10.2.7**)	Threatened fauna	The extent of the indirect disturbance buffer from the easement is uncertain	Short-term during construction	Disturbance to breeding activity
Dust pollution (**Section 10.2.8**)	Native vegetation and threatened species	The extent of the indirect disturbance buffer from the easement is uncertain	Short-term during construction	Negative changes to the structure and function of the adjoining vegetation
Contaminant pollution (**Section 10.2.9**)	Aquatic habitat	Yarrangobilly River and Wallace Creek	Potential long-term	Decline on habitat condition for aquatic species
	Booroolong Frog habitat	Yarrangobilly River and Wallace Creek	Long-term	Loss of Booroolong frog (*Litoria booroolongensis*) habitat leading to decline in population

10.2.1 Inadvertent impacts on adjacent vegetation and threatened species habitat

Nature, extent and duration of impact

The direct impact of clearing vegetation from the disturbance area is described previously, and will remove portions of seven PCTs with moderate to high vegetation integrity scores, and remove known habitat for threatened flora and fauna species. Areas of comparable vegetation and habitat also occur adjacent to and outside of the project disturbance area that may be indirectly impacted. Indirect impacts reportedly result in a reduced viability of the vegetation, and gradual decline in vegetation integrity and habitat value for threatened species. The indirect impact may displace resident threatened fauna through increased risk of exposure, and loss of shade or shelter, in turn interrupting movements and availability of breeding habitat. Species at greatest risk for this project are likely to include Eastern Pygmy Possum, Booroolong Frog, Yellow-bellied Glider, Gang-gang Cockatoo, and Greater Glider (if present). In-situ populations of *Caladenia montana* have been identified adjacent to the easement, outside of the easement clearing zone. These range from 5-150 m from the edge of the project and there is potential for some of these in-situ plants to be inadvertently impacted by changed abiotic conditions.

These indirect impacts could be reasonably expected occur in vegetation and habitat retained adjacent to the cleared easement and access tracks. This indirect impact specifically refers to negative changes to the structure and function of retained vegetation as a result of changed abiotic factors such as increased light intensity and duration, increased exposure to wind, and weed invasion in edge habitats, or displacement of soil into adjoining vegetation from areas of modified landforms These changes can have a negative impact on plant and animal species by changing habitat quality. The assessment of indirect impacts has been guided by Section 2.4.1 of the BAM Stage 2 manual. The case study (Box 2) in Section 2.4.1 describes the use of a 50 m buffer to capture the edge effects caused by a major road infrastructure project.

In post-construction much of the vegetation within the transmission easement zone will regenerate and be maintained during operation as low shrubs and intact ground layer. Bare surfaces will be limited to access tracks used for maintenance and around structures. The level of traffic following completion of construction will be minor and associated with maintenance and management of vegetation. As such, it is expected that weed spread will be typically limited, however the extent of weed spread and reduced vegetation integrity from the project edge is unknown and will require monitoring.

Other edge effects associated with a change in abiotic conditions will vary in distance from the edge, and the extent of the indirect impact has not been quantified for the purposes of generating offsets for indirect impacts. To assess this potential indirect impact, monitoring is proposed during and post-construction and the details of this monitoring program will be described in the Biodiversity Management Plan (BMP) to be developed post-approval. For example impacts on avifauna communities have been documented up to 125 m from the edge of powerlines (Baker, et al 1998) and further assessment required where threatened bird species are known or expected. Any impacts determined post-construction will be reported as part of the BMP adaptive management strategy.

The primary expected indirect impact from this project is an increase in exotic plant diversity and cover along the full length of new edges on both sides of the easement, particularly in areas already containing any cover of weeds. The largest impacts will be from species such as Blackberry (*Rubus fruticosus* species agg.), which will cause a flow-on effect of a reduction in native groundcover over time.

Mitigation and offset strategies

A suite of mitigation measures are proposed to avoid and minimise the disturbance to retained vegetation adjacent to the project during the construction phase. These are documented in **Section 11** and include but are not limited to placing exclusion zones around clearing limits, applying standard sediment and erosion control measures, hand-clearing in sensitive areas and steeper slopes and applying methods to prevent the transportation of weeds and pathogens.

It is difficult to quantify any loss in vegetation integrity in edge retained areas or the extent of this loss, and offset credits have not been generated for indirect impacts. Monitoring of vegetation integrity in adjacent areas will be conducted to identify any decline in condition relative to set performance criteria. Where measurable declines are identified, the area will be quantified and offsets applied.

10.2.2 Sedimentation into downhill stream habitat of threatened species

Nature, extent and duration of impact

Due to the steepness of the terrain and location of the project, it is evident that the direct clearing of vegetation for the disturbance area has potential to displace sediment, and in the event of heavy rainfall transport sediment along drainage lines eventually flowing into streams that provide habitat for threatened species. The following discusses the landscape and potential for downhill flow of sediment into the habitat of threatened species.

- The western portion of the project area contains the second order streams of Yorkers Creek, Native Dog Gully and New Zealand Gully that are fed by smaller ephemeral first order streams. Yorkers Creek eventually flows to the Tumut River at the Talbingo Reservoir. In the south of the substation site, New Zealand Gully flows into Native Dog Creek which flows into New Maragle Creek and eventually also flows into the Tumut River. West of the Talbingo Reservoir, the new structures will be built on steep ridges that are drained by first order streams flowing down the steep terrain into the Tumut River to the east

- East of the Talbingo Reservoir, the easement traverses ridges that are drained by first and second order streams. The streams on the western side of Sheep Station Ridge flow west down the steep slopes into the Tumut River at the Talbingo Reservoir. On the eastern side of Sheep Station Ridge, the area is drained by a number of first and second order streams that join flow into 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. Lick Hole Gully and Cave Gully flow into the Yarrangobilly River. Further to the east the project area crosses more first and second order streams and the larger fifth order stream of Wallaces Creek that also flows into the Yarrangobilly River.

Populations of Booroolong Frog and Murray Crayfish have been confirmed in Yarrangobilly River and Wallace Creek, and the Macquarie Perch is considered to potentially occur in the Tumut River and Talbingo Reservoir, although has not been confirmed. The potential for sediment to flow from the steep slopes either side of the Talbingo Reservoir is considered low, due to the fact that the transmission line has been designed to span these steep slopes and sediment and erosion controls around structure sites will effectively mitigate this issue.

The greatest risk is displaced sediment entering Yarrangobilly River via the slopes and ridge east of Lobs Hole Ravine road and associated with Sheep Station Creek, Lick Hole Gully, Cave Gully and Wallace Creek. The easement will directly cross over this slope and while vegetation clearing will be largely avoided in these gullies, there is a proposed access track crossing Sheep Station Creek, and partial clearing zones within proximity to the riparian corridor of Wallace Creek, and upstream environments along Lick Hole Gully and Cave Gully.

Any increased deposition of sediment into the Yarrangobilly River and Wallace creek could result in impacts to the habitat of Booroolong Frog and Murray Crayfish. Indeed, the Booroolong Frog national recovery plan (OEH 2012a) describes the most significant threat to the viability of Booroolong Frog populations is through smothering and entraining of rock crevices by sediments, and subsequent vegetation impacts, which reduces the quality and extent of breeding habitat for this species (Hunter 2007; in OEH 2012a). Sediment has potential to transport downhill from the cleared sections of the project area described for east of the Lobs Hole Ravine road (via the ephemeral drainage lines) and while ground cover vegetation will eventually recover in the ECZ, during the construction phase and early operational phase, any areas of exposed soil on these slopes presents the risk of sedimentation until this vegetation cover returns. There will be no use of heavy machinery in the riparian zones. The introduction of the partial clearing zones are likely to reduce the risk of erosion and sedimentation from the project to downstream waterways where parts of the groundcover in the ECZ, HCZ and HTZ will remain partially intact or intact, and reduce soil disturbance.

Over the long-term operational phase, the recovery of ground layer vegetation in the disturbance area will be expected to prevent further movement of sediment.

Mitigation strategies

A range of mitigation measures will be implemented to prevent sediment entering waterways in general, and specifically the habitat for Booroolong Frog and Murray Crayfish and these will be documented in the Soil and Water Management Plan (SWMP) and the Biodiversity Management Plan. A summary of these include:

- Final design for the permanent crossing structures on access roads (such as Sheep Station Creek) will focus on options that ensure stream flow is unaffected
- Exclusion zones around Yarrangobilly Creek, Wallace Creek and Sheep Station Creek and exclusion of heavy machinery from the riparian zone, which will be hand-cleared only
- The SWMP will include stringent controls to mitigate impacts of runoff and sediment transfer from the project area during construction and operation. Controls measures will remain in situ until site stabilisation completion criteria are met
- An assessment of the current sediment basin design for the Main Works project to determine if the design specifications are suitable for the additional sediment load expected during construction of the project. Where modification or augmentation is required, sediment basins will be increased in size to cope with any additional expected sediment load.

10.2.3 Transport of weeds and pathogens

Nature, extent and duration

The activities associated with clearing vegetation and increased human presence during construction and operation have potential to introduce weeds into adjacent vegetation outside the project as well as increase the risk of introducing plant and animal diseases. The exact distance from the disturbance area that weeds may become established in adjoining vegetation is uncertain, but is predicted to potentially up to 50 m. Indirect impacts may occur by relocating spoil to the disturbance footprint or to offsite locations, due to permanent changes to landforms, spreading of soil and impacts to biodiversity from ancillary activities for off-soil disposal. The location of the off-site spoil repository is unknown and any soil which cannot be reused onsite as fill material, landscaping or other means will be disposed of off-site at a suitably licenced facility and/or at a location(s) onsite approved by FCNSW.

Water dispersed weed seeds have potential to be transported downhill from the cleared sections of the easement via the ephemeral drainage lines and creeks. This may increase the spread and introduction of weeds into downstream Yarrangobilly River floodplain.

A consolidated list of plant species from the flora survey identified that only 10% were exotic species, representing currently low weed diversity. A list of weed species identified from the survey and their mechanism for dispersal is identified in **Table 10-8**, of these five species are considered high threat weeds including Blackberry (*Rubus fruticosus* agg.), Sweet Briar (*Rosa rubiginosa*), Red Sorrell (*Acetosella vulgaris*), Velvet Grass (*Holcus lanatus),* St Johns Wort (*Hypericum perforatum)*.

Table 10-8: Weed species identified from targeted flora survey (high threat species are identified with asterisk)

Species	Dispersal Mechanism
Acetosella vulgaris *	Produces numerous seeds, but can also spread rapidly vegetatively, at least locally, due to its extensive rhizome system
Aira caryophyllea	Seeds are small and could be dispersed by wind currents. Seeds may also get caught in the fur, feathers or hair of animals and be dispersed.

Species	Dispersal Mechanism
Aira elegantissima	The seeds can be dispersed by animals, by attaching to the fur, feathers, or hair, and can also be dispersed by wind.
Aira sp.	The seeds can be dispersed by animals, by attaching to the fur, feathers, or hair, and can also be dispersed by wind.
Anagallis arvensis	Seed falls from the parent plant and may be moved short distances by wind and water, and with any soil movement. Seed germinates from spring through to autumn.
Briza maxima	Seeds can be dispersed by water or wind, or in mud attached to animals or vehicles. Seeds may also be spread by mowers or slashers (of roadside vegetation) and that distant dispersal could result from movement of agricultural products such as hay or other fodder.
Cardamine hirsuta	Seeds are dispersed by explosive coiling of the fruit valves in Cardamine hirsuta. This rapid coiling launches the small seeds on ballistic trajectories to spread over a 2 m radius around the parent plant. Seeds may also be spread by water and in contaminated soil.
Centaurium erythraea	The seeds can be dispersed by animals, by attaching to the fur, feathers, or hair, and can also be dispersed by wind.
Cerastium glomeratum	A small capsule with tiny teeth splits open to disperse several seeds. The seeds can be dispersed by animals, by attaching to the fur, feathers, or hair, and can also be dispersed by wind.
Cerastium vulgare	The seeds can be dispersed by animals, by attaching to the fur, feathers, or hair, and can also be dispersed by wind.
Cirsium vulgare	Seeds are short-lived on the soil surface but can persist for many years when they are buried, such as from cultivation activities. Spreads freely by means of seed which can be dispersed by the wind over a large area.
Conyza bonariensis	Conyza bonariensis is principally a wind-dispersed species, facilitated by light seed accompanied by a pappus which aids flight. Mowing along roadsides, especially during seed production, is likely to increase spread.
Conyza sp.	Conyza is principally a wind-dispersed species, facilitated by light seed accompanied by a pappus which aids flight. Mowing along roadsides, especially during seed production, is likely to increase spread.
Erythranthe moschatus	The seeds can be dispersed by animals, by attaching to the fur, feathers, or hair, and can also be dispersed by wind.
*Holcus lanatus **	Seeds may be spread by wind and water movement, by adhering to clothing, animals, and vehicles, in mud and contaminated soil, in dumped garden waste, and in contaminated agricultural produce.
Hypericum endosteum	Small seeds readily contaminate agricultural produce, vehicles, machinery, animals, water, and mud. Dispersal also occurs by birds.
*Hypericum perforatum **	Seeds are dispersed by water, animals, vehicles, and wind. They may also be transported in mud, soil, and contaminated agricultural produce. Localised spread of colonies also occurs via the rhizomes, which can also be dispersed some distance during cultivation or other activities that disturb the soil.
Hypochaeris radicata	The species large number of seeds are mainly dispersed by wind. Birds are known to disperse the fruit by attachment to their feet and plumage, and ants have been observed carrying seeds
Medicago polymorpha	The non-dehiscent fruits are relatively large and are unlikely to move far from the parent plant, except perhaps in flood waters. Seeds are dispersed by adhering to animals.
Medicago sp.	The hooked spines commonly found on the fruits allow the entire burrs to adhere firmly to fur, wool, hair, and feathers.
Modiola caroliniana	The seeds can be dispersed by animals, by attaching to the fur, feathers, or hair, and can also be dispersed by wind.
Petrorhagia dubia	The seeds can be dispersed by animals, by attaching to the fur, feathers, or hair, and can also be dispersed by wind and excavation of soil.
Petrorhagia nanteuilii	The seeds can be dispersed by animals, by attaching to the fur, feathers, or hair, and can also be dispersed by wind and excavation of soil.
Potentilla recta	Seeds are wind-dispersed and travel an average 0.27 m from the parent plant. Long-distance dispersal via animals (in fur, hooves, etc.), people (seed heads readily attach to fleece, jeans, and boots), and vehicles is also likely. Seeds may also be carried in melting snow and surface flows.
Prunella vulgaris	Seeds may be dispersed by invertebrates and vertebrates, particularly as seeds have shown they are sticky when wet.

Species	Dispersal Mechanism
Prunus cerasus	Many of the fruits are readily eaten by numerous birds and mammals, which digest the fruit flesh and disperse the seeds in their droppings.
*Rosa rubiginosa**	Seeds are most commonly dispersed by birds and other animals (e.g. foxes) that eat the fruit. They may also be spread in water, soil excavation and dumped garden waste.
Rubus fruticosus agg*	There can be up to 13,000 seeds per square metre under a blackberry bush at the end of a fruiting season. Birds and animals feeding on the berries spread the seeds in their droppings. Seeds also spread by water and with soil.
Salvia verbenaca	This species reproduces via seed, which are dispersed by water and in mud adhering to animals, machinery and vehicles. They may also be dispersed in contaminated agricultural produce.
Sonchus oleraceus	This species spreads entirely by seed. The seeds are equipped with a small pappas, or parachute of hairs, which may carry the seed over large distances in strong winds. Seeds lying on the ground may also be transported in moving water.
Taraxacum officinale	After flowering, the scapes of Taraxacum officinale complex elongate significantly, allowing enhanced wind dispersal of seeds. The seeds have pappi that further aid in dispersal by wind. Seeds are also dispersed in the excreta of animals such as cattle, horses and birds.
Trifolium arvense	The seeds are dispersed by wind, water, birds, and grazing animals.
Trifolium campestre	The seeds are dispersed by wind, water, birds, and grazing animals.
Trifolium pratense	The seeds are dispersed by wind, water, birds, and grazing animals.
Trifolium repens	The seeds are dispersed by wind, water, birds, and grazing animals.
Verbascum virgatum	Seed dispersion requires the stem to be moved by wind or animal movement; 75% of the seeds fall within 1 m of the parent plant, and 93% fall within 5 m. Additionally, potential dispersal agents include wind, water, animals, and vehicles. Seeds may also be spread in mud and as a contaminant of agricultural produce.
Vulpia myuros	Spikelets disarticulate when ripe and release individual florets. These usually fall near the parent plant and can become dispersed by wind and water. Any disturbances exposing bare ground favor establishment of the species and contribute to its spread. Dispersal units of this species is not particularly well adapted to wind-dispersal but due to their long awns they easily attach to hair, feathers and clothing. Long-distance dispersal is thus most likely by animals or people.
Vulpia sp.	Any disturbances exposing bare ground favour establishment of these species and contribute to its spread. Dispersal units of these species is not particularly well adapted to wind-dispersal but due to the long awns they easily attach to hair, feathers, and clothing. Long-distance dispersal is thus most likely by animals or people.

<u>Mitigation strategies</u>

The list of weeds reported from the study area and shown in **Table 10.5**, includes information on the dispersal mechanisms of the plant. This information is provided to assist in developing appropriate weed control advice in the preparation of the Biodiversity Management Plan and the Rehabilitation Plan. Further advice on mitigation measures for controlling weed species are discussed in **Section 11** and focus on control of the high threat weeds prior to clearing, and ongoing monitoring of weed invasion in adjoining habitat during construction as a part of an adaptive management plan. The exact distance from the disturbance area that weeds may become established in adjoining vegetation is uncertain, but is predicted to potentially up to 50 m. Monitoring of priority weeds in adjacent vegetation is therefore important as part of the adaptive management strategy (refer **Section 11**).

10.2.4 Increase in predator and pest animal populations

<u>Nature, extent and duration of impact</u>

Predator and pest species refer to foxes, dogs, cats, feral horses, pigs, and rabbits, all of these species have been reported in the study area during the ecological surveys. There are a number of factors that suggest the project could lead to a short-term increase in predator and pest species activity at least during the construction phase. As the project will involve increased human activity in heavily forested environments that currently experience low levels of human activity, this presence may mean more opportunity for food waste and waste disposal, encouraging scavenging. Secondly, the removal of vegetation and habitat will lead to the temporary displacement of native fauna from occupied habitat and present greater opportunity for predation by feral predators exploiting this situation and may lead to increased activity and abundance of predators over the construction phase of the project.

During the operational phase, it is likely that the cleared disturbance area will be favoured by feral horses for grazing and also movement throughout the landscape. The 'right of way' of a cleared transmission line corridor may function as a wildlife corridor connecting areas of habitat. The literature indicates that large carnivores exhibit a strong preference to move through rights of way (Donida Biasotto and Kindel, 2018). This has implications for the increased movement of introduced vertebrate pests including foxes and dogs. Introduced herbivores, particularly horses and deer, were observed preferentially grazing in the Line 64 easement in the Australian Alps portion of the project area. This indicates that the creation of a power line easement through currently densely forested areas is likely to create further grazing habitat for horses and deer and may open up areas of habitat that currently have lower pest species densities.

Mitigation strategies

Refer to **Section 11** for mitigation measures to minimise the potential for increase predator and pest species activity during construction. This includes appropriate removal and storage of waste products generated at construction sites and by construction personnel. Monitoring is proposed to assess any significant change in predator and pest species in proximity to the project and inform the need for control measures.

10.2.5 Collisions and electrocutions of fauna with transmission lines

Nature, extent and duration of impact

Collisions and electrocutions of birds and bats with transmission lines is an uncertain operational impact that must be considered. Transmission lines carry the unique risk of electrocution. The most commonly reported impacts of transmission lines in the literature is the death and injury of birds due to electrocutions and collisions with wires (see Richardson *et al.*, 2017). The reported impacts of transmission lines associated with electrocution and collision include abandonment of territories where the risk of electrocution is high and increase in scavenger activity, and perhaps the population size of scavengers, near transmission lines because of the availability of bird carcasses (see Richardson *et al.*, 2017). While there was no obvious evidence of electrocuted birds or bats noted opportunistically during surveys (although no targeted surveys were undertaken as part of this assessment) under the existing Line 64 or other transmission lines, there is an increased risk of bird and bat electrocution, particularly to raptors, from the project as a new transmission line will be introduced into the environment.

Transmission lines can be used as a resource by fauna, being used for perching, nesting, roosting, and scavenging of electrocuted birds (Donida Biasotto and Kindel, 2018). Birds can frequently be seen in the locality using transmission lines and structures as perches. However, these structures are unlikely to be used as a significant resource for nesting as no evidence of structures being used as a nest site was observed during the survey.

A high level risk assessment is presented in **Appendix J** summarising overall risk for species that likely occur in the study area, based on risk factors for each species, likelihood and historical evidence of incidents and consequences of potential incidents to species, e.g. higher consequences for threatened species with smaller population numbers. Both common and threatened species of birds and bats were considered. All the bat species that were identified in the study area have low potential for collision given they all fly within or below the canopy, and have smaller wing spans. The EPBC Act and BC Act-listed Grey-headed Flying-fox may have potential to collide with transmission lines, given wing-span (up to 1180 cm, Churchill 2008) and habit of flying high above the canopy distant from camps sites (up to 50 km). However, this species was considered to have a low likelihood potential for occurring in the study area, given closest known camp is >130 km from the project area, and no flying-foxes were recorded from the nocturnal surveys. Given the species has conservation significance, adaptive management will need to be considered if they moved into the area.

Based on the information presented in **Appendix J**, the highest risks to birds and bats from the project are considered to be species which are:

- large bodied
- have poor flying ability, or low agility
- nocturnal, or disperse at dawn or dusk, given the lack of literature
- likely to migrate into and out of the region from nearby wetlands / or Reservoirs with wetlands habitat features and are therefore required to cross the proposed line (e.g. There are no naturally occurring wetlands in the project area, however the transmission lines will span across the Talbingo Reservoir, which is not a naturally occurring wetland, however, does offer wetland habitat features),
- threatened or conservation significant species which have low population numbers
- require a longer take off / landing distance (e.g. birds / bats with larger wing spans).

The summary of risk factors for species known to occur at in the study area or occur in KNP (**Table J-2**) indicated, species with higher 'likelihood' of impacts include:

- Larger to very large birds such as cormorants, egrets, Straw-necked Ibis, Black Swans and Pelicans (populations of these species are expected to be low given the largely forest and woodland habitats present)
- Smaller to moderate, but heavier bodied, flock forming species such as ducks and grebes (also expected to be low due to low presence of suitable habitat)

Species with moderate 'likelihood' of impacts include:

- Larger birds such as moderate to large raptors which have good eyesight, but may be 'behaviourally distracted' when swooping for or carrying prey, some are also fast fliers and have less time to change course (e.g. Peregrine Falcon, Little Eagle, White-bellied Sea Eagle, Grey-headed Flying-fox, if present)
- Smaller to moderate night dispersing species or nocturnal predators such as forest owls. These species aren't likely to be present in large numbers, and are more likely to be hunting closer to the ground or vegetation, with eyes adapted for nocturnal hunting.

Species with elevated consequence of potential impacts include:

- Species with smaller global or local populations such as the White-bellied Sea-eagle or species with decreasing populations (e.g. Goshawk)
- Species with conservation ratings such as threatened species (White-bellied Sea-eagle, Peregrine Falcon, Little Eagle, Masked Owl, Powerful Owl).

It is difficult to predict the consequences of any impacts to individual birds and pairs for the bioregional persistence of the threatened bird species identified. A summary of recent data from January 2000 – December 2020) is provided in Appendix J for the species with ABBBS records for recovered birds. There is a total of 3,861 records (from 47 species) nationally of recovered dead birds during this period. Of these records, 47 deaths (only 1.2%) were attributed to powerlines. The species with deaths attributed to powerlines were generally large wingspan species (Black Swan, Pelican, White Ibis, Magpie Goose, Bush Stone Curlew), heavy bodied / non-agile species (one Moorhen, Pacific Black-Duck) and fast flying species (Terns, Peregrine Falcon). The project is located within an extensive area of habitat associated with KNP, and surrounding state forests on private forested land suggesting that suitable and available habitat is abundant and widespread and that local populations will persist over the long-term particularly given the predicted low collision rates.

<u>Mitigation strategies</u>

Examples of appropriate measures for higher risk species include deploying species specific bird divertors, with day/night reflectors within appropriate buffer distance, along key sections of transmission line. This will be appropriate for diurnal and nocturnal birds. The BMP is to include adaptive management for high-risk bird and bat species:

- Regular monitoring in transmission line easements for evidence of bird / bat collision with transmission lines
- Regular monitoring of taller structures for evidence of raptor nest building
- Develop target trigger for number of high risk species incidents
- Deploy species specific bird / bat divertors / reflectors in areas where a defined number of incidents have occurred.

10.2.6 Changed fire regimes during operation

<u>Nature, extent and duration of impact</u>

A bushfire risk assessment has been completed as part of the EIS (Appendix F of the EIS). The installation of a transmission line into a densely vegetated landscape such as the KNP and Bago State Forest will increase the risk of fire ignition, potential causing fires that have the potential to spread far from the disturbance area. An altered fire frequency could have a detrimental long-term impact on flora and fauna populations, forest structure and weeds. Bird electrocution is a frequent cause of fires in hot climates (Manville, 2005), as are faulty transmission lines.

<u>Proposed avoidance and mitigation</u>

Fire risk will be managed in accordance with standard Transgrid procedures to minimise the chance of a fire starting from the transmission line. Bushfire mitigation measures are provided in **Section 7.10** of the bushfire risk assessment report (Appendix F of the EIS). The proposed operational vegetation maintenance activities to be conducted along the ECZ and HTZ, are designed to avoid and significantly decrease the risk of fire.

10.2.7 Noise, vibration, and light impacts

<u>Nature, extent and duration of impact</u>

Anthropogenic noise can alter the behaviour of animals or interfere with their normal functioning (Bowles, 1997). During all phases of the project there will be increased noise and vibration levels in the study area and immediate surrounds due to vegetation clearing, ground disturbance, machinery and vehicle movements, and general human presence. The predicted noise and vibration created by the project is outlined in Section 7.8 of the EIS. Noise impacts during operation are expected to be minimal and localised to the substation. The construction of the project will generally occur from 6am to 6pm and is expected to last 2.5 years (30 months) and the key sources of noise will include:

- Construction traffic – predicted impacts include an increase in noise along haulage roads at night. It is concluded that additional traffic movements from project construction activities are not expected to result in unacceptable changes in traffic noise levels at sensitive receivers along the intended haulage routes, however this will result in increased impacts in the immediate surroundings of the project
- Construction vibration – hydraulic rock breakers and vibratory rollers, as well as blasting activities.

Based on the information provided above, construction activities will likely result in an increase in ambient noise levels (mainly an increase from current night noise levels) as well as potentially loud noise and vibration for short periods associated with earth works. The noise and vibration from activities associated with the project will occur periodically over the 2.5-year construction period and will potentially disturb resident fauna and may disrupt foraging, reproductive, or movement behaviours of the short construction life-cycle. During breeding season of hollow-dependent fauna species, some individuals may be disturbed. The impacts from noise emissions are likely to be temporarily localised to the construction areas and immediate surrounds and moving as the construction progresses. These emissions are not considered likely to have a significant, long-term, impact on wildlife populations outside the area of impact. Within the area of impact (including habitats immediately adjacent to the disturbance area), some sensitive species (e.g. woodland birds and hollow-breeding mammals) may avoid the noise and some more tolerant species, including small mammals, will habituate over the longer-term.

Ecological light pollution is the descriptive term for light pollution that includes direct glare, chronic or periodic increased illumination, and temporary unexpected fluctuations in lighting (including lights from passing vehicles), that can have potentially adverse effects on wildlife (Longcore and Rich, 2004).

There are no planned night works that will be associated with the construction of the project. The construction hours will be conducted between 6am to 6pm. During winter, lighting may potentially be required in the early mornings and late afternoons.

During operation, the substation will require security lighting at all hours of the night, including interior and exterior lighting. The external low-level lighting will be installed in a manner that aims to minimise light spill to areas beyond the substation boundary fence, however there is likely to be some small amount of light pollution projected into the surrounding vegetation. The ecological light pollution may potentially affect nocturnal fauna by interrupting their life cycle, such as the Squirrel Glider, Yellow-bellied Glider, Greater Glider and Eastern Pygmy Possum, who are expected to remain around the substation. However, the amount of light spill is expected to be very low and the area around the substation is already exposed to some level of disturbance from the road and existing easement. It is likely that any nocturnal animals present will habituate over the long-term. Some species such as light tolerant microchiropteran bats may benefit from the lighting due to increased food availability (e.g. insects attracted to lights) around these areas.

Assuming that lighting is designed and installed to limit light spill, the impact of the residual light spill is unlikely to significantly affect any nocturnal species in the area.

<u>Mitigation strategies</u>

A number of measures are proposed and these are described in **Section 11**. This includes minimising noise from equipment through measures such as keeping both stationary and mobile plant and equipment in good working condition (including mufflers, enclosures etc), and avoid leaving engines running on standby for extended periods of time and selecting equipment with the lowest noise rating that meets task requirements and minimise operating loud machinery conjunctively

10.2.8 Dust impacts

<u>Nature, extent and duration of impact</u>

Elevated levels of dust may become deposited onto the foliage of retained vegetation adjacent to the project during construction activities, particularly during hot and dry conditions. This has the potential to temporarily reduce the process of photosynthesis and transpiration and cause abrasion and radioactive heating resulting in reduced growth rates and decreases in overall health of the vegetation. Consequently, changes in the structure and composition of plant communities and consequently the grazing patterns of fauna may occur.

Some level of dust is likely to be generated throughout the lifecycle of the project due to the clearing of vegetation, although dust pollution is likely to be greatest during construction, during periods of substantial earthworks, vegetation clearing, vehicle movements for construction and decommissioning activities and during adverse weather conditions (i.e. high wind). However, deposition of dust on foliage is likely to be highly localised, intermittent, and temporary (particularly during the wetter seasons) and is therefore not considered likely to be a major impact of the project. The likelihood of dust pollution occurring over the long term operational phase is considered very low and negligible.

<u>Mitigation strategies</u>

Adaptive dust management and monitoring programs using industry best practices and standards to control air quality will be implemented. No dust generating works will be conducted during high winds and stockpiles will be kept covered with material to prevent the generation of dust in addition to applying water dust suppression techniques during dust generating activities.

10.2.9 Contaminant pollution

Nature, extent and duration of impact

During the construction phase, localised release of contaminants (i.e. hydraulic fluids, oils, drilling fluids, etc.) into the surrounding environment (including drainage lines) may accidentally occur. The most likely result of contaminant discharge will be the localised contamination of soil, waterways, and potential direct physical trauma to flora and fauna that come into contact with contaminants. Accidental release of contaminants is likely to be localised.

Mitigation strategies

Control measures will include ensuring that accidental spills are immediately reported and remediated, contaminated water will be separated from stormwater and will be managed in a process water system and on-site signage will be provided to identify contaminated topsoils of relevant.

10.3 Prescribed biodiversity impacts

The prescribed impacts identified in Stage 1 of the BAM have been assessed in accordance with section 8.3 of the BAM, taking into consideration into account the nature, extent, frequency, duration and timing of prescribed impacts that may occur. These are impacts that are in addition to, or instead of, impacts from clearing vegetation and/or loss of habitat.

10.3.1 Karst, caves, crevices, cliffs, rocks and other geological features of significance

Nature, extent and duration of impact

The Pleistocene glacial landforms in KNP are the only examples of this landform on the mainland of Australia and are of national and international significance (OEH 2012b). The periglacial features of the park include terracing, solifluction loces, sliding and shattered boulders and block streams (also known as scree slopes or boulder streams). Periglacial features are more extensive than glacial features in KNP and are widespread and there is potential for impacts on these features, where currently unknown. Periglacial evidence is found in most areas above 1,000 m asl and possibly as far down as 600 m asl. There is a block stream along Lobs Hole Ravine Road to the south of the project area. This block stream will not be directly impacted by this project.

The tufa deposits and fossil sequence at Ravine are recognised in the KNP PoM as a significant natural feature. There are two tufa deposits near the project area. The Cave Gully deposit (**Photo 10-3** and **Photo 10-4**) is in Cave Gully approximately 1 km upstream of the Lobs Hole Copper Mine. The Lick Hole Gully Tufa is deposited near the headwaters of Lick Hole Gully and are visible from Lobs Hole Ravine Road. These tufa deposits occur to the south of the project area but will not be directly impacted. Karst features are considered to be rare within the Lick Hole Formation as there is a general lack of massive limestone. **Figure 4-1** and **Figure 4-3** illustrate the locations of rocky outcrops identified during surveys.

A low exposed cliff line is also present to the south of Mine Trail Road (**Photo 10-1**, **Photo 10-2** and **Photo 10-7**) though is outside of the study area and will not be directly impacted by the project.

The candidate list of threatened species using or dependent on these habitat features (species found in the caves, rock fissures, etc. class) includes the Dusky Woodswallow, Spotted-tailed Quoll, Booroolong Frog, Large Bent-winged Bat, Southern Myotis, Masked Owl, and Rosenberg's Goanna. Any caves and rock fissures associated with the tufa deposits at Ravine may support sheltering or roosting habitat for species including the Dusky Woodswallow, Spotted-tailed Quoll, Large Bent-winged Bat, Southern Myotis, Masked Owl, and Rosenberg's Goanna but these areas are outside of the project area and will not be impacted by the project.

Due to the nature of the project, it is considered unlikely that the environmental processes critical to the formation and persistence of the unique natural features of the area of karst, geological features of significance, and cliff fall will be impacted as these key areas are located outside of the project area. The project is not expected to have any consequences for the persistence of the suite of threatened species likely to use these areas as habitat as these features will not be directly affected.

Photo 10-1: The cliff line to the south of Mine Trail was examined for potential bat and bird roost sites

Photo 10-2: The cliff line to the south of Mine Trail was examined for potential bat and bird roost sites

Photo 10-3: Cave gully showing limestone

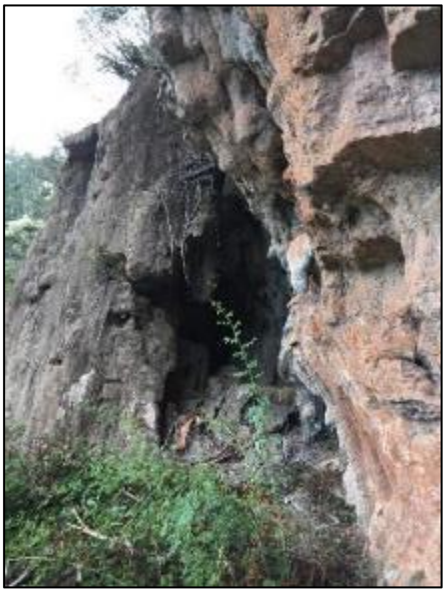


Photo 10-4: Cave gully showing limestone

The project area does have some occurrences of rock, mostly in the South Eastern Highlands portion where outcropping of sedimentary rocks occurs on the ridge tops and upper slopes. There are also some rare occurrences of volcanic boulders in the project area within the Australian Alps Bioregion (**Photo 10-5** and **Photo 10-6**) and there is also the quarry off Elliott Way with exposed rock cuttings. **Figure 4-1** and **Figure 4-3** illustrate the locations of rocks including outcrops and any scattered boulders. The figures also show the locations of more significant rock outcrops and cliff lines found outside of the project area including those on the Stable Walls and nearby outcrops. A low exposed cliff line is also present to the south of Mine Trail Road (**Photo 10-1**, **Photo 10-2** and **Photo 10-7**) and is the largest rocky habitat feature in the broader area though is outside and above slope of the study area and will not be directly or indirectly impacted by the project.

The threatened species subject to this assessment that are known to be associated with rocks (species found in the rocky cliffs, major rock outcrops etc. class) include the Dusky Woodswallow, Spotted-tailed Quoll, Little Eagle, Large Bent-winged Bat, Southern Myotis, Masked Owl, and Rosenberg's Goanna. The rocky outcrops and scattered rocks within the project area are likely to be used as refuge and foraging habitat by species including the Spotted-tailed Quoll and Rosenberg's Goanna and the rocky areas are likely to be within a home range of the Little Eagle. However, these three species are unlikely to be dependent on the rocky areas and the rocks are unlikely to be a limiting habitat. No evidence of den sites or latrine sites or sheltering sites were present in the project area. The Little Eagle is not dependent on these rocky areas within the project area for foraging. There are no significant open cliff faces with crevices or caves within the project area that may be suitable as shelter or roosting sites for the Dusky Woodswallow, Large Bent-winged Bat, Southern Myotis, or Masked Owl. Booroolong Frog habitat is restricted to the rocky drainage lines and not the ridges where rock outcrops occur.

The rocky outcrops are unlikely to be removed by the project. The structures will be built on the ridges and the transmission lines will span across the outcrops. Vegetation removal will be required but it is unlikely that the rocky outcrops will be removed. Two of the access roads are positioned over a small rocky outcrop, which will result in impacts to two small rocky outcrops. Impacts are to be minimised for any rocky outcrops affected. These are unlikely to present important habitat for any threatened species and a large number of rocky outcrops will remain around the transmission line corridor following the completion of the project. Therefore, the project is not considered likely to impact rocky habitats to the point where the bioregional persistence of the suite of threatened species likely to use these areas as habitat.

Photo 10-5: Volcanic boulders in the Australian Alps Bioregion

Photo 10-6: Sedimentary rocks in the South Eastern Highlands Bioregion

Avoidance and mitigation strategies

Detailed design and micro-siting of access tracks will aim to avoid and minimise impacts to rocks, outcrops, large boulders, and rock features where possible to avoid and minimise impacts to potential sheltering habitat for fauna including threatened species. During clearing works for construction, any important geological features identified from previously unknown locations, will initiate a stop work and plan for avoidance and mitigation. Monitoring during construction works will occur at strategic locations downslope from the project area (see **Section 11**).

Photo 10-7: The cliff line to the south of Mine Trail is the largest rocky habitat feature in the broader study area

10.3.2 Human-made structures or non-native vegetation

The project does not impact on human made structures or significant area of no-native vegetation of importance.

10.3.3 Habitat connectivity

Nature, extent and duration of impact

Habitat connectivity is identified as the degree to which a site connects different areas of habitat of threatened species to facilitate the movement of those species across their range. The habitats within and surrounding the project area have a high degree of connectivity to other large areas of habitat within the KNP and Bago State Forest. There are no obvious or mapped linear wildlife corridors. The project is predominantly located within the KNP, with the western end of the project area situated in the Bago State Forest. The KNP is largely vegetated across its 690,000 ha extent and intact remnant vegetation extends across the Australian Alps and into the South Eastern Highlands. The Talbingo Reservoir provides a barrier to east west movement for some fauna groups. South from the project area, there is habitat connectivity south into Victoria in national parks, state forests and on private land from the Snowy Mountains and Monaro, to the Victorian Highlands, Victorian Alps, South East Coastal Ranges, Kybean-Gaurock subregion, and into the East Gippsland Lowlands subregion to the coast on the south east corner. Connectivity to the north exists through the Bondo subregion extending through to the Inland Slopes and Murrumbateman subregions where agricultural land becomes dominant and habitats are largely cleared or fragmented. From the project area within the Snowy Mountains in the west, vegetation stretches into the Bondo and Inland Slopes subregions where the habitats start to become fragmented by agricultural development. Eastern connectivity exists through the Bondo subregion, Snowy Mountains, and into the Monaro where habitats start to become fragmented by agricultural development.

There are high levels of physical, and functional, habitat connectivity surrounding the project area that will remain intact. The proposed easement clearing zone along the length of the project will see the removal of a continuous canopy cover across a broad linear corridor ranging from 120 to 150 m wide over a length of about 9,000 m. The continued suppression of all tall growing vegetation above 200 mm will occur as part of ongoing operational maintenance throughout the life of the project. While the retention of the ground cover vegetation in the disturbance area will continue to provide shelter and movement opportunities for small ground-dwelling fauna groups including birds, small mammals and reptiles, other species groups (including threatened species) will be impacted.

Wide-ranging fauna species that are capable of moving across the cleared easement or exploit the modified habitat within the easement will be vulnerable to increased predation from native and introduced predators.

A summary of expected connectivity impacts to the species subject to this assessment is as follows:

Gang-gang Cockatoo

Gang-gang Cockatoo is a highly mobile species that can disperse or migrate tens of kilometres (NSW Scientific Committee, 2008a), so population fragmentation is unlikely from the project and habitat connectivity for this species will be unaltered

In terms of movements that maintain the lifecycle of the Gang-gang Cockatoo, this species undertakes seasonal altitudinal migration from high forests to lower areas during winter. The Gang-gang Cockatoo is common in the higher altitude areas of the Great Dividing Range during the summer months where the species breeds in tree hollows in moist eucalypt forests. Once breeding has finished, the Gang-gang Cockatoo moves to lower altitude areas for the autumn and winter. The Gang-gang Cockatoo is highly mobile (a partial or altitudinal migrant), but habitat fragmentation possibly inhibits dispersal and foraging efficiency (NSW Scientific Committee, 2008a). The project area is situated in an area where breeding is likely to take place over the summer period. The project is however unlikely to introduce any barriers to the movement of this species and it is likely that seasonal altitudinal movements will still take place during and after construction. The Gang-gang Cockatoo freely flies above the existing transmission lines and the current infrastructure does not prohibit seasonal movements. The Gang-gang Cockatoo is highly mobile and can disperse or migrate tens of km, so population fragmentation is unlikely except where populations are isolated by extensive suburbia (e.g. what has happened in northern Sydney) (NSW Scientific Committee, 2008a).

The impacts of the project are considered unlikely to influence any movements of the Gang-gang Cockatoo that are essential to maintain their life cycle. The project is unlikely to affect the bioregional persistence of the Gang-gang Cockatoo.

Powerful Owl and Masked Owl

The Powerful Owl and the Masked Owl are both sedentary species and do not undertake seasonal movements between habitats (Department of Environment and Conservation (NSW), 2006). Resident breeding pairs of Powerful Owls defend exclusive nesting territories within larger, defended home ranges of 400 to 4,000 ha, depending on habitat quality and prey densities (NSW Scientific Committee, 2008b, Department of Environment and Conservation (NSW), 2006). Home range of the Masked Owl has been estimated as 400 to 1,000 ha, variable according to habitat productivity (Department of Environment and Conservation (NSW), 2006). Logged forest (or other cleared areas) is not a barrier to owl movement (Department of Environment and Conservation (NSW), 2006), and dispersal ability of the Masked Owl is greater than 80 km over partly open country (Department of Environment and Conservation (NSW), 2006), suggesting that the project is unlikely to introduce barriers to dispersal or affect gene flow. Indeed the likely ability of the owls to disperse over tens of kms through a mosaic of forested and cleared land suggests that there are unlikely to be any barriers to gene flow within NSW (Department of Environment and Conservation (NSW), 2006) and that the project is unlikely to affect the bioregional persistence of either species. Additionally, the Masked Owl may be a disturbance opportunist in terms of its ability to forage along roads, tracks, ecotones, and recently harvested forest or cleared land (Department of Environment and Conservation (NSW), 2006) so the creation of the transmission line corridor and access tracks will likely be exploited by this species and won't be a barrier to this species.

The project has potential to impact on current fire regimes through introducing accidental ignition originating from the electricity infrastructure. The increased incidence of fire may impact on the availability of large mature trees, and large tree hollows used as nesting and roosting sites by these large forest owl species. The reduction of these features in the landscape has a flow on effect whereby further loss of habitat trees from bushfire has a cumulative impact. This reinforces the fact that avoidance during design and mitigation will require a strong focus on the protection of large, mature trees wherever possible

Booroolong Frog

Booroolong Frogs are heavily reliant on the presence of permanent water and movements are generally local and small scale. The dispersal capabilities and non-breeding habitats of the species are unknown, but the species is relatively sedentary with studies showing that the majority of recaptured individuals moved less than 50 m within a season, with maximum movements of up to 300 m being recorded across seasons (Department of the Environment, 2019a). Consequently, impacts to stream habitats may have a detrimental effect on the ability of the Booroolong Frog to move.

The transmission lines will span Booroolong Frog habitat and the bridge over Sheep Station Creek will be designed to avoid blocking streamflow. As such, impacts to the movement of the Booroolong Frog should be relatively minor and current movement patterns should remain comparatively unaltered. The design of waterway crossings and management measures that will be implemented during construction suggest that the project is considered unlikely to influence any movement of the Booroolong Frog that is essential to maintain its life cycle. The consequences of the project in terms of the effects on movement on the bioregional persistence of the Booroolong Frog are likely to be negligible.

Eastern Pygmy-possum

Given the ability of the Eastern Pygmy-possum to utilise disturbed habitats (see Law *et al.*, 2013), this species may continue to use the low, dense habitats that will form in the transmission easement. However it is also reasonable to expect that the resulting open habitats and reduction in shelter and cover may expose this species to greater predation rates, and or inhibit movements. Studies have shown that Eastern Pygmy-possum does not avoid disturbed habitat within their home ranges and that habitat disturbance such as tree clearing does not significantly influence habitat selection (Law *et al.*, 2013). Removal of vegetation within the disturbance area during construction is likely to cause temporary and localised barriers to movement. Therefore while populations will persist in the landscape, the scale and degree to which habitat connectivity for these populations will be affected is largely unknown.

Yellow-bellied Glider and Greater Glider

The cleared powerline easement and presence of powerline infrastructure has potential to impact the localised movements of these gliders in the landscape leading to reduced genetic exchange. The gliding capabilities of the Greater Glider are unknown. The Yellow-bellied Glider endangered population on the Bago Plateau is disjunct owing to the steep valleys and unsuitable habitat surrounding the Bago Plateau and, in addition, because of cleared agricultural land to the west and the Tumut River and Talbingo Reservoir to the east. The population is at threat from:

- Reduced population viability due to the partial fragmentation of the Bago Plateau and the populations highly restricted geographic distribution.
- Continual decline in habitat quality caused by timber harvesting operations.
- Loss of hollow-bearing trees.
- Loss of feed trees.

Yellow-bellied Gliders live in small social groups (2–6 individuals) that occupy exclusive territories of 25 to 84 ha in New South Wales. As such, it is likely that the project area crosses through the territories of several social groups from the population. There is unlikely to be any movement of animals in or out of the Bago Plateau population. The transmission line corridor may create a permanent barrier to movement of some individuals in the population depending on home range area, and also has potential to impact on the dispersal patterns and genetic exchange. However for this species and the Greater Glider, there will be opportunities for some individuals to cross the corridor, particularly in the steeper slopes and guiles east and west of Talbingo Reservoir, where the line height is well above the canopy.

Yellow-bellied Gliders have been observed to make glides of more than 50 m across a road (Goldingay and Kavanagh, 1991) and the openness of some forest areas and gaps such as roads do not appear to inhibit the use of the habitat by the Yellow-bellied Glider. However the predicted canopy gap caused by the transmission line corridor on the Bago Plateau ranges from 112 to 165 m across and can be reasonably considered a barrier to movements, particularly given the presence of the line infrastructure. The ability of the species to cross the easement along the ground is unknown, however this activity will expose individuals to predation.

Avoidance and mitigation strategies

- Detailed bridge design on access roads will focus on options that ensure stream flow is unaffected to prevent impact to the movements of the Booroolong Frog
- The use of barbed wire on fencing around the sub-station to be minimised and mitigation will focus on installing highly visible wire and attachments such as metal tags, tapping or cloth material on the existing barb wire to increase visibility and act as a deterrence technique for in flight fauna
- The easement clearing zone to allow for the retention of low shrub and groundcover, to provide displaced fauna with shelter from predation during movements
- Management of hazard trees adjacent to the easement to prevent the future incident of fires and consequence of altered fire regimes.

10.3.4 Water bodies, water quality and hydrological processes

Changes in soil and hydrologic quality are abiotic impacts that may occur due to the project. Unmitigated, erosion and contamination of watercourses and ephemeral drainage lines may result from earth movement during construction needed for creation of access tracks and vegetation clearing which will influence water runoff dynamics. The project may have impacts on water quality, water bodies and hydrological processes that sustain threatened species, in particular the Booroolong Frog and Murray Crayfish (which are known to inhabit the Yarrangobilly River and Wallaces Creek) in the following ways:

- There is potential for release of poor-quality sediment laden water into watercourses within and adjacent to the disturbance area when there are rainfall events during construction, particularly given the steep slopes east of Lobs Hole Ravine which directly flow downhill into the Yarrangobilly River habitat
- There is potential for a reduction in stream bank stability following vegetation removal for construction of bridges or clearances for transmission lines, resulting in bank erosion and sedimentation of watercourses
- There is potential for increased water flow into the waterways resulting from vegetation removal and access track construction (channelling of water) and increased erosion. This impact may also occur during operation if access tracks are not correctly designed with erosion protection measures
- There is potential for accidental release of contaminants during construction and maintenance (i.e. chemicals, fuel, oil, hydraulic fluid) that could result in the release of hydrocarbons and metal contaminants into watercourses
- There is potential for release of pesticides and/or herbicides during construction and operation into watercourses which may have detrimental effects.

Short term reductions in water quality and mobilisation of fine sediments into watercourses within and adjacent to the disturbance area during construction and operation is unlikely to result in any long-term detrimental impacts to the aquatic environments. The discharge of fine sediments and contaminants are likely to be short ‘pulse’ events and the fine sediments will be rapidly flushed out of the system. This will most likely result in negligible impact to threatened species such as the Booroolong Frog.

The greatest potential for a detrimental impact to the aquatic habitat of the Booroolong Frog is deposition of large amounts of coarse sediment during and post-construction from removal of vegetation on steep slopes that could significantly reduce water quality in the medium and long term. This may occur in areas close to the Yarrangobilly River and Wallace Creek, and along tracks and the easement where ephemeral drainage lines lead directly into the river. Coarse sediments that will not be flushed from the aquatic system will likely settle in the waterways filling the stream bed with sediment thereby removing any spaces between rocks and boulders reducing the opportunities for the Booroolong Frog to breed. Increased sediment loads can also adversely affect the growth and development of tadpoles, reducing their fitness and recruitment to the terrestrial frog stage (see Gillespie, 2002). This impact is most likely to occur during construction when earthworks are occurring, though there is also potential for this to occur during operation if access tracks are not correctly designed with erosion protection measures.

<u>Avoidance and mitigation strategies</u>

- Controlling impacts to water flow, water quality, and sedimentation associated with run-off from vegetation clearing, newly constructed access tracks, and structures will be key in mitigating the impacts on water quality and quantity, water bodies and hydrological processes that sustain threatened species (see **Section 11** for detail on proposed measures and monitoring of effectiveness).
- Detailed bridge design on access roads will focus on options that ensure stream flow is unaffected.

10.3.5 Wind turbine strikes

The impacts of wind turbines are not applicable to this project.

10.3.6 Vehicle strike

There are no TECs in the disturbance area or project area, and therefore no threatened fauna that are part of the TEC. However, there is a chance of fauna injury and mortality during the construction and operation of the project through vehicle collision (i.e. roadkill). Vehicle collision is a direct impact that reduces local population numbers and is a common occurrence in Australia (Department of the Environment, 2019a, Goldingay and Kavanagh, 1991). Mammals, reptiles, amphibians, and birds are all at risk of vehicle strike, particularly those common species (e.g. macropods) that are tolerant of disturbance and/or those species that can utilise roadways for movement pathways or as foraging habitat. Rare species and low-density populations of species may be placed at risk of a serious impact if the potential for vehicle strike is not managed in an appropriate manner. Vehicles will be introduced into relatively remote areas of the KNP and sections of the Bago State Forest, although vehicle presence and speeds may vary the mitigation measure BIO30 will need to impose a 20 km speed limit. It is likely that some sedentary animal species that live in these habitats will not be accustomed to roads or vehicles. It is also likely that the newly created access tracks through the habitats will provide an attraction point to some species increasing the potential for vehicle strike.

Threatened species most at risk of vehicle strike include the Eastern Pygmy-possum and Gang-gang Cockatoo. Eastern Pygmy-possum is likely to move across the access tracks to reach newly fragmented habitats, as was directly observed during surveys where an individual was identified running along on Bradleys Drive to the north of Elliott Way. Given this species is quite common in the South Eastern Highlands portion of the project area, vehicle strike is moderately likely. Gang-gang Cockatoos frequently forage on the ground on the roadside (as was observed along the Snowy Mountains Highway during surveys) and as such are at high risk of vehicle strike if roadside environments contain suitable grasses for foraging. If the Smoky Mouse is present in the Sub-alpine Woodland habitat and has been missed by the survey, it may also be at risk. The Yellow-bellied Glider and Greater Glider are unlikely to be affected by vehicle strike due to their arboreal habits. If dispersing Koalas or Spotted-tailed Quolls move through the project area they could be at risk of vehicle strike but the likelihood is considered low as population densities of these species are likely to be low.

<u>Avoidance and mitigation strategies</u>

Increased vehicle movements during construction of the project have the potential to result in fauna mortality from vehicle strikes. These potential impacts can be avoided and managed and will be addressed in the biodiversity management plan, and include examples such as on-site education, identifying and reporting hazards as they occur during construction, and setting appropriate working hours and vehicle speed limits.

10.4 Summary of uncertain impacts

The above description and analysis of impacts from the project has identified direct, indirect, and prescribed impacts. In some instances the extent, duration and consequence of the impact is uncertain and the management and monitoring of these is important and is a focus of the mitigation and monitoring strategy outlined in the following section of the BDAR. These uncertain impacts may include:

- It is expected that the clearing of vegetation along the easement may lead indirectly to weed invasion within intact vegetation adjoining the easement, where weeds currently don't exist. Similarly, the current vegetation integrity may experience decline in edge effected areas for the PCTs represented. In both instances the distance of this edge effect is predicted to extend between 20-50 m, however this is largely unknown and the degree to which vegetation integrity declines is unknown. These data will be used to inform a decline in vegetation integrity beyond a set performance threshold, whereby further offsets will be required
- The clearing of habitat along the easement may lead indirectly to negative impacts to certain populations of threatened species that are present or using habitat adjoining the easement, such as the Eastern Pygmy possum and *Caladenia montana*. While measures are proposed to mitigate the impact, the effective of these should be monitored and tested relative to undisturbed habitats not impacted by the (control areas). Corrective actions will apply where mitigation measures are found to be ineffective and impacts are identified beyond set performance thresholds
- The clearing of vegetation on steep slopes located within the catchment of Yarrangobilly River and Wallaces Creek may lead indirectly to downhill mobilisation of sediments, impacting on identified important habitat of Booroolong Frog located downslope of the project. This potential impact is particularly uncertain during high rainfall events after clearing. If sedimentation controls fail, this could lead to a substantial loss or adverse impact to Booroolong Frog breeding and dispersal habitat. Monitoring will be undertaken to ensure that the proposed mitigation measures are effective.
- The installation of powerline infrastructure leads indirectly to reduced populations through collision and electrocution of birds and bats identified in the BDAR as being at risk.

The management of these uncertain impacts requires the development of an adaptive management plan with the aim of adjusting actions based on results to achieve specified outcomes. Details of the proposed monitoring and adaptive management framework for all potential impacts is provided in **Section 11.2**.

10.5 Cumulative impacts

The potential biodiversity impacts of the project must be considered as a consequence of the construction and operation of the project within the existing environment. The project will not act alone in causing impacts to biodiversity. The incremental effects of multiple sources of impact (past, present, and future) are referred to as cumulative impacts and provide an opportunity to consider the project within a strategic context.

There have been historic disturbances due to settlement of the Ravine area and agriculture, building of infrastructure such as roads and transmission lines. However, the most immediate accumulation of impacts will be the impacts of the project in addition to those of the Snowy 2.0 main works project. The cumulative direct vegetation removal impacts of the project and the Snowy 2.0 Exploratory Works and Main Works is outlined in **Table 10-9**. The cumulative direct impacts to threatened species from the project and Snowy 2.0 Exploratory Works and Main Works is outlined in **Table 10-10**.

The three Snowy 2.0 components result in a relatively large cumulative impact considering the predominantly natural and undeveloped landscape.

Table 10-9: Cumulative impacts to native vegetation from the project and Snowy 2.0 Exploratory Works and Main Works

PCT ID No.	Plant community type name	Direct impact from the project (ha)		Direct impact from Snowy 2.0 Exploratory Works (ha)*	Direct impact from Snowy 2.0 Main Works (ha)*	Cumulative impact (ha)
		Full	Partial			
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	2.2	-	5.54	6.85	14.59
296	Brittle Gum - peppermint open forest of the Woomargama to Tumut region, NSW South Western Slopes Bioregion	8.13	10.89	48.37	25.60	92.99
300	Ribbon Gum - Narrow-leaved (Robertson's) Peppermint montane fern - grass tall open forest on deep clay loam soils in the upper NSW South Western Slopes Bioregion and western Kosciuszko escarpment	14.86	17.13	10.52	34.74	77.25
302	Riparian Blakely's Red Gum - Broad-leaved Sally woodland - tea-tree - bottlebrush - wattle shrubland wetland of the NSW South Western Slopes Bioregion and South Eastern Highlands Bioregion	0.58	1.75	12	2.83	17.17
729	Broad-leaved Peppermint - Candlebark shrubby open forest of montane areas, southern South Eastern Highlands Bioregion and South East Corner Bioregion	14.06	12.89	24.1	21.40	72.44
999	Norton's Box - Broad-leaved Peppermint open forest on footslopes, central and southern South Eastern Highlands Bioregion	6.13	2.46	1.28	12.30	22.29
1196	Snow Gum - Mountain Gum shrubby open forest of montane areas, South Eastern Highlands Bioregion and Australian Alps Bioregion	24.93	2.31	5.15	108.18	140.57
Total		**70.90**	**47.45**	**106.96**	**212.00**	**437.30**

* EMM CONSULTING 2017 and 2020a

Table 10-10: Cumulative impacts to threatened species from the project and Snowy 2.0 Exploratory Works and Main Works

Species name	Common name	Direct impact from the project (ha)	Direct impact from Snowy 2.0 Exploratory Works (ha)*	Direct impact from Snowy 2.0 Main Works (ha)*	Cumulative direct impact (ha)
Callocephalon fimbriatum	Gang-gang Cockatoo (breeding)	89.06	0.91	2.08	92.05
Tyto novaehollandiae	Masked Owl (breeding)	10.86	0.91	-	11.77
Litoria booroolongensis	Booroolong Frog	1.67	2.49	1.33	5.48
Cercartetus nanus	Eastern Pygmy-possum	117.29	76.17	197.95	391.41
Petaurus australis - endangered population	Yellow-bellied Glider Population on the Bago Plateau	59.03	-	-	59.03

* EMM CONSULTING 2017 and 2020a

11. Mitigating and managing impacts on biodiversity values

While direct impacts are easily quantified and controlled by managing the extent of clearing within the disturbance area, the indirect impacts are subject to the efficacy of implemented environmental controls. As such, direct impacts are defined during project design, whereas indirect impacts are mitigated through effective environmental management during construction and associated with an adaptive management strategy. The following section outlines measures to minimise, mitigate and monitor the predicted impacts to biodiversity that are described in **Section 10** of the BDAR.

These measures form the basis and framework for development of project specific Biodiversity Management Plan (BMP) that will include a biodiversity monitoring program to be developed post-approval of the project. The measures outlined in this section provide a framework for developing the BMP. The BMP will expand on, and provide more specific detail on the biodiversity mitigation measures described herein which have been devised for the protection and monitoring of biodiversity, individual threatened species, and their habitat. Feasible mitigation measures will be applied to ensure the vegetation zones that have been assessed as having future integrity values (partial impacts) maintain that predicted VI score.

The BMP will be based on SMART principals (Specific, Measurable, Achievable, Realistic, and Timebound) and will include details of a biodiversity monitoring and reporting program designed to monitor the performance of the mitigation measures proposed. The monitoring program will be designed to verify the extent of indirect impacts, identify where additional mitigation of indirect impacts is required. The BMP will include a program to evaluate and publicly report on the outcomes of such monitoring.

11.1 Mitigation measures

Proposed mitigation measures are documented in **Table 11-1** which includes details of the proposed action or technique, timing, frequency, and responsibility for implementing each measure.

Table 11-1: Proposed biodiversity mitigation measures

Direct and Indirect Impact (refer Chapters 9 and 10)	Action ID	Biodiversity mitigation action	Outcome	Timing and frequency	Responsibility	Effectiveness of action	Relevant vegetation management zone
Detailed design to avoid and minimise clearing of vegetation and habitat for threatened species (**Section 9.1**)	BIO1	Detailed design of the project will focus on the retention of managed shrub and groundcover vegetation zones, within the ECZ, HCZ and HTZ to avoid and minimise the loss of vegetation and habitat and movements of fauna across the landscape and to minimise the impact of predation on displaced fauna. The location of nest tree habitat buffers for Gang-gang Cockatoo and Masked Owl are shown in Figure 6-4 and habitat buffers for *Caladenia montana* in Figure 6-8. These locations should be used to identify areas to avoid or minimise impacts in the partial clearing zones, and can be used to inform the induction of construction teams as required for future construction and operational management plans. Final design for permanent creek crossing structures on access roads will implement a design option to ensure stream flow is unaffected. Design and micro-siting of access tracks will avoid and minimise impacts to rock outcrops, large boulders, piled rock, and rock features that provide potential sheltering and breeding habitat for fauna including threatened species and avoid mapped habitat trees. Locations of rock for micro siting are shown in Figure 4-4. This map should be used to identify areas to avoid or minimise impacts to rock outcrops and inform the induction of construction teams as required for future construction and operational management plans. Access track corridors will be established with consideration to terrain (e.g., utilisation of the ridgelines to navigate to the higher elevations) to minimise cut/fill and vegetation clearing.	Avoid and minimise clearing of vegetation and habitat during project planning	Detailed design, project survey and pre-construction	Transgrid	Known and proven effective	All zones
Removal of native vegetation and habitat (**Section 10.1.1 and 10.2.1**)	BIO2	A **Biodiversity Management Plan** (BMP) will be prepared and approved prior to construction. The BMP will be prepared by a qualified ecologist in consultation with BCS and NPWS and include a plan for implementing, evaluating and reporting on the effectiveness of all mitigation measures outlined in this BDAR, but not be limited to these measures. The overarching framework of the BMP will be based on SMART principals (Specific, Measurable, Achievable, Realistic, Timebound) and will focus on monitoring the performance of proposed measures and informing an adaptive management approach based on performance triggers for remedial action or additional offsets where further impacts are identified.	Avoid, minimise, and mitigate impacts to biodiversity through planning and active management	Pre-clearing, during and post construction	Transgrid and contractors	Known and proven effective measure	All zones

Direct and Indirect Impact (refer Chapters 9 and 10)	Action ID	Biodiversity mitigation action	Outcome	Timing and frequency	Responsibility	Effectiveness of action	Relevant vegetation management zone
Fire risk during operation (**Section 10.2.6**)		The BMP will detail required mitigation actions for the project for all biodiversity, including indirect, prescribed and uncertain impacts. The actions are to be prepared in consultation with BCS and NPWS and endorsed by BCS and NPWS. The BMP will include a program to monitor, evaluate and publicly report on the outcomes of a biodiversity monitoring program (refer **Section 11.2**). The BMP must stipulate objectives for monitoring, and how baseline data will be captured and represented. An Operational Management Plan for biodiversity will be prepared in consultation with BCS and NPWS and approved prior to clearing. The CEMP will replicate the requirements detailed in the BMP for all safeguards /mitigation measures particularly pre- clearing and clearing during construction (including B104-B108).					
	BIO3	A **Rehabilitation Plan** (RP) will be prepared and approved prior to clearing in consultation with BCS, NPWS and FCNSW. The Rehabilitation Plan will inform the implementation of rehabilitation within the lease/licence area. Such areas will be identified in the final detailed design and will also include areas disturbed during construction that are not required to be maintained or cleared for the operation of the project. ▪ The plan will focus on the implementation of soil erosion prevention, re-establishment of local expression of the original/adjacent plant community type, use local native plant species and habitat and outline the details of rehabilitation objectives and how their outcomes for success will be measured, locations, target landforms and plant community types ▪ Restoration of riparian vegetation (i.e. weed control) will be implemented to protect and improve key habitat areas of the Booroolong Frog ▪ The plan will include a program for adaptive monitoring of specific success measures and reporting and include a Trigger Action Response Plan (TARP). The TARP will include notification to NPWS and BCS that remedial actions have been triggered and agreement about the response	Avoid soil erosion and invasion of weeds in disturbed areas and their spread in adjoining edges of native vegetation	Developed pre-construction and implemented pre-clearing, during and post construction	Transgrid and contractors	Known and effective measures	All zones

Direct and Indirect Impact (refer Chapters 9 and 10)	Action ID	Biodiversity mitigation action	Outcome	Timing and frequency	Responsibility	Effectiveness of action	Relevant vegetation management zone
		▪ Revegetation of slopes will be undertaken in accordance with the rehabilitation plan ▪ Landscaping of pervious surfaces using native indigenous species only. ▪ Soil loss will be prevented by immediate stabilisation of exposed surfaces (e.g. use of Jute mesh and/or soil binder) ▪ Ongoing maintenance of the rehabilitation work will be required, including management of weeds and pathogens. ▪ Topsoil and subsoil generated during construction will be stockpiled separately on-site to be used for rehabilitation. Stockpiles will be managed according to best management practices (Managing Urban Stormwater: Soils and Construction).					
	BIO4	**Pre-clearing Process**: the BMP will provide detail with necessary mitigation measures for harm to live animals and threatened hollow dependent fauna during/all pre-clearing survey and translocation activities. This includes, but is not limited to: ▪ Pre-clearing surveys to be conducted with a suitably qualified and licenced wildlife handler to rescue and re-locate fauna ▪ Protocol for the removal of hollow bearing trees - hollow inspection /lowering limbs to the ground using cherry picker ▪ Protocol to mitigate harm to hollow dependant threatened fauna known or with potential to be utilising breeding habitat in the project area and disturbance footprint, e.g. Gang-gang Cockatoo, Eastern Pygmy-possum, Yellow-bellied Glider and Masked Owl. Further detail on mitigation measures during pre-clearing process is provided below. The pre-clearing process will include two stages. Stage 1 will include survey and translocation of any fauna from the disturbance area into areas of retained vegetation prior to the development of the project. This may include detailed markup of threatened species locations and their translocation such as *Caladenia*	Avoid, minimise, and mitigate impacts to biodiversity	Pre-clearing	Transgrid and contractors	Known and proven effective measure	All zones

Direct and Indirect Impact (refer Chapters 9 and 10)	Action ID	Biodiversity mitigation action	Outcome	Timing and frequency	Responsibility	Effectiveness of action	Relevant vegetation management zone
		montana. All work must be carried out by qualified ecologist. The next pre-clearing stage will include final inspections of the disturbance area immediately before the construction activity commences to check and physically mark any important habitat features that need to be considered when identifying exclusion zones and conducting the staged habitat removal process within the full and partial clearing zones. Document, mark and record the location of: ▪ large stick nests ▪ any rock features ▪ habitat/hollow-bearing trees ▪ threatened flora. Report the outcomes of the pre-clearing inspections to BCS/NPWS prior to the commencement of vegetation clearing. The report will include any fauna relocated or euthanised, including name of qualified/licensed handler, species, location notes, and release location and method. Specific measures to mitigate the impact to individual Masked Owl adults, chicks and eggs will be specified in CEMP and BMP. The pre-clearing protocol of breeding habitat for Masked Owl needs to comprise: ▪ hollow-bearing potential nest tree(s) is to be clearly identified on construction planning maps ▪ hollow bearing tree(s) are to be removed outside the breeding season. Breeding is in winter, owls may also be nesting in autumn or spring (The TBDC specifies breeding in May to August, however Masked Owls can have a variable breeding season depending on prey resources) ▪ a pre-clearing protocol will include inspection of the tree to determine if live owls are present and potentially nesting. Absence will be demonstrated by placing a songmeter underneath the tree for several weeks before planned clearing. Stag watching will not be as reliable for this purpose ▪ if nesting owls are present, the tree is to be clearly marked as a no-go zone and removal of the tree must be delayed until the chicks have fledged. There					

Direct and Indirect Impact (refer Chapters 9 and 10)	Action ID	Biodiversity mitigation action	Outcome	Timing and frequency	Responsibility	Effectiveness of action	Relevant vegetation management zone
		is to be no disturbance within 50 m of the tree, and disturbance between 50 - 100 m is to be minimised. The removal of the tree must allow time for fauna to vacate the habitat as outlined in BIO7. Alternative nest box sites are to be provided in adjacent habitat that will be assessed in a nest box strategy and comprise effective methods to reduce the risk to threatened birds. Specific measures to mitigate the impact to individual Yellow-bellied Glider will be specified in CEMP and BMP. The pre-clearing protocol of breeding habitat for Yellow-bellied Glider needs to comprise: ▪ Den trees and sap trees are to be clearly identified on construction planning maps ▪ a pre-clearing protocol will include inspection of the tree to determine if live gliders are present and potentially nesting or is a core feeding tree. ▪ if gliders are present or likely to be present, the tree is to be clearly marked as a no-go zone. The removal of the tree must allow time for fauna to vacate the habitat as outlined in BIO7. Alternative nest box sites are to be provided in adjacent habitat that will be assessed in a nest box strategy and comprise effective methods to reduce the risk to threatened gliders. Specific measures to mitigate the impact to Gang-Gang Cockatoo will be specified in CEMP and BMP. The pre-clearing protocol of breeding habitat for Gang-Gang Cockatoo needs to comprise: ▪ hollow-bearing potential nest tree(s) is to be clearly identified on construction planning maps ▪ hollow-bearing tree(s) are to be removed outside the breeding season. Breeding occurs in October to January, birds may also be roosting in hollows all year. ▪ a pre-clearing protocol will include inspection of the tree to determine if live birds are present and potentially nesting. Absence will be demonstrated by placing a songmeter underneath the tree for several weeks before planned clearing. Stag watching will not be as reliable for this purpose					

Direct and Indirect Impact (refer Chapters 9 and 10)	Action ID	Biodiversity mitigation action	Outcome	Timing and frequency	Responsibility	Effectiveness of action	Relevant vegetation management zone
		▪ if nesting birds are present, the tree is to be clearly marked as a no-go zone and removal of the tree must be delayed until the chicks have fledged. There is to be no disturbance within 100 m of the tree, and disturbance between 100-200 m is to be minimised. The removal of the tree must allow time for fauna to vacate the habitat as outlined in BIO7. Alternative nest box sites are to be provided in adjacent habitat that will be assessed in a nest box strategy and comprise effective methods to reduce the risk to threatened birds. Measures to mitigate the impact to other threatened species such as Eastern Pygmy Possum, Booroolong Frog and *Caladenia montana* will follow the BIO4 and BIO7. Mitigation actions for Booroolong Frog also need to follow BIO5 and BIO10.					
	BIO5	**Exclusion Zones**: The boundary of the clearing limits for each disturbance zone will be clearly marked on site by a surveyor before vegetation clearing commences: ▪ Exclusion zones, or 'No-Go' zones, will be clearly marked at the edge of the full clearing zones and ECZ to protect the vegetation to be retained outside the project from inadvertent direct impacts. These will be in place for pre-clearing, construction and remain in place until rehabilitation objectives for areas above/upstream of the zones have been met and slopes have been stabilised ▪ Exclusion zones and the edge of the clearing boundary will be marked with high visibility fencing and signage ▪ **Booroolong Frog**: A 50 m exclusion zone (refer to **Figure 11-1**) will be marked and clearly delineated from other survey markers with signage also placed around the tributaries that flow downhill into the Yarrangobilly Creek, this includes the limits of clearing on the lower end of Sheep Station Creek, Cave Gully, Lick Hole Gully and Wallace Creek that are crossed by the project to protect the downstream habitat of Booroolong Frog by clearly identifying exclusion zones. Parts of the 50 m exclusion zone along Lick Hole Gully and Cave Gully occur within the ECZ and will require clearing of trees and shrubs, However, the introduction of the partial clearing zones are likely to reduce the risk of erosion and sedimentation from the project to downstream waterways	Avoid, minimise, and mitigate impacts to biodiversity	Pre-clearing, construction and early operation	Transgrid and contractors	Known and proven effective measure	All zones

Direct and Indirect Impact (refer Chapters 9 and 10)	Action ID	Biodiversity mitigation action	Outcome	Timing and frequency	Responsibility	Effectiveness of action	Relevant vegetation management zone
		where parts of the groundcover in the ECZ, HCZ and HTZ will remain partially intact or intact, and reduce soil disturbance. There will be no use of heavy machinery in the riparian zones. Due to the risk of indirect impacts from increased runoff at these locations, strict sediment control measures will be implemented and outlined in a Soil and Water Management Plan (SWMP). The plan will ensure protection of aquatic habitat in the tributaries crossed by the project, and particularly aimed at protecting the habitat for the Booroolong Frog associated with Yarrangobilly Creek ▪ **Booroolong Frog**: The 50m exclusion zone adopted for the Main Works project on Yarrangobilly Creek, will be retained for construction of the transmission line. This will remain in place until rehabilitation objectives for areas upstream have been met and slopes have been stabilised ▪ Hazard trees identified from the LiDAR assessment will be flagged for removal, and any other adjacent and important habitat trees and features, also identified for retention and to avoid disturbance during the felling activity will be clearly marked and included in maps within the CEMP.					
	BIO6	**Vegetation clearing plan**: A vegetation clearing methodology has been developed (provided as Appendix K), the methods described focus on the removal of vegetation in full and partial clearing zones. These methods will be incorporated as a vegetation clearing plan within the BMP designed to document the methods of vegetation and habitat clearing within each zone, including soil protection measures, mechanical and non-mechanical approaches, removal of habitat, protection of retained vegetation, and appropriate storage and re-use of mulch and timber to avoid disturbance of retained vegetation. Hollows logs and limbs encountered during clearing will be retained for placement within adjacent vegetation or on the maintained easement within shrub retention areas. The plan will include a requirement to prepare a post clearing report that records the final clearing extent using GPS to demonstrate whether clearing is within the approved disturbance area, and if exceeded, recalculate additional offset obligations.	Avoid, minimise, and mitigate impacts to biodiversity through planning and active management	Pre-clearing, and during construction	Transgrid and contractors	Known and proven effective measure	All zones

Direct and Indirect Impact (refer Chapters 9 and 10)	Action ID	Biodiversity mitigation action	Outcome	Timing and frequency	Responsibility	Effectiveness of action	Relevant vegetation management zone
	BIO7	**Staged Habitat Removal**: the staged habitat removal process is required for removal of habitat (hollow-bearing trees, habitat trees, and bushrock) Staged habitat removal minimises direct impacts on fauna by providing them with an opportunity to vacate hollows and relocate naturally. The process includes: ▪ avoiding clearing during times when hollow-dependent fauna are breeding ▪ Contact vets and wildlife carers before works commence ▪ Ensure that licensed wildlife carers and/or ecologists are on site during habitat removal ▪ Adopt two staged removal clearing non-habitat first (e.g. shrubs, regrowth, ground cover and non-habitat trees). Allow at least 24 hours for fauna to vacate habitat before removing habitat trees ▪ Ensure wildlife carers and/or ecologists are present during removal of habitat trees, and that habitat trees are felled carefully, using equipment that allows habitat trees to be lowered to the ground with minimal impact ▪ A procedure for the ethical handling of injured or displaced fauna is to be documented in the BMP ▪ Record the effort and outcomes of the habitat removal process ▪ Save and reuse cleared material for rehab and habitat ▪ Preparation of an '**Unexpected threatened species finds procedure'** to be implemented during construction and operation. Applies to all activities that have potential to impact upon threatened flora and fauna species which have not already been assessed and approved. Any threatened entities found in a location previously unknown during construction or operation must be immediately notified to NPWS ▪ Preparation of a **Fauna handling and rescue procedure** to be implemented during construction and operation.	Avoid, minimise impacts to fauna during clearing and construction	Construction	Transgrid and contractors	Known and proven effective measure	All zones
	BIO8	Clearance of construction areas prior to commencement of daily construction to ensure there is no wildlife present. This will involve an on-foot pre-clearing survey by a suitably qualified ecologist. This will also involve a regular drive through	Avoid, minimise impacts to	Construction	Transgrid and contractors	Known and proven	All zones

Direct and Indirect Impact (refer Chapters 9 and 10)	Action ID	Biodiversity mitigation action	Outcome	Timing and frequency	Responsibility	Effectiveness of action	Relevant vegetation management zone
		sweep of areas planned for construction, by the contractors environmental representatives. If an animal is located within the construction area during works, the Delivery Manager and Project Management Site Representative are to be notified immediately. All work must immediately cease within the immediate area of the find and a local wildlife rescue or an ecologist will be required for assistance where necessary.	fauna during clearing and construction			effective measure	
	BIO9	An operational **Vegetation Management Plan** (VMP) will be prepared by an experienced ecologist prior to commencement of project operation. The plan will focus on vegetation management within the ECZ and HTZ with the aim of maintaining long-term Vegetation Integrity targets. The VMP will interpret the vegetation integrity scores into feasible actions to maintain vegetation condition, and outline project specific ongoing vegetation clearing requirements and methodology. The VMP will include a strategy for maintaining the expected vegetation outcomes for all partial impact zones assessed in the BDAR. The strategy will: ▪ Translate the vegetation integrity (VI) scores into management actions to be applied during construction and operation of the project ▪ Include triggers for corrective actions ▪ Include details for review and reporting by a qualified ecologist in consultation with NPWS and BCS. Details of a framework for the VMP is provided in Appendix K. ▪ The VMP will be guided by Transgrid's vegetation risk model and operational vegetation clearance requirements, in addition to the principles for Integrated Vegetation Management (IVM) which will aim to preserve future Vegetation Integrity scores within the ECZ ▪ Long-term monitoring will be conducted to measure the effectiveness of the VMP (see Section 11.2). The methods and timing of the monitoring will be documented in the VMP and will include a responsibility to report the results to BCS and NPWS	Maintain future vegetation integrity for components of the vegetation into the long-term	Operational phase for the life of the project	Transgrid	Known effectiveness on other easements within KNP	ECZ, HTZ

Direct and Indirect Impact (refer Chapters 9 and 10)	Action ID	Biodiversity mitigation action	Outcome	Timing and frequency	Responsibility	Effectiveness of action	Relevant vegetation management zone
		▪ The VMP will detail methods for vegetation maintenance in the ECZ with a focus on retaining plant species diversity and cover of low understorey and groundcover plants <200mm, while tree and shrub regrowth will be suppressed for long-term easement management ▪ The VMP will detail methods of maintenance in the HTZ with a focus on retaining all non-hazard trees, as well as shrubs, grasses, and forbs. Ongoing inspection (using Lidar, and follow-up on foot or drone) of hazard trees will occur and document the method of removal for each tree to ensure that non-hazard trees are not impacted during tree felling. Where threatened orchids are mapped (*Caladenia montana*), hazard trees will be sensitively removed to avoid impacting on the ground layer. This will include removing trees from the top down and cutting into small sections, transferring into the ECZ and mulching ▪ The VMP will address measures required to minimise fire risk during operation of the project (s.10.2.6).					
Changes to surface runoff regimes resulting in sedimentation due to the removal of habitat (**Section 10.2.2**) Impacts on water quality and hydrological processes and	BIO10	A **Soil and Water Management Plan** (SWMP) will be prepared and implemented as part of the CEMP in consultation with NPWS and BCS. The plan will include stringent controls to mitigate impacts of runoff and sediment transfer from the project area during construction and operation. Control measures will remain in situ until site stabilisation completion criteria are met. The plan will ensure protection of aquatic habitat in the tributaries crossed by the project, and particularly aimed at protecting the habitat for the Booroolong Frog associated with Yarrangobilly Creek. this is particularly important for the lower reaches of Sheep Station Creek and Wallace Creek where the exclusion zone is encroached (refer **Figure 11-1**). An assessment of the current sediment basin design for the Main Works project will occur prior to vegetation clearing, to assess if the basin design specifications and design capacity are suitable for the additional sediment load expected during construction of the easement. Where modification or augmentation is required,	Avoid, minimise impacts to aquatic habitat and particularly known habitat for the Booroolong Frog	Pre-construction and construction Operation (for removal of hazard trees upstream or within Booroolong Frog habitat)	Transgrid and contractor	Known effectiveness	All zones

Direct and Indirect Impact (refer Chapters 9 and 10)	Action ID	Biodiversity mitigation action	Outcome	Timing and frequency	Responsibility	Effectiveness of action	Relevant vegetation management zone
that sustain threatened species (**Section 10.3.5**)		sediment basins will be increased in size to cope with any additional expected sediment load. Sedimentation will be managed through implementation of effective sediment control management plans will be implemented to ensure that sediment does not enter the waterways and result in changes to the habitat structure of riparian areas or areas downstream of the project area. Effective control measures will include: ▪ Erosion and sediment control plans for all stages of construction ▪ The implementation of sediment control measures across the project area - sediment control ponds and sediment basins, coir logs and sediment fencing to control sediment run-off, catch drains and perimeter bunds and diversion drains ▪ A schedule will be included in the SWMP for cleaning and maintenance of sediment basins / controls with intervals to be informed from the outcomes of monitoring basins from Snowy 2 Main Works construction and catchment modelling. The schedule will include additional checks after rainfall events of >50 mm in 24 hours. A Trigger Action Response Plan will be documented n the SWMP, with management actions in place to address risk of sediment loads detrimental to Booroolong Frog entering the system. The triggers for response will be informed by evaluation of the construction monitoring results from Main Works. Immediate reporting to NPWS will occur in the event of any failure of sediment or stormwater mitigation measures, including overtopping of sediment basins. Indirect impacts are uncertain during high rainfall events during and/or after clearing. If mitigation measures and sedimentation controls fail, this could lead to a substantial loss or adverse impact to Booroolong Frog breeding and dispersal habitat. An adaptive management plan will be prepared in consultation with NPWS and BCS to address risk of increased sedimentation/run off to the identified breeding habitat and population extent downhill and downstream of the project area. ▪ Additional or supplementary control measures (i.e. sediment fencing, diversions, and detention ponds) will be implemented at high risk areas such					

Direct and Indirect Impact (refer Chapters 9 and 10)	Action ID	Biodiversity mitigation action	Outcome	Timing and frequency	Responsibility	Effectiveness of action	Relevant vegetation management zone
		as the bridge crossings at Sheep Station Creek, Cave Gully and Wallaces Creek and at tower structures site ad access roads on the slopes around Yarrangobilly Creek and associated tributaries ▪ Additional water quality monitoring points will be installed and monitored in locations to be agreed with NPWS and BCS, which are downhill of the construction footprint and upstream of Booroolong Frog habitat. ▪ An adaptive management plan as part of the monitoring program will be included in the SWMP to address risk of increased sedimentation/run off to the identified breeding habitat and population extent of the Booroolong Frog downhill and downstream of the project area. The plan will be designed to estimate any residual impact if sediment mitigation measures fail. ▪ Runoff from spoil piles will be managed through the above listed control measures to ensure that there is no contamination or sediment entering waterways or adjacent areas ▪ Accidental spills will be reported to the contractor's environmental representative as soon as the incident is observed so that the site can be remediated rapidly ▪ Implementation of tannin leachate management controls may be required as determined by the monitoring program ▪ Sediment traps or filters (targeting removal of coarse sediment) will be maintained at all discharge locations and will be monitored and maintained as per the scheduled requirements ▪ Other source controls, such as mulching, matting and sediment fences may be used in consultation with BCS and NPWS and need to be approved in the CEMP and any deviation from measures by DPIE will need to be sought. Similarly, natural erosion controls incorporating organic materials, micro water capture and contour shaping will need to be approved in the CEMP where appropriate ▪ Disturbed areas will be stabilised and rehabilitated to reduce erosion potential (i.e. exposure period of bare earth). This will be particularly important for					

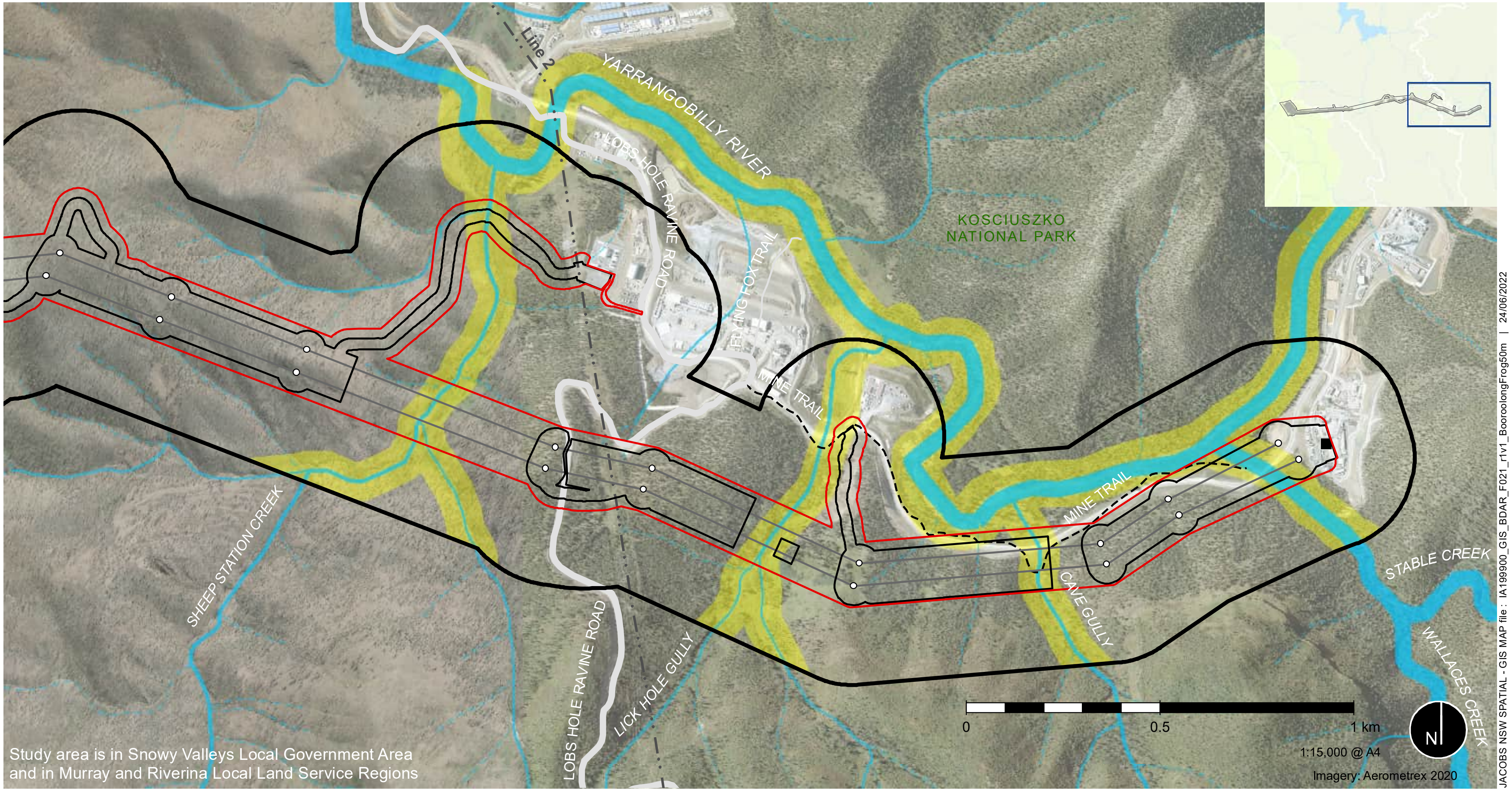
Direct and Indirect Impact (refer Chapters 9 and 10)	Action ID	Biodiversity mitigation action	Outcome	Timing and frequency	Responsibility	Effectiveness of action	Relevant vegetation management zone
		revegetation of slopes as soon as possible, in accordance with the rehabilitation plan. Landscaping of pervious surfaces using native indigenous species only. Soil loss will be prevented by immediate stabilisation of exposed surfaces (e.g. use of Jute mesh and/or soil binder) ▪ Any imported fill will be certified at source locations to ensure it is pathogen and weed free Excavated Natural Material or Virgin Excavated Natural Material) ▪ An induction protocol will be mandatory for all personnel involved in construction and operation works ▪ There needs to be acknowledgement of imported material e.g. road base being washed off tracks etc in the surrounding environment and how that will be dealt with.					
Increase in weeds and disease pathogens in adjacent vegetation (**Section 10.2.3**)	BIO11	Weed monitoring and control programs are to be documented in the BMP and Trigger Action Response Plan as part of the SWMP and in consultation with BCS and NPWS and any deviation from measures approved by DPIE are to be raised and approved. Additional monitoring and control measures for introduced plant introduction and spread should be implemented at and around locations used for sediment control structures. Monitoring of exotic plants with waterborne propagules and a Trigger Action Response Plan for control must be undertaken along drainage lines outside the project area in locations where runoff drains from the construction site, and from locations where sediment control has failed. The program will include adaptive management strategies for priority weed species during construction, and early operational phase. The details of the monitoring program will be determined during the preparation of the BMP and follow the principles outlined in Section 11.2.	Control spread of weed from the project	Pre-construction, and construction	Transgrid and contractors	Known effectiveness	All zones
	BIO12	Identify all weed species in KNP in consultation with NPWS. Priority weeds species in Bago State Forest are consistent with high threat weeds.					

