APPENDIX L

OFFSET STRATEGY

Snowy 2.0 Main Works

Revised Biodiversity Offset Strategy

Prepared for Snowy Hydro Limited
February 2020

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Snowy 2.0 Main Works

Revised Biodiversity Offset Strategy

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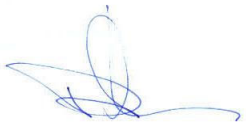

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Director
28 February 2020

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1 Introduction

The Secretary's Environmental Assessment Requirements (SEARs) for the EIS, issued by DPIE on 31 July 2019, require *"a strategy to offset the residual impacts of the project on these ecosystems, focussing on enhancing the biodiversity values of the Kosciuszko National Park in the medium to long term."*

The Snowy 2.0 Main Works Offset Strategy (EMM 2019a) was submitted to the Department of Planning, Industry and Environment (DPIE) as Appendix M.3 to the Snowy 2.0 Main Works Environmental Impact Statement (EIS; EMM 2019b).

Following submissions received on the Snowy 2.0 Main Works Offset Strategy (EMM 2019a), and further consultation with DPIE and other government agencies, this revised Biodiversity Offset Strategy is provided as a part of the preferred infrastructure report and response to submissions (PIR-RtS). The revised Biodiversity Offset Strategy (BOS) builds on previous work undertaken to develop a strategic offset package for Snowy 2.0 Main Works that will offset the residual impacts arising from the project.

It is proposed that this revised BOS addresses residual impacts of the project, including conservation management actions/measures required to fulfil Snowy Hydro's obligations under the NSW *Biodiversity Conservation Act 2016* (BC Act) and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

1.1 Biodiversity offset principles and guidelines

1.1.1 Principles

Significant and extensive consultation has been undertaken with DPIE, the NSW National Parks and Wildlife Service (NPWS), NSW Biodiversity and Conservation Division (BCD, formerly the Office of Environment and Heritage (OEH)) and Commonwealth Department of Environment and Energy (DoEE) regarding the biodiversity offsets for the Snowy 2.0 project, including for Exploratory Works and Main Works. Throughout this consultation process, the objective of the offset strategy has been to ensure any offsets achieve a positive outcome for the species and communities residually impacted by the project, preferably through the implementation of conservation management measures/actions in Kosciuszko National Park (KNP). This objective is reflected in the SEARs issued for the Snowy 2.0 Main Works.

Through these discussions, principles were developed for the preparation of an offset strategy for Snowy 2.0 Main Works which would add value over and above existing mechanisms and programs for KNP. These include:

- management measures/actions will seek to provide a net improvement in the biodiversity values of KNP over time;
- management measures/actions adopted should, where feasible, target threatened species, ecological communities or protected matters being impacted by the project;
- management measures/actions adopted should, where feasible, provide a measurable conservation gain for the threatened species, ecological communities or protected matters being impacted by the project;
- in some cases, a better conservation outcome may be achieved through management measures/actions directed at broader management of the KNP than management measures/actions which target specific species;
- management measures/actions adopted will seek to provide a whole of catchment benefit, providing measurable conservation gains for biodiversity in KNP;

- management measures/actions will be informed by scientific advice and evidence, and will be transparent, effective and efficient;

- management measures/actions that achieve a direct conservation outcome within KNP are preferred over out of park conservation or payment into the NSW Biodiversity Conservation Fund (BCF) established under the BC Act; and

- payment of any offsets by Snowy Hydro Limited (Snowy Hydro) will be proportional to the residual impacts after all measures to avoid, minimise and mitigate impacts have been considered.

1.1.2 Guidelines for the development of management actions

Snowy 2.0 is the largest committed renewable energy project in Australia. By expanding the current Snowy Scheme's renewable energy capacity by almost 50%, the National Electricity Market (NEM) will be served with an additional 2,000 MW generating capacity. In light of the unique location of Snowy 2.0 within KNP and the project's critical significance to the State of NSW and broader NEM, a number of mechanisms have been considered for the delivery of biodiversity offsets for Snowy 2.0, in consultation with DPIE, NPWS and DoEE. Following ongoing consultation, it was determined that a set of guidelines would be developed for the Snowy 2.0 offsets for Main Works, and offsets will be provided in accordance with these guidelines. For Snowy 2.0, biodiversity offsets will be delivered via like-for-like offsets where feasible. However, many of the species and communities impacted by the project are unique to KNP, and like-for-like offsets are not achievable outside the KNP. Where like-for-like offsets cannot be achieved or are not feasible, conservation management measures/actions will be undertaken in KNP to benefit the species and communities impacted. Conservation management measures/actions will:

- be delivered preferentially in the catchment(s) in which the impact is occurring. Actions that improve catchment health across KNP will also be considered;

- be delivered in the same interim biogeographic regionalisation of Australia (IBRA) subregion(s) or adjacent subregion(s); and

- benefit the threatened species or ecological communities impacted by Snowy 2.0 Main Works; and

- provide direct and measurable conservation outcomes for matters of national environmental significance (MNES), providing direct offsets in line with the EPBC Act Environmental Offsets Policy (Commonwealth of Australia 2012).

- In consultation with DPIE, NPWS, BCD and DoEE, it has been determined that the best way to ensure conservation actions benefit the threatened species or ecological communities impacted by Snowy 2.0 is to develop a set of management actions which:

- identifies the threatened species associated with the plant community types (PCTs) impacted by Snowy 2.0 Main Works;

- identifies Savings Our Species (SOS) actions and/or recovery plan actions that would benefit these threatened species;

- where SOS projects or activities and recovery plan actions have not been identified for threatened species, identify management actions for each threatened species; and

- considers projects that provide a cumulative benefit to key conservation actions across the catchments of KNP.

The above principles and guidelines have been used to develop the proposed offset package outlined below.

1.2 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 2012). The Environmental Offsets Policy sets out the DoEE'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 significant impact to MNES can be avoided or minimised to the extent that a significant impact can be avoided, offsets are not required. The burden to demonstrate a non-significant impact lies with the proponent.

Section 7.2 of the Environmental Offsets Policy requires that direct offsets form a minimum of 90% of the total offset requirement. Direct offsets are actions which '*provide a measurable conservation gain for an impacted protected matter*' (p.8) and may include actions such as pest species management where pest species are having a significant impact on the viability of the species and increasing threats to the species' long term survival.

Deviation from this approach is permitted where:

- it can be demonstrated that a greater benefit to the protected matter can be achieved through increasing the proportion of other compensatory measures; or
- scientific uncertainty is so high that it is not possible to determine a direct offset that is likely to benefit the protected matter.

When considering offsets for threatened species and communities protected under the EPBC Act, it is important to consider this requirement for direct offsets. This is particularly the case when considering any of the offset options under the BC Act, other than like-for-like offsets.

It is proposed that offsets for MNES meet the requirements of the EPBC Act through ensuring:

- management actions proposed provide a measurable conservation gain for an impacted protected matter wherever possible;
- demonstrating that a greater benefit to the protected matter can be achieved through increasing the proportion of other compensatory measures; or
- demonstrating that scientific uncertainty is so high that it is not possible to determine a direct offset that is likely to benefit the protected matter.

Given many of the species and communities listed under the EPBC Act that will be affected by Snowy 2.0 Main Works do not occur outside of KNP, it is likely that management actions in KNP will provide a greater benefit to these entities, or that determining a traditional 'like-for-like' offset is not available.

1.3 Conceptual framework

The conceptual framework shown in Plate 1.1 has been developed for the Snowy 20. Main Works Biodiversity Offset strategy.

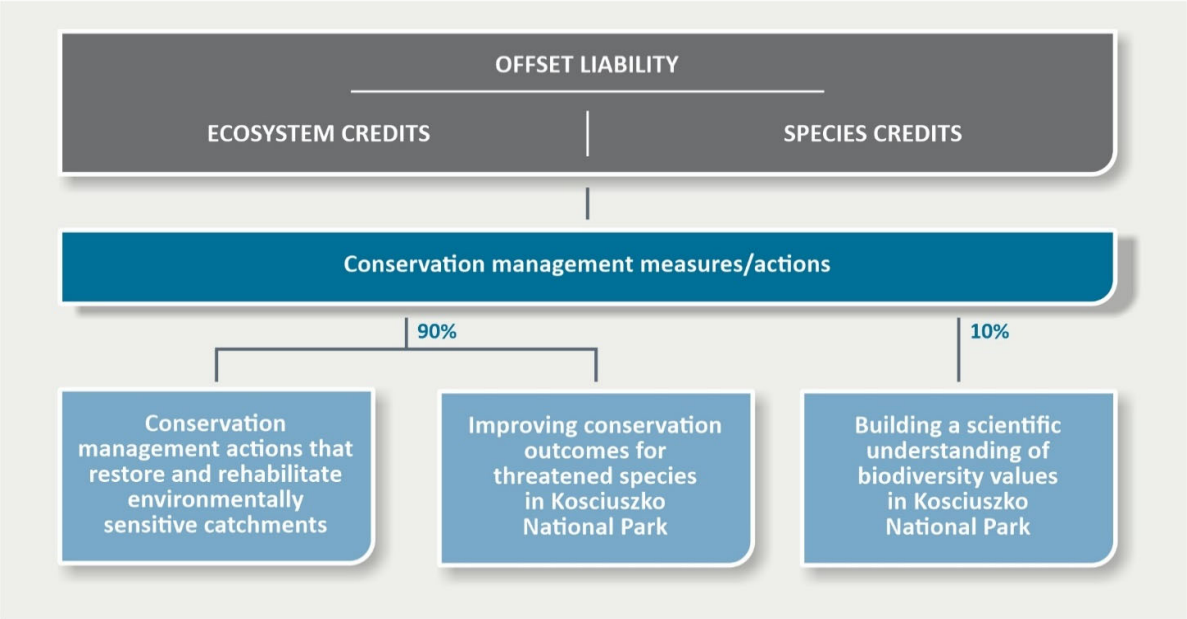

Plate 1.1 Snowy 2.0 Main Works Biodiversity Offset Strategy conceptual framework

The conceptual framework outlined above provides a framework for delivering holistic ecosystem management for catchments in KNP, resulting in broader benefits to species and communities. Offsets arising from Snowy 2.0 Main Works will be used to undertake conservation management actions to rehabilitate, restore and enhance altered catchments and habitat loss that has occurred due to weeds, pests and degraded aquatic habitat including loss of riparian corridors. These impacts have arisen from past land use in the Snowy region, including mining, agricultural use and the development of the original Snowy scheme. Ninety percent of funding will be used to derive direct conservation outcomes for the species and communities being impacted.

A maximum of 10% of the ecosystem credits offsets and a maximum of 10% of the species credits offsets will be allocated to quantitatively assess, monitor and report on key performance indicators (KPIs) of ecological health within KNP. This includes identifying ecological systems and processes that needs to be better understood, including identifying what needs to be measured and monitored to fill knowledge gaps.