Direct and Indirect Impact (refer Chapters 9 and 10)	Action ID	Biodiversity mitigation action	Outcome	Timing and frequency	Responsibility	Effectiveness of action	Relevant vegetation management zone
	BIO13	Identify, map, and remove all weeds before clearing for construction, and record location of weed and sprayed area for use in ongoing weed monitoring and management programs.					
	BIO14	Prepare a vehicle and machinery hygiene strategy and implement during construction and operation. The strategy will include specific locations, timing and methods for removing soil and plant matter from vehicles and machinery. Ensure vehicle and machinery hygiene measures in the strategy are applied during construction and operation.					
	BIO15	During the clearing works, weeds will be disposed and managed appropriately to stop the spread of weed species.					
	BIO16	Wash down stations will be constructed at suitable locations to wash down vehicles and employee shoes to stop the spread of weeds, pathogens (including amphibian chytrid fungus, *Phytophthora cinnamomi* and exotic rust fungi) and the introduction of new species.					
Increase in predatory and pest species (**Section 10.2.4**)	BIO17	Personal waste / refuse generated during construction will be stored appropriately in inaccessible bins and disposed at appropriate waste disposal facilities off-site. Any personal waste generated during operation will be removed from the site (including substation) and disposed in an appropriate waste facility.	Control attraction of introduced predators and pests to the construction area	During construction	Transgrid and contractors	Known effectiveness	All zones
	BIO18	A feral animal monitoring program will be developed and implemented as described in Section 11.2 based on performance triggers for adaptive management. It will be important to share data with NPWs and State Forests. Increased predator activity will trigger the need for predator control based on performance measures to be outlined in the BMP. Control will be done in consultation with NPWS and (DPIE - State Forests).					
Increase in risk of electrocution and EMF exposure	BIO19	Utilise the survey data for this project, and the Main Works EIS to identify specific bird and bat species that are at risk of collision with power lines and electrocution. For higher risk species a strategy will be developed in consultation with BCS focused on identifying key sections of the transmission line where mitigation is required and will include deploying bird divertors, with day/night reflectors within	Monitoring Minimise fauna electrocution	Operation	Transgrid	Likely effectiveness with management and adaptive	ECZ

Direct and Indirect Impact (refer Chapters 9 and 10)	Action ID	Biodiversity mitigation action	Outcome	Timing and frequency	Responsibility	Effectiveness of action	Relevant vegetation management zone
(**Section 10.2.5**)		approved buffer distance. This will be appropriate for diurnal and nocturnal birds The strategy will be developed as part of the BMP and include adaptive management for high risk bird and bat species as outlined below with intervals and strategies to be determined in consultation with NPWS: ▪ Regular monitoring in transmission line easements for evidence of bird / bat collision with transmission lines (intervals to be determined in consultation with NPWS) ▪ Monitoring of taller structures for evidence of raptor nest building ▪ Develop target trigger for number of high risk species incidents ▪ Deploy species specific bird / bat divertors / flappers / reflectors in areas where a defined number of incidents have occurred. The BMP will identify locations for specific measures and the monitoring method for testing effectiveness.	and EMF exposure risk			response approach	
Light and noise and vibration impacts during night works (**Section 10.2.7**)	BIO20	Directional lighting will be used for any permanent lighting required (i.e. substation) to minimise light spill as much as possible.	Avoid, minimise, and mitigate impacts to biodiversity	During construction	Transgrid and Contractor	Known and proven effective	All zones
	BIO21	Artificial lighting required during construction in the early morning and late afternoon in winter will be limited to within approved construction hours.					
	BIO22	The requirements of the Australian Standard AS2436-2010 Guide to noise and vibration control on construction, demolition, and maintenance sites to be integrated in design.					
	BIO23	Minimise noise from equipment through measures such as keeping both stationary and mobile plant and equipment in good working condition (including mufflers, enclosures etc), and avoid leaving engines running on standby when machinery is not being used.					
	BIO24	Select equipment with the lowest noise rating that meets task requirements and minimise operating loud machinery conjunctively. For example, operating a jackhammer and concrete saw.					

Direct and Indirect Impact (refer Chapters 9 and 10)	Action ID	Biodiversity mitigation action	Outcome	Timing and frequency	Responsibility	Effectiveness of action	Relevant vegetation management zone
Dust pollution (**Section 10.2.8**)	BIO25	Dust management and monitoring programs using industry best practices and standards to control air quality will be implemented. ▪ No dust generating works will be conducted during high winds ▪ Keep stockpiles covered with material to prevent the generation of dust. Apply water dust suppression techniques during dust generating activities.	Avoid, minimise, and mitigate impacts from dust pollution	During construction	Transgrid and Contractor	Known and proven effective measure	Full clearing areas, and ECZ
Contaminant pollution (**Section 10.2.9**)	BIO26	Provide sediment and erosion controls to manage exposed soil surfaces and stockpiles to prevent sediment discharge into waterways, vegetation, and fauna habitat. Control measures will include: ▪ Clearly identify stockpile and storage locations and provide erosion and sediment controls around stockpiles (documented in Vegetation Clearing Plan) ▪ Source controls, such as mulching, matting and sediment fences will only be used where approved in the CEMP ▪ Sediment traps or filters (targeting removal of sediment) will be maintained at all discharge locations and will be regularly monitored and maintained ▪ Disturbed areas will be stabilised and rehabilitated as soon as the event has been reported to reduce erosion potential (i.e., exposure period of bare earth) (as per Rehabilitation Plan) ▪ Accidental spills will be immediately reported and remediated ▪ Contaminated water will be separated from stormwater and will be managed in a process water system ▪ Provide on-site signage to identify contaminated topsoils.	Avoid, minimise, and mitigate impacts from contaminant pollution	During construction	Transgrid and Contractor	Known and proven effective measure	All zones
Fragmentation resulting in reduced connectivity	BIO27	The barbed wire/razor wire fencing installed around the substation switchyard will have improved visibility measures installed, such as adding visible objects to the fence, for example metal tags, tapping or cloth material on the existing barb wire to increase visibility and act as a deterrence technique for in flight fauna.	Avoid, minimise impacts from loss of	Construction	Contractor	Known and proven effective measure	All zones

Direct and Indirect Impact (refer Chapters 9 and 10)	Action ID	Biodiversity mitigation action	Outcome	Timing and frequency	Responsibility	Effectiveness of action	Relevant vegetation management zone
(**Section 10.3.3 and Section 10.3.4**)	BIO28	The ECZ will be maintained as per the VMP, with the preservation of low ground cover vegetation to provide cover for small ground-dwelling fauna and birds to cross the easement	connectivity, and movements of fauna Monitoring				
	BIO29	A number of measures to mitigate and monitor the impact of the project on Yellow-bellied Glider during construction and operation of the project are required and include: ▪ A targeted connectivity strategy ▪ The provision of arboreal crossing structures ▪ Targeted surveys Yellow-bellied Glider to refine crossing structures ▪ Nest box strategy ▪ A staged habitat removal process consistent with Action BIO4 and the Biodiversity Management Plan ▪ The minimum design and locations of crossing structures for Yellow-bellied Glider will be based on the process for managing connectivity requirements described in a Yellow-bellied Glider Connectivity Strategy ▪ Implementation of a comprehensive monitoring program before, during and after construction with performance targets and adaptive management actions ▪ The proposed approach to management of potential impacts to the Yellow-bellied Glider population throughout the pre-construction, construction and operational will be documented in the Biodiversity Management Plan.		Pre-construction, construction and operation	Transgrid and Contractor	Likely effectiveness with management and adaptive response approach	All zones
Wildlife impacts from vehicle strike (**Section 10.3.6**)	BIO30	Vehicle movements on newly formed access tracks will be limited to 20km/h speed limit implemented to reduce the risk of vehicle strike to fauna.	Minimise fauna strike during construction and operation	Construction and Operation	Transgrid and Contractor	Known and proven effective measure	All zones



Project area
Disturbance area
Study area
Proposed structure
Proposed transmission line

Snowy 2.0 cable yard

Booroolong Frog 50m exclusion area

Strahler stream order
1
2
3
5-7

Electricity transmission line
Minor road
Major road
Trail
NPWS estate

Data sources:
Jacobs 2021, TransGrid 2021, EMM 2020, DPI 2019, DPE 2018,
© Department Finance, Services and Innovation 2018

Figure 11-1 | Booroolong Frog 50m exclusion area

11.2 Yellow-bellied Glider Connectivity Strategy

The BDAR has identified a potential indirect impact associated with the transmission easement creating a barrier to movements of Yellow-bellied Glider, that may impact on home range of individuals, dispersal and genetic exchange. A Yellow-bellied Glider connectivity strategy will be developed for the project and will aim aims to address the barrier effect that an open transmission easement will have on glider movements. The strategy will continue to be developed during detailed design and form part of the Biodiversity Management Plan.

The goal of the strategy is to maintain connectivity in the landscape for Yellow-bellied Glider, as well as enhance movement where feasible and reasonable near the transmission easement. Additionally, the Yellow-bellied Glider connectivity strategy will present opportunities for a targeted survey to inform the location of fauna crossing structures.

The strategy will outline measures to be adopted for the detailed design in the form of connectivity design for crossing structure principles. The project will comprise dedicated fauna crossing structures based on the current project area. The location of crossing structures (glider poles) are subject to refinement during detailed design and consultation with BCS.

The Biodiversity Management Plan will identify specific goals for Yellow-bellied Glider management, implementation of management actions, followed with a monitoring program with an adaptive management approach (refer to **Section 11.3**). This will allow for performance thresholds to be evaluated to measure the effectiveness of management goals and implement corrective actions to improve mitigation if required.

11.3 Monitoring and adaptive management

A biodiversity monitoring program will be developed post-approval and approved prior to construction as part of the BMP and implemented before, during and after construction to monitor the effectiveness of the mitigation measures, and provide adaptive management where performance measures are not met. Monitoring will be conducted until such time as the mitigation measures have been proven to be effective after an agreed monitoring period. The monitoring data will provide robust information to draw sound conclusions around the effectiveness of mitigation measures for the target species and groups, and inform adaptive management actions. The BMP will include a program to evaluate and publicly report on the outcomes of a biodiversity monitoring program.

Monitoring of sections of the project within KNP and adjoining the Snowy 2.0 Main Works will be developed in consultation with BCS and NPWS with consideration of the existing Snowy 2.0 Main Works BMP and associated monitoring program. This is to ensure collaboration with monitoring and sharing of data, for example water quality monitoring and Booroolong Frog monitoring as part of the Main Works project will consider water quality changes that may be affected by construction of the Transmission Easement near Yarrangobilly River and Wallace Creek. Additional water quality monitoring sites will be included that are specific to the current project, and these data will be informed by outcomes of frog population monitoring that is conditioned for the Snowy 2.0 Main Works program.

As explained in the BAM Operational Manual Stage 2, some impacts are difficult to predict or assess prior to commencement of the development. The management of uncertain impacts requires the development of an adaptive management plan with the aim of adjusting actions based on results of monitoring to achieve a specified outcome. The plan is to be reviewed and approved by BCS and NPWS and any proposed deviation from the plan must be approved by DPIE. An example is the edge effects predicted for vegetation adjoining the easement. Monitoring is performance based and requires a trigger for necessary remedial action to be taken, such as adjusting the activity causing the impact or adjusting the mitigation measure. Monitoring is required to determine if measures are being implemented as planned and provide an early warning of measures that are ineffective and/or the uncertain impact is being realised.

A comprehensive biodiversity monitoring program will be developed post-approval as an integral part of the BMP. The information provided in **Table 11-2** shows a suggested framework for the key monitoring activities required, example of appropriate methods to be used and performance criteria are also identified.

Results will be reported to BCS and NPWS at least annually. Some programs may require more frequent reporting. All data collected for survey and monitoring programs will be provided in digital format (including spatial) to NPWS and NSW Department of Primary Industries/Forestry Corporation.

11.3.1 Booroolong Frog adaptive management strategy

The project will avoid direct impacts on Boorloolong Frog habitat. However, the BDAR has identified potential indirect impacts to Boorloolong Frog habitat associated with constructing the transmission easement. This may result in an increased risk of displaced sediment entering Yarrangobilly River via the slopes and ridge east of Lobs Hole Ravine road and associated with Sheep Station Creek, Lick Hole Gully, Cave Gully and Wallace Creek. While vegetation clearing will be largely avoided in gullies, there is a proposed access track crossing Sheep Station Creek, and partial clearing zones within proximity to the riparian corridor of Wallace Creek, and upstream habitats along Lick Hole Gully and Cave Gully. The introduction of the partial clearing zones are likely to reduce the risk of erosion and sedimentation from the project to downstream waterways where parts of the groundcover in the ECZ, HCZ and HTZ will remain partially intact or intact, and reduce soil disturbance. Over the long-term operational phase, the recovery of ground layer vegetation in the disturbance area will be expected to prevent further movement of sediment.

A range of mitigation measures will be implemented to prevent sediment entering waterways in general, and specifically the habitat for Booroolong Frog and Murray Crayfish and these will be documented in the Soil and Water Management Plan (SWMP) and the Biodiversity Management Plan. A summary of these include:

- Detailed design for the permanent crossing structures on access roads (such as Sheep Station Creek) will focus on options that ensure stream flow is unaffected
- A 50 m exclusion zone around Yarrangobilly Creek, Lick Hole Gully Cave Gully, Wallace Creek and Sheep Station Creek and exclusion of heavy machinery from the riparian zone, which will be hand-cleared only
- The SWMP will include stringent controls to mitigate impacts of runoff and sediment transfer from the project area during construction and operation. Controls measures will remain in situ until site stabilisation completion criteria are met
- An assessment of the current sediment basin design for the Main Works project to determine if the design specifications are suitable for the additional sediment load expected during construction of the project. Where modification or augmentation is required, sediment basins will be increased in size to cope with any additional expected sediment load.

Indirect impacts are uncertain during high rainfall events during and/or after clearing. If mitigation measures and sedimentation controls fail, this could lead to a substantial loss or adverse impact to Booroolong Frog breeding and dispersal habitat. An adaptive management plan will be prepared in consultation with NPWS and BCS to address risk of increased sedimentation/run off to the identified breeding habitat and population extent downhill and downstream of the project area. This will require an estimation of the residual impact if sediment mitigation measures fail. Information on stream health associated with Booroolong Frog breeding and dispersal habitat will be used as part of the adaptive management program.

The timing of monitoring surveys is to be provided in the program including pre-construction and post-construction duration and should be sufficient to allow any changes and/or degradation of Booroolong Frog habitat to be recorded and appropriate mitigation measures implemented as part of the adaptive management program. As a minimum the program should commence a minimum of 6 months prior to construction.

The Biodiversity Monitoring Program will include provision for annual reporting of monitoring results to the DPE and DAWE. As the program will focus on performance indicators and provide an adaptive management framework (**Table 11-2**), the outcomes of these will be reported in the monitoring program annual reports.

Table 11-2: Recommended framework for biodiversity monitoring program

Impact being mitigated	Action ID	Monitoring schedule	Example methods and triggers applied	Example performance criteria
Removal of native vegetation and habitat	BI01 BI02 BI03 BI04 BI05 BI06 BI07 BI08 BI09	During construction	Targeted threatened species monitoring program to focus on all species. Methods will focus on applying a Before, After, Control, Impact approach (BACI), designed to monitor population (based on occupancy) and distribution and comparing with baseline data collection at impact and control sites before construction commences. Note that any existing threatened species population monitoring program conducted for the Snowy 2.0 Main Works will be reviewed, and the new programs either focus on new impact sites, or any additional information that could assist the monitoring program, rather than replicating what is being done already (for example Booroolong Frog).	Negative change in site occupation comparing impact and control sites, and setting appropriate confidence limits
		Operation at years 5, 10 and 15 years post-construction	Monitoring the actual impacts from edge effects on key threatened species beyond the HTZ, and the edge of the ECZ to be agreed with BCS and NPWS. The monitoring plan will identify the specific locations proposed for conducting monitoring and the methods, variables, and timing of the proposed monitoring, to include impact and control sites. It is expected that monitoring will focus on Vegetation Integrity for the relevant PCT, as per the BAM and will be collected to detect change and set a reasonable and feasible distance from the easement for monitoring activity as approved by BCS.	Vegetation integrity scores monitoring in the edges of the hazard tree zone and in the zone 20-50 m from the ECZ
		Operational period over the life of project set at 5 yearly intervals for 25 years	Vegetation integrity in ECZ using appropriate density and location of BAM plots, focus will be on 20x20 m floristic plots as tree stems classes absent. Trigger for compliance action and revision of vegetation maintenance procedures if vegetation integrity scores show any reduction. Review must be undertaken by a qualified ecologist in consultation with BCS and NPWS.	Vegetation integrity scores are consistent with the prediction in the BAM for the ECZ to demonstrate that VI scores can be maintained in the long-term
Changes to surface runoff regimes resulting in sedimentation due to the removal of habitat Impacts on water quality and hydrological processes and that sustain threatened species	BI011	During construction	▪ Monitoring of sediment fencing performance, after rainfall events >50mm in 24 hour period ▪ Surface water quality monitoring is occurring as part of the Main Works project within Booroolong Frog habitat adjacent to the project. Additional monitoring sites will be required for establishment of the easement during construction, and focus on project specific locations in PCT 302 at the crossing of Wallace Creek and Sheep Station Creek. ▪ Testing of water quality indicators including turbidity, pH and dissolved oxygen within aquatic habitats occurring downstream of the construction area. Testing sites will be in addition to those used on the Main Works water quality monitoring	The monitoring plan will identify appropriate triggers and adaptive management measures

Impact being mitigated	Action ID	Monitoring schedule	Example methods and triggers applied	Example performance criteria
			program, to focus on sites specific the project, where the easement crosses tributaries flowing downstream into Yarrangobilly Creek ▪ If a decline in water quality is detected, all works will be stopped or scaled back until additional control measures are implemented and confirmed to be successful ▪ Testing of bunds and controlled water releases through landform for acidity.	
Increase in weeds and disease pathogens in adjacent vegetation	BIO11 BIO12 BIO13 BIO14 BIO15 BIO16	Construction and operation – controls will be determine to be effective if no corrective actions are triggered after a period of three consecutive monitoring periods post-construction	Weed / pathogen monitoring program, using a before, after, control and impact method (BACI) and comparing with baseline data collected before construction. Floristic plot based assessment focused on weeds identified in consultation with NPWS. Weed and pathogen spread and invasion particularly in areas subject to potential indirect impacts beyond the 20-metre edge effect buffer, by sampling out 20-50 metres from the disturbance area. Weed control and monitoring will be implemented as per the BMP requirements and/or conditions of consent.	Set acceptable limits of weed cover and performance criteria Measures will be considered effective after meeting performance for three (3) consecutive years post-construction
Increase in predator and pest species	BIO17 BIO18	Construction and operation – controls will be determine to be effective if no corrective actions are triggered after a period of three consecutive monitoring periods post-construction	Monitoring pest and predator species using remote cameras. Focus on construction compound areas and transmission substation where there is potential for increased pest activity, compare with baseline data.	Triggers based on increased pest activity, and will trigger the implementation of controls. Appropriate triggers will be decided in consultation with BCS and NPWS
Increase in risk of electrocution and EMF exposure	BIO19	Operational phase for 25 year life of project	The BMP to include adaptive management for high risk bird and bat species: ▪ Monitoring in transmission line easement for evidence of bird / bat collision with transmission lines ▪ Regular monitoring of taller structures for evidence of raptor nest building ▪ Develop target trigger for number of high risk species incidents. Deploy species specific bird / bat divertors / reflectors in areas where a defined number of incidents have occurred.	N/A

Impact being mitigated	Action ID	Monitoring schedule	Example methods and triggers applied	Example performance criteria
Fragmentation resulting in reduced connectivity	BIO29	Pre-construction, construction and operation – controls will be determine to be effective if no corrective actions are triggered after a period of three consecutive monitoring periods post-construction	The BMP will identify specific goals for Yellow-bellied Glider management, implementation of management actions and a monitoring program with an adaptive management approach (refer to **Section 11.2**) This will allow for performance thresholds to be evaluated to measure the effectiveness of management goals and implement corrective actions to improve mitigation if required.	The monitoring plan will identify appropriate triggers and adaptive management measures
Post-construction rehabilitation	N/A	Operational phase. Mitigation will be determined to be effective if no corrective actions are triggered after a period of three consecutive monitoring periods post-construction	The plan will include a program for adaptive monitoring of specific success measures and reporting and include a Trigger Action Response Plan (TARP).	N/A

*Where relevant, proposed mitigation actions BIO20, BIO21, BIO22, BIO23, BIO24, BIO25, BIO26, BIO27, BIO28, BIO29, BIO30 will be managed with monitoring activities using industry best practices and standards and implemented as part of the CEMP.

12. Thresholds for the assessment and offsetting of impacts of the project

This section of the BDAR identifies the impact thresholds that the assessor must apply including impacts:

- On a potential entity that are serious and irreversible impacts
- For which the assessor is required to determine an offset requirement
- That do not require further assessment by the assessor.

12.1 Impacts on a potential entity that are serious and irreversible impacts

No potential SAII entities have been identified within the disturbance area or project area or study area as part of this assessment. No SAII entities are expected to occur within the project area or study area and therefore serious and irreversible impacts are considered unlikely. As such, the additional impact assessment provision outlined in **subsection 10.2.3** of the BAM has not been completed.

12.2 Impacts for which the assessor is required to determine an offset requirement

The determination of impacts calculated within the disturbance area (see **Section 0**) which require an offset was undertaken in accordance with **section 10.3** of the BAM. Impacts requiring offsets are shown in **Figure 12-1**.

12.2.1 Impacts on native vegetation (ecosystem credits)

An offset is required for direct impacts (full and partial clearing) to PCTs, as outlined in **Table 12-1**.

Table 12-1: Direct impacts to PCTs which require an offset

PCT name	Vegetation zone / condition class	Clearing zones (ha)		Total impact (ha)	Current VI score	Change in VI	Future VI	Total VI loss
		Full loss	Partial loss					
SOUTH EASTERN HIGHLANDS BIOREGION								
PCT 296 Brittle Gum - peppermint open forest of the Woomargama to Tumut region, NSW South Western Slopes Bioregion	SEH-1 296_DNG	0.04	0.06 (ECZ)	0.10	39.5	-39.5 (full)	0 (full)	-26.4
						-17.8 (ECZ)	21.7 (ECZ)	
	SEH-2 296_Good, dry slopes	2.81	1.26 (ECZ)	4.07	88.7	-88.7 (full)	0 (full)	-72.2.1
						-48.1 (ECZ)	40.6 (ECZ)	
	SEH-3 296_Good, wet slopes	5.28	7.46 (ECZ)	13.56	75.3	-75.3 (full)	0 (full)	-50.4
						-38 (ECZ)	37.3 (ECZ)	
			0.82 (HTZ)			-2.8 (HTZ)	72.5 (HTZ)	
	SHE-4 296_Moderate Blackberry	-	1.17 (ECZ)	1.29	49.1	-43.3 (ECZ)	5.8 (ECZ)	-39.2
			0.12 (HTZ)			0 (HTZ)	49.1	
PCT 296 Total		**8.13**	**10.89**	**19.02**				

PCT name	Vegetation zone / condition class	Clearing zones (ha)		Total impact (ha)	Current VI score	Change in VI	Future VI	Total VI loss
		Full loss	Partial loss					
PCT 300 Ribbon Gum - Narrow-leaved (Robertsons) Peppermint montane fern - grass tall open forest on deep clay loam soils in the upper NSW South Western Slopes Bioregion and western Kosciuszko escarpment	SEH-5 300_Good	10.16	10.89 (ECZ)	23.19	81.1	-80.9(full)	0 (full)	-69.6
						-68.5 (ECZ)	12.3 (ECZ)	
			0.37 (HCZ)			-66.3 (HCZ)	14.6 (HCZ)	
			1.76 (HTZ)			-11.9 (HTZ)	69 (HTZ)	
PCT 300 Total		**10.16**	**13.02**	**23.19**				
PCT 302 Riparian Blakely's Red Gum - Broad-leaved Sally woodland - tea-tree - bottlebrush - wattle shrubland wetland of the NSW South Western Slopes Bioregion and South Eastern Highlands Bioregion	SEH-7 302_Moderate	0.58	1.42 (ECZ)	2.12	61.3	-61.3 (full)	0 (full)	-42.6
						-38.1 (ECZ)	23.2 (ECZ)	
			0.11 (HTZ)			-0.9 (HTZ)	60.4 (HTZ)	
PCT 302 Total		**0.58**	**1.53**	**2.12**				
PCT 729 Broad-leaved Peppermint - Candlebark shrubby open forest of montane areas, southern South Eastern Highlands Bioregion and South East Corner Bioregion	SEH-8 729_DNG	0.52	0.14 (ECZ)	0.72	23.4	-23.4 (full)	0 (full)	-15.3
			0.06 (HTZ)			+4.7 (ECZ)	28.1 (ECZ)	
						+8.9 (ECZ)	32.3 (ECZ)	
	SEH-9 729_Derived shrubland	0.61	-	0.61	36.6	-36.6	0	-36.6
	SEH-10 729_Good dry slopes	6.87	4.55 (ECZ)	12.82	81.5	-80.5 (full)	0 (full)	-61.3
						-43.9 (ECZ)	36.5 (ECZ)	
			1.09 (HCZ)			-28.6 (HCZ)	51.9 (HCZ)	
			0.32 (HTZ)			-5.8 (HTZ)	74.7 (HTC)	
	SEH-11 729_Good wetter slopes	6.06	3.72 (ECZ)	12.79	76	-72.2 (full)	0 (full)	-46.8
						-34.2 (ECZ)	38	
			1.49 (HCZ)			-19 (HCZ)	53.1	
			1.52 (HTZ)			-3.5 (HTZ)	68.7	

PCT name	Vegetation zone / condition class	Clearing zones (ha)		Total impact (ha)	Current VI score	Change in VI	Future VI	Total VI loss
		Full loss	Partial loss					
PCT 729 Total		**14.06**	**12.89**	**26.94**				
PCT 999 Norton's Box - Broad-leaved Peppermint open forest on footslopes, central and southern South Eastern Highlands Bioregion	SEH-12 999_Derived shrubland	1.14	0.20 (ECZ)	1.34	31.5	-31.5 (full)	0 (full)	-30.7
						-26.2 (ECZ)	5.2	
	SEH-13 999_Good dry Calytrix	4.99	2.09 (ECZ)	7.26	58.9	-58.9 (full)	0 (full)	-55.3
						-51.5 (ECZ)	7.4 (ECZ)	
			0.18 (HTZ)			-57.8 (HTC)	-1.1 (HTC)	
PCT 999 Total		**6.13**	**2.46**	**8.60**				
SUBTOTAL		**39.06**	**40.79**	**79.87**				
AUSTRALIAN ALPS BIOREGION								
PCT 285 Broad-leaved Sally grass - sedge woodland on valley flats and swamps in the NSW South Western Slopes Bioregion and adjoining South Eastern Highlands Bioregion	AA-1 285_Moderate Blackberry	2.20	-	2.2	78.7	-78.7 (full)	0 (full)	-78.7
PCT285 Total		**2.20**	-	**2.20**				
PCT 300 Ribbon Gum - Narrow-leaved (Robertsons) Peppermint montane fern - grass tall open forest on deep clay loam soils in the upper NSW South Western Slopes Bioregion and western Kosciuszko escarpment	AA-2 300_Good	4.70	3.55 (ECZ)	8.82	83.7	-83.7 (full)	0 (full)	-73.9
						-71.4 (ECZ)	12.3 (ECZ)	
			0.57 (HTZ)			-11.3 (HTZ)	72.2 (HTZ)	
PCT 300 Total		**4.70**	**4.12**	**8.82**				
PCT1196 Snow Gum - Mountain Gum shrubby open forest of montane areas, South Eastern Highlands Bioregion and Australian Alps Bioregion	AA-3 1196_DNG	0.09	-	0.09	38.6	-38.6 (full)	0 (full)	-38.6
	AA-4 1196_Good	24.8	2.04 (ECZ)	27.16	84.9	-84.9 (full)	0 (full)	-80.9
						-40.9 (ECZ)	44 (ECZ)	
			0.27 (HTZ)			-11.3 (HTZ)	73.6 (HTZ)	
PCT1196 Total		**24.93**	**2.31**	**27.24**				
SUBTOTAL		**31.83**	**6.42**	**38.26**				
GRAND TOTAL		**70.90**	**47.21**	**118.12**				

*SEH-6 302_DNG requires no offset for impact to native vegetation, as the vegetation integrity score for this vegetation zone is below 15.

12.2.2 Impacts on threatened species

An offset is required for impacts to threatened species as outlined in **Table 12-2** for the South Eastern Highlands Bioregion and **Table 12-3** for the Australian Alps Bioregion.

Table 12-2: Impacts to threatened species in the South Eastern Highlands Bioregion which require an offset

PCT name	Vegetation Zone*	Clearing area (ha)					
		Caladenia montana	Gang-gang Cockatoo (breeding)	Masked Owl (breeding)	Eastern Pygmy-possum	Yellow-bellied Glider Population on the Bago Plateau	Booroolong Frog
PCT 296 Brittle Gum - peppermint open forest of the Woomargama to Tumut region, NSW South Western Slopes Bioregion	SEH-1 296_DNG	-	0.10	-	0.10	-	-
	SEH-2 296_Good, dry slopes	-	3.75	-	4.07	-	-
	SEH-3 296_Good, wet slopes	4.69	5.92	-	13.56	-	0.15
	SEH-4 296_Moderate Blackberry	-	1.29	-	1.29	-	-
PCT 296 Total		**4.69**	**11.06**	**-**	**19.02**	**-**	**0.15**
PCT 300 Ribbon Gum - Narrow-leaved (Robertsons) Peppermint montane fern - grass tall open forest on deep clay loam soils in the upper NSW South Western Slopes Bioregion and western Kosciuszko escarpment	SEH-5 300_Good	1.56	17.33	0.04	23.19	15.49	-
PCT 300 Total		**1.56**	**17.33**	**0.04**	**23.19**	**15.49**	**-**

PCT name	Vegetation Zone*	Clearing area (ha)					
		Caladenia montana	Gang-gang Cockatoo (breeding)	Masked Owl (breeding)	Eastern Pygmy-possum	Yellow-bellied Glider Population on the Bago Plateau	Booroolong Frog
PCT 302 Riparian Blakely's Red Gum - Broad-leaved Sally woodland - tea-tree - bottlebrush - wattle shrubland wetland of the NSW South Western Slopes Bioregion and South Eastern Highlands Bioregion	SEH-7 302_Moderate	-	2.12	-	2.12	-	1.26
PCT 302 Total*		**-**	**2.12**	**-**	**2.12**	**-**	**1.26**
PCT 729 Broad-leaved Peppermint - Candlebark shrubby open forest of montane areas, southern South Eastern Highlands Bioregion and South East Corner Bioregion	SEH-8 729_DNG	-	0.72	-	-	-	-
	SEH-9 729_Derived shrubland	-	0.61	-	0.61	-	0.08
	SEH-10 729_Good dry slopes	1.13	10.21	-	12.82	5.38	0.18
	SEH-11 729_Good wetter slopes	0.56	2.94	-	12.79	-	-
PCT 729 Total		**1.69**	**14.48**	**-**	**26.22**	**5.38**	**0.25**
PCT 999 Norton's Box - Broad-leaved Peppermint open forest on footslopes, central and southern South Eastern Highlands Bioregion	SEH-12 999_Derived shrubland	0.36	1.23	-	1.34	-	-
	SEH-13 999_Good dry Calytrix	1.05	4.59	-	7.26	-	-
PCT 999 Total		**1.41**	**5.82**	**-**	**8.60**	**-**	**-**
Total		**9.35**	**50.81**	**0.04**	**79.14**	**20.87**	**1.67**

*SEH-6 302_DNG requires no offset for impact to native vegetation, as the vegetation integrity score for this vegetation zone is below 15.

Table 12-3: Impacts to threatened species in the Australian Alps Bioregion which require an offset

PCT name	Vegetation Zone*	Clearing zones (ha)			
		Gang-gang Cockatoo (breeding)	Masked Owl (breeding)	Eastern Pygmy-possum	Yellow-bellied Glider Population on the Bago Plateau
PCT 285 Broad-leaved Sally grass - sedge woodland on valley flats and swamps in the NSW South Western Slopes Bioregion and adjoining South Eastern Highlands Bioregion	AA-1 285_Moderate Blackberry	2.20	0.03	2.20	2.20
PCT 285 Total		**2.20**	**0.03**	**2.20**	**2.20**
PCT 300 Ribbon Gum - Narrow-leaved (Robertsons) Peppermint montane fern - grass tall open forest on deep clay loam soils in the upper NSW South Western Slopes Bioregion and western Kosciuszko escarpment	AA-2 300_Good	8.82	5.82	8.82	8.82
PCT 300 Total		**8.82**	**5.82**	**8.82**	**8.82**
PCT 1196 Snow Gum - Mountain Gum shrubby open forest of montane areas, South Eastern Highlands Bioregion and Australian Alps Bioregion	AA-3 1196_DNG	0.09	-	-	-
	AA-4 1196_Good	27.16	4.97	27.16	27.16
PCT 1196 Total		**27.24**	**4.97**	**27.16**	**27.16**
TOTAL		**38.26**	**10.82**	**38.16**	**38.16**

12.3 Impacts for which the assessor is not required to determine an offset requirement

An offset is not required for impacts where the vegetation integrity score is below those set out in paragraph 10.3.1.1 of the BAM for impacts on native vegetation and paragraph 10.3.2.1 of the BAM for impacts on threatened species. Impacts not requiring offset are described in **Table 12-4**.

The vegetation integrity score for the Riparian Blakely's Red Gum - Broad-leaved Sally woodland - tea-tree - bottlebrush - wattle shrubland wetland of the NSW South Western Slopes Bioregion and South Eastern Highlands Bioregion (PCT 302) derived native grassland (302_DNG) is 14.6. As the vegetation integrity score for this vegetation zone is below 15, an offset is not required for this impact to native vegetation. Similarly, as the vegetation integrity score for vegetation zone 302_DNG is below 17, an offset is not required for this impact to breeding habitat for the Gang-gang Cockatoo. The location of this vegetation zone is shown in **Figure 5-2.** Impacts not requiring offsets are also shown in **Figure 12-1**.

Table 12-4: Impacts which do not require an offset

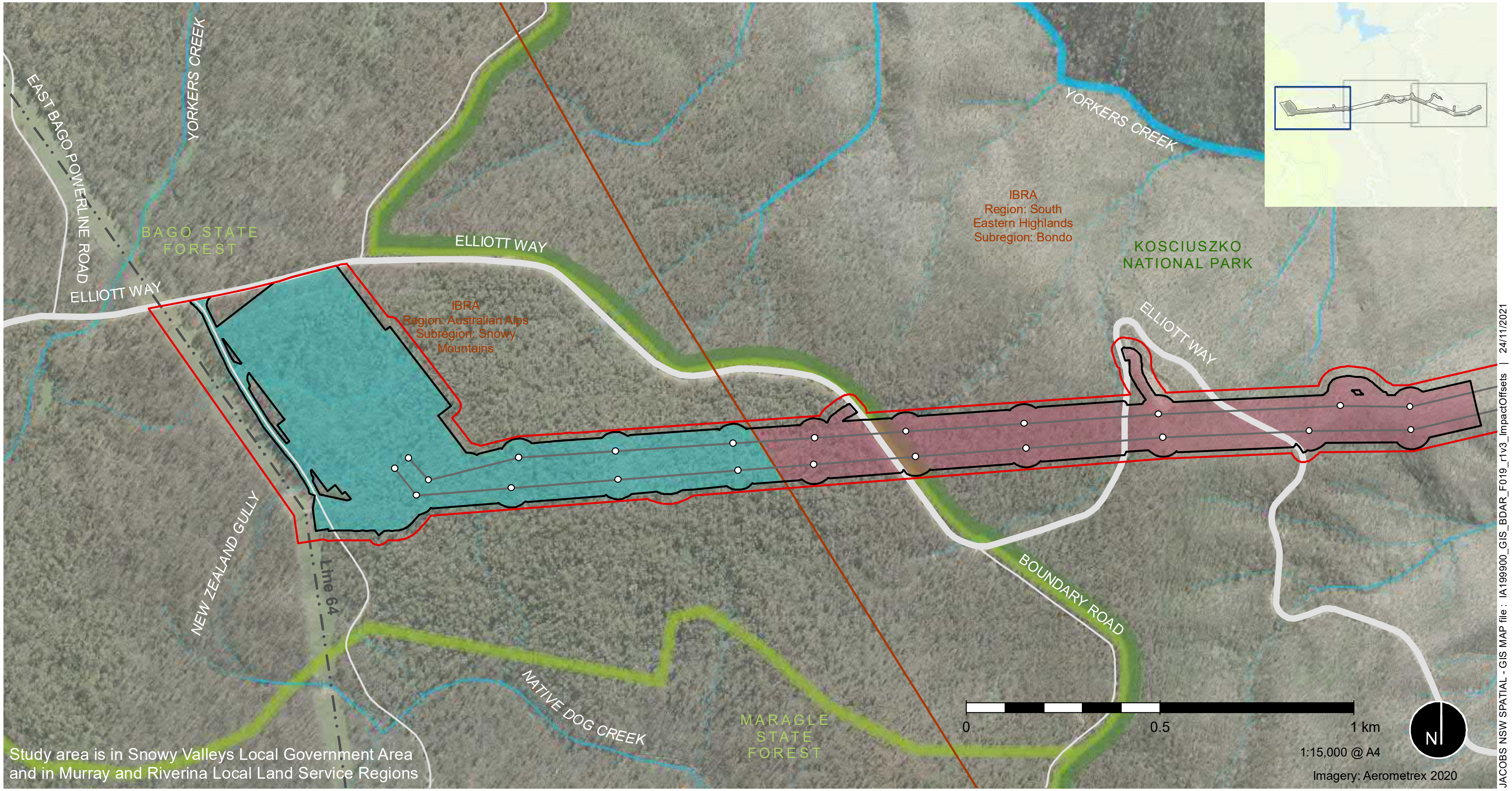
PCT	PCT name	Vegetation Zone	Vegetation zone area (ha)	Current VI score	Change in VI	Offset required
South Eastern Highlands Bioregion						

PCT	PCT name	Vegetation Zone	Vegetation zone area (ha)	Current VI score	Change in VI	Offset required
302	Riparian Blakely's Red Gum - Broad-leaved Sally woodland - tea-tree - bottlebrush - wattle shrubland wetland of the NSW South Western Slopes Bioregion and South Eastern Highlands Bioregion	SEH-6 302_DNG	0.22	14.6	≥15	No
Gang-gang Cockatoo						
302	Riparian Blakely's Red Gum - Broad-leaved Sally woodland - tea-tree - bottlebrush - wattle shrubland wetland of the NSW South Western Slopes Bioregion and South Eastern Highlands Bioregion	SEH-6 302_DNG	0.22	14.6	≥17	No

*Note: Vegetation integrity score thresholds as set out by section 10.3 of the BAM

12.4 Impacts that do not require further assessment by the assessor

An assessor is not required to assess areas of land on the disturbance area for ecosystem credits without native vegetation under Chapter 4 or Chapter 5 of the BAM. This section of the BAM is not applicable to the project.



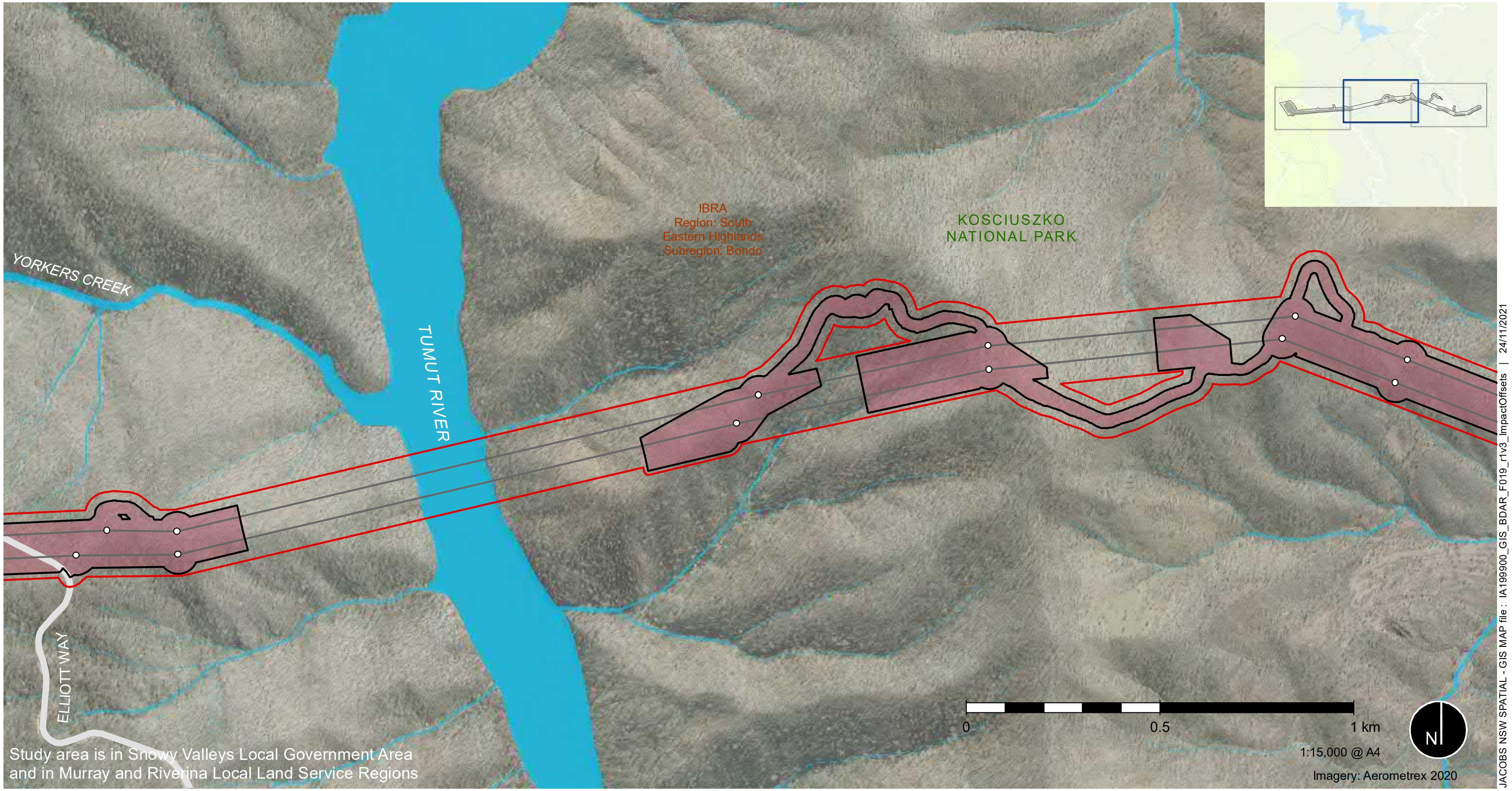
Project area
Disturbance area
Proposed structure
Proposed transmission line

Offsets not required
South Eastern Highlands Bioregion
Offsets required
Australian Alps Bioregion
South Eastern Highlands Bioregion

Electricity transmission line
Minor road
Major road
Waterway
IBRA
NPWS estate
State Forest

Data sources:
Jacobs 2021, TransGrid 2021, EMM 2020, DPE 2018,
© Department Finance, Services and Innovation 2018

Figure 12-1 | Impacts to PCTs requiring offsets and impacts not requiring offsets



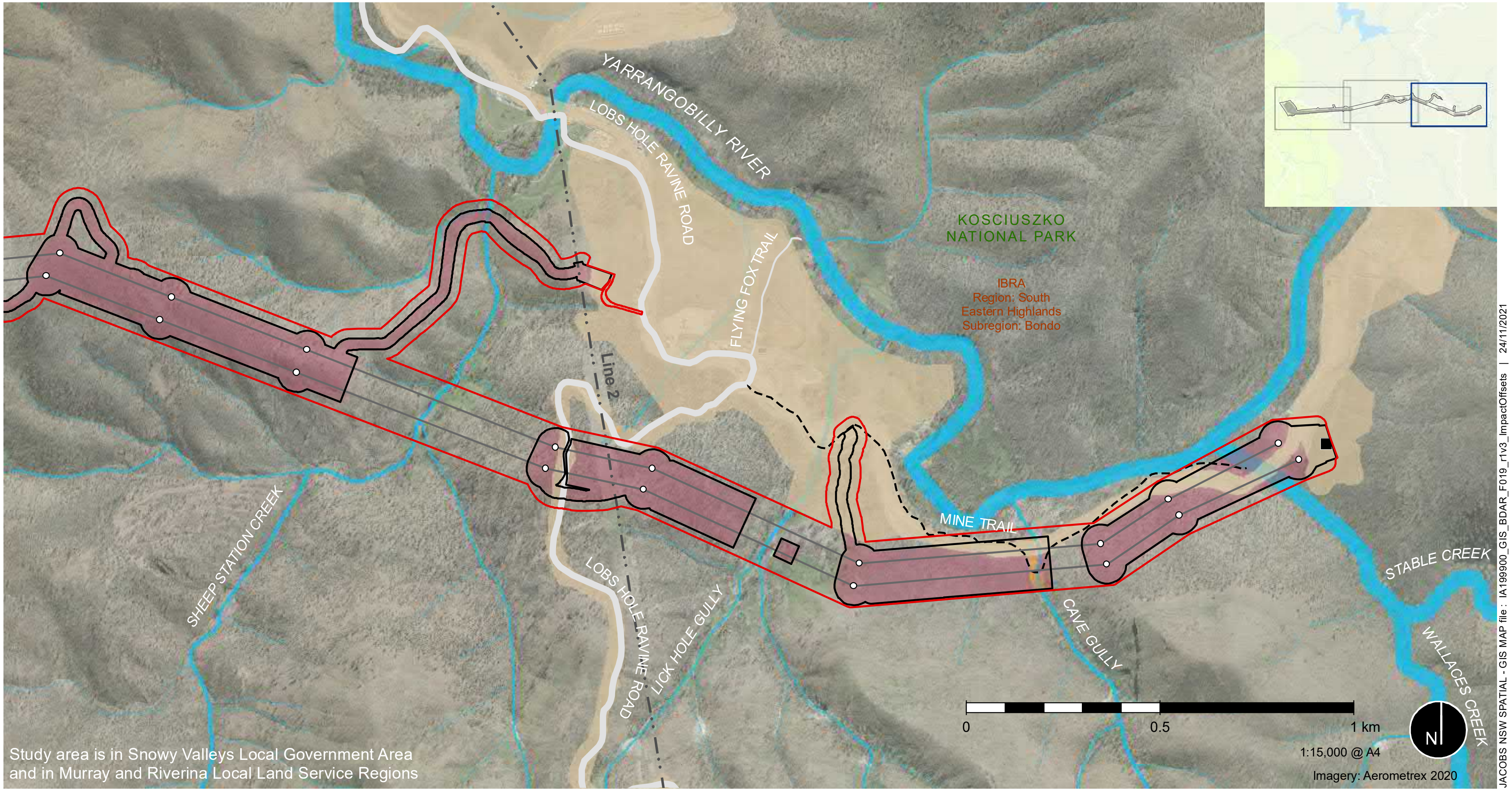
Project area
Disturbance area
Proposed structure
Proposed transmission line

Offsets not required
South Eastern Highlands Bioregion
Offsets required
Australian Alps Bioregion
South Eastern Highlands Bioregion

Major road
Waterway
NPWS estate

Data sources:
Jacobs 2021, TransGrid 2021, EMM 2020, DPE 2018,
© Department Finance, Services and Innovation 2018

Figure 12-1 | Impacts to PCTs requiring offsets and impacts not requiring offsets



Project area
Disturbance area
Proposed structure
Proposed transmission line

Snowy 2.0 cable yard
Snowy 2.0 disturbance footprint

Offsets not required
South Eastern Highlands Bioregion

Offsets required
Australian Alps Bioregion
South Eastern Highlands Bioregion

Electricity transmission line
Minor road
Major road
Trail
Waterway
NPWS estate

Data sources:
Jacobs 2021, TransGrid 2021, EMM 2020, DPE 2018,
© Department Finance, Services and Innovation 2018

Figure 12-1 | Impacts to PCTs requiring offsets and impacts not requiring offsets

13. Biodiversity credit requirements

A summary of the biodiversity credit requirements for the project are provided below in **Table 13-1, Table 13-2 and Table 13-3**. The credit report is provided in **Appendix I**. Credits have been calculated and displayed separately for each bioregion and include credits associated with the direct impacts of the project.

The project will have direct impacts on 118.35 ha of native vegetation within the disturbance area. Of this, 70.90 ha will have full clearing of vegetation to ground level and a further 47.45 ha maintained as a partially cleared vegetation. While the project will involve the removal of vegetation to allow the construction of, and ongoing operational maintenance of the asset for the life of the project, the design has allowed for full clearing only in areas identified for infrastructure and remaining areas of the project will, over the long-term result in partial clearing along the designated transmission easement. The resulting modified vegetation will be maintained in this state for the life of the project, thereby retaining some of the original biodiversity values in the lower stratum and preserving the surface soil structure. By achieving this, the loss of vegetation to accommodate the infrastructure has been reduced from the initial concept design plan.

Project impacts and offset obligations will be revised throughout the life of the project through the monitoring program. Where there is opportunity to modify the clearing extent and the potential biodiversity impact post-approval, this will be done as part of the detailed design and analysis of operational management requirements.

Indirect impacts are subject to the efficacy of implemented environmental controls. These are mitigated through effective environmental management during construction and associated with an adaptive management strategy. The monitoring program will be designed to verify the extent of indirect impacts, identify where additional mitigation of indirect impacts is required. Any substantial loss in future VI that cannot be mitigated will need to be reflected in the future offset obligation.

The future VI score for direct impacts in the full clearing areas has been set at zero (i.e. full clearing to ground-level). The method for calculating the future VI for direct impacts in partial clearing areas in the ECZ, HCZ and HTZ is outlined in **Section 10.1.2** and used assumptions based on advice from the BAM operational manual (DPIE, 2019b) and the level of impact that affected VI attributes to set a future value of VI condition. The Line 2 VI data was also applied to each VI attribute in the ECZ and HCZ to provide anticipated future outcomes based on local data. Modifications made to the future VI scores in the BAM-C comprised:

- ECZ – tree and shrub growth forms set to zero; other growth forms use average on Line 2 VIS data for each PCT
- HCZ – only tree growth form set to zero; other growth forms use average on Line 2 VIS data for each PCT
- HTZ - Set 'Stem Class' for 50-79 cm and 'Number of large trees (>50cm DBHOB)' to zero.

Table 13-1 provides a summary of the ecosystem credits required to offset direct impacts to native vegetation that will occur within the disturbance area.

Table 13-2 and **Table 13-3** provide a summary of the species credits required to offset direct impacts on threatened species credit species that will occur within the disturbance area for South Eastern Highlands bioregion and Australian Alps bioregion, respectively. Note PCT302_DNG has a vegetation integrity score below 15, an offset is not required for this impact to native vegetation.

Table 13-1: Ecosystem credits required by bioregion and vegetation zone

PCT name	Vegetation zone	Clearing zones (ha)		No. of credits
		Full loss	Partial loss	
SOUTH EASTERN HIGHLANDS BIOREGION				
PCT 296 Brittle Gum - peppermint open forest of the Woomargama to Tumut region, NSW South Western Slopes Bioregion	SEH-1 296_DNG	0.04	0.06 (ECZ)	1
	SEH-2 296_Good, dry slopes	2.81	1.26 (ECZ)	116
	SEH-3 296_Good, wet slopes	5.28	7.46 (ECZ)	256
			0.82 (HTZ)	
	SEH-4 296_Moderate Blackberry	-	1.17 (ECZ)	19
			0.12 (HTZ)	
PCT 296 Total		**8.13**	**10.89**	**392**
PCT 300 Ribbon Gum - Narrow-leaved (Robertsons) Peppermint montane fern - grass tall open forest on deep clay loam soils in the upper NSW South Western Slopes Bioregion and western Kosciuszko escarpment	SEH-5 300_Good	10.16	10.89 (ECZ)	605
			0.37 (HCZ)	
			1.76 (HTZ)	
PCT 300 Total		**10.16**	**13.02**	**605**
PCT 302 Riparian Blakely's Red Gum - Broad-leaved Sally woodland - tea-tree - bottlebrush - wattle shrubland wetland of the NSW South Western Slopes Bioregion and South Eastern Highlands Bioregion	SEH-6 302_DNG	-	0.18 (ECZ)	0
			0.04 (HTZ)	
	SEH-7 302_Moderate	0.58	1.42 (ECZ)	39
			0.11 (HTZ)	
PCT 302 Total		**0.58**	**1.75**	**39**
PCT 729 Broad-leaved Peppermint - Candlebark shrubby open forest of montane areas, southern South Eastern Highlands Bioregion and South East Corner Bioregion	SEH-8 729_DNG	0.52	0.14 (ECZ)	4
			0.06 (HTZ)	
	SEH-9 729_Derived shrubland	0.61	-	8
	SEH-10 729_Good dry slopes	6.87	4.55 (ECZ)	295
			1.09 (HCZ)	
			0.32 (HTZ)	
	SEH-11 729_Good wetter slopes	6.06	3.72 (ECZ)	224
			1.49 (HCZ)	
			1.52 (HTZ)	
PCT 729 Total		**14.06**	**12.89**	**531**
PCT 999 Norton's Box - Broad-leaved Peppermint open forest on footslopes, central and southern South Eastern Highlands Bioregion	SEH-12 999_Derived shrubland	1.14	0.20 (ECZ)	15
	SEH-13	4.99	2.09 (ECZ)	151

PCT name	Vegetation zone	Clearing zones (ha)		No. of credits
		Full loss	Partial loss	
	999_Good dry Calytrix		0.18 (HTZ)	
PCT 999 Total		**6.13**	**2.46**	**166**
SUBTOTAL		**39.06**	**41.01**	**1,733**
AUSTRALIAN ALPS BIOREGION				
PCT 285 Broad-leaved Sally grass - sedge woodland on valley flats and swamps in the NSW South Western Slopes Bioregion and adjoining South Eastern Highlands Bioregion	285_Moderate Blackberry	2.20	-	87
PCT285 Total		**2.20**	-	87
PCT 300 Ribbon Gum - Narrow-leaved (Robertsons) Peppermint montane fern - grass tall open forest on deep clay loam soils in the upper NSW South Western Slopes Bioregion and western Kosciuszko escarpment	300_Good	4.70	3.55 (ECZ)	244
			0.57 (HTZ)	
PCT 300 Total		**4.70**	**4.12**	**244**
PCT1196 Snow Gum - Mountain Gum shrubby open forest of montane areas, South Eastern Highlands Bioregion and Australian Alps Bioregion	1196_DNG	0.09	-	1
	1196_Good	24.85	2.04 (ECZ)	824
			0.27 (HTZ)	
PCT1196 Total		**24.93**	**2.31**	**825**
SUBTOTAL		**31.83**	**6.42**	**1,156**
GRAND TOTAL		**70.90**	**47.45**	**2,889**

Table 13-2: Species credits required by vegetation zone for the South Eastern Highlands bioregion

PCT	Vegetation Zone	Clearing area (ha)	Total VI loss	Species credits
SOUTH EASTERN HIGHLANDS BIOREGION				
Caladenia montana				
296	296_Good, wet slopes	4.69	-50.4	89
300	300_Good	1.56	-69.6	41
729	729_Good dry slopes	1.13	-61.3	26
	729_Good wetter slopes	0.56	-46.8	10
999	999_Derived shrubland	0.36	-30.7	4
	999_Good dry Calytrix	1.05	-55.3	22
Total *Caladenia montana* species credits				**192**
Gang-gang Cockatoo (breeding)				
296	296_DNG	0.10	-26.4	1
	296_Good, dry slopes	3.75	-72.2.1	143
	296_Good, wet slopes	5.92	-50.4	149

PCT	Vegetation Zone	Clearing area (ha)	Total VI loss	Species credits
	296_Moderate Blackberry	1.29	-39.2	25
300	300_Good	17.33	-69.6	603
302	302_Moderate	2.12	-42.6	45
729	729_DNG	0.72	-15.5	5
	729_Derived shrubland	0.61	-36.6	11
	729_Good dry slopes	10.21	-61.3	313
	729_Good wetter slopes	2.94	-46.8	69
999	999_Derived shrubland	1.23	-30.7	19
	999_Good dry Calytrix	4.59	-55.3	127
Total Gang-gang Cockatoo species credits				**1510**
Eastern Pygmy-possum				
296	296_DNG	0.10	-26.4	1
	296_Good, dry slopes	4.07	-72.2.1	155
	296_Good, wet slopes	13.56	-50.4	342
	296_Moderate Blackberry	1.29	-39.2	25
300	300_Good	23.19	-69.6	807
302	302_Moderate	2.12	-42.6	45
729	729_Derived shrubland	0.61	-36.6	11
	729_Good dry slopes	12.82	-61.3.0	393
	729_Good wetter slopes	12.79	-46.8	299
999	999_Derived shrubland	1.34	-30.7	21
	999_Good dry Calytrix	7.26	-55.3	201
Total Eastern Pygmy-possum species credits				**2300**
Booroolong Frog				
296	296_Good, wet slopes	0.15	-50.4	4
302	302_Moderate	1.26	-42.6	27
729	729_Derived shrubland	0.08	-36.6	1
729	729_Good dry slopes	0.18	-61.3.0	6
Total Booroolong Frog species credits				**38**
Yellow-bellied Glider population on the Bago Plateau				
300	300_Good	15.49	-69.6	539
729	729_Good dry slopes	5.38	-61.3.0	165
Total Yellow-bellied Glider population on the Bago Plateau species credits				**704**
Masked Owl (breeding)				
300	300_Good	0.04	-69.6	1
Total Masked Owl species credits				**1**

Table 13-3: Species credits required by vegetation zone for the Australian Alps bioregion

PCT	Vegetation Zone	Clearing area (ha)	Total VI loss	Species credits
Australian Alps Bioregion				
Gang-gang Cockatoo (breeding)				
285	285_Moderate Blackberry	2.20	-78.7	87
300	300_Good	8.82	-73.9	326
1196	1196_DNG	0.09	-38.6	2
	1196_Good	27.16	-80.9	1099
Total Gang-gang Cockatoo species credits				**1,514**
Eastern Pygmy-possum				
285	285_Moderate Blackberry	2.20	-78.7	87
300	300_Good	8.82	-73.9	326
1196	1196_Good	27.16	-80.9	1,099
Total Eastern Pygmy-possum species credits				**1,512**
Yellow-bellied Glider Population on the Bago Plateau				
285	285_Moderate Blackberry	2.20	-78.7	87
300	300_Good	8.82	-73.9	326
1196	1196_Good	27.16	-80.9	1,099
Total Yellow-bellied Glider population on the Bago Plateau species credits				**1,512**
Masked Owl (breeding)				
285	285_Moderate Blackberry	0.03	-78.7	1
300	300_Good	5.82	-73.9	215
1196	1196_Good	4.97	-80.9	201
Total Masked Owl species credits				**417**

14. Biodiversity Offset Strategy

The BOS is required to address the SEARs, which state that:

A strategy to offset any residual impacts of the project focusing on improving the biodiversity and conservation values of the Kosciuszko National Park (KNP) in the medium to long term.

A Biodiversity Offset Strategy (BOS) has been prepared by Snowy Hydro Limited. The BOS provided in **Appendix L**.

15. Conclusions

The project is located within a predominantly natural landscape containing a diversity of habitats with high biodiversity value within KNP and Bago State Forest. Design and options assessment have minimised impacts to biodiversity where possible, by introducing vegetation clearing zones and stringent environmental management and monitoring mechanisms. However, the nature of this project means there will be residual impacts, primarily as a result of direct removal of vegetation.

No areas of land that the Minister for Energy and Environment has declared as an area of outstanding biodiversity value in accordance with section 3.1 of the BC Act will be affected. The project has been declared a controlled action under the Commonwealth EPBC Act on the basis of potential impacts to the following MNES:

- Listed threatened species and communities (section 18 & section 18A)
- Listed migratory species (section 20 & section 20A)
- The heritage values of a National Heritage place (section 15B & section 15C).

The project will result in direct clearing of 118.35 ha of native vegetation within the disturbance area to allow the construction of, and ongoing operational maintenance of the asset for the life of the project. Full clearing will be required in areas that have been identified for future infrastructure, which includes the substation, individual twin transmission structures, and the development of construction and formal ongoing access tracks. Partial clearing will occur in areas that are safe to retain low growing vegetation within the operational limits of the asset. This includes large sections of the easement and off-easement hazard tree zone. The resulting modified vegetation will be maintained in this state for the life of the project, thereby retaining some of the original biodiversity values in the lower stratum and preserving the surface soil structure.

The project will remove areas of seven PCTs as described in **Table 15-1**. None of this vegetation corresponds to a threatened ecological community listed under the BC Act or EPBC Act.

Table 15-1: Direct impacts to native vegetation from the project

PCT ID No.	PCT name	TEC[1]	Area (ha) in disturbance area		Area (ha) in project area	
			SEH	AA	SEH	AA
296	Brittle Gum – peppermint open forest of the Woomargama to Tumut region, NSW South Western Slopes Bioregion	No	19.02	-	28.0	-
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	No	23.19	8.82	33.55	11.36
302	Riparian Blakely's Red Gum – Broad-leaved Sally woodland – tea-tree – bottlebrush – wattle shrubland wetland of the NSW South Western Slopes Bioregion and South Eastern Highlands Bioregion	No	2.11	-	6.78	-
729	Broad-leaved Peppermint – Candlebark shrubby open forest of montane areas, southern South Eastern Highlands Bioregion and South East Corner Bioregion	No	26.94	-	67.12	-
999	Norton's Box – Broad-leaved Peppermint open forest on footslopes, central and southern South Eastern Highlands Bioregion	No	8.60	-	14.48	-

PCT ID No.	PCT name	TEC[1]	Area (ha) in disturbance area		Area (ha) in project area	
			SEH	AA	SEH	AA
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	No	-	2.20	-	2.74
1196	Snow Gum – Mountain Gum shrubby open forest of montane areas, South Eastern Highlands Bioregion and Australian Alps Bioregion	No	-	27.24	-	35.84
TOTALS			**80.09**	**38.26**	**149.88**	**49.94**
			118.35		**199.87**	

The project will involve the loss of habitat within the disturbance area for the following species credit species:

- *Caladenia montana* - Surveys identified 166 plant clusters covered by a disturbance area of 9.35 ha (confined to South Eastern Highlands Bioregion)
- Gang-gang Cockatoo – 89.28 ha of breeding habitat (over both bioregions)
- Masked Owl – 10.86 ha of breeding habitat (over both bioregions)
- Booroolong Frog – 1.67 ha (confined to South Eastern Highlands Bioregion)
- Eastern Pygmy-possum – 117.29 ha (over both bioregions)
- Yellow-bellied Glider population on the Bago Plateau – 59.03 ha (over both bioregions).

The project area also provides habitat features for a range of ecosystem credit species and foraging habitat only for several dual-credit species.

Twenty-nine waterways or unnamed drainage lines are crossed by the project area (i.e. not all will be directly impacted). Six of these waterways are stream order three or greater and have also been mapped as Key Fish Habitat. The project will only directly impact three of these waterways during vegetation clearing, including Sheep Station Creek (which will also involve a bridge crossing for the access track), Cave Gully and Wallaces Creek. There is also potential for indirect impacts to surrounding aquatic habitats from erosion and contaminated run-off from construction and operation. The implementation of mitigation measures (i.e. track design, erosion and sediment control, spill control) will be implemented to control sediment and pollutants from any significant runoff events.

The project has potential to result in prescribed biodiversity impacts, namely impacts to connectivity and movement for gliding mammals (i.e. fragmentation by vegetation clearing and collision with barbed wire fences) and impacts on water quality for aquatic species and the Booroolong Frog. Measures to minimise and mitigate these potential impacts have been discussed.

Twenty-nine waterways or unnamed drainage lines are crossed by the project area (not all will be directly impacted). Six of these are stream order three or greater and have also been mapped as Key Fish Habitat. The project will only directly impact three of these waterways: Sheep Station Creek, Cave Gully and Wallaces Creek. There is potential for indirect impacts to surrounding aquatic habitats from unmitigated erosion and contaminants (e.g. hydraulic fluids, oils, drilling fluids) run-off from construction and operation. The implementation of mitigation measures (i.e. track design, erosion and sediment control, spill control) will be implemented to control sediment and pollutants from any runoff events.

The project has potential to result in prescribed biodiversity impacts, namely impacts to connectivity and movement for gliding mammals (i.e. fragmentation by clearing along the transmission line corridor and collision with razor wire fences around the substation) and impacts on water quality for aquatic species including Booroolong Frog. Measures to minimise and mitigate these potential impacts have been discussed within.

Due to the creation of new edges through remnant vegetation, there is also expected to be indirect impacts. While direct impacts are easily quantified and controlled by managing the extent of clearing within the disturbance area, the indirect impacts are subject to the efficacy of implemented environmental controls. As such, direct impacts are defined during project design, whereas indirect impacts are mitigated through effective environmental management during construction and associated with an adaptive management strategy.

Other potential indirect impacts that may occur due to the project include collision and electrocution of fauna with transmission lines, increased fire risk and increases in noise, vibration, dust, light and contaminants. The measures provided in this BDAR are likely to suitably mitigate these potential impacts.

Mitigation measures form the basis and framework for development of project specific Biodiversity Management Plan (BMP) that will include a biodiversity monitoring program to be developed post-approval of the project. The measures outlined in this section are intended to provide a framework for developing the BMP. The BMP will expand on, and provide more specific detail on the biodiversity mitigation measures.

The monitoring program will be designed to verify the extent of indirect impacts, identify where additional mitigation of indirect impacts is required. The BMP will include a program to evaluate and publicly report on the outcomes of such monitoring.

This BDAR has assessed the project area for its biodiversity values so that if the disturbance area may need to shift slightly during detailed design, this can be achieved without the need to modify the project subject to recommended environmental management measures and provided it does not exceed the limits defined by the project area, noting the calculation of impact area has been restricted to the disturbance area for this stage of the development assessment. Once detailed design is complete further analysis of the direct and indirect vegetation impact will be recalculated and where applicable the adjusted biodiversity offset liability updated post-approval.

A credit requirement has been generated by the BAM-C for the two bioregions assessed:

- South Eastern Highlands:
  - 1,733 ecosystem credits
  - 4,745 species credits
- Australian Alps Bioregion:
  - 1,156 ecosystem credits
  - 4,955 species credits.

A Biodiversity Offset Strategy (BOS) has been prepared by Snowy Hydro Limited for the project.

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Appendix A. Habitat assessment and likelihood of occurrence assessment for threatened species

State and nationally listed threatened species identified from the literature review, database searches and BAM-C, were considered in terms of their likelihood to occur in the habitats present within the survey area based on identified habitat requirements. The habitat suitability assessment for threatened species is provided in **Table A-1** and **Table A-2**.

Table A-1 Habitat suitability assessment for threatened plant species

Species name	Common name	EPBC Act	BC Act	Distribution and habitat	Data source	Habitat constraints and Geographic limitations (BAM-C)	Habitat suitability	Likelihood of occurrence
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 likely to be of *Caladenia fitzgeraldii*. *Caladenia montana* may occur in southern KNP to Victoria. Generally found after fires.	BAM-C EMM (2020)	None	Moderate Habitat in the study area may be suitable. This species was recorded during surveys for the Snowy 2.0 Main Works in some of the same PCTs. There is a record of *Caladenia montana* in Maragle State Forest from 2005 (although exact location is obscured). There is potential for this species to occur in the higher altitude montane areas in the west of the survey area in the KNP and Maragle and Bago State Forests in the tall wetter forests dominated by *Eucalyptus dalrympleana, E. dives, E. viminalis* and *E. robertsonii*.	High. *Caladenia montana* is identified as a candidate species for assessment and was targeted during surveys.
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.	PMST BAM-C EMM (2020)	No habitat constraints. Only occurs north of Eucumbene.	Low. Known records and modelled habitat are to the east of the project area on the montane or natural temperate grasslands.	Moderate. Included as a candidate species for assessment and

Species name	Common name	EPBC Act	BC Act	Distribution and habitat	Data source	Habitat constraints and Geographic limitations (BAM-C)	Habitat suitability	Likelihood of occurrence
				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 long in such sites. Does not persist in heavily-grazed pastures of the Monaro or the Shoalhaven area.			This habitat type is not present in the project area.	targeted during surveys.
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 KNP, 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.	EMM (2020)	-	Low. Only known to occur in the grasslands to the east of the project area on the sub-alpine treeless plains. No suitable habitat occurs in the project area.	Low. Not included as a candidate species for assessment.
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 Kosciuszko 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.	EMM (2020)	-	Low. There is no suitable habitat for this species in the project area as no alpine or sub-alpine peatlands or fens occur. There may be habitat for this species in the broader study area but it is unlikely to be affected by indirect impacts.	Low. Not included as a candidate species for assessment.

Species name	Common name	EPBC Act	BC Act	Distribution and habitat	Data source	Habitat constraints and Geographic limitations (BAM-C)	Habitat suitability	Likelihood of occurrence
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.	PMST	-	Low. Not known from habitats in or near the project area.	Low. Not included as a candidate species for assessment.
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 KNP, 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 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.	BioNet – 7 EMM (2020)	-	Low. There is known habitat for this species in the alpine areas to the east of the project area but there is no suitable habitat for this species in or directly adjacent to the project area. The related species *Discaria pubescens* was recorded in the grassland on McPhersons Plain during the surveys but no *Discaria* species were found in the project area.	Low. Not included as a candidate species for assessment.
Diuris ochroma	Pale Golden Moths	E	V	Recorded in south-eastern NSW on the sub-alpine plains of KNP and the Kybean area. Also recorded in eastern Victoria. Open grassy woodland of	PMST	-	Low. No records of this species exist in the project area and the project	Low.

Species name	Common name	EPBC Act	BC Act	Distribution and habitat	Data source	Habitat constraints and Geographic limitations (BAM-C)	Habitat suitability	Likelihood of occurrence
				Eucalyptus viminalis / E. pauciflora or *E. pauciflora / E. parvula* (or secondary grassland). Also found in sub-alpine grassland.			area does not contain any modelled habitat. No suitable open grassy woodlands are present.	Not included as a candidate species for assessment.
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.	BioNet - 2	-	Low. Known from the Yarrangobilly Caves area and the west near Tumbarumba. However, the project area does not contain any suitable swamp habitat for this species.	Low. Not included as a candidate species for assessment.
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.	BioNet – 3 PMST	-	Low. 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. However, these records are likely to be erroneous.	Low. Not included as a candidate species for assessment.
Glycine latrobeana	Clover Glycine	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 KNP. The Clover Glycine occurs mainly in grassland and grassy woodland habitats, less often in dry forests, and only rarely in heathland. Populations occur from sea level to c. 1,200 m	PMST EMM (2020)	-	Low. Known from the east of the project area on the grasslands near the Tantangara Reservoir. Restricted to the Sub-alpine dry grasslands and heathlands of valley slopes, southern South	Low. Not included as a candidate species for assessment.

Species name	Common name	EPBC Act	BC Act	Distribution and habitat	Data source	Habitat constraints and Geographic limitations (BAM-C)	Habitat suitability	Likelihood of occurrence
				altitude 6 (900 m in Tasmania). The NSW population is in subalpine grassland (at about 1300 m asl).			Eastern Highlands Bioregion and Australian Alps Bioregion PCT. No suitable habitat for this species is present in the project area.	
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.	PMST EMM (2020)	-	Low. Known from the highway near the Providence Portal and Adaminaby areas. Habitat association with Norton's Box - Broad-leaved Peppermint open forest on footslopes, central and southern South Eastern Highlands Bioregion.	Low. Included as a candidate species for assessment and targeted during surveys in associated habitat.
Pomaderris cotoneaster	Cotoneaster Pomaderris	E	E	Cotoneaster Pomaderris has a very disjunct distribution, being known from the Nungatta area, northern KNP (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.	BAM-C	No habitat constraints. Only occurs south of the northern Kosciuszko NP boundary.	Moderate. The 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.	Moderate. Included as a candidate species for assessment and targeted during surveys as a precautionary measure as data on this species is deficient.
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.	BioNet – 396 PMST BAM-C	-	Low. This species is only known from the McPhersons Plain area. No	Low.

Species name	Common name	EPBC Act	BC Act	Distribution and habitat	Data source	Habitat constraints and Geographic limitations (BAM-C)	Habitat suitability	Likelihood of occurrence
				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.			alpine or sub-alpine peatlands, damp herbfields and fens, or alpine grassland/herbfield and open heathlands are present in the project area.	Not included as a candidate species for assessment.
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.	BioNet – 2 PMST EMM (2020)	-	Low. This species is only known from the McPhersons Plain area. No alpine or sub-alpine peatlands, damp herbfields and fens, or alpine grassland/herbfield and open heathlands are present in the project area.	Low. Not included as a candidate species for assessment.
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	BioNet – 57 PMST BAM-C	-	Low. This species is only known from the McPhersons Plain area. No alpine or sub-alpine peatlands, damp herbfields and fens, or alpine grassland/herbfield and open heathlands are present in the project area.	Low. Not included as a candidate species for assessment.

Species name	Common name	EPBC Act	BC Act	Distribution and habitat	Data source	Habitat constraints and Geographic limitations (BAM-C)	Habitat suitability	Likelihood of occurrence
				boggy ground, though not sphagnum-dominated areas, but also occurs on some drier patches.				
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.	EMM (2020)	-	Low. This species is known from areas to the east of the project area on the subalpine grasslands and woodlands in the Long Plain, Kiandra, Tantangara area. No suitable habitat is present in the project area.	Low. Not included as a candidate species for assessment.
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.	BioNet -1 BAM-C EMM (2020)	-	Moderate. There is suitable habitat in the project area in the form of 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 slopes.	Moderate. Included as a candidate species for assessment and targeted during surveys as a precautionary measure as data on this species is deficient.
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.	BioNet – 5 BAM-C EMM (2020)	None	Moderate. 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	Moderate. Included as a candidate species for assessment and targeted during surveys.

Species name	Common name	EPBC Act	BC Act	Distribution and habitat	Data source	Habitat constraints and Geographic limitations (BAM-C)	Habitat suitability	Likelihood of occurrence
							escarpment 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 sheltered slopes.	
Pterostylis oreophila	Blue-tongued Greenhood	CE	CE	In New South Wales, the Blue-tongued Greenhood is known from a few small populations within KNP 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.	BioNet – 3 PMST	None	Moderate. There is potential habitat for this species in the western sub-alpine parts of the project area near watercourses where thickets of Tea-tree occur.	Moderate. Included as a candidate species for assessment and targeted during surveys as a precautionary measure.
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 KNP (e.g. Long Plain and Happy Jacks Plain). Found in Natural Temperate Grassland on the Monaro. Occurs in sub-alpine grasslands in KNP. Grows on basalt, granite and sedimentary substrates.	PMST EMM (2020)	-	Low. This species is known from the treeless plains to the east of the project area. There is no suitable habitat for this species in the project area.	Low. Not included as a candidate species for assessment.
Thelymitra alpicola	Alpine Sun Orchid		V	*Thelymitra alpicola* is distributed in south–eastern New South Wales and north–eastern Victoria. The northernmost populations are in the upper Blue Mountains. The remainder of the New South Wales distribution is from the Snowy Mountains extending north–west to Bago State Forest and to the eastern part of the Great Dividing Range south from Braidwood. In KNP and the Bago plateau the	EMM (2020)	None	Moderate. Potential habitat for *Thelymitra alpicola* is present within and at the edges of PCT 285 and PCT 1196.	Moderate. Included as a candidate species for assessment and targeted during surveys.

Species name	Common name	EPBC Act	BC Act	Distribution and habitat	Data source	Habitat constraints and Geographic limitations (BAM-C)	Habitat suitability	Likelihood of occurrence
				species occurs in wet heaths and adjacent to Sphagnum bogs between 1000-1500 m. Associated species include *Hakea microcarpa, Leptospermum myrtifolium, Baeckea utilis, Baeckea gunniana, Epacris breviflora, Epacris paludosa, Baloskion australe* and *Empodisma minus*.				
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.	BioNet – 1 BAM-C	None	Moderate. *Thelymitra atronitida* is known to occur in the Snow Gum - Mountain Gum shrubby open forest of montane areas, South Eastern Highlands Bioregion and Australian Alps Bioregion (PCT 1196). PCT 1196 occurs in the western Australian Alps portion of the project area. In the absence of any further publicly available research on *Thelymitra atronitida* within NSW at the time of writing this BDAR we have assumed that *Thelymitra atronitida* exists within the Bago State Forest and we have retained *Thelymitra atronitida* as a candidate species for the assessment.	Moderate. Included as a candidate species for assessment and targeted during surveys.
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*).	BioNet – 7 PMST BAM-C	None	Moderate. This species is known to occur in the locality. The population in the power line easement on Larry's Ridge north of Cabramurra was visited and plants found in February 2019. There is potential habitat for *Thesium australe* in	Moderate. Included as a candidate species for assessment and targeted during surveys.

Species name	Common name	EPBC Act	BC Act	Distribution and habitat	Data source	Habitat constraints and Geographic limitations (BAM-C)	Habitat suitability	Likelihood of occurrence
							the natural grassland patches within the forests and in regrowth grassland under transmission lines and roadsides in the project area.	
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 Bairnsdale, generally below 500 m altitude. Grows in wetlands including sedge-swamps and shallow freshwater marshes, often on heavy black clay soils.	PMST	-	Low. This species is known from the KNP in the high-altitude Alpine Creek, Boggy Plain, Rocky Plain areas. There are no suitable swamp habitats in the project area.	Low. Not included as a candidate species for assessment.

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

Key:

CE = critically endangered

E = endangered

EP = endangered population

Ex = extinct

V = vulnerable

Table A-2 Habitat assessment for threatened animal species

Animal type	Species name	Common name	EPBC Act	BC Act or FM Act	Credit type (BC Act)	Distribution and habitat	Data source	Habitat constraints & Geographic limitations (BAM-C)	Likelihood of occurrence
Bird	*Actitis hypoleucos*	Common Sandpiper	M	-	NA	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.	PMST	-	Low. No wading bird habitat is present. Not included for assessment
Bird	*Anthochaera phrygia*	Regent Honeyeater	CE	CE	Dual credit species. Ecosystem (foraging habitat) Species (breeding habitat)	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.	BioNet – 1 PMST	-	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 disturbance area near the Yarrangobilly river and the Ravine area but unlikely to be frequent. Not included for assessment

Animal type	Species name	Common name	EPBC Act	BC Act or FM Act	Credit type (BC Act)	Distribution and habitat	Data source	Habitat constraints & Geographic limitations (BAM-C)	Likelihood of occurrence
Bird	*Apus pacificus*	Fork-tailed Swift	M	-	NA	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. The Fork-tailed Swift breeds in Asia but migrates to Australia from September to April. There is one record of the Fork-tailed Swift within 10 km of the project area.	PMST	-	Moderate. Likely to fly over the disturbance area during migration. Not included for assessment
Bird	*Artamus cyanopterus cyanopterus*	Dusky Woodswallow	-	V	Ecosystem	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.	BioNet – 18 BAM-C EMM (2020)	None	Known to occur and recorded on site during the surveys. Habitat for this species is widespread and records of this species are widespread in the region. Included as a predicted species for assessment.
Bird	*Calidris acuminata*	Sharp-tailed Sandpiper	M	-	NA	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. Roosting occurs at the edges of wetlands, on wet open mud or sand or in sparse vegetation.	PMST	-	Low. No wading bird habitat is present. Not included for assessment

Animal type	Species name	Common name	EPBC Act	BC Act or FM Act	Credit type (BC Act)	Distribution and habitat	Data source	Habitat constraints & Geographic limitations (BAM-C)	Likelihood of occurrence
Bird	*Calidris ferruginea*	Curlew Sandpiper	CE	E	Dual credit species. Ecosystem (foraging habitat) Species (breeding habitat)	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.	PMST	-	Low. No wading bird habitat is present. Not included for assessment
Bird	*Calidris melanotos*	Pectoral Sandpiper	M	-	NA	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.	PMST	-	Low. No wading bird habitat is present. Not included for assessment

Animal type	Species name	Common name	EPBC Act	BC Act or FM Act	Credit type (BC Act)	Distribution and habitat	Data source	Habitat constraints & Geographic limitations (BAM-C)	Likelihood of occurrence
Bird	*Callocephalon fimbriatum*	Gang-gang Cockatoo	-	V	Dual credit species. Ecosystem (foraging habitat) Species (breeding habitat)	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.	BioNet – 52 BAM-C EMM (2020)	Hollow bearing trees Eucalypt tree species with hollows greater than 9 cm diameter No geographic limitations.	Known to occur and recorded on site during the surveys. 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 and east of the Tumut River during the field surveys. Breeding habitat is likely to be present. Included as a candidate and predicted species for assessment.

Animal type	Species name	Common name	EPBC Act	BC Act or FM Act	Credit type (BC Act)	Distribution and habitat	Data source	Habitat constraints & Geographic limitations (BAM-C)	Likelihood of occurrence
Bird	*Climacteris picumnus victoriae*	Brown Treecreeper (eastern subspecies)	-	V	Ecosystem	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.	BioNet – 3 BAM-C EMM (2020)	None	Known to occur and recorded on site during the surveys. Habitat for this species is widespread. There are scattered records of this species in the region. Included as a predicted species for assessment.
Bird	*Daphoenositta chrysoptera*	Varied Sittella	-	V	Ecosystem	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.	BioNet – 2 BAM-C EMM (2020)	None	Known to occur and recorded on site during the surveys. Habitat for this species is widespread. There are scattered records of this species in the region. Included as a predicted species for assessment.

Animal type	Species name	Common name	EPBC Act	BC Act or FM Act	Credit type (BC Act)	Distribution and habitat	Data source	Habitat constraints & Geographic limitations (BAM-C)	Likelihood of occurrence
Bird	*Gallinago hardwickii*	Latham's Snipe	M	-	NA	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.	PMST EMM (2020)	-	Moderate. This species was recorded by EMM within the Main Works project area (in alpine bogs and fens and sub-alpine wet grasslands). Some areas of the Tumut River and Yarrangobilly River are likely to provide suitable habitat for this species. Included in migratory species assessment.
Bird	*Grantiella picta*	Painted Honeyeater	V	V	Ecosystem	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.	PMST	-	Low. The vegetation in the disturbance area may provide some limited habitat for this species and there are scattered records of this species in the region. However, no large areas of high-quality habitat were identified. Not included for assessment

Animal type	Species name	Common name	EPBC Act	BC Act or FM Act	Credit type (BC Act)	Distribution and habitat	Data source	Habitat constraints & Geographic limitations (BAM-C)	Likelihood of occurrence
Bird	*Haliaeetus leucogaster*	White-bellied Sea-Eagle	M, V	-V	Dual credit species. Ecosystem (foraging habitat) Species (breeding habitat)	Distributed along the coastline (including offshore islands) of mainland Australia and Tasmania. Found in coastal habitats (especially those close to the seashore) 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).	BioNet – 1 PMST BAM-C EMM (2020)	Living or dead mature trees within suitable vegetation within 1km of a rivers, lakes, large dams or creeks, wetlands and coastlines No geographic limitations.	Moderate. This species is likely to hunt and nest in the broader study area along the Yarrangobilly River and Talbingo Reservoir. Included as a candidate and predicted species for assessment.
Bird	*Hieraaetus morphnoides*	Little Eagle	-	V	Dual credit species. Ecosystem (foraging habitat) Species (breeding habitat)	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.	BioNet – 2 BAM-C EMM (2020)	Nest trees - live (occasionally dead) large old trees within vegetation) No geographic limitations.	Moderate. This species is likely to hunt and nest in the disturbance area. Included as a candidate and predicted species for assessment.

Animal type	Species name	Common name	EPBC Act	BC Act or FM Act	Credit type (BC Act)	Distribution and habitat	Data source	Habitat constraints & Geographic limitations (BAM-C)	Likelihood of occurrence
Bird	*Hirundapus caudacutus*	White-throated Needletail	M, V	-	NA	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.	BioNet – 4 PMST EMM (2020)	-	Moderate. This species may fly over the disturbance area during migration. Included in migratory species assessment
Bird	*Lophoictinia isura*	Square-tailed Kite	-	V	Dual credit species. Ecosystem (foraging habitat) Species (breeding habitat)	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 km2. 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.	BAM-C EMM (2020)	Nest trees No geographical limitations	Moderate. Although records are lacking, this species is likely to hunt and nest in the disturbance area based on the presence of suitable habitat. Included as a candidate and predicted species for assessment.
Bird	*Melanodryas cucullata cucullata*	Hooded Robin (south-eastern form)	-	V	Ecosystem	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.	BAM-C	None	Moderate. Some records exist in the locality. The open habitats around the Ravine area and on the Bago Plateau may be suitable. Included as a predicted species for assessment.

Animal type	Species name	Common name	EPBC Act	BC Act or FM Act	Credit type (BC Act)	Distribution and habitat	Data source	Habitat constraints & Geographic limitations (BAM-C)	Likelihood of occurrence
Bird	*Melithreptus gularis gularis*	Black-chinned Honeyeater (eastern subsp.)	-	V	Ecosystem	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.	BioNet – 1	-	Low. Some suitable is likely to be present within the disturbance area but there are few records from the locality and the disturbance area is on the south eastern edge of the known distribution. Not included for assessment
Bird	*Motacilla flava*	Yellow Wagtail	M	-	NA	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.	PMST	-	Low. Habitat unsuitable for this species. Not included for assessment
Bird	*Myiagra cyanoleuca*	Satin Flycatcher	M	-	NA	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.	PMST EMM (2020)	-	Moderate. Suitable habitat is widespread, and this species has been frequently recorded in the locality. Included in migratory species assessment

Animal type	Species name	Common name	EPBC Act	BC Act or FM Act	Credit type (BC Act)	Distribution and habitat	Data source	Habitat constraints & Geographic limitations (BAM-C)	Likelihood of occurrence
Bird	*Neophema pulchella*	Turquoise Parrot	-	V	Ecosystem	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.	BioNet – 2	-	Low. The disturbance area is outside of the known range of this species and the habitat in the disturbance area is not considered suitable for this species. Not included for assessment
Bird	*Ninox connivens*	Barking Owl	-	V	Dual credit species. Ecosystem (foraging habitat) Species (breeding habitat)	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.	BAM-C	-	Moderate. This species is not known from the disturbance area and it is on the edge of the expert distribution. Included as a candidate and predicted species for assessment.

Animal type	Species name	Common name	EPBC Act	BC Act or FM Act	Credit type (BC Act)	Distribution and habitat	Data source	Habitat constraints & Geographic limitations (BAM-C)	Likelihood of occurrence
Bird	*Ninox strenua*	Powerful Owl	-	V	Dual credit species. Ecosystem (foraging habitat) Species (breeding habitat)	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 (*Exocarpos cupressiformis*) and a number of Eucalypt species.	BioNet – 8 BAM-C EMM (2020)	Hollow bearing trees - yes Living or dead trees with hollow greater than 20 cm diameter - yes No geographic limitations.	High. Suitable habitat is widespread in the tall wet forests within the disturbance area and broader study area. The disturbance area is likely to contain habitat for breeding pairs. Included as a candidate and predicted species for assessment.

Animal type	Species name	Common name	EPBC Act	BC Act or FM Act	Credit type (BC Act)	Distribution and habitat	Data source	Habitat constraints & Geographic limitations (BAM-C)	Likelihood of occurrence
Bird	*Numenius madagascariensis*	Eastern Curlew	CE, M	-	Dual credit species. Ecosystem (foraging habitat) Species (breeding habitat)	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.	PMST	-	Low. Habitat in the disturbance area is not considered suitable for this species. Not included for assessment
Bird	*Pachycephala olivacea*	Olive Whistler	-	V	Ecosystem	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.	BioNet – 3 BAM-C EMM (2020)	None	High. This species is known to occur in the higher altitude areas (>500m) in the disturbance area. Included as a predicted species for assessment.
Bird	*Petroica boodang*	Scarlet Robin	-	V	Ecosystem	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.	BioNet – 9 BAM-C EMM (2020)	None	High. This species has been recorded in the disturbance area and surround sin the past and suitable habitat for this species is widespread. Included as a predicted species for assessment.

Animal type	Species name	Common name	EPBC Act	BC Act or FM Act	Credit type (BC Act)	Distribution and habitat	Data source	Habitat constraints & Geographic limitations (BAM-C)	Likelihood of occurrence
Bird	*Petroica phoenicea*	Flame Robin	-	V	Ecosystem	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 ground layer 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.	BioNet – 75 BAM-C EMM (2020)	None	High. This species has been recorded in the disturbance area and surrounds in the past and suitable habitat for this species is widespread. Included as a predicted species for assessment.
Bird	Petroica rodinogaster	Pink Robin	-	V	Ecosystem	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.	BAM-C EMM (2020)	None	High. This species has been recorded in the survey area and surrounds in the past and suitable habitat for this species is widespread.

Animal type	Species name	Common name	EPBC Act	BC Act or FM Act	Credit type (BC Act)	Distribution and habitat	Data source	Habitat constraints & Geographic limitations (BAM-C)	Likelihood of occurrence
Bird	*Rhipidura rufifrons*	Rufous Fantail	M	-	NA	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.	PMST	-	High. This species has been recorded in the survey area and surrounds in the past and suitable habitat for this species is widespread. Not included for assessment
Bird	*Rostratula australis*	Australian Painted Snipe	E, M	E	Ecosystem	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.	PMST	-	Low. Habitat in the disturbance area is not considered suitable for this species. Not included for assessment
Bird	*Stagonopleura guttata*	Diamond Firetail	-	V	Ecosystem	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.	BioNet – 1 BAM-C EMM (2020)	None	Moderate. Records of this species are scattered all over the region. Suitable habitat is present in the survey area. Included as a predicted species for assessment.

Animal type	Species name	Common name	EPBC Act	BC Act or FM Act	Credit type (BC Act)	Distribution and habitat	Data source	Habitat constraints & Geographic limitations (BAM-C)	Likelihood of occurrence
Bird	*Tyto novaehollandiae*	Masked Owl	-	V	Dual credit species. Ecosystem (foraging habitat) Species (breeding habitat)	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.	BioNet – 4 BAM-C EMM (2020)	None	Moderate. Suitable habitat is widespread and there are records from around the locality. Study area may contain nesting individuals. Included as a candidate and predicted species for assessment.
Bird	*Tyto tenebricosa*	Sooty Owl	-	V	Dual credit species. Ecosystem (foraging habitat) Species (breeding habitat)	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.	BioNet – 1	-	Moderate. Suitable habitat is widespread in KNP, and this species has been recorded from the gullies near the Tumut River. However habitat in the study area is not optimal and this species is likely confined to wetter forest in KNP. Included as a candidate species for assessment.

Animal type	Species name	Common name	EPBC Act	BC Act or FM Act	Credit type (BC Act)	Distribution and habitat	Data source	Habitat constraints & Geographic limitations (BAM-C)	Likelihood of occurrence
Fish	Euastacus armatus	Murray Crayfish	-	V	NA	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.	Known from Tumut River	-	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	NA	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 riverbank. 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.	PMST	-	Low. This species' indicative distribution is restricted to the Murray River, Murrumbidgee River and some tributaries. Not included for assessment

Animal type	Species name	Common name	EPBC Act	BC Act or FM Act	Credit type (BC Act)	Distribution and habitat	Data source	Habitat constraints & Geographic limitations (BAM-C)	Likelihood of occurrence
Fish	*Maccullochella peelii*	Murray Cod	V	-	NA	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.	PMST	-	Low. This species is not known from the locality. Not included for assessment
Fish	*Macquaria australasica*	Macquarie Perch	E	E	NA	The Macquarie Perch is a riverine species that prefers clear water and deep, rocky holes with abundant 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	PMST	-	High. The indicative distribution of this species is mapped in the south of the survey area, where the Yarrangobilly River meets the Tumut River. Not included for assessment

Animal type	Species name	Common name	EPBC Act	BC Act or FM Act	Credit type (BC Act)	Distribution and habitat	Data source	Habitat constraints & Geographic limitations (BAM-C)	Likelihood of occurrence
Frogs	*Litoria booroolongensis*	Booroolong Frog	E	E	Species	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.	BioNet – 62 PMST BAM-C EMM (2020)	None	High. This species is considered highly likely to inhabit the permanent rivers and streams in the survey area. Recorded as part of the Snowy 2.0 Main Works surveys. Included as a candidate species for assessment.
Frogs	*Litoria raniformis*	Southern Bell Frog	V	E	Species	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.	PMST	-	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.

Animal type	Species name	Common name	EPBC Act	BC Act or FM Act	Credit type (BC Act)	Distribution and habitat	Data source	Habitat constraints & Geographic limitations (BAM-C)	Likelihood of occurrence
Frogs	*Litoria spenceri*	Spotted Tree Frog	E	CE	Species	The Spotted Tree Frog is extremely rare and occurs in scattered, geographically isolated populations. Historically it was known from two streams in southern NSW on the north-west side of the Great Dividing Range, however both populations appeared to have become locally extinct. One population has been re-established via a reintroduction program. It is also known from 15 locations in north-eastern Victoria. Occur among boulders or debris along naturally vegetated, rocky fast flowing upland streams and rivers.	PMST BAM-C	Waterbodies River environment with rocky habitat or within 500 m of a rocky river No geographic limitations.	Low. Waterbodies, and river environment with rocky habitat or within 500 m of a rocky river are in the South Eastern Highlands portion of the project area but not in the Australian Alps portion. Only two populations of the Spotted Tree Frog have been identified in New South Wales and these populations not within or near the project area and will not be impacted by the project. As such, the Spotted Tree Frog was removed from consideration as a species credit species and the Spotted Tree Frog has not been assessed.

Animal type	Species name	Common name	EPBC Act	BC Act or FM Act	Credit type (BC Act)	Distribution and habitat	Data source	Habitat constraints & Geographic limitations (BAM-C)	Likelihood of occurrence
Frogs	*Litoria verreauxii alpina*	Alpine Tree Frog	V	E	Species	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.	BioNet – 20 PMST BAM-C EMM (2020)	No habitat constraints. Above 1,000 m asl	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. Included as a candidate species for assessment.
Frogs	*Pseudophryne corroboree*	Southern Corroboree Frog	CE	CE	Species	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 KNP. 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 Snow Gum woodland to overwinter under litter, logs and dense groundcover.	PMST, BAM-C	Swamps Within 200 m of high montane sub-alpine bog or ephemeral pool environments Above 1,000 m asl	Low. The distribution of this species is fairly well known, which is south of the survey area. Not included for assessment.

Animal type	Species name	Common name	EPBC Act	BC Act or FM Act	Credit type (BC Act)	Distribution and habitat	Data source	Habitat constraints & Geographic limitations (BAM-C)	Likelihood of occurrence
Frogs	*Pseudophryne pengilleyi*	Northern Corroboree Frog	CE	CE	Species	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.	BioNet – 1, BAM-C	No habitat constraints. Above 700 m asl	Low. The distribution of this species is fairly well known, which is north of the survey area. Not included for assessment.
Mammals	*Burramys parvus*	Mountain Pygmy-possum	E	E	Species	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 KNP 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*).	PMST	-	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. Included as a candidate species for assessment.

Animal type	Species name	Common name	EPBC Act	BC Act or FM Act	Credit type (BC Act)	Distribution and habitat	Data source	Habitat constraints & Geographic limitations (BAM-C)	Likelihood of occurrence
Mammals	*Cercartetus nanus*	Eastern Pygmy-possum	-	V	Species	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.	BioNet – 51 BAM-C EMM (2020)	None	High. Recorded during surveys of the project area and suitable foraging and breeding habitat is widespread, particularly in areas with high abundance of *Banksia canei*. Included as a candidate species for assessment.

Animal type	Species name	Common name	EPBC Act	BC Act or FM Act	Credit type (BC Act)	Distribution and habitat	Data source	Habitat constraints & Geographic limitations (BAM-C)	Likelihood of occurrence
Mammals	*Dasyurus maculatus*	Spotted-tailed Quoll	E	V	Ecosystem	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.	BioNet – 8 PMST BAM-C EMM (2020)	None	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. Included as a predicted species for assessment.
Mammals	*Falsistrellus tasmaniensis*	Eastern False Pipistrelle	-	V	Ecosystem	Prefers moist habitats, with trees taller than 20 m. Generally, this species roosts in eucalypt hollows, but has also been found under loose bark on trees or in buildings.	BioNet – 12 BAM-C	None	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. Included as a predicted species for assessment.

Animal type	Species name	Common name	EPBC Act	BC Act or FM Act	Credit type (BC Act)	Distribution and habitat	Data source	Habitat constraints & Geographic limitations (BAM-C)	Likelihood of occurrence
Mammals	*Mastacomys fuscus*	Broad-toothed Rat	V	V	Species	In NSW the Broad-toothed Rat occurs in two widely separated areas: the wet alpine and subalpine heaths and woodlands in KNP, 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.	BioNet – 43 PMST EMM (2020)	None	Low. There are many records of this species to the east of the survey area on the high-altitude plains. EMM (2020) had reported a small area of potential habitat for Broad-toothed Rat, along Mines Trail at the junction of the Caves Creek, which is also within the current study area. Subsequent trapping did not confirm presence of the species, and the habitat is an isolated regrowth grassland, not suited to the species. Not included for assessment

Animal type	Species name	Common name	EPBC Act	BC Act or FM Act	Credit type (BC Act)	Distribution and habitat	Data source	Habitat constraints & Geographic limitations (BAM-C)	Likelihood of occurrence
Mammals	*Miniopterus orianae oceanensis*	Large Bent-winged Bat	-	V	Dual credit species. Ecosystem (foraging habitat) Species (breeding habitat)	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.	BioNet – 2 BAM-C EMM (2020)	Caves Cave, tunnel, mine, culvert or other structure known or suspected to be used for breeding including species records with microhabitat code "IC - in cave Observation type code "E nest-roost With numbers of individuals >500 No geographic limitations.	High. Suitable foraging habitat is widespread. Potential cave roosts are present along the Tumut River. This species has been frequently recorded in the locality. Included as a candidate and predicted species for assessment.

Animal type	Species name	Common name	EPBC Act	BC Act or FM Act	Credit type (BC Act)	Distribution and habitat	Data source	Habitat constraints & Geographic limitations (BAM-C)	Likelihood of occurrence
Mammals	*Myotis macropus (Myotis adversus)*	Southern Myotis	-	V	Species	Generally, this species 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.	BioNet – 1 EMM (2020)	Hollow bearing trees Within 200 m of riparian zone Bridges, caves or artificial structures within 200 m of riparian zone This include rivers, creeks, billabongs, lagoons, dams and other waterbodies on or within 200m of project area	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. Included as a candidate species for assessment.

Animal type	Species name	Common name	EPBC Act	BC Act or FM Act	Credit type (BC Act)	Distribution and habitat	Data source	Habitat constraints & Geographic limitations (BAM-C)	Likelihood of occurrence
Mammals	*Petauroides volans*	Greater Glider	V	-	NA	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 ha) 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 km2 may be required to maintain viable populations.	BioNet – 9 PMST	-	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. Not included for assessment
Mammals	*Petaurus australis*	Yellow-bellied Glider	-	V	Ecosystem	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.	BioNet – 141 BAM-C	None	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. Included as a predicted species for assessment.

Animal type	Species name	Common name	EPBC Act	BC Act or FM Act	Credit type (BC Act)	Distribution and habitat	Data source	Habitat constraints & Geographic limitations (BAM-C)	Likelihood of occurrence
Mammals	*Petaurus australis* (endangered population)	Yellow-bellied Glider population on the Bago Plateau	-	EP	Species	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 KNP 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.	BioNet – 139	-	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. Not included for assessment
Mammals	*Petaurus norfolcensis*	Squirrel Glider	-	V	Species	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.	BioNet – 5 BAM-C	None	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. Included as a candidate species for assessment.

Animal type	Species name	Common name	EPBC Act	BC Act or FM Act	Credit type (BC Act)	Distribution and habitat	Data source	Habitat constraints & Geographic limitations (BAM-C)	Likelihood of occurrence
Mammals	*Phascogale tapoatafa*	Brush-tailed Phascogale	-	V	Species	The Brush-tailed Phascogale has a patchy distribution around the coast of Australia. In NSW it is mainly found east of the Great Dividing Range although there are occasional records west of the divide. Prefer dry sclerophyll open forest with sparse groundcover of herbs, grasses, shrubs or leaf litter. Also inhabit heath, swamps, rainforest and wet sclerophyll forest. Agile climber foraging preferentially in rough barked trees of 25 cm DBH or greater.	BAM-C	Hollow bearing trees No geographic limitations.	Moderate. Suitable habitat is widespread though records of the Brush-tailed Phascogale within the KNP are very scarce. Included as a candidate species for assessment.
Mammals	*Phascolarctos cinereus*	Koala	V	V	Dual credit species. Ecosystem (foraging habitat) Species (breeding habitat)	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.	PMST BAM-C	Areas identified via survey as important habitat (see comments) No geographic limitations.	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. Included as a candidate and predicted species for assessment.

Animal type	Species name	Common name	EPBC Act	BC Act or FM Act	Credit type (BC Act)	Distribution and habitat	Data source	Habitat constraints & Geographic limitations (BAM-C)	Likelihood of occurrence
Mammals	*Pseudomys fumeus*	Smoky Mouse	E	CE	Species	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.	BioNet – 22 PMST BAM-C EMM (2020)	None	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 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. Included as a candidate species for assessment.
Mammals	*Pteropus poliocephalus*	Grey-headed Flying-fox	V	V	Dual credit species. Ecosystem (foraging habitat) Species (breeding habitat)	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.	PMST	-	Low. The closest known camp is >130 km from the survey area and there are no records of this species from the locality. Not included for assessment

Animal type	Species name	Common name	EPBC Act	BC Act or FM Act	Credit type (BC Act)	Distribution and habitat	Data source	Habitat constraints & Geographic limitations (BAM-C)	Likelihood of occurrence
Reptiles	*Cyclodomorphus praealtus*	Alpine She-oak Skink	E	E	Species	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 KNP 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.	BioNet – 18 PMST BAM-C EMM (2020)	None	Low. The Alpine She-oak Skink has very specific habitat requirements, preferring tree-less or very lightly treed areas that contain tussock grasses, low heath or a combination of both (i.e. alpine to sub-alpine grasslands or heath). The project area does not contain any alpine to sub-alpine grasslands or heath and therefore is not considered to provide suitable habitat for the Alpine She-oak Skink. Not included for assessment.
Reptiles	*Liopholis guthega*	Guthega Skink	E	E	Species	The Guthega Skink is restricted to locations above 1600 m in the Australian Alps, in the vicinity of Mt Kosciuszko, NSW, and the Bogong High Plains, Victoria. The Guthega Skink occurs between 1600 m and 2170 m – in the coldest (winter snow cover) and some of the wettest regions on mainland Australia. Preferred habitats are usually rocky or have sub-surface boulders hidden beneath soil or thick vegetation. The NSW distribution occurs where there is a granite substrate and decomposing granite soils. Individuals have been recorded in a range of vegetation types, including open *Eucalyptus pauciflora* (Snow Gum) woodland with grassy or shrubby understoreys, dry tussock grassland, and tall and short heath.	BAM-C	Granite substrate and decomposing granite soils Rocky areas including sub-surface boulders No geographic limitations.	Low. The Guthega Skink is restricted to locations above 1,600 m asl in the Australian Alps, near Mt Kosciuszko, NSW, and the Bogong High Plains, Victoria. The project area is well below this altitude with the highest point in the Australian Alps portion of the project area being 1,190 m asl. Not included for assessment.

Animal type	Species name	Common name	EPBC Act	BC Act or FM Act	Credit type (BC Act)	Distribution and habitat	Data source	Habitat constraints & Geographic limitations (BAM-C)	Likelihood of occurrence
Reptiles	*Varanus rosenbergi*	Rosenberg's Goanna, Heath Monitor	-	V	Ecosystem	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.	BAM-C	None	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 KNP 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. Included as a predicted species for assessment.

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

Key:

CE = critically endangered / E = endangered / V = vulnerable / M = migratory

Appendix B. Floristic survey composition and structure data

			Covers	**Native**	Trees	Shrubs	Grass	Forb	Fern	Other	**Exotic**	HighThreat
Plot 1			**# spp**	**Count**	Count	Count	Count	Count	Count	Count	**Count**	Count
PCT 285			**30**	**25**	4	5	6	9	0	1	**5**	2
Species	**Cover**	**Abundance**	**Sum cover**	**Sum**	Sum	Sum	Sum	Sum	Sum	Sum	**Sum**	Sum
			129.41	**104.1**	21.2	70.6	11.3	0.9	0	0.1	**25.31**	25.01
Eucalyptus camphora	20	5	TG		20							
Leptospermum lanigerum	70	50	SG			70						
Senecio prenanthoides	0.1	5	FG					0.1				
Carex appressa	10	250	GG				10					
Rubus fruticosus agg.	25	500	HT									25
Acacia dealbata	0.1	10	TG		0.1							
Senecio pinnatifolius	0.1	5	FG					0.1				
Pterostylis monticola	0.1	1	FG					0.1				
Geranium solanderi	0.1	100	FG					0.1				
Poa sieberiana	0.5	25	GG				0.5					
Stellaria pungens	0.1	25	FG					0.1				
Acaena novae-zelandiae	0.1	50	FG					0.1				
Eryanthe moschatus	0.1	100	EX								0.1	
Ranunculus lappaceus	0.1	25	FG					0.1				
Acacia melanoxylon	1	1	TG		1							
Mentha diemenica	0.1	5	FG					0.1				
Eucalyptus pauciflora	0.1	1	TG		0.1							
Poa helmsii	0.5	25	GG				0.5					
Conyza bonariensis	0.1	1	EX								0.1	
Coprosma quadrifida	0.1	10	SG			0.1						
Juncus sp.	0.1	10	GG				0.1					
Glycine clandestina	0.1	15	OG							0.1		
Hakea microcarpa	0.1	1	SG			0.1						
Epacris breviflora	0.2	10	SG			0.2						
Prunella vulgaris	0.1	5	EX								0.1	
Pterostylis decurva	0.1	1	FG					0.1				
Schoenus melanostachys	0.1	1	GG				0.1					
Carex sp.	0.1	1	GG				0.1					
Baeckea utilis	0.2	20	SG			0.2						
Holcus lanatus	0.01	25	HT									0.01

			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Plot 2			**# spp**	**Count**	Count	Count	Count	Count	Count	Count	**Count**	Count
PCT 285			**37**	**36**	4	7	7	16	0	2	**1**	1
Species	**Cover**	**Abundance**	**Sum cover**	**Sum**	Sum	Sum	Sum	Sum	Sum	Sum	**Sum**	Sum
			121.2	**121.1**	33.3	3.1	80.9	3.5	0	0.3	**0.1**	0.1
Acacia melanoxylon	0.3	5	TG		0.3							
Eucalyptus dalrympleana	5	6	TG		5							
Eucalyptus pauciflora	20	65	TG		20							
Eucalyptus robertsonii	8	8	TG		8							
Bossiaea foliosa	0.2	50	SG			0.2						
Cassinia aculeata	0.3	20	SG			0.3						
Coprosma hirtella	0.2	10	SG			0.2						
Daviesia ulicifolia	0.2	5	SG			0.2						
Olearia erubescens	0.1	5	SG			0.1						
Persoonia chamaepeuce	0.1	5	SG			0.1						
Platylobium formosum	2	100	SG			2						
Clematis aristata	0.2	100	OG							0.2		
Glycine tabacina	0.1	25	OG							0.1		
Rubus fruticosus agg.	0.1	1	HT									0.1
Lomandra filiformis	0.1	1	GG				0.1					
Lomandra laxa	0.2	10	GG				0.2					
Luzula flaccida	0.1	10	GG				0.1					
Microlaena stipoides	0.2	50	GG				0.2					
Poa labillardierei	0.1	1	GG				0.1					
Poa sieberiana	80	1000	GG				80					
Poa sp.	0.2	50	GG				0.2					
Acaena novae-zelandiae	0.5	100	FG					0.5				
Ajuga australis	0.1	5	FG					0.1				
Asperula scoparia	0.5	150	FG					0.5				
Chiloglottis valida	0.1	25	FG					0.1				
Cymbonotus sp.	0.1	50	FG					0.1				
Dianella tasmanica	0.2	5	FG					0.2				
Dichondra repens	0.1	200	FG					0.1				
Geranium solanderi	0.1	100	FG					0.1				
Gonocarpus sp.	0.1	20	FG					0.1				
Gonocarpus tetragynus	0.1	100	FG					0.1				
Hydrocotyle laxiflora	0.1	150	FG					0.1				
Microseris lanceolata	0.2	100	FG					0.2				
Ranunculus lappaceus	0.1	50	FG					0.1				
Solenogyne bellioides	0.1	100	FG					0.1				
Stellaria pungens	1	150	FG					1				
Veronica calycina	0.1	50	FG					0.1				

			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Plot 3			**# spp**	**Count**	Count	Count	Count	Count	Count	Count	**Count**	Count
PCT 285			**59**	**52**	5	10	6	30	0	1	**7**	4
Species	**Cover**	**Abundance**	**Sum cover**	**Sum**	Sum	Sum	Sum	Sum	Sum	Sum	**Sum**	Sum
			90.3	**74.5**	44	3.9	22.5	4	0	0.1	**15.8**	15.5
Acacia melanoxylon	3	20	TG		3							
Eucalyptus camphora	4	7	TG		4							
Eucalyptus dalrympleana	25	30	TG		25							
Eucalyptus pauciflora	2	20	TG		2							
Eucalyptus robertsonii	10	3	TG		10							
Astroloma humifusum	0.1	1	SG			0.1						
Bossiaea foliosa	1	50	SG			1						
Coprosma hirtella	0.1	5	SG			0.1						
Daviesia latifolia	0.1	1	SG			0.1						
Epacris paludosa	0.2	15	SG			0.2						
Olearia erubescens	0.1	1	SG			0.1						
Persoonia chamaepeuce	0.1	1	SG			0.1						
Pimelea curviflora	0.1	10	SG			0.1						
Platylobium formosum	2	40	SG			2						
Tetratheca labillardierei	0.1	20	SG			0.1						
Glycine clandestina	0.1	4	OG							0.1		
Holcus lanatus	0.2	50	HT									0.2
Hypericum perforatum	0.1	1	HT									0.1
Rosa rubiginosa	0.2	1	HT									0.2
Rubus fruticosus agg.	15	100	HT									15
Carex gaudichaudiana	0.2	20	GG				0.2					
Juncus sp.	0.1	10	GG				0.1					
Lomandra filiformis	0.1	50	GG				0.1					
Lomandra longifolia	2	80	GG				2					
Luzula densiflora	0.1	40	GG				0.1					
Poa sieberiana	20	500	GG				20					
Acaena novae-zelandiae	0.2	100	FG					0.2				
Arthropodium sp.	0.1	50	FG					0.1				
Asperula scoparia	0.3	400	FG					0.3				
Brachyscome scapigera	0.1	1	FG					0.1				
Calotis scabiosifolia var. integrifolia	0.1	3	FG					0.1				
Cymbonotus lawsonianus	0.1	3	FG					0.1				

Dianella revoluta	0.1	2	FG					0.1					
Dichondra repens	0.1	10	FG					0.1					
Geranium obtusisepalum	0.2	200	FG					0.2					
Gonocarpus tetragynus	0.1	50	FG					0.1					
Hydrocotyle sibthorpioides	0.4	400	FG					0.4					
Hypericum gramineum	0.1	1	FG					0.1					
Lagenophora stipitata	0.1	1	FG					0.1					
Leptinella filicula	0.2	200	FG					0.2					
Lobelia gibbosa	0.1	2	FG					0.1					
Lobelia purpurascens	0.1	2	FG					0.1					
Oreomyrrhis sp.	0.1	30	FG					0.1					
Plantago debilis	0.1	1	FG					0.1					
Poranthera microphylla	0.1	100	FG					0.1					
Ranunculus lappaceus	0.1	10	FG					0.1					
Senecio sp.	0.1	1	FG					0.1					
Stackhousia monogyna	0.1	3	FG					0.1					
Stellaria pungens	0.2	300	FG					0.2					
Stylidium lineare	0.1	10	FG					0.1					
Veronica calycina	0.1	150	FG					0.1					
Veronica derwentiana	0.1	1	FG					0.1					
Veronica sp.	0.1	1	FG					0.1					
Veronica sp. A	0.1	1	FG					0.1					
Viola betonicifolia	0.2	300	FG					0.2					
Wahlenbergia sp.	0.1	5	FG					0.1					
Eryanthe moschatus	0.1	60	EX								0.1		
Hypochaeris radicata	0.1	5	EX								0.1		
Trifolium repens	0.1	3	EX								0.1		

			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Plot 4			**# spp**	**Count**	Count	Count	Count	Count	Count	Count	**Count**	Count
PCT 300			**26**	**24**	4	2	3	14	0	1	**2**	0
Species	**Cover**	**Abundance**	**Sum cover**	**Sum**	Sum	Sum	Sum	Sum	Sum	Sum	**Sum**	Sum
			152	**150**	31.2	12.1	83	18.7	0	5	**2**	0
Platylobium formosum	12	110	SG			12						
Eucalyptus pauciflora	30	38	TG		30							
Eucalyptus robertsonii	0.1	2	TG		0.1							
Coprosma hirtella	0.1	5	SG			0.1						
Poa sieberiana	80	1000	GG				80					
Acacia dealbata	0.1	3	TG		0.1							
Dianella tasmanica	1	10	FG					1				
Stellaria pungens	5	400	FG					5				
Lomandra longifolia	2	25	GG				2					
Gonocarpus tetragynus	0.1	1	FG					0.1				
Glycine clandestina	5	40	OG							5		
Veronica calycina	5	30	FG					5				
Viola betonicifolia	1	10	FG					1				
Asperula conferta	0.1	1	FG					0.1				
Dipodium punctatum	0.1	2	FG					0.1				
Stylidium graminifolium	0.1	1	FG					0.1				
Acacia melanoxylon	1	1	TG		1							
Senecio prenanthoides	0.1	10	FG					0.1				
Dichondra repens	3	300	FG					3				
Geranium solanderi	0.1	10	FG					0.1				
Themeda triandra	1	20	GG				1					
Acaena ovina	2	100	FG					2				
Tricoryne elatior	0.1	5	FG					0.1				
Sonchus oleraceus	1	30	EX								1	
Hypericum gramineum	1	50	FG					1				
Centaurium erythraea	1	20	EX								1	

			Covers	**Native**	Trees	Shrubs	Grass	Forb	Fern	Other	**Exotic**	HighThreat
Plot 5			**# spp**	**Count**	Count	Count	Count	Count	Count	Count	**Count**	Count
PCT 300			**39**	**37**	4	8	4	19	0	2	**2**	1
Species	**Cover**	**Abundance**	**Sum cover**	**Sum**	Sum	Sum	Sum	Sum	Sum	Sum	**Sum**	Sum
			161.3	**161.1**	95	1.7	60.4	3.8	0	0.2	**0.2**	0.1
Acacia dealbata	10	10	TG		10							
Eucalyptus dalrympleana	10	3	TG		10							
Eucalyptus pauciflora	30	20	TG		30							
Eucalyptus robertsonii	45	8	TG		45							
Astroloma humifusum	0.1	2	SG			0.1						
Cassinia aculeata	0.1	3	SG			0.1						
Coprosma hirtella	0.5	10	SG			0.5						
Daviesia latifolia	0.1	1	SG			0.1						
Exocarpos cupressiformis	0.2	1	SG			0.2						
Olearia erubescens	0.1	1	SG			0.1						
Platylobium formosum	0.5	20	SG			0.5						
Tetratheca bauerifolia	0.1	2	SG			0.1						
Clematis aristata	0.1	10	OG							0.1		
Glycine clandestina	0.1	10	OG							0.1		
Rubus fruticosus agg.	0.1	1	HT									0.1
Lomandra filiformis	0.1	10	GG				0.1					
Lomandra longifolia	0.2	10	GG				0.2					
Microlaena stipoides	0.1	10	GG				0.1					
Poa labillardierei	60	500	GG				60					
Acaena novae-zelandiae	0.1	20	FG					0.1				
Stylidium graminifolium	0.1	2	FG					0.1				
Caladenia gracilis	0.1	10	FG					0.1				
Chiloglottis valida	0.1	10	FG					0.1				
Cymbonotus lawsonianus	0.1	10	FG					0.1				
Dianella revoluta	2	50	FG					2				
Dichondra repens	0.1	10	FG					0.1				
Euphrasia collina	0.1	2	FG					0.1				
Galium gaudichaudii	0.1	10	FG					0.1				
Geranium sp. 2	0.1	1	FG					0.1				
Hydrocotyle laxiflora	0.1	1	FG					0.1				
Lobelia purpurascens	0.1	1	FG					0.1				
Picris angustifolia	0.1	2	FG					0.1				
Poranthera microphylla	0.1	20	FG					0.1				
Stackhousia monogyna	0.1	10	FG					0.1				
Stellaria pungens	0.1	10	FG					0.1				
Veronica calycina	0.1	10	FG					0.1				
Viola betonicifolia	0.1	15	FG					0.1				
Wahlenbergia stricta	0.1	10	FG					0.1				
Hypochaeris radicata	0.1	10	EX								0.1	

			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Plot 6			**# spp**	**Count**	Count	Count	Count	Count	Count	Count	**Count**	Count
PCT 1196			**44**	**33**	1	7	10	13	0	2	**11**	4
Species	**Cover**	**Abundance**	**Sum cover**	**Cover**	Sum	Sum	Sum	Sum	Sum	Sum	**Sum**	Sum
			94.6	**52.7**	0.1	1.7	48.1	2.6	0	0.2	**41.9**	40.6
Eucalyptus pauciflora	0.1	1	TG		0.1							
Platylobium formosum	1	35	SG			1						
Tetratheca ciliata	0.1	1	SG			0.1						
Poa sieberiana	45	1000	GG				45					
Acaena novae-zelandiae	1	250	FG					1				
Glycine clandestina	0.1	25	OG							0.1		
Dichondra repens	0.1	100	FG					0.1				
Asperula scoparia	0.1	250	FG					0.1				
Hypochaeris radicata	0.2	100	EX								0.2	
Trifolium arvense	0.2	350	EX								0.2	
Hypericum perforatum	0.5	150	HT									0.5
Acetosella vulgaris	0.1	20	HT									0.1
Poa sp.	0.5	150	GG				0.5					
Centaurium erythraea	0.5	500	EX								0.5	
Geranium solanderi	0.1	50	FG					0.1				
Cymbonotus lawsonianus	0.5	250	FG					0.5				
Epacris breviflora	0.1	1	SG			0.1						
Leptospermum continentale	0.1	1	SG			0.1						
Gonocarpus tetragynus	0.1	25	FG					0.1				
Elymus scaber	0.1	25	GG				0.1					
Rytidosperma pilosum	1	250	GG				1					
Holcus lanatus	30	1000	HT									30
Lomandra filiformis	0.1	20	GG				0.1					
Rubus fruticosus agg.	10	50	HT									10
Carex inversa	0.1	25	GG				0.1					
Lomandra multiflora	0.1	20	GG				0.1					
Podolepis hieracioides	0.1	1	FG					0.1				
Solenogyne gunnii	0.1	10	FG					0.1				
Stellaria pungens	0.1	25	FG					0.1				
Dichelachne micrantha	0.1	1	GG				0.1					
Oreomyrrhis eriopoda	0.1	15	FG					0.1				
Clematis aristata	0.1	5	OG							0.1		
Trifolium repens	0.1	25	EX								0.1	
Prunella vulgaris	0.1	5	EX								0.1	
Viola betonicifolia	0.1	5	FG					0.1				
Themeda triandra	0.1	1	GG				0.1					
Cassinia aculeata	0.1	1	SG			0.1						
Leucopogon microphyllus	0.1	1	SG			0.1						
Aira caryophyllea	0.1	50	EX								0.1	
Arthropodium milleflorum	0.1	1	FG					0.1				
Epilobium billardierianum subsp. Billardierianum	0.1	200	FG					0.1				
Lomandra longifolia	1	8	GG				1					
Olearia erubescens	0.2	20	SG			0.2						
Potentilla recta	0.1	1	EX								0.1	

			Covers	**Native**	Trees	Shrubs	Grass	Forb	Fern	Other	**Exotic**	HighThreat
Plot 7			**# spp**	**Count**	Count	Count	Count	Count	Count	Count	**Count**	Count
PCT 1196			**29**	**23**	1	6	5	10	0	1	**6**	2
Species	**Cover**	**Abundance**	**Sum cover**	**Sum**	Sum	Sum	Sum	Sum	Sum	Sum	**Sum**	Sum
			91.7	**59.6**	0.1	1.1	31.4	26.9	0	0.1	**32.1**	12
Lomandra longifolia	1	20	GG				1					
Hypericum perforatum	2	100	HT									2
Centaurium erythraea	5	500	EX								5	
Platylobium formosum	0.3	10	SG			0.3						
Poa sieberiana	30	100	GG				30					
Dichelachne crinita	0.1	20	GG				0.1					
Holcus lanatus	10	100	HT									10
Epilobium billardierianum	0.2	10	FG					0.2				
Hypochaeris radicata	10	100	EX								10	
Olearia erubescens	0.3	25	SG			0.3						
Elymus scaber	0.1	20	GG				0.1					
Geranium solanderi	10	1000	FG					10				
Trifolium pratense	5	100	EX								5	
Acaena novae-zelandiae	10	500	FG					10				
Dichondra repens	0.2	50	FG					0.2				
Asperula conferta	1	50	FG					1				
Cymbonotus lawsonianus	0.2	20	FG					0.2				
Epacris breviflora	0.2	5	SG			0.2						
Glycine clandestina	0.1	10	OG							0.1		
Eucalyptus pauciflora	0.1	3	TG		0.1							
Stylidium graminifolium	0.1	1	FG					0.1				
Petrorhagia dubia	0.1	1	EX								0.1	
Themeda triandra	0.2	10	GG				0.2					
Veronica calycina	0.1	1	FG					0.1				
Leucopogon microphyllus	0.1	2	SG			0.1						
Stellaria pungens	0.1	10	FG					0.1				
Cassinia aculeata	0.1	2	SG			0.1						
Leptospermum lanigerum	0.1	1	SG			0.1						
Solenogyne gunnii	5	100	FG					5				

			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Plot 8			**# spp**	**Count**	Count	Count	Count	Count	Count	Count	**Count**	Count
PCT 1196			**41**	**41**	4	7	9	18	1	2	**0**	0
Species	**Cover**	**Abundance**	**Sum cover**	**Sum**	Sum	Sum	Sum	Sum	Sum	Sum	**Sum**	Sum
			124.5	**124.5**	57	2.8	31.3	3.2	30	0.2	**0**	0
Eucalyptus pauciflora	20	30	TG		20							
Eucalyptus dalrympleana	30	2	TG		30							
Pteridium esculentum	30	100	EG						30			
Platylobium formosum	0.2	20	SG			0.2						
Coronidium monticola	0.2	20	FG					0.2				
Eucalyptus robertsonii	2	1	TG		2							
Acacia dealbata	5	20	TG		5							
Clematis aristata	0.1	20	OG							0.1		
Stellaria pungens	0.3	50	FG					0.3				
Acaena novae-zelandiae	1	50	FG					1				
Glycine clandestina	0.1	20	OG							0.1		
Brachyscome spathulata	0.1	10	FG					0.1				
Senecio prenanthoides	0.1	1	FG					0.1				
Olearia erubescens	0.2	10	SG			0.2						
Poa sieberiana	30	100	GG				30					
Viola hederacea	0.1	10	FG					0.1				
Lomandra sp.	0.1	2	GG				0.1					
Geranium solanderi	0.1	10	FG					0.1				
Dianella tasmanica	0.2	15	FG					0.2				
Lomandra longifolia	0.1	5	GG				0.1					
Opercularia sp.	0.1	10	FG					0.1				
Wahlenbergia stricta	0.1	15	FG					0.1				
Luzula flaccida	0.1	10	GG				0.1					
Viola betonicifolia	0.1	10	FG					0.1				
Pterostylis monticola	0.1	1	FG					0.1				
Oreomyrrhis eriopoda	0.2	100	FG					0.2				
Tetratheca ciliata	0.1	10	SG			0.1						
Arthropodium milleflorum	0.1	10	FG					0.1				
Daviesia latifolia	0.1	1	SG			0.1						
Microlaena stipoides	0.5	200	GG				0.5					
Rytidosperma penicillatum	0.2	20	GG				0.2					
Goodenia hederacea	0.1	1	FG					0.1				
Choretrum pauciflorum	2	10	SG			2						
Cassinia arcuata	0.1	2	SG			0.1						
Poa helmsii	0.1	3	GG				0.1					
Ranunculus lappaceus	0.1	10	FG					0.1				
Elymus scaber	0.1	10	GG				0.1					
Hypericum gramineum	0.1	1	FG					0.1				
Veronica calycina	0.1	10	FG					0.1				
Dichelachne crinita	0.1	1	GG				0.1					
Pimelea curviflora	0.1	1	SG			0.1						

			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Plot 9			**# spp**	**Count**	Count	Count	Count	Count	Count	Count	**Count**	Count
PCT 1196			**40**	**34**	4	6	7	15	1	1	**6**	3
Species	**Cover**	**Abundance**	**Sum cover**	**Sum**	Sum	Sum	Sum	Sum	Sum	Sum	**Sum**	Sum
			187.6	**147.2**	21	21.7	100.8	2.6	1	0.1	**40.4**	40.1
Acacia melanoxylon	5	9	TG		5							
Eucalyptus camphora	10	12	TG		10							
Eucalyptus dalrympleana	2	1	TG		2							
Eucalyptus pauciflora	4	15	TG		4							
Baeckea utilis	0.5	10	SG			0.5						
Coprosma hirtella	5	50	SG			5						
Epacris breviflora	15	50	SG			15						
Epacris microphylla	0.1	1	SG			0.1						
Olearia erubescens	0.1	5	SG			0.1						
Platylobium formosum	1	10	SG			1						
Desmodium sp.	0.1	100	OG							0.1		
Holcus lanatus	5	100	HT									5
Rosa rubiginosa	0.1	1	HT									0.1
Rubus fruticosus agg.	35	250	HT									35
Agrostis sp.	0.1	1	GG				0.1					
Carex appressa	5	100	GG				5					
Deyeuxia sp.	0.1	1	GG				0.1					
Juncus australis	60	100	GG				60					
Juncus sarophorus	0.1	1	GG				0.1					
Lomandra longifolia	0.5	30	GG				0.5					
Poa sieberiana	35	1000	GG				35					
Acaena novae-zelandiae	0.2	50	FG					0.2				
Ajuga australis	0.1	5	FG					0.1				
Asperula scoparia	0.1	50	FG					0.1				
Euchiton sp.	0.1	10	FG					0.1				
Geranium sp. 2	0.2	100	FG					0.2				
Gonocarpus sp.	0.1	200	FG					0.1				
Hydrocotyle laxiflora	0.2	200	FG					0.2				
Hypericum japonicum	0.1	10	FG					0.1				
Lobelia purpurascens	0.1	20	FG					0.1				
Oreomyrrhis ciliata	0.1	5	FG					0.1				
Ranunculus lappaceus	0.5	500	FG					0.5				
Solenogyne bellioides	0.1	20	FG					0.1				
Stellaria angustifolia	0.1	50	FG					0.1				
Stellaria pungens	0.5	100	FG					0.5				
Stylidium graminifolium	0.1	5	FG					0.1				
Hypochaeris radicata	0.1	5	EX								0.1	
Taraxacum officinale	0.1	1	EX								0.1	
Trifolium repens	0.1	20	EX								0.1	
Blechnum nudum	1	25	EG						1			

			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Plot 10			**# spp**	**Count**	Count	Count	Count	Count	Count	Count	**Count**	Count
PCT 1196			**40**	**36**	2	6	4	22	0	2	**4**	1
Species	**Cover**	**Abundance**	**Sum cover**	**Sum**	Sum	Sum	Sum	Sum	Sum	Sum	**Sum**	Sum
			147.7	**147.2**	60.5	21.2	60.4	4.9	0	0.2	**0.5**	0.2
Acacia melanoxylon	0.5	250	TG		0.5							
Eucalyptus pauciflora	60	80	TG		60							
Acacia pravissima	0.3	5	SG			0.3						
Cassinia aculeata	0.5	10	SG			0.5						
Cassinia longifolia	0.1	1	SG			0.1						
Coprosma hirtella	0.1	1	SG			0.1						
Platylobium formosum	20	100	SG			20						
Tetratheca sp.	0.2	20	SG			0.2						
clematis aristata	0.1	20	OG							0.1		
Glycine clandestina	0.1	50	OG							0.1		
Rubus fruticosus agg.	0.2	5	HT									0.2
Lachnagrostis filiformis	0.1	1	GG				0.1					
Lomandra longifolia	0.1	5	GG				0.1					
Microlaena stipoides	0.2	20	GG				0.2					
Poa labillardierei	60	200	GG				60					
Acaena novae-zelandiae	2	20	FG					2				
Arthropodium sp.	0.1	10	FG					0.1				
Bulbine sp.	0.1	20	FG					0.1				
Caladenia gracilis	0.1	4	FG					0.1				
Chiloglottis valida	0.2	100	FG					0.2				
Chrysocephalum apiculatum	0.2	20	FG					0.2				
Cymbonotus lawsonianus	0.2	20	FG					0.2				
Dianella tasmanica	0.1	5	FG					0.1				
Galium gaudichaudii	0.2	50	FG					0.2				
Geranium obtusisepalum	0.1	1	FG					0.1				
Gonocarpus tetragynus	0.1	10	FG					0.1				
Hydrocotyle tripartita	0.1	10	FG					0.1				
Hypericum gramineum	0.1	10	FG					0.1				
Lobelia purpurascens	0.1	10	FG					0.1				
Oxalis perennans	0.1	1	FG					0.1				
Picris angustifolia	0.1	10	FG					0.1				
Plantago debilis	0.3	50	FG					0.3				
Poranthera microphylla	0.1	20	FG					0.1				
Ranunculus lappaceus	0.1	10	FG					0.1				
Stellaria pungens	0.2	50	FG					0.2				
Veronica calycina	0.1	10	FG					0.1				
Viola betonicifolia	0.2	20	FG					0.2				
Hypochaeris radicata	0.1	10	EX								0.1	
Taraxacum officinale	0.1	3	EX								0.1	
Trifolium repens	0.1	10	EX								0.1	

			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Plot 11			**# spp**	**Count**	Count	Count	Count	Count	Count	Count	**Count**	Count
PCT 1196			**38**	**34**	4	6	3	19	0	2	**4**	1
Species	**Cover**	**Abundance**	**Sum cover**	**Sum**	Sum	Sum	Sum	Sum	Sum	Sum	**Sum**	Sum
			136.8	**136.3**	65	5.9	63	2.2	0	0.2	**0.5**	0.1
Acacia dealbata	5	10	TG		5							
Eucalyptus dalrympleana	10	2	TG		10							
Eucalyptus pauciflora	25	20	TG		25							
Eucalyptus robertsonii	25	5	TG		25							
Acacia pravissima	0.5	10	SG			0.5						
Cassinia aculeata	0.1	1	SG			0.1						
Coprosma hirtella	0.1	1	SG			0.1						
Olearia erubescens	0.1	1	SG			0.1						
Platylobium formosum	5	60	SG			5						
Tetratheca bauerifolia	0.1	10	SG			0.1						
Clematis aristata	0.1	10	OG							0.1		
Glycine clandestina	0.1	10	OG							0.1		
Rosa rubiginosa	0.1	1	HT									0.1
Lomandra longifolia	1	20	GG				1					
Poa sieberiana	60	1000	GG				60					
Poa sp.	2	30	GG				2					
Arthropodium sp.	0.1	20	FG					0.1				
Caladenia gracilis	0.1	1	FG					0.1				
Chiloglottis valida	0.3	30	FG					0.3				
Chrysocephalum apiculatum	0.1	10	FG					0.1				
Craspedia sp.	0.1	1	FG					0.1				
Cymbonotus lawsonianus	0.1	10	FG					0.1				
Dianella revoluta	0.1	2	FG					0.1				
Dichondra repens	0.1	2	FG					0.1				
Galium gaudichaudii	0.1	10	FG					0.1				
Geranium obtusisepalum	0.1	10	FG					0.1				
Herpolirion novae-zelandiae	0.2	50	FG					0.2				
Hydrocotyle laxiflora	0.1	10	FG					0.1				
Picris angustifolia	0.1	1	FG					0.1				
Ranunculus lappaceus	0.1	1	FG					0.1				
Senecio prenanthoides	0.1	10	FG					0.1				
Stellaria pungens	0.1	20	FG					0.1				
Veronica calycina	0.1	5	FG					0.1				
Viola betonicifolia	0.1	20	FG					0.1				
Viola hederacea	0.1	5	FG					0.1				
Centaurium erythraea	0.1	2	EX								0.1	
Hypochaeris radicata	0.2	20	EX								0.2	
Trifolium repens	0.1	1	EX								0.1	

			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Plot 12			**# spp**	**Count**	Count	Count	Count	Count	Count	Count	**Count**	Count
PCT 1196			**38**	**36**	4	6	4	19	0	3	**2**	0
Species	**Cover**	**Abundance**	**Sum cover**	**Sum**	Sum	Sum	Sum	Sum	Sum	Sum	**Sum**	Sum
			129.9	**129.7**	75	11.4	40.4	2.6	0	0.3	**0.2**	0
Acacia dealbata	10	20	TG		10							
Acacia melanoxylon	5	2	TG		5							
Eucalyptus dalrympleana	40	5	TG		40							
Eucalyptus pauciflora	20	30	TG		20							
Astroloma humifusum	0.1	2	SG			0.1						
Cassinia aculeata	0.1	1	SG			0.1						
Coprosma hirtella	1	5	SG			1						
Olearia erubescens	0.1	1	SG			0.1						
Platylobium formosum	10	50	SG			10						
Tetratheca bauerifolia	0.1	10	SG			0.1						
Clematis aristata	0.1	10	OG							0.1		
Glycine clandestina	0.1	10	OG							0.1		
Glycine microphylla	0.1	10	OG							0.1		
Lomandra longifolia	0.2	5	GG				0.2					
Luzula flaccida	0.1	2	GG				0.1					
Poa sieberiana	40	300	GG				40					
Poa sp.	0.1	1	GG				0.1					
Acaena sp.	0.5	50	FG					0.5				
Arthropodium sp.	0.1	2	FG					0.1				
Bulbine sp.	0.1	1	FG					0.1				
Caladenia gracilis	0.1	1	FG					0.1				
Chiloglottis valida	0.2	50	FG					0.2				
Cotula australis	0.1	2	FG					0.1				
Craspedia sp.	0.1	3	FG					0.1				
Cymbonotus lawsonianus	0.1	1	FG					0.1				
Dianella revoluta	0.1	2	FG					0.1				
Dichondra repens	0.2	50	FG					0.2				
Galium gaudichaudii	0.1	30	FG					0.1				
Hydrocotyle laxiflora	0.1	10	FG					0.1				
Hydrocotyle sp.	0.1	5	FG					0.1				
Lobelia purpurascens	0.1	2	FG					0.1				
Picris angustifolia	0.1	20	FG					0.1				
Ranunculus lappaceus	0.2	20	FG					0.2				
Stellaria pungens	0.1	1	FG					0.1				
Veronica calycina	0.1	30	FG					0.1				
Viola betonicifolia	0.1	10	FG					0.1				
Centaurium erythraea	0.1	1	EX								0.1	
Hypochaeris radicata	0.1	10	EX								0.1	

			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Plot 13			**# spp**	**Count**	Count	Count	Count	Count	Count	Count	**Count**	Count
PCT 1196			**44**	**40**	4	6	4	24	0	2	**4**	2
Species	**Cover**	**Abundance**	**Sum cover**	**Sum**	Sum	Sum	Sum	Sum	Sum	Sum	**Sum**	Sum
			60.3	**59.9**	30	10.6	15.5	3.6	0	0.2	**0.4**	0.2
Acacia melanoxylon	2	8	TG		2							
Eucalyptus dalrympleana	1	2	TG		1							
Eucalyptus pauciflora	25	50	TG		25							
Eucalyptus robertsonii	2	6	TG		2							
Astroloma humifusum	0.1	3	SG			0.1						
Cassinia aculeata	0.1	2	SG			0.1						
Coprosma hirtella	0.2	3	SG			0.2						
Lomatia myricoides	0.1	1	SG			0.1						
Platylobium formosum	10	200	SG			10						
Tetratheca labillardierei	0.1	10	SG			0.1						
Clematis aristata	0.1	2	OG							0.1		
Glycine clandestina	0.1	20	OG							0.1		
Holcus lanatus	0.1	3	HT									0.1
Rubus fruticosus agg.	0.1	1	HT									0.1
Lomandra filiformis	0.1	2	GG				0.1					
Lomandra longifolia	0.3	40	GG				0.3					
Microlaena stipoides	0.1	5	GG				0.1					
Poa sieberiana	15	400	GG				15					
Acaena novae-zelandiae	0.2	200	FG					0.2				
Arthropodium sp.	0.1	20	FG					0.1				
Asperula scoparia	0.2	300	FG					0.2				
Brachyscome scapigera	0.1	4	FG					0.1				
Caladenia gracilis	0.1	10	FG					0.1				
Corybas sp.	0.1	20	FG					0.1				
Dianella revoluta	0.1	6	FG					0.1				
Dianella tasmanica	1	20	FG					1				
Euchiton involucratus	0.1	2	FG					0.1				
Geranium obtusisepalum	0.1	1	FG					0.1				
Gonocarpus tetragynus	0.1	20	FG					0.1				
Hydrocotyle pedicellosa	0.1	20	FG					0.1				
Hypericum gramineum	0.1	1	FG					0.1				
Lagenifera stipitata	0.1	2	FG					0.1				
Pterostylis sp.	0.1	1	FG					0.1				
Ranunculus lappaceus	0.1	3	FG					0.1				
Ranunculus sp.	0.1	2	FG					0.1				
Senecio quadridentatus	0.2	30	FG					0.2				
Senecio sp.	0.1	100	FG					0.1				
Stackhousia monogyna	0.1	1	FG					0.1				
Stellaria pungens	0.1	20	FG					0.1				
Stylidium graminifolium	0.1	6	FG					0.1				
Viola betonicifolia	0.1	100	FG					0.1				
Wahlenbergia stricta	0.1	2	FG					0.1				
Centaurium erythraea	0.1	2	EX								0.1	
Hypochaeris radicata	0.1	20	EX								0.1	

			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Plot 14			**# spp**	**Count**	Count	Count	Count	Count	Count	Count	**Count**	Count
PCT 296			**29**	**24**	2	7	7	7	1	0	**5**	3
Species	**Cover**	**Abundance**	**Sum cover**	**Sum**	Sum	Sum	Sum	Sum	Sum	Sum	**Sum**	Sum
			124	**123.4**	4	48.1	2.7	68.5	0.1	0	**2.5**	0.4
Eucalyptus nortonii	2	2	TG		2							
Acacia dealbata	0.3	5	TG		2							
brachyloma daphnoides	45	100	SG			0.3						
Acacia pravissima	0.5	2	SG			45						
Exocarpos strictus	0.3	10	SG			0.5						
Cymbopogon refractus	2	100	GG				0.3					
Grevillea rosmarinifolia	0.3	4	SG			2						
Themeda triandra	65	1000	GG				0.3					
dianella revoluta	1.5	35	FG					65				
Lepidosperma laterale	0.1	2	GG				1.5					
lomandra multiflora	0.1	2	GG				0.1					
Bursaria spinosa	0.1	1	SG			0.1						
Chrysocephalum semipapposum	0.1	30	FG					0.1				
Hypericum perforatum	2	250	HT									0.1
Hypochaeris radicata	0.1	1	EX								2	
Hibbertia obtusifolia	0.1	5	SG			0.1						
Carex inversa	0.2	50	GG				0.1					
Rubus fruticosus agg.	0.1	2	HT									0.2
Cheilanthes sieberi	0.1	15	EG						0.1			
Hydrocotyle laxiflora	0.1	25	FG					0.1				
Acaena ovina	0.1	2	FG					0.1				
Rosa rubiginosa	0.1	1	HT									0.1
Microlaena stipoides	3	500	GG				0.1					
Gonocarpus tetragynus	0.3	200	FG					3				
Poa sieberiana	0.1	5	GG				0.3					
Centaurium erythraea	0.1	50	EX								0.1	
Oxalis perennans	0.1	10	FG					0.1				
Euchiton involucratus	0.1	1	FG					0.1				
Leucopogon fletcheri	0.1	1	SG			0.1						

			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Plot 15			**# spp**	**Count**	Count	Count	Count	Count	Count	Count	**Count**	Count
PCT 296			**36**	**32**	3	10	8	10	1	0	**4**	2
Species	**Cover**	**Abundance**	**Sum cover**	**Sum**	Sum	Sum	Sum	Sum	Sum	Sum	**Sum**	Sum
			92.8	**92.4**	37	4.3	49.1	1.9	0.1	0	**0.4**	0.2
Eucalyptus nortonii	35	60	TG		35							
Eucalyptus mannifera	1	2	TG		1							
Acacia pravissima	1	5	SG			1						
Cassinia longifolia	0.2	2	SG			0.2						
Dianella revoluta	1	60	FG					1				
Hypericum perforatum	0.1	20	HT									0.1
Themeda triandra	45	1000	GG				45					
Eucalyptus rubida	1	1	TG		1							
Lomandra filiformis subsp. coriacea	2	100	GG				2					
Centaurium erythraea	0.1	5	EX								0.1	
Gonocarpus tetragynus	0.1	100	FG					0.1				
Brachyloma daphnoides	2	100	SG			2						
Hydrocotyle laxiflora	0.1	50	FG					0.1				
Hypericum gramineum	0.1	5	FG					0.1				
Microlaena stipoides	1	300	GG				1					
Lomandra filiformis subsp. filiformis	0.1	5	GG				0.1					
Acaena ovina	0.1	25	FG					0.1				
Cheilanthes sieberi	0.1	50	EG						0.1			
Hibbertia obtusifolia	0.2	10	SG			0.2						
Rubus fruticosus agg.	0.1	1	HT									0.1
Pimelea curviflora	0.1	30	SG			0.1						
Lomandra multiflora	0.5	50	GG				0.5					
Hypochaeris radicata	0.1	10	EX								0.1	
Poa sieberiana	0.3	50	GG				0.3					
Wahlenbergia stricta	0.1	5	FG					0.1				
Banksia canei	0.1	1	SG			0.1						
Stylidium graminifolium	0.1	1	FG					0.1				
Dodonaea viscosa	0.1	1	SG			0.1						
Monotoca scoparia	0.2	1	SG			0.2						
Hovea linearis	0.1	1	FG					0.1				
Exocarpos strictus	0.1	1	SG			0.1						
Bursaria spinosa	0.3	5	SG			0.3						
Chrysocephalum semipapposum	0.1	1	FG					0.1				
Stackhousia monogyna	0.1	1	FG					0.1				
Rytidosperma caespitosum	0.1	15	GG				0.1					
Rytidosperma racemosum	0.1	30	GG				0.1					

			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Plot 16			**# spp**	**Count**	Count	Count	Count	Count	Count	Count	**Count**	Count
PCT 296			**47**	**36**	0	3	16	17	0	0	**11**	4
Species	**Cover**	**Abundance**	**Sum cover**	**Cover**	Sum	Sum	Sum	Sum	Sum	Sum	**Sum**	Sum
			65.2	**24.2**	0	16.1	5.1	3	0	0	**41**	30.3
Epacris breviflora	15	250	SG			15						
Poa labillardierei	1	50	GG				1					
Themeda triandra	0.1	25	GG				0.1					
Eragrostis benthamii	0.5	500	GG				0.5					
Deyeuxia quadriseta	0.1	5	GG				0.1					
Juncus sp.	0.1	5	GG				0.1					
Juncus australis	1	30	GG				1					
Luzula flaccida			GG				0					
Poa sieberiana	1	25	GG				1					
Prunella vulgaris	0.1	50	EX								0.1	
Epilobium billardierianum subsp. Billardierianum			FG					0				
Carex appressa	0.5	50	GG				0.5					
Euchiton involucratus	0.1	200	FG					0.1				
Hydrocotyle tripartita	1	1000	FG					1				
Aira caryophyllea	0.1	50	EX								0.1	
Hypericum japonicum	0.1	50	FG					0.1				
Gonocarpus micranthus subsp. Micranthus	0.5	1000	FG					0.5				
Poa tenera	0.1	50	GG				0.1					
Centaurium erythraea	0.2	100	EX								0.2	
Baeckea utilis	0.1	50	SG			0.1						
Hypochaeris radicata	0.1	50	EX								0.1	
Austrostipa sp.	0.1	1	GG				0.1					
Leptospermum lanigerum	1	25	SG			1						
Stylidium graminifolium	0.2	50	FG					0.2				
Asperula conferta	0.1	50	FG					0.1				
Rytidosperma pilosum	0.1	20	GG				0.1					
Viola betonicifolia	0.1	5	FG					0.1				
Solenogyne gunnii	0.1	50	FG					0.1				
Geranium solanderi	0.1	50	FG					0.1				
Stellaria pungens	0.1	100	FG					0.1				
Trifolium arvense	0.1	100	EX								0.1	
Carex inversa	0.1	10	GG				0.1					
Hypericum perforatum	0.1	10	HT									0.1
Vulpia sp.	0.1	10	EX								0.1	
Elymus scaber	0.1	10	GG				0.1					
Lomandra longifolia	0.2	5	GG				0.2					
Microseris lanceolata	0.1	1	FG					0.1				
Ajuga australis	0.1	1	FG					0.1				
Rosa rubiginosa	0.1	1	HT									0.1
Dichelachne micrantha	0.1	25	GG				0.1					
Coronidium monticola	0.1	10	FG					0.1				
Brachyscome sp.	0.1	10	FG					0.1				
Spiranthes australis	0.1	1	FG					0.1				
Acetosella vulgaris	0.1	20	HT									0.1
Veronica sp.	0.1	50	FG					0.1				
Trifolium repens	10	1000	EX								10	
Holcus lanatus	30	1000	HT									30

			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Plot 17			**# spp**	**Count**	Count	Count	Count	Count	Count	Count	**Count**	Count
PCT 296			**29**	**24**	3	7	5	7	1	1	**5**	3
Species	**Cover**	**Abundance**	**Sum cover**	**Sum**	Sum	Sum	Sum	Sum	Sum	Sum	**Sum**	Sum
			82.5	**81.3**	22.2	46	5.2	6.4	1	0.5	**1.2**	1
Acacia dealbata	2	9	TG		2							
Acacia melanoxylon	0.2	1	TG		0.2							
Acaena novae-zelandiae	0.4	30	FG					0.4				
Austrostipa sp.	3	200	GG				3					
Brachyloma daphnoides	35	150	SG			35						
Bursaria spinosa	3	4	SG			3						
Cassinia longifolia	5	18	SG			5						
Centaurium erythraea	0.1	20	EX								0.1	
Cheilanthes sieberi	1	50	EG						1			
Chrysocephalum semipapposum	0.5	5	FG					0.5				
Conyza bonariensis	0.1	1	EX								0.1	
Dianella revoluta	5	200	FG					5				
Dodonaea viscosa subsp. angustissima	0.5	6	SG			0.5						
Eucalyptus dives	20	30	TG		20							
Exocarpos strictus	2	16	SG			2						
Gonocarpus tetragynus	0.1	50	FG					0.1				
Hardenbergia violacea	0.5	2	OG							0.5		
Hibbertia obtusifolia	0.2	10	SG			0.2						
Hydrocotyle laxiflora	0.2	20	FG					0.2				
Hypericum perforatum	0.3	200	HT									0.3
Indigofera australis	0.3	2	SG			0.3						
Lomandra multiflora	1	20	GG				1					
Microlaena stipoides	0.2	50	GG				0.2					
Oxalis perennans	0.1	20	FG					0.1				
Poa sieberiana	0.5	100	GG				0.5					
Rosa rubiginosa	0.5	3	HT									0.5
Rubus fruticosus agg.	0.2	5	HT									0.2
Themeda triandra	0.5	100	GG				0.5					
Vittadinia cuneata	0.1	10	FG					0.1				

			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Plot 18			**# spp**	**Count**	Count	Count	Count	Count	Count	Count	**Count**	Count
PCT 296			**41**	**40**	2	15	7	13	0	3	**1**	0
Species	**Cover**	**Abundance**	**Sum cover**	**Sum**	Sum	Sum	Sum	Sum	Sum	Sum	**Sum**	Sum
			38.1	**38**	20	14.2	2	1.5	0	0.3	**0.1**	0
Eucalyptus dives	15	12	TG		15							
Eucalyptus rubida	5	2	TG		5							
Banksia canei	5	10	SG			5						
Indigofera australis	0.2	50	SG			0.2						
Hovea linearis	0.2	100	FG					0.2				
Brachyloma daphnoides	5	100	SG			5						
Lepidosperma laterale	0.1	25	GG				0.1					
Hardenbergia violacea	0.1	50	OG							0.1		
Galium gaudichaudii	0.1	5	FG					0.1				
Dianella revoluta	0.2	50	FG					0.2				
Poa sieberiana	1	50	GG				1					
Pimelea curviflora	0.1	25	SG			0.1						
Glycine clandestina	0.1	100	OG							0.1		
Centaurium erythraea	0.1	10	EX								0.1	
Rytidosperma pilosum	0.1	50	GG				0.1					
Elymus scaber	0.1	5	GG				0.1					
Cassinia longifolia	0.5	20	SG			0.5						
Acacia pravissima	0.2	5	SG			0.2						
Leucopogon virgatus	1	100	SG			1						
Daviesia mimosoides	1	20	SG			1						
Hypericum gramineum	0.1	10	FG					0.1				
Thelymitra sp.	0.1	1	FG					0.1				
Themeda triandra	0.5	100	GG				0.5					
Hibbertia obtusifolia	0.5	50	SG			0.5						
Stylidium graminifolium	0.1	50	FG					0.1				
Gonocarpus tetragynus	0.1	50	FG					0.1				
Hydrocotyle laxiflora	0.1	25	FG					0.1				
Acaena ovina	0.1	25	FG					0.1				
Dichelachne crinita	0.1	5	GG				0.1					
Cassytha glabella	0.1	10	OG							0.1		
Senecio sp.	0.1	15	FG					0.1				
Dillwynia sericea	0.1	10	SG			0.1						
Astroloma humifusum	0.1	1	SG			0.1						
Melichrus urceolatus	0.1	2	SG			0.1						
Bursaria spinosa	0.2	2	SG			0.2						
Chrysocephalum semipapposum	0.1	5	FG					0.1				
Carex inversa	0.1	1	GG				0.1					
Desmodium sp.	0.1	1	FG					0.1				
Acacia rubida	0.1	1	SG			0.1						
Tetratheca bauerifolia	0.1	1	SG			0.1						
Euchiton involucratus	0.1	1	FG					0.1				
Solenogyne gunnii	0.1	1	FG					0.1				
Mirbelia oxylobioides	0.2	10	SG			0.2						

			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Plot 19			**# spp**	**Count**	Count	Count	Count	Count	Count	Count	**Count**	Count
PCT 296			**40**	**38**	2	17	7	9	0	3	**2**	1
Species	**Cover**	**Abundance**	**Sum cover**	**Sum**	Sum	Sum	Sum	Sum	Sum	Sum	**Sum**	Sum
			55.2	**55**	16	22.1	15.7	0.8	0	0.4	**0.2**	0.1
Eucalyptus dives	10	20	TG		10							
Eucalyptus rubida	6	12	TG		6							
Mirbelia oxylobioides	5	30	SG			5						
Cassinia longifolia	4	30	SG			4						
Dillwynia sp.	2	25	SG			2						
Brachyloma daphnoides	0.5	25	SG			0.5						
Cassytha glabella	0.2	50	OG							0.2		
Themeda triandra	10	200	GG				10					
Platylobium formosum	3	150	SG			3						
Acacia pravissima	2	16	SG			2						
Pimelea linifolia	0.1	15	SG			0.1						
Hibbertia obtusifolia	0.5	25	SG			0.5						
Gonocarpus tetragynus	0	200	FG					0				
Daviesia mimosoides	0.2	5	SG			0.2						
Persoonia chamaepeuce	0.1	5	SG			0.1						
Poa sieberiana	5	200	GG				5					
Rytidosperma pilosum	0.1	25	GG				0.1					
Pimelea curviflora	0.1	50	SG			0.1						
Lomandra longifolia	0.2	10	GG				0.2					
Hovea linearis	0.1	15	FG					0.1				
Centaurium erythraea	0.1	20	EX								0.1	
Senecio pinnatifolius	0.1	1	FG					0.1				
Geranium Sp.	0.1	1	FG					0.1				
Viola betonicifolia	0.1	1	FG					0.1				
Luzula flaccida	0.1	1	GG				0.1					
Indigofera australis	0.1	10	SG			0.1						
Hypericum perforatum	0.1	5	HT									0.1
Leucopogon virgatus	0.1	15	SG			0.1						
Tetratheca bauerifolia	0.1	5	SG			0.1						
Hypericum gramineum	0.1	10	FG					0.1				
Stylidium graminifolium	0.1	20	FG					0.1				
Lomandra filiformis subsp. coriacea	0.2	50	GG				0.2					
Lomandra multiflora	0.1	30	GG				0.1					
Melichrus urceolatus	0.1	5	SG			0.1						
Dianella revoluta	0.1	25	FG					0.1				
Hardenbergia violacea	0.1	5	OG							0.1		
Cynoglossum australe	0.1	1	FG					0.1				
Glycine clandestina	0.1	30	OG							0.1		
Monotoca scoparia	0.2	5	SG			0.2						
Calytrix tetragona	4	100	SG			4						

			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Plot 20			**# spp**	**Count**	Count	Count	Count	Count	Count	Count	**Count**	Count
PCT 296			**29**	**22**	3	5	9	5	0	0	**7**	3
Species	**Cover**	**Abundance**	**Sum cover**	**Sum**	Sum	Sum	Sum	Sum	Sum	Sum	**Sum**	Sum
			135.5	**129.7**	46	1.6	81.6	0.5	0	0	**5.8**	5.3
Eucalyptus rubida	20	25	TG		20							
Themeda triandra	1	50	GG				1					
Microlaena stipoides	40	1000	GG				40					
Dichelachne crinita	0.2	50	GG				0.2					
Rubus fruticosus agg.	5	25	HT									5
Centaurium erythraea	0.1	50	EX								0.1	
Hypericum perforatum	0.2	200	HT									0.2
Elymus scaber	10	500	GG				10					
Gonocarpus tetragynus	0.1	100	FG					0.1				
Acacia dealbata	25	60	TG		25							
Brachyloma daphnoides	0.5	20	SG			0.5						
Bursaria spinosa	0.2	3	SG			0.2						
Eucalyptus dives	1	0	TG		1							
Hydrocotyle laxiflora	0.1	40	FG					0.1				
Vulpia myuros	0.2	100	EX								0.2	
Exocarpos strictus	0.5	30	SG			0.5						
Acaena ovina	0.1	15	FG					0.1				
Rytidosperma racemosum	30	500	GG				30					
Rosa rubiginosa	0.1	5	HT									0.1
Pimelea linifolia	0.2	5	SG			0.2						
Carex longebrachiata	0.1	5	GG				0.1					
Juncus sp.	0.1	1	GG				0.1					
Aira elegantissima	0.1	50	EX								0.1	
Hypericum gramineum	0.1	25	FG					0.1				
Eragrostis sp.	0.1	1	GG				0.1					
Oxalis perennans	0.1	5	FG					0.1				
Panicum effusum	0.1	5	GG				0.1					
Hypochaeris radicata	0.1	5	EX								0.1	
Cassinia longifolia	0.2	2	SG			0.2						

			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Plot 22			**# spp**	**Count**	Count	Count	Count	Count	Count	Count	**Count**	Count
PCT 296			**32**	**30**	4	13	9	3	0	1	**2**	2
Species	**Cover**	**Abundance**	**Sum cover**	**Sum**	Sum	Sum	Sum	Sum	Sum	Sum	**Sum**	Sum
			70.1	**69.9**	14.1	50	5	0.7	0	0.1	**0.2**	0.2
Eucalyptus viminalis	3	3	TG		3							
Eucalyptus mannifera	10	5	TG		10							
Acacia pravissima	3	50	SG			3						
Eucalyptus dives	1	3	TG		1							
Mirbelia oxylobioides	0.5	3	SG			0.5						
Melichrus urceolatus	0.2	1	SG			0.2						
Themeda triandra	0.1	25	GG				0.1					
Hibbertia obtusifolia	0.2	50	SG			0.2						
Lomandra filiformis	1	50	GG				1					
Lomandra longifolia	3	25	GG				3					
Gonocarpus tetragynus	0.1	25	FG					0.1				
Brachyloma daphnoides	5	150	SG			5						
Leucopogon fletcheri	10	200	SG			10						
Dillwynia sp.	0.1	10	SG			0.1						
Microlaena stipoides	0.2	200	GG				0.2					
Lomandra filiformis	0.2	10	GG				0.2					
Dichelachne micrantha	0.1	15	GG				0.1					
Dianella revoluta	0.5	30	FG					0.5				
Pimelea linifolia	0.2	50	SG			0.2						
Rubus fruticosus agg.	0.1	1	HT									0.1
Rosa rubiginosa	0.1	1	HT									0.1
Lomandra multiflora	0.2	25	GG				0.2					
Acacia gunnii	0.1	1	SG			0.1						
Poa sieberiana	0.1	15	GG				0.1					
Cassytha glabella	0.1	5	OG							0.1		
Acacia melanoxylon	0.1	1	TG		0.1							
Aristida ramosa	0.1	1	GG				0.1					
Senecio prenanthoides	0.1	1	FG					0.1				
Leptospermum continentale	0.1	2	SG			0.1						
Exocarpos strictus	0.1	1	SG			0.1						
Bursaria spinosa	0.5	10	SG			0.5						
Calytrix tetragona	30	500	SG			30						

			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Plot 23			**# spp**	**Count**	Count	Count	Count	Count	Count	Count	**Count**	Count
PCT 296			**28**	**23**	3	7	9	3	0	1	**5**	4
Species	**Cover**	**Abundance**	**Sum cover**	**Sum**	Sum	Sum	Sum	Sum	Sum	Sum	**Sum**	Sum
			58.7	**58.1**	4.5	45.4	7.7	0.4	0	0.1	**0.6**	0.5
Microlaena stipoides	5	8	GG				5					
Eucalyptus viminalis	0.5	2	TG		0.5							
Acacia pravissima	15	50	SG			15						
Cassinia longifolia	25	150	SG			25						
Eucalyptus dives	1	5	TG		1							
Acacia dealbata	3	50	TG		3							
Bursaria spinosa	3	50	SG			3						
Brachyloma daphnoides	2	100	SG			2						
Hypericum perforatum	0.1	25	HT									0.1
Rubus fruticosus agg.	0.2	10	HT									0.2
Cassytha glabella	0.1	50	OG							0.1		
Calytrix tetragona	0.1	1	SG			0.1						
Gonocarpus tetragynus	0.2	500	FG					0.2				
Hydrocotyle laxiflora	0.1	200	FG					0.1				
Rosa rubiginosa	0.1	1	HT									0.1
Dichondra repens	0.1	25	FG					0.1				
Echinopogon sp.	0.2	50	GG				0.2					
Microlaena stipoides	1	150	GG				1					
Exocarpos strictus	0.2	20	SG			0.2						
Rytidosperma racemosum	1	50	GG				1					
Poa sieberiana	0.1	5	GG				0.1					
Monotoca scoparia	0.1	5	SG			0.1						
Carex inversa	0.1	1	GG				0.1					
Poa helmsii	0.1	1	GG				0.1					
Lomandra filiformis subsp. filiformis	0.1	5	GG				0.1					
Themeda triandra	0.1	15	GG				0.1					
Centaurium erythraea	0.1	35	EX								0.1	
Holcus lanatus	0.1	1	HT									0.1

			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Plot 24			**# spp**	**Count**	Count	Count	Count	Count	Count	Count	**Count**	Count
PCT 296			**21**	**21**	4	12	2	3	0	0	**0**	0
Species	**Cover**	**Abundance**	**Sum cover**	**Sum**	Sum	Sum	Sum	Sum	Sum	Sum	**Sum**	Sum
			9.2	**9.2**	2.5	6.2	0.2	0.3	0	0	**0**	0
Acacia dealbata	0.1	12	TG		0.1							
Acacia pravissima	0.2	11	SG			0.2						
Banksia canei	2	38	SG			2						
Calytrix tetragona	0.1	4	SG			0.1						
Cassinia aculeata	0.1	3	SG			0.1						
Cassinia longifolia	0.2	22	SG			0.2						
Eucalyptus dives	2	12	TG		2							
Eucalyptus mannifera	0.3	6	TG		0.3							
Eucalyptus robertsonii	0.1	1	TG		0.1							
Exocarpos strictus	0.1	5	SG			0.1						
Gompholobium sp.	0.1	4	SG			0.1						
Gonocarpus sp.	0.1	22	FG					0.1				
Hibbertia obtusifolia	0.1	6	SG			0.1						
Leucopogon virgatus	0.1	12	SG			0.1						
Lomandra filiformis	0.1	6	GG				0.1					
Monotoca scoparia	0.1	18	SG			0.1						
Pimelea linifolia	0.1	6	SG			0.1						
Platylobium formosum	3	150	SG			3						
Poa sieberiana	0.1	90	GG				0.1					
Viola sp.	0.1	2	FG					0.1				
Wahlenbergia sp.	0.1	4	FG					0.1				

			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Plot 25			**# spp**	**Count**	Count	Count	Count	Count	Count	Count	**Count**	Count
PCT 296			**26**	**26**	2	16	4	4	0	0	**0**	0
Species	**Cover**	**Abundance**	**Sum cover**	**Sum**	Sum	Sum	Sum	Sum	Sum	Sum	**Sum**	Sum
			67.9	**67.9**	16	48.4	3.1	0.4	0	0	**0**	0
Acacia pravissima	0.5	40	SG			0.5						
Asperula gunnii	0.1	150	FG					0.1				
Astroloma humifusum	0.1	50	SG			0.1						
Banksia canei	30	200	SG			30						
Bossiaea foliosa	5	200	SG			5						
Brachyloma daphnoides	0.1	50	SG			0.1						
Calytrix tetragona	0.5	30	SG			0.5						
Dillwynia phylicoides	0.2	50	SG			0.2						
Eucalyptus dives	15	10	TG		15							
Eucalyptus viminalis	1	1	TG		1							
Gonocarpus tetragynus	0.1	100	FG					0.1				
Hibbertia obtusifolia	0.1	50	SG			0.1						
Hovea heterophylla	0.1	5	FG					0.1				
Leucopogon fletcheri	4	200	SG			4						
Leucopogon virgatus	0.1	50	SG			0.1						
Lomandra filiformis subsp. coriacea	0.1	20	GG				0.1					
Lomandra longifolia	0.5	50	GG				0.5					
Mirbelia oxylobioides	5	200	SG			5						
Monotoca scoparia	0.1	50	SG			0.1						
Persoonia chamaepeuce	0.1	10	SG			0.1						
Pimelea linifolia	0.1	50	SG			0.1						
Platylobium formosum	0.5	50	SG			0.5						
Poa sieberiana	2	500	GG				2					
Podolobium procumbens	2	100	SG			2						
Stylidium graminifolium	0.1	30	FG					0.1				
Microlaena stipoides	0.5	200	GG				0.5					

			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Plot 27			**# spp**	**Count**	Count	Count	Count	Count	Count	Count	**Count**	Count
PCT 296			**31**	**30**	3	14	5	6	0	2	**1**	0
Species	**Cover**	**Abundance**	**Sum cover**	**Sum**	Sum	Sum	Sum	Sum	Sum	Sum	**Sum**	Sum
			176	**175.9**	62	92.3	20.8	0.6	0	0.2	**0.1**	0
Eucalyptus dives	20	7	TG		20							
Eucalyptus nortonii	40	12	TG		40							
Eucalyptus rubida	2	4	TG		2							
Acacia buxifolia	0.3	5	SG			0.3						
Acacia gunnii	0.1	1	SG			0.1						
Banksia canei	70	50	SG			70						
Brachyloma daphnoides	1	20	SG			1						
Calytrix tetragona	10	30	SG			10						
Cassinia longifolia	0.1	1	SG			0.1						
Dillwynia phylicoides	1	10	SG			1						
Hibbertia obtusifolia	0.3	20	SG			0.3						
Leucopogon virgatus	0.1	1	SG			0.1						
Monotoca scoparia	2	5	SG			2						
Pimelea linifolia	0.2	50	SG			0.2						
Platylobium formosum	5	40	SG			5						
Rhytidosporum sp.	2	40	SG			2						
Tetratheca rubioides	0.2	20	SG			0.2						
Cassytha sp.	0.1	1	OG							0.1		
Hardenbergia violacea	0.1	10	OG							0.1		
Lomandra filiformis	0.1	10	GG				0.1					
Lomandra glauca	0.1	3	GG				0.1					
Lomandra gracilis	0.5	20	GG				0.5					
Lomandra longifolia	0.1	1	GG				0.1					
Poa sp.	20	30	GG				20					
Boronia nana	0.1	10	FG					0.1				
Caladenia congesta	0.1	5	FG					0.1				
Gonocarpus tetragynus	0.1	1	FG					0.1				
Hovea sp.	0.1	10	FG					0.1				
Hypericum gramineum	0.1	5	FG					0.1				
Wahlenbergia stricta	0.1	2	FG					0.1				
Aira sp.	0.1	20	EX								0.1	

			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Plot 28			**# spp**	**Count**	Count	Count	Count	Count	Count	Count	**Count**	Count
PCT 296			**41**	**40**	3	16	4	16	0	1	**1**	0
Species	**Cover**	**Abundance**	**Sum cover**	**Sum**	Sum	Sum	Sum	Sum	Sum	Sum	**Sum**	Sum
			216.5	**216.4**	55.2	91.3	61.3	6.6	0	2	**0.1**	0
Acacia dealbata	0.2	10	TG		0.2							
Eucalyptus dives	30	5	TG		30							
Eucalyptus rubida	25	6	TG		25							
Banksia canei	2	43	SG			2						
Bossiaea foliosa	0.1	1	SG			0.1						
Brachyloma daphnoides	30	50	SG			30						
Cassinia longifolia	1	5	SG			1						
Dillwynia phylicoides	30	50	SG			30						
Exocarpos cupressiformis	10	15	SG			10						
Grevillea arenaria subsp. canescens	2	20	SG			2						
Grevillea rosmarinifolia	0.1	1	SG			0.1						
Hibbertia obtusifolia	0.2	20	SG			0.2						
Leucopogon virgatus	5	20	SG			5						
Mirbelia oxylobioides	10	20	SG			10						
Persoonia chamaepeuce	0.3	20	SG			0.3						
Pimelea curviflora	0.1	10	SG			0.1						
Pimelea linifolia	0.1	10	SG			0.1						
Platylobium formosum	0.2	5	SG			0.2						
Tetratheca bauerifolia	0.2	10	SG			0.2						
Cassytha pubescens	2	10	OG							2		
Lomandra longifolia	0.1	1	GG				0.1					
Microlaena stipoides	0.2	20	GG				0.2					
Poa sp.	60	200	GG				60					
Themeda triandra	1	20	GG				1					
Asperula conferta	0.1	2	FG					0.1				
Caladenia gracilis	0.1	1	FG					0.1				
Dianella revoluta	5	50	FG					5				
Diuris pardina	0.1	2	FG					0.1				
Geranium obtusisepalum	0.1	1	FG					0.1				
Gonocarpus tetragynus	0.1	10	FG					0.1				
Hovea heterophylla	0.2	10	FG					0.2				
Hydrocotyle laxiflora	0.1	10	FG					0.1				
Plantago gaudichaudii	0.1	2	FG					0.1				
Pterostylis longifolia	0.1	1	FG					0.1				
Ranunculus lappaceus	0.1	10	FG					0.1				
Stellaria pungens	0.1	20	FG					0.1				
Stylidium graminifolium	0.1	20	FG					0.1				
Thelymitra megacalyptra	0.1	1	FG					0.1				
Viola betonicifolia	0.1	1	FG					0.1				
Wahlenbergia stricta	0.1	20	FG					0.1				
Centaurium erythraea	0.1	20	EX								0.1	

			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Plot 29			**# spp**	**Count**	Count	Count	Count	Count	Count	Count	**Count**	Count
PCT 296			**32**	**32**	2	14	5	10	0	1	**0**	0
Species	**Cover**	**Abundance**	**Sum cover**	**Sum**	Sum	Sum	Sum	Sum	Sum	Sum	**Sum**	Sum
			75.6	**75.6**	18	45.9	10.4	1.2	0	0.1	**0**	0
Eucalyptus dives	15	20	TG		15							
Eucalyptus nortonii	3	4	TG		3							
Banksia canei	40	120	SG			40						
Brachyloma daphnoides	2	30	SG			2						
Cassinia longifolia	0.1	1	SG			0.1						
Daviesia mimosoides	0.2	3	SG			0.2						
Dillwynia phylicoides	0.2	6	SG			0.2						
Exocarpos cupressiformis	2	10	SG			2						
Hibbertia obtusifolia	0.2	20	SG			0.2						
Leucopogon virgatus	0.1	10	SG			0.1						
Mirbelia oxylobioides	0.1	2	SG			0.1						
Monotoca scoparia	0.1	2	SG			0.1						
Persoonia chamaepeuce	0.1	1	SG			0.1						
Pimelea linifolia	0.2	30	SG			0.2						
Platylobium formosum	0.5	20	SG			0.5						
Tetratheca bauerifolia	0.1	2	SG			0.1						
Hardenbergia violacea	0.1	5	OG							0.1		
Dichelachne sp.	0.1	20	GG				0.1					
Lomandra filiformis	0.1	4	GG				0.1					
Lomandra longifolia	0.2	8	GG				0.2					
Poa sieberiana	8	150	GG				8					
Poa sp.	2	80	GG				2					
Caladenia congesta	0.1	2	FG					0.1				
Geranium obtusisepalum	0.1	1	FG					0.1				
Gonocarpus tetragynus	0.2	50	FG					0.2				
Hovea heterophylla	0.1	10	FG					0.1				
Prasophyllum sp.	0.1	2	FG					0.1				
Pterostylis longifolia	0.1	1	FG					0.1				
Pterostylis sp.	0.1	7	FG					0.1				
Stellaria pungens	0.1	1	FG					0.1				
Stylidium graminifolium	0.2	30	FG					0.2				
Wahlenbergia stricta	0.1	3	FG					0.1				