Further detail is provided in Section 3.

2 Offset requirements

The Snowy 2.0 Main Works EIS (EMM 2019b) and associated Biodiversity Development Assessment Report (BDAR; EMM 2019c) and BOS (EMM 2019a) outlined a disturbance area of 1,680 ha that resulted in a total of 32,118 ecosystem credits and 44,100 species credits were required to offset residual impacts arising from Snowy 2.0 Main Works.

Following submission of the Snowy 2.0 Main Works EIS and BDAR revisions to the disturbance footprint have been undertaken. Revised impacts are provided in the updated BDAR (EMM 2020). As a result of these design changes the main works direct impacts to native vegetation have been significantly reduced from 1,047.83 ha to 424.24 ha. It is estimated that 65% of this direct disturbance footprint will be rehabilitated, with an ongoing operational disturbance footprint of 92 ha (Figure 2.1).

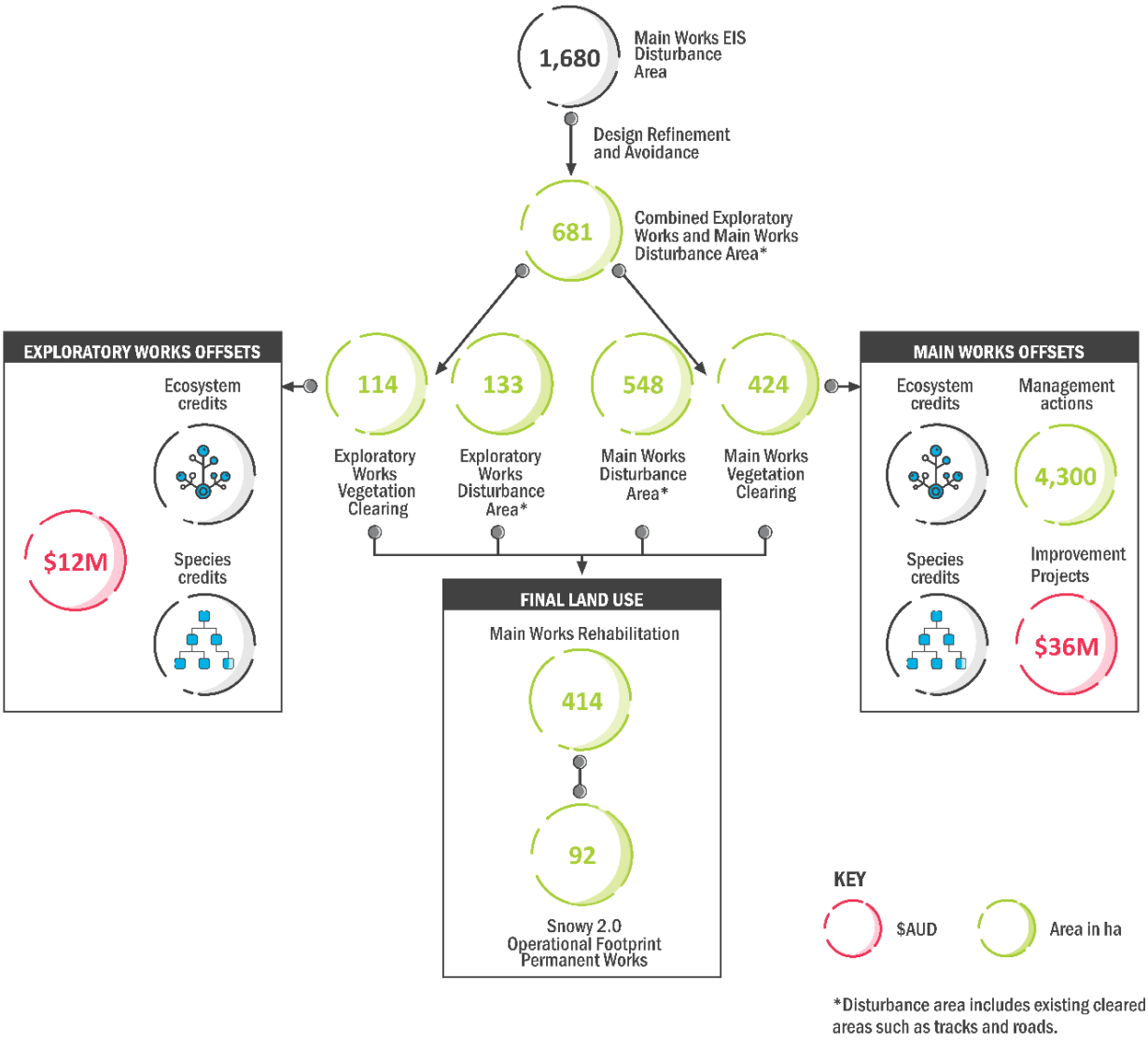

Figure 2.1 **Concept diagram showing how proposed conservation actions have been derived through changes in footprint**

As a result, the number of credits required to offset these revised impacts has reduced to 19,927 ecosystem credits (Table 2.1) and 22,283 species credits (Table 2.2).

Table 2.1 Summary of ecosystems credits required to offsets Snowy 2.0 Main Works (based on a revised disturbance footprint)

PCT	Sum of credits required
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	97
PCT 296 – Brittle Gum – Peppermint open forest of the Woomargama to Tumut region, NSW South Western Slopes Bioregion	602
PCT 299 – Riparian Ribbon Gum - Robertsons Peppermint - Apple Box riverine very tall open forest of the NSW South Western Slopes Bioregion and South Eastern Highlands	30
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	770
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	59
PCT 303 – Black Sally grassy low woodland in valleys in the upper slopes sub-region of the NSW South Western Slopes Bioregion and western South Eastern Highlands Bioregion	1,261
PCT 311 – 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	213
PCT 637 – Alpine and sub-alpine peatlands, damp herbfields and fens, South Eastern Highlands Bioregion and Australian Alps Bioregion	45
PCT 639 – Alpine Ash - Snow Gum shrubby tall open forest of montane areas, South Eastern Highlands Bioregion and Australian Alps Bioregion	230
PCT 644 – Alpine Snow Gum - Snow Gum shrubby woodland at intermediate altitudes in northern Kosciuszko NP, South Eastern Highlands Bioregion and Australian Alps Bioregion	1,685
PCT 679 – Black Sallee - Snow Gum low woodland of montane valleys, South Eastern Highlands Bioregion and Australian Alps Bioregion	2
PCT 729 - Broad-leaved Peppermint - Candlebark shrubby open forest of montane areas, southern South Eastern Highlands Bioregion and South East Corner Bioregion	569
PCT 953 – Mountain Gum - Snow Gum - Broad-leaved Peppermint shrubby open forest of montane ranges, South Eastern Highlands Bioregion and Australian Alps Bioregion	253
PCT 999 - Norton's Box - Broad-leaved Peppermint open forest on footslopes, central and southern South Eastern Highlands Bioregion	320
PCT 1191 – Snow Gum - Candle Bark woodland on broad valley flats of the tablelands and slopes, South Eastern Highlands Bioregion	370
PCT 1196 - Snow Gum - Mountain Gum shrubby open forest of montane areas, South Eastern Highlands Bioregion and Australian Alps Bioregion	3,281
PCT 1224 – Sub-alpine dry grasslands and heathlands of valley slopes, southern South Eastern Highlands Bioregion and Australian Alps Bioregion	2,890
PCT 1225 – Sub-alpine grasslands of valley floors, southern South Eastern Highlands Bioregion and Australian Alps Bioregion	250
TOTAL	12,927

A summary of the species credits required to offset the impacts of Snowy 2.0 Main Works is provided in Table 2.2.

Table 2.2 Summary of species credits required to offset Snowy 2.0 Main Works (based on a revised disturbance footprint)

Species	Sum of credits required
Alpine She-oak Skink	3,852
Alpine Tree Frog	895
Booroolong Frog	57
Broad-toothed Rat	2,794
Caladenia montana	24
Clover glycine	41
Eastern Pygmy-possum	7,836
Gang-gang Cockatoo	93
Kiandra Leek Orchid	108
Leafy Anchor Plant	90
Mauve Burr-daisy	571
Max Mueller's Burr-daisy	46
Raleigh Sedge	14
Slender Greenhood	5
Smoky Mouse	5,276
Southern Myotis	86
Thelymitra alpicola	0
White-bellied Sea-eagle	495
TOTAL	22,283

3 Offset strategy

Offsets for Snowy 2.0 Main Works will be provided through conservation management measures/actions to rehabilitate, restore and enhance altered catchments and habitat loss that has occurred due to weeds, pests and degraded aquatic habitat including loss of riparian corridors. This approach will ensure holistic ecosystem management is undertaken, resulting in broader benefits to species and communities, rather than individual management of individual species or communities.

In developing the offset strategy, 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.

The *Kosciuszko National Park Plan of Management 2006* (KNP PoM, DEC 2006) provide(s) *"a framework of objectives, principles and policies to guide the long-term management of the broad range of values contained in the park ... (and) contains a suite of actions to be undertaken by the National Parks and Wildlife Service and other organisations to protect and conserve the values of the park."* Given the importance of this document to the ongoing management and conservation of KNP, the management objectives in the PoM were reviewed and all conservation actions proposed have been aligned with the relevant management objective(s).

Caring for our Australian Alps Catchments (Worboys and Good 2011) was commissioned by the Australian Alps Liaison Committee as a technical report to the Commonwealth Government to *"evaluate the natural condition of Australia's high mountain catchments ...; to identify significant current and future threats to those catchments associated with climate change and to assess priority adaptation responses."* This document provided a number of policy recommendations to protect the natural values of the Alps, including recommendations for catchment based management at the whole-of-Alps scale to protect water yield. This document was reviewed to ensure conservation actions proposed in this BOS were aligned with the recommendations from Worboys and Good (2011).

Key conservation actions are outlined further below.

3.1 Key threats

A summary of the key threats and management actions for threatened species and communities impacted by Snowy 2.0 is provided in Annexure A. Review of this information highlights the following key threats for species and communities:

- impacts from feral Rabbits, Horses, Deer and Pigs, including:
- grazing, trampling and ground disturbance, resulting in loss or modification of foraging habitat and loss of breeding habitat;
- sedimentation causing in-filling of breeding habitat for aquatic species;
- trampling and associated erosion of stream banks;
- reduction in food resources;
- spread of key weed species;

- predation by rats, foxes, cats and dogs.
- weed invasion, resulting in reduced viability of flora and fauna populations;
- impacts of recreational activities on vegetation communities and habitat for threatened species;
- impacts of too frequent fires on vegetation communities and habitat for threatened species;
- changes to hydrology, resulting in degradation of habitat for surface water and groundwater dependent ecosystems; and
- dieback caused by cinnamon fungus (Phytophthora cinnamomi).