			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Plot 30			**# spp**	**Count**	Count	Count	Count	Count	Count	Count	**Count**	Count
PCT 296			**17**	**14**	3	7	4	0	0	0	**3**	3
Species	**Cover**	**Abundance**	**Sum cover**	**Sum**	Sum	Sum	Sum	Sum	Sum	Sum	**Sum**	Sum
			126.7	**36.1**	32.1	1.5	2.5	0	0	0	**90.6**	90.6
Eucalyptus rubida	30	20	TG		30							
Microlaena stipoides	2	500	GG				2					
Rubus fruticosus agg.	90	500	HT									90
Hypericum perforatum	0.5	50	HT									0.5
Acacia dealbata	2	20	TG		2							
Bursaria spinosa	0.5	5	SG			0.5						
Exocarpos strictus	0.1	20	SG			0.1						
Dodonaea viscosa	0.1	1	SG			0.1						
Rytidosperma racemosum	0.3	100	GG				0.3					
Rosa rubiginosa	0.1	1	HT									0.1
Pimelea linifolia	0.2	10	SG			0.2						
Acacia melanoxylon	0.1	5	TG		0.1							
Acacia pravissima	0.1	1	SG			0.1						
Juncus sp.	0.1	5	GG				0.1					
Cassinia longifolia	0.3	2	SG			0.3						
Cassinia aculeata	0.2	5	SG			0.2						
Carex longebrachiata	0.1	10	GG				0.1					

			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Plot 31			**# spp**	**Count**	Count	Count	Count	Count	Count	Count	**Count**	Count
PCT 300			**41**	**39**	2	9	4	20	1	3	**2**	1
Species	**Cover**	**Abundance**	**Sum cover**	**Sum**	Sum	Sum	Sum	Sum	Sum	Sum	**Sum**	Sum
			155.9	**155.6**	21	59.7	42.2	12.4	20	0.3	**0.3**	0.1
Asperula scoparia	0.1	100	FG					0.1				
Brachyscome spathulata	0.1	20	FG					0.1				
Clematis aristata	0.1	1	OG							0.1		
Desmodium varians	0.1	1	OG							0.1		
Dipodium punctatum	0.1	2	FG					0.1				
Euchiton sp.	0.1	1	FG					0.1				
Euphrasia collina	0.1	1	FG					0.1				
Glycine clandestina	0.1	20	OG							0.1		
Gonocarpus tetragynus	0.1	10	FG					0.1				
Hydrocotyle laxiflora	0.1	20	FG					0.1				
Lagenifera stipitata	0.1	20	FG					0.1				
Leucopogon lanceolatus	0.1	1	SG			0.1						
Monotoca scoparia	0.1	1	SG			0.1						
Oreomyrrhis sp.	0.1	2	FG					0.1				
Pterostylis decurva	0.1	1	FG					0.1				
Ranunculus lappaceus	0.1	2	FG					0.1				
Rubus fruticosus agg.	0.1	1	HT									0.1
Stylidium graminifolium	0.1	25	FG					0.1				
Veronica calycina	0.1	10	FG					0.1				
Viola betonicifolia	0.1	10	FG					0.1				
Acaena novae-zelandiae	0.2	50	FG					0.2				
Asperula conferta	0.2	50	FG					0.2				
Exocarpos strictus	0.2	10	SG			0.2						
Microlaena stipoides	0.2	20	GG				0.2					
Stellaria pungens	0.2	50	FG					0.2				
Trifolium repens	0.2	250	EX								0.2	
Veronica derwentiana	0.2	10	FG					0.2				
Viola hederacea	0.2	20	FG					0.2				
Olearia sp.	0.3	30	SG			0.3						
Acacia dealbata	1	20	TG		1							
Coprosma hirtella	2	20	SG			2						
Coprosma quadrifida	2	10	SG			2						
Lomandra longifolia	2	20	GG				2					
Daviesia latifolia	5	20	SG			5						
Dianella tasmanica	10	50	FG					10				
Platylobium formosum	10	40	SG			10						
Poa labillardierei	10	200	GG				10					
Eucalyptus dalrympleana	20	3	TG		20							
Pteridium esculentum	20	50	EG						20			
Poa sieberiana	30	200	GG				30					
Cassinia aculeata	40	50	SG			40						

			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Plot 32			**# spp**	**Count**	Count	Count	Count	Count	Count	Count	**Count**	Count
PCT 300			**22**	**22**	4	10	3	3	0	2	**0**	0
Species	**Cover**	**Abundance**	**Sum cover**	**Sum**	Sum	Sum	Sum	Sum	Sum	Sum	**Sum**	Sum
			142.8	**142.8**	21.5	40	76	1.3	0	4	**0**	0
Acacia melanoxylon	0.5	1	TG		0.5							
Acacia pravissima	1	3	SG			1						
Arthropodium sp.	0.2	8	FG					0.2				
Banksia canei	10	26	SG			10						
Brachyloma daphnoides	0.5	15	SG			0.5						
Cassinia aculeata	2	12	SG			2						
Cassinia longifolia	1	4	SG			1						
Dianella sp.	1	20	FG					1				
Dillwynia phylicoides	15	45	SG			15						
Eucalyptus dalrympleana	3	1	TG		3							
Eucalyptus dives	8	15	TG		8							
Eucalyptus robertsonii	10	8	TG		10							
Glycine clandestina	1	40	OG							1		
Gompholobium sp.	2	55	SG			2						
Leptomeria drupacea	0.5	2	SG			0.5						
Leucopogon fletcheri	3	28	SG			3						
Lomandra longifolia	1	12	GG				1					
Glycine sp.	3	18	OG							3		
Platylobium formosum	5	60	SG			5						
Poa sieberiana	70	1000	GG				70					
Poa sp.	5	200	GG				5					
Stellaria pungens	0.1	40	FG					0.1				

			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Plot 33			**# spp**	**Count**	Count	Count	Count	Count	Count	Count	**Count**	Count
PCT 300			**27**	**27**	4	8	1	10	1	3	**0**	0
Species	**Cover**	**Abundance**	**Sum cover**	**Sum**	Sum	Sum	Sum	Sum	Sum	Sum	**Sum**	Sum
			36.4	**36.4**	23	7.6	0.2	3.3	2	0.3	**0**	0
Acacia dealbata	2	60	TG		2							
Acaena novae-zelandiae	0.1	10	FG					0.1				
Cassinia aculeata	2	75	SG			2						
Cassinia longifolia	0.1	2	SG			0.1						
Cassytha sp.	0.1	10	OG							0.1		
Clematis aristata	0.1	8	OG							0.1		
Coprosma hirtella	2	42	SG			2						
Coprosma quadrifida	3	45	SG			3						
Dianella tasmanica	0.1	10	FG					0.1				
Dichondra repens	0.5	1000	FG					0.5				
Eucalyptus dives	15	8	TG		15							
Eucalyptus robertsonii	5	3	TG		5							
Eucalyptus viminalis	1	1	TG		1							
Exocarpos strictus	0.1	14	SG			0.1						
Geranium sp.	0.1	50	FG					0.1				
Glycine sp.	0.1	15	OG							0.1		
Lomandra longifolia	0.2	80	GG				0.2					
Arthropodium sp.	0.2	205	FG					0.2				
Platylobium formosum	0.1	15	SG			0.1						
Polyscias sambucifolia	0.1	3	SG			0.1						
Pteridium esculentum	2	40	EG						2			
Rubus sp.	0.2	10	SG			0.2						
Senecio sp.	0.1	10	FG					0.1				
Stellaria pungens	1	600	FG					1				
Veronica plebeia	0.1	50	FG					0.1				
Veronica sp.	1	85	FG					1				
Viola hederacea	0.1	60	FG					0.1				

			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Plot 34			**# spp**	**Count**	Count	Count	Count	Count	Count	Count	**Count**	Count
PCT 300			**22**	**21**	3	6	2	8	1	1	**1**	1
Species	**Cover**	**Abundance**	**Sum cover**	**Sum**	Sum	Sum	Sum	Sum	Sum	Sum	**Sum**	Sum
			85.2	**55.2**	17	11.2	20.2	1.7	5	0.1	**30**	30
Acacia dealbata	5	35	TG		5							
Acaena novae-zelandiae	0.1	80	FG					0.1				
Bulbine bulbosa	0.1	30	FG					0.1				
Cassinia aculeata	4	27	SG			4						
Cassinia longifolia	0.5	3	SG			0.5						
Coprosma hirtella	1	28	SG			1						
Coprosma quadrifida	5	20	SG			5						
Dichondra repens	0.1	40	FG					0.1				
Eucalyptus pauciflora	2	4	TG		2							
Eucalyptus robertsonii	10	4	TG		10							
Geranium obtusisepalum	0.1	50	FG					0.1				
Glycine clandestina	0.1	20	OG							0.1		
Lomandra longifolia	0.2	15	GG				0.2					
Arthropodium sp.	0.1	6	FG					0.1				
Platylobium formosum	0.5	25	SG			0.5						
Poa sieberiana	20	500	GG				20					
Pteridium esculentum	5	180	EG						5			
Pterostylis monticola	0.1	18	FG					0.1				
Rubus fruticosus agg.	30	50+	HT									30
Rubus sp.	0.2	20	SG			0.2						
Stellaria pungens	0.1	200	FG					0.1				
Veronica derwentiana	1	45	FG					1				

			Covers	**Native**	Trees	Shrubs	Grass	Forb	Fern	Other	**Exotic**	HighThreat
Plot 35			**# spp**	**Count**	Count	Count	Count	Count	Count	Count	**Count**	Count
PCT 300			**23**	**23**	6	7	2	6	1	1	**0**	0
Species	**Cover**	**Abundance**	**Sum cover**	**Sum**	Sum	Sum	Sum	Sum	Sum	Sum	**Sum**	Sum
			50.6	**50.6**	17.5	3.6	25.5	1.9	2	0.1	**0**	0
Acacia dealbata	2	20	TG		2							
Acacia melanoxylon	1	2	TG		1							
Acaena novae-zelandiae	0.1	20	FG					0.1				
Bulbine bulbosa	0.1	10	FG					0.1				
Cassinia aculeata	0.2	2	SG			0.2						
Cassinia longifolia	0.5	3	SG			0.5						
Coprosma hirtella	1	35	SG			1						
Coprosma quadrifida	0.2	5	SG			0.2						
Daviesia ulicifolia	0.5	7	SG			0.5						
Dianella sp.	0.5	16	FG					0.5				
Diuris sulphurea	0.1	2	FG					0.1				
Eucalyptus dives	0.5	1	TG		0.5							
Eucalyptus pauciflora	5	6	TG		5							
Eucalyptus robertsonii	8	17	TG		8							
Eucalyptus viminalis	1	3	TG		1							
Exocarpos strictus	0.2	1	SG			0.2						
Glycine clandestina	0.1	15	OG							0.1		
Lomandra longifolia	0.5	18	GG				0.5					
Arthropodium sp.	1	100	FG					1				
Platylobium formosum	1	80	SG			1						
Poa sieberiana	25	800+	GG				25					
Pteridium esculentum	2	65	EG						2			
Stellaria pungens	0.1	100+	FG					0.1				

			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Plot 36			**# spp**	**Count**	Count	Count	Count	Count	Count	Count	**Count**	Count
PCT 300			**32**	**32**	3	9	2	15	1	2	**0**	0
Species	**Cover**	**Abundance**	**Sum cover**	**Sum**	Sum	Sum	Sum	Sum	Sum	Sum	**Sum**	Sum
			168	**168**	25	49	75	12.9	5	1.1	**0**	0
Pteridium esculentum	5	80	EG						5			
Coprosma hirtella	8	100	SG			8						
Dianella tasmanica	5	140	FG					5				
Platylobium formosum	8	135	SG			8						
Daviesia latifolia	8	25	SG			8						
Cassinia aculeata	10	64	SG			10						
Exocarpos strictus	4	28	SG			4						
Leucopogon lanceolatus	1	1	SG			1						
Lomandra longifolia	5	95	GG				5					
Eucalyptus robertsonii	15	21	TG		15							
Eucalyptus dalrympleana	6	2	TG		6							
Glycine clandestina	0.1	20	OG							0.1		
Acaena ovina	0.1	35	FG					0.1				
Poa sieberiana	70	1000	GG				70					
Acacia dealbata	4	8	TG		4							
Lomatia myricoides	5	8	SG			5						
Coprosma quadrifida	3	5	SG			3						
Veronica calycina	0.1	17	FG					0.1				
Stellaria pungens	2	400	FG					2				
Clematis aristata	1	15	OG							1		
Senecio prenanthoides	1	5	FG					1				
Dipodium punctatum	0.1	1	FG					0.1				
Cassinia longifolia	2	3	SG			2						
Veronica derwentiana	2	15	FG					2				
Dichondra repens	1	200	FG					1				
Arthropodium sp.	1	23	FG					1				
Stackhousia monogyna	0.1	10	FG					0.1				
Ranunculus lappaceus	0.1	35	FG					0.1				
Geranium solanderi	0.1	20	FG					0.1				
Stylidium graminifolium	0.1	3	FG					0.1				
Hypericum gramineum	0.1	10	FG					0.1				
Hydrocotyle laxiflora	0.1	1	FG					0.1				

			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Plot 37			**# spp**	**Count**	Count	Count	Count	Count	Count	Count	**Count**	Count
PCT 300			**20**	**19**	4	2	3	5	4	1	**1**	1
Species	**Cover**	**Abundance**	**Sum cover**	**Sum**	Sum	Sum	Sum	Sum	Sum	Sum	**Sum**	Sum
			151.2	**131.2**	50	5.2	42	0.9	33	0.1	**20**	20
Eucalyptus viminalis	20	15	TG		20							
Acacia melanoxylon	15	40	TG		15							
Eucalyptus robertsonii	5	4	TG		5							
Carex appressa	35	1000	GG				35					
Blechnum ambiguum	20	500	EG						20			
Mentha diemenica	0.2	50	FG					0.2				
Acacia dealbata	10	45	TG		10							
Poa helmsii	5	50	GG				5					
Rubus fruticosus agg.	20	25	HT									20
Stellaria pungens	0.3	150	FG					0.3				
Pteridium esculentum	2	50	EG						2			
Clematis aristata	0.1	15	OG							0.1		
Acaena novae-zelandiae	0.1	40	FG					0.1				
Ranunculus lappaceus	0.1	15	FG					0.1				
Poa sieberiana	2	120	GG				2					
Coprosma hirtella	0.2	5	SG			0.2						
Cassinia aculeata	5	10	SG			5						
Dichondra repens	0.2	130	FG					0.2				
Polystichum proliferum	10	90	EG						10			
Blechnum nudum	1	5	EG						1			

			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Plot 38			**# spp**	**Count**	Count	Count	Count	Count	Count	Count	**Count**	Count
PCT 300			**24**	**24**	3	13	2	5	0	1	**0**	0
Species	**Cover**	**Abundance**	**Sum cover**	**Sum**	Sum	Sum	Sum	Sum	Sum	Sum	**Sum**	Sum
			160.2	**160.2**	65.5	73.8	20.1	0.7	0	0.1	**0**	0
Eucalyptus dives	35	10	TG		35							
Eucalyptus robertsonii	30	5	TG		30							
Eucalyptus viminalis	0.5	3	TG		0.5							
Choretrum pauciflorum	0.2	10	SG			0.2						
Coprosma hirtella	0.2	15	SG			0.2						
Daviesia latifolia	40	100	SG			40						
Daviesia ulicifolia	5	20	SG			5						
Exocarpos strictus	0.1	1	SG			0.1						
Grevillea arenaria subsp. canescens	10	50	SG			10						
Leucopogon virgatus	0.1	10	SG			0.1						
Lomatia myricoides	1	5	SG			1						
Monotoca scoparia	2	20	SG			2						
Persoonia chamaepeuce	5	50	SG			5						
Pimelea linifolia	0.1	2	SG			0.1						
Platylobium formosum	10	20	SG			10						
Tetratheca bauerifolia	0.1	10	SG			0.1						
Clematis aristata	0.1	1	OG							0.1		
Lomandra longifolia	0.1	10	GG				0.1					
Poa labillardierei	20	100	GG				20					
Caladenia gracilis	0.1	1	FG					0.1				
Chiloglottis valida	0.1	20	FG					0.1				
Dianella revoluta	0.2	25	FG					0.2				
Gonocarpus tetragynus	0.1	1	FG					0.1				
Stylidium graminifolium	0.2	20	FG					0.2				

			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Plot 39			**# spp**	**Count**	Count	Count	Count	Count	Count	Count	**Count**	Count
PCT 300			**37**	**37**	4	16	4	10	1	2	**0**	0
Species	**Cover**	**Abundance**	**Sum cover**	**Sum**	Sum	Sum	Sum	Sum	Sum	Sum	**Sum**	Sum
			109.9	**109.9**	81.1	6.8	20.4	1.1	0.2	0.3	**0**	0
Acacia dealbata	0.1	6	TG		0.1							
Acacia melanoxylon	1	3	TG		1							
Eucalyptus robertsonii	60	50	TG		60							
Eucalyptus viminalis	20	10	TG		20							
Bossiaea foliosa	0.2	15	SG			0.2						
Cassinia longifolia	2	10	SG			2						
Choretrum pauciflorum	0.3	10	SG			0.3						
Coprosma hirtella	0.3	5	SG			0.3						
Daviesia latifolia	0.1	1	SG			0.1						
Exocarpos strictus	0.3	5	SG			0.3						
Grevillea rosmarinifolia	1	10	SG			1						
Indigofera australis	0.2	5	SG			0.2						
Leucopogon fletcheri	0.3	10	SG			0.3						
Leucopogon lanceolatus	0.1	1	SG			0.1						
Mirbelia oxylobioides	0.5	10	SG			0.5						
Monotoca scoparia	0.3	1	SG			0.3						
Olearia erubescens	0.5	10	SG			0.5						
Pimelea linifolia	0.1	1	SG			0.1						
Platylobium formosum	0.5	1	SG			0.5						
Tetratheca bauerifolia	0.1	1	SG			0.1						
Glycine clandestina	0.1	10	OG							0.1		
Hardenbergia violacea	0.2	20	OG							0.2		
Lomandra filiformis	0.1	1	GG				0.1					
Lomandra longifolia	0.2	10	GG				0.2					
Microlaena stipoides	0.1	10	GG				0.1					
Poa labillardierei	20	50	GG				20					
Asperula scoparia	0.1	2	FG					0.1				
Dianella revoluta	0.1	2	FG					0.1				
Gonocarpus tetragynus	0.1	10	FG					0.1				
Hydrocotyle laxiflora	0.1	1	FG					0.1				
Plantago sp.	0.1	1	FG					0.1				
Ranunculus lappaceus	0.1	1	FG					0.1				
Senecio sp.	0.1	10	FG					0.1				
Stylidium graminifolium	0.1	1	FG					0.1				
Veronica derwentiana	0.2	5	FG					0.2				
Viola betonicifolia	0.1	20	FG					0.1				
Pteridium esculentum	0.2	10	EG						0.2			

			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Plot 40			**# spp**	**Count**	Count	Count	Count	Count	Count	Count	**Count**	Count
PCT 300			**38**	**36**	4	7	4	18	1	2	**2**	1
Species	**Cover**	**Abundance**	**Sum cover**	**Cover**	Sum	Sum	Sum	Sum	Sum	Sum	**Sum**	Sum
			115.5	**115.2**	48	29.3	10.4	19.1	8	0.4	**0.3**	0.2
Acacia dealbata	7	20	TG		7							
Acacia melanoxylon	1	3	TG		1							
Eucalyptus robertsonii	30	10	TG		30							
Eucalyptus viminalis	10	2	TG		10							
Bursaria spinosa	0.3	4	SG			0.3						
Cassinia aculeata	20	40	SG			20						
Cassinia longifolia	0.5	6	SG			0.5						
Choretrum sp.	0.1	1	SG			0.1						
Coprosma hirtella	8	25	SG			8						
Platylobium formosum	0.2	30	SG			0.2						
Rubus parvifolius	0.2	20	SG			0.2						
Clematis aristata	0.2	20	OG							0.2		
Glycine clandestina	0.2	60	OG							0.2		
Rubus fruticosus agg.	0.2	6	HT									0.2
Lomandra filiformis	0.1	8	GG				0.1					
Lomandra longifolia	0.1	4	GG				0.1					
Poa sieberiana	10	200	GG				10					
Poa sp.	0.2	20	GG				0.2					
Acaena novae-zelandiae	0.1	40	FG					0.1				
Arthropodium sp.	0.1	2	FG					0.1				
Asperula scoparia	0.8	200	FG					0.8				
Brunoniella australis	0.1	1	FG					0.1				
Cardamine paucijuga	0.1	2	FG					0.1				
Dianella tasmanica	0.1	4	FG					0.1				
Dichondra repens	0.3	80	FG					0.3				
Epilobium billardierianum	0.1	2	FG					0.1				
Euphrasia collina subsp. paludosa	0.1	3	FG					0.1				
Geranium obtusisepalum	0.3	100	FG					0.3				
Gonocarpus tetragynus	0.1	1	FG					0.1				
Picris angustifolia	0.1	2	FG					0.1				
Ranunculus lappaceus	0.1	10	FG					0.1				
Senecio gunnii	0.2	20	FG					0.2				
Senecio sp.	0.4	40	FG					0.4				
Stellaria pungens	4	300	FG					4				
Veronica derwentiana	12	80	FG					12				
Viola eminens	0.1	3	FG					0.1				
Cerastium vulgare	0.1	3	EX								0.1	
Pteridium esculentum	8	100	EG						8			

			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Plot 41			**# spp**	**Count**	Count	Count	Count	Count	Count	Count	**Count**	Count
PCT 300			**32**	**26**	3	4	4	12	2	1	**6**	1
Species	**Cover**	**Abundance**	**Sum cover**	**Sum**	Sum	Sum	Sum	Sum	Sum	Sum	**Sum**	Sum
			78.6	**7.9**	4.1	0.6	0.6	2.1	0.4	0.1	**70.7**	70
Acacia dealbata	0.1	2	TG		0.1							
Eucalyptus robertsonii	1	1	TG		1							
Eucalyptus viminalis	3	2	TG		3							
Cassinia aculeata	0.3	7	SG			0.3						
Coprosma sp.	0.1	4	SG			0.1						
Olearia erubescens	0.1	1	SG			0.1						
Rubus parvifolius	0.1	7	SG			0.1						
Glycine clandestina	0.1	1	OG							0.1		
Rubus fruticosus agg.	70	100	HT									70
Carex gaudichaudiana	0.3	20	GG				0.3					
Echinopogon ovatus	0.1	1	GG				0.1					
Luzula flaccida	0.1	20	GG				0.1					
Poa sieberiana	0.1	10	GG				0.1					
Ajuga australis	0.2	60	FG					0.2				
Dianella tasmanica	0.1	10	FG					0.1				
Epilobium billardierianum	0.2	200	FG					0.2				
Euchiton sphaericus	0.1	20	FG					0.1				
Geranium obtusisepalum	0.1	1	FG					0.1				
Gratiola peruviana	0.2	40	FG					0.2				
Hydrocotyle laxiflora	0.5	400	FG					0.5				
Hypericum japonicum	0.2	20	FG					0.2				
Mentha laxiflora	0.1	20	FG					0.1				
Ranunculus pimpinellifolius	0.1	1	FG					0.1				
Ranunculus pumilio	0.2	120	FG					0.2				
Rumex brownii	0.1	1	FG					0.1				
Cardamine hirsuta	0.1	20	EX								0.1	
Cerastium glomeratum	0.1	10	EX								0.1	
Cirsium vulgare	0.2	20	EX								0.2	
Taraxacum officinale	0.1	10	EX								0.1	
Trifolium repens	0.2	20	EX								0.2	
Polystichum proliferum	0.3	13	EG						0.3			
Pteridium esculentum	0.1	2	EG						0.1			

			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Plot 42			**# spp**	**Count**	Count	Count	Count	Count	Count	Count	**Count**	Count
PCT 300			**23**	**22**	2	10	2	5	1	2	**1**	0
Species	**Cover**	**Abundance**	**Sum cover**	**Sum**	Sum	Sum	Sum	Sum	Sum	Sum	**Sum**	Sum
			129.1	**129**	50	26.7	33	7.2	10	2.1	**0.1**	0
Acacia pravissima	0.2	5	SG			0.2						
Acaena novae-zelandiae	0.1	5	FG					0.1				
Arthropodium milleflorum	2	310	FG					2				
Cassinia aculeata	10	60	SG			10						
Cassinia longifolia	8	50	SG			8						
Centaurium erythraea	0.1	50	EX								0.1	
Clematis aristata	0.1	30	OG							0.1		
Coprosma hirtella	1	25	SG			1						
Dichondra repens	2	500	FG					2				
Dodonaea viscosa	2	170	SG			2						
Eucalyptus robertsonii	45	28	TG		45							
Exocarpos strictus	0.2	10	SG			0.2						
Glycine clandestina	2	170	OG							2		
Lomandra longifolia	3	55	GG				3					
Lomatia myricoides	0.1	18	SG			0.1						
Persoonia chamaepeuce	0.1	50	SG			0.1						
Pimelea sp.	0.1	25	SG			0.1						
Platylobium formosum	5	120	SG			5						
Poa sieberiana	30	800	GG				30					
Pteridium esculentum	10	250	EG						10			
Ranunculus sp.	0.1	2	FG					0.1				
Stellaria pungens	3	500	FG					3				
Eucalyptus viminalis	5	1	TG		5							

			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Plot 43			**# spp**	**Count**	Count	Count	Count	Count	Count	Count	**Count**	Count
PCT 302			**12**	**4**	0	1	1	1	1	0	**8**	3
Species	**Cover**	**Abundance**	**Sum cover**	**Sum**	Sum	Sum	Sum	Sum	Sum	Sum	**Sum**	Sum
			96.3	**94.6**	0	0.5	90	0.1	4	0	**1.7**	1.2
Poa helmsii	90	1000	GG				90					
Pteridium esculentum	4	250	EG						4			
Hypericum perforatum	1	100	HT									1
Cirsium vulgare	0.1	20	EX								0.1	
Geranium solanderi	0.1	25	FG					0.1				
Rubus fruticosus agg.	0.1	5	HT									0.1
Centaurium erythraea	0.1	25	EX								0.1	
Conyza bonariensis	0.1	5	EX								0.1	
Medicago polymorpha	0.1	20	EX								0.1	
Leptospermum lanigerum	0.5	1	SG			0.5						
Hypericum androsaemum	0.1	1	EX								0.1	
Rosa rubiginosa	0.1	1	HT									0.1

			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Plot 44			**# spp**	**Count**	Count	Count	Count	Count	Count	Count	**Count**	Count
PCT 302			**25**	**18**	2	6	7	2	1	0	**7**	4
Species	**Cover**	**Abundance**	**Sum cover**	**Sum**	Sum	Sum	Sum	Sum	Sum	Sum	**Sum**	Sum
			122.2	**88.8**	65	9	14.5	0.2	0.1	0	**33.4**	32.2
Eucalyptus viminalis	50	45	TG		50							
Themeda triandra	2	50	GG				2					
Microlaena stipoides	2	150	GG				2					
Acacia melanoxylon	15	50	TG		15							
Acetosella vulgaris	0.1	25	HT									0.1
Centaurium erythraea	0.1	150	EX								0.1	
Hypericum perforatum	2	250	HT									2
Rubus fruticosus agg.	30	50	HT									30
Calytrix tetragona	5	100	SG			5						
Exocarpos strictus	3	20	SG			3						
Cheilanthes sieberi	0.1	1	EG						0.1			
Aira sp.	1	500	EX								1	
Vulpia sp.	0.1	100	EX								0.1	
Rosa rubiginosa	0.1	5	HT									0.1
Carex appressa	0.2	5	GG				0.2					
Oxalis perennans	0.1	25	FG					0.1				
Hydrocotyle laxiflora	0.1	1	FG					0.1				
Brachyloma daphnoides	0.2	15	SG			0.2						
Cassinia aculeata	0.2	5	SG			0.2						
Cassinia longifolia	0.5	500	SG			0.5						
Rytidosperma racemosum	5	250	GG				5					
Carex inversa	0.1	50	GG				0.1					
Acacia pravissima	0.1	1	SG			0.1						
Elymus scaber	5	500	GG				5					
Poa helmsii	0.2	1	GG				0.2					

			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Plot 45			**# spp**	**Count**	Count	Count	Count	Count	Count	Count	**Count**	Count
PCT 302			**41**	**31**	5	7	6	8	3	2	**10**	4
Species	**Cover**	**Abundance**	**Sum cover**	**Sum**	Sum	Sum	Sum	Sum	Sum	Sum	**Sum**	Sum
			182.1	**173**	101	13.2	57.3	0.8	0.5	0.2	**9.1**	8.4
Eucalyptus viminalis	45	11	TG		45							
Eucalyptus stellulata	1	7	TG		1							
Eucalyptus robertsonii	3	1	TG		3							
Acacia melanoxylon	50	100	TG		50							
Poa helmsii	40	500	GG				40					
Austrostipa sp.	1	200	GG				1					
Sporobolus sp.	15	1000	GG				15					
Banksia canei	3	3	SG			3						
Exocarpos strictus	2	10	SG			2						
Rubus fruticosus agg.	3	30	HT									3
Rosa rubiginosa	0.2	10	HT									0.2
Pomaderris aspera	5	30	SG			5						
Hypochaeris radicata	0.2	250	EX								0.2	
Bursaria spinosa	1	20	SG			1						
Cassinia aculeata	2	15	SG			2						
Acacia dealbata	2	20	TG		2							
Hypericum perforatum	0.2	50	HT									0.2
Holcus lanatus	5	250	HT									5
Aira sp.	0.1	25	EX								0.1	
Centaurium erythraea	0.1	50	EX								0.1	
Geranium sp.	0.1	5	FG					0.1				
Glycine clandestina	0.1	25	OG							0.1		
Poranthera microphylla	0.1	25	FG					0.1				
Oxalis perennans	0.1	20	FG					0.1				
Pteridium esculentum	0.2	20	EG						0.2			
Carex fascicularis	1	50	GG				1					
Juncus sp.	0.2	5	GG				0.2					
Prunella vulgaris	0.1	50	EX								0.1	
Blechnum minus	0.1	1	EG						0.1			
Eryanthe moschatus	0.1	50	EX								0.1	
Euchiton involucratus	0.1	50	FG					0.1				
Cirsium vulgare	0.1	2	EX								0.1	
Senecio quadridentatus	0.1	5	FG					0.1				
Epilobium billardierianum	0.1	5	FG					0.1				
Microlaena stipoides	0.1	30	GG				0.1					
Blechnum wattsii	0.2	15	EG						0.2			
Gynatrix pulchella	0.1	1	SG			0.1						
Pimelea linifolia	0.1	1	SG			0.1						
Wahlenbergia sp.	0.1	1	FG					0.1				
Rumex brownii	0.1	5	FG					0.1				
Clematis aristata	0.1	5	OG							0.1		
Chrysocephalum semipapposum	0.1	1	FG					0.1				
Hemarthria uncinata	5	200	GG				5					
Carex appressa	0.1	1	GG				0.1					

			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Plot 48			**# spp**	**Count**	Count	Count	Count	Count	Count	Count	**Count**	Count
PCT 302			**31**	**20**	2	3	6	7	1	1	**11**	3
Species	**Cover**	**Abundance**	**Sum cover**	**Sum**	Sum	Sum	Sum	Sum	Sum	Sum	**Sum**	Sum
			43.2	**10.1**	5	3.6	0.6	0.7	0.1	0.1	**33.1**	30.4
Eucalyptus camphora	2	10	TG		2							
Eucalyptus viminalis	3	10	TG		3							
Acacia pravissima	3	20	SG			3						
Cassinia aculeata	0.5	4	SG			0.5						
Rhytidosporum sp.	0.1	2	SG			0.1						
Clematis aristata	0.1	2	OG							0.1		
Hypericum perforatum	0.3	200	HT									0.3
Rosa rubiginosa	0.1	2	HT									0.1
Rubus fruticosus agg.	30	150	HT									30
Carex appressa	0.1	2	GG				0.1					
Carex inversa	0.1	6	GG				0.1					
Echinopogon ovatus	0.1	2	GG				0.1					
Microlaena stipoides	0.1	10	GG				0.1					
Poa labillardierei	0.1	2	GG				0.1					
Poa sp.	0.1	1	GG				0.1					
Acaena novae-zelandiae	0.1	20	FG					0.1				
Galium gaudichaudii	0.1	2	FG					0.1				
Geranium obtusisepalum	0.1	1	FG					0.1				
Hydrocotyle laxiflora	0.1	100	FG					0.1				
Myosotis australis	0.1	20	FG					0.1				
Oxalis exilis	0.1	1	FG					0.1				
Rumex brownii	0.1	3	FG					0.1				
Briza maxima	0.1	1	EX								0.1	
Centaurium erythraea	0.1	20	EX								0.1	
Cirsium vulgare	0.1	2	EX								0.1	
Conyza sp.	0.1	1	EX								0.1	
Medicago sp.	0.1	2	EX								0.1	
Prunus cerasus	2	13	EX								2	
Salvia verbenaca	0.1	1	EX								0.1	
Taraxacum officinale	0.1	1	EX								0.1	
Pteridium esculentum	0.1	2	EG						0.1			

			Covers	**Native**	Trees	Shrubs	Grass	Forb	Fern	Other	**Exotic**	HighThreat
Plot 49			**# spp**	**Count**	Count	Count	Count	Count	Count	Count	**Count**	Count
PCT 729			**34**	**24**	0	7	8	7	0	2	**10**	4
Species	**Cover**	**Abundance**	**Sum cover**	**Sum**	Sum	Sum	Sum	Sum	Sum	Sum	**Sum**	Sum
			139.4	**98.1**	0	21.4	75.7	0.8	0	0.2	**41.3**	40.7
Themeda triandra	75	1000	GG				75					
Rubus fruticosus agg.	40	200	HT									40
Centaurium erythraea	0.1	100	EX								0.1	
Dillwynia sericea	0.1	5	SG			0.1						
Aira sp.	0.1	200	EX								0.1	
Euchiton involucratus	0.1	5	FG					0.1				
Carex inversa	0.1	150	GG				0.1					
Hypochaeris radicata	0.1	35	EX								0.1	
Hypericum perforatum	0.5	60	HT									0.5
vulpia sp.	0.1	100	EX								0.1	
Gonocarpus tetragynus	0.1	50	FG					0.1				
Rytidosperma sp.	0.1	50	GG				0.1					
Acacia pravissima	20	350	SG			20						
Oxalis sp.	0.1	5	FG					0.1				
Microlaena stipoides	0.1	5	GG				0.1					
Rytidosperma pilosum	0.1	30	GG				0.1					
Verbascum virgatum	0.1	1	EX								0.1	
Acaena ovina	0.1	5	FG					0.1				
Lomandra filiformis subsp. coriacea	0.1	1	GG				0.1					
Acetosella vulgaris	0.1	35	HT									0.1
Exocarpos strictus	0.5	50	SG			0.5						
Scleranthus fasciculatus	0.1	2	FG					0.1				
Brachyloma daphnoides	0.1	3	SG			0.1						
Astroloma humifusum	0.1	1	SG			0.1						
Petrorhagia dubia	0.1	2	EX								0.1	
Lomandra filiformis	0.1	1	GG				0.1					
Rosa rubiginosa	0.1	1	HT									0.1
Desmodium varians	0.1	1	OG							0.1		
Bossiaea foliosa	0.1	5	SG			0.1						
Calytrix tetragona	0.5	20	SG			0.5						
Coronidium monticola	0.2	5	FG					0.2				
Hypericum gramineum	0.1	5	FG					0.1				
Schoenus apogon	0.1	35	GG				0.1					
Convolvulus erubescens	0.1	1	OG							0.1		

			Covers	**Native**	Trees	Shrubs	Grass	Forb	Fern	Other	**Exotic**	HighThreat
Plot 50			**# spp**	**Count**	Count	Count	Count	Count	Count	Count	**Count**	Count
PCT 729			**27**	**17**	1	1	7	7	1	0	**10**	4
Species	**Cover**	**Abundance**	**Sum cover**	**Sum**	Sum	Sum	Sum	Sum	Sum	Sum	**Sum**	Sum
			100	**78.1**	1.5	0.2	75.6	0.7	0.1	0	**21.9**	21.2
Themeda triandra	20	250	GG				20					
Microlaena stipoides	5	500	GG				5					
Panicum effusum	50	1000	GG				50					
Rubus fruticosus agg.	20	25	HT									20
Centaurium erythraea	0.1	100	EX								0.1	
Hypericum perforatum	1	100	HT									1
Juncus australis	0.2	10	GG				0.2					
Verbascum virgatum	0.1	5	EX								0.1	
Acacia dealbata	1.5	25	TG		1.5							
Persicaria prostrata	0.1	25	FG					0.1				
Modiola caroliniana	0.1	5	EX								0.1	
Wahlenbergia gracilis	0.1	5	FG					0.1				
Dysphania pumilio	0.1	5	FG					0.1				
Vulpia myuros	0.2	150	EX								0.2	
Exocarpos strictus	0.2	5	SG			0.2						
Rytidosperma caespitosum	0.1	100	GG				0.1					
Rytidosperma racemosum	0.2	50	GG				0.2					
Rosa rubiginosa	0.1	5	HT									0.1
Cheilanthes sieberi	0.1	50	EG						0.1			
Solenogyne gunnii	0.1	25	FG					0.1				
Rumex brownii	0.1	2	FG					0.1				
Aira elegantissima	0.1	50	EX								0.1	
Carex inversa	0.1	25	GG				0.1					
Senecio prenanthoides	0.1	5	FG					0.1				
Acetosella vulgaris	0.1	50	HT									0.1
Oxalis perennans	0.1	20	FG					0.1				
Trifolium arvense	0.1	15	EX								0.1	

			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Plot 51			**# spp**	**Count**	Count	Count	Count	Count	Count	Count	**Count**	Count
PCT 729			**19**	**14**	1	2	6	4	0	1	**5**	2
Species	**Cover**	**Abundance**	**Sum cover**	**Sum**	Sum	Sum	Sum	Sum	Sum	Sum	**Sum**	Sum
			102.1	**101.6**	0.1	0.2	100.4	0.7	0	0.2	**0.5**	0.2
Themeda triandra	90	1000	GG				90					
Hypericum perforatum	0.1	20	HT									0.1
Dichondra repens	0.3	200	FG					0.3				
Rubus fruticosus agg.	0.1	1	HT									0.1
Centaurium erythraea	0.1	10	EX								0.1	
Hypochaeris radicata	0.1	10	EX								0.1	
Calytrix tetragona	0.1	1	SG			0.1						
Elymus scaber	0.1	10	GG				0.1					
Austrostipa sp.	0.1	10	GG				0.1					
Brachyloma daphnoides	0.1	3	SG			0.1						
Rytidosperma pilosum	0.1	10	GG				0.1					
Hydrocotyle laxiflora	0.2	20	FG					0.2				
Gonocarpus tetragynus	0.1	20	FG					0.1				
Acacia dealbata	0.1	1	TG		0.1							
Desmodium varians	0.2	50	OG							0.2		
Microlaena stipoides	10	500	GG				10					
Anagallis arvensis	0.1	1	EX								0.1	
Oxalis perennans	0.1	1	FG					0.1				
Juncus sp.	0.1	1	GG				0.1					

			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Plot 52			**# spp**	**Count**	Count	Count	Count	Count	Count	Count	**Count**	Count
PCT 729			**26**	**21**	2	5	6	6	1	1	**5**	2
Species	**Cover**	**Abundance**	**Sum cover**	**Sum**	Sum	Sum	Sum	Sum	Sum	Sum	**Sum**	Sum
			112.1	**111.1**	5	100.8	4.4	0.7	0.1	0.1	**1**	0.7
Calytrix tetragona	75	1000	SG			75						
Brachyloma daphnoides	25	250	SG			25						
Pimelea curviflora	0.5	200	SG			0.5						
Centaurium erythraea	0.1	50	EX								0.1	
Hypericum perforatum	0.5	200	HT									0.5
Petrorhagia dubia	0.1	1	EX								0.1	
Carex inversa	0.1	25	GG				0.1					
Plantago varia	0.1	25	FG					0.1				
Eucalyptus dives	2	1	TG		2							
Eucalyptus rubida	3	1	TG		3							
Acaena ovina	0.1	1	FG					0.1				
Bursaria spinosa	0.2	2	SG			0.2						
Cassytha glabella	0.1	25	OG							0.1		
Senecio linearifolius	0.1	1	FG					0.1				
Lomandra filiformis subsp. coriacea	0.1	5	GG				0.1					
Rytidosperma pilosum	1	200	GG				1					
Microlaena stipoides	0.1	5	GG				0.1					
Wahlenbergia stricta	0.1	1	FG					0.1				
Themeda triandra	3	250	GG				3					
Aira elegantissima	0.1	15	EX								0.1	
Hydrocotyle laxiflora	0.1	15	FG					0.1				
Cheilanthes sp.	0.1	1	EG						0.1			
Dichelachne sp.	0.1	1	GG				0.1					
Gonocarpus tetragynus	0.2	35	FG					0.2				
Rubus fruticosus agg.	0.2	5	HT									0.2
Leucopogon fletcheri	0.1	1	SG			0.1						

			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Plot 53			**# spp**	**Count**	Count	Count	Count	Count	Count	Count	**Count**	Count
PCT 729			**20**	**16**	1	4	5	6	0	0	**4**	3
Species	**Cover**	**Abundance**	**Sum cover**	**Sum**	Sum	Sum	Sum	Sum	Sum	Sum	**Sum**	Sum
			155	**149.7**	0.1	145.6	2.4	1.6	0	0	**5.3**	0.3
Themeda triandra	0.1	1	GG				0.1					
Calytrix tetragona	65	500	SG			65						
Bursaria spinosa	80	1000	SG			80						
Centaurium erythraea	5	100	EX								5	
Hypericum perforatum	0.1	100	HT									0.1
Oxalis sp.	0.2	50	FG					0.2				
Gonocarpus tetragynus	0.1	5	FG					0.1				
Rubus fruticosus agg.	0.1	50	HT									0.1
Acacia dealbata	0.1	1	TG		0.1							
Acaena ovina	1	50	FG					1				
Acetosella vulgaris	0.1	1	HT									0.1
Pimelea curviflora	0.5	500	SG			0.5						
Lomandra filiformis subsp. coriacea	0.1	5	GG				0.1					
Stackhousia monogyna	0.1	5	FG					0.1				
Hydrocotyle laxiflora	0.1	20	FG					0.1				
Brachyloma daphnoides	0.1	50	SG			0.1						
Juncus sp.	2	100	GG				2					
Euchiton involucratus	0.1	5	FG					0.1				
Rytidosperma racemosum	0.1	1	GG				0.1					
Austrostipa sp.	0.1	5	GG				0.1					

			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Plot 54			**# spp**	**Count**	Count	Count	Count	Count	Count	Count	**Count**	Count
PCT 729			**16**	**14**	3	5	0	5	1	0	**2**	0
Species	**Cover**	**Abundance**	**Sum cover**	**Sum**	Sum	Sum	Sum	Sum	Sum	Sum	**Sum**	Sum
			132.2	**132**	11.1	120.3	0	0.5	0.1	0	**0.2**	0
Callitris endlicheri	1	4	TG		1							
Eucalyptus dives	0.1	3	TG		0.1							
Eucalyptus rubida	10	3	TG		10							
Brachyloma daphnoides	40	200	SG			40						
Bursaria spinosa	0.2	1	SG			0.2						
Calytrix tetragona	60	400	SG			60						
Dillwynia phylicoides	20	50	SG			20						
Rhytidosporum sp.	0.1	1	SG			0.1						
Caladenia congesta	0.1	2	FG					0.1				
Gonocarpus tetragynus	0.1	10	FG					0.1				
Hypericum gramineum	0.1	10	FG					0.1				
Stylidium graminifolium	0.1	10	FG					0.1				
Wahlenbergia stricta	0.1	10	FG					0.1				
Aira sp.	0.1	20	EX								0.1	
Centaurium erythraea	0.1	10	EX								0.1	
Cheilanthes sieberi	0.1	10	EG						0.1			

			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Plot 55			**# spp**	**Count**	Count	Count	Count	Count	Count	Count	**Count**	Count
PCT 729			**22**	**20**	3	8	2	5	0	2	**2**	1
Species	**Cover**	**Abundance**	**Sum cover**	**Sum**	Sum	Sum	Sum	Sum	Sum	Sum	**Sum**	Sum
			98	**97.8**	15.1	81.6	0.2	0.7	0	0.2	**0.2**	0.1
Acacia dealbata	0.1	1	TG		0.1							
Eucalyptus mannifera	10	2	TG		10							
Eucalyptus rubida	5	2	TG		5							
Acacia pravissima	0.2	1	SG			0.2						
Brachyloma daphnoides	0.2	20	SG			0.2						
Bursaria spinosa	0.3	3	SG			0.3						
Calytrix tetragona	80	1000	SG			80						
Cassinia longifolia	0.2	6	SG			0.2						
Dillwynia rudis	0.5	20	SG			0.5						
Leucopogon sp.	0.1	5	SG			0.1						
Rhytidosporum sp.	0.1	10	SG			0.1						
Cassytha sp.	0.1	10	OG							0.1		
Hardenbergia violacea	0.1	1	OG							0.1		
Hypericum perforatum	0.1	20	HT									0.1
Lomandra glauca	0.1	1	GG				0.1					
Poa sieberiana	0.1	10	GG				0.1					
Diuris sulphurea	0.2	20	FG					0.2				
Geranium solanderi	0.1	1	FG					0.1				
Gonocarpus tetragynus	0.2	30	FG					0.2				
Patersonia sp.	0.1	1	FG					0.1				
Wahlenbergia sp.	0.1	1	FG					0.1				
Hypochaeris radicata	0.1	1	EX								0.1	

			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Plot 56			**# spp**	**Count**	Count	Count	Count	Count	Count	Count	**Count**	Count
PCT 729			**37**	**36**	2	16	5	12	0	1	**1**	0
Species	**Cover**	**Abundance**	**Sum cover**	**Sum**	Sum	Sum	Sum	Sum	Sum	Sum	**Sum**	Sum
			98.9	**98.8**	22.5	7.6	67.3	1.3	0	0.1	**0.1**	0
Eucalyptus dives	18	22	TG		18							
Eucalyptus rubida	4.5	4	TG		4.5							
Senecio sp.	0.1	10	FG					0.1				
Poa sieberiana	1	50	GG				1					
Banksia canei	2	2	SG			2						
Themeda triandra	65	500	GG				65					
Desmodium sp.	0.1	10	FG					0.1				
Persoonia chamaepeuce	0.1	5	SG			0.1						
Hibbertia obtusifolia	0.5	15	SG			0.5						
Euchiton involucratus	0.1	1	FG					0.1				
Galium gaudichaudii	0.1	15	FG					0.1				
Rytidosperma pilosum	0.2	50	GG				0.2					
Cassinia longifolia	1	25	SG			1						
Bursaria spinosa	0.2	5	SG			0.2						
Brachyloma daphnoides	2	100	SG			2						
Indigofera australis	0.2	50	SG			0.2						
Lepidosperma laterale	1	100	GG				1					
Acaena ovina	0.1	15	FG					0.1				
Dianella revoluta	0.2	50	FG					0.2				
Grevillea rosmarinifolia	0.1	2	SG			0.1						
Gonocarpus tetragynus	0.1	50	FG					0.1				
Senecio pinnatifolius	0.1	50	FG					0.1				
Geranium Sp.	0.1	25	FG					0.1				
Stylidium graminifolium	0.1	50	FG					0.1				
Cassytha glabella	0.1	5	OG							0.1		
Pimelea linifolia	0.1	1	SG			0.1						
Pimelea curviflora	0.1	50	SG			0.1						
Leucopogon virgatus	0.5	50	SG			0.5						
Tetratheca bauerifolia	0.2	3	SG			0.2						
Melichrus urceolatus	0.1	5	SG			0.1						
Lomandra longifolia	0.1	5	GG				0.1					
Hypericum gramineum	0.1	25	FG					0.1				
Mirbelia oxylobioides	0.1	5	SG			0.1						
Centaurium erythraea	0.1	25	EX								0.1	
Astroloma humifusum	0.2	5	SG			0.2						
Acacia pravissima	0.2	3	SG			0.2						
Wahlenbergia stricta	0.1	5	FG					0.1				

			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Plot 57			**# spp**	**Count**	Count	Count	Count	Count	Count	Count	**Count**	Count
PCT 729			**25**	**22**	2	11	2	6	0	1	**3**	1
Species	**Cover**	**Abundance**	**Sum cover**	**Sum**	Sum	Sum	Sum	Sum	Sum	Sum	**Sum**	Sum
			54.75	**54.45**	10.15	43.2	0.3	0.7	0	0.1	**0.3**	0.1
Eucalyptus dives	0.15	22	TG		0.15							
Eucalyptus rubida	10	10	TG		10							
Calytrix tetragona	40	500	SG			40						
Hypericum gramineum	0.1	2	FG					0.1				
Brachyloma daphnoides	1	30	SG			1						
Acacia pravissima	0.5	0.5	SG			0.5						
Astroloma humifusum	0.1	2	SG			0.1						
Melichrus urceolatus	0.1	2	SG			0.1						
Dillwynia sp.	0.1	10	SG			0.1						
Leucopogon virgatus	0.2	15	SG			0.2						
Hardenbergia violacea	0.1	5	OG							0.1		
Hibbertia obtusifolia	0.1	15	SG			0.1						
Hypericum perforatum	0.1	20	HT									0.1
Cassinia longifolia	0.1	1	SG			0.1						
Banksia canei	0.5	1	SG			0.5						
Lomandra filiformis	0.2	50	GG				0.2					
Gonocarpus tetragynus	0.1	50	FG					0.1				
Rytidosperma pilosum	0.1	15	GG				0.1					
Senecio quadridentatus	0.1	1	FG					0.1				
Centaurium erythraea	0.1	5	EX								0.1	
Hovea linearis	0.1	5	FG					0.1				
Senecio pinnatifolius	0.2	200	FG					0.2				
Geranium Sp.	0.1	15	FG					0.1				
Mirbelia oxylobioides	0.5	10	SG			0.5						
Aira elegantissima	0.1	10	EX								0.1	

			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Plot 58			**# spp**	**Count**	Count	Count	Count	Count	Count	Count	**Count**	Count
PCT 729			**24**	**21**	3	8	4	5	1	0	**3**	1
Species	**Cover**	**Abundance**	**Sum cover**	**Sum**	Sum	Sum	Sum	Sum	Sum	Sum	**Sum**	Sum
			79	**78.7**	25	52.1	0.9	0.6	0.1	0	**0.3**	0.1
Eucalyptus dives	13	22	TG		13							
Eucalyptus rubida	2	7	TG		2							
Wahlenbergia stricta	0.1	5	FG					0.1				
Grevillea lanigera	0.5	5	SG			0.5						
Eucalyptus viminalis	10	22	TG		10							
Exocarpos strictus	0.5	20	SG			0.5						
Calytrix tetragona	35	200	SG			35						
Hypericum perforatum	0.1	25	HT									0.1
Cheilanthes sieberi	0.1	1	EG						0.1			
Brachyloma daphnoides	5	50	SG			5						
Lomandra filiformis	0.1	15	GG				0.1					
Centaurium erythraea	0.1	5	EX								0.1	
Euchiton involucratus	0.1	5	FG					0.1				
Aira caryophyllea	0.1	25	EX								0.1	
Carex inversa	0.1	10	GG				0.1					
Banksia canei	5	10	SG			5						
Bursaria spinosa	5	100	SG			5						
Rytidosperma racemosum	0.2	50	GG				0.2					
Stackhousia monogyna	0.1	25	FG					0.1				
Lomandra longifolia	0.5	15	GG				0.5					
Acacia pravissima	1	10	SG			1						
Senecio prenanthoides	0.1	25	FG					0.1				
Geranium Sp.	0.2	3	FG					0.2				
Acacia siculiformis	0.1	1	SG			0.1						

			Covers	**Native**	Trees	Shrubs	Grass	Forb	Fern	Other	**Exotic**	HighThreat
Plot 59			**# spp**	**Count**	Count	Count	Count	Count	Count	Count	**Count**	Count
PCT 729			**24**	**24**	2	15	3	4	0	0	**0**	0
Species	**Cover**	**Abundance**	**Sum cover**	**Sum**	Sum	Sum	Sum	Sum	Sum	Sum	**Sum**	Sum
			62.4	**62.4**	15	24	23	0.4	0	0	**0**	0
Bossiaea sp.	5	45	SG			5						
Brachyloma daphnoides	0.5	9	SG			0.5						
Cassinia longifolia	1	4	SG			1						
Coprosma hirtella	0.1	2	SG			0.1						
Daviesia latifolia	12	75	SG			12						
Diuris sp.	0.1	1	FG					0.1				
Eucalyptus dives	10	18	TG		10							
Eucalyptus mannifera	5	3	TG		5							
Exocarpos strictus	0.1	1	SG			0.1						
Grevillea rosmarinifolia	1	85	SG			1						
Hibbertia obtusifolia	0.1	3	SG			0.1						
Indigofera australis	0.1	2	SG			0.1						
Leptomeria drupacea	0.5	6	SG			0.5						
Leucopogon fletcheri	0.5	5	SG			0.5						
Monotoca scoparia	2	15	SG			2						
Persoonia chamaepeuce	0.8	40	SG			0.8						
Pimelea sp.	0.2	30	SG			0.2						
Platylobium formosum	0.1	14	SG			0.1						
Poa sp.	1	30	GG				1					
Poa sieberiana	20	500	GG				20					
Stylidium graminifolium	0.1	12	FG					0.1				
Themeda triandra	2	30	GG				2					
Viola sp.	0.1	2	FG					0.1				
Wahlenbergia sp.	0.1	3	FG					0.1				

			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Plot 60			**# spp**	**Count**	Count	Count	Count	Count	Count	Count	**Count**	Count
PCT 729			**37**	**35**	3	15	3	12	0	2	**2**	0
Species	**Cover**	**Abundance**	**Sum cover**	**Sum**	Sum	Sum	Sum	Sum	Sum	Sum	**Sum**	Sum
			211.6	**211.3**	55.1	133.9	20.5	1.4	0	0.4	**0.3**	0
Eucalyptus dives	30	10	TG		30							
Eucalyptus robertsonii	0.1	1	TG		0.1							
Eucalyptus rubida	25	4	TG		25							
Astroloma humifusum	0.1	1	SG			0.1						
Banksia canei	45	5	SG			45						
Brachyloma daphnoides	20	50	SG			20						
Bursaria spinosa	2	5	SG			2						
Cassinia longifolia	20	50	SG			20						
Dillwynia phylicoides	0.1	2	SG			0.1						
Exocarpos strictus	0.1	1	SG			0.1						
Gompholobium huegelii	0.3	20	SG			0.3						
Hibbertia obtusifolia	0.2	20	SG			0.2						
Indigofera australis	0.2	10	SG			0.2						
Leucopogon virgatus	0.4	20	SG			0.4						
Mirbelia oxylobioides	45	50	SG			45						
Pimelea curviflora	0.1	10	SG			0.1						
Rhytidosporum sp.	0.3	50	SG			0.3						
Tetratheca bauerifolia	0.1	10	SG			0.1						
Cassytha glabella	0.3	10	OG							0.3		
Glycine clandestina	0.1	10	OG							0.1		
Lepidosperma cf. laterale	0.2	210	GG				0.2					
Microlaena stipoides	0.3	50	GG				0.3					
Poa sp.	20	100	GG				20					
Asperula scoparia	0.1	20	FG					0.1				
Dianella revoluta	0.3	40	FG					0.3				
Diuris sulphurea	0.1	1	FG					0.1				
Geranium obtusisepalum	0.1	2	FG					0.1				
Gonocarpus sp.	0.1	1	FG					0.1				
Gonocarpus tetragynus	0.1	10	FG					0.1				
Hovea heterophylla	0.1	10	FG					0.1				
Hydrocotyle laxiflora	0.1	20	FG					0.1				
Hypericum gramineum	0.1	20	FG					0.1				
Ranunculus lappaceus	0.1	1	FG					0.1				
Senecio quadridentatus	0.1	1	FG					0.1				
Wahlenbergia sp.	0.1	10	FG					0.1				
Aira sp.	0.2	80	EX								0.2	
Centaurium erythraea	0.1	1	EX								0.1	

			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Plot 61			**# spp**	**Count**	Count	Count	Count	Count	Count	Count	**Count**	Count
PCT 729			**42**	**41**	2	16	4	17	0	2	**1**	0
Species	**Cover**	**Abundance**	**Sum cover**	**Sum**	Sum	Sum	Sum	Sum	Sum	Sum	**Sum**	Sum
			163.9	**163.8**	60	57.6	44.1	1.9	0	0.2	**0.1**	0
Eucalyptus dives	55		TG		55							
Eucalyptus rubida	5	1	TG		5							
Bossiaea foliosa	20	100	SG			20						
Brachyloma daphnoides	0.1	1	SG			0.1						
Bursaria spinosa	2	2	SG			2						
Cassinia longifolia	5	10	SG			5						
Chorizema parviflorum	0.1	1	SG			0.1						
Coprosma hirtella	20	30	SG			20						
Daviesia latifolia	2	10	SG			2						
Exocarpos strictus	0.1	1	SG			0.1						
Grevillea rosmarinifolia	2	20	SG			2						
Hibbertia obtusifolia	0.1	10	SG			0.1						
Leucopogon fletcheri	0.1	2	SG			0.1						
Mirbelia oxylobioides	0.5	10	SG			0.5						
Persoonia chamaepeuce	5	50	SG			5						
Pimelea linifolia	0.2	30	SG			0.2						
Platylobium formosum	0.3	10	SG			0.3						
Tetratheca bauerifolia	0.1	1	SG			0.1						
Glycine clandestina	0.1	10	OG							0.1		
Hardenbergia violacea	0.1	5	OG							0.1		
Lomandra filiformis	0.1	10	GG				0.1					
Lomandra longifolia	2	30	GG				2					
Poa labillardierei	40	200	GG				40					
Themeda triandra	2	50	GG				2					
Asperula scoparia	0.1	1	FG					0.1				
Brachyscome scapigera	0.1	2	FG					0.1				
Chrysocephalum apiculatum	0.1	1	FG					0.1				
Dianella revoluta	0.2	20	FG					0.2				
Diuris pardina	0.1	1	FG					0.1				
Geranium obtusisepalum	0.1	10	FG					0.1				
Gonocarpus tetragynus	0.1	20	FG					0.1				
Hydrocotyle laxiflora	0.1	10	FG					0.1				
Hypericum gramineum	0.1	10	FG					0.1				
Ranunculus lappaceus	0.1	10	FG					0.1				
Senecio sp.	0.1	10	FG					0.1				
Stackhousia monogyna	0.1	10	FG					0.1				
Stellaria pungens	0.2	50	FG					0.2				
Stylidium graminifolium	0.1	2	FG					0.1				
Thelymitra sp.	0.1	1	FG					0.1				
Veronica derwentiana	0.1	10	FG					0.1				
Viola betonicifolia	0.1	10	FG					0.1				
Centaurium erythraea	0.1	1	EX								0.1	

			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Plot 62			**# spp**	**Count**	Count	Count	Count	Count	Count	Count	**Count**	Count
PCT 729			**44**	**43**	2	16	7	16	1	1	**1**	0
Species	**Cover**	**Abundance**	**Sum cover**	**Sum**	Sum	Sum	Sum	Sum	Sum	Sum	**Sum**	Sum
			79.3	**79.2**	30	21.5	25.7	1.8	0.1	0.1	**0.1**	0
Eucalyptus dives	20	17	TG		20							
Eucalyptus rubida	10	4	TG		10							
Astroloma humifusum	0.2	30	SG			0.2						
Banksia canei	0.1	1	SG			0.1						
Brachyloma daphnoides	0.1	6	SG			0.1						
Bursaria spinosa	0.2	4	SG			0.2						
Cassinia aculeata	0.1	2	SG			0.1						
Cassinia longifolia	2	20	SG			2						
Choretrum pauciflorum	0.7	20	SG			0.7						
Coprosma hirtella	2	60	SG			2						
Daviesia latifolia	15	100	SG			15						
Grevillea rosmarinifolia	0.2	50	SG			0.2						
Leucopogon fletcheri	0.2	20	SG			0.2						
Mirbelia oxylobioides	0.1	2	SG			0.1						
Monotoca scoparia	0.1	8	SG			0.1						
Pimelea linifolia	0.2	20	SG			0.2						
Platylobium formosum	0.2	30	SG			0.2						
Tetratheca bauerifolia	0.1	20	SG			0.1						
Glycine clandestina	0.1	1	OG							0.1		
Lepidosperma cf. laterale	0.2	20	GG				0.2					
Lomandra filiformis	0.1	20	GG				0.1					
Lomandra longifolia	5	300	GG				5					
Lomandra multiflora	0.1	3	GG				0.1					
Poa sieberiana	20	1000	GG				20					
Poa sp.	0.1	10	GG				0.1					
Themeda triandra	0.2	40	GG				0.2					
Asperula scoparia	0.2	100	FG					0.2				
Dianella revoluta	0.1	4	FG					0.1				
Diuris pardina	0.1	3	FG					0.1				
Euphrasia collina subsp. paludosa	0.1	2	FG					0.1				
Geranium obtusisepalum	0.1	20	FG					0.1				
Gonocarpus tetragynus	0.1	40	FG					0.1				
Hypericum gramineum	0.1	30	FG					0.1				
Picris angustifolia	0.1	5	FG					0.1				
Ranunculus lappaceus	0.1	20	FG					0.1				
Stackhousia monogyna	0.1	7	FG					0.1				
Stylidium graminifolium	0.2	80	FG					0.2				
Thelymitra megacalyptra	0.1	3	FG					0.1				
Vernonia cinerea	0.1	2	FG					0.1				
Veronica derwentiana	0.1	6	FG					0.1				
Viola betonicifolia	0.1	10	FG					0.1				
Wahlenbergia stricta	0.1	4	FG					0.1				
Centaurium erythraea	0.1	2	EX								0.1	
Pteridium esculentum	0.1	2	EG						0.1			

			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Plot 63			**# spp**	**Count**	Count	Count	Count	Count	Count	Count	**Count**	Count
PCT 729			**29**	**28**	2	9	4	10	1	2	**1**	0
Species	**Cover**	**Abundance**	**Sum cover**	**Sum**	Sum	Sum	Sum	Sum	Sum	Sum	**Sum**	Sum
			45.3	**45.2**	30	9.1	4.6	1.2	0.1	0.2	**0.1**	0
Eucalyptus dives	25	15	TG		25							
Eucalyptus nortonii	5	4	TG		5							
Banksia canei	3	9	SG			3						
Brachyloma daphnoides	5	150	SG			5						
Cassinia longifolia	0.1	2	SG			0.1						
Dillwynia crispii	0.1	8	SG			0.1						
Hibbertia obtusifolia	0.2	7	SG			0.2						
Leucopogon virgatus	0.1	2	SG			0.1						
Monotoca scoparia	0.4	5	SG			0.4						
Omphacomeria acerba	0.1	1	SG			0.1						
Tetratheca bauerifolia	0.1	2	SG			0.1						
Amyema pendula	0.1	1	OG							0.1		
Hardenbergia violacea	0.1	1	OG							0.1		
Dichelachne sp.	0.1	30	GG				0.1					
Lomandra longifolia	0.4	30	GG				0.4					
Lomandra multiflora	0.1	8	GG				0.1					
Poa sieberiana	4	200	GG				4					
Caladenia gracilis	0.1	3	FG					0.1				
Crassula sieberiana	0.1	20	FG					0.1				
Daucus glochidiatus	0.1	3	FG					0.1				
Dianella revoluta	0.2	20	FG					0.2				
Gonocarpus tetragynus	0.1	20	FG					0.1				
Hovea heterophylla	0.1	20	FG					0.1				
Senecio quadridentatus	0.1	5	FG					0.1				
Senecio sp.	0.1	2	FG					0.1				
Stylidium graminifolium	0.2	60	FG					0.2				
Wahlenbergia stricta	0.1	4	FG					0.1				
Aira sp.	0.1	2	EX								0.1	
Hypolepis sp.	0.1	4	EG						0.1			

			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Plot 64			**# spp**	**Count**	Count	Count	Count	Count	Count	Count	**Count**	Count
PCT 729			**41**	**36**	5	11	8	12	0	0	**5**	2
Species	**Cover**	**Abundance**	**Sum cover**	**Sum**	Sum	Sum	Sum	Sum	Sum	Sum	**Sum**	Sum
			167.8	**152.3**	19	69.3	62.6	1.4	0	0	**15.5**	15.1
Eucalyptus dives	4	9	TG		4							
Eucalyptus robertsonii	7	2	TG		7							
Eucalyptus rubida	2	2	TG		2							
Eucalyptus viminalis	5	2	TG		5							
Exocarpos strictus	0.3	25	SG			0.3						
Centaurium erythraea	0.2	150	EX								0.2	
Microlaena stipoides	30	500	GG				30					
Poranthera microphylla	0.1	5	FG					0.1				
Dichondra repens	0.1	100	FG					0.1				
Astroloma humifusum	0.2	10	SG			0.2						
Acaena ovina	0.2	50	FG					0.2				
Cymbonotus lawsonianus	0.1	10	FG					0.1				
Leucopogon fletcheri	0.1	2	SG			0.1						
Wahlenbergia communis	0.2	15	FG					0.2				
Asperula conferta	0.1	25	FG					0.1				
Hypericum gramineum	0.1	100	FG					0.1				
Callitris endlicheri	1	4	TG		1							
Banksia canei	1	2	SG			1						
Rytidosperma pilosum	2	250	GG				2					
Pimelea linifolia	0.2	100	SG			0.2						
Poa sieberiana	30	250	GG				30					
Lomandra filiformis subsp. coriacea	0.2	30	GG				0.2					
Hibbertia obtusifolia	0.1	1	SG			0.1						
Acacia pravissima	65	250	SG			65						
Senecio prenanthoides	0.1	5	FG					0.1				
Plantago sp.	0.1	5	FG					0.1				
Hypericum perforatum	15	500	HT									15

Tetratheca bauerifolia	0.1	10	SG			0.1						
Platylobium formosum	2	150	SG			2						
Elymus scaber	0.1	5	GG				0.1					
Lomandra filiformis subsp. Filiformis	0.1	5	GG				0.1					
Aira elegantissima	0.1	100	EX								0.1	
Taraxacum officinale	0.1	1	EX								0.1	
Hydrocotyle laxiflora	0.1	50	FG					0.1				
Gonocarpus tetragynus	0.1	50	FG					0.1				
Galium gaudichaudii	0.1	25	FG					0.1				
Rubus fruticosus agg.	0.1	5	HT									0.1
Lomandra multiflora	0.1	10	GG				0.1					
Luzula flaccida	0.1	1	GG				0.1					
Gompholobium huegelii	0.1	1	SG			0.1						
Brachyloma daphnoides	0.2	15	SG			0.2						
Rosa rubiginosa	0.1	1	HT									0.1
Pimelea curviflora	0.1	10	SG			0.1						
Chrysocephalum semipapposum	0.1	15	FG					0.1				
Daviesia mimosoides subsp. mimosoides	0.1	1	SG			0.1						
Calytrix tetragona	0.1	2	SG			0.1						
Themeda triandra	0.5	25	GG				0.5					

			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Plot 65			**# spp**	**Count**	Count	Count	Count	Count	Count	Count	**Count**	Count
PCT 729			**28**	**25**	2	12	7	3	0	1	**3**	1
Species	**Cover**	**Abundance**	**Sum cover**	**Sum**	Sum	Sum	Sum	Sum	Sum	Sum	**Sum**	Sum
			83.5	**83.2**	1.3	70.7	10.8	0.3	0	0.1	**0.3**	0.1
Themeda triandra	10	500	GG				10					
Eucalyptus dives	1	2	TG		1							
Calytrix tetragona	65	300	SG			65						
Brachyloma daphnoides	2	100	SG			2						
Cassytha glabella	0.1	50	OG							0.1		
Dillwynia sp.	0.1	5	SG			0.1						
Gonocarpus tetragynus	0.1	25	FG					0.1				
Austrostipa sp.	0.1	3	GG				0.1					
Mirbelia oxylobioides	2	25	SG			2						
Pimelea linifolia	0.1	5	SG			0.1						
Acacia pravissima	0.2	5	SG			0.2						
Hovea linearis	0.1	5	FG					0.1				
Acacia buxifolia	0.2	5	SG			0.2						
Lomandra filiformis subsp. coriacea	0.1	5	GG				0.1					
Centaurium erythraea	0.1	5	EX								0.1	
Hypericum gramineum	0.1	5	FG					0.1				
Hypericum perforatum	0.1	25	HT									0.1
Acacia dealbata	0.3	30	TG		0.3							
Cassinia longifolia	0.5	10	SG			0.5						
Bursaria spinosa	0.2	2	SG			0.2						
Pimelea curviflora	0.1	25	SG			0.1						
Exocarpos strictus	0.2	5	SG			0.2						
Rytidosperma pilosum	0.1	5	GG				0.1					
Lomandra filiformis subsp. filiformis	0.1	5	GG				0.1					
Vulpia myuros	0.1	25	EX								0.1	
Lomandra longifolia	0.1	1	GG				0.1					
Astroloma humifusum	0.1	1	SG			0.1						
Poa sieberiana	0.3	25	GG				0.3					

			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Plot 66			**# spp**	**Count**	Count	Count	Count	Count	Count	Count	**Count**	Count
PCT 729			**38**	**38**	3	14	6	12	0	3	**0**	0
Species	**Cover**	**Abundance**	**Sum cover**	**Cover**	Sum	Sum	Sum	Sum	Sum	Sum	**Sum**	Sum
			128.8	**128.8**	61	48.7	17.1	1.6	0	0.4	**0**	0
Eucalyptus dives	40	50	TG		40							
Choretrum sp.	30	100	SG			30						
Eucalyptus rubida	20	8	TG		20							
Poa sieberiana	15	400	GG				15					
Cassinia aculeata	10	40	SG			10						
Platylobium formosum	4	50	SG			4						
Cassinia longifolia	2	20	SG			2						
Brachyloma daphnoides	1	10	SG			1						
Eucalyptus robertsonii	1	2	TG		1							
Poa sp.	1	80	GG				1					
Themeda triandra	0.7	20	GG				0.7					
Daviesia sp.	0.3	6	SG			0.3						
Dianella revoluta	0.3	30	FG					0.3				
Hibbertia obtusifolia	0.3	15	SG			0.3						
Gonocarpus tetragynus	0.2	80	FG					0.2				
Hardenbergia violacea	0.2	4	OG							0.2		
Leucopogon virgatus	0.2	10	SG			0.2						
Lomandra longifolia	0.2	30	GG				0.2					
Mirbelia oxylobioides	0.2	4	SG			0.2						
Persoonia chamaepeuce	0.2	10	SG			0.2						
Stylidium graminifolium	0.2	20	FG					0.2				
Tetratheca ciliata	0.2	20	SG			0.2						
Caladenia gracilis	0.1	2	FG					0.1				
Cassytha melantha	0.1	1	OG							0.1		
Dichelachne sp.	0.1	3	GG				0.1					
Geranium obtusisepalum	0.1	3	FG					0.1				
Glycine clandestina	0.1	2	OG							0.1		
Grevillea rosmarinifolia	0.1	2	SG			0.1						
Hovea heterophylla	0.1	10	FG					0.1				
Lomandra filiformis	0.1	20	GG				0.1					
Pimelea glauca	0.1	10	SG			0.1						
Pterostylis longifolia	0.1	1	FG					0.1				
Rhytidosporum sp.	0.1	2	SG			0.1						
Senecio gunnii	0.1	1	FG					0.1				
Senecio prenanthoides	0.1	4	FG					0.1				
Senecio sp.	0.1	4	FG					0.1				
Stackhousia monogyna	0.1	1	FG					0.1				
Wahlenbergia stricta	0.1	4	FG					0.1				

			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Plot 67			**# spp**	**Count**	Count	Count	Count	Count	Count	Count	**Count**	Count
PCT 300			**27**	**27**	3	11	4	4	1	4	**0**	0
Species	**Cover**	**Abundance**	**Sum cover**	**Sum**	Sum	Sum	Sum	Sum	Sum	Sum	**Sum**	Sum
			123.7	**123.7**	33	34	49	2.2	5	0.5	**0**	0
Banksia canei	1	2	SG			1						
Billardiera scandens	0.2	40	OG							0.2		
Cassinia aculeata	1	8	SG			1						
Cassinia longifolia	4	10	SG			4						
Cassytha pubescens	0.1	50	OG							0.1		
Cassytha sp.	0.1	25	OG							0.1		
Dillwynia phylicoides	10	110	SG			10						
Eucalyptus dalrympleana	5	2	TG		5							
Eucalyptus dives	20	36	TG		20							
Eucalyptus robertsonii	8	11	TG		8							
Geranium sp.	0.1	60	FG					0.1				
Glycine clandestina	0.1	30	OG							0.1		
Gompholobium sp.	1	18	SG			1						
Gonocarpus tetragynus	1	20	FG					1				
Grevillea rosmarinifolia	1	3	SG			1						
Hibbertia obtusifolia	1	7	SG			1						
Leptomeria drupacea	2	6	SG			2						
Leucopogon fletcheri	1	6	SG			1						
Lomandra filiformis	2	22	GG				2					
Lomandra longifolia	2	20	GG				2					
Monotoca scoparia	2	15	SG			2						
Platylobium formosum	10	90	SG			10						
Poa sieberiana	40	500	GG				40					
Poa sp.	5	60	GG				5					
Pteridium esculentum	5	60	EG						5			
Stellaria pungens	0.1	45	FG					0.1				
Stylidium graminifolium	1	30	FG					1				

			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Plot 68			**# spp**	**Count**	Count	Count	Count	Count	Count	Count	**Count**	Count
PCT 729			**18**	**18**	3	10	3	2	0	0	**0**	0
Species	**Cover**	**Abundance**	**Sum cover**	**Sum**	Sum	Sum	Sum	Sum	Sum	Sum	**Sum**	Sum
			95.7	**95.7**	28	15.5	52	0.2	0	0	**0**	0
Eucalyptus dives	15	31	TG		15							
Eucalyptus robertsonii	8	14	TG		8							
Eucalyptus rubida	5	6	TG		5							
Leptomeria drupacea	3	11	SG			3						
Platylobium formosum	4	50	SG			4						
Leucopogon fletcheri	3	25	SG			3						
Leucopogon virgatus	1	15	SG			1						
Banksia canei	1	2	SG			1						
Pimelea linifolia	1	40	SG			1						
Gompholobium sp.	1	25	SG			1						
Stylidium graminifolium	0.1	20	FG					0.1				
Poa sieberiana	40	400	GG				40					
Stellaria pungens	0.1	30	FG					0.1				
Monotoca scoparia	1	4	SG			1						
Grevillea sp.	0.2	4	SG			0.2						
Lomandra filiformis	2	25	GG				2					
Poa sp.	10	300	GG				10					
Cassinia longifolia	0.3	2	SG			0.3						

			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Plot 69			**# spp**	**Count**	Count	Count	Count	Count	Count	Count	**Count**	Count
PCT 729			**33**	**30**	3	13	5	7	1	1	**3**	2
Species	**Cover**	**Abundance**	**Sum cover**	**Sum**	Sum	Sum	Sum	Sum	Sum	Sum	**Sum**	Sum
			42.1	**41.7**	8	31.5	1.3	0.7	0.1	0.1	**0.4**	0.3
Bursaria spinosa	0.1	3	SG			0.1						
Eucalyptus dives	2	4	TG		2							
Carex appressa	0.1	5	GG				0.1					
Dillwynia sp.	0.1	5	SG			0.1						
Indigofera australis	0.1	5	SG			0.1						
Senecio gunnii	0.1	5	FG					0.1				
Exocarpos strictus	0.2	5	SG			0.2						
Leptospermum sp.	0.2	5	SG			0.2						
Acaena novae-zelandiae	0.1	10	FG					0.1				
Bossiaea foliosa	0.1	10	SG			0.1						
Euchiton involucratus	0.1	10	FG					0.1				
Leucopogon virgatus	0.1	10	SG			0.1						
Lomandra filiformis subsp. coriacea	0.1	10	GG				0.1					
Oxalis perennans	0.1	10	FG					0.1				
Brachyloma daphnoides	0.2	10	SG			0.2						
Eucalyptus rubida	5	11	TG		5							
Cassytha sp.	0.1	20	OG							0.1		
Cheilanthes sieberi	0.1	20	EG						0.1			
Pimelea linifolia	0.1	20	SG			0.1						
Leucopogon fletcheri	0.2	20	SG			0.2						
Acacia pravissima	0.1	25	SG			0.1						
Gonocarpus tetragynus	0.1	30	FG					0.1				
Rubus fruticosus agg.	0.1	30	HT									0.1
Stellaria pungens	0.1	30	FG					0.1				
Rytidosperma pilosum	0.1	50	GG				0.1					
Acacia dealbata	1	50	TG		1							
Cassinia longifolia	20	60	SG			20						
Centaurium erythraea	0.1	100	EX								0.1	
Lomandra filiformis subsp. filiformis	0.5	100	GG				0.5					
Calytrix tetragona	10	100	SG			10						
Hypericum perforatum	0.2	150	HT									0.2
Microlaena stipoides	0.5	200	GG				0.5					
Hydrocotyle laxiflora	0.1	10	FG					0.1				

			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Plot 70			**# spp**	**Count**	Count	Count	Count	Count	Count	Count	**Count**	Count
PCT 729			**31**	**30**	2	13	2	11	0	2	**1**	0
Species	**Cover**	**Abundance**	**Sum cover**	**Sum**	Sum	Sum	Sum	Sum	Sum	Sum	**Sum**	Sum
			43.5	**43.4**	15	11.8	15	1.4	0	0.2	**0.1**	0
Eucalyptus dives	10	25	TG		10							
Eucalyptus rubida	5	4	TG		5							
Banksia canei	0.2	1	SG			0.2						
Cassinia longifolia	0.1	2	SG			0.1						
Choretrum pauciflorum	3	60	SG			3						
Grevillea rosmarinifolia	1	40	SG			1						
Hibbertia obtusifolia	0.3	20	SG			0.3						
Hovea lanceolata	0.5	40	SG			0.5						
Leucopogon virgatus	0.2	20	SG			0.2						
Mirbelia oxylobioides	2	50	SG			2						
Monotoca scoparia	0.2	30	SG			0.2						
Persoonia chamaepeuce	0.1	3	SG			0.1						
Pimelea linifolia	0.1	15	SG			0.1						
Platylobium formosum	4	70	SG			4						
Tetratheca bauerifolia	0.1	30	SG			0.1						
Cassytha melantha	0.1	10	OG							0.1		
Hardenbergia violacea	0.1	3	OG							0.1		
Poa sieberiana	10	200	GG				10					
Rytidosperma sp.	5	100	GG				5					
Asperula scoparia	0.1	3	FG					0.1				
Caladenia gracilis	0.1	2	FG					0.1				
Dianella revoluta	0.3	30	FG					0.3				
Diuris pardina	0.1	5	FG					0.1				
Gonocarpus tetragynus	0.2	50	FG					0.2				
Poranthera microphylla	0.1	1	FG					0.1				
Prasophyllum brevilabre	0.1	4	FG					0.1				
Stylidium graminifolium	0.1	6	FG					0.1				
Thelymitra megacalyptra	0.1	2	FG					0.1				
Vernonia cinerea	0.1	2	FG					0.1				
Wahlenbergia stricta	0.1	2	FG					0.1				
Hypochaeris radicata	0.1	1	EX								0.1	

			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Plot 71			**# spp**	**Count**	Count	Count	Count	Count	Count	Count	**Count**	Count
PCT 729			**47**	**44**	3	15	6	18	0	2	**3**	0
Species	**Cover**	**Abundance**	**Sum cover**	**Sum**	Sum	Sum	Sum	Sum	Sum	Sum	**Sum**	Sum
			45	**44.7**	22.1	5	15.4	2	0	0.2	**0.3**	0
Acacia dealbata	0.1	1	TG		0.1							
Eucalyptus dives	15	20	TG		15							
Eucalyptus rubida	7	8	TG		7							
Astroloma humifusum	0.3	10	SG			0.3						
Brachyloma daphnoides	0.5	30	SG			0.5						
Cassinia longifolia	1	40	SG			1						
Choretrum pauciflorum	0.1	3	SG			0.1						
Dodonaea viscosa	1	40	SG			1						
Exocarpos strictus	0.5	8	SG			0.5						
Hibbertia obtusifolia	0.2	50	SG			0.2						
Indigofera australis	0.5	8	SG			0.5						
Leucopogon fletcheri	0.1	4	SG			0.1						
Leucopogon virgatus	0.1	2	SG			0.1						
Melichrus urceolatus	0.1	1	SG			0.1						
Pimelea curviflora	0.1	2	SG			0.1						
Pimelea latifolia	0.1	2	SG			0.1						
Platylobium formosum	0.3	20	SG			0.3						
Tetratheca bauerifolia	0.1	1	SG			0.1						
Glycine clandestina	0.1	1	OG							0.1		
Hardenbergia violacea	0.1	1	OG							0.1		
Dichelachne sp.	0.1	20	GG				0.1					
Lepidosperma curtisiae	0.1	20	GG				0.1					
Lomandra filiformis	0.1	3	GG				0.1					
Lomandra multiflora	0.1	2	GG				0.1					
Poa sieberiana	5	200	GG				5					

Poa sp.	10	300	GG				10					
Acaena novae-zelandiae	0.1	1	FG					0.1				
Arthropodium sp.	0.1	60	FG					0.1				
Asperula conferta	0.1	5	FG					0.1				
Asperula scoparia	0.1	3	FG					0.1				
Chrysocephalum semipapposum	0.1	10	FG					0.1				
Dianella revoluta	0.3	30	FG					0.3				
Galium Leiocarpum	0.1	1	FG					0.1				
Geranium obtusisepalum	0.1	1	FG					0.1				
Gonocarpus tetragynus	0.1	10	FG					0.1				
Hovea heterophylla	0.1	20	FG					0.1				
Oxalis exilis	0.1	4	FG					0.1				
Picris angustifolia	0.1	1	FG					0.1				
Pterostylis longifolia	0.1	1	FG					0.1				
Ranunculus lappaceus	0.1	4	FG					0.1				
Stellaria pungens	0.1	3	FG					0.1				
Stylidium graminifolium	0.1	30	FG					0.1				
Veronica derwentiana	0.1	20	FG					0.1				
Wahlenbergia stricta	0.1	2	FG					0.1				
Centaurium erythraea	0.1	2	EX								0.1	
Petrorhagia nanteuilii	0.1	3	EX								0.1	
Trifolium campestre	0.1	10	EX								0.1	

			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Plot 72			**# spp**	**Count**	Count	Count	Count	Count	Count	Count	**Count**	Count
PCT 999			**24**	**20**	1	9	2	6	0	2	**4**	2
Species	**Cover**	**Abundance**	**Sum cover**	**Sum**	Sum	Sum	Sum	Sum	Sum	Sum	**Sum**	Sum
			78.5	**78.1**	0.5	75.1	0.7	1.1	0	0.7	**0.4**	0.2
Banksia canei	0.5	1	SG			0.5						
Bossiaea foliosa	10	50	SG			10						
Brachyloma daphnoides	2	100	SG			2						
Calytrix tetragona	60	400	SG			60						
Cassytha sp.	0.5	200	OG							0.5		
Centaurium erythraea	0.1	50	EX								0.1	
Eucalyptus rubida	0.5	2	TG		0.5							
Euchiton involucratus	0.1	10	FG					0.1				
Geranium sp. 2	0.1	10	FG					0.1				
Hardenbergia violacea	0.2	10	OG							0.2		
Hibbertia obtusifolia	0.1	25	SG			0.1						
Hovea heterophylla	0.2	50	FG					0.2				
Hypericum perforatum	0.1	10	HT									0.1
Hypochaeris radicata	0.1	20	EX								0.1	
Leptospermum sp.	2	20	SG			2						
Leucopogon fletcheri	0.2	25	SG			0.2						
Leucopogon virgatus	0.2	50	SG			0.2						
Lomandra filiformis	0.5	50	GG				0.5					
Microlaena stipoides	0.2	100	GG				0.2					
Oxalis perennans	0.1	50	FG					0.1				
Pimelea curviflora	0.1	30	SG			0.1						
Stylidium graminifolium	0.5	100	FG					0.5				
Rubus fruticosus agg.	0.1	1	HT									0.1
Hydrocotyle laxiflora	0.1	20	FG					0.1				

			Covers	**Native**	Trees	Shrubs	Grass	Forb	Fern	Other	**Exotic**	HighThreat
Plot 73			**# spp**	**Count**	Count	Count	Count	Count	Count	Count	**Count**	Count
PCT 999			**12**	**11**	1	3	2	3	1	1	**1**	0
Species	**Cover**	**Abundance**	**Sum cover**	**Sum**	Sum	Sum	Sum	Sum	Sum	Sum	**Sum**	Sum
			103	**102**	2	97	2.1	0.3	0.1	0.5	**1**	0
Eucalyptus nortonii	2	3	TG		2							
Brachyloma daphnoides	2	20	SG			2						
Calytrix tetragona	90	2000	SG			90						
Dillwynia phylicoides	5	30	SG			5						
Cassytha sp.	0.5	10	OG							0.5		
Austrostipa sp.	2	200	GG				2					
Luzula sp.	0.1	1	GG				0.1					
Gonocarpus tetragynus	0.1	20	FG					0.1				
Hypericum gramineum	0.1	1	FG					0.1				
Prasophyllum sp.	0.1	1	FG					0.1				
Aira sp.	1	200	EX								1	
Cheilanthes sieberi	0.1	20	EG						0.1			

			Covers	**Native**	Trees	Shrubs	Grass	Forb	Fern	Other	**Exotic**	HighThreat
Plot 74			**# spp**	**Count**	Count	Count	Count	Count	Count	Count	**Count**	Count
PCT 999			**20**	**20**	3	10	2	3	0	2	**0**	0
Species	**Cover**	**Abundance**	**Sum cover**	**Sum**	Sum	Sum	Sum	Sum	Sum	Sum	**Sum**	Sum
			106.4	**106.4**	32.1	73.1	0.4	0.4	0	0.4	**0**	0
Eucalyptus dives	7	8	TG		7							
Eucalyptus nortonii	25	13	TG		25							
Acacia buxifolia	0.2	5	SG			0.2						
Cassinia aculeata	0.1	2	SG			0.1						
Calytrix tetragona	40	250	SG			40						
Brachyloma daphnoides	30	15	SG			30						
Dillwynia sericea	0.2	5	SG			0.2						
Hibbertia obtusifolia	0.3	15	SG			0.3						
Callitris endlicheri	0.1	1	TG		0.1							
Lomandra filiformis	0.2	30	GG				0.2					
Gonocarpus tetragynus	0.2	25	FG					0.2				
Austrostipa sp.	0.2	15	GG				0.2					
Cassytha glabella	0.3	15	OG							0.3		
Caladenia sp.	0.1	1	FG					0.1				
Banksia canei	1	1	SG			1						
Leucopogon virgatus	0.2	3	SG			0.2						
Leucopogon fletcheri	1	20	SG			1						
Indigofera australis	0.1	1	SG			0.1						
Hovea linearis	0.1	5	FG					0.1				
Hardenbergia violacea	0.1	1	OG							0.1		

			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Plot 75			**# spp**	**Count**	Count	Count	Count	Count	Count	Count	**Count**	Count
PCT 999			**32**	**31**	2	10	6	10	0	3	**1**	0
Species	**Cover**	**Abundance**	**Sum cover**	**Sum**	Sum	Sum	Sum	Sum	Sum	Sum	**Sum**	Sum
			43.4	**43.3**	35	5.2	1.8	1	0	0.3	**0.1**	0
Eucalyptus dives	5	7	TG		5							
Eucalyptus nortonii	30	20	TG		30							
Acacia buxifolia	0.1	5	SG			0.1						
Calytrix tetragona	2	100	SG			2						
Austrostipa sp.	0.1	20	GG				0.1					
Brachyloma daphnoides	1	35	SG			1						
Dillwynia sericea	0.1	10	SG			0.1						
Lomandra filiformis subsp. coriacea	1	50	GG				1					
Poa sieberiana	0.3	35	GG				0.3					
Cassytha glabella	0.1	5	OG							0.1		
Hovea linearis	0.1	5	FG					0.1				
Dianella revoluta	0.1	35	FG					0.1				
Gonocarpus tetragynus	0.1	35	FG					0.1				
Hibbertia obtusifolia	0.1	5	SG			0.1						
Pimelea linifolia	0.1	50	SG			0.1						
Leucopogon virgatus	0.1	5	SG			0.1						
Hardenbergia violacea	0.1	10	OG							0.1		
Hydrocotyle laxiflora	0.1	35	FG					0.1				
Rytidosperma pilosum	0.1	25	GG				0.1					
Billardiera scandens	0.1	1	OG							0.1		
Hypochaeris radicata	0.1	2	EX								0.1	
Senecio prenanthoides	0.1	5	FG					0.1				
Hovea linearis	0.1	15	FG					0.1				
Boronia nana	0.1	50	FG					0.1				
Lomandra filiformis subsp. filiformis	0.2	25	GG				0.2					
Banksia canei	1.5	1	SG			1.5						
Lomandra multiflora	0.1	5	GG				0.1					
Coronidium monticola	0.1	15	FG					0.1				
Hypericum gramineum	0.1	1	FG					0.1				
Tetratheca bauerifolia	0.1	5	SG			0.1						
Euchiton involucratus	0.1	1	FG					0.1				
Exocarpos strictus	0.1	1	SG			0.1						

			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Plot 77			**# spp**	**Count**	Count	Count	Count	Count	Count	Count	**Count**	Count
PCT 999			**23**	**23**	2	12	3	3	0	3	**0**	0
Species	**Cover**	**Abundance**	**Sum cover**	**Sum**	Sum	Sum	Sum	Sum	Sum	Sum	**Sum**	Sum
			95.9	**95.9**	60	35	0.3	0.3	0	0.3	**0**	0
Eucalyptus nortonii	20	11	TG		20							
Eucalyptus dives	40	25	TG		40							
Calytrix tetragona	20	300	SG			20						
Brachyloma daphnoides	5	50	SG			5						
Lomandra multiflora	0.1	10	GG				0.1					
Cassytha glabella	0.1	10	OG							0.1		
Dillwynia sp.	0.1	5	SG			0.1						
Hibbertia obtusifolia	0.1	10	SG			0.1						
Leucopogon virgatus	0.2	20	SG			0.2						
Leucopogon fletcheri	2	5	SG			2						
Gonocarpus tetragynus	0.1	10	FG					0.1				
Austrostipa sp.	0.1	10	GG				0.1					
Mirbelia oxylobioides	5	20	SG			5						
Pimelea linifolia	0.1	20	SG			0.1						
Patersonia sp.	0.1	10	FG					0.1				
Acacia pravissima	2	5	SG			2						
Billardiera scandens	0.1	1	OG							0.1		
Hovea linearis	0.1	1	FG					0.1				
Hardenbergia violacea	0.1	1	OG							0.1		
Acacia buxifolia	0.1	5	SG			0.1						
Banksia canei	0.3	1	SG			0.3						
Indigofera australis	0.1	1	SG			0.1						
Lomandra filiformis	0.1	1	GG				0.1					

			Covers	**Native**	Trees	Shrubs	Grass	Forb	Fern	Other	**Exotic**	HighThreat
Plot 78			**# spp**	**Count**	Count	Count	Count	Count	Count	Count	**Count**	Count
PCT 999			**19**	**19**	2	10	2	4	0	1	**0**	0
Species	**Cover**	**Abundance**	**Sum cover**	**Sum**	Sum	Sum	Sum	Sum	Sum	Sum	**Sum**	Sum
			111.2	**111.2**	18	92.4	0.2	0.4	0	0.2	**0**	0
Eucalyptus nortonii	8	7	TG		8							
Eucalyptus dives	10	2	TG		10							
Calytrix tetragona	60	500	SG			60						
Brachyloma daphnoides	0.1	10	SG			0.1						
Lomandra multiflora	0.1	5	GG				0.1					
Cassytha glabella	0.2	50	OG							0.2		
Dillwynia sp.	0.1	5	SG			0.1						
Hibbertia obtusifolia	0.2	10	SG			0.2						
Leucopogon virgatus	0.4	10	SG			0.4						
Leucopogon fletcheri subsp. Brevisepalus	30	200	SG			30						
Gonocarpus tetragynus	0.1	20	FG					0.1				
Mirbelia oxylobioides	0.4	5	SG			0.4						
Pimelea linifolia	0.1	20	SG			0.1						
Patersonia sp.	0.1	5	FG					0.1				
Acacia pravissima	0.1	2	SG			0.1						
Hovea linearis	0.1	5	FG					0.1				
Acacia buxifolia	1	30	SG			1						
Lomandra filiformis	0.1	20	GG				0.1					
Boronia nana	0.1	5	FG					0.1				

			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Plot 79			**# spp**	**Count**	Count	Count	Count	Count	Count	Count	**Count**	Count
PCT 999			**19**	**18**	2	9	3	3	0	1	**1**	1
Species	**Cover**	**Abundance**	**Sum cover**	**Sum**	Sum	Sum	Sum	Sum	Sum	Sum	**Sum**	Sum
			53	**52.9**	20	31.6	0.4	0.7	0	0.2	**0.1**	0.1
Acacia buxifolia	0.1	1	SG			0.1						
Acacia pravissima	0.1	2	SG			0.1						
Asperula gunnii	0.5	100	FG					0.5				
Banksia canei	0.5	1	SG			0.5						
Bossiaea foliosa	0.1	2	SG			0.1						
Brachyloma daphnoides	0.2	20	SG			0.2						
Calytrix tetragona	20	200	SG			20						
Cassytha sp.	0.2	30	OG							0.2		
Eucalyptus dives	10	8	TG		10							
Eucalyptus nortonii	10	8	TG		10							
Hovea heterophylla	0.1	20	FG					0.1				
Leucopogon fletcheri	10	100	SG			10						
Leucopogon virgatus	0.5	10	SG			0.5						
Lomandra filiformis subsp. coriacea	0.2	50	GG				0.2					
Lomandra filiformis subsp. filiformis	0.1	5	GG				0.1					
Rytidosperma pilosum	0.1	10	GG				0.1					
Acaena novae-zelandiae	0.1	10	FG					0.1				
Rosa rubiginosa	0.1	5	HT									0.1
Podolobium procumbens	0.1	1	SG			0.1						

			Covers	**Native**	Trees	Shrubs	Grass	Forb	Fern	Other	**Exotic**	HighThreat
Plot 80			**# spp**	**Count**	Count	Count	Count	Count	Count	Count	**Count**	Count
PCT 999			**15**	**13**	2	5	2	4	0	0	**2**	0
Species	**Cover**	**Abundance**	**Sum cover**	**Sum**	Sum	Sum	Sum	Sum	Sum	Sum	**Sum**	Sum
			147.1	**146.5**	55	90.8	0.3	0.4	0	0	**0.6**	0
Eucalyptus dives	5	1	TG		5							
Eucalyptus nortonii	50	50	TG		50							
Brachyloma daphnoides	5	20	SG			5						
Calytrix tetragona	80	500	SG			80						
Cassinia longifolia	0.5	3	SG			0.5						
Dillwynia phylicoides	5	20	SG			5						
Rhytidosporum sp.	0.3	30	SG			0.3						
Luzula sp.	0.1	10	GG				0.1					
Poa sp.	0.2	20	GG				0.2					
Caladenia congesta	0.1	20	FG					0.1				
Gonocarpus tetragynus	0.1	10	FG					0.1				
Hypericum gramineum	0.1	10	FG					0.1				
Wahlenbergia sp.	0.1	20	FG					0.1				
Aira sp.	0.5	100	EX								0.5	
Centaurium erythraea	0.1	10	EX								0.1	

Appendix C. Vegetation integrity assessment plot data

Table C-1 Vegetation integrity assessment plot data for vegetation zones in the South Eastern Highlands Bioregion

Vegetation zone	Plot	Pct	Area	Patch size	Condition class	Zone	Easting	Northing	Bearing	Comptree	Compshrub	Compgrass	Compforbs	Compferns	Compother	Structree	Strucshrub	Strucgrass	Strucforbs	Strucferns	Strucother	Funlargetrees	Funhollowtrees	Funlittercover	Funlenfallenlogs	Funtreestem5to10	Funtreestem10to20	Funtreestem20to30	Funtreestem30to50	Funtreestem50to80	Funtreeregen	Funhighthreatexotic
SEH-1	Plot 14	296	0.10	101	DNG	55	627415.8055	6037977.1	300	2	7	7	7	1	0	4.0	48.1	2.7	68.5	0.1	0.0	0	0	3.2	0.0	1	1	1	0	0	1	0.4
SEH-2	Plot 15	296	4.07	101	Good_dry_slopes	55	627706.7532	6037994.4	268	3	10	8	10	1	0	37.0	4.3	49.1	1.9	0.1	0.0	0	0	79.0	50.0	1	1	1	1	0	1	0.2
SEH-2	Plot 16	296	4.07	101	Good_dry_slopes	55	627246.596	6037819.3	30	2	7	6	8	1	2	15.2	1.5	36.3	0.9	0.1	10.1	0	1	35.0	81.0	1	1	1	0	0	1	0.1
SEH-2	Plot 17	296	4.07	101	Good_dry_slopes	55	627500.0142	6037855.0	32	3	7	5	7	1	1	22.2	46.0	5.2	6.4	1.0	0.5	7	5	81.0	45.0	1	1	1	1	1	1	1.0
SEH-3	Plot 18	296	13.56	101	Good_wet_slopes	55	624455.5119	6038548.9	60	2	15	7	13	0	3	20.0	14.2	2.0	1.5	0.0	0.3	0	0	65.0	35.0	1	1	1	1	0	1	0.0
SEH-3	Plot 19	296	13.56	101	Good_wet_slopes	55	624268.1687	6038590.5	200	2	17	7	9	0	3	16.0	22.1	15.7	0.8	0.0	0.4	1	1	57.0	84.0	1	1	1	1	1	1	0.1
SEH-3	Plot 20	296	13.56	101	Good_wet_slopes	55	626708.5192	6037781.2	92	3	5	9	5	0	0	46.0	1.6	81.6	0.5	0.0	0.0	1	0	49.0	9.0	1	1	1	1	1	1	5.3
SEH-3	Plot 21	296	13.56	101	Good_wet_slopes	55	626936.196	6037881.5	249	4	8	8	7	1	0	24.5	13.3	46.0	1.1	0.1	0.0	0	1	65.0	55.0	1	1	1	0	0	1	0.5
SEH-3	Plot 22	296	13.56	101	Good_wet_slopes	55	626585.9005	6038049.1	6	4	13	9	3	0	1	14.1	50.0	5.0	0.7	0.0	0.1	3	0	91.3	35.0	1	1	1	1	1	1	0.2
SEH-3	Plot 23	296	13.56	101	Good_wet_slopes	55	627021.6493	6037758.2	71	3	7	9	3	0	1	4.5	45.4	7.7	0.4	0.0	0.1	0	0	87.5	45.0	1	1	1	1	0	1	0.5
SEH-3	Plot 24	296	13.56	101	Good_wet_slopes	55	625117.4023	625117.4	45	4	12	2	3	0	0	2.5	6.2	0.2	0.3	0.0	0.0	1	3	80.0	35.0	1	1	1	1	1	1	0.0
SEH-3	Plot 25	296	13.56	101	Good_wet_slopes	55	627829.9963	6038110.0	150	2	16	4	4	0	0	16.0	48.4	3.1	0.4	0.0	0.0	0	3	82.0	16.0	1	1	1	1	0	1	0.0
SEH-3	Plot 26	296	13.56	101	Good_wet_slopes	55	626744.9828	6037929.0	53	3	4	3	1	0	0	36.0	96.0	17.0	0.1	0.0	0.0	0	0	67.0	58.0	1	1	1	1	0	1	0.0
SEH-3	Plot 27	296	13.56	101	Good_wet_slopes	55	625034.8498	6038466.3	177	3	14	5	6	0	2	62.0	92.3	20.8	0.6	0.0	0.2	0	1	70.0	35.0	1	1	1	1	0	1	0.0
SEH-3	Plot 28	296	13.56	101	Good_wet_slopes	55	624325.2598	6038472.0	22	3	16	4	16	0	1	55.2	91.3	61.3	6.6	0.0	2.0	4	4	74.0	17.0	1	1	1	1	1	1	0.0
SEH-3	Plot 29	296	13.56	101	Good_wet_slopes	55	624583.2534	6038582.2	87	2	14	5	10	0	1	18.0	45.9	10.4	1.2	0.0	0.1	0	2	48.0	106.0	1	1	1	1	0	1	0.0
SEH-4	Plot 30	296	1.29	101	Moderate_Blackberry	55	626811.7025	6037753.292	347	3	7	4	0	0	0	32.1	1.5	2.5	0.0	0.0	0.0	0	2	45.0	71.0	1	1	1	1	0	1	90.6
SEH-5	Plot 31	300	23.19	101	Good	55	620801.7001	6038013.3	37	2	9	4	20	1	3	21.0	59.7	42.2	12.4	20.0	0.3	6	2	95.8	94.0	1	1	1	1	1	1	0.1
SEH-5	Plot 32	300	23.19	101	Good	55	623730.364	6038641.0	105	4	10	3	3	0	2	21.5	40.0	76.0	1.3	0.0	4.0	4	0	14.0	43.0	1	1	1	1	1	0	0.0
SEH-5	Plot 33	300	23.19	101	Good	55	620414.8466	6037973.0	140	4	8	1	10	1	3	23.0	7.6	0.2	3.3	2.0	0.3	2	4	56.0	60.0	0	1	1	1	1	1	0.0
SEH-5	Plot 34	300	23.19	101	Good	55	620180.0995	6037895.0	120	3	6	2	8	1	1	17.0	11.2	20.2	1.7	5.0	0.1	2	0	25.0	12.0	1	1	1	1	1	1	30.0

Vegetation zone	Plot	Pct	Area	Patch size	Condition class	Zone	Easting	Northing	Bearing	Comptree	Compshrub	Compgrass	Compforbs	Compferns	Compother	Structree	Strucshrub	Strucgrass	Strucforbs	Strucferns	Strucother	Funlargetrees	Funhollowtrees	Funlittercover	Funlenfallenlogs	Funtreestem5to10	Funtreestem10to20	Funtreestem20to30	Funtreestem30to50	Funtreestem50to80	Funtreeregen	Funhighthreatexotic
SEH-5	Plot 35	300	23.19	101	Good	55	620046.9526	6037990.0	38	6	7	2	6	1	1	17.5	3.6	25.5	1.9	2.0	0.1	0	0	100.0	130.0	1	1	1	1	1	1	0.0
SEH-5	Plot 36	300	23.19	101	Good	55	620593.8695	6038030.7	270	3	9	2	15	1	2	25.0	49.0	75.0	12.9	5.0	1.1	12	6	41.0	73.0	1	1	1	1	1	1	0.0
SEH-5	Plot 37	300	23.19	101	Good	55	620947.8051	6037987.0	340	4	2	3	5	4	1	50.0	5.2	42.0	0.9	33.0	0.1	4	4	86.0	12.0	1	1	1	1	1	1	20.0
SEH-5	Plot 38	300	23.19	101	Good	55	621041.8745	6038041.2	201	3	13	2	5	0	1	65.5	73.8	20.1	0.7	0.0	0.1	7	2	53.0	80.0	1	1	1	1	1	1	0.0
SEH-5	Plot 39	300	23.19	101	Good	55	621723.9857	6038065.143	353	4	16	4	10	1	2	81.1	6.8	20.4	1.1	0.2	0.3	1	1	56.0	50.0	1	1	1	1	1	1	0.0
SEH-5	Plot 40	300	23.19	101	Good	55	620938.2138	6038061.936	177	4	7	4	18	1	2	48.0	29.3	10.4	19.1	8.0	0.4	6	3	80.0	165.0	1	1	1	1	1	1	0.2
SEH-5	Plot 41	300	23.19	101	Good	55	620438.4483	6038066.976	189	3	4	4	12	2	1	4.1	0.6	0.6	2.1	0.4	0.1	2	3	3.0	40.0	1	1	1	0	1	1	70.0
SEH-5	Plot 42	300	23.19	101	Good	55	623622.0134	6038511.007	245	2	10	2	5	1	2	50.0	26.7	33.0	7.2	10.0	2.1	8	4	42.0	56.0	1	1	1	1	1	1	0.0
SEH-5	Plot 67	300	23.19	101	Good	55	623523.6678	623523.6678	225	3	11	4	4	1	4	33.0	34.0	49.0	2.2	5.0	0.5	1	3	40.0	57.0	1	1	1	1	0	1	0.0
SEH-6	Plot 43	302	0.22	101	DNG	55	627126.2542	6037804.141	150	0	1	1	1	1	0	0.0	0.5	90.0	0.1	4.0	0.0	0	0	50.0	0.0	0	0	0	0	0	1	1.2
SEH-7	Plot 44	302	2.12	101	Moderate	55	626550.9675	6037907.021	155	2	6	7	2	1	0	65.0	9.0	14.5	0.2	0.1	0.0	0	2	76.0	55.0	1	1	1	1	0	1	32.2
SEH-7	Plot 45	302	2.12	101	Moderate	55	627750.8244	6038054.314	118	5	7	6	8	3	2	101.0	13.2	57.3	0.8	0.5	0.2	2	0	87.0	15.0	1	1	1	1	1	1	8.4
SEH-7	Plot 46	302	2.12	101	Moderate	55	627136.9921	6037935.012	330	3	8	8	1	0	0	47.0	6.2	61.5	0.1	0.0	0.0	0	0	79.6	54.0	1	1	1	1	1	1	0.0
SEH-7	Plot 47	302	2.12	101	Moderate	55	627676.9811	6038086	105	2	3	8	3	0	0	9.0	1.2	10.8	0.3	0.0	0.0	0	0	14.0	5.0	1	1	1	0	0	0	0.0
SEH-7	Plot 48	302	2.12	101	Moderate	55	626535.3864	6038012.086	0	2	3	6	7	1	1	5.0	3.6	0.6	0.7	0.1	0.1	1	0	30.0	58.0	1	1	1	1	1	1	30.4
SEH-8	Plot 49	729	0.72	101	DNG	55	625663.9911	6038275.899	238	0	7	8	7	0	2	0.0	21.4	75.7	0.8	0.0	0.2	0	0	6.0	4.0	1	1	1	0	0	1	40.7
SEH-8	Plot 50	729	0.72	101	DNG	55	626650.8806	6037795.757	340	1	1	7	7	1	0	1.5	0.2	75.6	0.7	0.1	0.0	0	0	9.0	0.0	0	0	0	0	0	0	21.2
SEH-8	Plot 51	729	0.72	101	DNG	55	626528.8108	6037798.723	227	1	2	6	4	0	1	0.1	0.2	100.4	0.7	0.0	0.2	0	0	11.0	0.0	0	0	0	0	0	0	0.2
SEH-9	Plot 52	729	0.61	101	Derived_shrubland	55	625527.265	6038265.635	303	2	5	6	6	1	1	5.0	100.8	4.4	0.7	0.1	0.1	1	0	54.0	0.0	1	1	0	0	0	1	0.7
SEH-9	Plot 53	729	0.61	101	Derived_shrubland	55	626573.0908	6037760.147	125	1	4	5	6	0	0	0.1	145.6	2.4	1.6	0.0	0.0	0	0	11.0	0.0	0	0	0	0	0	0	0.3
SEH-9	Plot 54	729	0.61	101	Derived_shrubland	55	625579.1365	6038538.708	174	3	5	0	5	1	0	11.1	120.3	0.0	0.5	0.1	0.0	1	2	44.0	25.0	1	1	1	1	1	1	0.0
SEH-9	Plot 55	729	0.61	101	Derived_shrubland	55	626665.5559	6038006.452	251	3	8	2	5	0	2	15.1	81.6	0.2	0.7	0.0	0.2	1	0	19.0	6.0	1	1	1	1	1	1	0.1

Vegetation zone	Plot	Pct	Area	Patch size	Condition class	Zone	Easting	Northing	Bearing	Comptree	Compshrub	Compgrass	Compforbs	Compferns	Compother	Structree	Strucshrub	Strucgrass	Strucforbs	Strucferns	Strucother	Funlargetrees	Funhollowtrees	Funlittercover	Funlenfallenlogs	Funtreestem5to10	Funtreestem10to20	Funtreestem20to30	Funtreestem30to50	Funtreestem50to80	Funtreeregen	Funhighthreatexotic
SEH-10	Plot 56	729	12.82	101	Good_dry_slopes	55	624396.6018	6038627.961	279	2	16	5	12	0	1	22.5	7.6	67.3	1.3	0.0	0.1	0	1	37.0	99.0	1	1	1	1	1	1	0.0
SEH-10	Plot 57	729	12.82	101	Good_dry_slopes	55	625465.2561	6038444.135	58	2	11	2	6	0	1	10.2	43.2	0.3	0.7	0.0	0.1	0	1	81.0	64.0	1	1	1	0	0	1	0.1
SEH-10	Plot 58	729	12.82	101	Good_dry_slopes	55	625625.9888	6038693.586	128	3	8	4	5	1	0	25.0	52.1	0.9	0.6	0.1	0.0	0	0	66.0	32.0	1	1	1	1	0	1	0.1
SEH-10	Plot 59	729	12.82	101	Good_dry_slopes	55	621545.1928	621545.1928	280	2	15	3	4	0	0	15.0	24.0	23.0	0.4	0.0	0.0	2	1	30.0	9.0	1	1	1	1	1	1	0.0
SEH-10	Plot 60	729	12.82	101	Good_dry_slopes	55	624682.5139	6038756.072	138	3	15	3	12	0	2	55.1	133.9	20.5	1.4	0.0	0.4	2	1	54.0	42.0	1	1	1	0	1	0	0.0
SEH-10	Plot 61	729	12.82	101	Good_dry_slopes	55	621491.6069	6038058.905	54	2	16	4	17	0	2	60.0	57.6	44.1	1.9	0.0	0.2	2	0	52.0	65.0	1	1	1	1	1	0	0.0
SEH-10	Plot 62	729	12.82	101	Good_dry_slopes	55	621260.1089	6038057.532	270	2	16	7	16	1	1	30.0	21.5	25.7	1.8	0.1	0.1	4	4	32.0	95.0	1	1	1	1	1	1	0.0
SEH-10	Plot 63	729	12.82	101	Good_dry_slopes	55	624577.4202	6038610.885	228	2	9	4	10	1	2	30.0	9.1	4.6	1.2	0.1	0.2	0	2	42.0	71.0	1	1	1	1	1	1	0.0
SEH-10	Plot 70	729	12.82	101	Good_dry_slopes	55	623813.1496	6038527.306	184	2	13	2	11	0	2	15.0	11.8	15.0	1.4	0.0	0.2	1	8	72.0	131.0	1	1	1	1	1	1	0.0
SEH-10	Plot 71	729	12.82	101	Good_dry_slopes	55	624165.4671	6038383.635	273	3	15	6	18	0	2	22.1	5.0	15.4	2.0	0.0	0.2	0	3	20.0	74.0	1	1	1	1	0	1	0.0
SEH-11	Plot 64	729	12.79	101	Good_wet_slopes	55	625513.0329	6038301.006	40	5	11	8	12	0	0	19.0	69.3	62.6	1.4	0.0	0.0	0	0	71.0	25.0	1	1	1	1	0	1	15.1
SEH-11	Plot 65	729	12.79	101	Good_wet_slopes	55	626416.0916	6037994.375	19	2	12	7	3	0	1	1.3	70.7	10.8	0.3	0.0	0.1	0	0	22.0	0.0	1	1	0	0	0	1	0.1
SEH-11	Plot 66	729	12.79	101	Good_wet_slopes	55	623179.6935	6038404.788	211	3	14	6	12	0	3	61.0	48.7	17.1	1.6	0.0	0.4	3	2	75.0	92.0	1	1	1	1	1	1	0.0
SEH-11	Plot 68	729	12.79	101	Good_wet_slopes	55	623341.2862	623341.2862	200	3	10	3	2	0	0	28.0	15.5	52.0	0.2	0.0	0.0	1	4	80.0	27.0	1	1	1	1	1	1	0.0
SEH-11	Plot 69	729	12.79	101	Good_wet_slopes	55	626287.647	6037943.511	70	3	13	5	7	1	1	8.0	31.5	1.3	0.7	0.1	0.1	0	0	50.0	0.0	1	1	1	1	0	1	0.3
SEH-12	Plot 72	999	1.34	101	Derived_shrubland	55	626007.0619	6038100.723	90	1	9	2	6	0	2	0.5	75.1	0.7	1.1	0.0	0.7	0	0	46.0	32.0	1	1	1	0	0	1	0.2
SEH-12	Plot 73	999	1.34	101	Derived_shrubland	55	625322.1834	6038381.593	237	1	3	2	3	1	1	2.0	97.0	2.1	0.3	0.1	0.5	0	0	10.0	10.0	1	1	1	0	0	1	0.0
SEH-13	Plot 74	999	7.26	101	Good_dry_Calytrix	55	625882.7593	6038143.985	195	3	10	2	3	0	2	32.1	73.1	0.4	0.4	0.0	0.4	0	5	79.0	36.0	1	1	1	1	0	1	0.0
SEH-13	Plot 75	999	7.26	101	Good_dry_Calytrix	55	625945.1649	6038089.4	322	2	10	6	10	0	3	35.0	5.2	1.8	1.0	0.0	0.3	4	3	87.0	72.0	1	1	1	1	1	1	0.0
SEH-13	Plot 76	999	7.26	101	Good_dry_Calytrix	55	625736.0218	6038160.604	60	1	7	7	8	1	1	18.0	36.7	15.6	0.8	0.1	0.1	0	0	84.0	10.0	1	1	1	0	0	1	0.1
SEH-13	Plot 77	999	7.26	101	Good_dry_Calytrix	55	626137.5702	6038137.806	136	2	12	3	3	0	3	60.0	35.0	0.3	0.3	0.0	0.3	0	0	92.0	30.0	1	1	1	1	0	1	0.0
SEH-13	Plot 78	999	7.26	101	Good_dry_Calytrix	55	626273.9854	6038062.97	232	2	10	2	4	0	1	18.0	92.4	0.2	0.4	0.0	0.2	1	2	88.0	75.0	1	1	1	1	1	1	0.0

Vegetation zone	Plot	Pct	Area	Patch size	Condition class	Zone	Easting	Northing	Bearing	Comptree	Compshrub	Compgrass	Compforbs	Compferns	Compother	Structree	Strucshrub	Strucgrass	Strucforbs	Strucferns	Strucother	Funlargetrees	Funhollowtrees	Funlittercover	Funlenfallenlogs	Funtreestem5to10	Funtreestem10to20	Funtreestem20to30	Funtreestem30to50	Funtreestem50to80	Funtreeregen	Funhighthreatexotic
SEH-13	Plot 79	999	7.26	101	Good_dry_Calytrix	55	626147.131	6038009.529	270	2	9	3	3	0	1	20.0	31.6	0.4	0.7	0.0	0.2	0	0	43.0	21.0	1	1	1	1	0	1	0.1
SEH-13	Plot 80	999	7.26	101	Good_dry_Calytrix	55	624860.0123	6038541.891	250	2	5	2	4	0	0	55.0	90.8	0.3	0.4	0.0	0.0	0	3	7.0	20.0	1	1	1	1	0	1	0.0
SEH-13	Plot 81	999	7.26	101	Good_dry_Calytrix	55	625233.0021	6038371.317	73	2	4	1	3	0	1	5.0	33.2	0.5	0.3	0.0	0.1	0	2	25.0	26.0	1	1	1	1	0	1	0.0

Table C-2Vegetation integrity assessment plot data for vegetation zones in the Australian Alps Bioregion

	Plot	Pct	Area	Patch size	Condition class/vegetation zone	Zone	Easting	Northing	Bearing	Comptree	Compshrub	Compgrass	Compforbs	Compferns	Compother	Structree	Strucshrub	Strucgrass	Strucforbs	Strucferns	Strucother	Funlargetrees	Funhollowtrees	Funlittercover	Funlenfallenlogs	Funtreestem5to10	Funtreestem10to20	Funtreestem20to30	Funtreestem30to50	Funtreestem50to80	Funtreeregen	Funhightthreatexotic
AA-1	Plot 1	285	2.2	101	Moderate_Blackberry	55	618922.7	6037901.8	230	4	5	6	9	0	1	21.2	70.6	11.3	0.9	0.0	0.1	2	2	79.8	65.0	1	1	1	0	0	0	30.3
AA-1	Plot 2	285	2.2	101	Moderate_Blackberry	55	618857.1	6038329.2	168	4	7	7	16	0	2	33.3	3.1	80.9	3.5	0.0	0.3	1	9	71.0	197.0	1	1	1	0	0	0	1.5
AA-1	Plot 3	285	2.2	101	Moderate_Blackberry	55	618769.0	6038168.9	225	5	10	6	30	0	1	44.0	3.9	22.5	4.0	0.0	0.1	6	4	56.0	0.0	1	1	0	1	1	1	20.4
AA-2	Plot 35	300	8.82	101	Good	55	620045.5	6037990.0	38	6	7	2	6	1	1	17.5	3.6	25.5	1.9	2	0.1	0	0	178	130.0	1	1	1	1	1	0	25.0
AA-2	Plot 4	300	8.82	101	Good	55	619667.0	6037958.5	110	4	2	3	14	0	1	31.2	12.1	83.0	18.7	0.0	5.0	13	2	19.0	96.0	1	1	1	1	1	1	40.1
AA-2	Plot 5	300	8.82	101	Good	55	619861.1	6037975.2	76	4	8	4	19	0	2	95.0	1.7	60.4	3.8	0.0	0.2	6	0	48.0	210.0	1	1	1	0	0	1	15.5
AA-3	Plot 6	1196	0.09	101	Native_grassland	55	618871.0	6037781.5	159	1	7	10	13	0	2	0.1	1.7	48.1	2.6	0.0	0.2	0	0	2.8	0.0	0	0	0	1	1	1	1.2
AA-3	Plot 7	1196	0.09	101	Native_grassland	55	618737.4	6038026.7	177	1	6	5	10	0	1	0.1	1.1	31.4	26.9	0.0	0.1	0	0	0.0	0.0	0	0	0	1	1	1	0.1
AA-4	Plot 8	1196	27.16	101	Good	55	619031.7	6037725.3	9	4	7	9	18	1	2	57.0	2.8	31.3	3.2	30.0	0.2	2	2	95.6	76.0	1	1	1	1	1	1	0.0
AA-4	Plot 9	1196	27.16	101	Good	55	618960.6	6038105.2	250	4	6	7	15	1	1	21.0	21.7	100.8	2.6	1.0	0.1	1	4	43.0	54.0	1	1	1	1	1	1	0.0
AA-4	Plot 10	1196	27.16	101	Good	55	619037.2	6038005.1	298	2	6	4	22	0	2	60.5	21.2	60.4	4.9	0.0	0.2	7	1	44.0	500.0	1	1	1	1	1	1	0.0
AA-4	Plot 11	1196	27.16	101	Good	55	618970.0	6037818.9	78	4	6	3	19	0	2	65.0	5.9	63.0	2.2	0.0	0.2	6	0	52.0	230.0	1	1	1	1	1	1	0.1
AA-4	Plot 12	1196	27.16	101	Good	55	619403.2	6037947.0	184	4	6	4	19	0	3	75.0	11.4	40.4	2.6	0.0	0.3	5	0	47.0	260.0	1	1	1	1	1	1	0.0
AA-4	Plot 13	1196	27.16	101	Good	55	619126.7	6037904.9	135	4	6	4	24	0	2	30.0	10.6	15.5	3.6	0.0	0.2	6	7	30.0	306.0	1	1	1	1	1	1	0.2

Appendix D. Fauna survey results

Table D-1 Results of the mammal trapping program in the Australian Alps portion of the project area

PCT / Vegetation formation	Trap site	Date	Species
PCT 300 Wet Sclerophyll Forests (Grassy sub-formation) Southern Tableland Wet Sclerophyll Forests	1	Monday, 3 December 2018	Bush Rat Agile Antechinus
		Tuesday, 4 December 2018	No captures
		Wednesday, 5 December 2018	No captures
		Thursday, 6 December 2018	Bush Rat
	2	Tuesday, 4 December 2018	Bush Rat
		Wednesday, 5 December 2018	Bush Rat
		Thursday, 6 December 2018	Bush Rat Agile Antechinus
		Friday, 7 December 2018	Bush Rat x 2 Blotched Blue Tongue Lizard
	3	Monday, 3 December 2018	Agile Antechinus
		Tuesday, 4 December 2018	No captures
		Wednesday, 5 December 2018	No captures
		Thursday, 6 December 2018	No captures
	4	Tuesday, 4 December 2018	No captures
		Wednesday, 5 December 2018	No captures
		Thursday, 6 December 2018	No captures
		Friday, 7 December 2018	Bush Rat Agile Antechinus
PCT 1196 Grassy Woodlands Subalpine Woodlands	5	Wednesday, 5 December 2018	No captures
		Thursday, 6 December 2018	Bush Rat
		Friday, 7 December 2018	Bush Rat
		Saturday, 8 December 2018	No captures
	6	Wednesday, 5 December 2018	No captures
		Thursday, 6 December 2018	No captures
		Friday, 7 December 2018	No captures
		Saturday, 8 December 2018	No captures
	7	Wednesday, 5 December 2018	No captures
		Thursday, 6 December 2018	No captures
		Friday, 7 December 2018	Bush Rat
		Saturday, 8 December 2018	No captures

Table D-2 Results of the mammal trapping program in the Southern Highlands portion of the project area

PCT / Vegetation formation	Trap site	Date	Species
PCT 729 Dry Sclerophyll Forests (Shrubby sub-formation) Southern Tableland Dry Sclerophyll Forests	8	Saturday, 26 January 2019	No captures
		Sunday, 27 January 2019	No captures
		Monday, 28 January 2019	Agile Antechinus
		Tuesday, 29 January 2019	No captures
	9	Saturday, 26 January 2019	Agile Antechinus x 3
		Sunday, 27 January 2019	Agile Antechinus x 2
		Monday, 28 January 2019	Agile Antechinus x 4
		Tuesday, 29 January 2019	Agile Antechinus x 2
PCT 302 Dry Sclerophyll Forests (Shrub/grass sub-formation) Upper Riverina Dry Sclerophyll Forests	10	Wednesday, 30 January 2019	Agile Antechinus x 3 Bush Rat
		Thursday, 31 January 2019	Agile Antechinus x 6 Bush Rat
		Friday, 1 February 2019	Agile Antechinus x 2 Bush Rat
		Saturday, 2 February 2019	No captures
PCT 296 Dry Sclerophyll Forests (Shrubby sub-formation) Southern Tableland Dry Sclerophyll Forests	11	Wednesday, 30 January 2019	Agile Antechinus
		Thursday, 31 January 2019	Agile Antechinus
		Friday, 1 February 2019	Agile Antechinus Bush Rat
		Saturday, 2 February 2019	No captures
PCT 999 Dry Sclerophyll Forests (Shrubby sub-formation) Southern Tableland Dry Sclerophyll Forests	12	Wednesday, 30 January 2019	Agile Antechinus
		Thursday, 31 January 2019	Agile Antechinus
		Friday, 1 February 2019	Agile Antechinus
		Saturday, 2 February 2019	Agile Antechinus

Table D-3 Results of the spotlighting surveys in the Australian Alps portion of the project area

PCT / Vegetation formation	Date	Species
PCT 300 Wet Sclerophyll Forests (Grassy sub-formation) Southern Tableland Wet Sclerophyll Forests	Monday, 3 December 2018	No results
	Tuesday, 4 December 2018	Pheasant Coucal Southern Boobook Crinia signifera Sugar Glider Yellow-bellied Glider
	Wednesday, 5 December 2018	No results

PCT / Vegetation formation	Date	Species
PCT 1196 Grassy Woodlands Subalpine Woodlands	Thursday, 6 December 2018	Yellow-bellied Glider Brushtail Possum
	Friday, 7 December 2018	Yellow-bellied Glider
	Saturday, 8 December 2018	Spotted Nightjar Southern Boobook
	Sunday, 9 December 2018	Yellow-bellied Glider
	Monday 10 December 2018	Yellow-bellied Glider Brushtail Possum Eastern Pygmy-possum (recorded off site on Bradleys Drive)
	12 August 2021	Masked Owl
	16 August 2021	Masked Owl
	18 August 2021	Masked Owl

Table D-4 Results of the spotlighting surveys in the Southern Highlands portion of the project area

PCT / Vegetation formation	Date	Species
PCT 296 Dry Sclerophyll Forests (Shrubby sub-formation) Southern Tableland Dry Sclerophyll Forests	Wednesday, 23 January 2019	Southern boobook Owlet nightjar Masked owl Brushtail possum Sugar Glider Tawny Frogmouth
PCT 302 Dry Sclerophyll Forests (Shrub/grass sub-formation) Upper Riverina Dry Sclerophyll Forests PCT 999 Dry Sclerophyll Forests (Shrubby sub-formation) Southern Tableland Dry Sclerophyll Forests	Thursday, 24 January 2019	Brushtail Possum Tawny Frogmouth Southern Boobook Sacred Kingfisher Bronzewing
	Friday, 25 January 2019	No results
PCT 729 Dry Sclerophyll Forests (Shrubby sub-formation) Southern Tableland Dry Sclerophyll Forests PCT 999 Dry Sclerophyll Forests (Shrubby sub-formation) Southern Tableland Dry Sclerophyll Forests	Saturday, 26 January 2019	Brushtail Possum x2 Eastern Pygmy-possum Eastern Tiger Snake
	Monday, 28 January 2019	Brushtail Possum Owlet Nightjar Southern Boobook
PCT 729 Dry Sclerophyll Forests (Shrubby sub-formation) Southern Tableland Dry Sclerophyll Forests	Tuesday, January 29, 2019	Common Brushtail Possum Eastern Pygmy-possum Sothern Boobook Tawny Frogmouth
	Wednesday, January 30, 2019	No results

PCT / Vegetation formation	Date	Species
PCT 999 Dry Sclerophyll Forests (Shrubby sub-formation) Southern Tableland Dry Sclerophyll Forests	Thursday, January 31, 2019	Brushtail Possum Tawny Frogmouth Sugar Glider Eastern Pygmy-possum *Antechinus agilis* Southern Boobook

Table D-5 Results of the camera trapping program in the Australian Alps portion of the project area

PCT / Vegetation formation	Set date	End Date	No. cameras	Species	No. photos
PCT 300 Wet Sclerophyll Forests (Grassy sub-formation) Southern Tableland Wet Sclerophyll Forests	Tuesday, 4 December 2018	Sunday, 20 January 2019	10	Deer Pig Bush Rat Agile Antechinus Brushtail Possum Wombat Lyrebird Cat Wallaby	4 60 151 9 907 37 4 32 329
PCT 1196 Grassy Woodlands Subalpine Woodlands	Tuesday, 4 December 2018	Sunday, 20 January 2019	6	Deer Brushtail Possum wombat Lyrebird Cat Wallaby Kangaroo	3 214 74 0 2 2 3
PCT 285 Dry Sclerophyll Forests (Shrub/grass sub-formation) Upper Riverina Dry Sclerophyll Forests	Tuesday, 4 December 2018	Sunday, 20 January 2019	2	Deer Brushtail possum Wombat	8 58 4

Table D-6 Results of the camera trapping program in the South Eastern Highlands portion of the project area

PCT / Vegetation formation	Set date	End Date	No. cameras	Species	No. photos
PCT 729 Dry Sclerophyll Forests (Shrubby sub-formation) Southern Tableland Dry Sclerophyll Forests	Tuesday, 4 December 2018	Sunday, 20 January 2019	3	Pig Brushtail Possum Wallaby Bush Rat Agile Antechinus Eastern Pygmy-possum	37 272 107 75 41 38

PCT / Vegetation formation	Set date	End Date	No. cameras	Species	No. photos
	Tuesday, 22 January 2019	Friday, 1 February 2019	13 E-cam2 E-cam7	Brushtail Possum Eastern Pygmy-possum Agile Antechinus Wallaby Pig	330 6 5 233 8
PCT 302 Dry Sclerophyll Forests (Shrub/grass sub-formation) Upper Riverina Dry Sclerophyll Forests	Tuesday, 22 January 2019	Friday, 1 February 2019	0	No camera in this PCT	0
PCT 296 Dry Sclerophyll Forests (Shrubby sub-formation) Southern Tableland Dry Sclerophyll Forests	Tuesday, 22 January 2019	Friday, 1 February 2019	11 E-cam27A E-cam8	Brushtail Possum Agile Antechinus Wallaby Bronzewing Rabbit	6 10 25 6 20
PCT 999 Dry Sclerophyll Forests (Shrubby sub-formation) Southern Tableland Dry Sclerophyll Forests	Tuesday, 22 January 2019	Friday, 1 February 2019	7	Eastern Pygmy-possum Common Ringtail Possum Brushtail Possum Wallaby Agile Antechinus Yellow-faced Honeyeater Eastern Whipbird Sugar Glider	5 1 130 520 2 1 2 2
PCT 300 Wet Sclerophyll Forests (Grassy sub-formation) Southern Tableland Wet Sclerophyll Forests	Tuesday, 22 January 2019	Friday, 1 February 2019	2	Brushtail Possum	27

Table D-7 Results of hair analysis from predator scats

Scat No.	PCT / Vegetation formation	Species identified from the scat
Sample 1	PCT 300 Wet Sclerophyll Forests (Grassy sub-formation) Southern Tableland Wet Sclerophyll Forests	Fox scat containing Platypus and Beetle
Sample 2	PCT 300 Wet Sclerophyll Forests (Grassy sub-formation) Southern Tableland Wet Sclerophyll Forests	Dog scat containing Eastern Grey Kangaroo

Scat No.	PCT / Vegetation formation	Species identified from the scat
Sample 3	PCT 729 Dry Sclerophyll Forests (Shrubby sub-formation) Southern Tableland Dry Sclerophyll Forests	Dog scat containing Horse and seed

Note: Scat hair analysis performed by Georgeanna Story from Scats About.

Table D-8 Results of the bird surveys in the Australian Alps portion of the project area

PCT / Vegetation formation	Site	Date	Species
PCT 729 Dry Sclerophyll Forests (Shrubby sub-formation) Southern Tableland Dry Sclerophyll Forests	1	Thursday, December 6, 2018	Cicada bird Grey Shrike-thrush Yellow-tailed Black Cockatoo Gang-gang Cockatoo Yellow-faced Honeyeater Grey Fantail Red Wattlebird Fan-tailed Cuckoo Shining Bronze Cuckoo Superb lyrebird
PCT 300 Wet Sclerophyll Forests (Grassy sub-formation) Southern Tableland Wet Sclerophyll Forests	3	Friday, December 7, 2018	Striated Thornbill White-browed Scrubwren White-throated Treecreeper Spotted Pardalote Grey Shrike-thrush Australian Magpie Laughing Kookaburra Yellow-faced Honeyeater White-winged Chough Crimson Rosella Grey Fantail
PCT 1196 Grassy Woodlands Subalpine Woodlands	5	Sunday, December 9, 2018	Red Wattlebird Yellow-faced Honeyeater Fan-tailed Cuckoo Grey Shrike-thrush Wonga Pigeon Brush Cuckoo Spotted Pardalote
	6	Sunday, December 9, 2018	Grey Fantail White-browed Scrubwren Australian Magpie Red Wattlebird Yellow-faced Honeyeater Striated Thornbill Little raven Crimson Rosella Rufous Fantail White-eared Honeyeater Rufous Whistler Wonga Pigeon

PCT / Vegetation formation	Site	Date	Species
PCT 1196 Grassy Woodlands Subalpine Woodlands	7	Monday, December 10, 2018	Eastern Whipbird White-eared Honeyeater Yellow-faced Honeyeater Silvereye Grey Shrike-thrush Gang-gang Cockatoo Australian Magpie Spotted Pardalote Brush Cuckoo Fan-tailed Cuckoo Nankeen Kestrel Flame Robin Superb fairy wren
Various opportunistic recordings	NA	Monday, December 3, 2018 - Monday, December 10, 2018	Sulphur-crested Cockatoo White-naped Honeyeater Southern boobook spotted nightjar Sacred Kingfisher Satin Bowerbird Satin Flycatcher Pheasant Coucal Pied Currawong Australian Golden Whistler Australian King Parrot Bassian Thrush Eastern Spinebill

Table D-9 Results of the bird surveys in the South Eastern Highlands portion of the project area

PCT / Vegetation formation	Site	Date	Species
PCT 302 Dry Sclerophyll Forests (Shrub/grass sub-formation) Upper Riverina Dry Sclerophyll Forests	10	Thursday, January 24, 2019	Brown-headed Honeyeater Eastern Whipbird Eurasian Blackbird Fuscous Honeyeater Olive-backed Oriole Silvereye Superb Fairywren White-throated Treecreeper Yellow-faced Honeyeater
	Near Lick Hole Gully	Saturday, January 26, 2019	New Holland Honeyeater Silvereye Fuscous Honeyeater Satin Bowerbird Rufous Whistler Superb Fairy Wren Red-browed Finch

PCT / Vegetation formation	Site	Date	Species
PCT 296 Southern Tableland Dry Sclerophyll Forests Dry Sclerophyll Forests (Shrubby sub-formation)	11	Thursday, January 24, 2019	Golden Whistler White-throated Treecreeper Black-faced Cuckoo Shrike Fuscous Honeyeater Rufous Whistler Gang-gang Cockatoo Wedge-tailed Eagle
PCT 302 Dry Sclerophyll Forests (Shrub/grass sub-formation) Upper Riverina Dry Sclerophyll Forests PCT 296 Southern Tableland Dry Sclerophyll Forests Dry Sclerophyll Forests (Shrubby sub-formation)	10, 11 – general observations	January - February, 2019	Crimson Rosella Olive-backed Oriole Fuscous Honeyeater White-throated Treecreeper Red-browed Finch Satin Bowerbird Tree Martin Sacred Kingfisher Black-faced Cuckoo Shrike Gang-gang Cockatoo Common Bronzewing Brush Cuckoo Diamond Firetail (x3) Yellow-faced Honeyeater Eastern Yellow Robin Superb Fairy Wren Striated Thornbill White-throated Honeyeater Grey Shrike Thrush Silvereye Eastern Whipbird Owlet Nightjar New Holland Honeyeater White-naped Honeyeater Brown-headed Honeyeater Pied Currawong Australian Magpie Southern Boobook Tawny Frogmouth Rufous Whistler Golden Whistler Noisy Friarbird Grey Fantail Spotted Pardalote Striated Pardalote Leaden Flycatcher White-browed Scrubwren Eastern Spinebill King Parrot Rufous Fantail

PCT / Vegetation formation	Site	Date	Species
			Wonga Pigeon Wedge-tailed Eagle Brown Goshawk Buff-rumped Thornbill Blackbird Peaceful Dove Brown Quail
PCT 729 Dry Sclerophyll Forests (Shrubby sub-formation) Southern Tableland Dry Sclerophyll Forests	8	Sunday, January 27, 2019	No new species
	9	Sunday, January 27, 2019	No new species
PCT 999 Dry Sclerophyll Forests (Shrubby sub-formation) Southern Tableland Dry Sclerophyll Forests	12	Sunday, January 27, 2019	No new species

Table D-10 Results of the bat survey (harp trapping) in the Australian Alps portion of the project area

PCT / Vegetation formation	Site	Date	Species
PCT 1196 Grassy Woodlands Subalpine Woodlands	Harp 1	Wednesday, 5 December 2018	No captures
		Thursday, 6 December 2018	*Nyctophilus geoffroyi*
PCT 285 Dry Sclerophyll Forests (Shrub/grass sub-formation) Upper Riverina Dry Sclerophyll Forests	Harp 2	Thursday, 6 December 2018	*Vespadelus darlingtoni* x 15 *Vespadelus regulus* x 2 *Nyctophilus geoffroyi* *Chalinolobus morio*
		Friday, 7 December 2018	*Nyctophilus geoffroyi* *Vespadelus darlingtoni* x 5 *Vespadelus regulus* x 4
PCT 300 Wet Sclerophyll Forests (Grassy sub-formation) Southern Tableland Wet Sclerophyll Forests	Harp 3	Saturday, 8 December 2018	*Vespadelus vulturnus* *Chalinolobus morio*
		Sunday, 9 December 2018	*Vespadelus vulturnus* *Vespadelus darlingtoni* x 3
PCT 300 Wet Sclerophyll Forests (Grassy sub-formation) Southern Tableland Wet Sclerophyll Forests	Harp 4	Friday, 7 December 2018	*Vespadelus darlingtoni* *Chalinolobus morio* *Nyctophilus geoffroyi*
PCT 300 Wet Sclerophyll Forests (Grassy sub-formation) Southern Tableland Wet Sclerophyll Forests	Harp 5	Saturday, 8 December 2018	*Vespadelus vulturnus* *Chalinolobus morio*

Table D-11 Results of the bat survey (harp trapping) in the South Eastern Highlands portion of the project area

PCT / Vegetation formation	Site	Date	Species
	Harp 6		No captures
PCT 302 Dry Sclerophyll Forests (Shrub/grass sub-formation)	Harp 7	Wednesday, 23 January 23 2019	*Vespadelus darlingtoni*
		Monday, 28 January 2019	*Nyctophilus gouldi x 2* *Nyctophilus geoffroyi* x 14 *Vespadelus vulturnus* x 6
		Tuesday, 29 January 2019	*Vespadelus vulturnus* x 5
	Harp 8	Monday, 28 January 28 2019	*Nyctophilus geoffroyi* *Vespadelus darlingtoni* *Vespadelus vulturnus* x 8 *Scoteanax rueppellii* or *Falsistrellus tasmaniensis* (escaped before positive ID could be made)
		Tuesday, 29 January 2019	*Vespadelus vulturnus* x 7 *Chalinolobus morio* x 2 *Nyctophilus geoffroyi* x 4 *Vespadelus darlingtoni* x 2 *Nyctophilus gouldi* x 4 *Scotorepens orion*

Table D-12 Results of the reptile surveys in the Australian Alps portion of the project area

PCT / Vegetation formation	Site	Date	Species
PCT 300 Wet Sclerophyll Forests (Grassy sub-formation) Southern Tableland Wet Sclerophyll Forests	2	Thursday, 6 December 2018	Alpine meadow-skink x 3
	3	Thursday, 6 December 2018	Tree-crevice skink Delicate skink Blotched Blue Tongue Lizard
		Monday, 10 December 2018	Alpine meadow-skink Delicate skink Tree-crevice skink
	4	Thursday, 6 December 2018	Delicate skink x 2
PCT 1196 Grassy Woodlands Subalpine Woodlands	5	December 2018	Copperhead snake Alpine meadow-skink x 3 Delicate skink x 5 Pale-Flecked Garden Sunskink x 3
	6	December 2018	Alpine meadow-skink x 1 Delicate skink x 3 Pale-Flecked Garden Sunskink x 20
	7	December 2018	No results

Table D-13 Results of the reptile surveys in the South Eastern Highlands portion of the project area

PCT / Vegetation formation	Site	Date	Species
PCT 729 Dry Sclerophyll Forests (Shrubby sub-formation) Southern Tableland Dry Sclerophyll Forests	1	Thursday, 6 December 2018	No results
PCT 729 Dry Sclerophyll Forests (Shrubby sub-formation) Southern Tableland Dry Sclerophyll Forests	8	Wednesday, January 23, 2019	No results
PCT 296 Southern Tableland Dry Sclerophyll Forests Dry Sclerophyll Forests (Shrubby sub-formation)	9	Thursday, 24 January 2019	No results
PCT 296 Southern Tableland Dry Sclerophyll Forests Dry Sclerophyll Forests (Shrubby sub-formation)	10	Thursday, 24 January 2019	No results
PCT 296 Southern Tableland Dry Sclerophyll Forests Dry Sclerophyll Forests (Shrubby sub-formation)	11	Thursday, 24 January 2019	Jacky Dragon Skink sp.
PCT 999 Dry Sclerophyll Forests (Shrub/grass sub-formation) Upper Riverina Dry Sclerophyll Forests	12	Friday, 25 January 2019	No results
PCT 999 Dry Sclerophyll Forests (Shrub/grass sub-formation) Upper Riverina Dry Sclerophyll Forests	13	Sunday, 27 January 2019	No results
Opportunistic sightings	Various	Wednesday, 23 January 2019 - Friday, 1 February 2019	Robust Ctenotus Blotched Blue Tongue Lizard Copper-Tailed Skink Inland Snake-eyed Skink Tiger Snake Red-bellied Black Snake Eastern Small-eyed Snake Australian Water Dragon Jacky Dragon

Appendix E. Echolocation call analysis

Microbat Call Identification Report

Prepared for ("Client"):	Jacobs
Survey location/project name:	Snowy Hydro 2.0 Transmission
Survey dates:	December 2018
Client project reference:	IA199900
Job no.:	JAC-1903
Report date:	31 May 2019

Methods

Data supplied

Balance! Environmental received 21 raw ZCA files and associated log files recorded by two Anabat Express bat-detectors during two survey periods (4-12 December 2018 and 23-30 January 2019).

Post-processing

All ZCA files were converted to zero-crossing analysis bat-call sequence files (ZC files) using *Anabat Insight* (Version 1.8.3; Titley Scientific, Brisbane). This process yielded 12,825 ZC files for analysis.

Call identification

Call analyses were performed in *Anabat Insight* (Titley Scientific, Brisbane), with all **ZC** files passed through a Decision Tree analysis to exclude files containing only background noise and group the remaining bat calls based on zero-crossing analysis parameters (e.g. characteristic frequency (Fc), time between calls (TBC) and pulse curvature).

The preliminary call identities applied by the Decision Tree process were then confirmed or adjusted manually by comparing call spectrograms and derived metrics with those of regionally relevant reference calls from **a**nd/or with published call descriptions (e.g. Pennay *et al*. 2004). Consideration was also given to the probability of species' occurrence based on published distribution information (e.g. Churchill 2008; van Dyck et al. 2013) and on-line database records (e.g. http://www.ala.org.au).

Reporting standard

The format and content of this report follows Australasian Bat Society standards for the interpretation and reporting of bat call data (Reardon 2003). Species nomenclature follows Jackson and Groves (2015).

Results & Discussion

Of the 12,825 ZC files generated from the raw detector files, 8987 contained only non-bat background noise. The remaining 3838 ZC files included 4115 bat-calls, two-thirds (2751) of which were positively identifiable, while the other 1364 calls (33%) were unresolved as they had characteristics that were potentially attributable to two or more species.

Fourteen call types were reliably identified (see **Table 1**), 13 to individual species and the other to the *Nyctophilus* genus, two species of which probably occur in the study area (*N. geoffroyi* and *N. gouldi*).

The unresolved calls were allocated to 11 multi-species groups, most of which represented species that were also positively identified elsewhere in the data set. Where calls were attributed to an unresolved group, **Table 1** lists all group members as "possible" for the relevant detector-night unless reliably identified calls were available for one or more of those species for the same detector-night.

Appendix 1 provides a full list of the unresolved species groups and shows the numbers of calls allocated to each unique species and unresolved group per detector-night.

Table 1 Bats recorded during the summer 2018-19 surveys for Snowy 2.0 Transmission Project.

♦ = 'definite' - at least one call was attributed unequivocally to the species

□ = 'possible' - calls like those of the species were recorded, but were not reliably identified

Part A – December surveys

Detector:	Anabat 1			Anabat 2							
Date:	7/12	10/12	11/12	4/12	5/12	6/12	7/12	8/12	9/12	10/12	11/12
Chalinolobus gouldii		♦	♦	♦	♦	♦	♦	♦		□	□
Chalinolobus morio	♦	♦	♦	♦	♦	♦	♦	♦		♦	♦
Falsistrellus tasmaniensis	□	♦	□	□	□	□		□	♦		□
Nyctophilus sp.	♦	♦		♦	♦	♦		♦		♦	♦
Scoteanax rueppellii				□	□		□		□		□
Scotorepens greyii		□	□		□			□			□
Scotorepens orion	□	□		♦	♦	♦	□		♦		□
Vespadelus darlingtoni	□	♦	□	♦	♦	♦	♦	♦	♦	♦	♦
Vespadelus regulus	♦	♦	□	♦	♦	♦	♦	♦	♦	♦	□
Vespadelus vulturnus	♦	□	□	♦	♦	♦	♦	□	♦	□	
Miniopterus orianae oceanensis	□	□	□	♦	♦	♦	□	♦	□	□	♦
Austronomus australis		♦	♦	♦	♦	♦	♦	♦	♦	♦	♦
Ozimops planiceps		♦	♦	♦	♦	♦	♦	♦		♦	♦
Ozimops ridei	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦

Part B – January surveys

Detector:	Anabat 1					Anabat 2				
Date:	23/1	24/1	25/1	28/1	29/1	23/1	24/1	25/1	26/1	27/1
Chalinolobus gouldii	♦	□	♦		♦	♦	♦		♦	
Chalinolobus morio	♦	♦	♦	♦	♦					
Falsistrellus tasmaniensis	♦	♦	♦	♦	♦		□	□	□	□
Nyctophilus sp.	♦	♦	♦	♦	♦				♦	♦
Scoteanax rueppellii									□	□
Scotorepens greyii			□	□	□		□			
Scotorepens orion	□	□	□	□	□		□	♦	♦	♦
Vespadelus darlingtoni	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦
Vespadelus regulus	♦	♦	♦	♦	♦	♦	♦	♦	♦	□
Vespadelus vulturnus	♦	♦	♦	♦	♦	♦	♦	♦	♦	□
Miniopterus orianae oceanensis	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦
Austronomus australis	♦	♦	♦		♦	♦	♦	♦	♦	♦
Ozimops planiceps	♦	♦	□		□	□	□		□	
Ozimops ridei	♦	♦	♦	♦	♦	♦		♦	♦	♦
Saccolaimus flaviventris		♦			♦					

Appendix 2 provides sample spectrograms of calls recorded during the present survey for each identified species or unresolved group

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Appendix 1 Bats recorded during the summer 2018-19 surveys for Snowy 2.0 Transmission Project. **Part A – December surveys**

Number of calls detected per detector-night for individual species and unresolved groups.

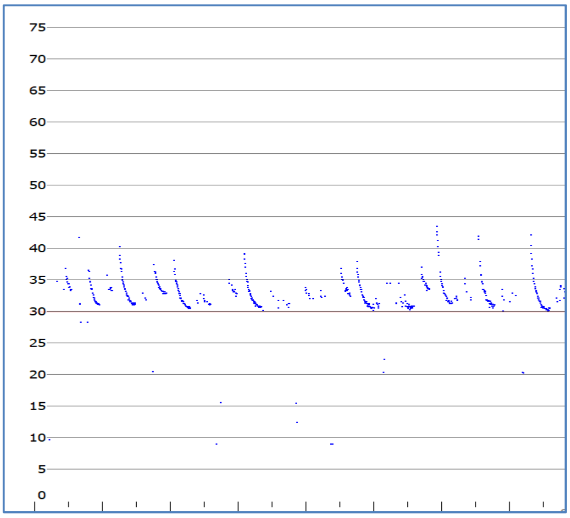
Detector:	Anabat 1			Anabat 2								Species total
Date:	7/12	10/12	11/12	4/12	5/12	6/12	7/12	8/12	9/12	10/12	11/12	
Positively identified calls												
Chalinolobus gouldii		3	3	9	4	1	8	6				34
Chalinolobus morio	4	7	1	19	12	3	4	4		3	4	61
Falsistrellus tasmaniensis		3							1			4
Nyctophilus sp.	2	2		1	8	6		6		1	1	27
Scotorepens orion				1	3	1			2			7
Vespadelus darlingtoni		1		61	105	115	54	61	10	10	2	419
Vespadelus regulus	4	2		38	16	3	16	65	2	1		147
Vespadelus vulturnus	1			2	3	1	1		1			9
Miniopterus orianae oceanensis				1	7	4		1			1	14
Austronomus australis		48	2	2	109	1	5	4	7	2	4	184
Ozimops planiceps		228	82	5	39	5	18	14		10	1	402
Ozimops ridei	1	6	2	2	34	2	1	4	1	17	3	73
Saccolaimus flaviventris												0
Unresolved calls												
F. tasmaniensis / Scotorepens greyii		7	1									8
F. tasmaniensis / S. greyii / V. darlingtoni					1			1			1	3
F. tasmaniensis / S. orion	1	3		2	1	1						8
S. orion / Scoteanax rueppellii				3	5		1		2		1	12
V. darlingtoni / V. regulus	1	4	1	21	19	32	21	72	16	2		189
V. darlingtoni / V. regulus / M. o. oceanensis	3	1			3	1	4	1	4	1	1	19
V. vulturnus / C. morio		1	3									4
V. vulturnus / M. o. oceanensis			1	6	13	7		40		1		68
O. planiceps / C. gouldii		84	46	15	19	2	21	34		24	6	251
O. ridei / C. gouldii		16	16	2								34
O. planiceps / O. ridei		26	12	13	63	12	6	8		18	2	160
Detector-night total	17	442	170	203	464	197	160	321	46	90	27	2137

Appendix 1 Bats recorded during the summer 2018-19 surveys for Snowy 2.0 Transmission Project. **Part B – January surveys**

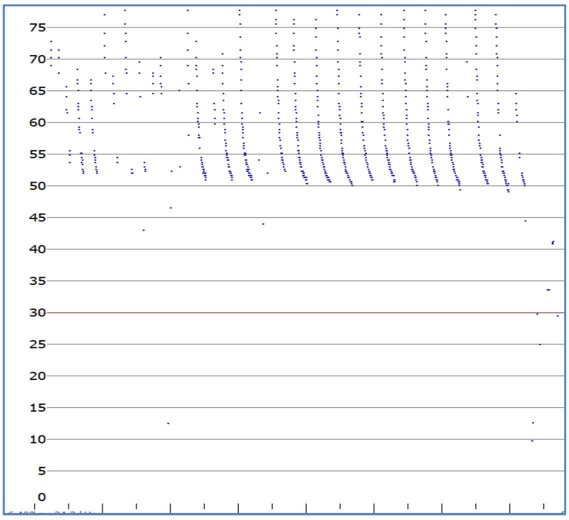
Number of calls detected per detector-night for individual species and unresolved groups.

Detector:	Anabat 1					Anabat 2					Species total
Date:	23/1	24/1	25/1	28/1	29/1	23/1	24/1	25/1	26/1	27/1	
Positively identified calls											
Chalinolobus gouldii	3		3		2	3	2		1		14
Chalinolobus morio	1	2	1	6	3						13
Falsistrellus tasmaniensis	3	5	3	16	13						40
Nyctophilus sp.	8	24	24	42	55				1	2	156
Scotorepens orion								1	1	1	3
Vespadelus darlingtoni	168	120	93	51	44	5	3	6	3	4	497
Vespadelus regulus	79	29	12	1	8	2	1	1	2		135
Vespadelus vulturnus	5	11	3	4	2	1	4	1	1		32
Miniopterus orianae oceanensis	16	14	5	15	15	1	2	2	3	2	75
Austronomus australis	5	65	135		6	6	19	25	39	2	302
Ozimops planiceps	7	3									10
Ozimops ridei	17	23	24	4	9	2		1	8	2	90
Saccolaimus flaviventris		1			2						3
Unresolved calls											
F. tasmaniensis / Scotorepens greyii			1	1			1				3
F. tasmaniensis / S. greyii / V. darlingtoni			1	2	1						4
F. tasmaniensis / S. orion	3	8	7	3	4		2	1	2	2	32
S. orion / Scoteanax rueppellii									6	3	9
V. darlingtoni / V. regulus	84	89	61	45	46	1	1	5	5	6	343
V. darlingtoni / V. regulus / M. o. oceanensis	8	14	2	20	6	7	8	4	6		75
V. vulturnus / C. morio	1		1	3	1						6
V. vulturnus / M. o. oceanensis	8	9	6	13	20			3	4	4	67
O. planiceps / C. gouldii	1	2	3			1	1				8
O. ridei / C. gouldii	1	4	5		8	1					19
O. planiceps / O. ridei	21	13	5		2				1		42
Detector-night total	439	436	395	226	247	30	44	50	83	28	1978

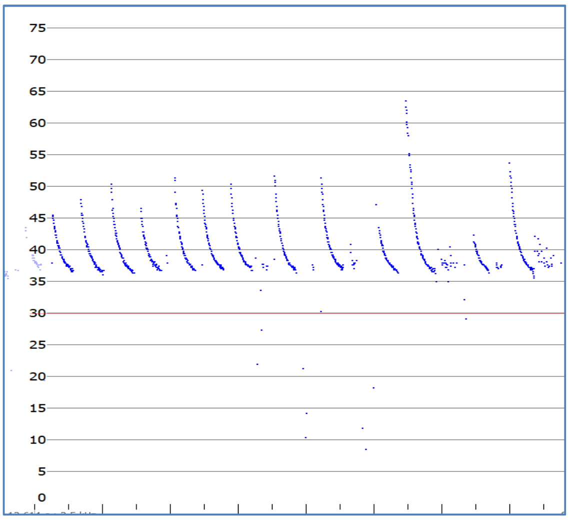
Appendix 2 Representative call sequences: Snowy 2.0 Transmission surveys, summer 2018-19. (Scale: 10msec per tick; time between pulses removed)



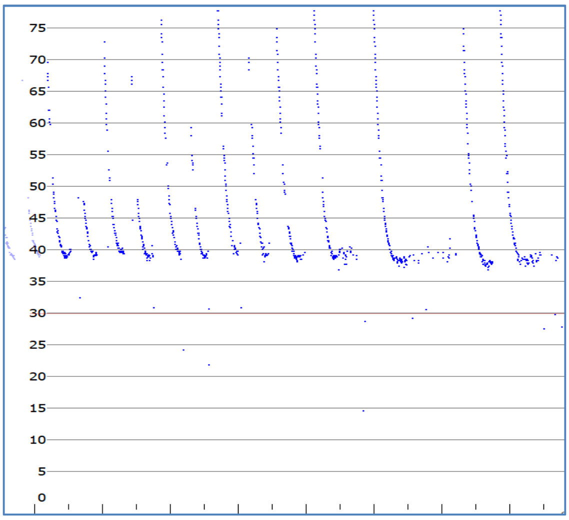
Chalinolobus gouldii



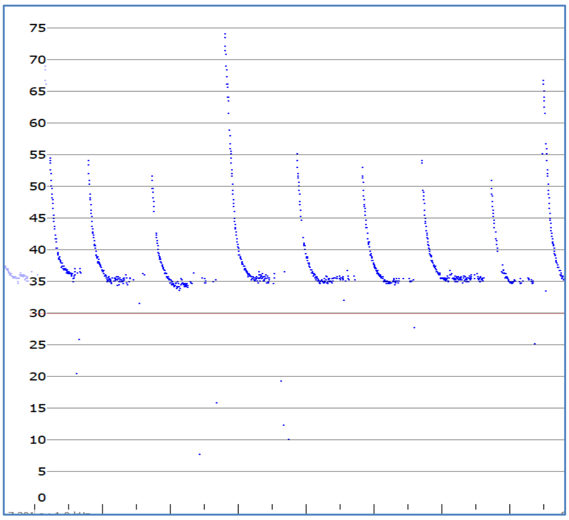
Chalinolobus morio



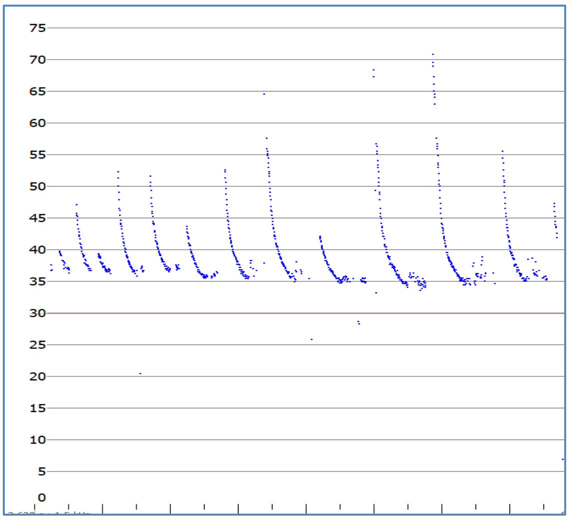
Falsistrellus tasmaniensis



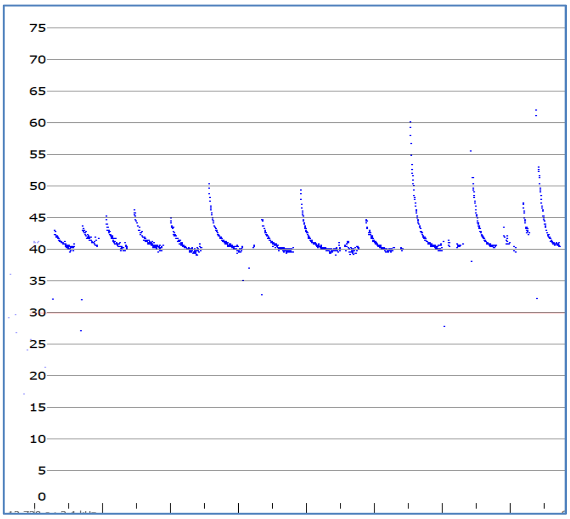
F. tasmaniensis / Scotorepens greyii



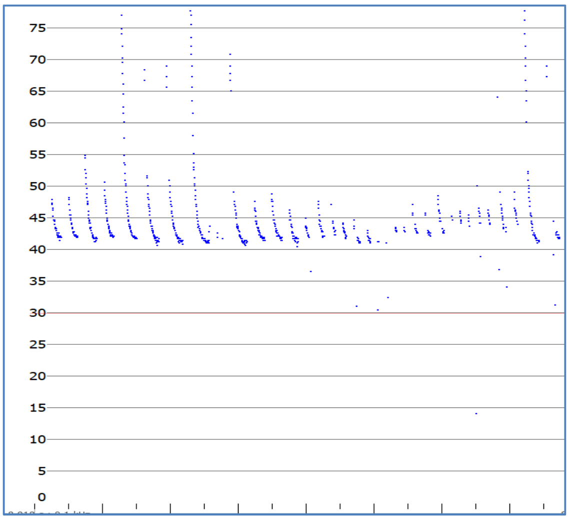
Scotorepens orion



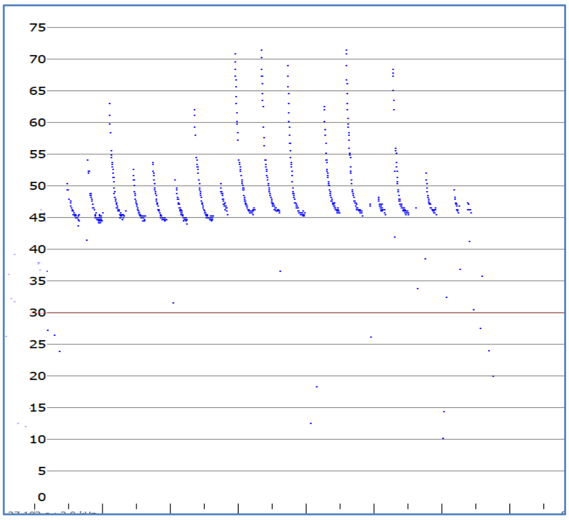
S. orion / Scoteanax rueppellii



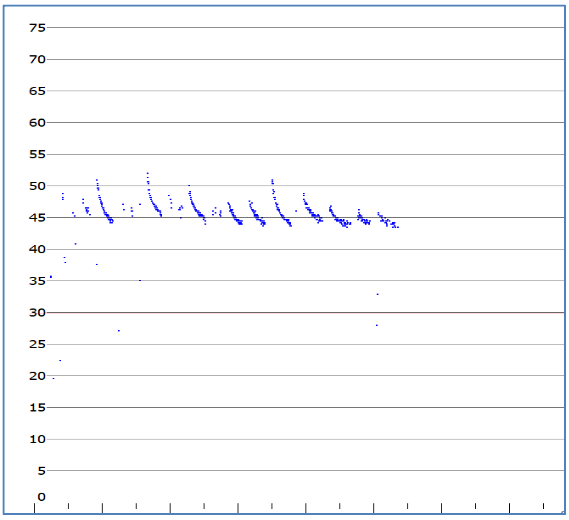
Vespadelus darlingtoni



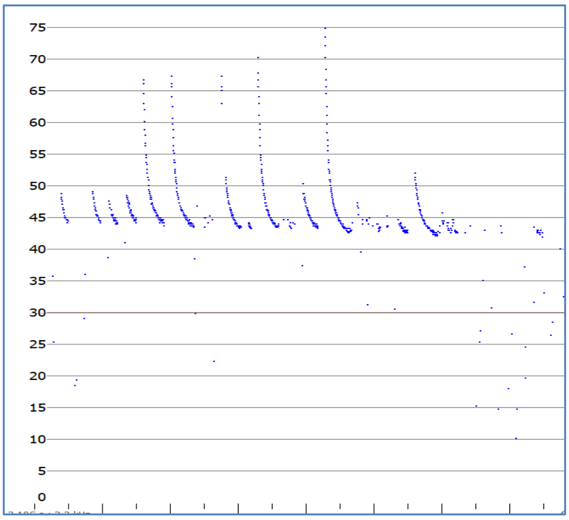
Vespadelus regulus



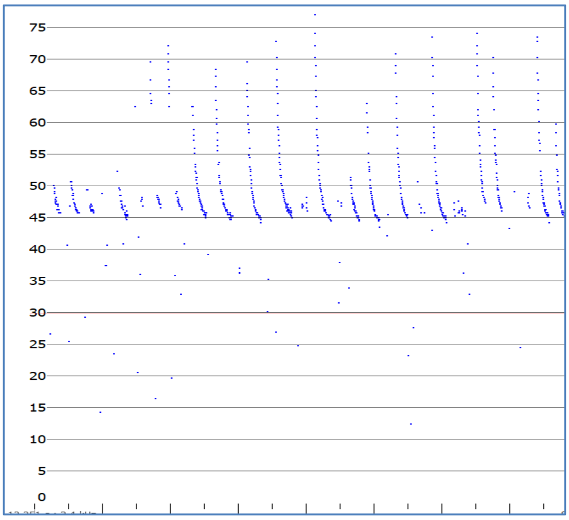
Vespadelus vulturnus



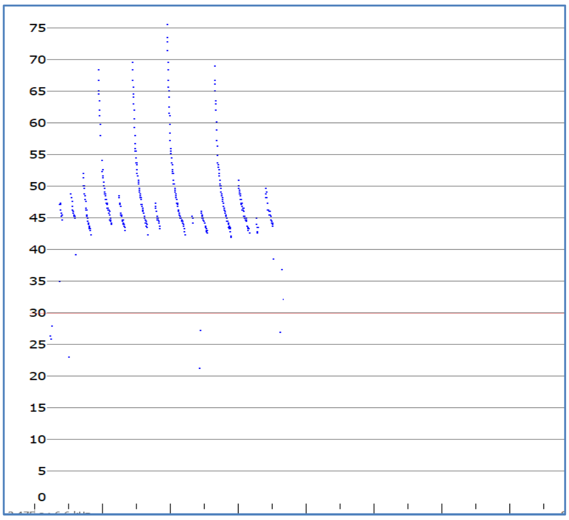
Miniopterus orianae oceanensis



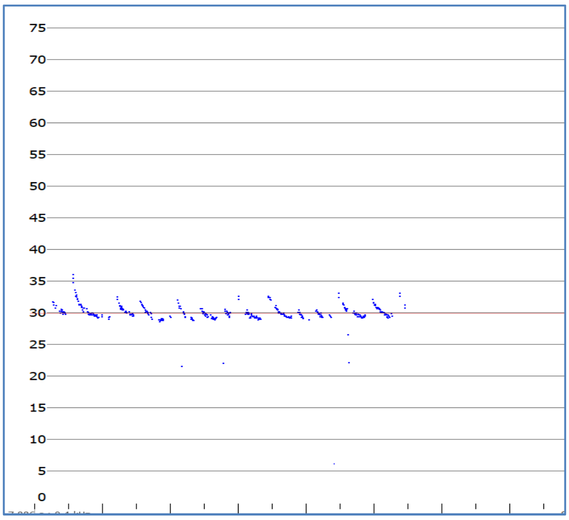
V. darlingtoni / V. regulus / M. o. oceanensis



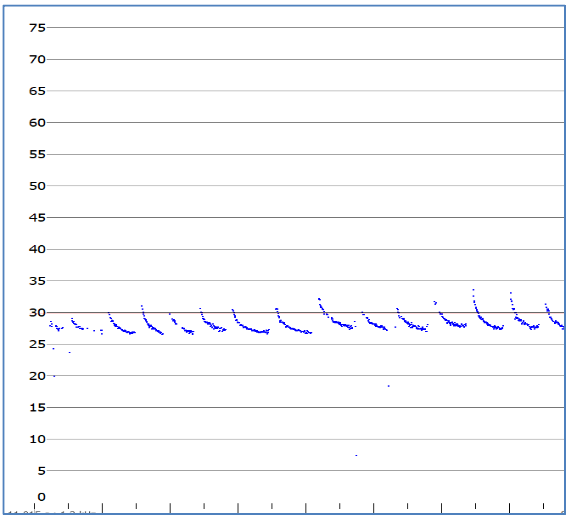
V. vulturnus. / M. o. oceanensis



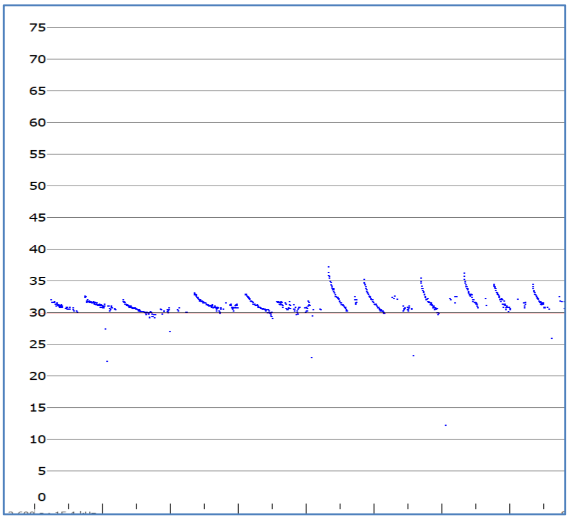
Nyctophilus sp.



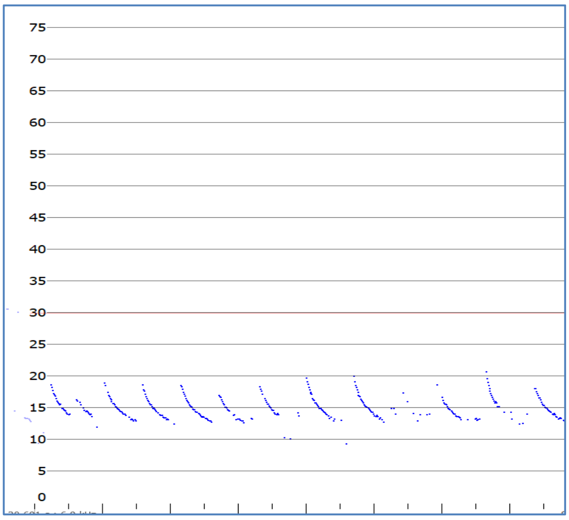
Ozimops sp. / *C. gouldii*



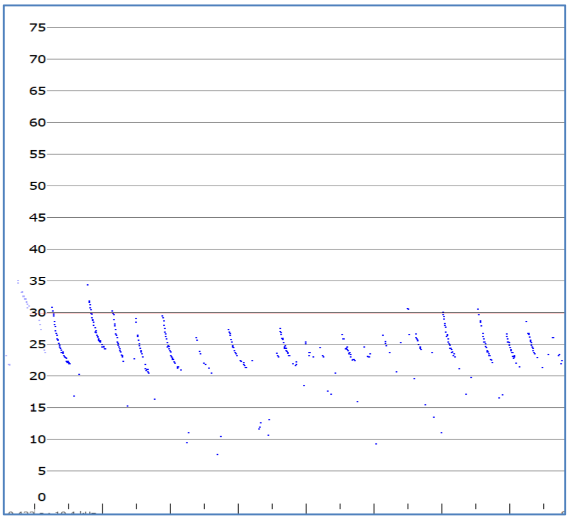
Ozimops planiceps



Ozimops ridei



Austronomus australis



Saccolaimus flaviventris

Appendix F. Thelymitra atronitida expert report

SoS Data Deficient Species: Targeted Survey Results and Management Recommendations for *Thelymitra atronitida* Jeanes

Prepared by AMBS Ecology & Heritage Pty Ltd
for NSW Office of Environment and Heritage

Final

June 2019

AMBS Reference: 17481

Document Information

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Recipient:	James Brazill-Boast, NSW Government Office of Environment and Heritage, James.brazillboast@environment.nsw.gov.au
Author	Diane Callaghan
Approved by:	Belinda Pellow, David Keith

Executive Summary

AMBS Ecology & Heritage Pty Ltd (AMBS) was commissioned by the NSW Office of Environment and Heritage (OEH) to prepare a species-specific report to address priority knowledge gaps for the data deficient species (DDS) *Thelymitra atronitida* Jeanes. Records of *Thelymitra atronitida* occurrence were accessed from BioNet, the Atlas of Living Australia, and the Australasian Virtual Herbarium to determine appropriate survey areas. Contact with numerous experts and former collectors was an essential component of the preliminary assessment. Two locations for this species are recorded in BioNet, Kamay Botany National Park and Bago State Forest. The Bago State Forest herbarium specimen was examined by Dr Mark Clements and determined to be likely misidentified therefore surveys focused on the records from Kamay Botany Bay National Park which were confirmed by Jeanes from collections by Dean Rouse and Peter Weston. Margaret Bradhurst also provided details on orchid sightings at the National Park. Approximate locations of former collections, locality descriptions provided by experts, and likely suitable habitat based on habitat descriptions from previous records, were all used to inform the search areas. Targeted searches were conducted on 13 August and 19 September 2018.

A population of four orchids was found in the vicinity of previous collections by Peter Weston and Dean Rouse. One specimen was collected and determined to be *Thelymitra malvina* M.A. Clem., D.L. Jones & Molloy. This species is not listed as a threatened species in NSW. The specimens were located under unburnt shrubs adjacent to a walking track. Although the extant population was small, it appears to be in good condition. Evident threats to this population include herbivory by introduced vertebrates and human disturbance which could be exacerbated by stochastic environmental events (e.g. weather events or fire). Should a population of *Thelymitra atronitida* be located in this location in the future these threats would apply to the population.

We recommend additional searches during known flowering times in suitable habitat i.e. Sydney Sandstone Heath, in Kamay Botany National Park, to determine whether any other *Thelymitra* specimens recorded match the taxonomic description of *Thelymitra atronitida.* Additional areas identified as suitable habitat (e.g. Nadgee Nature Reserve and southern heathland in NSW) may also be targeted. We also recommend a taxonomic review of this species, given its resemblance in morphology and ecology to the co-occurring *Thelymitra malvina*.

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1 Introduction

1.1 Background

AMBS Ecology & Heritage Pty Ltd (AMBS) was commissioned by the NSW Office of Environment and Heritage (OEH) to prepare a report to address priority knowledge gaps for the data deficient species (DDS) *Thelymitra atronitida* Jeanes. The data deficient species management stream, as a component of the larger Saving our Species (SoS) program, include threatened species which are currently lacking important knowledge to inform effective management. The primary objective is to fill gaps pertaining to threatened species' ecology, distribution, threats and/or management strategies (OEH 2016). This requires review of all existing information, field surveys, and thorough reporting of results.

1.2 Project overview

This report aims to address knowledge gaps for *Thelymitra atronitida* by investigating historical records, literature searches, ecological field techniques, known vegetation mapping, in-house botanical proficiency and expert opinions. A significant portion of this project relied on communications with expert botanists with first-hand experience with the species itself and its associated records.

Deliverables associated with this project were to:

- identify all known records of *Thelymitra atronitida;*
- survey areas where records occur unless suitable habitat is questionable;
- characterise habitat, associated species, and soil types;
- record population size, extent, reproductive status, and health;
- identify any possible threats to existing populations; and
- provide recommendations for managing populations and advise where additional searches or data are required.

Archived email communications, shapefiles of search areas and waypoints, and additional photographs will be provided separately.

1.3 Species Description

Thelymitra atronitida Jeanes (Black-hooded Sun Orchid) is currently one of 22 priority plants under the SoS DDS program. It was originally described by Jeffrey A. Jeanes in 2000 and is one of many species that form the *Thelymitra pauciflora* R.Br. complex (Bates 2010; Jeanes 2000, 2004). The species is described as a glabrous terrestrial herb, leaf linear to linear-lanceolate, dark green with purplish base, apex acute; scape 30-50 cm tall; flowers 2-8, moderately dark blue with darker longitudinal veins; post-anther lobe tubular, inflated, hooded, dorsally compressed, apex shortly bilobed, lobes toothed, mostly glossy black, apex yellow; lateral lobes with terminal toothbrush-like white hairs (PlantNET accessed 25/04/2019; Plate 1.1).

Plate 1.1 Distinctive characteristics of *Thelymitra atronitida*, image courtesy of Backhouse et al. (2016).

This species has a limited known distribution in NSW with only two disjunct populations, Kamay Botany Bay National Park in Kurnell and Bago State Forest in Tumbarumba (AVH 2019). Its' national distribution includes records from the eastern coast of Victoria, Wellington VIC, Cape Barren Island, Kingston TAS, and Coles Bay TAS (AVH 2019, Figure 1.1).