3.2 Proposed conservation program

3.2.1 Purpose

The proposed conservation program will include conservation management measures/actions, benefiting the ecosystems and species impacted, whilst providing a holistic approach to management that will result in broader benefits to the species and communities of KNP. The proposed conservation program is aligned with key threats outlined above and detailed in Annexure A.

3.2.2 Method

To determine the areas to which conservation management measures/actions would be applied, consistent with other development proposals across NSW, the following actions were undertaken:

A fictional stewardship (offset) site was created in the calculator associated with the Biodiversity Assessment Method (BAM, OEH 2017). Plot data collected from KNP as a part of the biodiversity surveys for Snowy 2.0 was inputted into the calculator to provide a representation of the conservation gains that could be expected from management of vegetation in KNP, in line with other offset sites across NSW.

To ensure the correct number of credits was generated for each PCT to offset impacts arising from Snowy 2.0 Main Works the number of hectares that would need to be managed to meet the offset requirement was determined based on the plot data outlined above. For example, 97 credits are required to offset impacts to PCT 285. The process above determined that 1.84 credits are generated per hectare within the fictional offset site. Therefore, to meet the offset requirements for Snowy 2.0 Main Works, management of 53 ha of PCT 285 is required. Areas requiring management are outlined in Table B.1 in Annexure B. A total area of 4,383 ha will benefit from the proposed management actions.

To ensure wholistic management was undertaken, and allow for assessment of management actions for associated communities, PCTs were grouped up into four management groups:

- Montane dry sclerophyll forests and woodlands;
- Subalpine woodlands;
- Subalpine grasslands, bogs and fens; and
- Subalpine tall forests.

PCTs and associated management groups are shown in Table B.2 in Annexure B.

Appropriate conservation management measures/actions for each management group were determined based on impacts observed during the biodiversity assessment undertaken for Snowy 2.0 and review of relevant literature and management plans, outlined above. Individual management conservation management measures/actions were determined for key threatened species where additional or specific actions were required to address impacts.

Costing to implement these conservation management measures/actions was undertaken. Costs are based on the conservation program occurring for 20 years, as per the requirements of the SEARs to focus on *"enhancing the biodiversity values of the Kosciuszko National Park in the medium to long term"*.

3.2.3 Management actions

Based on the process outlined above, conservation management measures/actions were derived and costed. As outlined, a holistic approach was undertaken as many of the conservation management measures/actions proposed will derive benefits for PCTs as well as threatened species associated with these PCTs.

- weed control;
- feral animal control;
- revegetation works; and
- species specific actions.

Table 3.1 summarises implementation of management actions across the management groups, while Table 3.2 summarises how the proposed management actions will benefit threatened species impacted by Snowy 2.0 Main Works. Figure 3.1 provides a conceptual diagram showing how this wholistic approach will provide benefits for threatened species as well as general ecosystems impacted by Snowy 2.0 Main Works.

Further detail is provided below.

Table 3.1 Implementation of management actions across management groups

Management group	Weed control	Feral animal control (aerial shooting)	Feral animal control (ground shooting)	Feral predator control (baiting)	Feral herbivore control (gassing / poisoning)	Revegetation works
Montane dry sclerophyll forests	✓		✓	✓	✓	
Subalpine grasslands and bogs	✓	✓	✓	✓	✓	
Subalpine woodlands	✓		✓	✓	✓	✓
Subalpine tall forests	✓		✓	✓	✓	

Table 3.2 Proposed conservation measures/actions and benefits to threatened species

Proposed conservation measure/action	Alpine bogs and fens	Alpine She-oak Skink	Alpine Tree Frog	Booroolong Frog	Broad-toothed Rat	*Caladenia montana*	Clover glycine	Eastern Pygmy-Gang-gang Cockatoo	Kiandra Leek Orchid	Leafy Anchor	Mauve Burr-daisy	Max Mueller's Raleigh Sedge	Slender Greenhood	Smoky Mouse	Southern Myotis	*Thelymitra alpicola*	White-bellied Sea-
Feral herbivore control	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓			✓	
Feral predator control			✓	✓	✓			✓						✓	✓		
Weed control	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	
Revegetation works								✓	✓					✓			
Species specific actions	✓	✓	✓	✓	✓		✓	✓						✓			

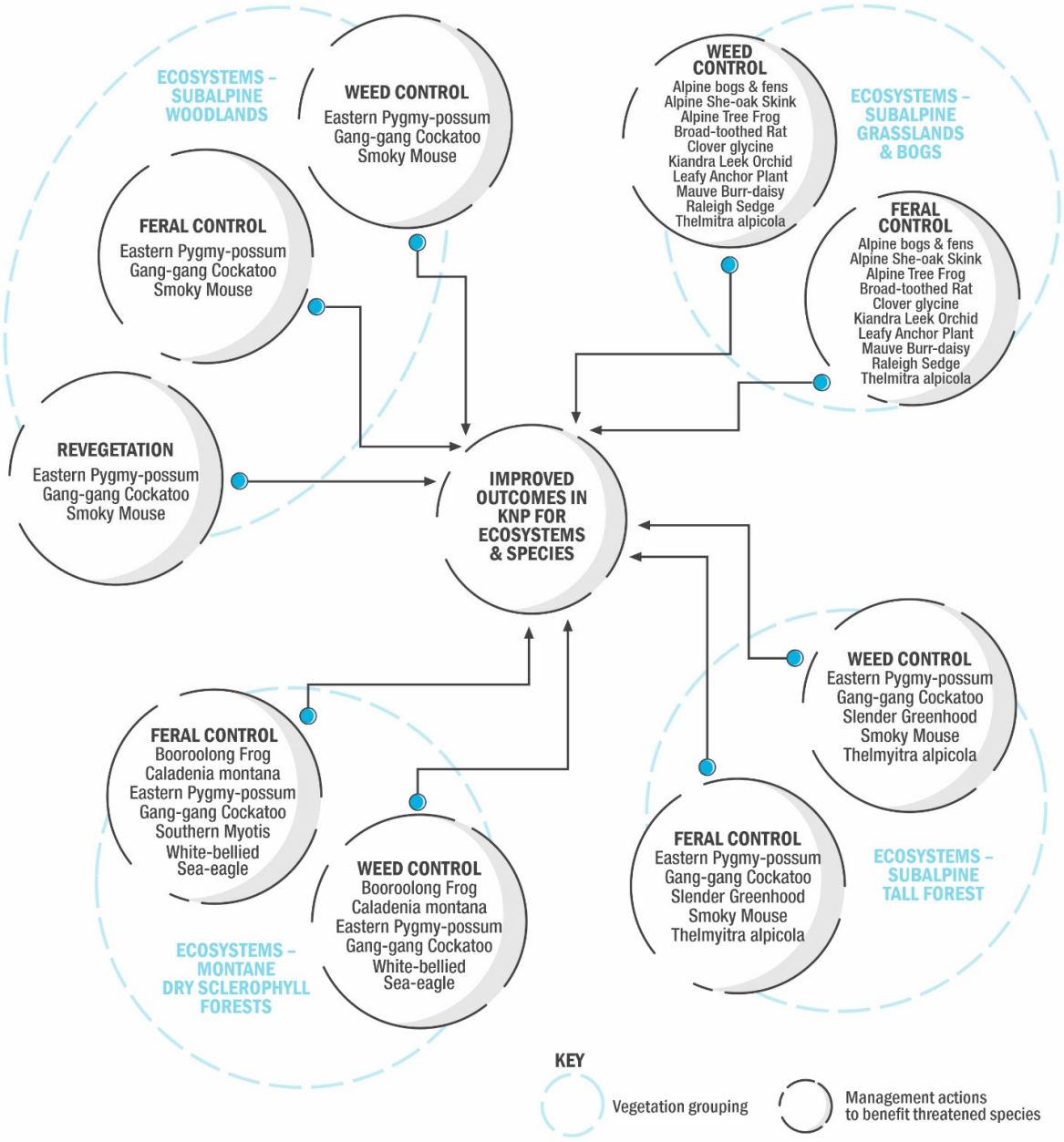

Figure 3.1 Conceptual diagram showing how proposed management actions provide benefits for threatened species and general ecosystems impacted by Snowy 2.0 Main Works

i Weed control

Weed control is identified as a key management measure for the species and communities within KNP, with invasion by weeds resulting in reduced viability of flora and fauna populations and degradation of vegetation communities. To address this key threat, weed control will be implemented across each of the management groups outlined above, based on the existing (current) conditions within KNP.

Primary weed control, targeting key weed species (eg Blackberry) will be undertaken in the limited areas of low condition vegetation in years 1-5. This will include intensive and targeted control. Areas in poor condition, with some minor levels of existing impacts, will be subjected to secondary weed control in years 1-5. General weed control, including spot control of key weed species, will be undertaken across remaining areas, with 25% of each management group targeted per annum.

This approach to weed management is consistent with the conditions observed in KNP. Review of PCT mapping undertaken as a part of Snowy 2.0 biodiversity surveys indicated that approximately 3% of vegetation was mapped in Low condition with a further 3% mapped in Poor condition. Remaining areas were found to be in moderate to high condition.

ii Feral animal control

Feral animals were observed to be impacting on the vegetation and threatened species within KNP during biodiversity surveys undertaken for the project and this is also reflected in the reviewed literature. Impacts included trampling of vegetation by feral Horses, degradation of vegetation by Rabbits, and spread of weed species across KNP. Feral predators were found to be abundant in some areas, with Foxes and Cats observed on remote cameras in Smoky Mouse habitat (as an example). These findings are consistent with the summary of key threats outlined above, and lead to reduced viability of vegetation and threatened species in the Park. To address this, management of feral animals is proposed using a combination of aerial shooting, on ground shooting, baiting, and poisoning/gassing.

Aerial shooting of feral animals (particularly herbivores) across the Subalpine Grasslands and Bogs management group is proposed. Feral herbivores were found to be significantly impacting vegetation and threatened species habitat in this area, with lower levels of impacts in other areas, and the ability to undertake aerial shooting is benefited by the open nature of this management group. Aerial shooting will be undertaken over nine-day period per annum over a five year period.

On ground shooting will be undertaken across all management groups, targeting feral predators and herbivores. Shooting will be undertaken by a licensed shooter, approved by NPWS, with 25% of each management group to be targeted per annum, with control undertaken across 20 years.

Baiting of feral predators is proposed using 1080, with baiting undertaken twice per year in autumn and spring. Baiting will be undertaken at a rate of 10 baits km^{-1} using a fixed wing aircraft, with control undertaken every two years for 20 years.

Control of feral herbivores, targeting Rabbits and Foxes, is proposed using poisoning or gassing of warrens and den sites. Control is proposed across 25% of each management group per annum, with control undertaken across 20 years.

This integrated pest management strategy will provide wide ranging benefits of the species and communities currently being impacted across KNP.

iii Revegetation works

During biodiversity surveys undertaken for Snowy 2.0 it was observed that some areas of PCT 644 – Alpine Snow Gum - Snow Gum shrubby woodland at intermediate altitudes in northern Kosciuszko NP, South Eastern Highlands Bioregion and Australian Alps Bioregion that had burned during the 2003 fires were failing to recover, with minimal recruitment. Following the recent 2020 fires in the region, with a fire interval of just 17 years, there is a possibility that these communities may be lost without intervention. To address this, it is proposed that revegetation of degraded Snow Gum Woodland is undertaken.

Revegetation of Snow Gum Woodland (PCT 644) degraded through repeated fire events will be undertaken through planting of overstorey species, predominantly Snow Gum (*Eucalyptus pauciflora* subsp*. paucilflora*). It is assumed that revegetation works will be required across up to 50% of the 700 ha of PCT 644 required to be managed. Planting of tubestock at density of 60 trees/ha in year 1 with follow up planting of 25% of the 700 ha in year 5 is proposed.

This conservation management measure/action will have long lasting benefits for this community, a key and iconic community within KNP.

iv Species specific actions

Multiple specific actions are proposed to benefit the following key species impacted by the Snowy 2.0 Main Works:

- Eastern Pygmy-possum;
- Smoky Mouse;
- Clover Glycine;
- Alpine Bogs and Fens;
- Alpine She-oak Skink;
- Broad-toothed Rat;
- Alpine Tree Frog; and
- Booroolong Frog.

Following the fires in 2020, refuge habitat for the Eastern Pygmy-possum is likely to be scarce, impacting on the ability of this species to recover from the fires. To address this, it is proposed that construction and distribution of nesting logs for Eastern Pygmy-possum in burnt habitats is undertaken. One nest log per hectare would be constructed and placed out across the 3,563 ha of the Montane dry sclerophyll forests and woodlands, Subalpine tall forests and Subalpine woodlands management groups.

A number of conservation management measures/actions are proposed to benefit the Smoky Mouse.

Regional Smoky Mouse surveys are proposed to be undertaken across KNP and surrounding national Parks and State Forests to document the distribution of the species. This is a key action of this species given the extent and severity of fires across the habitat identified as a part of the Snowy 2.0 biodiversity surveys, and will provide key information to inform the species recovery. Surveys at 345 locations on a 5km grid are proposed across the region, with two cameras per site (690 cameras). These surveys will provide important information on the distribution of the Smoky Mouse in subalpine and montane environments in the region.

A captive breeding program can be established, in consultation with species experts. Animals captured as a part of regional surveys or the monitoring program can be provided to supplement this breeding program, with the aim of returning animals to the wild when conditions are suitable. This would likely occur over a five year period.

The surveys outlined above will be supplemented by establishment of a post-fire monitoring program. Field surveys to be undertaken over 50 sites, including collection of genetic data and habitat information at each site, including recovery of vegetation post-fire. These surveys would target areas identified during the regional surveys outlined above and be undertaken biennially over a 20 year period to look at the recovery of the species.

As for the Eastern Pygmy-possum, the Smoky Mouse is likely to have been significantly impacted by bushfires with limited refuge habitat available. To address this, placement of hollow-bearing logs, sourced locally from clearing works, into burnt habitat to provide refuge habitat and nesting habitat for Smoky Mouse is proposed. Placement of logs to focus on key habitat areas identified during biodiversity surveys for Snowy 2.0, including gullies and adjacent to unburnt or low intensity burnt areas. This work is proposed over a five year period, to coincide with clearing works for Snowy 2.0 Main Works.

Following surveys for Snowy 2.0 a large population of Clover Glycine was identified in the Gulf Plain area, south-east of Tantangara Reservoir. This area also provides key habitat for other species and communities, including Alpine bogs and fens, Alpine She-oak Skink, Alpine Tree Frog, and the Broad-toothed Rat. The area is currently relatively unimpacted by weeds such as Ox-eye Daisy, providing a unique opportunity restrict access by feral Horses and thus reduce the potential spread of weeds into these areas. It is proposed that fencing of this area will be undertaken, protecting a 346 ha area.

To provide a key conservation outcome of the Alpine Tree Frog, fencing of key habitat for key populations in Nungar Creek, Tantangara Creek/Murrumbidgee River and the Eucumbene River is proposed. This will prevent access to breeding habitat by feral Horses. Key sites have been identified, with exclusion fencing of 49 km of habitat proposed across the three sites.

This would be supplemented by implementation of a broad monitoring program looking at habitat characteristics, fecundity and breeding success in managed and unmanaged sites, in combination with local microclimate variables, particularly moisture, to better understand the impacts of feral Horses, as well as the impacts of climate change on populations and to identify potential climate change refugia. Surveys of 12 x 500 m transects (2 per site, plus same number of controls) would be completed annually, with surveys undertaken across 20 years. This would provide long term population data on the species in relation to both management and climate change.

To provide conservation outcomes for the Booroolong Frog, weed control along the banks of the Yarrangobilly River, targeting key weed species (particularly Blackberry) is proposed using appropriate control methods. Weed control would be undertaken within 50 m of the River banks, at two sites across 100 ha. Weed control to include intensive (primary) control of woody weeds in years 1-5 and then annual control thereafter for a further 15 years.

This would be accompanied by establishment of a monitoring program for the Booroolong Frog, including baseline surveys across the two sites on the Yarrangobilly River to determine occupancy of breeding habitat by males, including testing of the population for Chytrid fungus. Surveys of 10 x 500 m transects (5 per site) would be completed annually for 20 years.

The conservation measures/actions outlined above will have broad benefits for a range of species impacted by Snowy 2.0 Main Works. Table 3.2 provides a summary of how each conservation measure/action will benefit each of these species.

3.3 Financial commitment

To offset the residual impacts arising from the Snowy 2.0 Main Works, Snowy Hydro is proposing to invest $35M to implement the proposed program of conservations management actions/measures outlined above, over a 20 year period in KNP(Table 3.3).

Table 3.3 Summary of the proposed conservation measures/actions and investment value

Row Labels	Sum of Total cost
Montane dry sclerophyll forests	
Feral animal control	$931,250.00
Weed control	$1,558,327.50
Feral predator control	$119,200.00

Table 3.3 Summary of the proposed conservation measures/actions and investment value

Row Labels	Sum of Total cost
Feral herbivore control	$931,250.00
Subalpine grasslands and bogs	
Feral animal control	$1,026,250.00
Weed control	$1,754,945.00
Feral predator control	$131,360.00
Feral herbivore control	$1,768,750.00
Subalpine tall forests	
Feral animal control	$2,078,750.00
Weed control	$3,488,548.50
Feral predator control	$266,080.00
Feral herbivore control	$2,078,750.00
Subalpine woodlands	
Feral animal control	$1,443,750.00
Revegetation	$220,500.00
Weed control	$2,934,028.13
Feral predator control	$184,800.00
Feral herbivore control	$1,443,750.00
Clover Glycine, Alpine bogs and fens and grasslands and associated species	
Protection of key habitat in Gulf Plain	$399,200.00
Alpine Tree Frog	
Protection of key habitat in Nungar Creek, Tantangara Creek/Murrumbidgee River and Eucumbene River	$1,960,000.00
Implementation of broad-scale monitoring to understand impacts of feral Horses and climate change	$1,540,000.00
Booroolong Frog	
Weed control works to protect key riparian habitat along the Yarrangobilly River	$1,395,000.00
Monitoring of key Booroolong Frog populations along the Yarrangobilly River to assess positive impacts of management works	$1,420,000.00
Eastern Pygmy-possum	
Habitat improvement works post-fire	$521,890.00
Smoky Mouse	
Regional surveys	$405,000.00
Captive breeding program	$650,000.00
Habitat improvement works post-fire	$850,000.00
Post-fire recovery monitoring program	$4,050,000.00
Grand Total	**$35,551,379.13**

4 Roles and responsibilities

Delivery of the programs will be the subject of further discussion and agreement between Snowy Hydro and NPWS. This Offset Strategy will be implemented to fulfil Snowy Hydro's obligations to offset the residual impacts of the Project, including as required under the BC Act and the EPBC Act.

This Offset Strategy is proposed to be binding and form a condition of approval. The final agreed management act ions will be measured, monitored and audited by DPIE and NPWS as part of compliance and park management functions.

5 Closing

The residual impacts arising from Snowy 2.0 Main Works will be offset in line with the principles and guidelines developed over extensive consultation with Commonwealth and NSW government agencies. Offsets will be delivered in accordance with the conceptual framework outlined in Section 1.3.

Focusing on biodiversity values of KNP is in line with the key objectives identified in a number of plans, particularly the KNP PoM (DEC 2006), Worboys and Good (2011) and Pittock et al. (2018). A set of principles and guidelines have been developed to inform the development of this BOS and the proposed conservation actions.

The offset strategy proposes a substantial investment of $36m to implement a number of proposed conservation measures/actions that will provide a direct, holistic and long term benefit to the biodiversity values of KNP, including the species and communities impacted by Snowy 2.0 Main Works.

Snowy Hydro will continue to engage with Commonwealth and NSW government agencies and identified recreational user groups regarding the implementation of these actions as part of carrying out Snowy 2.0 Main Works.

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Annexure A

Key threats and management actions

A.1 Key threats and management actions for threatened species and communities

The tables below provide a summary of the key threats and management actions for threatened species and communities impacted by Snowy 2.0. This information has been used to inform the development of the conservation management measures/actions outlined above.

Table A.1 Key threats and management actions for Alpine Bogs and Fens

Alpine Sphagnum Bogs and Associated Fens

Status	BC Act: Endangered EPBC Act: Endangered
Key threats	• Hydrological change (including erosion and sedimentation) from roadworks, drainage works, and aqueducts. • Land clearing, filling, drainage. • Weed invasion (including scotch broom, grey willow, blackberry, exotic perennial grasses and emerging weeds). • Too frequent fire, planned fire during periods of rainfall deficit, or major underground peat fires. • Grazing and trampling by domestic stock, feral animals (deer and pigs), and feral horses. • Pollution (including herbicide, pesticides, fertilisers) and sedimentation from runoff. • Recreational activities (including vehicle use, commercial horse-riding, mountain bikes, bushwalking). • Habitat degradation from current or past mining operations (historic peat mining, ruby mining). • Periodic or long-term drying of peatlands leading to habitat degradation and vulnerability to fire. • Plant and animal pathogens leading to local extinction of susceptible species. • Lack of knowledge of ecology, particularly in relation to groundwater dependent species.
Saving our Species (SOS) actions and relevance to project and KNP	Currently, one priority management site has been identified for this community, in KNP. Management actions identified at this site include: • Maintain appropriate fire regime for the species/community. • Reduce and maintain weed densities at low levels. • Reduce the frequency/intensity of grazing. • Track species abundance / condition over time.
Management actions and relevance to project and KNP	The *National Recovery Plan for the Alpine Sphagnum Bogs and Associated Fens ecological community* (Department of the Environment 2015) lists the following recovery actions: • Plan and manage the effects of fire on the ecological community – low. • Minimise the impacts of weeds (woody and nonwoody) on the ecological community, (consistent with national and regional weed management plans, where applicable) – high. • Minimise the impact of invasive herbivores/omnivores on the ecological community, (consistent with national and regional invasive animal plans, where applicable) – high. • Minimise impact of invasive carnivores on the ecological community's fauna (consistent with national and regional invasive animal plans) – moderate. • Minimise the impacts of pathogens/diseases on the ecological community, (consistent with national and regional disease management plans) – low. • Avoid and minimise the impacts from livestock on the ecological community – low. • Avoid and minimise impacts of infrastructure and development – low. • Avoid and minimise impacts of recreational activities – moderate. • Increase surveillance and enforcement of penalties to deter illegal activities that may impact the ecological community – low. • Avoid impacts from resource use (e.g. peat, Sphagnum and timber harvesting, groundwater extraction), and mitigate past impacts, where possible – not applicable.