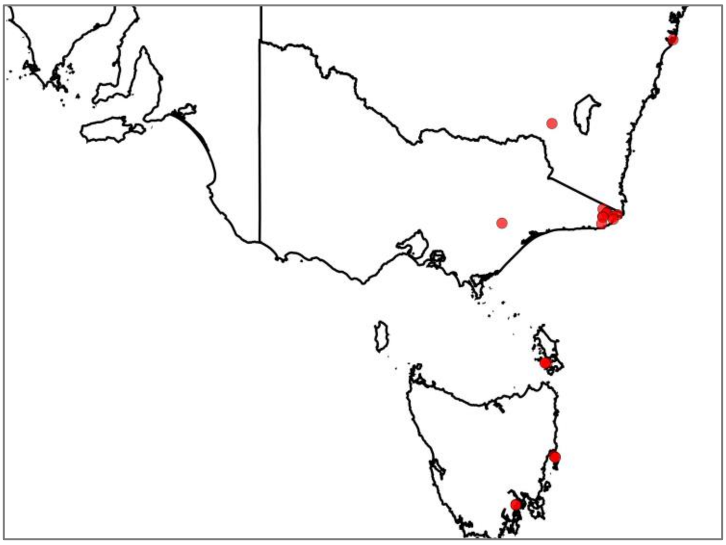

Figure 1.1 Distribution of *Thelymitra atronitida* (AVH 2019).

Thelymitra atronitida very closely resembles *Thelymitra malvina* M.A. Clem., D.L. Jones & Molloy. The taxonomic key describes *Thelymitra atronitida* as having a glossy black post-anther lobe, white trichomes, two sterile bracts, and pale blue flowers. Alternatively, *Thelymitra malvina* has a dark reddish-brown post-anther lobe, pink or mauve trichomes (rarely white), three sterile bracts, and slate blue to purplish flowers (Jeanes 2004).

2 Methods

2.1 Species background research

Records of *Thelymitra atronitida* were accessed from BioNet on 07 March 2018 (Appendix A). These records were compared with records from the Atlas of Living Australia (ALA) and the Australasian Virtual Herbarium (AVH). There are five records of *Thelymitra atronitida* occurring in NSW according to both BioNet and AVH records (Table 2.1, Figure 2.1). The earliest is from Cape Solander (Kamay Botany Bay National Park) on 08 August 1988 (NSW417826, Plate 2.1) and was originally identified as *Thelymitra pauciflora* and later revised by Jeff Jeanes. The habitat was described as “Gently undulating sandstone pavements. Coastal heath dominated by *Baeckea imbricata, Allocasuarina distyla, Banksia ericifolia, Westringia fruticosa*. Hawkesbury Sandstone. Shallow, peaty, black soil.” The AVH indicates that according to NSWDATA there should be a dried sheet collection but that only the spirit material could be located (spirit collection no. 6086). The identification of the preserved spirit collection as *Thelymitra atronitida* was confirmed by Dr Mark Clements at the Australian National Herbarium (Clements pers. comm. 29 January 2019). We were unable to contact Jeff Jeanes for more details on the records from both Cape Solander and Bago State Forest.

Table 2.1 Consolidated records of *Thelymitra atronitida* from NSW.

Collector	Date of collection	Record ID	Location description	Coordinates (decimal)
A. Bishop, P.H. Weston	08/08/1988	NSW417826 (spirit collection 6086)	End of Cape Solander Drive, Cape Solander	-34.019255, 151.228935
P.G. Branwhite	03/12/1999	CANB609392	Bago State Forest	-35.700000, 148.150000 (generalised coordinates)
Jim Kelton	07/02/2004	Not available	Brandy Marys Bago State Forest Crown Leases	-35.762889, 148.288872
P.G. Branwhite, D. Jones, J. Kelton	23/6/2005	Not available	Bago State Forest	-35.632346, 148.182963
Dean Rouse	14/09/2006	MEL2296309A	End of Cape Solander Drive, Cape Solander	-34.016750, 151.228278

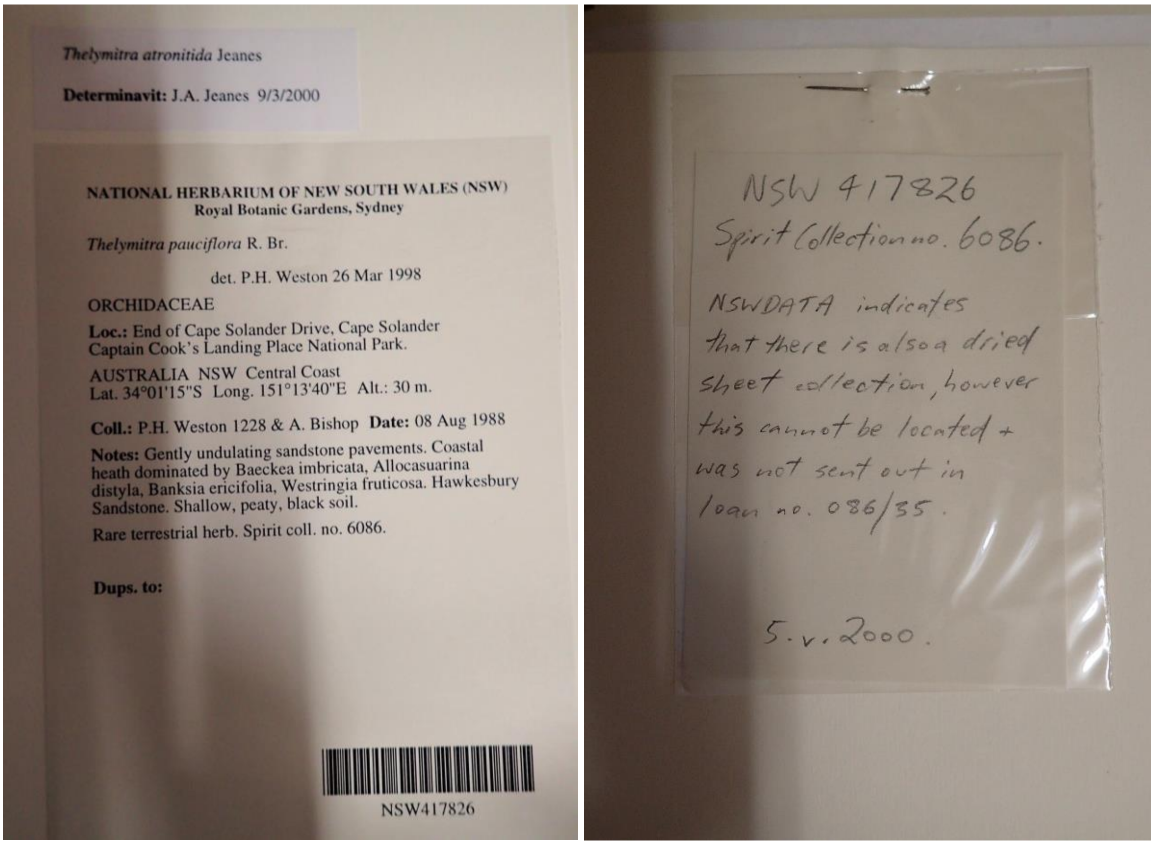

Plate 2.1 Original and revised record description for NSW417826, National Herbarium of New South Wales.

A later collection was made in Cape Solander in 2005 by Dean Rouse, and the specimen was identified as *Thelymitra malvina* by Jeanes (MEL2296309A). Jeanes requested additional material from Rouse because the plants looked unusual (Rouse pers. comm. 08 September 2018). The following year, on 14 September 2006, a specimen from the same area was collected by Rouse and identified by Jeanes as *Thelymitra atronitida* (MEL2296487A, Plate 2.2).

Plate 2.2 *Thelymitra atronitida*, Cape Solander 2006. Courtesy of Dean Rouse.

Three records of *Thelymitra atronitida* come from a disjunct locality in Bago State Forest (Tumbarumba LGA) on the southern tablelands of NSW. The first specimen was collected on 03 December 1999 by P.G. Branwhite (Plate 2.3Plate 2.3) and identified by David L. Jones of the Australian National Herbarium. The habitat was recorded as open forest with a heathy understorey on well-drained sand or clay-loam soils (OEH 2007). This specimen was originally identified as *Thelymitra pauciflora* R.Br. but later re assigned to *Thelymitra atronitida* by Jeanes. The other two records do not have herbarium ID numbers and may be unvouchered records. They include one collected by J. Kelton in 2004 and another by P.G. Branwhite, J. Kelton, and D. Jones in 2005, the former occurring in Brandy Marys Bago State Forest Crown Leases. The original estimate for the Bago population was 50 plants but further searches have proven unsuccessful, possibly due to logging in the area (*in. litt.*, P. Branwhite 2005, J. Kelton 2006; OEH 2007).

According to information obtained from Jeff Jeanes by the NSW Scientific Committee (2007) during the determination of *Thelymitra atronitida* as a critically endangered species, the incongruent morphology and ecology of the Bago population suggests that it may be taxonomically distinct from the Cape Solander population. Jeanes indicated the unlikelihood of the species occurring in the habitats around Bago- montane grassland, bog or forest (Geoff Robertson pers comm. 08 August 2018). Mark Clements also suggested that the Bago specimens had likely been misidentified (Clements pers. comm. 22 August 2018). Based on this information we focused our search efforts on the records from Kamay Botany Bay National Park and did not search for the populations in Bago State Forest.

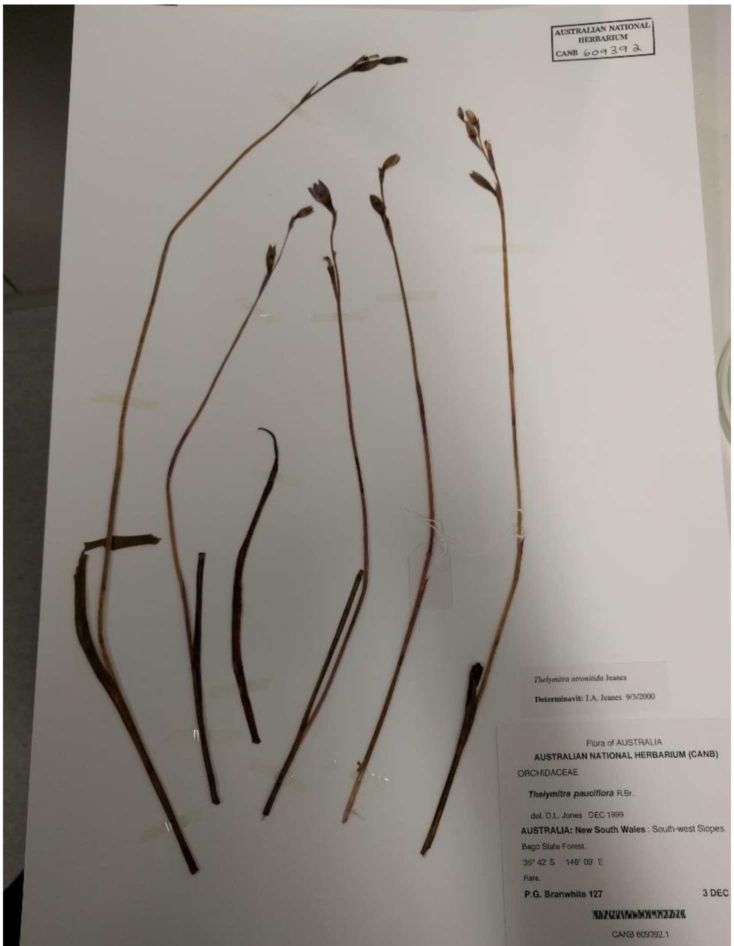

Plate 2.3 Peter Branwhite specimen 1999, Bago State Forest; image courtesy of the Australian National Herbarium.

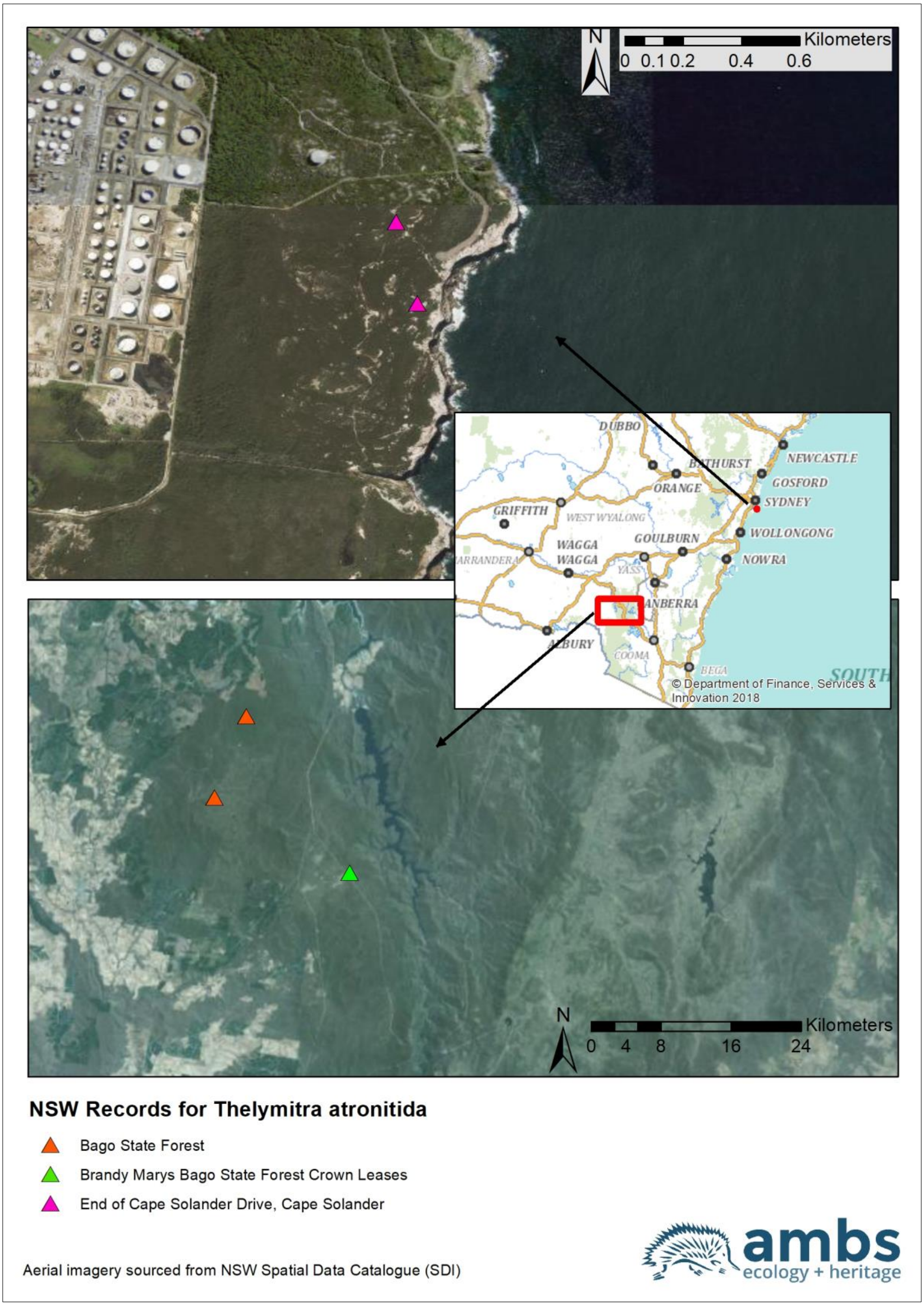

Figure 2.1 Location of BioNet records for *Thelymitra atronitida.* The upper mapped area shows the Cape Solander records, and the lower shows the Bago State Forest records.

2.2 Survey design

Surveys of the Cape Solander population were undertaken in Spring 2018. The flowering period of *Thelymitra atronitida* is August to December in New South Wales (Jeanes 2004). This timeframe matches dates from the BioNet records for specimen collections in NSW (08/08/1988, 03/12/1999, 14/09/2006). We also contacted Margaret Bradhurst, a local orchid expert, who indicated having seen *Thelymitra atronitida* in flower at Kamay Botany Bay National Park on 24/9/2001 and 11/10/2004 (pers. comm. 20 September 2018). The BioNet BioBanking report provides a smaller window of detection and recommends surveying for this species in November and December (BioNet, accessed 29/4/19).

Surveyed locations were based on the historic records as well as consultation with Dean Rouse, who provided coordinates and a hand drawn map of his collection location in Kamay Botany Bay National Park, and Margaret Bradhurst who provided an approximate description of the location where she had seen the the species flowering near the Yena Track in the Kamay Botany Bay National Park. The original collector, Peter Weston, described the record location as being in heathland near the carpark at the end of Cape Solander Road (Weston pers. comm. 28 May 2018).

Approximate locations of former collections, locality descriptions provided by experts, and likely suitable habitat based on habitat descriptions from previous records, were all used to inform the search areas. Targeted searches were conducted over two field days (13 August and 19 September 2018) throughout Kamay Botany Bay National Park.

We used search methods described by Keith (2000) and the NSW Guide to Threatened Plants (OEH 2016) to estimate population size, structure, and status. In this case, given the small number of individuals found, the applicable method for estimating population size is direct counting.

We used an iPad and GPS to navigate and record all searched areas. Habitat, associated species, disturbance, and possible threats, as well as any information relevant to the species' population size and status, were recorded.

3 Results

3.1 Summary of results

A population of four orchids was found in the vicinity of the previous collections by Peter Weston and Dean Rouse. One specimen was collected and determined by Dr Matt Renner to be *Thelymitra malvina.* The specimen has been lodged at the National Herbarium of NSW. Although the detected population is small, it appears to be in good condition. Threats include exotic herbivory and human disturbance which could be exacerbated by stochastic environmental events (e.g. climate or fire). *Thelymitra malvina* is not currently listed as a threatened species in NSW or Australia, however information on threats may be of use should *Thelymitra atronitida* be found in this area in the future.

3.2 Overview of searched areas

AMBS botanists Belinda Pellow and Ruby Stephens performed a comprehensive survey in the Cape Solander location on 13 August 2018. It should be noted that a significant portion of the park had been burnt by a wildfire in September 2017. No target plants were found during this first survey. A second, more targeted, survey was undertaken on 19 September 2018 after receiving detailed instructions about former plant locality from Dean Rouse and Margaret Bradhurst (Cape Bailey Track and Yena Track, respectively; Figure 3.1). Four adult *Thelymitra* plants were found in the vicinity of Weston and Rouse's records growing under unburnt shrubs of *Baeckea imbricata* adjacent to Cape Bailey walking track (Figure 3.2). All four individuals were in flower and appeared healthy (Plate 3.1**Error! Reference source not found.**).

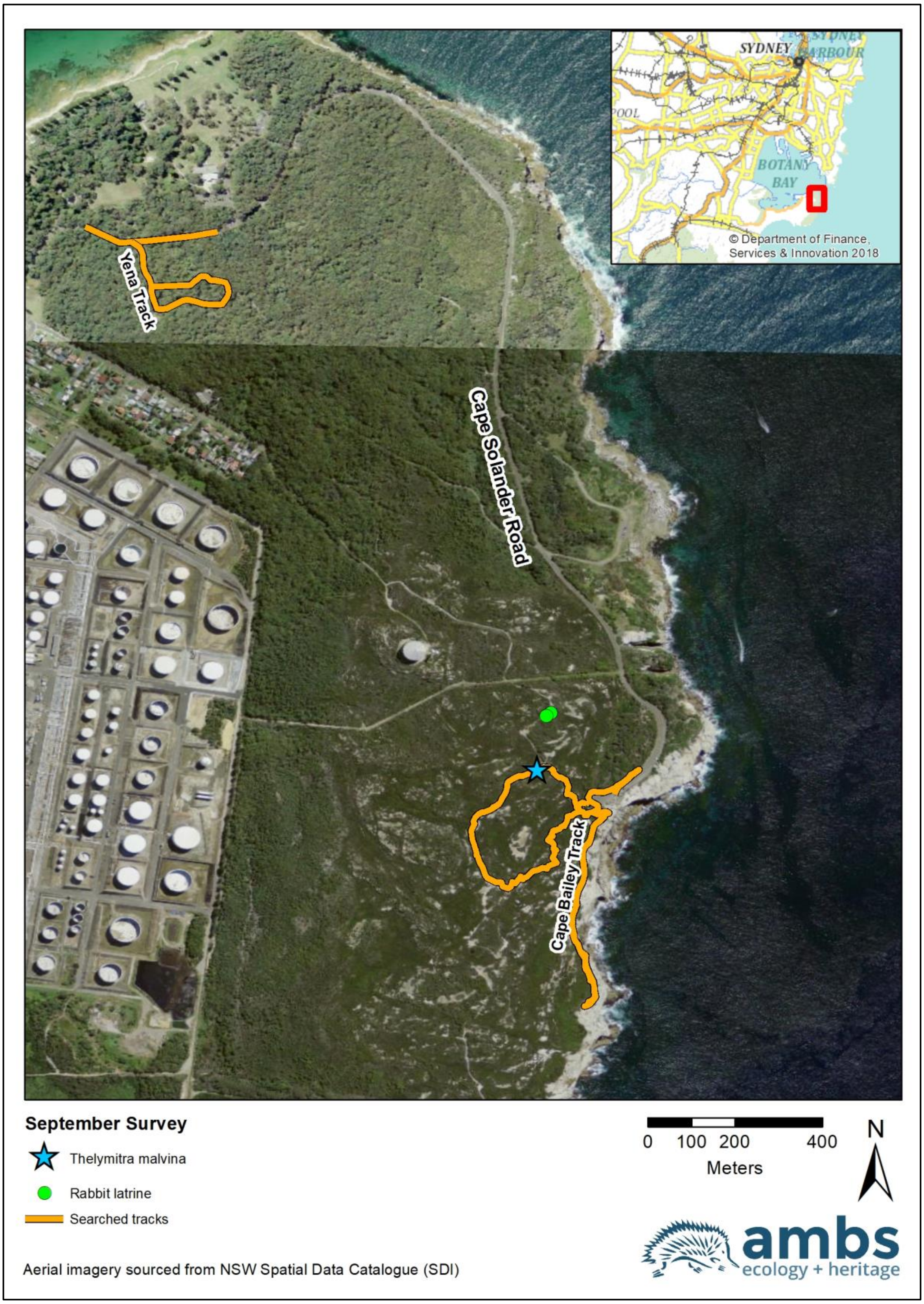

Figure 3.1 Overview of searched areas within Kamay Botany Bay National Park.

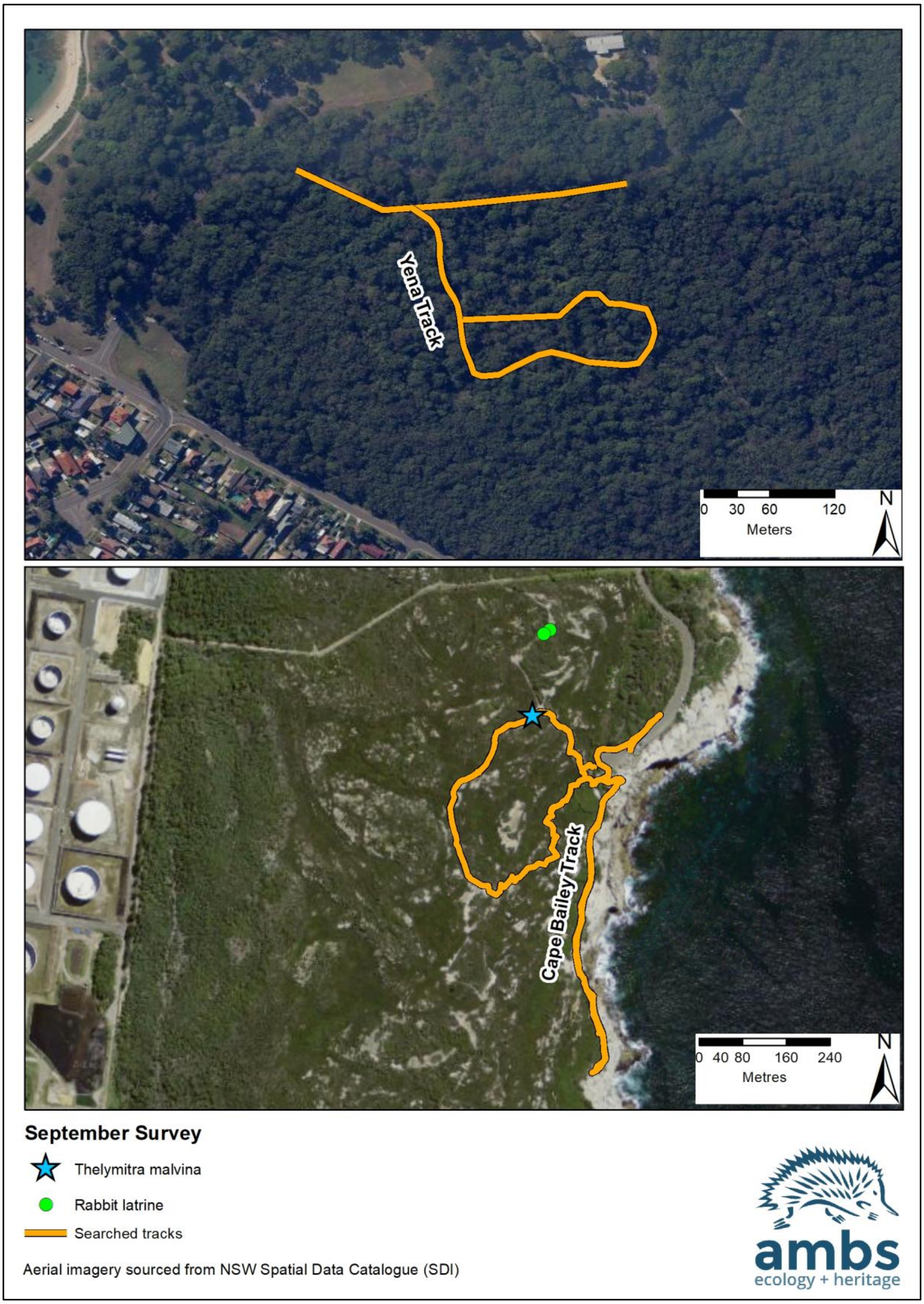

Figure 3.2 Close-up of searched tracks and adjacent habitat.

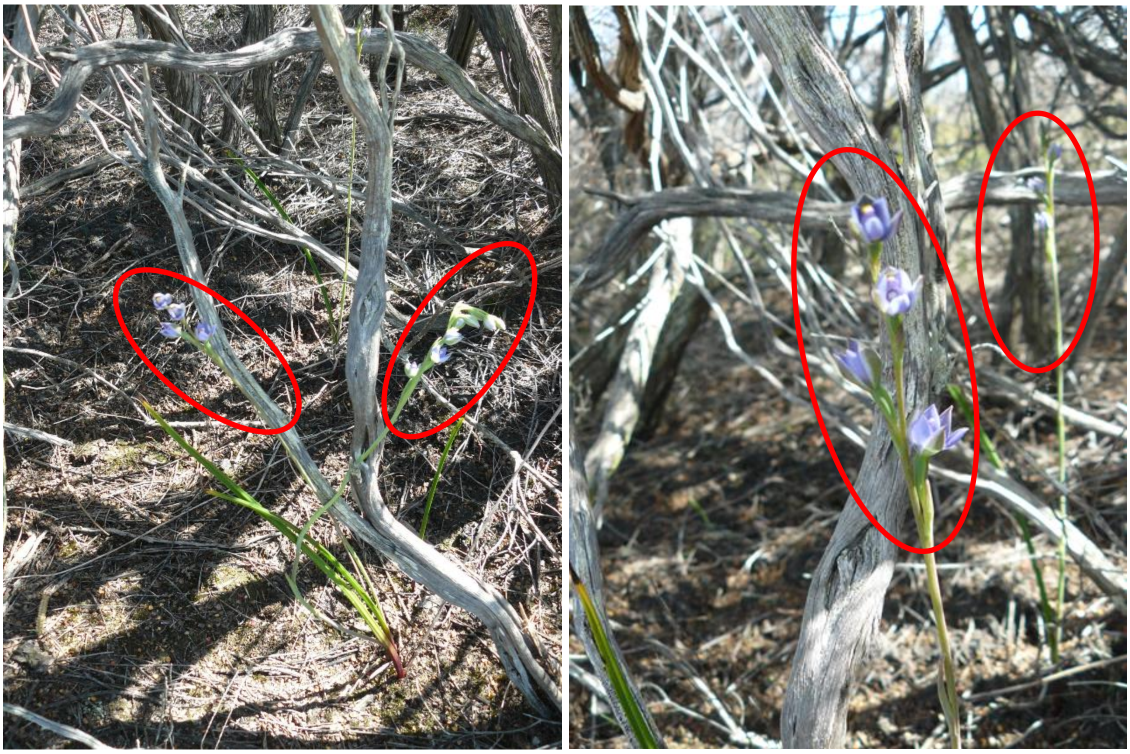

Plate 3.1 *Thelymitra malvina* flowering inflorescences (circled) in Cape Solander on 19 September 2018.

3.3 Identification of specimens

One specimen was collected during surveys by removing the above-ground portion without disturbing its tuber. The specimen was delivered to Dr Matt Renner at the National Herbarium of NSW who determined it to be the closely related species, *Thelymitra malvina* M.A. Clem., D.L. Jones & Molloy based on the following characteristics: three inflorescence bracts, purple-hued trichomes, entire shallow notch in post-anther lobe (Renner pers. comm. 26 February 2019; Plate 3.2).

Plate 3.2 Entire inflorescence and individual flower of *Thelymitra malvina* collected from Cape Solander survey during targeted searches.

Renner compared our specimen with one from Victoria and one collected by Peter Weston in 1988 at Cape Solander. His professional opinion was that neither looked exactly like the *Thelymitra atronitida* illustrated in Jeanes (2004) (Figure 3.3), both lacking the dentate notch margins on the post anther lobe, and that morphology for both was incongruent. Based on morphology alone, Renner concluded that Weston's specimen (inflorescence in spirits) did not differ from ours, having the inflated post anther lobe with a shallow entire notch, but information about colour or bract number was not available making the assessment difficult.

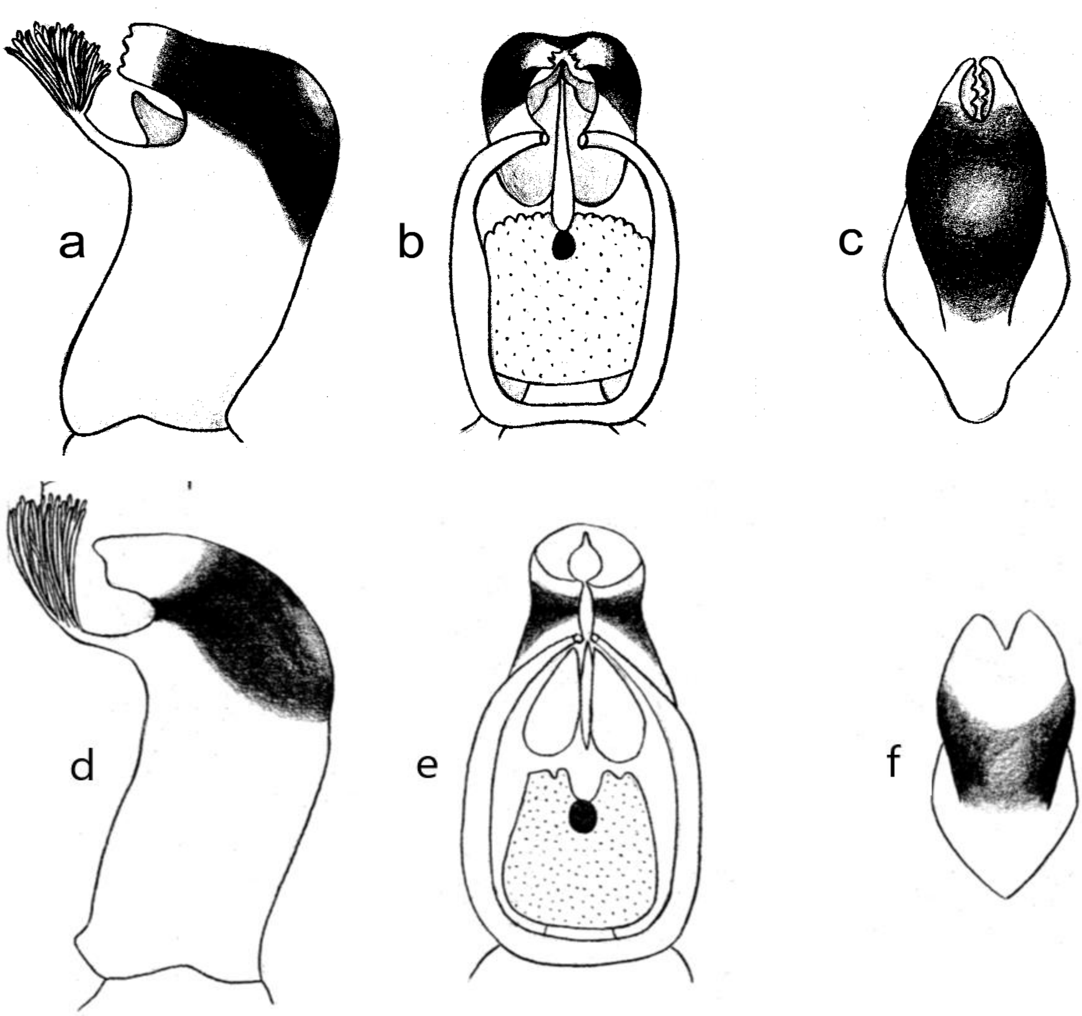

Figure 3.3 *Thelymitra atronitida*: a. column from side, b. column from front, c. post-anther lobe from rear; *Thelymitra malvina*: d. column from side, e. column from front, f. post-anther lobe from rear (Jeanes 2004).

The Bago herbarium specimen was examined and compared with an isotype of *Thelymitra atronitida* (preserved in spirits) by Dr Mark Clements on 30 January 2018. He indicated that, although identification based solely on morphology is subjective and tricky (e.g. differences in hood colour, trichome colour, etc.), the Bago specimen did not have the correct morphology or habitat for *Thelymitra atronitida* and was quite likely misidentified previously (Clements pers. comm). Clements is also currently doing genetic work on the genus and will be reviewing other records from the *Thelymitra pauciflora* complex.

The results from the Cape Solander searches suggest that these two distinct, yet closely related species (*Thelymitra atronitida* and *Thelymitra malvina*) may occur sympatrically, but their presence is asynchronous and possibly dependent upon climate, disturbance or some other factor. There is also the possibility that the two species are indeed present and may intergrade resulting in phenotypic variation within a single population, and the characteristics defining the taxonomic differences are unreliable for identification.

3.4 Habitat description

3.4.1 Land status and mapped vegetation

Cape Solander is in the Kurnell area in Kamay Botany Bay National Park and is a National Heritage listed region having outstanding value in terms of natural history and native plant diversity. The vegetation communities we searched within the National Park include Sydney Sandstone Heath (open-heath/closed scrub) and Sydney Sandstone Gully Forest (open forest/woodland) (Benson & Howell 1994; Keith 2004; OEH 2015; Figure 3.4).

The Sydney Sandstone Heath vegetation communities are characterised by Hawkesbury sandstone rock plateaus overlain with shallow soils, ranging from earthy sands, yellow and grey earths, lithsols, leached sands, and gleyed podzolics (Chapman & Murphy 1989). Species assemblages are strongly influenced by fire regimes and soil moisture, depth and drainage (Benson & Howell 1994). The dominate species of the open-heath/closed scrub communities are *Banksia ericifolia*, *Darwinia fascicularis*, and *Allocasuarina distyla.*

The Sydney Sandstone Gully Forest has similar soil attributes but with deeper podzolic soils created from material that is washed down into the lower slopes and valleys of the rock formation (Chapman & Murphy 1989). The open-forest/woodland vegetation community is characterised by a canopy of *Eucalyptus piperita*, *Angophora costata*, and/or *Eucalyptus gummifera* and an understorey dominated by a variety of shrubs primarily from the Proteaceae, Fabaceae, and Myrtaceae families (Benson & Howell 1994).

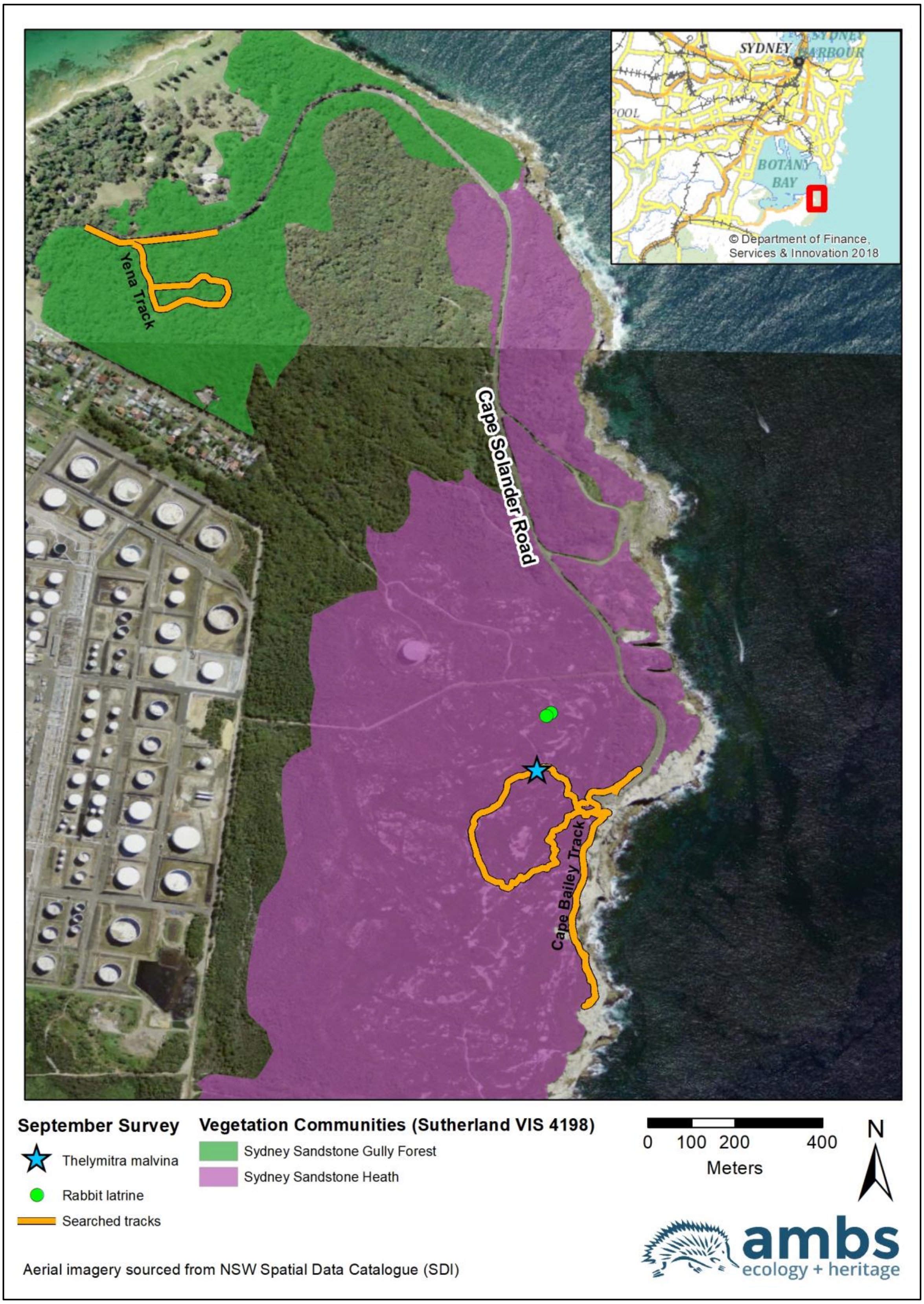

Figure 3.4 Search areas, location of population and identified threats, and mapped vegetation communities (OEH 2015).

3.4.2 Associated species

Plants were found in Sydney Sandstone Heath growing under unburnt shrubs of *Baeckea imbricata* immediately adjacent to the Cape Baily Track on the western side of Cape Solander Road (Plate 3.3). The soil is grey, very shallow sand overlying sandstone, with surface leaf litter and twigs from overstorey shrubs. There was evidence of the 2017 wild fire in the vicinity of the population, but no target plants were found in burnt areas (Plate 3.4). Associated plant species at the site include *Philotheca buxifolia*, *Melaleuca nodosa*, *Rulingia hermanniifolia*, *Opercularia aspera*, *Allocasuarina distyla*, *Dampiera stricta*, *Kunzea ambigua*, *Melaleuca armillaris*, *Darwinia fascicularis*, and *Banksia ericifolia*.

Plate 3.3 Coastal heath plant community associated with the *Thelymitra* population.

Plate 3.4 Burnt area in the vicinity of the *Thelymitra* population, with regenerating vegetation.

The area described by Margaret Bradhurst along the northern coast of the National Park in the vicinity of the Yena Track was also searched, but no target plants were identified (Figure 3.4). This was Sydney Sandstone Gully Forest and was characterised by *Angophora costata*, *Pittosporum undulatum*, *Lomandra longifolia*, *Banksia integrifolia*, *Elaeocarpus reticulatus*, *Entolasia marginata*, *Monotoca elliptica*, *Kunzea ambigua*, *Smilax glyciphylla*, and *Hardenbergia violacea*.

3.4.3 Possible threats

Primary threats to *Thelymitra malvina* and *Thelymitra atronitida*, should it occur in the area, include herbivory by introduced rabbits (Plate 3.5, see location in Figure 3.1) and disturbance to soils and vegetation by people. Plants were found adjacent to a walking track which likely receives heavy use during the warmer months and peak tourist times (Plate 3.6). The cliffs in the Cape Solander region are also known for whale-watching during certain times of the year which makes the area at risk from high visitor densities. With human disturbance also comes the potential for weed invasion, illegal collection, track widening, and trampling.

The effects of fire are unclear and prescribed burning at inappropriate times could be considered a threat. Periodic fires to reduce biomass accumulation and encourage establishment may be beneficial although there is no evidence suggesting that *Thelymitra atronitida* flowers more readily following fire. Most *Thelymitra* species experience a dormancy period during the hot, dry summer months (Jones 2006), but a very hot fire during the early growing season (autumn), when the plant is storing energy in the belowground tubers, could have a negative impact. Flowering is promoted by fire in many species of *Thelymitra* in Tasmania (Wapstra 2008) as well as *Thelymitra xanthotricha* (part of the *Thelymitra pauciflora* complex) in Western Australia (Jeanes 2004), but no such response has been noted for *Thelymitra atronitida* in Tasmania or Victoria. In South Australia *Thelymitra spp*. are often found in slashed firebreaks, but recruitment has not been linked to fire (Bates 2010).

The following additional threats are identified in the BioNet profile for *Thelymitra atronitida*.

- Demographic threats: The small population size and disjunct distribution can lead to demographic stochasticity and a higher risk of local extinction.
- Disturbance: Heavy rainfall may also lead to erosion given the shallow soils present at Cape Solander.
- Lack of knowledge: Deficiency in understanding of species.

Plate 3.5 Latrine, indicating the presence of European rabbit

Plate 3.6 Trail marker for the Cape Baily track in Kamay Botany Bay National Park.

4 Conclusions and Recommendations

We did not find *Thelymitra atronitida* in this survey, despite careful search of the precise site of previous records and the surrounding area. It has been 30 years since the original collection by Peter Weston and nearly 15 years since Dean Rouse collected an individual, identified as *Thelymitra atronitida.* It is possible that the species may have been lost from the area as a result of rabbit herbivory or human disturbance (i.e. illegal collection, trampling, etc.). However, it is premature to infer that the species is locally extinct. Searches at different times or after climatic or environmental cues (e.g. high summer rainfall, bushfire) may yet reveal an extant population.

We recommend the following actions:

1. Future searches for *Thelymitra atronitida* be conducted at Cape Solander between early August and late December, acknowledging that it occurs sympatrically with *Thelymitra malvina* in Victoria and Tasmania (Jeanes 2000). In the event that target plants are found in the future, it would be advisable to install fencing to protect plants from grazing, soil erosion, and human disturbance. We would also recommend additional searches in likely habitat such as the coastal heathlands in far southern NSW (i.e. Nadgee Nature Reserve) which are geographically closer to the known populations in Victoria.

2. Review the identification of previous specimens collected in the Cape Solander and Bago areas. Numerous sources, including the original collectors, raise questions about the identification, given the subtle morphological differences which can be variable within a given species. Peter Weston commented that species within the *Thelymitra pauciflora* complex are difficult to identify using available techniques and that they could all possibly be highly inbred microspecies (Weston pers. comm. 28 May 2018). We recommend further collections and renewed efforts to track down all herbarium specimens (pressed and spirit

preserved) from Cape Solander and Bago State Forest and, if required genetic analysis, to resolve uncertainties on species identification.

3. Despite the current uncertainties on species identification and extant status of *Thelymitra atronitida* at Cape Solander, we recommend precautionary site-specific management to protect and maintain suitable habitat for the species. This requires:

    a. ensuring the walking track is monitored and that future wear, maintenance and upgrade works avoid any degradation or damage to plants or their habitat;
    b. ongoing control of rabbit populations; and
    c. avoiding or minimising occurrence of fires in autumn or winter.

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Appendix A

BioNet records for *Thelymitra atronitida*

Data from the BioNet BioNet Atlas website which holds records from a number of custodians. The data are only indicative and cannot be considered a comprehensive inventory and may contain errors and omissions.
Location accuracy varies. Records of species listed under the Sensitive Species Data Policy are identified in the Sensitivity Class column.
Copyright the State of NSW through the Office of Environment and Heritage.
Search criteria: Public Report of all Valid Records of Black-hooded Sun Orchid (Species: Thelymitra atronitida) returned a total of 4 records of 1 species. Report generated on 7/03/2018 2:03 PM

DatasetName	SightingKey	SpeciesCode	FamilyName	SortOrder	ScientificName	CommonName	NSWStatus	CommStatus	SensitivityClass	DateFirst	DateLast	Status	LocationKey	Description	Latitude_GDA94	Longitude_GDA94	Accuracy	SightingNotes	LocationNotes
OEH Data from Scientific Licences dataset	SDMPI0121586	11638	Orchidaceae	13518	Thelymitra atronitida	Black-hooded Sun Orchid	E4A	P	2	23/06/2005	23/06/2005	Accepted as valid from quarantine	Withheld	Location Description withheld	-35.6	148.2	30000	Sighting Notes withheld	Location Notes withheld
OEH Data from Scientific Licences dataset	SSLSI0008096	11638	Orchidaceae	13518	Thelymitra atronitida	Black-hooded Sun Orchid	E4A	P	2	21/10/2004	7/02/2005	Accepted as valid from quarantine	Withheld	Location Description withheld	-35.8	148.3	5000	Sighting Notes withheld	Location Notes withheld
Royal Botanic Gardens Herbarium Specimen Register	NSW417826	11638	Orchidaceae	13518	Thelymitra atronitida	Black-hooded Sun Orchid	E4A	P	2	8/08/1988	8/08/1988	Valid and accepted without modification	Withheld	Location Description withheld	-34	151.2	1000	Sighting Notes withheld	Location Notes withheld

DatasetName	SightingKey	SpeciesCode	FamilyName	SortOrder	ScientificName	CommonName	NSWStatus	CommStatus	SensitivityClass	DateFirst	DateLast	Status	LocationKey	Description	Latitude_GDA94	Longitude_GDA94	Accuracy	SightingNotes	LocationNotes
Royal Botanic Gardens Herbarium Specimen Register	NSW706086	11638	Orchidaceae	13518	Thelymitra atronitida	Black-hooded Sun Orchid	E4A	P	2	8/08/1988	8/08/1988	Valid and accepted without modification	Withheld	Location Description withheld	-34	151.2	1000	Sighting Notes withheld	Location Notes withheld

Appendix G. EPBC Act significance assessments

Tests of significance have been conducted for threatened species, populations and communities that were recorded in the study area during field surveys or were identified as having a moderate or higher potential to occur in the study area based on the presence of habitat. For threatened biodiversity listed under the EPBC Act, significance assessments have been completed in accordance with the *EPBC Act Policy Statement 1.1 Significant Impact Guidelines* (Department of Environment, 2013). Whether or not an action is likely to have a significant impact depends upon the sensitivity, value, and quality of the environment that is affected, and upon the intensity, duration, magnitude and geographic extent of the impacts (Department of Environment, 2013). Importantly, for a 'significant impact' to be 'likely', it is not necessary for a significant impact to have a greater than 50 per cent chance of happening; it is sufficient if a significant impact on the environment is a real or not remote chance or possibility (Department of Environment, 2013). This advice has been considered while undertaking the assessments.

The EPBC Act listed species subject to this assessment include:

- Spotted-tailed Quoll (*Dasyurus maculatus*)
- Greater Glider (*Petauroides volans*)
- Smoky Mouse (*Pseudomys fumeus*)
- Booroolong Frog (*Litoria booroolongensis*)
- Macquarie Perch (*Macquaria australasica*)
- White-throated Needletail (*Hirundapus caudacutus*)
- Migratory species.

When assessing Vulnerable species, the assessment centres around whether the population that will be impacted is an 'important population' or not. An 'important population' is a population that is necessary for a species' long-term survival and recovery (Department of Environment, 2013). This may include populations identified as such in recovery plans, and/or that are:

- Key source populations either for breeding or dispersal
- Populations that are necessary for maintaining genetic diversity, and/or
- Populations that are near the limit of the species range.

This definition of what constitutes an 'important population' has guided the assessments for Vulnerable species below.

G.1 Spotted-tailed Quoll (*Dasyurus maculatus*)

The Spotted-tailed Quoll (south eastern mainland population) is listed as Endangered under the EPBC Act.

The Spotted-tailed Quoll was not recorded within the project area during the surveys undertaken for this BDAR. Likewise, the Spotted-tailed Quoll was not recorded during the surveys undertaken for the Snowy 2.0 Exploratory Works and Main Works BDARs (EMM Consulting, 2017 and 2020a).

Despite the lack of records from recent surveys, there are a number of Spotted-tailed Quoll records to the north of the project area within the Bago State Forest, Brandy Marys Crown Lease area and McPhersons Plain (from 2001 to 2004). The Spotted-tailed Quoll occurs at low densities and individuals have a large home range, so it is likely that the project area lies within the home range of one or more Spotted-tailed Quolls. The project area contains suitable habitat including potential den sites in areas with boulders, rocky outcrops, small caves (particularly the South Eastern Highlands portion), and large woody debris and hollow-bearing trees (large hollow logs and hollow-bearing trees are abundant in the Australian Alps portion).

An action is likely to have a significant impact on a Critically Endangered or Endangered species if there is a real chance or possibility that it will:

Lead to a long-term decrease in the size of a population

The Spotted-tail Quoll typically has a large home range and occupies a diversity of habitat types, including rainforest, open forest, woodland, coastal heath, and inland riparian forest, from the sub-alpine zone to the coastline. The Spotted-tail Quoll is predominantly nocturnal and rests during the day in dens, such as hollow logs, tree hollows, rock outcrops or caves. The project may remove potential habitat for the species however the overall reduction of habitat is a small proportion of the available potential habitat.

The vegetation to be impacted represents only a small percentage of the total extent of important foraging vegetation types present within the locality. Given the relative widespread nature of similar vegetation in the locality the project is not expected to lead to a long-term decrease in the size of a viable local population of this species.

Reduce the area of occupancy of the species

The area of occupancy of this species is estimated at 2,512 km^2. There is approximately 118.34 ha of potential habitat for the Spotted-tailed Quoll within the disturbance area. This includes approximately 70.90 ha of full clearing and 47.43 ha of partial clearing of native vegetation comprising of all PCT types within the project area. While clearing of potential habitat for this species will be likely, there is an abundance of suitable breeding and foraging habitat for this species in Bago State Forest, Maragle State Forest and KNP surrounding the study area. The habitat to be removed will not result in a reduction in the area of occupancy for this species.

Fragment an existing population into two or more populations

The Spotted-tail Quoll population in the locality will not be fragmented by the project as this species is able to disperse through a wide range of habitat types (including areas without tree canopy). The removal of wooded vegetation along the transmission line corridor will therefore not serve as a permanent barrier. The species regularly moves over very long distances with home ranges of 200-500 ha for females and from 500 to over 4000 ha for males. Therefore, the project will not fragment an existing population into two or more populations.

Adversely affect habitat critical to the survival of a species

The Spotted-tail Quoll typically has a large home range and occupies a diversity of habitat types, including rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline. The vegetation occurring along the transmission line corridor edges to be impacted by the project is not considered to be critical habitat for this species.

Disrupt the breeding cycle of a population

Breeding habitat for the Spotted-tail Quoll includes daytime den sites such as hollow logs, tree hollows, rock outcrops or caves. Hollow logs, tree hollows, rock outcrops are present in the project area and could be used as refuge and foraging habitat by the Spotted-tailed Quoll. However, this species is unlikely to be dependent on these sites for breeding as no evidence of den sites, latrine sites or sheltering sites were present in the project area.

The rocky outcrops are unlikely to be removed by the project. The structures will be built on the ridges and the transmission lines will span across the outcrops. Vegetation removal will be required but it is unlikely that the rocky outcrops will be removed.

As a result of the project, the total clearing zone of potential habitat for the Spotted-tail Quoll is approximately 70.90 ha, where partial clearing will total 47.43 ha. Therefore, a large number of hollow logs, tree hollows and rocky outcrops will remain in partial clearing areas and areas surrounding the project area following the completion of the project. Any important habitat features (such as large hollow logs) occurring within the project area are to be retained and relocated into adjacent bushland. Therefore, the project is unlikely to disrupt the breeding cycle of the Spotted-tail Quoll.

Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline

While 70.90 ha of native vegetation representing potential habitat for this species will result in total clearance, with 47.43 ha of partial clearing to occur, there is an abundance of high-quality breeding and foraging habitat for this species in Bago State Forest, Maragle State Forest and KNP surrounding the disturbance area. The project area is a linear corridor with a width small enough to maintain the dispersal and movements of Spotted-tail Quoll throughout the locality. Therefore, the habitat to be removed is unlikely to result in a decline of the Spotted-tail Quoll.

Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat

The main disturbance regimes affecting habitats in the study area are weed invasion, fragmentation and edge effects and maintenance regimes such as slashing and pruning. The Spotted-tail Quoll is also predated upon by Red Foxes (*Vulpes vulpes*), Dingoes (*Canis lupus dingo*) and Domestic Dogs (*Canis lupus familiaris*), which may utilise cleared areas resulting from the project. Mitigation measures will be implemented to limit the exacerbation of these current disturbance regimes. Any impacts from change of habitat condition associated with altering disturbance regimes in proximity to the transmission line corridor may be offset by this species' ability to move widely throughout the landscape and access disturbed and fragmented habitats. The management of invasive species will be managed under the construction environmental management plan (CEMP) and during operation of the transmission lines.

Introduce disease that may cause the species to decline, or

There are no known disease issues affecting this species in relation to the project. The project would be unlikely to increase feral animal abundance or the potential for significant disease vectors to affect local populations.

Infection of native plants by *Phytophthora cinnamomi* has been identified as being spread by construction machinery. This water-borne mould infects the roots of plants and has the potential to cause dieback. Machinery associated with vegetation clearance and subsequent construction has the potential to transmit the fungus to remaining native vegetation remnants of the species. This is a potential indirect impact to the species through the transmission of pathogens into retained habitat near the pipeline. This can be mitigated through the development and implementation of suitable control measures for construction personnel and plant hygiene and is unlikely to have a significant impact. It is the intention to use current best practice hygiene protocols on this project as part of the CEMP to prevent the introduction or spread of pathogens.

The mitigation strategy and environmental management procedures for the project would include guidance for preventing the introduction and/or spread of disease-causing agents such as bacteria and fungi.

Interfere with the recovery of the species.

A recovery plan does not exist for the Spotted-tail Quoll. However, the following actions have been identified by the DPIE for recovery of this species:

- Consult with the DPIE / NPWS if Spotted-tail Quolls are raiding poultry, rather than taking direct action
- Consult with the DPIE / NPWS if poison baiting is planned in or near areas where Spotted-tail Quolls are known or likely to occur

- Undertake cat and fox control using poison-baiting techniques least likely to affect quolls
- Retain and protect large, forested areas with hollow logs and rocky outcrops, particularly areas with thick understory or dense vegetation along drainage lines.

The recovery action "Retain and protect large, forested areas with hollow logs and rocky outcrops, particularly areas with thick understory or dense vegetation along drainage lines" will be impacted by the project area. However, the design will reduce this impact by structures being built on the ridges and the transmission lines spanning across the outcrops, avoiding their removal. Dense vegetation will be maintained along drainage lines where possible. While hollow logs in the project area will be removed, a large number of hollow logs, tree hollows will be retained and relocated to adjacent vegetation.

Considering these impacts in the context of the suitable habitat surrounding the project area, the project will not interfere with the recovery of the Spotted-tail Quoll.

Conclusion

The Spotted-tail Quoll (*Dasyurus maculatus*) may suffer a small reduction in extent of foraging and shelter habitat from the project. The project is unlikely to reduce the size of a population of the Spotted-tail Quoll or decrease the reproductive success of this species. The project will not interfere with the recovery of the Spotted-tail Quoll. After consideration of the factors above, an overall conclusion has been made that the project is unlikely to result in a significant impact to the Spotted-tail Quoll.

G.2 Greater Glider (*Petauroides volans*)

The Greater Glider is listed as Vulnerable under the EPBC Act. A key consideration in assessing the significance of impacts to a Vulnerable species is whether the project will impact an 'important population'. As defined in the *EPBC Act Policy Statement 1.1 Significant Impact Guidelines* (Department of Environment, 2013), an 'important population' is a population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in recovery plans, and/or that are:

- Key source populations either for breeding or dispersal
- Populations that are necessary for maintaining genetic diversity, and/or
- Populations that are near the limit of the species range.

The Greater Glider was not recorded within the project area or broader study area during the surveys undertaken for this BDAR. Likewise, the Greater Glider was not recorded during the surveys undertaken for the Snowy 2.0 Exploratory Works and Main Works BDARs (EMM Consulting, 2017 and 2020a). Despite the lack of records from these surveys, the Greater Glider has potential to occur in the taller wetter forests (i.e. PCT 300) and sub-alpine woodland (PCT 1196) habitats. Previous surveys in the region suggest this species is only likely to inhabit vegetation within the project area west of the Tumut River (see Kavanagh and Stanton, 1998). These habitats appear to provide suitable forging resources for the Greater Glider in the form of eucalypts species *Eucalyptus dalrympleana, Eucalyptus viminalis,* and *Eucalyptus robertsonii* and trees large enough to contain hollows of suitable size for the Greater Glider.

Additionally, there are credible records of the Greater Glider from wet forest dominated by *Eucalyptus dalrympleana* and *Eucalyptus robertsonii* in the Bago State Forest to the north and west of the study area, including records from State Forest surveys. There are records of the Greater Glider in habitats like that which occur in the project area from the north adjacent to the Line 64 easement. The records are from 1995, 2004, 2007, 2008, and 2009. The distribution of the Greater Glider is known to be patchy even in seemingly optimal habitats (see Kavanagh, 2000). Therefore, the Greater Glider may have been temporarily absent from the habitats within the project area during the survey period.

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

Lead to a long-term decrease in the size of an important population

Only a small amount of habitat impacted by the project has the required old trees with abundant hollows that are the preferred breeding habitat for this species. A total of 59.26 ha of suitable breeding and foraging habitat will be removed as a result of the project. This however consists of 39.8 ha of habitat which will require total clearance for the project, with 19.46 ha of suitable habitat to be partially cleared. Potential habitat for the Greater Glider within the project area is situated on the western side of the project, located in Bago State Forest. This area is dominated by tall large tree species, such as *Eucalyptus robertsonii*, *Eucalyptus dalrympleana* and *Eucalyptus viminalis*, likely to contain tree hollows with a diameter of >10, suitable for the Greater Glider. An impact of 59.26 ha could however have the potential to interrupt the movements of this species and the population, and may result in isolation of the population. However, the project will affect a relatively narrow tract of old trees with potentially suitable hollows. This impact is small in the context of the extent of habitat in the locality and with mitigation measures in place and through project design, this impact can be reduced however may lead to a decrease in size of the population.

Furthermore, the population of the Greater Glider that may use the habitats within the project area would not meet the definition of an ‘important population’. There is no adopted or made recovery plan for the Greater Glider so ‘important populations’ have not been identified in this manner. It is unlikely that the population that may be affected by the project would be a key source population or a stronghold of genetic diversity as the population is likely to be low in numbers. The population that may be affected by the project is not at the limit of the species range. Therefore, the project would not lead to a long-term decrease in the size of an important population of this species.

Reduce the area of occupancy of an important population

Approximately 59.26 ha of suitable habitat for breeding and foraging will be removed, with 39.8 ha having a total clearance and 19.46 ha being partially removed. This will not result in an appreciable reduction in the area of occupancy of an important population of the species, given the extent of suitable habitat in the vicinity of the project. Also, no important population of the Greater Glider has been identified in the area.

Fragment an existing important population into two or more populations

The extent of habitats within the project area and surrounds does not represent an important population for this species. It is unlikely that the population that may be affected by the project would be a key source population or a stronghold of genetic diversity as the population is likely to be low in numbers and extend throughout a much larger area of KNP.

Linear infrastructure, such as transmission lines, is ubiquitous in the Australian landscape including the KNP and Bago State Forest and is known to be responsible for the loss of habitats and disruption of landscape connectivity. The creation of open and shrubby corridors within areas of intact forest is the key impact to habitat connectivity that would result from the project. The creation of access roads and the transmission line corridor underneath the transmission lines will introduce linear features through environments that can be considered relatively undisturbed and where these features currently do not exist. As such, there is likely to be a level of impact to habitat connectivity. As there is no evidence of Greater Gliders crossing transmission easements, it is likely that the project will impact upon species movements, reducing the functional connectivity of the species. therefore, bioregional persistence of these species would be placed at risk.

Adversely affect habitat critical to the survival of a species

Habitat critical to the survival of a species refers to areas that are necessary for activities such as:

- Foraging, breeding, roosting, or dispersal
- For the long-term maintenance of the species including the maintenance of other species essential to the survival of the species, such as pollinators

- To maintain genetic diversity and long-term evolutionary development
- For the reintroduction of populations or recovery of the species.

The project area will impact a small and localised section of potential habitat for the species and due to the abundance of high-quality habitat in the general area, the project is unlikely to adversely impact critical habitat that would affect the survival of this species.

Disrupt the breeding cycle of an important population

The population of the Greater Glider that may use the habitats within the project area would not meet the definition of an 'important population' as there is no adopted or made recovery plan for the Greater Glider. It is unlikely that the population that may be affected by the project would be a key source population or a stronghold of genetic diversity as the population is likely to be low in numbers. The population that may be affected by the project is not at the limit of the species range. However, the breeding cycle, for at lease one season, may be disrupted as a result of the project. Due to the small amount of potential breeding habitat lost (59.26 ha) and the low density of Greater Gliders likely to occur in the area, the activity is therefore unlikely to disrupt the long-term breeding cycle of an important population of the Greater Glider.

Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline

There is a moderate risk that the project could contribute slightly to weed or plant pathogen invasion and further degradation of the species' habitat in the locality. This risk will be limited through equipment weed and pathogen hygiene and weed control activities and is unlikely to significantly affect the species.

While 39.8 ha of suitable habitat will be totally cleared and 19.46 ha will be partially cleared as a result of the project, there is an abundance of high-quality breeding and foraging habitat for this species in Bago State Forest, Maragle State Forest and KNP surrounding the study area. Therefore, the relatively small amount of suitable habitat to be removed is unlikely to lead to a species decline.

Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat

No invasive species are currently considered to pose a significant threat to this species. However, the management of invasive species would be managed under the CEMP and during operation. Therefore, the project is unlikely to result in the establishment of invasive species that are harmful to this species.

Introduce disease that may cause the species to decline, or

Infection of native plants by *Phytophthora cinnamomi* has been identified as being spread by construction machinery. This water-borne fungus infects the roots of plants and has the potential to cause dieback. Machinery associated with vegetation clearance and subsequent construction for the project has the potential to transmit the fungus to remaining native vegetation remnants of the species. This is a potential indirect impact to the species where key Greater Glider feed trees can be infected and die. This can be suitably mitigated through the development and implementation of suitable control measures for vehicle and plant hygiene and is unlikely to have a significant impact. It is the intention to use current best practice hygiene protocols on this project as part of the CEMP to prevent the introduction or spread of pathogens. The project would be unlikely to increase the potential for significant disease vectors to affect a local population of this species.

Interfere substantially with the recovery of the species

No recovery plan currently exists for this species. However, the Threatened Species Scientific Committee has proposed the following primary conservation actions:

1) Reduce the frequency and intensity of prescribed burns.
2) Identify appropriate levels of patch retention, habitat tree retention, and logging rotation in hardwood production.
3) Protect and retain hollow-bearing trees, suitable habitat and habitat connectivity.

The project will reduce habitat connectivity in the area and is inconsistent with number 3 of the conservation actions identified for this species. However, the recovery of the Greater Glider as a species is not dependent on the reduced connectivity of habitat in this locality. The project will also contribute slightly to degradation of native vegetation. The impact is not significant in the context of the quality and extent of habitat in the locality. The project is unlikely to interfere with the recovery of the species.

Conclusion

The Greater Glider will suffer a small reduction in extent of suitable habitat from the project. The project is considered unlikely to reduce the size of an important population of the Greater Glider or decrease the reproductive success of this species long-term. The project will not interfere with the recovery of the Greater Glider. After consideration of the factors above, an overall conclusion has been made however, that the project is unlikely to result in a significant impact to the Greater Glider. The impact to Greater Glider habitat from the project is not considered to be of significance having regard to its context and intensity.

G.3 Booroolong Frog (*Litoria booroolongensis*)

The Booroolong Frog is known to inhabit the Yarrangobilly River, Wallaces Creek and Sheep Station Creek as identified in the Snowy 2.0 Exploratory Works and Main Works BDARs (EMM Consulting, 2017 and 2020a). The Yarrangobilly River was identified as providing optimal breeding habitat for the Booroolong Frog, with a series of cobble banks and bedrock structures along stream margins, with slow flowing water connected by larger, slow flowing pools (EMM Consulting, 2017 and 2020a). The breeding habitat in Wallaces Creek is considered to be much more limited, with only small sections providing suitable breeding habitat and it is likely this area provides sub-optimal breeding habitat as well as connective and dispersal habitat (EMM Consulting, 2017 and 2020a). Sheep Station Creek is also likely to be sub-optimal as breeding habitat for the Booroolong Frog.

During targeted surveys undertaken for the Snowy 2.0 Exploratory Works and Main Works BDARs (EMM Consulting, 2017 and 2020a) the Booroolong Frog was observed up to 130 m from the Yarrangobilly River during a high rainfall event that saw key breeding habitat flooded. During this period most frogs were observed within the riparian zone, i.e. within 50 m of the River (EMM Consulting, 2017 and 2020a). Based on that information, the Yarrangobilly River and Wallaces Creek have been identified as breeding habitat, while areas within 50 m of this breeding habitat was identified as potential dispersal and refuge habitat.

Surveys undertaken for this BDAR also identified suitable habitat features within riparian vegetation (PCT 302) around Sheep Station Creek, Lick Hole Gully and Cave Gully. One Booroolong Frog sighting has been recorded on Sheep Station Creek within the project area. Considering the connectivity of these waterways with the Yarrangobilly River, they are considered likely to provide suitable foraging habitat during times of suitable rainfall, however, may not contain the permanent habitat features required for breeding. Booroolong Frog habitat is shown on Figure 6-6 and the 50m exclusion area is shown on Figure 7-1.

An action is likely to have a significant impact on a Critically Endangered or Endangered species if there is a real chance or possibility that it will:

Lead to a long-term decrease in the size of a population

The Booroolong Frog is known to inhabit the Yarrangobilly River, Wallaces Creek and Sheep Station Creek as identified in the Snowy 2.0 Exploratory Works and Main Works BDARs (EMM Consulting, 2017 and 2020a). The Lick Hole Gully and Cave Gully waterways may also provide habitat for this species during suitable rainfall. The Booroolong Frog was recorded along the Yarrangobilly River from the Talbingo Reservoir full supply level to the upper reaches of the Yarrangobilly River and in Wallaces Creek (EMM Consulting, 2017 and 2020a). The Booroolong Frog population is thought likely to extend upstream to the Blue Creek fire trail (EMM Consulting, 2017 and 2020a). The size of the population is however not known.

The Yarrangobilly River, and to a lesser extent Wallaces Creek, provides breeding habitat for the Booroolong Frog. The stream edge is the preferred habitat but during high rainfall events the area of suitable habitat expands considerably. During targeted surveys undertaken for the Snowy 2.0 Exploratory Works and Main Works BDARs (EMM Consulting, 2017 and 2020a) the Booroolong Frog was observed up to 130 m from the Yarrangobilly River during a high rainfall event that saw key breeding habitat flooded. During this period most frogs were observed within the riparian zone (i.e. within 50 m of the River (EMM Consulting, 2017 and 2020a).

Importantly, the project will not directly impact the optimal Booroolong Frog breeding habitats along the Yarrangobilly River. Recent fires within the KNP have impacted on all Booroolong Frog habitat along Yarrangobilly River and Wallace's Creek fire trail, however the project would not result in the removal of any unburnt critical vegetation for Booroolong frog. There will however be a direct impact to riparian vegetation identified as sub-optimal breeding habitat and/or dispersal habitat along Wallaces Creek and Sheep Station Creek due to trimming of vegetation for power line clearance over Wallaces Creek and removal of vegetation for bridge construction over Sheep Station Creek. The other potential impacts to the Booroolong Frog are indirect and relate to the potential for habitat degradation through sedimentation of the waterways.

The project will directly impact on 1.66 ha of suitable habitat within the project area for the Booroolong Frog, confined to the South Eastern Highlands Bioregion, comprising of PCT 296, 302 and 729. This habitat is associated with the access road crossing of Sheep Station Creek, near the junction with the Yarrangobilly River, and the easement clearing associated with the crossing of Wallace Creek also neat the junction of the Yarrangobilly River. The cumulative impacts from the project, in addition to the Exploratory and Main works, would total 5.48 ha of habitat to be impacted on.

The project has the potential to show increased risks above that assessed for the Main Works of indirect impacts from sedimentation due to the location of steep ridges and the proximity to mapped Booroolong frog breeding habitat. A 50-metre buffer has been identified as the appropriate distance to protect the Booroolong frog habitat from the impacts of the project. However, the potential for an encroachment of the 50-metre buffer, as a result of the project, has been identified to be of a higher risk than the Main Works project. The impacts are likely to increase due to the risk of steep slopes surrounding catchment causing movement of sediment from erosion and runoff from the project into waterways, particularly after large rain events from Wallaces Creek and Sheep Station Creek. These effects exceed those of the Main Works project.

The project may have impacts on water quality, water bodies and hydrological processes that sustain the Booroolong Frog in the following ways:

- There is potential for release of poor-quality sediment laden water into watercourses within and adjacent to the disturbance area when there are rainfall events during construction
- There is potential for a reduction in stream bank stability following vegetation removal for construction of bridges or clearances for power lines, resulting in bank erosion and sedimentation of watercourses
- There is potential for increased water flow into the waterways resulting from vegetation removal and access track construction (channelling of water) and increased erosion
- There is potential for accidental release of contaminants during construction and maintenance (i.e. chemicals, fuel, oil, hydraulic fluid) that could result in the release of hydrocarbons and metal contaminants into watercourses
- There is potential for release of pesticides and/or herbicides into watercourses which may have detrimental effects.

As identified in the Snowy 2.0 Exploratory Works and Main Works BDARs (EMM Consulting, 2017 and 2020a), short term reductions in water quality and mobilisation of fine sediments into watercourses within and adjacent to the disturbance area is considered unlikely to result in any long-term detrimental impacts to the aquatic environments. The discharge of fine sediments and contaminants are likely to be short 'pulse' events and the fine sediments would be rapidly flushed out of the system. This would most likely result in negligible impacts to threatened species such as the Booroolong Frog.

Given the location of the project, upslope from the Booroolong Frog habitat, there is potential for indirect impacts on the habitat of the species associated with mobilisation of sediment during construction and operation. Consideration has been given during the project design to avoiding and minimising the direct impact on this habitat through ensuring that permanent structures have been placed outside of the habitat and floodplain. The potential for short and long-term mobilisation of sediment downslope has also been avoided during the operational maintenance phase, by allowing regeneration of groundcover vegetation in the easement. The potential for downslope sediment mobilisation is able to be managed during construction through implementation of sediment control measures and water quality monitoring.

If the failure of the sedimentation mitigation measures occur, it is possible that the impact could lead to a long-term decrease in the size of the population. The greatest potential for a detrimental impact to the aquatic habitat of the Booroolong Frog is deposition of large amounts of sediment that could significantly reduce water quality in the long term. Coarse sediments that would not be flushed from the aquatic system will likely settle in the waterways filling the stream bed with sediment thereby removing any spaces between rocks and boulders reducing the opportunities for the Booroolong Frog to breed. Increased sediment loads can also adversely affect the growth and development of tadpoles, reducing their fitness and recruitment to the terrestrial frog stage (see Gillespie, 2002).

Importantly, sedimentation will be managed through implementation of effective sediment control measures. A Soil and Water Management Plan (SWMP) will be prepared and implemented as part of the CEMP. All erosion and sediment control measures will be designed, implemented, progressively rehabilitated and maintained in accordance with relevant sections of Managing Urban Stormwater: Soil and Construction Volume 1 (Landcom, 2004) ('the Blue Book') (particularly Section 2.2) and Managing Urban Stormwater: Soil and Construction Volume 2A – Installation of Services (DECC, 2008). Controlling impacts to water flow, water quality, and sedimentation associated with run-off from vegetation clearing, newly constructed access tracks, and structures will be key in mitigating the impacts on water quality, water bodies and hydrological processes that sustain threatened species (see Section 12). Additionally, water quality and sediment monitoring for the Booroolong frog will be undertaken prior to and during the construction activities, to prevent any long-term impacts which would decrease the size of the Booroolong Frog population.

Reduce the area of occupancy of the species

There are no estimates of the extent of occurrence or the area of occupancy of the Booroolong Frog available at this time, and therefore there are no quantitative data available assess the species against this criterion. However, it is indicated that the Booroolong Frog has undergone a severe decline and is no longer present across more than 50 per cent of the species former range. There is approximately 1.66 ha of habitat for the Booroolong Frog within the disturbance area. The cumulative impacts from the project, in addition to the 2.49 ha and 1.33 ha from the Exploratory and Main Works projects respectively, would total 5.48 ha of habitat to be impacted on. However, avoidance of the 50 m buffer zone around the edge of the Yarrangobilly River and Wallaces Creek that has been identified as Booroolong Frog breeding and dispersal habitat (EMM Consulting, 2017 and 2020a) will avoid the optimal habitat for the species in the area. Also, structures would be located off the floodplains at least 50 m from waterways where the Booroolong Frog is known to occur.

The greatest potential for a permanent impact to the aquatic habitat of the Booroolong Frog is deposition of large amounts of sediment that could significantly reduce water quality in the long term. Coarse sediments that would not be flushed from the aquatic system will likely settle in the waterways filling the stream bed with sediment thereby removing any spaces between rocks and boulders reducing the opportunities for the Booroolong Frog to breed. Impacts to water flow, water quality, and sedimentation associated with run-off from vegetation clearing, newly constructed access tracks, and structures will be mitigated against in the CEMP. Therefore, the design adjustments and mitigation measures for the project make it unlikely to reduce the area of occupancy of the Booroolong Frog.

Fragment an existing population into two or more populations

The dispersal capabilities and non-breeding habitats of the species are unknown, but the species is relatively sedentary with studies showing that the majority of recaptured individuals moved less than 50 m within a season, with maximum movements of up to 300 m being recorded across seasons (Department of the Environment, 2019a). Consequently, impacts to stream habitats may have a detrimental effect on the ability of the Booroolong Frog to move.

The power lines would span Booroolong Frog habitat and the bridge over Sheep Station Creek will be designed to avoid blocking streamflow. As such, impacts to the movement of the Booroolong Frog should be relatively minor and current movement patterns should remain comparatively unaltered. The design of waterway crossings and management measures that will be implemented during construction suggest that the project is considered unlikely to influence any movement of the Booroolong Frog that is essential to maintain its life cycle. The consequences of the project in terms of the effects on movement on the bioregional persistence of the Booroolong Frog are likely to be negligible. Therefore, the project is unlikely to fragment an existing population into two or more populations.

Adversely affect habitat critical to the survival of a species

Critical habitat for this species as defined by the National Recovery Plan for Booroolong Frog is "rocky sections of permanent streams occupied by the species. Any action that reduces stream permanency (e.g. pumping water) or results in loss of rock crevices (e.g. smothering by weeds or sedimentation), is likely to threaten the persistence of local populations of this species." These features will not be directly impacted by the project, as the power lines will span the waterways. Design of bridges and culverts will also ensure that streamflow is unaffected. Therefore, the project is unlikely adversely affect habitat critical to the survival of the Booroolong Frog.

Disrupt the breeding cycle of a population

Importantly, the project will not directly impact the optimal Booroolong Frog breeding habitats along the Yarrangobilly River. Increased sediment loads can also adversely affect the growth and development of tadpoles, reducing their fitness and recruitment to the terrestrial frog stage (see Gillespie, 2002). A key avoidance measure to avoid sedimentation associated with run-off from vegetation clearing is the avoidance of the 50 m buffer zone around the edge of the Yarrangobilly River and Wallaces Creek that has been identified as Booroolong Frog breeding and dispersal habitat (EMM Consulting, 2017 and 2020a). Structures are located off the floodplains and are at least 50 m from waterways where the Booroolong Frog is known to occur. Therefore, the project is unlikely to disrupt the breeding cycle of this Booroolong Frog population. However, the potential for an encroachment of the 50-metre buffer, as a result of the project, has been identified to be of a higher risk than the Main Works project. The impacts are likely to increase due to the risk of steep slopes surrounding catchment causing movement of sediment from erosion and runoff from the project into waterways, particularly after large rain events from Wallaces Creek and Sheep Station Creek. These effects exceed those of the Main Works project.

Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline

There will be approximately 1.66 ha of direct habitat impacts as a result of the project. The cumulative impacts from the project, in addition to the 2.49 ha and 1.33 ha from the Exploratory and Main Works projects respectively, would total 5.48 ha of habitat to be impacted on. However, the project will not directly impact the optimal Booroolong Frog breeding habitats along the Yarrangobilly River. Also, a 50 m buffer zone around the edge of the Yarrangobilly River and Wallaces Creek that has been identified as Booroolong

Frog breeding and dispersal habitat will be avoided by the project. However, the potential for an encroachment of the 50-metre buffer, as a result of the project, has been identified to be of a higher risk than the Main Works project. The impacts are likely to increase due to the risk of steep slopes surrounding catchment causing movement of sediment from erosion and runoff from the project into waterways, particularly after large rain events from Wallaces Creek and Sheep Station Creek. These effects exceed those of the Main Works project. In addition, potential impacts to water flow, water quality, and sedimentation associated with run-off from vegetation clearing, newly constructed access tracks, and structures would be mitigated against in the CEMP.

Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat

Nearly all streams currently occupied by the Booroolong Frog are also inhabited by a range of exotic fish species including Brown Trout (*Salmo trutta*), Rainbow Trout (*Oncorhynchus mykiss*), European Carp (*Cyprinus carpio*) Goldfish (*Carassius auratus*), Redfin Perch (*Perca fluviatilis*) and Mosquito Fish (*Gambusia holbrooki*) and all are known to predate the tadpoles of the Booroolong Frog. The Brown Trout (*Salmo trutta*) is already present in Yarrangobilly River. The project will not result in new exotic fish species becoming established in the streams that are habitat for Booroolong Frog adjacent the project.

Introduce disease that may cause the species to decline, or

The presence and spread of the Chytrid Fungus is recognised as a Key Threatening Process for this species. Chytrid Fungus is already widespread in NSW. Specific hygiene protocols to minimise the risk of the spread of Chytrid Fungus are detailed in the Frog Hygiene Protocols (DECC, 2008). Measures include, clothing and equipment wash down procedures and the sourcing of suitable materials that are not likely to be contaminated with the Chytrid Fungus. The project mitigation strategy and environmental management procedures would include guidance for preventing the introduction and/or spread of disease-causing agents such as bacteria and fungi.

Interfere with the recovery of the species

The National Recovery Plan for Booroolong Frog includes the following recovery objectives:

- Determine the species distribution in areas that have not been the focus of targeted surveys.
- Determine the taxonomic status of northern and southern Booroolong Frog populations and identify further genetic sub-division within these populations
- Reduce the impact of known or perceived threats contributing to the ongoing decline of the Booroolong Frog
- Determine population trends across the species range, and in areas subject to different management regimes
- Identify the potential impacts of climate change and determine management responses to reduce these impacts
- Identify other potentially threatening processes
- Increase community awareness and involvement in the Booroolong Frog recovery program
- Achieve the effective implementation of the recovery plan

Recovery objectives relevant to the project would be managed, using best practice methods, under the construction environmental management plan and during operation.

The project will not interfere with the recovery of this species.

Conclusion

The alignment of the project has been changed to minimise impacts on the population of the Booroolong Frog and the local population would suffer a small reduction in extent of sub optimal breeding habitat from the disturbance area. Unsatisfactory sedimentation mitigation measures have the potential to result in a long-term decrease in the size of the population. However, all erosion and sediment control measures will be designed, implemented, progressively rehabilitated and maintained in accordance with relevant sections of Managing Urban Stormwater: Soil and Construction Volume 1 (Landcom, 2004) ('the Blue Book') (particularly Section 2.2) and Managing Urban Stormwater: Soil and Construction Volume 2A – Installation of Services (DECC, 2008). Therefore, the project is considered unlikely to reduce the population size of the Booroolong Frog or decrease the reproductive success of this species. The project would not interfere with the recovery of the Booroolong Frog. After consideration of the factors above, the impact to habitat for the Booroolong Frog from the project is not considered to be of significance having regard to its context and intensity.

G.4 Smoky Mouse (*Pseudomys fumeus*)

Prior to the surveys undertaken for the Snowy 2.0 Exploratory Works and Main Works BDARs (EMM Consulting, 2017 and 2020a) the Smoky Mouse was known from one other site in the KNP from captures at spoil dumps (see Schulz and Wilks, 2017). During surveys for the Snowy 2.0 Exploratory Works and Main Works BDARs, the Smoky Mouse was captured in 13 locations in the higher elevation habitats above 1,100 m along Lobs Hole Ravine Road (EMM Consulting, 2017 and 2020a). The Smoky Mouse was only captured in the sub-alpine woodland habitat of PCT 1196 and was not found in the drier habitats below 1,100 m in elevation.

PCT 1196 is present in the western portion of the project area within the Bago State Forest in the Australian Alps Bioregion. This area of habitat within the project area was considered likely to be suitable for the Smoky Mouse based off the recent work undertaken for the Snowy 2.0 Exploratory Works and Main Works BDARs (see EMM Consulting, 2017 and 2020a). PCT 285 and PCT 300 may also be suitable based off the information in the EESG Threatened Biodiversity Data Collection. Despite a trapping program targeting PCT 1196, PCT 285 and PCT 300 using remote cameras and ground Elliott traps, the Smoky Mouse was not recorded within the project area during the surveys undertaken for this BDAR (see Appendix D for trapping results). Despite the lack of captures from the surveys undertaken for this BDAR, the habitat appears suitable and may be utilised by the Smoky Mouse in the future. A characteristic of Smoky Mouse colonies is their ephemeral nature, both spatially and temporally (Menkhorst and Broome, 2008a). Populations of rodents can disappear and reappear rapidly and as a precautionary measure we have undertaken the assessment below.

An action is likely to have a significant impact on a Critically Endangered or Endangered species if there is a real chance or possibility that it will:

Lead to a long-term decrease in the size of a population

The Department of the Environment (2019b) indicates that there are no reliable data on which to base Smoky Mouse population estimates or to estimate trends. The species has irruptive demography based on resource availability and has ephemeral spatial and temporal abundance (Menkhorst and Broome, 2008b). Populations can disappear rapidly, possibly caused by resource availability (associated with weather or time since fire), trap-ability, vegetation succession or predation (Menkhorst and Broome, 2008b). The Smoky Mouse was not captured during the trapping program undertaken for this BDAR suggesting that the species does not currently inhabit the areas within which the trap sites were located. This may be due to the habitat quality and structure, with the habitats impacted by horses, pigs, and weeds, being unsuitable for the species. Feral cats are quite abundant in the habitat as evidenced from the camera trap results, so predation pressure is likely to be high, or, it may just be that the Smoky Mouse was absent from the habitat at the point in time during which the trapping was undertaken due to the irruptive nature of the populations. Either way, the population size is not known.

Long-term survival of Smoky Mouse populations appear to be contingent on recruitment and immigration between subpopulations, and the regional dynamics of resource availability (Menkhorst, 2003). Due to the large area of contiguous similar habitats that appear to be suitable for the Smoky Mouse, the project is considered unlikely to lead to a long-term decrease in the size of a population. If this species is present, there is likely to be a number of sub-populations in the locality. Fluctuations in numbers and patchiness in distribution within apparently suitable habitat are characteristic of many species of Pseudomys (Menkhorst and Broome, 2008a) and it is unlikely that a population would be wholly restricted to the area of habitat to be impacted. The results of the trapping suggest that at the time of the surveys a population was absent but future colonisation of the habitats created by the transmission line corridor is possible as there will likely be areas that develop a dense shrubby health like midstorey composed of leguminous plant species (a habitat structure known to be favoured by the Smoky Mouse).

Reduce the area of occupancy of the species

As previously stated there are no data on which to base population estimates or to estimate trends, but some studied populations have clearly declined (Menkhorst and Broome, 2008b). Prior to 1985, the species was thought restricted to Victoria but more recent records from NSW and the ACT, including the recent KNP records, have substantially expanded the known range (Menkhorst and Broome, 2008b). The area of occupancy for this species is not known. However, it is unlikely that the project will reduce the current known area of occupancy as the species is not known from the project area.

Fragment an existing population into two or more populations

The Smoky Mouse occurs in small, isolated populations that are probably restricted to patches of quality habitat that combine a rich and diverse range of food items with adequate shelter from wildfire and predators (Menkhorst and Broome, 2008b). Whilst the project area will separate areas of tree canopy, the width of the clearing will likely allow for dispersal between habitats (through dense shrubs and groundcover). The results of the trapping suggest that at the time of the surveys a population was absent so fragmentation of a population is unlikely. Future colonisation of the habitats created by the transmission line corridor is possible if a population exists. The Smoky Mouse may utilise areas that develop a dense / shrubby midstorey composed of leguminous plant species (a habitat structure known to be favoured by the Smoky Mouse).

Adversely affect habitat critical to the survival of a species

Knowledge of the habitat requirements of the Smoky Mouse is inadequate to allow a meaningful description of habitat critical to survival, as required under the EPBC Act (Menkhorst and Broome, 2008b). However, there are three identified critical Smoky Mouse regions - The Grampians, South Eastern Highlands and Eden Hinterland (Menkhorst and Broome, 2008a). The recent captures of the Smoky Mouse in the Australian Alps region of the KNP suggest that this region is also important for the species.