Table A.1 Key threats and management actions for Alpine Bogs and Fens

Alpine Sphagnum Bogs and Associated Fens	
	• Increase compliance and enforcement for illegal resource use – low. • Implement Actions 1-5 under Strategy 1 to support resilience and adaptation to climate change impacts – not applicable. • Identify other potential climate change impacts and investigate latest research and techniques to combat them at a local scale – moderate. • Implement Actions 1-5 under Strategy 1 to assist restoring catchments to maintain the hydrological processes upon which the ecological community depends – not applicable. • Rehabilitate and restore flows to damaged areas of the ecological community (e.g. from fire, historic grazing, infrastructure damage, areas containing erosion tunnels, flow line incisions and bog collapse) – high. • Develop rehabilitation management methods for the ecological community – moderate. • Improve mapping of the ecological community – moderate. • Increase field research and monitoring – moderate. • Improve knowledge associated with threat abatement techniques and effectiveness – high. • Coordinate implementation • Secure partnerships and resources for implementation • Communicate effectively with partners, stakeholders and the community

Table A.2 Key threats and management actions for Clover Glycine

Clover Glycine (*Glycine latrobeana*)	
Status	BC Act: Critically Endangered EPBC Act: Vulnerable
Key threats	• Feral horses disperse weeds including Ox-eye Daisy, leave manure piles, and browse plants. • Ox-eye daisy competes with the species and dominates the habitat including through allelopathic (i.e. biochemical) exclusion. • Small population size (estimated at about 1,000 plants within a few ha) increasing vulnerability to local extinction in NSW. • Feral pigs trampling and rooting at the site. • Poor recruitment limiting the viability of the population.
Saving our Species (SOS) actions and relevance to project and KNP	Currently being developed.

Table A.2 Key threats and management actions for Clover Glycine

Clover Glycine (*Glycine latrobeana*)	
Management actions and relevance to project and KNP	The *National Recovery Plan for the Clover Glycine* Glycine latrobeana (Carter and Sutter 2010) outlines the following recovery actions: • Clarify taxonomy to enable a more accurate assessment of distribution and abundance – moderate. • Undertake surveys to determine the area and extent of populations, the number, size and structure of populations, and inference or estimation of population change – high. • Survey known habitat and collect floristic and environmental information relevant to community ecology and condition – high. • Identify and survey potential habitat, using ecological and bioclimatic information that may indicate habitat preference – high. • Protect unreserved populations on public Land – not applicable. • Protect populations on private land – not applicable. • Control threats from pest plants at priority sites – high. • Control threats from pest animals at priority sites – high. • Control the threat of direct damage by human activities – low. • Evaluate current reproductive status, seed bank status, longevity, fecundity and recruitment levels – moderate. • Identify key stimuli for seed germination requirements – moderate. • Identify optimal fire regimes to maintain habitat – moderate. • Measure population trends and responses against recovery actions by collecting demographic information including recruitment and mortality, timing of life history stages and morphological data – moderate. • Establish a seed bank and determine seed viability – moderate. • Identify opportunities for community involvement in the conservation of the Clover Glycine – low.

Table A.3 Key threats and management actions for Mauve Burr-daisy

Mauve Burr-daisy (*Calotis glandulosa*)	
Status	BC Act: Vulnerable EPBC Act: Vulnerable
Key threats	• Loss and degradation of habitat and / or populations from road works (particularly widening or rerouting). • Loss and degradation of habitat and / or populations by clearing of habitat for residential and agricultural developments. • Loss and degradation of habitat and / or populations by intensification of grazing regimes. • Loss and degradation of habitat and / or populations by invasion of weeds. • Loss and degradation of local habitat and / or populations in Kosciuszko National Park by horses and roadworks. • Potential encroachment and competition from *Kunzea ericoides* and *Kunzea parvifolia*. • Pigs digging up individuals. • Grazing by cattle and sheep is a threat to plants while the plants are actively growing, flowering or in fruit.

Table A.3 Key threats and management actions for Mauve Burr-daisy

Mauve Burr-daisy (*Calotis glandulosa*)	
Saving our Species (SOS) actions and relevance to project and KNP	Five priority management sites have been identified for the Mauve Burr-daisy at Back Creek, Kellys Plain, Nungar Plain, Lake Eucumbene area and Bibbenluke Common. Management actions for Kellys Plain are outlined below: • Aerial shooting (of pigs). • Spraying and survey to find the weed (Ox-eye Daisy). Searches by foot, vehicle and helicopter to isolate patches. Sensitive herbicide required for spraying near / in creeklines. Continue NPWS control program on nearby Nungar Ridge to minimise risks of invasion. • Continue horse trapping programmes currently implemented within Kosciuszko National Park in accordance with the Regional Pest Management Strategy. • Quantitative assessment of pest animal abundance/density/activity using appropriate methodology or qualitative estimate. • Monitor target weed density using methodologies outlined in the monitoring manual for bitou bush control and native plant recovery (http://www.environment.nsw.gov.au/resources/pestsweeds/09352MM anualStandardTier.pdf). • Quantitative assessment of pest animal abundance/density/activity using appropriate methodology or qualitative estimate. • Undertake quadrant/transect monitoring appropriate for the demographics of the population Every 3 years October / Nov (possibly later for Kosciusko pops). Management actions for Nungar Plain are outlined below: • Spraying and survey to find the weed. Searches by foot, vehicle and helicopter to isolate patches. Sensitive herbicide required for spraying near / in creeklines. • Continue horse trapping programmes currently implemented within Kosciuszko National Park in accordance with the Regional Pest Management Strategy. • Aerial (pig) shooting annually. • Monitor target weed density using methodologies outlined in the monitoring manual for bitou bush control and native plant recovery (http://www.environment.nsw.gov.a u/resources/pestsweeds/09352MM anualStandardTier.pdf). • Quantitative assessment of pest animal abundance/density/activity using appropriate methodology or qualitative estimate. • Undertake quadrant/transect monitoring appropriate for the demographics of the population Every 3 years October / Nov (possibly later for Kosciusko pops). Management actions for Lake Eucumbene are outlined below: • Liaise with landholder(s) about entering into a voluntarily management agreement to maintain or enhance the species and its habitat including a management plan and possibly funding for fencing. • Collect seed from plants once fruits are mature. • Monitor for evidence of overgrazing and/or disturbance such as trampling due to stock access. • Survey significant weed distribution within population. • Undertake quadrant/transect monitoring appropriate for the demographics of the population Every 3 years October / Nov (possibly later for Kosciusko pops).

Table A.3 Key threats and management actions for Mauve Burr-daisy

Mauve Burr-daisy (*Calotis glandulosa*)	
Management actions and relevance to project and KNP	No recovery plan has been developed for the species. The *Approved Conservation Advice for* Calotis glandulosa (DEWHA 2008) lists recovery actions for the Mauve Burr-daisy. • Regional priority actions: – Monitor known populations to identify key threats. – Monitor the progress of recovery, including the effectiveness of management actions and the need to adapt them if necessary. – Identify populations of high conservation priority. – Mark sites and potential habitat onto maps (of the farm, shire, region, etc) used for planning roadwork, residential and infrastructure developments, remnant protection and rehabilitation. – Investigate further formal conservation arrangements, management agreements and covenants on private land, and for crown and private land investigate inclusion in reserve tenure if possible. – Ensure road widening and maintenance activities (or other infrastructure or development activities) involving substrate or vegetation disturbance in areas where Mauve Burr-daisy occurs do not adversely impact on known populations. – Develop and implement a stock management plan for roadside verges and travelling stock routes. – Implement the Threat Abatement Plan for the control and eradication of feral pigs in the region. – Raise awareness of Mauve Burr-daisy within the local community by facilitating information and skills exchange between landholders, land managers, government agencies, community groups and other stakeholders. – Develop, implement and maintain up to date 'best practice' management guidelines for landholders to manage the species, including site specific actions. – Undertake appropriate seed collection and storage. – Investigate options for linking, enhancing or establishing additional populations. – Implement national translocation protocols if establishing additional populations is considered necessary and feasible. • Local priority actions: – Control access routes to suitably constrain public access to known sites on public land. – Suitably control and manage access on private land. – Minimise adverse impacts from land use at known sites. – Identify and remove weeds in the local area, which could become a threat to Mauve Burrdaisy, using appropriate methods to spray or dig out only target weeds. – Manage sites to prevent introduction of invasive weeds, which could become a threat to Mauve Burr-daisy, using appropriate methods. – Ensure chemicals or other mechanisms used to eradicate weeds do not have a significant adverse impact on Mauve Burr-daisy. – Manage known sites on private property to reduce grazing pressure where possible and ensure grazing regimes allow for reproduction. – Prevent grazing pressure at known sites through exclusion fencing or other barriers.