The habitat that would be impacted by the project (i.e. PCT 1196, 24.94 ha of total clearance and 2.31 ha of partial clearance) in the Bago State Forest may potentially be suitable for the Smoky Mouse but there are some attributes of the habitat that make it less than optimal. Predation rates from feral cats are likely to be high (due to the high capture rate of cats on remote cameras). Habitat structure is impacted by horses and pigs. The absence of the Smoky Mouse during the trapping period also suggests that a high-density population is currently not present in the project area indicating that the habitat is not optimal for establishment of a breeding group and therefore is unlikely to be critical to the survival of the species.

Disrupt the breeding cycle of a population

The Smoky Mouse tend to occur in small discrete colonies based around patches of dense heathy understorey and shelter in small groups (comprising a male and up to five breeding females), in a large, complex burrow system that can be up to 10 m^2 and more than 25 m in length, with multiple nesting chambers (Menkhorst and Broome, 2008a). Breeding occurs from September–April, and 1–2 litters, each of 3–4 young, are produced (Menkhorst and Broome, 2008a).

The absence of the Smoky Mouse during the trapping period (undertaken within the known breeding period in December 2018) also suggests that a high-density population is currently not present in the project area. This suggests that the habitat is not optimal for establishment of a breeding group and that the breeding cycle of a population is unlikely to be disrupted. The habitat may however be suitable for transient males as they move between sub-populations in search of mates. Any barriers to movement introduced by the project (e.g. access roads, cleared power line easements) may restrict movements of males between sub-populations but as the presence of the Smoky Mouse is not known in the project area or contiguous habitats the potential impacts on breeding cycles are not known.

Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline

The complete removal of approximately 24.94 ha and 2.31 ha of partial removal of potential habitat in the form of PCT 1196 is considered unlikely to result in the decline of the species. Despite a trapping program targeting PCT 1196, PCT 285 and PCT 300 using remote cameras and ground Elliott traps, the Smoky Mouse was not recorded within the project area during the surveys undertaken for this BDAR. This suggest that a high-density population, or breeding population of females, was not present in the project area during the survey period. The habitat may however be suitable for transient males as they move between optimal habitats in search of mates.

As the Smoky Mouse was not recorded during the surveys suggesting that the habitat was not optimal for a resident breeding population at the time of the survey, the project is not considered likely to modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.

Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat

The Smoky Mouse is highly susceptible to predation from introduced predators such as feral cats, foxes and dogs. The Smoky Mouse is particularly susceptible to predation because it has a relatively low reproductive rate, frequently uses vegetation with an open ground layer, and uses communal burrows with well-defined entrances that can be staked out by 'sit and wait' predators (Menkhorst and Broome, 2008b).

Feral cats and dogs are already established and abundant in the habitats within the project area as evidenced by the camera trapping results. Predation pressure from introduced predators is likely to be high. The 'right of way' created by a transmission line and associated access tracks may function as a wildlife corridor connecting areas of habitat. The literature indicates that large carnivores exhibit a strong preference to move through rights of way (Donida Biasotto and Kindel, 2018). This has implications for the increased movement of introduced vertebrate pests and the creation of the transmission line corridor and access tracks through areas that are currently densely forested may open areas of habitat that currently have lower pest species densities.

Introduce disease that may cause the species to decline, or

Habitat loss through *Phytophthora cinnamomi* infection is a known threat to the Smoky Mouse. The extent of *Phytophthora cinnamomi* occurrence in the Kosciuszko regions is however not known (Menkhorst and Broome, 2008b) but the habitats possess many of the plant families that are known to be susceptible to *Phytophthora cinnamomi* infection including Ericaceae, Fabaceae, Proteaceae, Dilleniaceae, Elaeocarpaceae, and Lomandraceae. However, the plants within the habitats within the project area and contiguous habitats did not display evidence of any dieback that may be related to *Phytophthora cinnamomi* infection. No significant modification of habitat structure or loss of plant species has occurred suggesting that *Phytophthora cinnamomi* infection is not currently an issue within the habitats to be impacted.

Of concern is the potential introduction and spread of *Phytophthora cinnamomi* during construction. Propagules may be dispersed by vehicles and earth-moving equipment containing infected soil and root material, and by animals such as feral pigs. Mitigation measures will be put in place to ensure that the risk of *Phytophthora cinnamomi* introduction and/or spread is minimised.

Interfere with the recovery of the species

The *National Recovery Plan for the Smoky Mouse Pseudomys fumeus* (Menkhorst and Broome, 2008b) outlines the following objectives for recovery of the species:

4) Designate protection zones around known populations
5) Refine knowledge of the distribution and abundance
6) Examine population partitioning
7) Minimise predation by the Red Fox, Feral Cat and Wild Dog
8) Establish small-mammal refuges
9) Develop and test burning regimes to maintain and enhance habitat quality
10) Study habitat preference, diet and the effects of disturbance on population survival and connectivity
11) Establish a captive breeding colony of Smoky Mice
12) Establish and minimise risk of *Phytophthora cinnamomi* infection
13) Increase community awareness and involvement.

The project will not interfere with any of these objectives or the actions identified to achieve them.

Conclusion

The absence of the Smoky Mouse during the trapping period (undertaken within the known breeding period in December 2018) suggests that a breeding population, or high-density population, was not present in the project area. The habitat may however be suitable for transient males as they move between sub-populations in search of mates. Due to the lack of captures of the species in the project area and the large area of contiguous similar habitats that appear to be suitable for the Smoky Mouse, the project is considered unlikely to lead to a long-term decrease in the size of a population. It is unlikely that the project will reduce the current known area of occupancy as the species is not known from the project area. It would appear that a breeding group was not present, so the habitat is unlikely to be critical to the survival of the species and the breeding cycle of a population is unlikely to be disrupted. Whilst the project area will separate areas of tree canopy, the width of the clearing will likely allow for dispersal between habitats (through dense shrubs and groundcover). Introduced predators such as cats, foxes and dogs are already well established in the habitats and the project is likely to have little effect on their abundance, but movement may be increased.

Given the absence of the Smoky Mouse during the survey period and the apparently less than optimal habitat quality due to high predator numbers, a significant impact to the Smoky Mouse is not considered likely.

G.5 Macquarie Perch (*Macquaria australasica*)

Despite fish stocking of Macquarie Perch within the Talbingo Reservoir, these species were not located during surveys and it is unknown if self-sustaining populations occur within the study area. However, based on the habitat assessment and review of the work undertaken for the Snowy 2.0 Exploratory Works and Main Works EISs (Cardno, 2018 and Cardno, 2019), the Macquarie Perch is considered likely to occur in the habitats that may be affected by the project area including Wallaces Creek.

A ‘population of a species’ is defined under the EPBC Act as an occurrence of the species in a particular area. In relation to critically endangered, endangered or vulnerable threatened species, occurrences include but are not limited to:

- A geographically distinct regional population, or collection of local populations, or

- A population, or collection of local populations, that occurs within a particular bioregion

The 'population' of Macquarie Perch subject to this assessment is taken to be the translocated population which may utilise the habitats impacted by the project area including any fish in Wallaces Creek and the Yarrangobilly River and interconnected waterways.

An action is likely to have a significant impact on a Critically Endangered or Endangered species if there is a real chance or possibility that it will:

Lead to a long-term decrease in the size of a population

The National Recovery Plan for Macquarie Perch (*Macquaria australasica*) (Department of the Environment and Energy, 2018) identifies that a small population persists in the upper Murrumbidgee River near 'Cooma Gorge' at Binjura Nature Reserve (upstream of Cooma and downstream of Tantangara Dam). The Macquarie Perch was stocked or translocated into the Talbingo Reservoir (NSW Department of Primary Industries, 2016) and any fish present in the Yarrangobilly River or Wallaces Creek would be from this introduction. As described by Cardno (2018), while there is potential for a self-sustaining population of Macquarie Perch to occur within the habitats impacted by the project area, the potential for this population to contribute to the integrity (e.g. population numbers and genetic diversity) of the wider Murray-Darling Basin population is likely to be minimal due to the presence of barriers to fish passage including the Talbingo and Blowering dam walls.

As identified by Cardno (2018), the removal of a small amount of riparian and aquatic habitat is not expected to have a detrimental effect on any population to the extent that it would lead to a long-term decrease in the size of a population. Impacts to water quality in Yarrangobilly River and Wallaces Creek due to run-off of sediment-laden water are likely to be very small, localised and short term (due to the mitigation that will be implemented) and unlikely to lead to a long-term decrease in the size of a population.

Reduce the area of occupancy of the species

The current area of occupancy for the Macquarie Perch in the ACT and NSW includes below Cotter Dam (Macquarie Perch are sometimes recorded in the Cotter River), above the Cotter Dam (Macquarie perch are now found in Cotter Reservoir and for a possible 27 km of the Cotter River upstream of the reservoir and downstream of Bendora Reservoir), Goodradigbee River and upper Murrumbidgee River from Cooma to Yaouk, a small population persists in the upper Murrumbidgee River near 'Cooma Gorge' at Binjura Nature Reserve (upstream of Cooma and downstream of Tantangara Dam), the Abercrombie and the Lachlan rivers, east coast catchments of the Hawkesbury-Nepean river system and the Georges River. Macquarie Perch were translocated from the Murray-Darling Basin (most likely from the Murrumbidgee River) to the Mongarlowe River, and the Shoalhaven River itself at Nithsdale, on multiple occasions in the late-1800s. The species was also translocated to Cataract Reservoir (Nepean River catchment) and the Nepean River itself near Sydney using fish captured from the Berembed Weir area of the Murrumbidgee River in around 1916.

It is unlikely that the project would reduce the area of occupancy of the species. If this species is present in Wallaces Creek and the Yarrangobilly River, the extent of the impacts are considered small scale and temporary and would not result in a reduction in the area of occupancy of the species. It is likely that the Macquarie Perch would still use Wallaces Creek and the Yarrangobilly River during and after construction if this species does indeed utilise the waterways.

Fragment an existing population into two or more populations

Importantly, the project will not result in the breaking apart of large blocks of high-quality habitat and fish passage will not be blocked. As such, the project is considered unlikely to fragment an existing population into two or more populations.

Adversely affect habitat critical to the survival of a species

Habitat critical to the survival of the Macquarie Perch is described as:

- All areas within the species' range which are characterised by flowing runs or riffles and small complex rock piles
- The current area of occupancy of the species (including historically translocated populations in Cataract Reservoir and the Mongarlowe River in New South Wales and the Yarra River in Victoria)
- Any newly discovered locations within the species' natural range which hold populations that extend the area of occupancy for the species
- Unoccupied habitat within the species' natural range into which the species could disperse, be stocked or be translocated.

If the Macquarie Perch is present in Wallaces Creek and the Yarrangobilly River, the habitat would therefore be considered as critical to the survival of the Macquarie Perch. However, as identified by Cardno (2018), the removal of a small amount of riparian and aquatic habitat is not expected to have a detrimental effect on the species. The trimming of riparian vegetation and creation of watercourse crossings is unlikely to result in a long-term detrimental impact due to the application of mitigation measures designed to prevent sedimentation of the waterways.

Disrupt the breeding cycle of a population

The project will not disrupt the breeding cycle of the Macquarie Perch. Macquarie Perch undertake upstream migrations to breed in October to January. Temporary noise or minor habitat alteration during this time is unlikely to prevent breeding. More importantly, any crossings will be designed so that fish passage is not blocked. Therefore, breeding movements would not be affected if this species does in fact use Wallaces Creek and the Yarrangobilly River for breeding.

Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline

The removal of a small amount of riparian and aquatic habitat is not expected to have a detrimental effect on the population. The predicted impact to riparian vegetation (PCT 302) is estimated at 0.58 ha of total clearance and 1.72 ha of partial clearance. This impact is small scale and it not considered likely to cause the species to decline.

Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat

Redfin Perch, Wild Goldfish, Eastern Gambusia, Rainbow Trout and Brown Trout are introduced species that are known to occur in the habitats. These species are well established. As such, the project is not likely to result in the establishment of these species or increase their spread through other waterways.

Introduce disease that may cause the species to decline, or

The project does not involve the movement of animals or any materials likely to be contaminated by pathogens and are unlikely to result in the introduction of any animal diseases. The project mitigation strategy and environmental management procedures would include guidance for preventing the introduction and/or spread of disease-causing agents.

Interfere with the recovery of the species

The National Recovery Plan for Macquarie Perch (*Macquaria australasica*) (Department of the Environment and Energy, 2018) identifies the following actions for recovery of the species:

- Protect Macquarie Perch from competition with and predation by introduced fish species

- Ensure that the impacts of recreational fishing are minimised
- Protect Macquarie Perch populations from outbreaks of disease and parasites
- Restore Macquarie Perch population connectivity by conducting regular assisted gene flow (i.e. translocations) in order to decrease inbreeding, prevent further loss of genetic diversity by drift and improve adaptive potential (consistent with EPBC Act requirements)
- Develop an emergency management response plan for rescue translocations (consistent with EPBC Act requirements)
- Undertake priority habitat rehabilitation, restoration and enhancement work
- Seek to provide appropriate flow regimes in all waters where Macquarie Perch occur below water storages or offtakes
- Undertake works to minimise cold water pollution
- Improve in-stream habitat to improve productivity of lower food web
- Investigate methods to promote spawning and recruitment activity of Macquarie Perch in naturally occurring and stocked populations
- Better understand competition and predation on Macquarie Perch by introduced fish species
- Increase the confidence that the viruses and pathogens impacting Macquarie Perch are all identified and known
- Increase understanding of the degree of impact parasites are having on Macquarie Perch populations
- Research best practice for habitat restoration
- Refine and improve captive breeding techniques for Macquarie Perch
- Undertake a conservation stocking program for Macquarie Perch
- Implement a long-term monitoring program for the Macquarie Perch which is able to record the size and importance of natural, self-sustaining populations and stocked populations
- Increase understanding of spawning and recruitment ecology of the Macquarie Perch and its relationship to habitat
- Increase understanding of how the Macquarie Perch's life cycle is related to flow and temperature
- Investigate the fate of released fingerlings
- Raise awareness for the conservation status of Macquarie Perch in the community
- Engage with private landholders and land managers responsible for the land adjacent to waterways which populations occur and encourage these key stakeholders to support the conservation of the Macquarie Perch.

The project would not interfere with any of the above identified management actions.

Conclusion

Given the context and intensity of the potential impact and the low magnitude of the potential impacts to the Macquarie Perch and its potential habitat, a significant impact to the Macquarie Perch is considered unlikely.

G.6 White-throated Needletail

The White-throated Needletail is a migratory species which breeds in forests in south-eastern Siberia, Mongolia, the Korean Peninsula and Northern Japan between June to August. Most often seen in eastern Australia before storms, low pressure troughs and approaching cold fronts and occasionally bushfire. These conditions are often used by insects to swarm (e.g. termites and ants) or tend to lift insects away from the surface which favours sighting of White-throated Needletails as they feed. The White-throated Needletail is more common in coastal areas, rather than inland.

The White-throated Needletail is listed as Vulnerable under the EPBC Act and is moderately likely to occur within the project area and may fly over the area during migration.

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

Lead to a long-term decrease in the size of an important population of a species

An 'important population' is a population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in recovery plans, and/or that are:

- Key source populations either for breeding or dispersal
- Populations that are necessary for maintaining genetic diversity, and/or
- Populations that are near the limit of the species range.

Tarburton (2014) demonstrated that from three sites in Victoria, at the level of each eastern state and at the national scale, a 30-50 per cent decline in White-throated Needletail flock size has occurred over three generations (25.5 years). The reduction of this species has not ceased, and the cause of the decline is unknown. However, vegetation clearing has seen to be a contributor to the decline of the species. Furthermore, the White-throated Needletail is susceptible to collision with overhead powerlines, though as this affects only a few individuals, it is not a threat to the species overall.

The whole area impacted by the project provides possible habitat for the White-throated Needletail, however, as this species is predominantly aerial, it is unlikely that the development would impact on this species. As there is no evidence to suggest that an ecologically significant proportion of the population exists within the study area. There is no 'important habitat' mapped for this species within the study area, where the White-throated Needletail is likely to fly over and may forage within the study area. As this species breeds in south-eastern Siberia, Mongolia, the Korean Peninsula and northern Japan, there is no breeding habitat located within the study area, and therefore the project would not contribute to a long-term decrease in the size of the population.

Reduce the area of occupancy of an important population

Within Australia, the extent of occurrence is estimated at >20,000 km^2, and the area of occupancy estimated at >18,000 km^2. The project will not substantially change the hydrological conditions of the habitats within the study area and surrounding habitat. The project area also requires a small amount of preferred vegetation clearing, therefore, it is unlikely to reduce the area of occupancy of an important population.

Fragment an existing important population into two or more populations

The proposal is considered unlikely to result in the creation of barriers to movement to, between or within habitat for the White-throated Needletail. This species is highly mobile and capable of long-distance flights. Whilst the project area will separate areas of tree canopy, the width of the clearing will likely allow for dispersal between habitats. The action is considered unlikely to fragment existing populations as movement corridors within the locality would remain intact for this species. The project will not be significant to the breeding and dispersal or the genetic diversity of this species. Therefore, the project is not expected to lead to fragmentation of habitat for in important population of the White-throated Needletail.

Adversely affect habitat critical to the survival of a species

In Australia, White-throated Needletails almost always forage aerially, at heights up to 'cloud level', above a wide variety of habitats ranging from heavily treed forests to open habitats, such as farmland, heathland or mudflats. They often forage in areas of updraughts, such as ridges, cliffs or sand-dunes, and they seldom alight on the ground or vertical substrates to catch insect. There is no 'important habitat' areas located within the project area for the White-throated needletail Therefore, the habitat in the project area is not considered critical for this species.

Disrupt the breeding cycle of an important population

The White-throated Needletail does not breed within Australia, therefore the project will not impact upon the breeding cycle of the population.

Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline

As the White-throated Needletail forages almost exclusively, above a wide variety of habitats, and is considered unlikely to rely on the habitats present within the project site, the impacts to foraging habitat as a result of the project are minimal. Considering the mitigation measures proposed to reduce the vegetation clearance, the project is unlikely to modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline. The impact to habitat from the project is not expected to lead to a decline in the species in this region considering the large amount of higher quality foraging habitat available to local animals within the locality.

Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat

The potential for weed invasion has been considered a low potential, with a project of this nature and appropriate controls have been provided during the construction to reduce this threat as it may have long term implications for the habitat of the White-throated Needletail. The management of invasive species would be managed under the construction environmental management plan.

Introduce disease that may cause the species to decline, or

There are no known disease issues affecting this species in relation to the action. The action would be unlikely to increase the potential for significant disease vectors to affect local populations.

Additionally, infection of native plants by Phytophthora cinnamomi has been identified as being spread by construction machinery. This water-borne mould infects the roots of plants and has the potential to cause dieback. Machinery associated with vegetation clearance and subsequent construction has the potential to transmit the fungus to remaining native vegetation remnants of the species. This is a potential indirect impact to the species through the transmission of pathogens into retained habitat near the facility. This can be mitigated through the development and implementation of suitable control measures for vehicle and plant hygiene and is unlikely to have a significant impact. It is the intention to use current best practice hygiene protocols as part of the CEMP to prevent the introduction or spread of pathogens.

The proposal mitigation strategy and environmental management procedures would include guidance for preventing the introduction and/or spread of disease-causing agents such as bacteria and fungi.

Interfere substantially with the recovery of the species.

Due to the limited nature of any threats to the species and its mobility, there are no threat abatement or recovery actions either underway or proposed. However, an approved Conservation Advice for the species provides sufficient direction to implement priority actions, mitigate against key threats and enable recovery. Management and research activities are being undertaken at international, national, state and local levels.

Conclusion

The project area contains habitat that could potentially be used by the White-throated Needletail, however this species is predominantly aerial. This species is moderately likely to occur within the project area and may fly over the area during migration. The project, however, is not classed as 'important habitat' and would not seriously disrupt the lifecycle of an ecologically significant proportion of the White-throated Needletail population.

G.7 Migratory species

An area of 'important habitat' for a migratory species is:

- Habitat used by a migratory species occasionally or periodically within a region that supports an ecologically significant proportion of the population of the species, and/or
- Habitat that is of critical importance to the species at particular life-cycle stages, and/or
- Habitat used by a migratory species which is at the limit of the species range, and/or
- Habitat within an area where the species is declining.

Listed migratory species cover a broad range of species with habitat requirements, life cycles and population sizes. Therefore, what is an 'ecologically significant proportion' of the population varies with the species. Some factors that would be considered include the species' population status, genetic distinctiveness and species-specific behavioural patterns (for example, site fidelity and dispersal rates). These factors have been considered in the following assessment.

Substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species

There is no evidence to suggest that an ecologically significant proportion of the population of any identified migratory species exists within the study area.

Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species

The potential for weed invasion has been considered a low potential, with a project of this nature and appropriate controls have been provided during the construction to reduce this threat as it may have long term implications for the habitat of threatened and migratory species. The management of invasive species would be managed under the construction environmental management plan.

Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.

As discussed, there is no evidence to suggest that an ecologically significant proportion of the population of a migratory species exists within the study area.

Appendix H. Fisheries Management Act 1994 significance assessments

H.1 Macquarie Perch (*Macquaria australasica*)

Despite fish stocking of Macquarie Perch within the Talbingo Reservoir, this species was not located during the Cardno (2018) surveys and it is unknown if a self-sustaining population occurs. The Macquarie Perch may also occur in the Yarrangobilly River (Cardno, 2018). Based on the habitat assessment and review of the work undertaken for the Snowy 2.0 Exploratory Works and Main Works EISs (Cardno, 2018 and Cardno 2019), the Macquarie Perch is considered likely to occur in the habitats that may be affected by the project area.

In accordance with Section 221ZV of the FM Act, the following is to be taken into account for the purposes of determining whether a proposed development or activity is likely to significantly affect threatened species, populations or ecological communities (unless it is carried out in critical habitat):

a) in the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction,

The project will not disrupt the breeding cycle of the Macquarie Perch. Macquarie Perch undertake upstream migrations to breed in October to January. Temporary noise or minor habitat alteration during this time is unlikely to prevent breeding. More importantly, any crossings will be designed so that fish passage is not blocked. Therefore, breeding movements would not be affected if this species does in fact use Wallaces Creek and the Yarrangobilly River for breeding. As such, the project is not likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

b) in the case of an endangered population, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction,

Not applicable.

c) in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:

   i. is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

   ii. is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,

Not applicable.

(d) in relation to the habitat of a threatened species, population or ecological community:

   i. (i) the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and

   ii. (ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and

   iii. (iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the threatened species, population or ecological community in the locality,

The removal of a small amount of riparian and aquatic habitat is not expected to have a detrimental effect on the population. The predicted impact to riparian vegetation (PCT 302) is estimated at 2.12 ha. This impact is small scale and it not considered likely to cause the species to decline.

Importantly, the action will not result in the breaking apart of large blocks of high-quality habitat and fish passage will not be blocked. As such, the project is considered unlikely to fragment or isolate an area of habitat from other areas of habitat.

Wallaces Creek and the Yarrangobilly River are not specifically recognised as an important habitat for the Macquarie Perch (see Department of the Environment and Energy, 2018).

(e) whether the proposed development or activity is likely to have an adverse effect on any critical habitat (either directly or indirectly),

No critical habitat has been listed for the Macquarie Perch.

(f) whether the proposed development or activity is consistent with a Priorities Action Statement,

The *Priorities Action Statement – Actions for Macquarie Perch* (Department of Primary industries, 2019b) identifies the following recovery actions:

- Advice to consent and determining authorities
  - Provide information on the distribution of the Macquarie Perch to local councils and determining authorities to ensure appropriate consideration during development assessment processes (High priority).
- Collate and review existing information
  - Compile existing information on Macquarie Perch and identify knowledge gaps for the purpose of targeting future research activities (Medium priority)
  - Collate data on the historical distribution of Macquarie Perch including anecdotal and indigenous knowledge (Low priority).
- Community and stakeholder liaison, awareness and education
  - Install signs and/or interpretive displays at appropriate locations to assist with identification and awareness of Macquarie Perch (Medium priority)
  - Encourage community reporting of Macquarie Perch via the NSW DPI Threatened and Pest Species Sightings Program online form (Low priority)
  - Implement education initiatives to improve awareness of the status of the Macquarie Perch and ways to minimise impacts on the species by preparing and distributing appropriate advisory material (Low priority)
  - Foster long-term, two-way knowledge transfer and capacity building to enhance the role of indigenous ecological knowledge in the recovery of Macquarie Perch (Low medium).
- Compliance / enforcement
  - Maximise compliance activities at identified important sites (Medium priority).
- Enhance, modify or implement NRM planning processes to minimize adverse impacts on threatened species
  - Negotiate with relevant authorities to encourage the identification, assessment, and modification of natural resource management plans and policies to minimise impacts on Macquarie Perch habitats and water quality (High priority).
  - Implement relevant State policies and programs (e.g. the NSW Diffuse Source Water Pollution Strategy) in an effort to reduce water pollution (particularly chemical pollution from agricultural pesticides) impacts on Macquarie Perch habitats in NSW (High priority).

- Habitat rehabilitation
  - Undertake work to identify, restore and protect known and potential Macquarie Perch habitats and address key threats such as habitat degradation and water quality decline from expanding development (High priority)
  - Allocate and manage environmental water flows in regulated rivers to restore natural seasonal flow patterns, and to reduce the impact of cold water downstream of dams (High priority)
  - Actively seek funds through grant schemes or other sources to implement riparian vegetation and water quality improvement projects in priority areas (High priority)
  - Undertake priority rehabilitation, restoration and enhancement work (e.g. rehabilitating riparian vegetation, cold water pollution reduction measures, reinstating large woody debris, removal of barriers to fish passage, removal of willows from riverbanks, sediment and erosion control measures) at key sites known to support Macquarie Perch populations (High priority).
- Pest eradication and control
  - Investigate and implement integrated management of introduced species in and adjacent to identified Macquarie Perch habitats and take action to prevent the spread of introduced species into these habitats (High priority).
- Research / monitoring
  - Conduct research on the biology and ecology of Macquarie Perch, particularly the species' ecological role, environmental tolerances, factors influencing population dynamics, age and growth, life cycle and diet (High priority)
  - Monitor Macquarie Perch populations over time to assess trends in abundance and distribution and to identify emerging threatening processes (High priority)
  - Undertake research to identify, prioritise and improve understanding of the threatening processes and causes of decline of Macquarie Perch (High priority)
  - Actively seek grants or investor partnerships to fund research and monitoring programs for Macquarie Perch (High priority)
  - Actively encourage community involvement in aspects of Macquarie Perch research and monitoring programs (Low priority).
- Stocking / translocation
  - Implement the NSW Freshwater Fish Stocking Fishery Management Strategy to prevent significant impacts from stocking on Macquarie Perch populations (High priority)
  - Conduct research to evaluate the effectiveness of translocation of adult fish compared to stocking of juveniles to inform future conservation actions (High priority)
  - Conduct targeted sampling at stocked sites to assess the status of stocked populations including growth and recruitment rates (High priority)
  - Develop an emergency response policy to guide the collection and captive husbandry of Macquarie Perch. The policy should address the circumstances in which wild individuals may be collected, held and re-released, and identify holding facilities, potential funding sources and legal requirements (Low priority)
  - Identify potential candidate sites for possible future translocation of Macquarie Perch (Low priority).
  - Undertake emergency rescues of Macquarie Perch in response to droughts, oil spills/ pollution, detection of biosecurity threats (e.g. disease or pests), or to avoid imminent impacts in accordance with the emergency response policy (Low priority)
  - Review and assess the potential of artificial refuge areas for the protection of Macquarie Perch (Low priority).

- Survey / mapping
  - Conduct targeted surveys to determine the current distribution and abundance of Macquarie Perch (Medium priority)
  - Collect data on the presence/absence of Macquarie Perch during incidental surveys (Medium priority).

The project will not interfere with any of the above recovery actions identified in the Priorities Action Statement.

(g) whether the proposed development constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

The Key threatening Processes outlined in Schedule 6 of the FM Act include:

- Degradation of native riparian vegetation along New South Wales watercourses
- Hook and line fishing in areas important for the survival of threatened fish species
- Human-caused climate change
- Installation and operation of instream structures and other mechanisms that alter natural flow regimes of rivers and streams
- Introduction of fish to waters within a river catchment outside their natural range
- Introduction of non-indigenous fish and marine vegetation to the coastal waters of New South Wales
- Removal of large woody debris from New South Wales rivers and streams
- The current shark meshing program in New South Wales waters

The project will involve removal of some native riparian vegetation. As such, the project will result in the operation of a key threatening process.

Conclusion

There will be some removal of riparian vegetation and aquatic habitat, but it is not expected to have a detrimental effect on the population (if indeed the Macquarie Perch utilises the habitats affected by the project). The project is not likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction. The project is considered unlikely to fragment or isolate an area of habitat from other areas of habitat. Wallaces Creek and the Yarrangobilly River are not specifically recognised as an important habitat for the Macquarie Perch. No critical habitat will be impacted. The project will not interfere with the recovery actions identified for the Macquarie Perch. The degradation of riparian vegetation along New South Wales watercourses is however a Key Threatening Process identified in Schedule 6 of the FM Act. Considering the factors above, the project is considered unlikely to significantly affect the Macquarie Perch.

H.2 Murray Crayfish (*Euastacus armatus*).

The Murray Crayfish is known to occur in the Yarrangobilly River and Wallaces Creek (see Cardno, 2018).

In accordance with Section 221ZV of the FM Act, the following is to be taken into account for the purposes of determining whether a proposed development or activity is likely to significantly affect threatened species, populations or ecological communities (unless it is carried out in critical habitat):

a) in the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction,

A viable local population of the Murray Crayfish is known to be present in the habitats to be impacted by the project area. The Murray Crayfish was caught in the Yarrangobilly River and Wallaces Creek during recent surveys (see Cardno, 2018). The species is slow growing, with females taking up to 10 years to reach sexual maturity, and 4 years for males. They can live up to an estimated 28 years of age (Department of Primary industries, 2019a). The lifecycle to sexual maturity is long. Habitat modification can detrimentally impact the Murray Crayfish and may have an adverse effect on the lifecycle of the species.

Importantly for this project, sedimentation must be managed. Sedimentation can fill deeper holes, smother snags and other cover, and bury clay banks required for burrowing (Department of Primary industries, 2019a). Mitigation measures will be put in place to prevent the habitats being impacted by sedimentation so that burrowing will be able to continue. There will be no obstruction to the waterway and the preferred flowing streams will persist in a similar state during and after construction. As such, the life cycle of the species is considered unlikely to be affected to the point where a viable local population would be placed at risk of extinction.

b) in the case of an endangered population, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction,

Not applicable.

c) in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:

   i. is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

   ii. is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,

Not applicable.

(d) in relation to the habitat of a threatened species, population or ecological community:

   i. (i) the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and

   ii. (ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and

   iii. (iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the threatened species, population or ecological community in the locality,

The removal of a small amount of riparian and aquatic habitat is not expected to have a detrimental effect on the population. The predicted impact to riparian vegetation (PCT 302) is estimated at 2.12 ha. This impact is small scale and it not considered likely to cause the species to decline.

Importantly, the action will not result in the breaking apart of large blocks of high-quality habitat and fish passage will not be blocked. As such, the project is considered unlikely to fragment or isolate an area of habitat from other areas of habitat.

Wallaces Creek and the Yarrangobilly River are not specifically recognised as an important habitat for the Murray Crayfish.

(e) whether the proposed development or activity is likely to have an adverse effect on any critical habitat (either directly or indirectly),

No critical habitat has been listed for the Murray Crayfish.

(f) whether the proposed development or activity is consistent with a Priorities Action Statement,

The *Priorities Action Statement – Actions for Murray Crayfish* (Department of Primary industries, 2019c) identifies the following recovery actions:

- Advice to consent and determining authorities
  - Provide information on the distribution of the Murray Crayfish to local councils and determining authorities to ensure appropriate consideration during development assessment processes (Medium priority).
- Collate and review existing information
  - Compile existing information on Murray Crayfish and identify knowledge gaps for the purpose of targeting future research activities (High priority)
  - Collate data on the historical distribution of Murray Crayfish including anecdotal and indigenous knowledge (Low priority).
- Community and stakeholder liaison, awareness and education
  - Install signs and/or interpretive displays at appropriate locations to assist with identification and awareness of Murray Crayfish (High priority)
  - Educate fishers about the open and closed Murray Crayfish fishing seasons and locations as well as bag and size restrictions (High priority)
  - Implement education initiatives to improve awareness of the status of the Murray Crayfish and ways to minimise impacts on the species by preparing and distributing appropriate advisory material (Medium priority)
  - Encourage community reporting of Murray Crayfish via the NSW DPI Threatened and Pest Species Sightings Program online form (Low priority)
  - Foster long-term, two-way knowledge transfer and capacity building to enhance the role of indigenous ecological knowledge in the recovery of Murray Crayfish (Low priority).
- Compliance / enforcement
  - Maximise compliance activities at identified important sites (High priority).
- Enhance, modify or implement NRM planning processes to minimize adverse impacts on threatened species
  - Negotiate with relevant authorities to encourage the identification, assessment, and modification of natural resource management plans and policies to minimise impacts on Murray Crayfish habitats and water quality (High priority)
  - Implement relevant State policies and programs (e.g. the NSW Diffuse Source Water Pollution Strategy) in an effort to reduce water pollution (particularly chemical pollution from agricultural pesticides) impacts on Murray Crayfish habitats in NSW (Medium priority).

- Habitat rehabilitation
  - Undertake work to identify, restore and protect known and potential Murray Crayfish habitats and address key threats such as habitat degradation and water quality decline (High priority)
  - Allocate and manage environmental water flows in regulated rivers to restore natural seasonal flow patterns (High priority)
  - Actively seek funds through grant schemes or other sources to implement riparian vegetation and water quality improvement projects in priority areas (High priority)
  - Undertake priority rehabilitation, restoration and enhancement work (e.g. rehabilitating riparian vegetation, cold water pollution reduction measures, reinstating large woody debris, removal of barriers to fish passage, removal of willows from riverbanks, sediment and erosion control measures) at key sites known to support Murray Crayfish populations (High priority).
- Pest eradication and control
  - Investigate and implement integrated management of introduced species in and adjacent to identified Murray Crayfish habitats and take action to prevent the spread of introduced species into these habitats (High priority).
- Research / monitoring
  - Conduct research on the biology and ecology of Murray Crayfish, particularly the species' ecological role, environmental tolerances, factors influencing population dynamics, age and growth, life cycle and diet (High priority)
  - Undertake research to identify, prioritise and improve understanding of the threatening processes and causes of decline of Murray Crayfish (High priority)
  - Actively seek grants or investor partnerships to fund research and monitoring programs for Murray Crayfish (High priority)
  - Monitor populations of Murray Crayfish over time to assess trends in abundance and distribution and to identify emerging threatening processes (Medium priority)
  - Actively encourage community involvement in aspects of Murray Crayfish research and monitoring programs (Low priority)
  - Undertake research into the translocation and/or captive breeding of Murray Crayfish (Low priority)
  - Obtain and analyse genetic material from remnant populations of Murray Crayfish to identify genetic units to inform conservation breeding or translocation (Low priority).
- Stocking / translocation
  - Implement the NSW Freshwater Fish Stocking Fishery Management Strategy to prevent significant impacts from stocking on Murray Crayfish populations (High priority)
  - Identify potential candidate sites for possible future translocation of Murray Crayfish (Low priority)
  - Undertake emergency rescues of Murray Crayfish in response to droughts, oil spills/ pollution, detection of biosecurity threats (e.g. disease or pests), or to avoid imminent impacts in accordance with the emergency response policy (Low priority)
  - Review and assess the potential of artificial refuge areas for the protection of Murray Crayfish (Low priority).
- Survey / mapping
  - Conduct targeted surveys to determine the current distribution and abundance of Murray Crayfish (High priority)
  - Collect data on the presence/absence of Murray Crayfish during incidental surveys (Medium priority).

The project will not interfere with any of the above recovery actions identified in the Priorities Action Statement.

(g) whether the proposed development constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

The Key threatening Processes outlined in Schedule 6 of the FM Act include:

- Degradation of native riparian vegetation along New South Wales watercourses
- Hook and line fishing in areas important for the survival of threatened fish species
- Human-caused climate change
- Installation and operation of instream structures and other mechanisms that alter natural flow regimes of rivers and streams
- Introduction of fish to waters within a river catchment outside their natural range
- Introduction of non-indigenous fish and marine vegetation to the coastal waters of New South Wales
- Removal of large woody debris from New South Wales rivers and streams
- The current shark meshing program in New South Wales waters

The project will involve removal of some native riparian vegetation. As such, the project will result in the operation of a key threatening process.

Conclusion

There will be some removal of riparian vegetation and aquatic habitat, but it is not expected to have a detrimental effect on the population of Murray Crayfish. The project is not likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction. The project is considered unlikely to fragment or isolate an area of habitat from other areas of habitat. Wallaces Creek and the Yarrangobilly River are not specifically recognised as an important habitat for the Murray Crayfish. No critical habitat will be impacted. The project will not interfere with the recovery actions identified for the Murray Crayfish. The degradation of riparian vegetation along New South Wales watercourses is however a Key Threatening Process identified in Schedule 6 of the FM Act. Considering the factors above, the project is considered unlikely to significantly affect the Murray Crayfish.

Appendix I. Biodiversity credit report

BAM Credit Summary Report

Proposal Details

Assessment Id

00033469/BAAS18009/22/00033471

Proposal Name

TransGrid Snowy 20 Transmission Connection EIS - South East Highlands

BAM data last updated *

16/06/2022

Assessor Name

Report Created

09/08/2022

BAM Data version *

54

Assessor Number

BAAS18058

BAM Case Status

Finalised

Date Finalised

09/08/2022

Assessment Revision

3

Assessment Type

Major Projects

* Disclaimer: BAM data last updated may indicate either complete or partial update of the BAM calculator database. BAM calculator database may not be completely aligned with Bionet.

Ecosystem credits for plant communities types (PCT), ecological communities & threatened species habitat

Zone	Vegetation zone name	TEC name	Current Vegetation integrity score	Change in Vegetation integrity (loss / gain)	Area (ha)	Sensitivity to loss (Justification)	Species sensitivity to gain class	BC Act Listing status	EPBC Act listing status	Biodiversity risk weighting	Potential SAII	Ecosystem credits
Brittle Gum - peppermint open forest of the Woomargama to Tumut region, NSW South Western Slopes Bioregion												
1	296_DNG	Not a TEC	39.5	26.4	0.1	PCT Cleared - 40%	High Sensitivity to Gain			1.50		1

2	296_Good_dry_slopes	Not a TEC	88.7	76.1	4.1	PCT Cleared - 40%	High Sensitivity to Gain			1.50		116
3	296_Good_wet_slopes	Not a TEC	75.3	50.4	13.6	PCT Cleared - 40%	High Sensitivity to Gain			1.50		256
4	296_Moderate_Blackberry	Not a TEC	49.1	39.2	1.3	PCT Cleared - 40%	High Sensitivity to Gain			1.50		19
											Subtotal	**392**
Broad-leaved Peppermint - Candlebark shrubby open forest of montane areas, southern South Eastern Highlands Bioregion and South East Corner Bioregion												
8	729_DNG	Not a TEC	23.4	15.3	0.72	PCT Cleared - 35%	High Sensitivity to Gain			1.50		4
9	729_Derived_shrubland	Not a TEC	36.6	36.6	0.61	PCT Cleared - 35%	High Sensitivity to Gain			1.50		8
10	729_Good_dry_slopes	Not a TEC	80.5	61.3	12.8	PCT Cleared - 35%	High Sensitivity to Gain			1.50		295
11	729_Good_wet_slopes	Not a TEC	72.2	46.8	12.8	PCT Cleared - 35%	High Sensitivity to Gain			1.50		224
											Subtotal	**531**

Norton's Box - Broad-leaved Peppermint open forest on footslopes, central and southern South Eastern Highlands Bioregion												
12	999_Derived_shrubland	Not a TEC	31.5	30.7	1.3	PCT Cleared - 15%	High Sensitivity to Gain			1.50		15
13	999_Good_dry_Calytrix	Not a TEC	58.9	55.3	7.3	PCT Cleared - 15%	High Sensitivity to Gain			1.50		151
											Subtotal	**166**
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												
5	300_Good	Not a TEC	80.9	69.6	23.2	PCT Cleared - 20%	High Sensitivity to Gain			1.50		605
											Subtotal	**605**
Riparian Blakely's Red Gum - Broad-leaved Sally woodland - tea-tree - bottlebrush - wattle shrubland wetland of the NSW South Western Slopes Bioregion and South Eastern Highlands Bioregion												
6	302_DNG	Not a TEC	14.6	6.3	0.22	PCT Cleared - 50%	High Sensitivity to Gain			1.75		0
7	302_Moderate	Not a TEC	61.3	42.5	2.1	PCT Cleared - 50%	High Sensitivity to Gain			1.75		39
											Subtotal	**39**
											Total	**1733**

Species credits for threatened species

Vegetation zone name	Habitat condition (Vegetation Integrity)	Change in habitat condition	Area (ha)/Count (no. individuals)	Sensitivity to loss (Justification)	Sensitivity to gain (Justification)	BC Act Listing status	EPBC Act listing status	Potential SAII	Species credits
Caladenia montana / Caladenia montana (Flora)									
296_Good_wet_slopes	50.4	50.4	4.7	Biodiversity Conservation Act listing status	Effectiveness of management in controlling threats	Vulnerable	Not Listed	False	89
300_Good	69.6	69.6	1.6	Biodiversity Conservation Act listing status	Effectiveness of management in controlling threats	Vulnerable	Not Listed	False	41
729_Good_dry_slopes	61.3	61.3	1.1	Biodiversity Conservation Act listing status	Effectiveness of management in controlling threats	Vulnerable	Not Listed	False	26
729_Good_wet_slopes	46.8	46.8	0.56	Biodiversity Conservation Act listing status	Effectiveness of management in controlling threats	Vulnerable	Not Listed	False	10

999_Derived_shrubland	30.7	30.7	0.36	Biodiversity Conservation Act listing status	Effectiveness of management in controlling threats	Vulnerable	Not Listed	False	4
999_Good_dry_Calytrix	55.3	55.3	1	Biodiversity Conservation Act listing status	Effectiveness of management in controlling threats	Vulnerable	Not Listed	False	22
								Subtotal	**192**
Callocephalon fimbriatum / Gang-gang Cockatoo (Fauna)									
296_DNG	26.4	26.4	0.1	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Endangered	False	1
296_Good_dry_slopes	76.1	76.1	3.8	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Endangered	False	143
296_Good_wet_slopes	50.4	50.4	5.9	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Endangered	False	149
300_Good	69.6	69.6	17.3	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Endangered	False	603

302_Moderate	42.5	42.5	2.1	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Endangered	False	45
729_DNG	15.3	15.3	0.72	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Endangered	False	5
729_Derived_shrubland	36.6	36.6	0.61	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Endangered	False	11
729_Good_dry_slopes	61.3	61.3	10.2	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Endangered	False	313
729_Good_wet_slopes	46.8	46.8	2.9	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Endangered	False	69
999_Derived_shrubland	30.7	30.7	1.2	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Endangered	False	19
999_Good_dry_Calytrix	55.3	55.3	4.6	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Endangered	False	127

296_Moderate_ Blackberry	39.2	39.2	1.3	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Endangered	False	25
								Subtotal	**1510**
Cercartetus nanus / Eastern Pygmy-possum (Fauna)									
296_DNG	26.4	26.4	0.1	Biodiversity Conservation Act listing status	Effectiveness of management in controlling threats	Vulnerable	Not Listed	False	1
296_Good_dry_s lopes	76.1	76.1	4.1	Biodiversity Conservation Act listing status	Effectiveness of management in controlling threats	Vulnerable	Not Listed	False	155
296_Good_wet_ slopes	50.4	50.4	13.6	Biodiversity Conservation Act listing status	Effectiveness of management in controlling threats	Vulnerable	Not Listed	False	342
300_Good	69.6	69.6	23.2	Biodiversity Conservation Act listing status	Effectiveness of management in controlling threats	Vulnerable	Not Listed	False	807

302_Moderate	42.5	42.5	2.1	Biodiversity Conservation Act listing status	Effectiveness of management in controlling threats	Vulnerable	Not Listed	False	45
729_Derived_shrubland	36.6	36.6	0.61	Biodiversity Conservation Act listing status	Effectiveness of management in controlling threats	Vulnerable	Not Listed	False	11
729_Good_dry_slopes	61.3	61.3	12.8	Biodiversity Conservation Act listing status	Effectiveness of management in controlling threats	Vulnerable	Not Listed	False	393
729_Good_wet_slopes	46.8	46.8	12.8	Biodiversity Conservation Act listing status	Effectiveness of management in controlling threats	Vulnerable	Not Listed	False	299
999_Derived_shrubland	30.7	30.7	1.3	Biodiversity Conservation Act listing status	Effectiveness of management in controlling threats	Vulnerable	Not Listed	False	21
999_Good_dry_Calytrix	55.3	55.3	7.3	Biodiversity Conservation Act listing status	Effectiveness of management in controlling threats	Vulnerable	Not Listed	False	201

296_Moderate_ Blackberry	39.2	39.2	1.3	Biodiversity Conservation Act listing status	Effectiveness of management in controlling threats	Vulnerable	Not Listed	False	25
								Subtotal	**2300**
Litoria booroolongensis / Booroolong Frog (Fauna)									
296_Good_wet_ slopes	50.4	50.4	0.15	Biodiversity Conservation Act listing status	Ability to colonise improved habitat	Endangered	Endangered	False	4
302_Moderate	42.5	42.5	1.3	Biodiversity Conservation Act listing status	Ability to colonise improved habitat	Endangered	Endangered	False	27
729_Derived_shr ubland	36.6	36.6	0.08	Biodiversity Conservation Act listing status	Ability to colonise improved habitat	Endangered	Endangered	False	1
729_Good_dry_s lopes	61.3	61.3	0.18	Biodiversity Conservation Act listing status	Ability to colonise improved habitat	Endangered	Endangered	False	6
								Subtotal	**38**

Petaurus australis - endangered population / Yellow-bellied Glider population on the Bago Plateau (Fauna)									
300_Good	69.6	69.6	15.5	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Endangered Population	Not Listed	False	539
729_Good_dry_slopes	61.3	61.3	5.4	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Endangered Population	Not Listed	False	165
								Subtotal	**704**
Tyto novaehollandiae / Masked Owl (Fauna)									
300_Good	69.6	69.6	0.04	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Not Listed	False	1
								Subtotal	**1**

BAM Credit Summary Report

Proposal Details

Assessment Id	Proposal Name	BAM data last updated *
00033469/BAAS18009/22/00033472	TransGrid Snowy 20 Transmission Connection EIS - Australian Alps	16/06/2022
Assessor Name	Report Created	BAM Data version *
	09/08/2022	54
Assessor Number	BAM Case Status	Date Finalised
BAAS18058	Finalised	09/08/2022
Assessment Revision	Assessment Type	
4	Major Projects	

* Disclaimer: BAM data last updated may indicate either complete or partial update of the BAM calculator database. BAM calculator database may not be completely aligned with Bionet.

Ecosystem credits for plant communities types (PCT), ecological communities & threatened species habitat

Zone	Vegetation zone name	TEC name	Current Vegetation integrity score	Change in Vegetation integrity (loss / gain)	Area (ha)	Sensitivity to loss (Justification)	Species sensitivity to gain class	BC Act Listing status	EPBC Act listing status	Biodiversity risk weighting	Potential SAII	Ecosystem credits

Broad-leaved Sally grass - sedge woodland on valley flats and swamps in the NSW South Western Slopes Bioregion and adjoining South Eastern Highlands Bioregion												
1	285_Moderate_Blackberry	Not a TEC	78.7	78.7	2.2	PCT Cleared - 75%	High Sensitivity to Gain			2.00		87
											Subtotal	**87**
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												
2	300_Good	Not a TEC	83.5	73.9	8.8	PCT Cleared - 20%	High Sensitivity to Gain			1.50		244
											Subtotal	**244**
Snow Gum - Mountain Gum shrubby open forest of montane areas, South Eastern Highlands Bioregion and Australian Alps Bioregion												
3	1196_DNG	Not a TEC	38.6	38.6	0.09	PCT Cleared - 5%	High Sensitivity to Gain			1.50		1
4	1196_Good	Not a TEC	84.9	80.9	27.2	PCT Cleared - 5%	High Sensitivity to Gain			1.50		824
											Subtotal	**825**
											Total	**1156**

Species credits for threatened species

Vegetation zone name	Habitat condition (Vegetation Integrity)	Change in habitat condition	Area (ha)/Count (no. individuals)	Sensitivity to loss (Justification)	Sensitivity to gain (Justification)	BC Act Listing status	EPBC Act listing status	Potential SAII	Species credits
Callocephalon fimbriatum / Gang-gang Cockatoo (Fauna)									
285_Moderate_ Blackberry	78.7	78.7	2.2	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Endangered	False	87
300_Good	73.9	73.9	8.8	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Endangered	False	326
1196_DNG	38.6	38.6	0.09	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Endangered	False	2
1196_Good	80.9	80.9	27.2	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Endangered	False	1099
								Subtotal	**1514**
Cercartetus nanus / Eastern Pygmy-possum (Fauna)									
285_Moderate_ Blackberry	78.7	78.7	2.2	Biodiversity Conservation Act listing status	Effectiveness of management in controlling threats	Vulnerable	Not Listed	False	87

300_Good	73.9	73.9	8.8	Biodiversity Conservation Act listing status	Effectiveness of management in controlling threats	Vulnerable	Not Listed	False	326
1196_Good	80.9	80.9	27.2	Biodiversity Conservation Act listing status	Effectiveness of management in controlling threats	Vulnerable	Not Listed	False	1099
								Subtotal	**1512**
Petaurus australis - endangered population / Yellow-bellied Glider population on the Bago Plateau (Fauna)									
285_Moderate_ Blackberry	78.7	78.7	2.2	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Endangered Population	Not Listed	False	87
300_Good	73.9	73.9	8.8	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Endangered Population	Not Listed	False	326
1196_Good	80.9	80.9	27.2	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Endangered Population	Not Listed	False	1099
								Subtotal	**1512**

Tyto novaehollandiae / Masked Owl (Fauna)									
285_Moderate_ Blackberry	78.7	78.7	0.03	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Not Listed	False	1
300_Good	73.9	73.9	5.8	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Not Listed	False	215
1196_Good	80.9	80.9	5	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Not Listed	False	201
								Subtotal	**417**

Appendix J. Bird / Bat collision risk assessment

The aim of this assessment is to summarise available bird / bat data and relevant information to assist with better understanding the potential risks associated with electrocution / Electromagnetic fields (EMF) as a result of the project. Key project components associated with risk of bird electrocution include 330kV overhead double-circuit transmission lines - two lines 9 km in length, steel lattice structures up to 75 m in height, short connection lines (300m long, two structures, eight steel poles). Assessment of risk to bird and bat species will be achieved by:

- High level review of at-risk species from literature
- Review of species likely to occur in the study area from field and background review
- Review of Australian Bird Bat Banding data for deaths associated with transmission lines
- Develop a high-level risk assessment for species likely to occur in the study area, based on risk factors for each species and likelihood of incidents and consequences of potential incidents to species.

Background

Summary of potential birds / bats in the study area

Section 4.8.2 of the BDAR summarises the threatened fauna that were targeted for assessment. The species were targeted based on desktop assessment, consideration of the project area and in consultation with the then Office of Environment and Heritage (OEH). Of the threatened species that were targeted, those that would have potential to be at risk of electrocution / collision with transmission line structures are summarised in Table J-1.

Additional common species that have records in the study area include Wedge-tailed Eagle, several Cockatoo species and some common Bat Species. A preliminary assessment of potential to fly at the height of the proposed transmission line cables suggests that the ‘bushbirds’ are all too small and flight habits would preclude them from collision with transmission line cables. Similarly, all the bat species that were identified at site have low potential for collision given they all fly within or below the canopy; one non-agile bat species Greater Broad-nosed Bat is also considered to fly well beneath the height of the transmission lines. Whilst little is known of the Eastern Broad-nosed Bat foraging habits, it is considered that given that this species prefers tall to low forest, it also flies within or close to vegetation and has low potential to collide with the transmission line cables. The EPBC-listed Grey-headed Flying-fox may have potential to collide with transmission line cables, given wing-span (up to 1180 cm, Churchill 2008) and habit of flying high above the canopy distant from camps sites (up to 50 km). However, this species was considered to have a low likelihood potential for occurring in the study area, given closest known camp is >130km from the project area. Given the species has conservation significance, adaptive management would need to be considered if they moved into the area.

Birds that were considered to have some potential to collide with the transmission lines include larger flocking species (e.g. Cockatoo species), nocturnal species and raptors. These terrestrial species are considered further in a risk-based approach below, along with a number of waterbirds that may occur in the Talbingo Reservoir in the study area. It should be noted that native parrots and pigeon species were also not considered to have potential to collide with transmission lines given smaller body sizes and agile flight, smaller groups of birds (e.g. native pigeons), daylight flight habits within vegetation (pigeons) or above vegetation (parrots) and lack of historical evidence of collisions with transmission lines. Species known to occur in the KNP include pigeon species (Bronzewing, Crested Pigeon, Wonga, Peaceful Dove) and parrot species (King, Turquoise, Swift, Crimson, Eastern, Red-rumped, Rainbow Lorikeet).

Table J-1 Summary of key threatened terrestrial fauna species and some common fauna species with potential to occur in the study area.

Fauna Type	Common Name	*Species Name*	Threatened Species Status[1]		Likelihood of occurrence / identified on sites	Has some potential to fly at height of transmission line / collision / electrocution[2]
			EPBC Act	BC Act		
Bat	Large Bent-winged Bat	*Miniopterus orianae oceanensis*	-	V	Yes, calls recorded	Low, fast fly between shrub and canopy
Bat	Southern Myotis	*Myotis macropus*	-	V	Unlikely	No
Bat	Eastern False Pipistrelle	*Falsistrellis tasmaniensis*	-	V	Yes, likely identification	Low, swift flight within and below canopy
Bat	Yellow-bellied Sheathtail-bat	*Saccolaimus flaviventris*	-	V	Yes, identified on site	Low, fast flight above canopy, but low over open space and forest edge
Bat	Greater Broad-nosed Bat	*Scoteanax rueppellii*	-	V	Yes	Low, high wing loading, non-agile, but forage 5m from edge of isolated trees, forest or remnants.
Bat	Lesser Long-eared Bat	*Nyctophilus geoffroyi*	-	-	Yes, identified on site	Low, fly slow, agile, 6-10m above ground within forest, close to vegetation
Bat	Large Forest Bat	*Vespadelus darlingtoni*	-	-	Yes, identified on site	Low, fast flying within space amongst trees, between canopy and understorey
Bat	Southern Forest Bat	*Vespadelus regulus*	-	-	Yes, identified on site	Low, fast agile flight very close to vegetation, less than half canopy height
Bat	Gould's Long-eaed Bat	*Nyctophilus gouldi*	-	-	Yes, identified on site	Low, slow flight but 2-5m above ground and below canopy of forest trees
Bat	Eastern Broad-nosed Bat	*Scotorepens orion*	-	-	Yes, identified on site	Low – Moderate, robust bat, nothing known about flight habits.
Bat	Little Forest Bat	*Vespadelus vulturnus*	-	-	Yes, identified on site	Low, very agile, flies within upper levels of forest canopy, very close to foliage and canopy
Bat	Chocolate Wattled Bat	*Chalinolobus morio*	-	-	Yes, identified on site	Low, very agile, fast flying between top of understorey and canopy or low along forest trails
Bird-migratory	White-throated Needletail	*Hirundapus caudacutus*	V	-	High / known	High
Bird – bush bird	Pink Robin	*Petroica rodinogaster*	-	V	High / known	Low, present but very small size and scrub flight
Bird – bush bird	Painted Honeyeater	*Painted Honeyeater*	V	V	Low	No
Bird – bush bird	Diamond Firetail	*Stagonopleura guttata*	-	V	Yes	No
Bird – bush bird	Varied Sittella	*Daphoenositta chrysoptera*	-	V	Yes,identified on site	Low, but small and flight in and just above canopy

Fauna Type	Common Name	*Species Name*	Threatened Species Status[1]		Likelihood of occurrence / identified on sites	Has some potential to fly at height of transmission line / collision / electrocution[2]
			EPBC Act	BC Act		
Bird – bush bird	Flame Robin	*Petroica phoenicea*	-	V	Identified on site	No, small and low flight height
Bird – bush bird	Scarlet Robin	*Petroica boodang*	-	V	Known to occur	No, small and low flight height
Bird – bush bird	Dusky Woodswallow	*Artamus cyanopterus*	-	V	Known to occur and identified on site	No, small and moderate flight height
Bird – bush bird	Rufous Fantail	*Rhipidura rufifrons*	M	-	Known	No, small and low flying
Birds - Cockatoo	Gang-gang Cockatoo	*Callocephalon fimbriatum*	-	V	Identified on site	Moderate
Bird - cockatoo	Yellow-tailed Black Cockatoo	*Calyptorhynchus funereus*	-	-	Identified on site	Moderate
Bird - cockatoo	Sulphur-crested Cockatoo	*Cacatua galerita*	-	-	Identified on site	Moderate
Birds - Raptor	Little Eagle	*Hieraaetus morphnoides*	-	V	Known to occur in the locality	High
Birds - Raptor	Square-tailed Kite	*Lophoictinia isura*	-	V	Known to occur in the locality	High
Birds - Raptor	Wedge-tailed Eagle	*Aquila audax*	-	-	Identified / Known	High
Birds - Raptor	White-bellied Sea-Eagle	*Haliaeetus leucogaster*	LM	V	Known to occur in the locality	High
Birds - Raptor	Brown Goshawk	*Accipiter fasciatus*	-	-	Known	High
Nocturnal bird	Barking Owl	*Ninox connivens*	-	V	Unlikely to occur	No
Nocturnal bird	Powerful Owl	*Ninox strenua*	-	V	Breeding habitat known; assumed present in low numbers	High
Nocturnal bird	Masked Owl	*Tyto novaehollandiae*	-	V	Identified on site	High
Nocturnal bird	Sooty Owl	*Tyto tenebricosa*	-	V	Moderate	High
Nocturnal bird	Southern Boobook	*Ninox boobook*	-	-	Identified on site	High

Status[1] codes; LM = Listed Marine, Migratory, V = Vulnerable; Bat flight information from Churchill 2008

Risks from Power Lines

Documented evidence of risks to birds from electricity infrastructure is relatively limited in Australia. Scottish Natural Heritage (2016) describe three main risks to birds (including birds that use wetland habitats) associated with the overhead wires of power lines (high-voltage transmission lines, as well as smaller distribution lines). These include:

- Mortality via collision with power lines or the guy wires that support meteorological masts. Mortality can occur from the bird either hitting the wires, the ground, or from injuries sustained with either of those events. In general bird collisions with power lines do not occur evenly along the entire length of the line, but are often concentrated near collision 'hotspots'. Multiple factors, that are not always evident to humans, may interact to create such a hotspot.

- Mortality via electrocution from the power lines or supporting structures, e.g. perching or nesting on steel lattice structures, short circuit, touching two live wires or a live and earthed component simultaneously. This generally only occurs where there are smaller gaps between live components, therefore mainly occurs for larger birds species that would nest or perch in the structures (e.g. raptors) and flying-foxes.

- Displacement / habitat loss to accommodate the infrastructure. This can be clearing for structure construction, indirect loss of habitat if birds avoid the structure and the surrounding area, increased predation (e.g. raptors, corvid, gulls) or ground-nesting birds. Displacement can also occur via barrier effects if birds are deterred from using normal routes to feeding or roosting grounds.

Bird mortality associated with transmission lines is influenced by a range of factors (Scottish Heritage Trust 2016):

- Species-specific morphology / biology: Birds /bats are considered to be at higher risk of mortality from transmission lines if they have larger body sizes, high wing loadings or large wing length. Birds that fly in tight or fast moving flocks or disperse at periods of low visibility, and birds with limited visual capacity (e.g. related to the location of eyes / peripheral vision – birds that forage at close range) are also considered at higher risk. Other factors include birds which may be behaviourally 'distracted' while engaged in predation (e.g. raptors) or breeding displays (e.g. territorial flights / displays), or younger and more inexperienced birds and migrants not familiar with the landscape. Birds that require a large distance to takeoff / land (e.g. birds with large wing spans) such as swans and large waterfowl, may also be at risk (Taylor et al. 2015, cited in Scottish Heritage Trust 2016; Winnings and Murray 1997).

- Conversely it is noted that nocturnal species (e.g. Owls, Owlet Nightjars) have specific adaptations to enable visibility in poor light, similarly marine birds such as terns, gulls and albatrosses have adaptations to their eyes to improve distance vision in hazy conditions (Wikipedia 2019), hence mortality for these bird types associated with transmission lines is unlikely to be associated with poor visibility, but could be associated with other behavioural factors. For example, studies of collisions with terns and windfarms suggested that tern collisions were related to high numbers of terns flying at the locality (due to proximity to breeding colony), only occurring during the breeding season and only including adults (Everert and Stienen 2007).

- Landscape and topography: Where power lines are near or cross important habitats (e.g. wetlands, or reservoirs) or flyways regularly used by birds, there is considered to be an elevated risk of bird strike and potential mortality. Birds will fly lower (i.e. down valleys) or higher (i.e. over mountains and hillslopes) to naturally optimise their energy efficiency in travelling, thus when infrastructure aligns with landscape features, collisions are reduced because the birds are already altering flight to avoid landscape features. Similarly, height of vegetation near infrastructure can also affect flight height with presence of short vegetation enabling lower flight and presence of existing taller vegetation facilitating higher flight paths.

- Weather conditions: Unusual weather events, such as very strong winds, dust storms, fog or heavy rain may result in reduced visibility and/or flying agility, and therefore increase the risk of bird strike with electrical infrastructure.

- Technical and design aspects: Conductor spacing, perch availability, location of earth wires in the array, structure or pole guy wires, high visibility plates along wires all have the potential to influence the impact of structures on birds.

Transmission lines and associated structures are generally known to impact wetland birds, particularly when transmission lines cross wetland areas. While the highest mortality rates occur where transmission lines pass directly through wetlands, lower rates of mortality are still known to occur when transmission lines pass near wetlands. Information about the frequency and extent of the impacts can be derived from bird collision studies which involve daily collision observations at established transmission lines (i.e. observations of successful flights over compared to collisions for target species) and ground searches (day and night) for victims beneath transmission lines. It is noted that results from ground surveys also consider undetermined losses attributed to scavengers and birds that may die elsewhere following collision. Most studies suggest that waterbird collisions with transmission lines are a relatively low occurrence, and mortalities attributable to electrical lines are relatively low compared to the regional / resident population numbers of target species, with the exception of endangered species that naturally exhibit smaller population numbers.

Mortality rates (as a function of overall population size) for bird collision with powerlines are generally low compared with other causes. Most studies have shown a reduction in collisions and/or an increase in behavioural avoidance at lines marked with reflective ‘diverters’ when compared to unmarked lines, but this can vary with location, type of line marking device, and bird species (APLIC 2012). Many studies of transmission lines with high collision rates indicate that collision risk can be lowered by 50% to 80% when these lines are marked, although some studies report much lower levels of reduction, particularly for species which move after dusk.

<u>Raptors</u>

Raptors are considered higher risk of collision, as have larger body size and less agile flight or heavy and fast flying, also predators that could be distracted by prey they are chasing or carrying. Consequences of collision would also be higher for species with small local and global population numbers.

Specific risks to raptors associated with transmission lines include:

- Roosting in structures to increase field of view for foraging and hunting, resulting in collision with wires or electrocution,
- Location of powerlines to broadcast territory resulting in collision with wires
- Collision / electrocution of juvenile raptors (e.g. less experienced flight agility)
- Wingspan / separation of conductors and conductors to ground – leading cause of electrocution
- Collision with wires associated with distraction (e.g. if power lines are close to prey habitat, over water).

<u>Bats</u>

It is noted that whilst microbats have been recorded in the study area, studies on impacts to bats arising from EMFs, note very little literature of direct impacts to bats, impacts associated with transmission line construction and operation are more likely associated with indirect effects of habitat alteration associated with vegetation clearance and trimming (EirGRid 2015). Studies in Ireland found that where vegetation was managed and unmanaged near transmission lines (110kV, 220 kV and 400kV) with known bat activity did not have deterrent effects on common resident bat species. Whilst there is literature about bat collision with Wind Farms, there are no peer reviewed studies about bat collisions or electrocutions associated with overhead transmission lines (EIRGRid 2015). The studies key suggestion was that post construction monitoring of bats should be undertaken where impacts to bats are predicted.

Similarly studies in Kenya noted that bats have different flight heights and wing loadings, some are fast and some prefer open habitats, dividing them into low feeders, intermediate, high and very high. Based on this it was considered that bats were vulnerable to 50m long rotating turbine blades on 80m high turbines. High flying bats were considered to be at greater collisions than slow flying bats (e.g. Giant Free-tailed Bat). Medium flight height bats (fly over bushed sand trees or low near ground) were considered moderate risk for collision, low flight bat lower risk for collision with moving turbines. All species present in the study area had Least Concern IUCN threatened species status, hence consequences to species as a whole from any potential impacts was considered very low. Impacts associated with non-moving transmission lines were however indirect impacts associated with habitat alteration, noise and dust, rather than collision. Impacts for multiple transmission lines (220kV, 400 kv) were also assessed. It was considered that risks to bat species was minimal, particularly where mitigation measures were deployed, minimising habitat clearance, spacing of overhead cables > 60 cm apart, minimising herbicide use for retained vegetation during operations (Kipeto Energy Limited 2013).

Table J-2 below summarises the key points associated with bird / bat collisions and transmission lines discussed above.

Table J-2 Summary of key points regarding bird / bat collision with transmission lines

Impact	Reasons	Comments
Electrocution	• Smaller earth wires, smaller voltage KV lines. • Earth wires pose greater risk than bunded conductor wires that are lower in the array	• Mostly associated with raptors and corvids perching / nesting on structures or unbunded earth wires close to conductors. • More risk for larger birds / larger wing span • Little evidence of bat collision with transmission lines, more evidence of bat collisions with moving wind farm blades where high risk species are those that fly above vegetation height.
Bird collision with wires, conductors and earth wires, or ground following collision with wires	Flight paths a) Season – migratory / direction that crosses the transmission line Poor flight behaviour / ability b) heavy body e.g. swan, pelican (6.8-8.7 kg) c) Distance to take off / landing points required d) Body shape / flight type (e.g. ducks) e) Newly arrived migrants, weak, ill, fledglings Periods of low visibility f) Timing of movement - nocturnal versus day / diurnal (e.g. herons migrate at dawn / dusk; g) Weather conditions (e.g. fogs, strong winds) Dispersal numbers / flock forming h) breeding concentrations i) feeding aggregations j) dispersal in tight / large flocks (e.g. ducks) Collision 'hotspots' involving a variety of these factors Distraction due to natural behaviour k) predators (e.g. raptors / gulls) l) territorial flight displays (e.g. cranes)	Collisions studies summary (Carpenter 2002) m) Daily collision observations relative to number that fly over successfully – at established transmission lines n) Ground searches for victims under transmission lines (day /night) o) Consider undetermined losses attributed to scavengers and birds that may die elsewhere p) Most studies suggest waterbird collision as a result of transmission lines are low relative to regional populations (except for endangered species with naturally low populations) q) Estimates for transmission lines are lower than collisions with cars / buildings r) Estimates for collisions are lower for longer stretches of line s) Collisions with transmission lines are a greater threat where large concentrations of birds occur / and / or endangered species occur (e.g. wetlands) t) Risks are greater when transmission lines pass through or in close proximity to wetlands u) Consequences are greatest to bird species that occur in lower population numbers v) Impacts can be difficult to quantify in locations where there is great variability in numbers related to seasons and breeding / flood conditions (e.g. Riverland Complex) w) Impacts can be difficult to quantify when there is little known about flight paths of species at a location (e.g. Riverland Complex)
Displacement	x) Habitat clearance for infrastructure or access tracks y) Increased predators (e.g. raptors, gulls)	• No wetland habitat will be cleared as a result of this project. • An increase in the exiting predator level is not anticipated as a result of this project.

Impact	Reasons	Comments
	z) Barrier effects / change of flight path to feeding / roosting grounds	• Significant alteration of flight paths between feeding and roosting grounds are not expected.

Based on the above information, the highest risks to birds and bats from the project are considered to be to species which are:

- large bodied
- have poor flying ability, or low agility
- nocturnal, or disperse at dawn or dusk, given the lack of literature
- likely to migrate into and out of the region from nearby wetlands / or Reservoirs with wetlands habitat features and are therefore required to cross the proposed line (e.g. There are no naturally occurring wetlands in the project area, however the transmission lines will span across the Talbingo Reservoir, which is not a naturally occurring wetland, however, does offer wetland habitat features),
- threatened or conservation significant species which have low population numbers
- require a longer take off / landing distance (e.g. birds / bats with larger wing spans)

Historic evidence

The Australian Government (DotEE) under the auspices of the Australian Bird and Bat Banding Scheme (ABBBS) manages the collation of information on threatened and migratory bird and bat species, as well as common species which have been banded by accredited ABBBS banders. A range of data is collected by this scheme about both live and dead birds (and bats) collected in the field. Whilst this data only provides a snapshot view (given that only a subset of birds are banded and re-identified, and that not all dead banded birds are recovered) the data does provide some useful insights.

A summary of this recent data from January 2000 – December 2020) is provided in **Table J-3** below for the species with ABBBS records for recovered birds. There were a total of 3,861 records (from 47 species) nationally of recovered dead birds during this period. Of these records, 47 deaths (1.2%) were attributed to powerlines. The species with deaths attributed to powerlines were generally large wingspan species (Black Swan, Pelican, White Ibis, Magpie Goose, Bush Stone Curlew), heavy bodied / non-agile species (one Moorhen, Pacific Black-Duck) and fast flying species (Terns, Peregrine Falcon).

Table J-3 ABBBS bird summary data 2000-2020 (DAWE 2021)

Bird Type	Number of Species with records	National Records			
		Total Recovered Dead Birds	Total attributed to powerlines	% attributed to powerlines	Species with records attributed to powerlines
Waterbird / wetland bird	24	1,061	20	1.9	Black Swan (5), Pelican (9), White Ibis (2), Magpie Goose (2), Moorhen (1, Pacific Black-Duck (1))
Raptor	4	83	5	6	Peregrine Falcon (5)
EPBC listed Migratory Shorebirds	8	138	0	0	0
Resident Shorebirds	2	29	0	0	0
Migratory Marine	6	2,507	20	0.8	Crested Tern (17), Silver Gull (2), Caspian Tern (1)
Other	3	43	1	2.3	Bush Stonecurlew (1)
Total	**47**	**3,861**	**46**	**1.2**	**11**

Whilst it is acknowledged that ABBBS data only provides an indication of what actually occurs across the country based on recorded incidents, the trends from the last 20 years or so indicate that deaths attributed to powerlines nationally are infrequent events. Regardless, species deaths that have been attributed to powerlines generally include large-bodied water birds and duck-shaped birds as well as Terns (migratory marine species) and Peregrine Falcons (small fast raptors). These species are all species that are well represented in Australian populations and global populations (Birdlife International 2019). There are limited records for threatened species collisions with powerlines; Peregrine Falcon and Bush Stone Curlew (rated Endangered in NSW), Crested Tern and Caspian Tern (Migratory). National Raptor Deaths included 5 Peregrine Falcon deaths that were attributed to power lines (of the 4,478 banded in total). One of 45 deaths recorded for Bush Stone Curlew across Australia, one was attributed to powerlines. Whilst there are deaths of Caspian Tern and Crested Terns attributed to powerlines nationally, they are a small proportion of total deaths reported for each species (e.g. 4% and 12%, respectively); Crested Terns are primarily a coastal species. It was noted that no deaths for cockatoos or parrots were attributed to powerlines.

Risk Assessment

The following section provides information regarding risks to bird species identified in the study area, presented in a 'risk-based' context, considering both likelihood and consequence factors for individual species where data is available. There are numerous factors which contribute to the likelihood and the consequence of collision with power lines, which make a formalised or structured risk assessment challenging, however the information below is useful in considering which species are considered at elevated risk from the project.

<u>Likelihood and Consequence of Collision</u>

The overall significance of potential impacts (risks) to bird species which may occur in the project area or nearby and be expected to pass near transmission lines can be considered by using a broad risk assessment approach. Under this approach, factors which influence the likelihood of impacts to species are considered along with associated resultant consequences to the species of any impacts which arise. Where the likelihood of impacts to a given species is considered high and the consequence of impacts to that species are also considered high, the overall risk to the species is potentially high, and requires more detailed evaluation.

Based on the information reviewed above, the key factors associated with elevated potential for bird / bat collisions with transmission lines (i.e. increased likelihood of collision) include:

- Large wing-span species
- Species which are non-agile fliers
- Species which disperse in tight flocks, particularly those which fly at high speeds
- Species which disperse or hunt at night, or are crepuscular
- Species which are thought to, or known to, regularly traverse the proposed power line location, occur in the study area.

Elevated consequences for a species would result where:

- The species is considered to be threatened, having a low or reduced regional / global population estimate
- The species is migratory and of conservation significance, and has a low global population estimate.

Other factors relevant to the overall risks to birds and bats in the project habitat, but which are not necessarily species-specific, include:

- Distance from wetland type habitat to the transmission line (e.g. would use reservoir habitat)
- Historic evidence of impacts from transmission lines for particular species.

Table J-4 below provides a summary of a number of the key likelihood and consequence variables (where data is available) for species that occur are known to occur at or near the project area (based on desktop habitat assessments, field surveys and bird lists from the Kosciuszko National Park). These species represent a subset of species ever reported in the study area. In reality those which have been regularly recorded during the ongoing surveys in the study area, would have increased potential for occurrence and hence for impacts, it is likely that a number of these species only occur very occasionally.

Classification of data and justification for risk likelihood categories are as follows:

- Higher risk likelihoods are colour coded as red and bold, *moderate risk are orange and italics*, and low risks are green. Where there is no risk considered, or data is unavailable, the risk has no colour code.
- Size data is based on wing length (not wingspan) and as per Menkhorst et al. 2017, acknowledging that there is some overlap, particularly for heavy bodied species like ducks. Categories are defined in footnote 3 of Table J-4 below. Species are considered to have a higher likelihood of collision if their size is large or above. If they are medium / large (usually based on weight, e.g. ducks), they are considered to have a moderate risk of collision.
- Timing of dispersal (or hunting) data is limited for most species, but is based on information broadly provided in Carpenter 2002 and Menkhorst et al. 2017. Species are considered to have a higher likelihood of collision if they disperse at night or when visibility is lower. It is noted thought that bird vision is adapted to behaviour, particularly for predators, hence these night dispersing species may respond positively to reflective markers (a mitigation measure being used in European countries) (SNH 2016).
- Flight type is based on general information in Menkhorst et al. 2017, fact sheets or information in Carpenter 2002. Species are considered to have a higher likelihood of collision if they are considered or known to be non-agile fliers, heavy bodied, fly in tight flocks. Risks are considered to be high if they exhibit all of these factors, low if they only exhibit one of these factors or only occasionally fly in a flock.
- Likelihood of occurrence is as per Table 1 above, and / or known to occur as per Kosciuszko National Park Bird list (cited online at https://avibase.bsc-eoc.org/checklist.jsp?region=AUns0119).
- Historical evidence of collision with powerlines is based on ABBBS data 1995-2020 (DAWE 2021). Species with historical records of death attributed to powerlines are considered to have a higher likelihood of collision. Data not obtained for all species, some species not banded.

Classification of data and justification for risk consequence categories are as follows:

- Higher consequence categories are coded red, moderate consequences are coded orange, low / no consequence has no colour.
- Conservation status based on EPBC Act (excluding Listed Marine) and NPW Act. Species with conservation status are considered to have a higher consequence from impacts as they generally have lower local population numbers and they are considered to be threatened or protected.
- Global populations estimates are based on minimum estimates of mature individuals of a species as per IUCN categories (Birdlife International (2019-2021), see footnote 4 of Table 13 below). Consequences are considered to be higher for species with small global population and lower for species with large to extremely large global populations.

Table J-4 Summary of risk factors for bird species with higher potential to occur in the vicinity of transmission lines

Common name	Likelihood factors					Consequence Factors		
	Size (determined by wing length / weight) [1]	Dispersal timing[2]	Flight type[2]	Likelihood [3]	Recorded deaths attributed to power lines[4] Aus	EPBC status[5]	NSW status[6]	Global Population Estimate [7]
Waterbirds								
Dusky Moorhen	*M*	Night	*Non-agile, heavy*	Known		None	None	
Lewin's Rail	S	Night	*Non-agile*	Known		None	None	
White-faced Heron	M / L	Daylight[2]	*Non-agile*	Known	0	None	None	Small to Large
Pacific Heron / White-necked Heron	L		*Non-agile*	Known	0	None	None	Large
Rufous Night Heron	*M*		*Non-agile*	Known	0	LM	None	
Australasian Grebe	S	Night[2]	*Fast*	Known	0	None	None	Small to Very Large
Little Black Cormorant	M	Daylight[2]	*Flock*	Known	0	None	None	Very large
Great (Black) Cormorant	L	Daylight[2]	Flock or single	Known	0	None	None	Extremely Large
Australian White Ibis	L	Daylight[2]	*Flock / non-agile*	Known	2	LM	None	Very large
Straw-necked Ibis	L	Daylight[2]	*Flock / non-agile*	Known	0	LM	None	Extremely large
Little Pied Cormorant	M	Daylight[2]	Single	Known	0	None	None	Very large
Australian Wood Duck / Maned Duck	*M /L*	Night[2]	Fast / flock / heavy	*Known*	0	None	None	Very large
Pacific Black Duck	*M / L*	Night[2]	Fast / flock / heavy	*Known*	*1*	None	None	Very large
Black Swan	VL	Night[2]	*Pairs / Flocks when wetlands dry[2]*	*Known*	5	None	None	Very large
Musk Duck	M/L	Night	*unknown*	*Known*	*1*	LM	None	*decreasing*
Australian Pelican	VL	Daylight[2]	Soar over floodplain permanent water / will flock to inland salt lakes	Known	9	LM	None	Very large
Hoary-headed Grebe	S	Night[2]	*Fast / Non-agile*	Known	0	None	None	Moderate to Very Large
Hardhead	*M / L*	Night[2]	Fast / flock / heavy	Known	0	None	None	Very large

Common name	Likelihood factors					Consequence Factors		
	Size (determined by wing length / weight) [1]	Dispersal timing[2]	Flight type[2]	Likelihood [3]	Recorded deaths attributed to power lines[4] Aus	EPBC status[5]	NSW status[6]	Global Population Estimate [7]
Eurasian Coot	*M*	Night[2]	Fast / flock / heavy	Known	0	None	None	Extremely large
Grey Teal	*M*	Night[2]	Fast / flock / heavy	Known	0	None	None	Extremely large
Migratory Shorebirds								
Latham's Snipe	*S/M*	Night	Small flock	*Known*	0			
Resident Shorebirds								
Black-fronted Dotterel	S	Night[2]	Small flocks during non-breeding	*Known*	0	None	None	Moderate to large
Masked Lapwing	*M*	Night[2]	Can form aggregations non-breeding	*Known*	0	None	None	Moderate
Marine / Migratory								
Silver Gull	*M*	Daylight[2]	*Flocks*	Known	*2*	LM	None	Very large
White-throated Needletail	*M*	*Daylight*	*Flocks*	*Known*	*0*	*LM, Vu*	*None*	*Large*
Raptors								
White-bellied Sea-eagle	VL	Daylight	*Non-agile*	*Known*	0	LM	E	*Small to Mod*
Swamp Harrier	L	Daylight	*Non-agile*	*Known*	0	LM	-	Mod to large
Peregrine Falcon	M / L	Daylight	*Agile, but fast*	*Known*	5	None	*R*	Very Large
Black Shouldered Kite	*M*	Daylight	agile	Known		None	None	increasing
Little Eagle	L	Daylight	*Fast, agile*	Known	6	None	*Vu*	Large
Wedge-tailed Eagle	VL	Daylight	*Heavy, non agile*	*Known*		None	None	increasing
Grey Goshawk	*M*	Daylight	agile	*Known*		None	None	*Small*
Brown Goshawk	*M*	Daylight	agile	*Known*		None	None	*decreasing*
Collared Sparrowhawk	*S/M*	Daylight	agile	*Known*		None	None	*decreasing*
Whistling Kite	L	Daylight	*Non-agile*	*Known*		None	None	*decreasing*
Australian Kestrel	*S/M*	Daylight	agile	*Known*		None	None	increasing
Brown Falcon	*M*	Daylight	*Non-agile*	*Known*		None	None	*decreasing*
Australian Hobby	*S/M*	*Diurnal / predator*	agile	*Known*		None	None	increasing
Nocturnal								
Tawny Frogmouth	*S/M*	*Nocturnal / predator*	agile	*Known*		None	None	stable

Common name	Likelihood factors					Consequence Factors		
	Size (determined by wing length / weight) [1]	Dispersal timing[2]	Flight type[2]	Likelihood [3]	Recorded deaths attributed to power lines[4] Aus	EPBC status[5]	NSW status[6]	Global Population Estimate [7]
White-throated Nightjar	Small	*Nocturnal / predator*	agile	*Known*		None	None	*decreasing*
Australian Owlet-Nightjar	Small	*Nocturnal / predator*	agile	*Known*		None	None	stable
Sooty Owl	L	*Nocturnal / predator*	Agile / large	*Known*		None	*Vu*	*decreasing*
Masked Owl	*M*	*Nocturnal / predator*	agile	High		None	*Vu*	stable
Barn Owl	*M*	*Nocturnal / predator*	agile	*Known*		None	None	stable
Powerful Owl	L	*Nocturnal / predator*	*Agile / large*	*Known, low numbers*		None	*Vu*	stable
Southern Boobook	*S/M*	*Nocturnal / predator*	agile	High		None	None	stable
Large Cockatoo species								
Gang-gang Cockatoo	*M*	Daylight	Strong flights / small flocks	*Known*		None	Vulnerable	increasing
Yellow-tailed Black Cockatoo	*M/L*	Daylight	Slow, small to medium flocks	*Known*		None	None	stable
Sulphur-crested Cockatoo	*M/L*	Daylight	flocks	*Known*		None	None	*decreasing*

1: Approximate size reference based on wing length (not span) and weight as per Menkhorst et al 2017, acknowledging some overlap, particularly for heavy bodied species like ducks, where categories are; Small =25-200g, wing length 80mm-236mm, Medium = 201-799 grams, wing length 174-450mm, Large = 800g -3.9 kg, wing length 285-633mm, Very Large > 4 kg, wing length 430-680mm.
2: Flight types and dispersal based on Carpenter (2002) and flight types Menkhorst et al. 2017;
3: Likelihood: moderate = moderate known, likely to occur, high = observed at site; Low, moderate, high likelihood based on desktop and field assessment, known based on KNP bird list available at https://avibase.bsc-eoc.org/checklist.jsp?region=AUns0119, where the majority of waterbirds may be present near, in or above the Reservoir.
4: ABBBS data 2000-2021 (DAWE 2021); Numbers of individuals potentially present at site not considered
5: EPBC status, where LM = List Marine (protection not applicable to terrestrial location), Mi = Migratory/; Vu = Vulnerable
6: BC status, where En = Endangered, Vu = Vulnerable, R =Rare;
7: Birdlife International (2019), global population estimates based on IUCN criteria (IUCN Standards and Petitions Subcommittee. 2016. Guidelines for Using the IUCN Red List Categories and Criteria. Version 12. Prepared by the Standards and Petitions Subcommittee. Download from http://www.iucnredlist.org/documents/RedListGuidelines.pdf. Where minimum estimate for mature individuals in a population is: Small = < 10,000 (dependent on conservation status) or decreasing; moderate > 10,000; Large 20,000-99,000; Very Large 100,000 – 500,000; Extremely large > 500,000.

Based on the above information, species with higher 'likelihood' of impacts include:

- Larger to very large birds such as cormorants, egrets, Straw-necked Ibis, Black Swans and Pelicans
- Smaller to moderate, but heavier bodied, flock forming species such as ducks, grebes and White-throated Needletail.

Species with moderate 'likelihood' of impacts include:

- Larger birds such as moderate to large raptors which have good eyesight, but may be 'behaviourally distracted' when swooping for or carrying prey, some are also fast fliers and have less time to change course (e.g. Peregrine Falcon, Little Eagle, Grey-headed Flying-fox).
- Smaller to moderate night dispersing species or nocturnal predators such as owls. These species aren't likely to be present in large numbers, and are more likely to be hunting closer to the ground or vegetation, with eyes adapted for nocturnal hunting.

Species with elevated consequence of potential impacts include:

- Species with smaller global or local populations such as the White-bellied Sea-eagle or species with decreasing populations (e.g. Goshawk).
- Species with conservation ratings such as threatened species (White-bellied Sea-eagle, Peregrine Falcon, Little Eagle, Sooty Owl, Masked Owl, Powerful Owl).

Species with both elevated likelihood and elevated consequence risk factors represent those species with an *overall elevated risk of collision with powerlines*. These species are listed below with further consideration of overall risk:

- Musk Duck; has a global population that is estimated to be decreasing. In addition, they have a higher likelihood of impacts as they are night dispersers, however little is known about flight type. There has also been one recorded death in since 1995 of these species attributed to powerlines (which may be related to the number of this species that are actually banded, e.g. only 81 have been banded). Overall, this species is considered to be at low to moderate risk from the transmission line, if present.
- White-bellied Sea-eagle; as they are state-listed (Endangered) and have small to moderate global populations and may be behaviourally distracted whilst swooping on carrying prey (mainly eat fish, but will also eat waterbirds, rabbits, flying foxes). However, whilst they also have a moderate likelihood of impacts related to size and flight agility, they generally occur less frequently at inland sites (being primarily considered a coastal species) and have not had any deaths attributed to powerlines to date attributed to powerlines. Overall, this species is considered to be at moderate risk from the transmission line, if present.
- Peregrine Falcon; as they are state-listed (Rare), have medium to large wingspans and historical evidence of collision. They are considered agile fast flyers and like other raptors have good eyesight but are potentially distracted whilst capturing or handling prey. However, the consequences to the species in the event of a collision are considered to be low given the very large population size. Overall, this species is considered to be at low risk from the transmission line.
- Little Eagle: as they are state-listed (Vulnerable), have large wingspans and historical evidence of collision. They are considered agile fast flyers and like other raptors have good eyesight but are potentially distracted whilst capturing or handling prey. However, the consequences to the species in the event of a collision are considered to be low given the large population size. Overall, this species is considered to be at low risk from the transmission line.
- Sooty Owl: as they are state-listed (Vulnerable), have large wingspans but no historical evidence of collision. They are considered agile flyers and like other owls have good eyesight, but are potentially distracted whilst capturing or handling prey. However, the consequences to the species in the event of a collision are considered to be moderate given the decreasing population size. Overall, this species is considered to be at moderate risk from the transmission line.