Table A.4 Key threats and management actions for Smoky Mouse

Smoky Mouse (*Pseudomys fumeus*)	
Status	BC Act: Critically Endangered EPBC Act: Endangered
Key threats	• Loss of habitat, primarily through timber harvesting and road construction along ridges. • Too frequent burning, such as 4-7 years for hazard reduction burning, is likely to be deleterious to the shrub and hypogeal fungi resource. • Predation from feral cats. • Predation by foxes. • Dieback caused by cinnamon fungus (*Phytophthora cinnamomi*) - many of the heath plants in the habitat are highly susceptible. • Uncertainty about the species' density and distribution throughout the area. • Feral herbivore grazing resulting in the reduction of food resources and the depletion of shrub cover. • Predation from domestic cats and dogs from adjacent land holdings. • Loss of site occupancy / low recruitment leading to metapopulation collapse • Senescing of understory vegetation on long unburnt sites
Saving our Species (SOS) actions and relevance to project and KNP	Three priority management sites have been identified for the Smoky Mouse at the Priam breeding facility and Nullica. Management actions at the Priam breeding facility are focused on Smoky Mouse captive breeding and re-introduction programs. Management actions for Nullica are outlined below: • Construct and maintain predator proof fences at two release sites. • Trap cats using soft-catch traps especially in and around known locations of high-density. • Develop appropriate fire / forestry prescription for the species based on monitoring data that is ongoing for the species and vegetation characteristics (Species Management Plan; P Kambouris and L. Broome). • Implement fox threat abatement plan (Fox TAP) for the South East Forests site. • Implement hygiene protocols for vehicles and walkers entering the areas; State Forest and Office of Environment and Heritage staff predominantly. • Spray habitat infected with Phytophthora with Phosphonate to increase vegetation resilience. • Survey sample plots where there are indications of disease; test soil for presence of Phytophthora, to ensure infection does not enter uninfected areas. • Conduct ecological burn on two long unburnt sites in South East Forests National Park and monitor vegetation recovery. • Trial (feral Cat) grooming traps. • Quantitative assessment of pest animal abundance/density/activity using sandpads. • Monitor vegetation species recruitment and adult condition post fire / logging events annually for three years, then every third year to year 12 and every five years thereafter. • Monitoring of fox activity as per the relevant fox threat abatement site plan. • Collect soil samples from the 30 monitoring sites and conduct appropriate testing to identify infection. • Monitor vegetation. • 30 permanent plots established with motion-sensor cameras. Collect presence / absence data only for each plot. Data collection during Spring; currently ongoing.

Table A.4 Key threats and management actions for Smoky Mouse

Smoky Mouse (*Pseudomys fumeus*)	
Management actions and relevance to project and KNP	The *National Recovery Plan for the Smoky Mouse* Pseudomys fumeus (Menkhorst and Broome 2006) lists the following recovery actions: • Designate protection zones around key Smoky Mouse populations – not applicable. • Review current protection zones in the Eden Hinterland – not applicable. • Review current Integrated Forestry Operations Approval Package (IFOA) conditions for Smoky Mouse in NSW – not applicable. • Develop targeted survey techniques and monitoring protocols – low. • Develop habitat suitability index – high. • Undertake field survey and mapping in the ACT – not applicable. • Undertake field survey and mapping in NSW – high. • Undertake field survey and mapping in Victoria – not applicable. • Estimate levels of genetic partitioning between the biogeographical regions – moderate. • Measure levels of heterozygosity within and between biogeographical regions – moderate. • Develop predator control strategies – high. • Implement predator control strategies – high. • Establish small-mammal refuges in The Grampians or South Eastern Highlands and Eden Hinterland – not applicable. • Review data on floristic composition of Smoky Mouse sites and fire response life history attributes of key plant species at those sites – moderate. • Select sites and undertake trial ecological burns – moderate. • Monitor vegetation and small mammal response to ecological burns – moderate. • Investigate utilisation of habitat and diet in undisturbed, burnt and logged sites – moderate. • Establish the nutritional importance of food resources and their relationship to habitat quality – moderate. • Monitor vegetation succession in disturbed and undisturbed sites – low. • Review data and survey floristic composition and small mammals at regenerating logged sites – not applicable. • Establish a captive breeding colony of Smoky Mouse – low. • Identify the presence and risk of *Phytophthora cinnamomi* infection and protect key areas of habitat – moderate. • Involve the community in the Recovery Program – low. • Provide information about the Recovery Program – low.

Table A.5 Key threats and management actions for Broad-toothed rat

Broad-toothed rat (*Mastacomys fuscus*)	
Status	BC Act: Vulnerable EPBC Act: Vulnerable
Key threats	• Predation by feral cats, especially around ski resorts where cat densities are high. • Habitat loss, fragmentation and degradation from roads, ski runs and buildings. • Broad-toothed rats may be mistaken for vermin when they enter ski lodges and other buildings. • Catastrophic fire events, hazard reduction burning can cause and localised extinction. • Grazing by stock, rabbits and hares may eliminates grass cover and trampling by stock can destroy nests. Rabbits attract predators to areas of habitat. • Invasion of habitat by exotic weeds. • Global warming causing loss of snow cover will result in increased exposure to foxes and cats in alpine areas. Competition with other rodent species may also increase. Populations at lower altitudes have already suffered local extinction. • Wild horses degrade habitat / cover and disturb the species. • Direct degradation of suitable habitat / cover as well as competition for food. • Predation by European red foxes causes high mortality and restricts population growth. • Invasion of habitat by Scotch broom (Cytisus scoparius). • Invasion of habitat by Blackberry (Rubus spp.) and acts as a refuge area for feral pigs, cats, and foxes. • Damage from recreational activities. • Lack of distribution information.
Saving our Species (SOS) actions and relevance to project and KNP	Three priority management sites have been identified for the Broad-toothed rat at Barrington Tops, Gloucester Tops and KNP. Management actions for KNP are outlined below: • Aerial shooting campaign combined with trapping, targeted towards wet swampy areas (10- 20km2). These programs are linked with a number of other threatened species programs. • Continue horse trapping programmes currently implemented within Kosciuszko National Park in accordance with the Regional Pest Management Strategy. • Keep species records and known/predicted fire regime requirements up to date in all appropriate databases. • Intensify baiting program at targeted areas burnt following fire. • Implement fox threat abatement plan (TAP) - Snowy Mountains and Kosciuszko North sites. Assess the need to extend baiting to the northern areas of the park. • Targeted leg-hold trapping in response to sightings throughout summer; opportunistic cage trapping througout winter. This is reported on and funded as part of the Mountain Pygmy-possum program. • Quantitative assessment of pest herbivore abundance/density/activity using appropriate methodology or qualitative estimate. • Quantitative assessment of pest animal abundance/density/activity using appropriate methodology or qualitative estimate. • Monitor species occurrence immediately post fire event and subsequently every 12 months for three years. • Monitoring of fox activity as per the fox TAP site plan - this includes scat transects & snow transects. • Integrated program consisting of plots with elliot traps at five long term localities - Whites River, Rainbow Lake, Horsecamp, Perisher Creek, Smiggin Holes.

Table A.5 Key threats and management actions for Broad-toothed rat

Broad-toothed rat (*Mastacomys fuscus*)	
Management actions and relevance to project and KNP	No recovery plan has been prepared for the Broad-toothed Rat. *The Action Plan for Australian Mammals 2012* (Woinarski et al 2012) lists the following recovery actions for the Broad-toothed rat: • Implement control mechanisms for non-native predators, that minimise adverse impacts on this subspecies. • Undertake landscape-scale fire management, including ignition surveillance and rapid response on extreme fire-weather days, to decrease the incidence of extensive and intense fire. • Constrain grazing by livestock and feral herbivores to within acceptable limits in and around important subpopulations. • Maintain a captive breeding colony. • Reintroduce to parts of its former range, once threat management is effective. • Seek conservation covenants on private land holding important subpopulations. • Assess population size (or relative abundance) of all subpopulations, and then prioritise subpopulations for management. • Undertake a targeted survey of all suitable habitat within the subspecies' range. • Design an integrated monitoring program across subpopulations, linked to an assessment of management effectiveness. • Monitor the abundance of feral predators at key subpopulations, in response to management actions. • Monitor the incidence of fire, and vegetation response, at key subpopulations. • Assess the impacts of feral predators (under different densities and seasonal conditions). • Assess the impacts of livestock and feral herbivores, and develop thresholds for safe grazing pressure. • Assess the impacts of fire, and identify fire regimes that are compatible with persistence of populations. • Assess the impacts of competition with other native rodents. • Assess the efficacy of a range of management regimes for non-native predators. • Assess the efficacy of a range of management regimes for weeds. • Identify options for management control of other native rodents, if necessary. Develop broad-scale, targeted feral cat control methods.

Table A.6 Key threats and management actions for Alpine Tree Frog

Alpine Tree Frog (*Litoria verreauxii alpina*)	
Status	BC Act: Endangered EPBC Act: Vulnerable
Key threats	• Loss or modification of habitat including damage by feral horses. • Changes to natural water flows as a result of groundwater extraction. • Disease - chytrid fungus. • Climate change including increased UV-B radiation. • Poor knowledge of the species' distribution and population dynamics across its range.

Table A.6 Key threats and management actions for Alpine Tree Frog

Alpine Tree Frog (*Litoria verreauxii alpina*)

Saving our Species (SOS) actions and relevance to project and KNP	The Alpine Tree Frog is assigned to the landscape species management stream. Thus, not site specific measures are provided, rather management actions to be implemented at a site, regional or state scale: • Conduct broad-scale surveys in suitable habitat throughout the species' historical range to identify key populations and sample individuals to test for chytrid infection if/where feasible. • Monitor local populations for their response to chytrid infection - swab and test individuals and assess mortality rates. Target research to better understand factors influencing resilience or immunity. • Identify and monitor individual populations in combination with local microclimate variables, particularly moisture, to better understand the likely impacts of climate change on populations and identify potential climate change refugia. • Work with Kosciuszko National Park managers to implement strategies to reduce the number and impacts of feral horses on the frog's habitat.
Management actions and relevance to project and KNP	No recovery plan has been prepared for this species. Regional priority actions outlined in the Approved Conservation Advice for *Litoria verreauxii alpina* (alpine tree frog) include: • Implement the strategic plan 2012-2015 for the Australian Alps national parks cooperative management program (AALC, 2012) – not applicable. • Monitor selected populations of the alpine tree frog to determine population persistence and demography trends (NSW OEH, 2012) – high. • Monitor the progress of recovery, including the effectiveness of management actions and the need to adapt them if necessary – high. • Maintain natural water flows in all breeding habitats – low. • Manage any changes to hydrology that may result in changes to water table levels and/or increased run-off, sedimentation or pollution – low. • Investigate formal conservation arrangements, management agreements and covenants on private land – not applicable. • Consider the use of signage to increase awareness of the alpine tree frog in areas being developed or proposed for development, or where groundwater is extracted – not applicable. • Raise awareness of the alpine tree frog and its habitat requirements with land managers/owners/builders responsible for such activities - low. • Raise awareness with the appropriate road authority and/or land owner/manager of the effects of pollution on the alpine tree frog, and the proximity of these sources of pollution to where the alpine tree frog occurs. Investigate measures to mitigate these sources of pollution – low. • Identify and undertake weed management at sites to reduce and/or remove weeds using appropriate methods, especially at sites where new weeds are becoming established – low. • Maintain specific management programs in national parks of the Australian Alps to reduce the size of populations of feral horses, and subsequently reduce the damage being caused to natural environments – high. • Increase the control and removal of feral horses in national parks, to counter the current and projected population increases – high. • Maintain the restoration program for bogs and fens to mitigate domestic grazing, as part of the Alps national parks co-operative management agreement – low. • Erect and maintain fencing to prevent domestic stock from accessing the breeding habitat of the alpine tree frog – not applicable. • Maintain the restoration program for bogs and fens to mitigate inappropriate fire regimes, as part of the Alps national parks co-operative management agreement – low.

Table A.7 Key threats and management actions for Booroolong Frog

Booroolong Frog (*Litoria booroolongensis*)	
Status	BC Act: Endangered EPBC Act: Endangered
Key threats	• Modification of steam channels and loss of cobble banks. • Loss of native streamside vegetation. • Damage to stream margins by stock. • Predation of eggs and tadpoles by introduced fish. • Weed invasion of streamside habitats, particularly by willows. • Disease - chytrid fungus. • Changes to water quality through sedimentation and use of herbicides or pesticides near streams. • Stream drying caused by severe drought or water extraction/impoundment. • Large amounts of sedimentation due to wild horse activity in the National Park, causing filling of breeding crevices. • High density of fossicking and in particular the illegal use of powered sluices and deliberate damming of stretches to facilitate use. • Cause damage and erosion to stream margins.
Saving our Species (SOS) actions and relevance to project and KNP	Seven priority management sites have been identified for the Booroolong Frog at Cockburn River Catchment in Tamworth Regional, Peel River Catchment in Tamworth Regional, Sewells Creek Catchment in Bathurst Regional, Abercrombie River in Oberon, Adjungbilly Creek in Cootamundra-Gundagai Regional, Goobarragandra in Snowy Valleys and Jingellic Catchment in Greater Hume Shire. No priority management sites have been developed within the Murrumbidgee catchment, in which the species was recorded within the project area. Goobarrangandra management site is located within the KNP, north of the project area and is relevant to this offset strategy. Management actions for Goobarragandra are outlined below: • Continue horse trapping programmes currently implemented within Kosciuszko National Park in accordance with the Regional Pest Management Strategy. • Liaise with landholder(s) with grazing properties adjacent to rivers and tributaries about entering into a voluntary management agreement to maintain or enhance the species and its habitat. Provide incentives for landholder(s) to regulate stock access in riparian areas via fencing a 50m buffer zone from stream banks. • Cut and paint seedlings in the riparian zone where cost-effective. Staged removal of large willows, leaving stumps and removing debris to minimise disturbance to stream margins. Revegetate these areas to stabilise stream banks. • Weed Control site led, Combination, Cutting and painting. Access to the river and tributaries in the national park is difficult and must be conducted on foot. • Quantitative assessment of pest animal abundance/density/activity using appropriate methodology or qualitative estimate. • Monitor for evidence of direct disturbance on the species at the sites. • Monitor target weed density using methodologies outlined in the monitoring manual for bitou bush control and native plant recovery (http://www.environment.nsw.gov.au/resources/pestsweeds/09352MM anualStandardTier.pdf). • Spotlights surveys to determine occupancy of breeding habitat by males. Map distribution of rocky habitats, determining the abundance of rock crevices in rocky habitat, determining the distribution and proximity to rocky habitat of significant weeds (particularly invasive willow and blackberry).

Table A.7 Key threats and management actions for Booroolong Frog

Booroolong Frog (*Litoria booroolongensis*)	
Management actions and relevance to project and KNP	The *National Recovery Plan for the Booroolong Frog* Litoria booroolongensis (OEH 2012) lists the following recovery actions: • Complete systematic surveys for the Booroolong Frog across its entire range – high. • Determine the taxonomic status of northern and southern Booroolong Frog populations using molecular genetic techniques – moderate. • Identify genetic sub-division within northern and southern populations of the Booroolong Frog – moderate. • Continue and expand riparian protection and restoration where the Booroolong Frog occurs in the agricultural landscape – moderate. • Regulate the establishment of softwood plantations immediately adjacent to, or upstream of Booroolong Frog populations – no applicable. • Enforce legislation protecting streams and water flow – not applicable. • Reduce the transmission of potentially harmful pathogens both within and among populations of the Booroolong Frog – moderate. • Prevent impacts from introduced predatory fish – low. • Implement an effective monitoring program to assess ongoing conservation status, impact of stream drying, and population response to riparian restoration works – high. • Model the influence of predicted climate change on streams supporting populations of the Booroolong Frog – moderate. • Develop efficient reintroduction techniques for establishing wild populations of the Booroolong Frog – not applicable. • Assess the capacity to use assisted colonisation to conserve wild populations of the Booroolong Frog – not applicable. • Determine the impact of herbicide use on the Booroolong Frog – not applicable. • Determine the current influence of Chytridiomycosis on Booroolong Frog populations – high. • Determine the current impact of predation by introduced fish on the Booroolong Frog – moderate. • Determine the likely influence of reduced water quality to Booroolong Frog population persistence – low. • Increase public awareness about the conservation of the Booroolong Frog – low. • Provide specific education and training about the Booroolong Frog to relevant members of the public and management authorities – low. • Establish a recovery team for the Booroolong Frog to oversee the implementation of this recovery plan – not applicable.

Table A.8 Key threats and management actions for Alpine She-oak Skink

Alpine She-oak Skink (*Cyclodomorphus praealtus*)	
Status	BC Act: Endangered EPBC Act: Endangered
Key threats	• Changes in vegetation structure within preferred habitat brought about by wildfire, weed invasion, and climate change. • Grazing, trampling and ground disturbance by feral horses, deer and pigs. • Construction of infrastructure in alpine areas such as roads, tracks, buildings and ski runs resulting in loss and fragmentation of subalpine and alpine habitat. • Predation by rats, foxes, cats and dogs. • Lack of knowledge of the distribution and habitat requirements of the species.
Saving our Species (SOS) actions and relevance to project and KNP	The Alpine She-oak Skink is assigned to the data-deficient management stream. Thus, no measures are provided.
Management actions and relevance to project and KNP	A national recovery plan has not been prepared for this species yet. The *Approved Conservation Advice for* Cyclodomorphus praealtus *(Alpine She-oak Skink)* (DEWHA 2009) lists the following recovery actions for the Alpine She-oak Skink: • Survey known habitats to identify key threats – high. • Monitor the progress of recovery, including the effectiveness of management actions and the need to adapt them if necessary – high. • Ensure infrastructure or development activities involving substrate or vegetation disturbance in areas where the Alpine She-oak Skink occurs do not adversely impact on known populations – low. • Protect populations of the listed species through the development of conservation agreements and/or covenants – not applicable. • Develop and implement a management plan for the control of weeds within the species range, in particular Orange Hawkweed (*Hieracium aurantiacum*) – moderate. • Develop and implement a stock management plan for the area in which the Alpine She-oak Skink occurs – not applicable. • Where appropriate, manage total grazing pressure at important/significant sites through exclusion fencing or other barriers not applicable. • Develop and implement a management plan for the control and eradication of feral horses (*Equus caballus*), red deer (*Cervus elaphus*), fallow deer (*Dama dama*), Sambar deer (*Cervus unicolour*) and pigs (*Sus scrofa*) in the region. Implement the Kosciuszko National Park Final Horse Management Plan – high. • Develop and implement a management plan for the control and eradication of black rats (*Rattus rattus*), foxes (*Vulpes vulpes*), cats (*Felis catus*) and wild dogs (*Canis lupus familiaris*) in the region. Implement the New South Wales Threat Abatement Plan – Predation by the red fox. Implement the Wild Dog Policy. Implement the Commonwealth Threat Abatement Plan – Predation by European red fox. Implement the Commonwealth Threat Abatement Plan – Predation by feral cats – moderate. • Where appropriate provide maps of known occurrences to local and state Rural Fire Services and seek inclusion of mitigative measures in bush fire risk management plans, risk register and/or operation maps – moderate. • Raise awareness of the Alpine She-oak Skink within the local community – low. • Frequently engage with private landholders and land managers responsible for the land on which populations occur, particularly alpine resorts, and encourage these key stakeholders to contribute to the implementation of conservation management actions – low.

Table A.9 Key threats and management actions for Kiandra Leek Orchid

Kiandra Leek Orchid (*Prasophyllum retroflexum*)

Status	BC Act: Vulnerable EPBA Act: Vulnerable
Key threats	• Pigs rooting for food cause direct damage to the species and to the surrounding habitat. • Competition from the weed Ox-eye Daisy • Horses browse the species and promote the spread of ox-eye daisy, as well as trampling causing direct damage and disturbance. • Grazing and substrate disturbance from rabbits, causes adult mortality and changes the habitat - shifts to more shrubby conditions.
Saving our Species (SOS) actions and relevance to project and KNP	Two priority management sites have been identified for the Kiandra Leek Orchid at Kellys Plain and Nungar Plain, both in the Snowy Monaro Regional local government area (LGA). Management actions for Kellys Plain are outlined below: • Continue horse trapping programmes currently implemented within Kosciuszko National Park in accordance with the Regional Pest Management Strategy. • Integrated rabbit control program - likely baiting. Speak to Duane Shawcross (Pests officer at Tumut). • Targeted chemical control of Oxeye daisy in core areas (low-mid parts of the slope - approx 1/3 of the site - 100 ha). Currently of the core calotis population, ox-eye daisy occurs over 5-10%). • Aerial shooting of pigs annually. Although this is a less urgent action than at Nungar Plain. • Quantitative assessment of pest animal abundance/density/activity using appropriate methodology or qualitative estimate. • Monitor target weed density using methodologies outlined in the monitoring manual for bitou bush control and native plant recovery (http://www.environment.nsw.gov.a u/resources/pestsweeds/09352MM anualStandardTier.pdf). • Initially locate plants and erect permanent 10m x 10m plots across the range - counting individuals within (smaller plots with many replicates are better at determining species distribution). 4 days each visit every 2 years early summer – January. Management actions for Nungar Plain are outlined below: • Aerial shooting of pigs annually. • Continue horse trapping programmes currently implemented within Kosciuszko National Park in accordance with the Regional Pest Management Strategy. • Annual monitoring of oxe-eye daisy presence and spot-spraying as appropriate within the site. Also eradicate isolated oxe-eye daisy populations. Continue implementation of active NPWS control program in the Nungar Ridge. • Quantitative assessment of pest animal abundance/density/activity using appropriate methodology or qualitative estimate. • Monitor target weed density using methodologies outlined in the monitoring manual for bitou bush control and native plant recovery (http://www.environment.nsw.gov.a u/resources/pestsweeds/09352MM anualStandardTier.pdf). • Initially locate plants and erect permanent 20x20m plots x 20 across the range - counting individuals within. 4 days each visit every 5 years early summer - January.
Management actions and relevance to project and KNP	None have been developed.