- Masked Owl: as they are state-listed (Vulnerable), have medium wingspans, but no historical evidence of collision. They are considered to have good eyesight, but are potentially distracted whilst capturing or handling prey. However, the consequences to the species in the event of a collision are considered to be low given the stable population size. Overall, this species is considered to be at low risk from the transmission line.
- Powerful Owl: as they are state-listed (Vulnerable), have large wingspans, but no historical evidence of collision. They are considered to be agile and have good eyesight, but are potentially distracted whilst capturing or handling prey. However, the consequences to the species in the event of a collision are considered to be low given the stable population size. Overall, this species is considered to be at low risk from the transmission line.

Mitigation Measures

A number of mitigation measures have been reported elsewhere (globally) to reduce the likelihood of bird collision risk. These include measures such as location of the transmission line to avoid directly crossing wetland areas or known flight paths, and a range of design measures to minimise the risk of collision. Key mitigation measures that will be considered during detailed design to minimise impacts to birds from transmission lines (based on Scottish Heritage Trust 2016)) are outlined below.

- Consider inclusion of bird-friendly design options, including:
  - Deter perching and nesting on structures.
    - Use perch management techniques (i.e. construct cross-arms, insulators etc. so there is no space for birds to perch or touch energised wires). Use of exclusion devices, or perch discouragers, and providing safe artificial perches / nesting platforms at a safe distance from energised parts. (Prinsen et al. 2011 provide specific design options).
    - Line design / configuration of pole top. Ensure that perching space is well clear of dangerous components so that birds cannot touch them (e.g. for large raptors - > 2.7 m between transmission lines and > 1.8 m between perches and energised parts).
    - For bats, wires to be at least > 60cm apart.
  - Reduce risk of electrification by use of insulated components and / or large air gaps, less vertical cables, no earth wires.
    - Insulation of energised parts / cover grounded parts with materials appropriate for providing incidental contact protection (e.g. suspend insulators and vertical disconnectors or covering of upright insulators / horizontal disconnectors).
  - Install suitable line markers and / or reflectors in conductors to reduce collision where the line is in the vicinity of wetland type habitats (e.g. above reservoir).
    - Line marking is the most common and practical form of wire collision mitigation worldwide – can reduce bird collisions for some species by 50-95% (Prinson et al 2011), and is particularly useful for swans (Frost 2008).
    - Efficiency varies with species and cannot eliminate mortality for crepuscular or nocturnal species (although new high vision markers are being developed).
- Adaptive monitoring and management as part of site Biodiversity Management Plan.

Conclusion

It is concluded that with the implementation of effective mitigation measures, the likelihood of collision with the transmission line is considered to be relatively low. Regardless, collision remains a possibility, given that portions of the line traverse over a reservoir which has some wetland habitat features which can be expected to attract some waterbird species at risk of collision. Raptors, owls and potentially cockatoos are considered to have an overall risk of collision. However, consequences to individual species are not considered to be significant when overall population numbers and conservation status are considered. There is minimal evidence of substantial mortality directly attributed to transmission lines (for birds and bats), rather, the data suggests a very low incidence of death over a long period of time (1995-2020). Species present within study area are also present in relatively low numbers compared with regional, national and global populations estimates, and overall, the project is not expected to significantly impact any species as a result of electrocution.

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Appendix K. Vegetation Clearing Method

Snowy 2.0 Transmission Connection

Biodiversity Conservation Division Memo: Vegetation Clearing Method and Management- July 2021

1. Background

On 16 June 2021 a meeting between TransGrid, their Consultant (Jacobs) and the Biodiversity Conservation Division (BCD) was held to discuss (among other things) the notion of partial vegetation loss and the associated reassessment of offsets credits in various management zones within the Snowy 2.0 Transmission Connection footprint.

To better understand the actual impacts on the plant community types (PCTs) and relevant threatened fauna species within these management zones, BCD have requested further information pertaining to the clearing method, both as part of construction and during the ongoing future vegetation maintenance during operation of the connection asset. This additional information would also assist BCD in their decision making on how varying Vegetation Integrity (VI) scores could be applied to areas where only partial vegetation removal would be required. Specifically, BCD have requested:

- Additional information on how tall growing vegetation within and external to the easement (hazard tree zone) would be removed without impacting other vegetation, such as the shrub and grass layer.
- Further detail on the vegetation clearing methodology within each management zone with consideration to:
  - the effects of soil compaction from large machinery, vehicles and other equipment;
  - work health and safety requirements given the steep alpine terrain in parts of the project area; and
  - vegetation management during operation.

2. Disturbance Zones

The disturbance footprint for the project is made up of five distinct zones, which would be subject to specific clearing requirements as part of the initial construction of the project and during ongoing operational maintenance of the asset. These zones are described with respect to construction and operational clearing requirements and methodology. The zones are shown in the indicative revised disturbance footprint shown in Attachment A.1.

2.1 Rationale for Vegetation Management Methods

Removal and management of vegetation for the construction of the access tracks and transmission connection is constrained and determined by a number of factors:

a) Operational electrical clearances
b) Vegetation community structure, ground cover/low growing vegetation conditions
c) Landform constraints i.e. slope stability and steepness
d) Construction and operational safety
e) Suitable management of vegetation debris and soils
f) Environmental aspects/constraints
g) Habitat value of removed vegetation (where required/practicable).

Given the above, a variety of approaches will be undertaken for the removal/management of vegetation for the construction phase. From an operational perspective, this Memo will not furnish a detailed Operational Plan, but will describe the fundamental actions/requirements for operational vegetation management.

It is noted that removal of vegetation for the construction of the transmission line, access tracks and substation will be subject to Conditions of Approval and the provisions under a Biodiversity Management Plan (pending).

Minimum environmental mitigation measures that will be relevant/required include:

a) Vegetation Clearing Plans;

b) Pre-clearing assessment for/of habitat values;

c) Two stage clearing;

d) Distribution of topsoil and mulched material (as part of site rehabilitation); and

e) Placement of residual tree debris (hollow tree barrels) as habitat.

Vegetation clearing, debris management and default mitigation measures for construction is summarised in Attachment A2.

2.2 Transmission Structure Zone

The majority of the transmission structure zones (TSZ) would be subject to complete vegetation clearing (clearing to bare earth) to facilitate the formation of level crane/construction benches, machine/vehicle access and tower foundations (identified as civil works areas) to expedite the safe construction of the transmission structures. The TSZ will comprise an assumed 50 metre radius surrounding each individual transmission structure along the extent of the transmission line connection.

2.2.1 Establishment of the TSZ

For construction, the TSZ areas have been delineated from field inspection, analysis of ground conditions, design for transmission line structures and the required footprint for construction and operation.

2.2.2 TSZ Construction Clearing Methodology

Due to the variable terrain, the majority of TSZs will require complete removal of vegetation (including root balls) during construction to facilitate safe work, set up and civil/construction areas. Vegetation clearing within these areas will generally comprise removal of trees by either being 'pushed' out or removed by forest harvester and stumps grubbed out. Trees will only be pushed out where there will be negligible impacts to areas outside the TSZ civil works areas.

In TSZs outside of civil works areas (i.e. areas not impacted by construction/benching/access track construction) a forest harvester or excavator-mulcher would be used to minimise disturbance and root balls/stumps would be left in-situ. These areas would be cleared as for the Easement Clearing Zone.

Processing of vegetation debris in the TSZ will generally comprise tub grinding of removed trees and reuse of the material for erosion and sediment control and stabilisation of disturbed areas during and in post construction rehabilitation.

Where vegetation is removed by an excavator-mulcher method (outside civil/construction areas), mulched material will be evenly spread on bare, disturbed or exposed areas (to no greater than 50 millimetres in depth) to assist in protection of the soil. Where low growing vegetation, grasses or ground cover exists, care will be taken to avoid excess debris build up/smothering.

Any areas in the TSZ 'construction/civil' works areas not required for a safe work/construction bench/access track, will be managed as Easement Clearing Zones.

Post construction, any salvaged topsoil that does not contain significant weed loads will be respread over disturbed areas and soil protected from erosion by installing mulch (stockpiled from Tub Grinding) and stabilised and revegetated in accordance with an approved Rehabilitation Plan.

2.2.3 Operational Maintenance

During operation, the TSZ is required to be maintained to provide safe access and set up for operational inspection and maintenance and prevent vegetation encroachment around the structures. Typically, these areas will be free of shrub and tree regrowth and are generally slashed or mulched on a cyclic/routine basis. Benches are expected to remain in-situ to facilitate the safe operation of plant and equipment (e.g. cranes and elevated work platforms) during routine structure inspection and maintenance activities.

Generally, operational maintenance of tower bases requires that an area of approximately 30 metres around the tower will be required to be maintained as an Operational TSZ as well as any safe work platforms/benches. Disturbed areas outside of this 30 metre buffer would be rehabilitated.

2.3 Access Track Zone

The access track zone (ATZ) is defined as the corridor that may be impacted to construct the access tracks to the transmission structure locations. An area averaging approximately 30 metre in width has been assumed, which considers the worst-case impact area including the required cuts/fill along the steep sections of the access track route.

2.3.1 Establishment of the ATZ

As part of construction, it is assumed the ATZ would be subject to complete vegetation clearing on areas of cut/fill, which would be primarily undertaken using an excavator, bulldozer and/or tree harvester. The access track corridor was established with consideration to terrain (e.g. utilisation of the ridgelines to navigate to the higher elevations) to minimise cut/fill and vegetation clearing.

2.3.2 ATZ Construction Clearing Methodology

Vegetation clearing for the access tracks will utilise similar methods as for the TSZ. Construction of the access tracks would be staged to progressively complete discrete sections of track and install erosion/sediment controls and utilise mulch to stabilise batter slopes and other non-operational areas, pending permanent rehabilitation/revegetation of these areas. Manual felling of trees may be carried out in the steeper sections of the access track route where the use of machines would carry work health and safety risks.

Whilst a 30 metre wide fully cleared corridor has been assumed to encompass the worst-case disturbance to construct the tracks, the 'as built' access track width would be 4 metres to mineral earth i.e. trafficable surface (minimum) with 1-2 metres either side cleared to facilitated safe access /egress. As such, the areas external to the operational access tracks including the batters would be stabilised and revegetated in accordance with an approved Rehabilitation Plan.

2.3.3 Operational Maintenance

During operation, routine vegetation maintenance would be carried out along the 'as built' road corridor, which would generally involve maintenance, repair or reinstatement of damaged/eroded track surfaces/drainage and slashing/mulching of the track sides (to 1-2 metres) and/or manual pruning of tree branches which encroach the access track corridor and prevent safe vehicle passage.

2.4 Substation Zone

The Substation Zone is defined as the area required for construction and installation of the 500/330 kV switchyard that will be permanently modified and includes the Substation access road and Substation Asset Protection Zone.

2.4.1 Establishment of the Substation Zone

Due to the civil construction requirements for the Substation, total removal of vegetation (including root balls and root systems) would be required for the installation of the substation and associated sub-surface infrastructure.

2.4.2 Substation Zone Construction Clearing Methodology

Vegetation clearing within these areas will utilise similar methods as for the TSZ.

As for the TSZ, where vegetation is managed by an excavator-mulcher method (outside civil works areas), mulched material will be evenly spread on bare, disturbed or exposed areas (to no greater than 50mm in depth) to assist in protection of the soil. Where low growing vegetation, grasses or ground cover exists, care will be taken to avoid excess debris build up/smothering.

It is noted that large trees or habitat trees suitable for re-use as habitat features would be placed outside the Substation Asset Protection Zone.

2.4.3 Operational Maintenance

Operationally, the management of vegetation for the substation will be required on the Substation access road and substation Asset Protection Zone. Other areas will have permanent infrastructure constructed.

The substation access road will be predominantly cut/fill and vegetation outside civil construction boundaries would be retained. Operational maintenance would comprise slashing or mulching of the road verge and any road surface or drainage maintenance as required.

The substation Asset Protection Zone vegetation (where it falls outside civil works areas) will be managed so that operational maintenance can be facilitated by either slashing or mulching. Trees will be removed to ground level and root systems retained and the ground layer retained. Other vegetation will be managed to a height of 10 cm.

2.5 Easement Clearing Zone

The easement clearing zone (ECZ) is defined as the vegetation zones along the transmission line easement which would require the clearing and ongoing maintenance of tall growing vegetation which may intrude on the Vegetation Clearance Requirements at Maximum Line Operating Conditions (maximum conductor sag and maximum conductor blowout) at that location now or at any time in the future. To minimise impacts on biodiversity and ground stability within this zone, ground cover vegetation would be retained, with partial midstorey removal required along with complete removal of the canopy layer.

In accordance with TransGrid's *Maintenance Plan – Easement and Access Tracks* (December 2020), the vegetation clearance requirements (VCR) for 330 kV transmission lines at maximum line operating conditions would involve the management of any tree within 3 metres of the overhead conductors <u>plus</u> a regrowth allowance over a given maintenance and inspection cycle.

With consideration to the plant community types (PCTs) within the project area and the worst-case growth rate used by TransGrid for the construction of new transmission lines, the regrowth rate of tall growing trees was estimated to be 1.5 metres per year. Furthermore, for all new transmission lines the maintenance and inspection period has been set at three years until such time where the vegetation growth rates can be more accurately defined. Given the above, the vegetation clearance requirements in the ECZ are defined as:

VCR = 3 metres + Regrowth Allowance

= 3 metres + (3 x 1.5 metres)

= 7.5 metres

The VCR is in place to ensure that all vegetation remains at least 7.5 metres from the overhead conductors modelled under Maximum Line Operating Conditions from the initial clearing of the ECZ to the next subsequent inspection/vegetation maintenance round. This is driven by the risk of flashover, which could result in the ignition of the underlying trees causing a bushfire.

2.5.1 Establishing the ECZ

Light Detection and Ranging (LiDAR) analysis was performed on the transmission connection concept design modelled under Maximum Line Operating Conditions to identify the zones which breached the VCR. The outer boundary of the LiDAR breach is shown in Attachment A.1. This area was then buffered by up to 1.5 metres with consideration to terrain and construction requirements and for project flexibility purposes to establish the ECZ.

2.5.2 Construction Clearing Methodology

ECZ vegetation will be removed/managed by a variety of methods, which will primarily be determined by:

a) Vegetation type/structure;

b) Slope/terrain; and/or

c) Environmental/ecological constraints.

In areas safely accessible to a machine, smaller trees (or other tall growing vegetation) <200 mm DBH will be removed using an excavator-mulcher to mulch the aerial portion of the vegetation down to ground level.

Vegetation over 200 mm DBH will be removed using a forest harvester type machine, noting that tree branches/canopy may be mulched in-situ. The tree barrels will either be:

- Tub Ground to provide material for erosion/sediment control and rehabilitation;
- Relocated to the edge of the easement and retained as habitat;
- Re-used by FCNSW/NPWS (pending negotiations); and/or
- Windrowed either on the edge of the easement or on easement (where operationally safe to do so).

The use of machine clearing will cause disturbance to shrubs and ground cover; however, careful management and supervision of these operations will be undertaken to minimise impacts. It is noted that while some impacts to all vegetation strata may occur during clearing operations, natural regeneration coupled with rehabilitation of heavily impacted areas will result in regeneration of the majority of the ECZ (see Photograph 1).

It must be noted that areas accessible for machine clearing are generally located where transmission line conductors have the minimum clearance to ground and as such hand felling and leaving of timber debris is not optimal for the operational management of the transmission line due to the safety and bushfire risks.

In areas of the ECZ that are not safety or practicably accessible for machine clearing, removal/management of vegetation will be undertaken by hand clearing/felling.

Felled trees will remain in-situ with the crowns/heads being cut/docked and laid flat.

2.5.3 Operational Vegetation Maintenance

Management of the ECZ, from an operational perspective, will be largely determined by the classification of the easement as per TransGrid's vegetation Risk Model and operational Vegetation Clearance requirements based on the expected yearly vegetation growth. The vegetation clearing requirements and methodology as to retain the approved Vegetation Integrity scores will be detailed in an Operational Vegetation Management Plan. The management of vegetation would occur on a cyclic basis, which would be determined by vegetation response and growth rate once this has been established. Based on TransGrid's existing transmission assets in the local region, the cyclic management period is expected to be four to six years.

TransGrid undertakes vegetation management of easements under its control in line with Integrated Vegetation Management (IVM) principles which entails the creation, promotion and conservation of sustainable plant communities that are compatible with the intended use of the site and manage incompatible plants and vegetation structural forms that may conflict with the intended use.

Typical integrated vegetation management methods used during vegetation management cycles for the Snowy 2.0 Connection would potentially include:

- Selective removal of tall growing species by hand cutting + herbicide application;
- Selective removal of tall growing species by herbicide application (foliar spraying);
- Pruning or removal of mature trees that encroach on safe electrical clearances.
- Slashing / mulching in areas of low conductor to ground clearance to mitigate flashover and bushfire risks posed by tall growing and mid-storey vegetation; and/or
- Slashing / mulching limited areas to provide safe access and egress to works areas within the easement.

In terms of the use of mechanical management methods, within the ECZ there are areas which, over the operational life of the line, may develop, or have the potential to develop, vegetation structural forms that pose a significant risk to the integrity of the transmission line. Where dense vegetation, generally encompassing understory strata, develops there is a significant bushfire risk created especially in areas of the ECZ where conductor clearance to ground is low. These areas are referred to the wire / conductor zone.

With regard to the above points, the table below describes the operational vegetation management methods. Figure 1 shows a cross section of a typical easement showing the relative areas of vegetation management.

Table: ECZ Operational Vegetation Management Methods

Method Of Vegetation Management	Location in ECZ	Requirement	Impacts	Probable Cycle[1]
Selective removal of tall growing regrowth by hand cutting + herbicide application (cut stump method).	Whole	Manage tall growing vegetation with potential to infringe on safe electrical clearances.	Removal of tall growing regrowth with retention of understory and ground cover vegetation.	4-6 years
Selective removal of tall growing regrowth by herbicide application (foliar spraying).	Whole	Manage tall growing vegetation with potential to infringe on safe electrical clearances.	Removal of tall growing regrowth with retention of understory and ground cover vegetation.	4-6 years.
Pruning or removal of mature trees that encroach on safe electrical clearances	Whole	Manage tall growing vegetation with potential to infringe on safe electrical clearances.	Partial or whole removal of trees.	4-6 years.
Slashing[2] / mulching[3] of vegetation.	Areas of low conductor to ground clearance. Generally limited to the alignment of the TL conductors (*wire/conductor zone*). Notwithstanding, TransGrid cannot discount the need for future potential slashing and mulching across all areas of the easement, aside from those areas on steep slopes where hand clearing is designated.	To mitigate flashover and bushfire risks posed by tall and/or dense growing and mid-story vegetation.	Removal of regrowth vegetation including mid story and understory shrubs to 100-200 millimetres	Under the advice of TransGrid's Maintenance Team
Slashing / mulching of safe access work area and for narrow corridor to provide safe access for vegetation management.	Where required.	Under WHS Regulations TransGrid has an obligation to provide a safe work environment. To facilitate this the creation of safe access corridors/work zones may be required.	Removal of regrowth vegetation including mid story and understory shrubs to 100-200 millimetres	No definitive cycle. Would be undertaken where required to facilitate safe access egress to work areas to facilitate vegetation management.
Management of vegetation to facilitate external requirements for Strategic Bushfire Management.	Whole.	External stakeholder requirements.	To be determined.	To be determined.

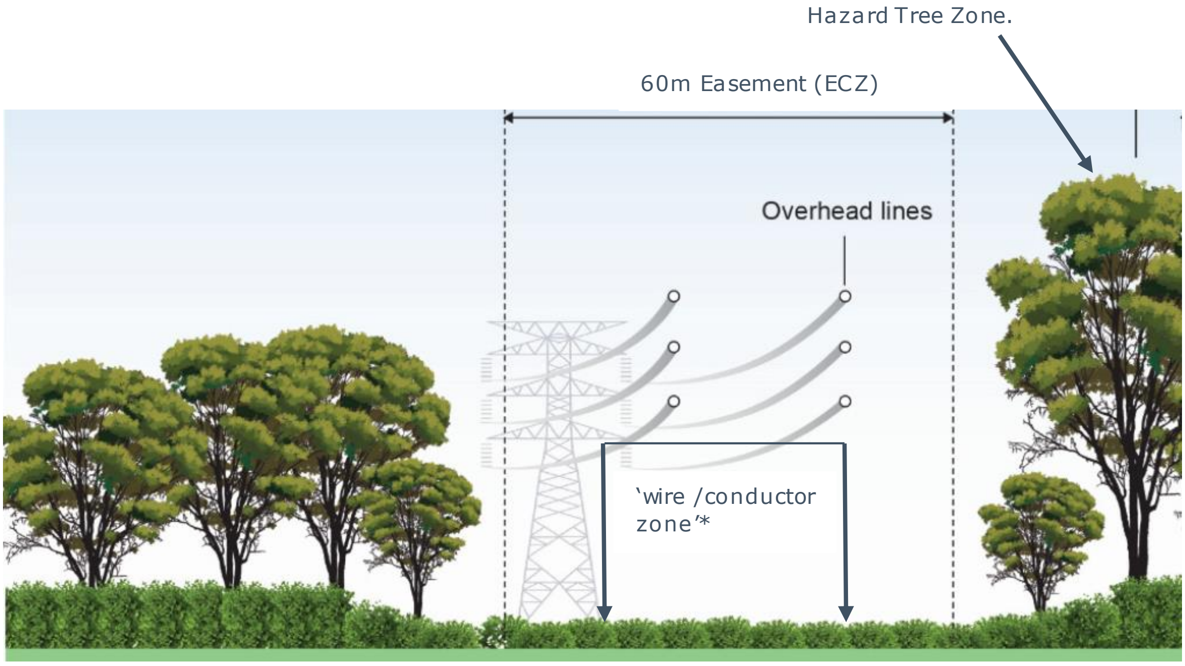
[1] Cycles for vegetation management will be determined using TransGrid's Vegetation Risk Model.

[2] Slashing is typically undertaken with a deck mounted slasher, set to 200 millimetres above the ground.

[3] Mulching is typically undertaken with a chipper/barrel mounted attachment set to 100 millimetres above the ground.

[4] Vegetation management required for the maintenance/repair of the transmission line outside the Transmission Structure Zone (TSZ) would generally only be required for emergency repairs

Figure 1: Operational Vegetation Management of a Typical Easement



*Note that the 'wire / conductor zone' (within the ECZ) refers to the area directly below the transmission line conductors.
This 'zone' presents the highest risks in terms of flashover and bushfire risks posed by tall and/or dense growing and mid-story vegetation, especially in areas of low conductor to ground clearance. Where clearance and/or bushfire risks are identified in this area slashing and/or mulching is the safest, most preferred method of management.

Photograph 1 below shows TransGrid's Line 2 in the Lobs Hole Ravine area which is located in close proximity to the project area. It shows a managed easement consisting of the shrub and grass layer void of the tall growth trees, which is considered to be representative of the proposed ECZ during operation.

In addition to the cyclic vegetation management within the ECZ, LiDAR would also be performed on the transmission connection once per year to identify potential vegetation intrusions. Any on-easement intrusion within the safe clearance limit (i.e. the VCR) would be managed in accordance with the methods outlined in Section 2.6.3.

Photograph 1 Line 2 easement in proximity to the project

2.6 Off Easement Hazard Tree Zone

The off easement hazard tree zone (HTZ) is defined as the areas external to the ECZ which contain trees of a sufficient height which, if they were to fall, would strike the overhead conductors or the transmission structures (known as Hazard Trees). These trees pose a considerable bushfire risk and risk to the asset and require management/removed as part of the initial construction of the line and during ongoing operation.

2.6.1 Establishing the HTZ

LiDAR analysis was performed on the transmission connection concept design modelled under Maximum Line Operating Conditions to identify the zones external to identify existing Hazard Trees. The outer boundary of the mapped hazard trees was then taken and buffered appropriately with consideration to terrain and potential mature tree heights within the PCTs across the project area in order to capture potential future hazard trees.

2.6.2 Construction Clearing Methodology

During construction the identified hazard trees would be individually felled or pruned by hand as it is unlikely that terrain will facilitate mechanical clearing.

2.6.3 Operational Clearing Methodology

In accordance with TransGrid's *Maintenance Plan – Easement and Access Tracks* (December 2020) a LiDAR inspection of the line would be carried out once per year for the life of the asset. As well as on vegetation easement intrusions, the LiDAR would also aim to identify off-easement vegetation intrusions. Any off-easement hazard trees identified as part of the annual LiDAR inspection would be individually inspected by a suitably qualified arborist to:

> Assess the health of the tree and identify any defects which may contribute to the potential failure of the tree; and
> Identify any habitat features associated with the identified tree (hollows / nests / occupancy etc).

Trees in poor health or that contain explicit defects would be removed or pruned.

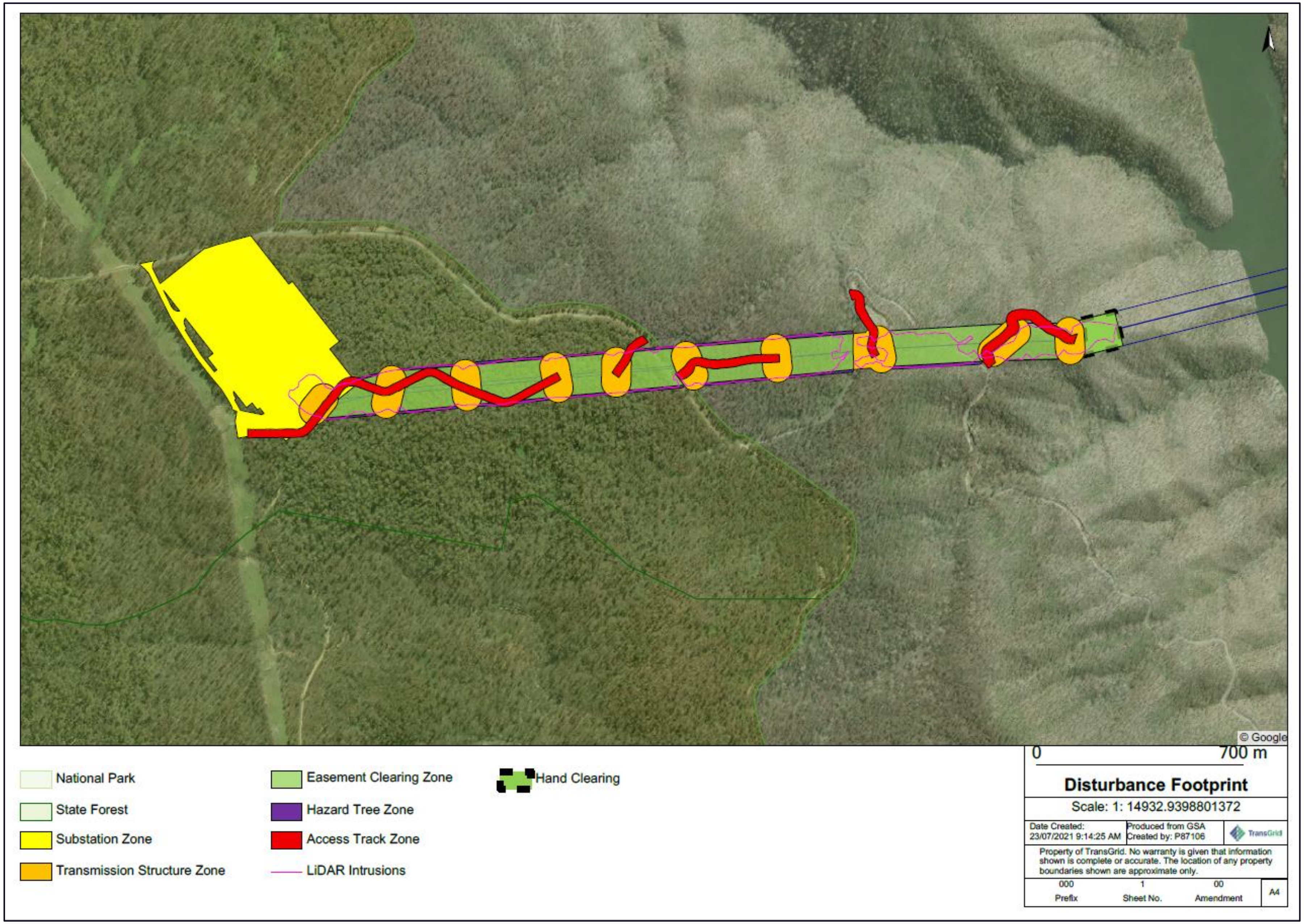
Hazard Trees may be felled; however, where constraints, such as significant damage to surrounding vegetation or potential impact to the asset, could occur hazard trees may be dismantled from the top down in a staged approach.

Where unsafe to leave tree debris in situ material may be mulched and either re-used, disposed of or respread on the easement.

Where the arborist confirms that an identified hazard tree is in good health, it may be left and no management action taken or be pruned to remove intrusions from individual branches or the crown of the tree. For tree pruning, identified elevated branches/crown are accessed by climbing or using an elevated work platform (where terrain allows). If a tree has multiple branches requiring removal a staged approach would be undertaken.

All tree pruning operations are undertaken in accordance with the *AS4373-2007 Pruning of Amenity Trees*.

A.1 Indicative revised disturbance footprint


© Google
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Disturbance Footprint
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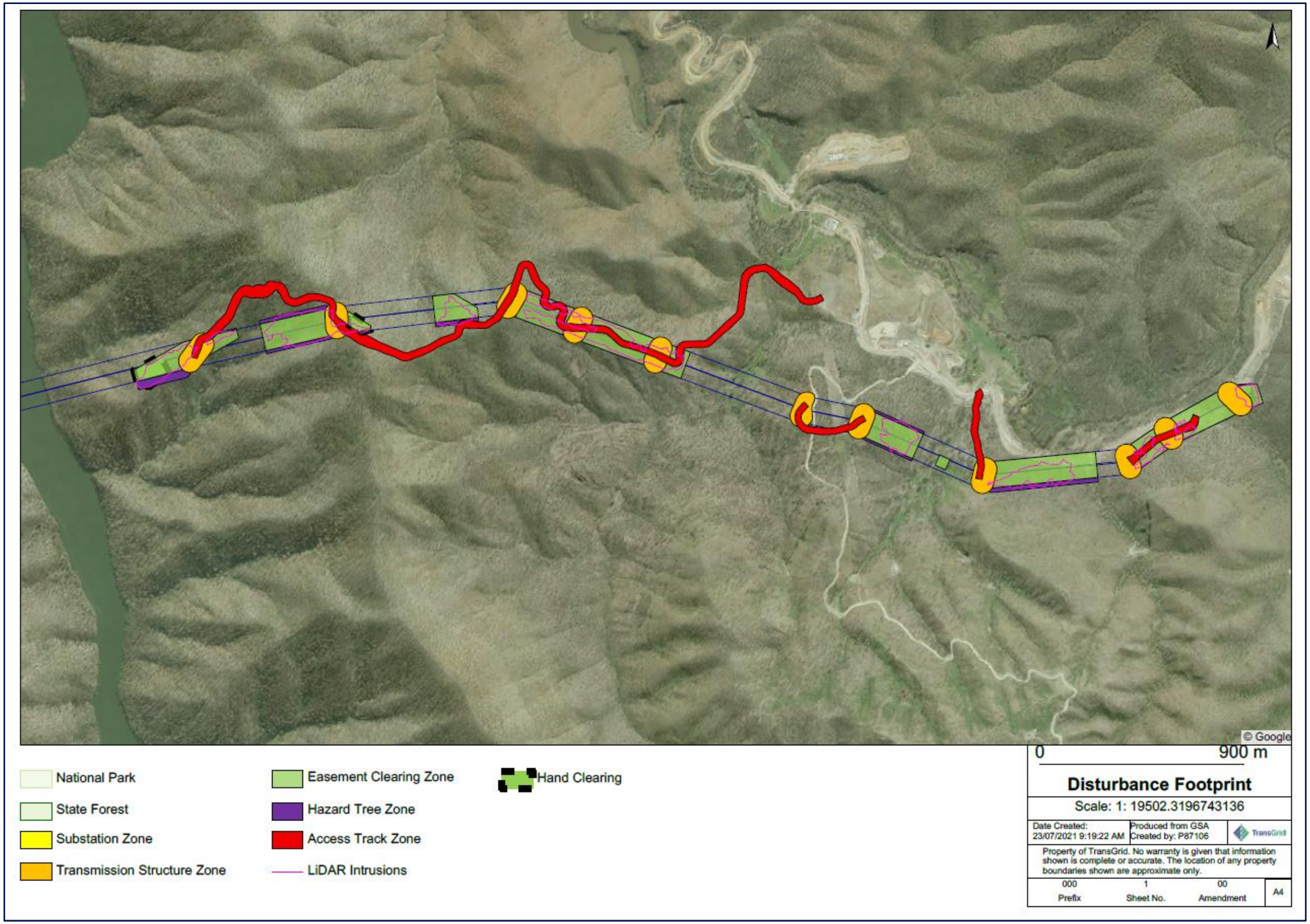
TransGrid
Property of TransGrid. No warranty is given that information shown is complete or accurate. The location of any property boundaries shown are approximate only.
000 Prefix
1 Sheet No.
00 Amendment
A4
National Park
State Forest
Substation Zone
Transmission Structure Zone
Easement Clearing Zone
Hazard Tree Zone
Access Track Zone
LiDAR Intrusions
Hand Clearing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900 m
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Amendment
A4
National Park
State Forest
Substation Zone
Transmission Structure Zone
Easement Clearing Zone
Hazard Tree Zone
Access Track Zone
LiDAR Intrusions
Hand Clearing

A.2 Summary of Vegetation Clearing, Impact and Debris Management During Construction

Clearing Zone	Vegetation Clearing Method (in order of task)	Impact	Debris Management	Environmental Aspects/Constraints[1]	Minimum Mitigation Measures
Transmission Structure Zone – within Civil Works Areas / Construction Benches	Smaller trees / shrubs removed/managed by excavator-mulcher. Removal of vegetation and root balls (larger trees) by 'pushing' and/or forest harvester.	Complete clearing and loss of habitat.	Mulch debris will either be windrowed or stockpiled for later re-spreading. Material will be Tub Ground and re-used for erosion/sediment control and rehabilitation. Excavator-mulched material will be evenly spread no greater than 50 mm in depth, care will be taken to avoid excess debris build up/smothering of existing vegetation.	Topsoil will be stripped and stockpiled for re-use. Tree barrels with habitat features (such as hollows) will be removed and retained. Tree barrels will be relocated to the edge of the easement and placed suitably.	Removal of root balls / root stock will be limited to civil/construction areas. Assessment of ecological /habitat values for trees Staged clearing process. Spreading of mulch on bare earth to stabilise prior to rehabilitation. Relocation of hollow tree barrels as habitat. Rehabilitation of outer 20 m around each structure.
Transmission Structure Zone – outside Civil Works Areas / Construction Benches / Access Tracks	As for Easement Clearing Zone	During the removal of the tall growing trees, there would be trampling of the grass/ground cover and shrubs caused by the movement of the tracked forest harvester and excavator-mulcher. Whilst the shrubs would not be targeted for removal, there is reason to expect that some damage may also occur from the movement of tree clearing machinery. There is a potential for mulched material (from excavator-mulcher operations) being left on the ground surface, with a mulch layer that is too thick, which may impede the ability for plant regeneration/recruitment. However, it is considered that a mulch layer not exceeding 50 mm in thickness would be sufficient as to not limit/restrict the	As for Easement Clearing Zone	As for Easement Clearing Zone	As for Easement Clearing Zone

TransGrid

Clearing Zone	Vegetation Clearing Method (in order of task)	Impact	Debris Management	Environmental Aspects/Constraints[1]	Minimum Mitigation Measures
		regeneration of the groundcover/grasses or understory. The retention of some mulch within the ECZ will assist in minimising soil erosion in any areas affected by the use of the clearing machinery. It should be noted that from structure 1 to structure 10 that recent bushfires have left the majority of the line route devoid of leaf litter and there are many bare areas with minimal groundcover; the retention of mulched organic matter should be of a net benefit. Whilst there will be areas which will not be subject to civil works as described in the TSZ, for the purpose of the BDAR, it has been assumed that this area would be subject to complete clearing and vegetation loss.			
Access Track Zone	As for TSZ. Areas required for access track 'clearances' (but unaffected by civil earthworks) will be excavator-mulched.	Assumed complete clearing and loss of habitat within the full ~30 m wide corridor. An operational track width of 4 m plus 1-2 m of clearance (i.e. 8 m maximum width) will be required. Other areas will be allowed to regenerate or be rehabilitated where required.	As for TSZ.	As for TSZ.	As for TSZ.
Easement Clearing Zone – machine accessible	Removal of trees and tall growing species by either forest harvester or excavator-mulcher.	During the removal of the tall growing trees, there would be trampling of the grass/ground cover and shrubs caused by the movement of the tracked forest harvester and excavator-mulcher. Whilst the shrubs would not be targeted for removal, there is reason to expect that some damage may also occur from the movement of tree	As for TSZ.	Tree barrels with habitat features (such as hollows) will be removed and retained. Tree barrels will be relocated to the edge of the easement and placed suitably. Tree	Assessment of ecological /habitat values for trees Staged clearing process. Spreading of mulch on bare earth to stabilise prior to rehabilitation.

Clearing Zone	Vegetation Clearing Method (in order of task)	Impact	Debris Management	Environmental Aspects/Constraints[1]	Minimum Mitigation Measures
		clearing machinery. There is a potential for mulched material (from excavator-mulcher operations) being left on the ground surface, with a mulch layer that is too thick, which may impede the ability for plant regeneration/recruitment. However, it is considered that a mulch layer not exceeding 50 mm in thickness would be sufficient as to not limit/restrict the regeneration of the groundcover/grasses or understory. The retention of some mulch within the ECZ will assist in minimising soil erosion in any areas affected by the use of the clearing machinery. It should be noted that from structure 1 to structure 10 that recent bushfires have left the majority of the line route devoid of leaf litter and there are many bare areas with minimal groundcover; the retention of mulched organic matter should be of a net benefit.		canopy/crowns will be mulched and re-used. To maintain operational standards, windowed timber will not be placed in areas of low conductor clearance (will be placed preferably on the edge of the easement) or placed on the easement where access/safety for operational maintenance will not be compromised.	Relocation of hollow tree barrels as habitat. Any mulch left on the ground surface is to not exceed 50 mm in thickness in any location within the ECZ. TransGrid would commit to the monitoring of the ECZ for at years 5 and 10 (post construction) to in accordance with the Biodiversity Assessment Method (BAM) to measure the predicted versus actual future value for the Vegetation Integrity Scores.
Easement Clearing Zone – steep / constrained areas	Hand felling of trees and tall growing regrowth will be the preferred method where terrain (or other constraints) preclude management by machine.	Potential trampling and tree fall impacts to understory vegetation during felling; however minimal long term impact on the integrity of the shrub and grass/ground cover layer is expected.	Felled vegetation will be left in-situ with tree crowns cut/docked and laid flat. Note that some areas within the ECZ may require tree debris to be moved once felled to avoid bushfire and safety risks.	-	Assessment of ecological /habitat values for trees Staged clearing process.
Substation Zone	As for TSZ. Outside civil/construction areas smaller trees / shrubs	Complete clearing and loss of habitat.	Material will be Tub Ground and re-used for erosion/sediment control and rehabilitation.	Topsoil will be stripped and stockpiled for re-use. Tree barrels with habitat features (such as hollows) will be removed and	As for TSZ

Clearing Zone	Vegetation Clearing Method (in order of task)	Impact	Debris Management	Environmental Aspects/Constraints[1]	Minimum Mitigation Measures
	may be removed/managed by excavator-mulcher.		Mulch debris will either be windrowed or stockpiled for later re-spreading.	retained. Tree barrels will be relocated to the edge of the easement and placed suitably.	
Hazard Tree Zone	Hand felling of trees will be the preferred method where terrain (or other constraints) preclude management by machine.	Partial loss of habitat and vegetation integrity caused from the individual removal/pruning of identified hazard trees.	Removed/felled vegetation will be left in-situ with tree crowns cut/docked and laid flat.	Where habitat features are identified preference for pruning will be mandated, unless unsafe to do so.	Pre-clearance inspections

1 Vegetation removal methods and retention for habitat value will be undertaken in accordance with Biodiversity CoA and Management Plan (pending). Management/removal of identified habitat trees will be carried out under the guidance of a suitably qualified person.

Appendix L. Biodiversity Offset Strategy

Memorandum

Level 3, 175 Scott Street
Newcastle NSW 2300

T 02 4907 4800
E info@emmconsulting.com.au
www.emmconsulting.com.au

22 August 2022

To: Transmission Connection Project Team
From: Nathan Garvey
Subject: Snowy 2.0 Transmission Connection Project: Biodiversity Offset Strategy

1 Offset requirements

Impacts and offset requirements for the Snowy 2.0 Transmission Connection Project (the project) have been determined by Jacobs in the Biodiversity Development Assessment Report (Jacobs 2022). While Jacobs (2022) assesses impacts and required offsets within both the Australian Alps and South Eastern Highlands Interim Biogeographic Regionalisation of Australia (IBRA) regions, this offset strategy considers impacts within and outside Kosciuszko National Park (KNP) separately to ensure alignment with the biodiversity offset strategy proposed for the project, including offsetting of impacts within KNP through management actions and offsetting of impacts outside KNP in accordance with the mechanisms outlined in the NSW Biodiversity Offsets Scheme.

The project will result in clearing of approximately 118 ha of native vegetation and habitat for threatened species, including approximately 74 ha within Kosciuszko National Park (KNP) and an additional 44 ha of clearing outside KNP. Offset requirements, including ecosystem and species credits within and outside KNP, are summarised in Table 1.1. The credit calculations are based upon the transmission connection layout as currently proposed. The credits required to be offset may be less than what is set out in the below tables, subject to final design refinement. Offset requirements will be updated in the Biodiversity Offset Package to be prepared prior to any development being carried out that would impact on biodiversity values (see Section 4).

Table 1.1 Snowy 2.0 Transmission Connection Project offset requirements (Jacobs 2022) outside and inside KNP

Plant Community Type or Species	Credits		Total
	Outside KNP	Inside KNP	
Ecosystem credits			
PCT 285 - Broad-leaved Sally grass – sedge woodland on valley flats and swamps in the NSW South Western Slopes Bioregion and adjoining South Eastern Highlands Bioregion	87	-	87
PCT 296 - Brittle Gum - peppermint open forest of the Woomargama to Tumut region, NSW South Western Slopes Bioregion	-	392	392
PCT 300 - Ribbon Gum - Narrow-leaved (Robertsons) Peppermint montane fern - grass tall open forest on deep clay loam soils in the upper NSW South Western Slopes Bioregion and western Kosciuszko escarpment	452	397	849
PCT 302 - Riparian Blakely's Red Gum - Broad-leaved Sally woodland - tea-tree - bottlebrush - wattle shrubland wetland of the NSW South Western Slopes Bioregion and South Eastern Highlands Bioregion	-	39	39

Table 1.1 Snowy 2.0 Transmission Connection Project offset requirements (Jacobs 2022) outside and inside KNP

Plant Community Type or Species	Credits		Total
	Outside KNP	Inside KNP	
PCT 729 - Broad-leaved Peppermint - Candlebark shrubby open forest of montane areas, southern South Eastern Highlands Bioregion and South East Corner Bioregion	-	531	531
PCT 999 - Norton's Box - Broad-leaved Peppermint open forest on footslopes, central and southern South Eastern Highlands Bioregion	-	166	166
PCT 1196 - Snow Gum - Mountain Gum shrubby open forest of montane areas, South Eastern Highlands Bioregion and Australian Alps Bioregion	825	-	825
Total Ecosystem credits	***1,364***	***1,525***	***2,889***
Species			
Caladenia montana (*Caladenia montana*)	-	192	192
Gang-gang Cockatoo (*Callocephalon fimbriatum*)	1,721	1,303	3,024
Eastern Pygmy-possum (*Cercartetus nanus*)	1,789	2,023	3,812
Booroolong Frog (*Litoria booroolongensis*)	-	38	38
Yellow-bellied Glider (*Petaurus australis*) endangered population on the Bago Plateau	1,697	519	2,216
Masked Owl (*Tyto novaehollandiae*)	417	1	418
Total species credits	***5,624***	***4,076***	***9,700***
Total	**6,988**	**5,601**	**12,589**

2 Offset strategy

This Biodiversity Offset Strategy proposes a two-part approach to the provision of biodiversity offsets for the project to address impacts inside and outside KNP separately. This two-part approach includes:

1. application of the Snowy 2.0 Main Works (the Main Works) offset strategy framework and principles to impacts within KNP and undertaking of conservation management actions to offset these impacts; and
2. application of the mechanisms for providing offsets, outlined in NSW Biodiversity Offset Scheme, to impacts occurring outside KNP.

The principles and guidelines developed for the Main Works offset strategy (EMM 2020) have been reviewed and are considered relevant to the impacts to biodiversity values arising from the project within KNP. Therefore, it is proposed to apply the conservation management actions approach, outlined in the Main Works offset strategy, to offset requirements for the project for impacts within KNP. However, impacts occurring outside KNP will be offset in accordance with the NSW Biodiversity Offsets Scheme.

This approach is outlined further below.

2.1 Offsets for impacts within Kosciuszko National Park

A conceptual framework was developed for the Main Works offset strategy (EMM 2020) as shown in Plate 2.1. This framework was designed to deliver holistic ecosystem management for catchments in KNP, resulting in broader benefits to species and communities. Offsets arising from the Main Works will be used to undertake conservation management actions to rehabilitate, restore and enhance altered catchments and habitat loss that have occurred due to weeds, pests and degraded aquatic habitat including loss of riparian corridors to the equivalent magnitude of the residual impacts associated with the works. These historical impacts have arisen from past land use in KNP, including mining, agricultural use and the development of the original Snowy scheme.

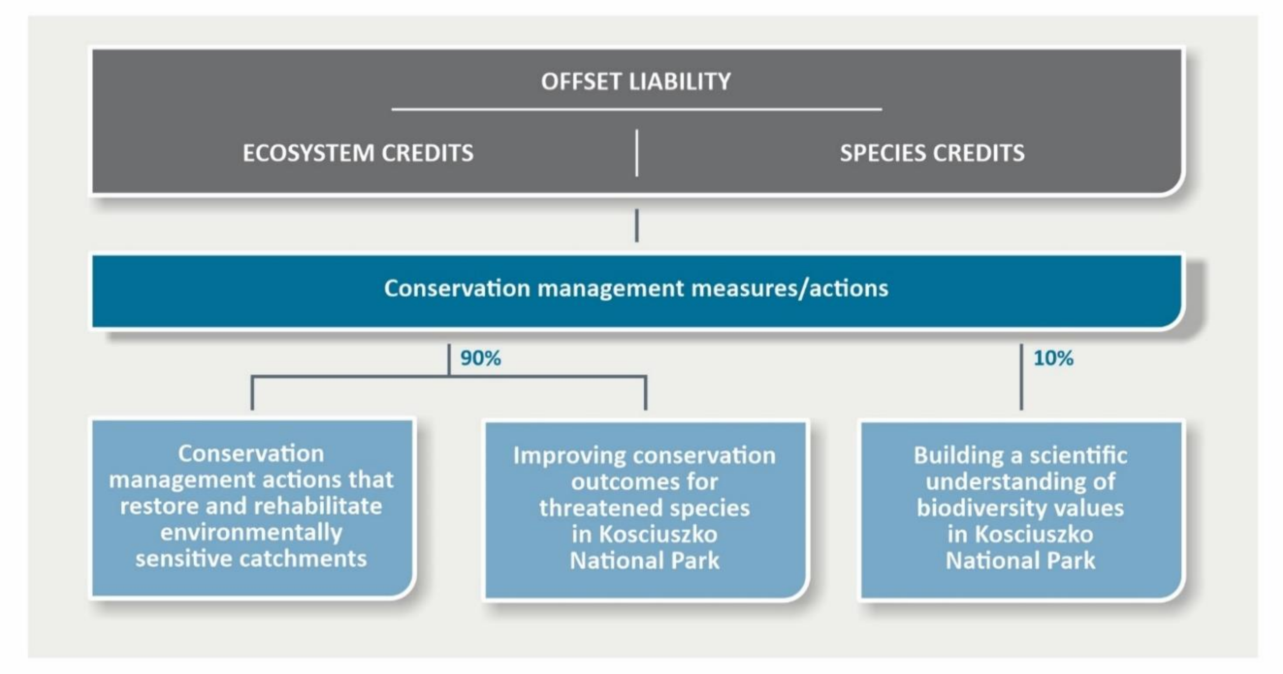

Plate 2.1 Snowy 2.0 Main Works Biodiversity Offset Strategy conceptual framework

In developing the Main Works offset strategy and associated management actions, a review of background information was undertaken, including the following:

- key threats as documented in Bionet and the Threatened Biodiversity Data Collection (TBDC);
- any Savings our Species (SoS) actions for each species; and
- management actions outlined in a species recovery plan, conservation advice or listing advice.

Arising from this, a summary of the key threats and management actions for threatened species and communities impacted by the Main Works Project was prepared (see Appendix A of EMM 2020). A review of these threats was undertaken for the species and communities impacted by the project. This review indicated that while there is one additional species impacted by the project (Yellow-bellied Glider), for those species impacted by both projects the threats and management actions for these species are still relevant and considered suitable. The communities impacted are common across both projects and therefore the threats and management actions are also still relevant and considered suitable. Overall, these management actions can be applied over a broader area of KNP, resulting in broader positive impacts to the values of the Park.

EMM (2020) outlines a method for determining the areas to which conservation management measures/actions would be applied. This method is also deemed relevant and suitable for application to the project, noting changes in the method for determining offsets between BAM 2017 (OEH 2017) and BAM 2020 (DPIE 2020) would result in a higher number of credits generated per hectare and thus a lower area required to offset impacts. However, this change has not been incorporated into this Biodiversity Offset Strategy, and the method for determining the areas to which offsets would be applied remains consistent with EMM (2020).

To ensure holistic management was undertaken and allow for assessment of management actions for associated communities, PCTs were grouped into four management groups. Only the Montane dry sclerophyll forests management group will be impacted by the project within KNP. Appropriate conservation management measures/actions for each management group were determined based on impacts observed during the biodiversity assessment undertaken for the Main Works and review of relevant literature and management plans. Individual management conservation management measures/actions were determined for key threatened species where additional or specific actions were required to address impacts. A review of these indicates that the management actions proposed are still relevant and will provide a broader benefit for species and communities within KNP. However, given the project will result in impacts to the Yellow-bellied Glider, which was not impacted by the Main Works Project, an analysis of the key threats and management actions for this species is required, as for the Main Works Offset Strategy. This analysis is provided in Appendix A along with recommendations for management actions that could be implemented.

Given the key threats and management actions for threatened species and communities impacted by the project are consistent with the Main Works offset strategy, the method for determining the areas to which conservation management measures/actions should be applied, remains relevant. The actions proposed will still provide a benefit to species and communities impacted by the project. As such, the application of the Main Works offset strategy to impacts arising from the project is therefore considered relevant and appropriate.

An additional $10.59 M of funding will be provided to NPWS for implementation of management actions outlined in the Main Works offset strategy to a broader area of KNP, resulting in a positive benefit for the biodiversity values of the Park over the long-term. This is in addition to the $82.3 M already committed by Snowy Hydro to management of KNP for the Main Works and Exploratory Works Projects. Combined, this provides a substantial investment in management of biodiversity values in KNP, resulting in a direct, holistic and long-term benefit to the biodiversity values of KNP, including the species and communities impacted by both the Main Works and the project.

2.2 Offsets for impacts outside Kosciuszko National Park

Under the NSW Biodiversity Offsets Scheme, several pathways are available to the proponent to meet the offset obligation arising from the project for impacts outside KNP. These pathways are shown in Plate 2.2. Funding of a biodiversity conservation action is only available for a limited set of species and communities, as set out in the *Ancillary rules: Biodiversity conservation actions* (OEH 2017). The project is not a State Significant Development (SSD) mining project and thus ecological rehabilitation is not available. This means that offsets will need to be provided via retirement of like-for-like credits or payment into the Biodiversity Conservation Fund (BCF).

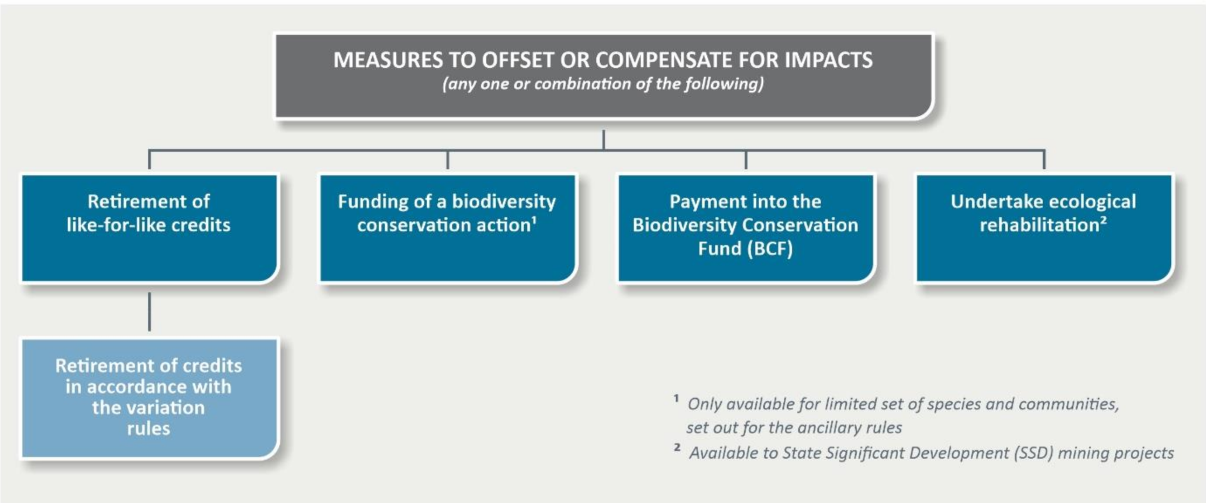

Plate 2.2 NSW Biodiversity Offset Scheme offset options

The various options available to meet the offset requirements of the project for impacts occurring outside of KNP are discussed below.

2.2.1 Retirement of like-for-like credits from existing sites

i Credits available on the market

A review of existing BioBank and Biodiversity Stewardship credits available in the market indicates that there are limited credits available that would be suitable as offsets for the project, with no credits available under the BAM that would meet project needs. A review of ecosystem credits available in the market is provided in Table 2.1.

Table 2.1 Summary of like-for-like credits available to offset impacts of the Transmission Connection Project for impacts outside KNP

Plant Community Type / Species	Credits required	Credits available
PCT 285 - Broad-leaved Sally grass - sedge woodland on valley flats and swamps in the NSW South Western Slopes Bioregion and adjoining South Eastern Highlands Bioregion	87	0
PCT 300 - Ribbon Gum - Narrow-leaved (Robertsons) Peppermint montane fern - grass tall open forest on deep clay loam soils in the upper NSW South Western Slopes Bioregion and western Kosciuszko escarpment	452	0
PCT 1196 - Snow Gum - Mountain Gum shrubby open forest of montane areas, South Eastern Highlands Bioregion and Australian Alps Bioregion	825	0
Gang-gang Cockatoo	1,721	280[1]
Eastern Pygmy-possum	1,789	1,042[2]
Yellow-bellied Glider endangered population on the Bago Plateau	1,697	0
Masked Owl	417	0
Grand Total	**6,988**	**1,322**

Notes: 1. BAM equivalence credits.
2. No BAM credits available. These credits are BioBanking credits and will require a statement of reasonable equivalence. Credits available will change.

The proponent has made contact with all existing credit owners and EOIs to seek credit availability and pricing. This contact has determined that while a number of credits are listed on these registers some credits are either committed or are no longer available.

Credits are available to suit two species credits species (Gang-gang Cockatoo and Eastern Pygmy-possum), meeting an estimated 23% of the species credit requirements of the project. No ecosystem credits are available to meet the needs of the project. There would be a residual of 5,667 credits, including all 1,364 ecosystem credits and 4,303 species credits, which will need to be sourced. It should be noted that all credits generated under the BioBanking scheme will need to be converted to an equivalent number of BAM credits. This process can result in a reduction in the number of credits generated under the BAM. As BioBanking credits are converted to BAM credits this deficit may increase.

In addition to the above, there are a further ten sites which have submitted an expression of interest (EOI) to generate BAM credits for all the PCTs and species listed above. At this stage the number of credits these sites are capable of generating is unknown and these sites would need to develop a Biodiversity Stewardship Agreement (BSA) to realise these credits and make them available for the project. Initial contact with these landholders indicates most are not willing to enter into a BSA for the number of credits required.

ii Proponent driven offsets

The proponent is currently investigating possible offsets for the project, including land within the locality of the project. It is proposed that a BSA would be developed on suitable sites to generate credits to meet the needs of the project.

An initial spatial analysis was completed to identify potential properties that support the ecosystem and species credits required to offset impacts of the project. A total of 95 lots across 52 landholders were identified as potentially supporting suitable PCTs and threatened species habitat. The areas of the relevant trading groups and an estimate of the potential credit yield is provided in Table 2.2. As can be seen, the identified properties are more than sufficient to meet the offset requirements of the project.

Table 2.2 Mapped areas and an estimate of the potential credit yield for each trading group for all properties

	Southern Tableland Wet Sclerophyll Forests; <50%	Subalpine Woodlands; <50%	Upper Riverina Dry Sclerophyll Forests; >=70% and <90%
Area	1,902.68	1,024.49	174.67
Estimated credits	9,513	5,122	873
Credits required	452	825	87
Percentage of required	2,105%	621%	1,003%

Based on the above, contact was made with landowners to ascertain their interest in entering into a BSA. Preliminary assessments, including PCT mapping and initial surveys for the Yellow-bellied Glider at one property, have been completed of three properties. This preliminary work has identified that two properties are likely to generate sufficient credits to meet a significant proportion of the offset requirements for the project across two offset trading groups and one species, with the Yellow-bellied Glider confirmed at one property. The third property did not support the PCTs required by the project and no further assessment of this property will be undertaken.

Table 2.3 Mapped PCTs and an estimate of the potential credit yield for each trading group for two high priority properties

Property	PCT	Trading Group	Area (ha)	Estimate of credits generated	Credits required	Percentage of credits requiremen t met
Property 1	1196	Subalpine Woodlands; <50%	566.20	3,397	825	412%
	1100	Tableland Clay Grassy Woodlands; >=70% and <90%	15.87	95	0	-
		Yellow-bellied Glider (*Petaurus australis*) endangered population on the Bago Plateau	582.07	3,492	1,697	206%
Property 2	295	Southern Tableland Wet Sclerophyll Forests; <50%	18.43	111	452	90%
	300	Southern Tableland Wet Sclerophyll Forests; <50%	49.57	297		
	953	Southern Tableland Dry Sclerophyll Forests; <50%	33.24	199	0	-

Further detailed assessment of these properties is proposed in coming months, including targeted surveys for the Eastern Pygmy-possum. Subject to agreements with landowners, the proponent intends to develop BSAs over these two properties to offset the impacts arising from the project.

Work is ongoing to determine suitable properties to meet the like-for-like offset requirements for the Upper Riverina Dry Sclerophyll Forests; >=70% and <90% offset trading group.

2.2.2 Credits under the variation rules

Following reasonable steps to obtain like-for-like credits the proponent may seek to retire credits under the variation rules. The variation rules allow broader trading:

- For ecosystem credits:

- they represent the same vegetation formation; and
- they are in the same or a higher offset trading group; and
- they represent a location that is in:
  - the same Interim Biogeographic Regionalisation of Australia region as the impacted site; or
  - a subregion that is within 100 kilometres of the outer edge of the impacted site; and
- if the impacted habitat contains hollow bearing trees—they represent vegetation that contains hollow bearing trees or artificial hollows.

• For species credits:
  - if the impacted species is a plant—they represent a plant; and
  - if the impacted species is an animal—they represent an animal; and
  - they represent a species that has the same or a higher category of listing under the BC Act as a threatened species; and
  - they represent a location that is in:
    - the same Interim Biogeographic Regionalisation of Australia region as the impacted site; or
    - a subregion that is within 100 kilometres of the outer edge of the impacted site; and

A review of public registers indicates that currently there are no additional ecosystem or species credits available under the variation rules. The proponent will continue to investigate these options.

2.2.3 Payment into the BCF

The offset liability for all impacts occurring outside of KNP can be met by paying $24.87 M into the BCF (Table 2.4).

Table 2.4 Total credits and cost of payment into the BCF for impacts outside of KNP

Credit type	Credits	Payment into BCF (all impacts outside KNP)
Ecosystem	1,364	$9,645,387.41
Species	5,625	$15,221,587.67
Total	**6,988**	**$24,866,975.08**

Notes: Costs calculated using BCF prices as on 5 July 2022

2.2.4 Securing the Biodiversity Offset Package

Securing like-for-like credits through BSAs is seen as the best option for relative benefit to the local species. As outlined above, the proponent is currently engaged with both existing credit holders and local landowners to:

a) purchase and retire suitable credits that are existing in the market; and

b) develop BSAs on land with the local area supporting biodiversity values required by the project.

If offsets cannot be secured via these mechanisms, payment would be made into the BCF for any residual offset liability.

To ensure the security of the offsets and confirm the performance of the obligations in relation to biodiversity offsets, the proponent intends to enter into a deed of agreement with the Planning Secretary. This deed of agreement will secure the financial liability commensurate to the cost of payment into the BCF. In the event that offsets are unable to be secured via the mechanisms outlined above the Planning Secretary would release the pro-rata funds for payment into the BCF.

3 Offsets for impacts to Matters of National Environmental Significance

Any residual significant impacts on MNES listed under the EPBC Act arising from the project, including threatened species and ecological communities, will need to be offset with consideration of the EPBC Act Environmental Offsets Policy (Commonwealth of Australia 2021). The Environmental Offsets Policy sets out the Department of Agriculture, Water and the Environment's (DAWE's) approach to provision of offsets under the EPBC Act.

Offsets are only required for significant residual impacts to MNES, once all measures to avoid, minimise and mitigate impacts have been considered. This means that if a impact to MNES can be avoided or minimised to the extent that a <u>significant</u> impact can be avoided, offsets are not required. The burden to demonstrate a non-significant impact lies with the proponent.

Jacobs (2022) undertook assessment of the following species against the requirements of the EPBC Act:

- Spotted-tailed Quoll (*Dasyurus maculatus*);
- Greater Glider (*Petauroides volans*);
- Smoky Mouse (*Pseudomys fumeus*);
- Booroolong Frog (*Litoria booroolongensis*);
- Macquarie Perch (*Macquaria australasica*);
- White-throated Needletail (*Hirundapus caudacutus*); and
- Migratory species.

Jacobs concluded that the project would not result in a significant residual impact to any MNES. As such, offsets are not required under the EPBC Act.

4 Biodiversity Offset Package

Prior to any development being carried out that would impact on biodiversity values, a detailed Biodiversity Offset Package will be prepared that is consistent with this EIS and this Biodiversity Offset Strategy. The Biodiversity Offset Package will include:

- the agreed management actions for impacts occurring within KNP, resulting in a positive benefit for the biodiversity values of the Park over the long-term and the financial contribution to made by the proponent to the implementation of these actions;
- details of the specific biodiversity offset measures to be implemented and delivered in accordance with the EIS and this Biodiversity Offset Strategy, including the proposed location for the retirement of like-for-like credits from existing and proponent drive offset sites and certainty that this can be achieved;
- the cost which would be required to be paid into the BCF if the relevant measure is not implemented and delivered (as calculated in accordance with Division 6 of the *Biodiversity Conservation Act 2016* (NSW) and the biodiversity offsets payment calculator);

- the timing and responsibilities for the implementation and delivery of the measures required in the Package; and
- confirmation that the biodiversity offset measures will be implemented and delivered within two years of approval.

The Biodiversity Offset Strategy outlined herein, and the detailed Biodiversity Package to be developed post-approval provided certainty that the residual impacts of the project can be adequately offset.

Prepared by: **Nathan Garvey,** Associate Director

ngarvey@emmconsulting.com.au

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Appendix A

Key threats and management actions for the Yellow-bellied Glider

A.1 Key threats and management actions for the Yellow-bellied Glider

The table below provides a summary of the key threats and management actions for Yellow-bellied Glider population on the Bago Plateau. This information has been used to inform the development of the conservation management measures/actions for this species.

Table A.1 Key threats and management actions for the Yellow-bellied Glider population on the Bago Plateau

Yellow-bellied Glider (*Petaurus australis*) population on the Bago Plateau	
Status	BC Act: Endangered population EPBC Act: Not listed
Key threats	• Reduced population viability due to the partial fragmentation of the Bago Plateau and the populations highly restricted geographic distribution. • Continual decline in habitat quality caused by timber harvesting operations. • Loss of hollow-bearing trees. • Loss of feed trees. The species has also been impacted by the 2019/2020 fires, which burnt large areas of habitat for the endangered population to varying intensity.
Saving our Species (SOS) actions and relevance to project and KNP	The Yellow-bellied Glider population on the Bago Plateau has been assigned to the Population management stream under the SoS program. No site-specific measures are provided; rather, a number of state-wide conservation actions have been identified for this endangered population: • Minimise the direct and indirect impacts of timber harvesting operations on individuals and their habitat. • Encourage retention of the hollow bearing trees through PVPs and EIA. • Encourage retention of the Yellow-bellied Glider feed trees through PVPs. These are considered of limited applicability to the management of the endangered population in KNP.
Management actions and relevance to project and KNP	No recovery plan has been prepared for this species. The threatened species profile for the Yellow-bellied Glider population on the Bago Plateau (DPIE 2021) lists a number of activities that will assist the species: • Retain den trees and recruitment trees (future hollow-bearing trees). • Retain food resources, particularly sap-feeding trees. • Retain and protect areas of habitat, particularly mature or old-growth forest containing hollow-bearing trees and sap-feeding trees. • Maintain connectivity between habitat patches. • In urban and rural areas retain and rehabilitate habitat to maintain or increase the total area of habitat available, reduce edge effects, minimise foraging distances and increase the types of resources available. Retention and recruitment of denning trees and maintaining connectivity between patches are considered highly relevant to the management of the species within and adjacent to KNP.

A.2 Proposed management actions

Based on the above, the following management actions are proposed for this species:

- detailed survey and monitoring program to assess the status of the endangered population in the context of KNP; and
- development of a strategy to address fragmentation issues, looking at
  - measures to improve connectivity across electricity easements on the Bago Plateau, particularly:

- the Upper Murray Power Line (Line 65) which fragments the endangered population along it's southern boundary; and
- Line 3 and Line 66, which run directly through habitat for the endangered population, particularly in areas where these lines join and areas of up to 100 m wide are cleared.

A.2.1 Survey and monitoring of the Yellow-bellied Glider Bago plateau population

Systematic monitoring of the Yellow-bellied Glider population on the Bago plateau has been undertaken by (Kavanagh & Stanton 1998) and (Kambouris, Kavanagh & Rowley 2013), with further detailed monitoring currently being undertaken by Forestry Corporation within Bago and Maragle State Forests on the Bago Plateau (Rohan Bilney pers. comm.). To date, limited monitoring has been undertaken within KNP, inhibiting the ability to understand connectivity between records in KNP, particularly south of Cabramurra at Ogilvie's Creek and Clover Flat, with the Bago population of the Yellow-bellied Glider, and whether the Bago population is genetically, ecologically or morphologically distinct from surrounding areas (NSWSC 2014; Kambouris, Kavanagh & Rowley 2013).

To address this, a monitoring program involving an initial round of occupancy surveys followed by collection of genetic material is proposed. This survey design will help to understand whether transmission easements crossing the Bago plateau present functional barriers to movement and whether gene flow is occurring both within the Bago population and with areas of KNP to the south and east.

i Initial surveys

To understand occupancy and gene flow across the Bago plateau and adjacent areas of KNP, the study area will be divided into four survey units:

- West – the area west of Line 64 and Line 66;
- East – the area east of Line 64 and Line 66;
- Mid – the area between Line 64 and Line 66, north of Line 65; and
- South – the area south of Line 65.

Thirty (30) monitoring sites are proposed per survey unit. Monitoring currently being undertaken in Bago and Maragle State Forests by Forestry Corporation provides a baseline dataset against which further systematic monitoring of the Bago population and areas of KNP can be compared. Table A.2 provides summary of the existing survey sites within each survey unit and the number of additional sites that will be required. An additional 54 sites are required to be established across the four survey units. These sites will be established along the same 1.7 km grid as used by Kambouris, Kavanagh & Rowley (2013) and Forestry Corporation, with sites generally established close to roads to allow ease of access.

Table A.2 Summary of existing survey sites per survey unit, and additional sites proposed

Survey unit	Forestry Corporation survey sites	Additional sites proposed
West	89[1]	0
East	14	16
Mid	23	7
South	0	30
TOTAL	928	53

Notes: 1. Only 30 of the 89 sites will be used in this study

The use of Songmeters is proposed to assess occupancy. Songmeters placed out for seven nights of clear weather provide a >0.9 probability of detection (Rohan Bilney pers. comm.) and are considered more effective at assessing occupancy than call playback and spotlighting. At each survey site a Songmeter will be placed out for a minimum of 14 nights, with a minimum of seven nights of clear weather. If seven nights of clear weather are not achieved Songmeters will be left in situ for longer periods. Weather details will be recorded for each survey period.

Songmeters will be downloaded and calls analysed through call recognisers. Where the Yellow-bellied Glider is recorded at a site that site will be considered occupied for that survey period.

Following completion of the initial surveys a report will be developed outlining the methods and results of these surveys.

ii Genetic study

The initial surveys will help establish occupancy across the four survey units. To look at gene flow across these areas, and determine whether powerline easements are presenting functional barriers to movement, a genetic study will be undertaken.

Given issues with trapping Yellow-bellied Gliders, with low capture rates of 14.3% (Brown 2006), a pilot study is proposed to determine whether scats can be collected from the base of feed trees and whether genetic material can be collected from these scats. The pilot study will involve setting up of small gauge mesh nets at the base of feed trees. Feed trees will be identified through the characteristic v-notch incision made the Yellow-bellied Glider. A plastic collar will be placed below the mesh net to present access to the tree or the mesh net by other arboreal mammals such as the Common Brushtailed-possum (*Trichosurus vulpecula*). Twenty nets will be established, with nets checked weekly for a period of four weeks. Samples will be collected and stored in 50:50 ethanol/saline and sent off for extraction of mitochonrial DNA. If this method proves successful it will be expanded on and replace the trapping proposed below. This may allow collection of a greater amount of genetic material more effectively and with a smaller amount of effort.

If the pilot study is unsuccessful, trapping of Yellow-bellied Gliders will be undertaken at 40 sites across the four survey units outlined above to collect genetic material, with ten sites per survey unit. Sites will be selected based on the results of the initial surveys, with sites selected where occupancy was strongest. Cage traps will be set on feed trees, approximately 3-6 m above the ground. Traps will be baited with creamed honey placed on toilet paper at the back of the trap with a honey/water solution sprayed around the trap and as high as possible on the tree as an attractant. Traps will be opened at dusk and checked every morning for a period of four nights per trapping session. Any animals captured will be placed in a cloth bag for weighing and taking of morphological measurements along with collection of genetic material via skin biopsy. Genetic material collected via skin biopsy will be stored in vials of 50:50 ethanol/saline before being sent off for extraction of mitochondrial DNA.

The study will aim to collect a minimum of 40 genetic samples, with ten from each survey unit (one per site). Based on trapping success of 14% observed in other studies (Brown 2006) it is anticipated that two rounds of survey, with four nights per round, will be required per trap site to collect one sample per site. This will equate to 320 trap nights.

Analysis of mitochondrial DNA haplotypes, in line with the methods outlined in Brown (2006), will help to determine whether gene flow is occurring across powerline easements, helping to determine whether the Yellow-bellied Glider population on the Bago plateau is isolated from other records of the species in KNP.

Following completion of the surveys a report will be developed outlining the methods and results of these study.

A.2.2 Improving connectivity

A key threat to the Yellow-bellied Glider population on the Bago plateau is the fragmentation of habitat occurring due to cleared powerline easements (DPIE 2021), (NSWSC 2014), with the Upper Murray Power Line (Line 65) the southern boundary of the endangered population (NSWSC 2014) while Lines 64 and 66 intersect the Bago plateau. This fragmentation is thought to provide a functional barrier to movement (NSWSC 2014) and may disrupt gene flow comparative to continuous and unfragmented forest environments (Kambouris, Kavanagh & Rowley 2013).

However, given the glide ratio of the Yellow-bellied Glider (2.0 or 2 m horizontal distance to 1 m drop of vertical height) (Goldingay & Kavanagh 1991), Kambouris, Kavanagh & Rowley (2013) posit that the Yellow-bellied Glider may be able to glide across powerline easements of up to 67 m width, meaning Yellow-bellied Gliders may be capable of traversing these powerline easements across the Bago plateau, other than in the northen part of the plateau where co-located easements have resulted in easement widths of ~100 m. Even though movement across these powerline easements is feasible, powerline easements may be an impediment to movement, with Yellow-bellied Gliders more reluctant to traverse easements when compared to movement through forested environments. The impacts that conductors and towers have on movement is unknown.

To ensure connectivity is maintained and gene flow occurs between individuals within the endangered population and individuals across the species range, particularly in contiguous areas of KNP, there is an opportunity to develop a strategy to minimise the impacts of fragmentation on the Yellow-bellied Glider population on the Bago plateau.

To ensure powerline easements do not act as complete or partial barriers to movement easements could be retrofitted with glider poles to improve connectivity (Plate A.1). Consultation has been undertaken with TransGrid indicating this retrofitting is feasible provided minimum clearance distance to conductors (~9 m) can be maintained. It is estimated that up to 20 locations along Lines 64, 65 and 66 would be retrofitted with glider poles (40 poles). Location would be informed by a detailed analysis looking at factors such as:

- areas where Gliders cannot cross, assessed using LiDAR data and modelling Glider crossing capability;
- suitability of habitat determined by presence of feed trees;
- areas of occupancy identified during the initial surveys outlined in Section A.2.1i;
- unoccupied areas supporting suitable habitat; and
- design considerations for these easements.

The key aim of this strategy is to reconnect areas of suitable habitat to improve gene flow and overall population viability.

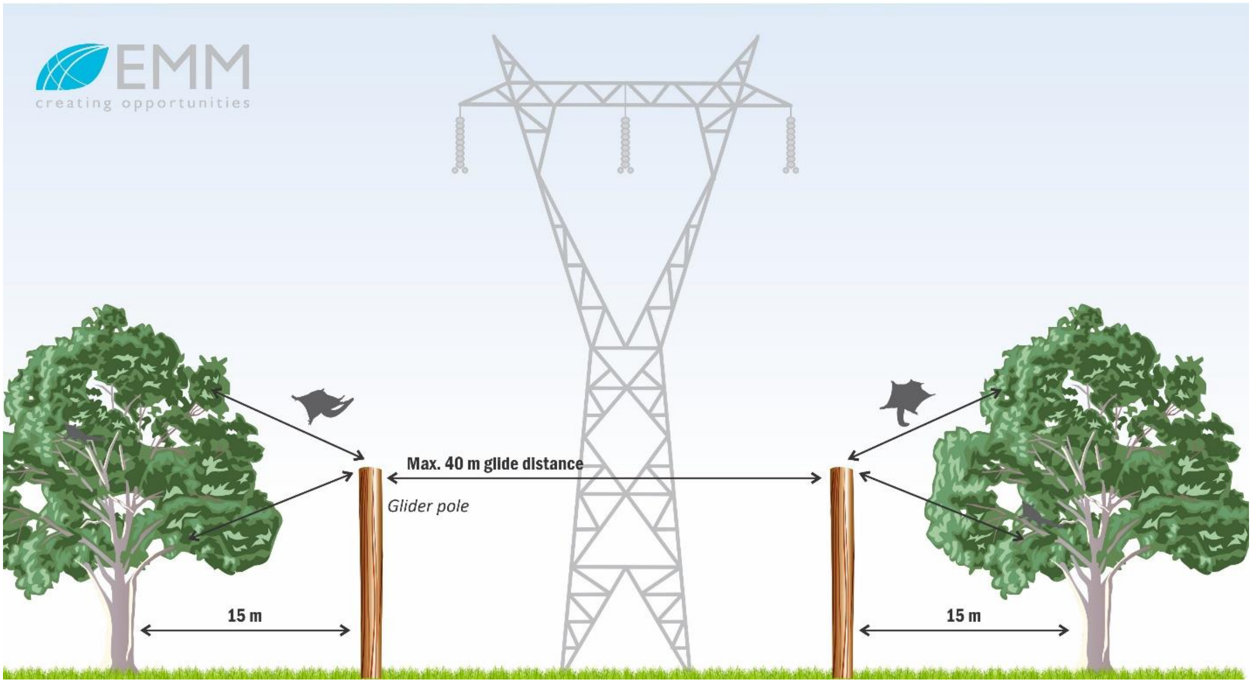

Plate A.1 Conceptual drawing showing retrofitted glider poles on powerline easements to improve connectivity

To monitor the usage of these glider poles, motion-activated cameras would be fitted to glider poles. Solar panels will be connected to the cameras to limit maintenance requirements, with wireless data retrieval enabled. Plastic collars, with a single gap in the collar, will be installed below the camera and gliding platform (Plate A.2). The purpose of these collars is to allow animals to pass up or down the pole but directed into the full view of the camera (GHD 2017).

Cameras will be set up on both glider poles, on either side of the easement. This setup will ensure that a successful glider can be documented based on the direction the animal is facing and the timing of photos on each pole. Cameras will be set up to take one photo per trigger. Cameras will be checked once per month, with data downloaded via wireless connection. Data will be analysed with the species of animal identified and determination of direction of crossing and whether a successful crossing was made. Data will be collected for a period of one year following establishment of the glider poles.

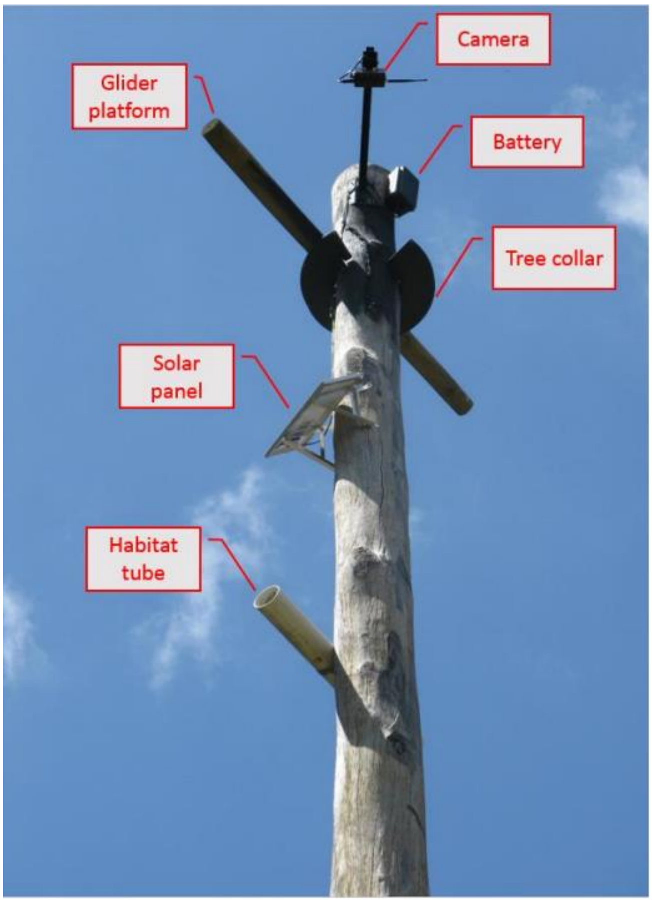

Plate A.2 Glider pole camera set up (photo sourced from GHD (2017))

Following one year of monitoring a report will be developed outlining the methods and results of these surveys, including the efficacy of glider poles in assisting movement across powerline easements.

Following a meeting with species experts and concerns raised over the ability (or lack thereof) of the species to cross the canopy gap along the Tumut River, consideration was given to installation of glider poles along the River. To determine whether this would be beneficial a spatial analysis was undertaken using canopy height modelling derived from LiDAR data and looking at the gliding distances for the Yellow-bellied Glider (Goldingay 2014). The spatial analysis modelled canopy height and looked at the ability of the Yellow-bellied Glider to glider from the outer edge of the canopy to a tree on the other side. This analysis identified that the species is capable of gliding across the canopy gap along the majority of the Tumut River, from Sue City to Tumut Two Pondage. This analysis indicates that the Tumut River does not fragment the species or impact on connectivity. Thus, installation of glider poles within the Tumut River is not considered to be required.

Appendix M. Line 2 reference future vegetation integrity data (EMM consulting 2020a)

Plot	Pct	Patch size	Condition class / vegetation zone	Zone	Easting	Northing	Bearing	Comptree	Compshrub	Compgrass	Compforbs	Compferns	Compother	Structree	Strucshrub	Strucgrass	Strucforbs	Strucferns	Strucother	Funlargetrees	Funhollowtrees	Funlittercover	Funlenfallenlogs	Funtreestem5to10	Funtreestem10to20	Funtreestem20to30	Funtreestem30to50	Funtreestem50to80	Funtreeregen	Funhighthreatexotic
Southern Tableland Dry Sclerophyll Forests																														
187	296	101	DNG	55	628142	6046952	90	3	10	6	6	1	1	2	10.8	7.2	3.8	60	0.5	0	0	77.6	84	0	0	0	0	0	0	1.1
3301	296	101	DNG	55	628221	6047161	12	3	12	8	8	1	1	15	41.6	26.9	2.6	35	0.1	0	0	35	6	1	1	0	0	0	1	2.5
1008	729	101	DNG	55	625440	6039643	13	0	8	6	7	0	0	0	15.1	45.8	1.1	0	0	0	0	70	3	1	1	1	0	0	0	3.2
3177	729	101	DNG	55	625074	6040198	318	3	7	7	7	0	1	13	181	95	22	0	1	0	0	13	0	1	0	0	0	0	1	3
218	999	101	DNG	55	625998	6038194	318	2	14	5	9	1	1	0.2	85.6	3.6	3.3	0.2	1	0	0	20	0	1	1	0	0	0	1	0.5
Mean								2.2	10.2	6.4	7.4	0.6	0.8	6.0	66.8	35.7	6.6	19.0	0.5	0.0	0.0	43.1	18.6	0.8	0.6	0.2	0.0	0.0	0.6	2.1
Southern Tableland Wet Sclerophyll Forests																														
2284	300	101	DNG	55	625379	6039763	172	0	3	2	9	0	0	0.0	7.6	36.0	5.8	0.0	0.0	0	0	3.6	0.0	0	0	0	0	0	0	40.1
3265	300	101	DNG	55	626151	6037213	165	1	4	8	7	1	0	10.0	35.5	8.6	4.6	0.1	0.0	0	0	33.0	13.0	0	0	0	0	0	0	55.2
Mean								0.5	3.5	5.0	8.0	0.5	0.0	5.0	21.6	22.3	5.2	0.1	0.0	0.0	0.0	18.3	6.5	0.0	0.0	0.0	0.0	0.0	0.0	47.7
Upper Riverina Dry Sclerophyll Forests																														
92	302	101	DNG	55	625905	6038899	182	1	1	7	8	0	1	0.2	0.2	45.4	0.9	0.0	0.1	0	0	3.6	0.0	0	0	0	0	0	1	3.4
96	302	101	DNG	55	625791	6038789	75	0	1	9	5	0	1	0.0	0.2	60.1	0.5	0.0	0.1	0	0	7.0	0.0	0	0	0	0	0	0	15.9
Mean								0.5	1.0	8.0	6.5	0.0	1.0	0.1	0.2	52.8	0.7	0.0	0.1	0.0	0.0	5.3	0.0	0.0	0.0	0.0	0.0	0.0	0.5	9.7
Subalpine Woodlands																														
178	1196	101	DNG	55	647441	6032429	179	2	9	5	11	0	0	1.1	12.4	85.3	1.3	0.0	0.0	0	0	43.0	12.0	0	0	0	0	0	1	0.3

Plot	Pct	Patch size	Condition class / vegetation zone	Zone	Easting	Northing	Bearing	Comptree	Compshrub	Compgrass	Compforbs	Compferns	Compother	Structree	Strucshrub	Strucgrass	Strucforbs	Strucferns	Strucother	Funlargetrees	Funhollowtrees	Funlittercover	Funlenfallenlogs	Funtreestem5to10	Funtreestem10to20	Funtreestem20to30	Funtreestem30to50	Funtreestem50to80	Funtreeregen	Funhighthreatexotic
1039	1196	101	DNG	55	627147	6029463	33	2	5	5	5	0	2	5.2	3.3	97.2	0.5	0.0	0.2	0	0	50.0	0.0	0	0	0	0	0	0	0.4
2014	1196	101	DNG	55	642654	6024016	132	1	9	5	24	0	1	0.1	85.5	39.0	9.8	0.0	0.1	0	0	1.4	0.0	0	0	0	0	0	0	1.6
2134	1196	101	DNG	55	642866	6023773	318	2	7	6	24	2	1	0.4	23.0	46.1	10.6	0.2	0.1	0	0	2.6	14.0	1	1	0	0	0	0	1.5
2219	1196	101	DNG	55	640703	6024614	180	0	3	4	12	1	1	0.0	1.2	29.5	3.0	0.1	0.1	0	0	19.0	4.0	0	0	0	0	0	0	0.6
2240	1196	101	DNG	55	646714	6027069	2	0	4	5	15	0	0	0.0	5.4	62.7	1.7	0.0	0.0	0	0	69.0	18.0	0	0	0	0	0	1	0.3
2249	1196	101	DNG	55	647540	6032837	179	1	3	5	10	0	0	0.1	0.4	73.3	1.0	0.0	0.0	0	0	40.0	22.0	0	0	0	0	0	0	0.0
2250	1196	101	DNG	55	646400	6025212	15	0	4	5	13	1	0	0.0	1.5	45.4	1.3	0.2	0.0	0	0	31.0	0.0	0	0	0	0	0	0	0.3
2256	1196	101	DNG	55	645736	6022859	92	0	7	9	9	0	0	0.0	48.3	57.4	0.9	0.0	0.0	0	0	23.0	2.0	0	0	0	0	0	0	0.0
Mean								0.9	5.7	5.4	13.7	0.4	0.6	0.8	20.1	59.5	3.3	0.1	0.1	0.0	0.0	31.0	8.0	0.1	0.1	0.0	0.0	0.0	0.2	0.6