Table A.10 Key threats and management actions for Leafy Anchor Plant

Leafy Anchor Plant (*Discaria nitida*)	
Status	BC Act: Vulnerable EPBC Act: Not listed
Key threats	• Fire is a threat to the species as plants are generally killed by even low intensity fires, and post fire recruitment has been observed to be very low. • Major flooding events since 2010 have caused significant stream bank erosion and the consequent loss of numerous plants at some sites. • Competition from weeds (especially woody weeds such as blackberry, briar rose and willows). • Feral horses have recently been observed at sites supporting *Discaria nitida*. At these sites browsing damage, including breakage of major stems of plants, has been observed. • Feral deer have recently been observed at sites supporting *Discaria nitida*. At these sites browsing damage, including breakage of major stems of plants, has been observed. • Loss of local populations. • Clearing of habitat on private land is a potential threat. • Grazing by domestic stock has the potential to impact those populations on private land.
Saving our Species (SOS) actions and relevance to project and KNP	Four priority management sites have been identified for the Leafy Anchor Plant at Peppercorn Creek, Boggy Plain, Racecourse Creek and Little Thredbo River. Management actions for Peppercorn Creek are outlined below: • Rapid response waterbombing if/when wildfire threatens the site. • Mechanically reduce the surrounding vegetation or rake hoe around the population. Keep species records and known/predicted fire regime requirements up to date and concur in all appropriate databases. • Conduct shooting program to maintain low levels of deer at this site. • Collect seed from as many plants as practicable within each population. • Quantitative assessment of pest animal abundance/density/activity using appropriate methodology or qualitative estimate. • Count individuals in all age classes along a subsection of the stream (distribution is patchy). Management actions for Boggy Plain are outlined below: • Employ waterbombing to retard fire front from encroaching into the creek lines when there is a threat of encroaching wildfire. • Mechanically reduce the surrounding vegetation or rake hoe around the population. Keep species records and known/predicted fire regime requirements up to date and concur in all appropriate databases. • Conduct shooting program to maintain low levels of deer at this site. • Collect seed from as many plants as practicable within each population. • Quantitative assessment of pest animal abundance/density/activity using appropriate methodology or qualitative estimate. • Count individuals in all age classes along a subsection of the stream (distribution is patchy). Management actions for Racecourse Creek are outlined below: • Rapid suppression of wildfires is required at the site. Wetline surrounding area if fires occur • Mechanically reduce the surrounding vegetation or rake hoe around the population. Keep species records and known/predicted fire regime requirements up to date and concur in all appropriate databases. • Cut and paint woody weeds. Frilling for willow.

Table A.10 Key threats and management actions for Leafy Anchor Plant

Leafy Anchor Plant (*Discaria nitida*)	
	• Existing control program in the area - target to this site. Conduct shooting program to maintain low numbers of deer in the local area. • Collect seed from as many plants as practicable within each population. • Monitor species recruitment and adult condition immediately post fire event and subsequently every six months for three years. • Monitor target weed density using methodologies outlined in the monitoring manual for bitou bush control and native plant recovery (http://www.environment.nsw.gov.a u/resources/pestsweeds/09352MM anualStandardTier.pdf). • Assess current threats including weeds and browsing impacts. Direct count in size classes. Monitor in summer when it still has its leaves (December ideal). Management actions for Little Thredbo River are outlined below: • Employ waterbombing to retard fire front from encroaching into the creek lines when there is a threat of encroaching wildfire. • Mechanically reduce the surrounding vegetation or rake hoe around the population. Keep species records and known/predicted fire regime requirements up to date and concur in all appropriate databases. Liaise with local landholders to educate about hazard reduction techniques. • Cut and paint for blackberry and sweet briar, frill and stem inject for willows and possibly other larger woody weeds like hawthorn, given proximity to private property. Leave plants standing to die *in situ*. • Install and maintain a stock proof fence. • Collect seed from as many plants as practicable within each population. • Existing control program in the area - target to this site. Conduct shooting program to maintain low numbers of deer in the local area. • Monitor species recruitment and adult condition immediately post fire event and subsequently every six months for three years. • Monitor target weed density using methodologies outlined in the monitoring manual for bitou bush control and native plant recovery (http://www.environment.nsw.gov.a u/resources/pestsweeds/09352MM anualStandardTier.pdf). • Quantitative assessment of pest animal abundance/density/activity using appropriate methodology or qualitative estimate. Count individuals in all age classes along a subsection of the stream (distribution is patchy).
Management actions and relevance to project and KNP	No recovery plan has been prepared for this species.

Table A.11 Key threats and management actions for Raleigh Sedge

Raleigh Sedge (*Carex raleighii*)	
Status	BC Act: Endangered EPBC Act: Not listed
Key threats	• The habitat of this species is at risk from feral pigs and horses. • Populations on private land may be threatened by cattle grazing. • Water release from Tantagara dam causing destruction of *Carex raleighii* habitat. • Invasion and encroachment into suitable habitat by Ox-eye daisy. • Lack of distributional information. • Full extent of threats unknown.
Saving our Species (SOS) actions and relevance to project and KNP	Two priority management sites have been identified for Raleigh Sedge at Northern Kosciuszko and Southern Kosciusko. Management actions for Northern Kosciuszko are outlined below: • Conduct baiting, trapping and aerial shooting program annually. • Continue horse trapping programmes currently implemented within Kosciuszko National Park in accordance with the Regional Pest Management Strategy. • Survey potential habitat. • Physical removal of Ox-eye daisy to prevent invasion of the key locations where the species occurs (approximately 5 known locations). • Continue to liaise with Office of Water to ensure releases do not impact habitat of the species, e.g. reduce the amount of water released at any one time. • Quantitative assessment of pest animal abundance/density/activity using appropriate methodology or qualitative estimate. • Monitor target weed density using methodologies outlined in the monitoring manual for bitou bush control and native plant recovery (http://www.environment.nsw.gov.a u/resources/pestsweeds/09352MM anualStandardTier.pdf). • Monitor for evidence of direct disturbance on the species at the sites. • Count flowering stems in permanent plots in Jan-March. Monitor once every 5 years. Management actions for Soutern Kosciuszko are outlined below: • Survey potential habitat across the site. • Survey the two sub-populations and assess the impact of walking trails. Very little opportunity for moving walking trail on western population, but may be opportunity to reduce impacts of walking trails on eastern population. • Count flowering stems in permanent plots in Jan-March.
Management actions and relevance to project and KNP	No recovery plan has been prepared for this species.

Table A.12 Key threats and management actions for *Thelymitra alpicola*

Thelymitra alpicola	
Status	BC Act: Vulnerable EPBC Act: Not listed
Key threats	• Feral horses affect the population on the Bago plateau and may affect populations near Kiandra in KNP. • The distribution of populations is not well understood. Several populations have not been relocated. • Forestry activities may affect populations in Bago and Maragle State Forests although wetlands are buffered during forestry operations. • Road maintenance may affect a population in KNP • Heathlands not subject to periodic fire often become too dense and/or shaded for smaller herbaceous species such as *Thelymitra alpicola*. This may affect a population in KNP.
Saving our Species (SOS) actions and relevance to project and KNP	Currently being developed.
Management actions and relevance to project and KNP	No recovery plan has been prepared for this species.

Table A.13 Key threats and management actions for Gang-gang Cockatoo

Gang-gang Cockatoo (*Callocephalon fimbriatum*)	
Status	BC Act: Vulnerable EPBC Act: Not listed
Key threats	• Loss of key breeding and foraging habitat from intensive wildfire events and inappropriate hazard reduction burns. • Loss and degradation of breeding and foraging habitat from rural and urban development. • Loss of breeding and foraging habitat from forestry management practices. • Climate change impacts to habitat suitability and distribution. • Psittacine cirovirus disease (PCD). • Lack of knowledge of locations of key breeding habitat and breeding ecology and success. • Infestation of habitat by invasive weeds. • Aggressive exclusion from forest and woodland habitat by over abundant Noisy Miners.

Table A.13 Key threats and management actions for Gang-gang Cockatoo

Gang-gang Cockatoo (*Callocephalon fimbriatum*)	
Saving our Species (SOS) actions and relevance to project and KNP	The Gang-gang Cockatoo is assigned to the landscape species management stream. Thus, no site specific measures are provided, rather management actions to be implemented at a site, regional or state scale: • Protect known and potential remnant gang-gang cockatoo habitat, particularly tall wet forest and dry sclerophyll forest vegetation communities with large trees supporting hollows that are 10cm in diameter or larger and manage these areas to allow ongoing regeneration of local native trees, shrubs and ground layer plants. Where possible, negotiate management agreements with landholders that are funded in perpetuity that allows ongoing recruitment of native local trees, shrubs and grasses. • Restore gang-gang cockatoo habitat in strategic locations close to known habitat and movement corridors, using appropriate local tree, shrub and ground cover species. Care must be taken to ensure that the removal of exotic berry-bearing shrubs and trees such as cotoneatser, hawthorn and pyracantha, that provide foraging habitat, is compensated for by planting of appropriate native foraging plant species such as acacias and eucalypts. • Liaise with land managers and landholders managing fire to raise awareness about the importance of live and standing dead hollow bearing trees, and to minimise losses of these trees when carrying out prescribed burns.
Management actions and relevance to project and KNP	No recovery plan has been prepared for this species.

Table A.14 Key threats and management actions for Eastern Pygmy-possum

Eastern Pygmy-possum (*Cercartetus nanus*)	
Status	BC Act: Vulnerable EPBC Act: Not listed
Key threats	• Loss and fragmentation habitat through land-clearing for agriculture, forestry and urban development. • Changed fire regimes that affect the abundance of flowering proteaceous and myrtaceous shrubs, particularly banksias. • Declining shrub diversity in forests and woodlands due to overgrazing by stock and rabbits. • Predation from cats, dogs and foxes. • Loss of nest sites due to removal of firewood. • Mortality on roads through habitat and movement areas.
Saving our Species (SOS) actions and relevance to project and KNP	The Eastern Pygmy-possum is assigned to the landscape species management stream. Thus, no site specific measures are provided, rather management actions to be implemented at a site, regional or state scale: • In known habitat and movement areas investigate options for safer road crossing options such as underpasses or overpasses. • Negotiate conservation agreements to protect known habitat, preferably perpetual, funded mechanisms such as BioBanking agreements. Target areas with hollow-bearing trees and an abundance of flowering proteaceous and myrtaceous shrubs, particularly banksias. Include the retention of fallen timber as a standard management action. • Develop and undertake community education strategy that reduces demand for firewood and provides/promotes alternatives.

Table A.14 Key threats and management actions for Eastern Pygmy-possum

Eastern Pygmy-possum (*Cercartetus nanus*)	
Management actions and relevance to project and KNP	No recovery plan has been prepared for this species.

Annexure B

Summary of offset requirements and management groups

B.1 Areas requiring management

Table B.1 Summary of credits generated per hectare and consequent areas to be managed to offset residual impacts arising from Snowy 2.0 Main Works

PCT	Credits generated per ha	Credits required	Hectares required to offset impacts
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	1.84	97	52.73
PCT 296 – Brittle Gum – Peppermint open forest of the Woomargama to Tumut region, NSW South Western Slopes Bioregion	3.42	602	176.17
PCT 299 – Riparian Ribbon Gum - Robertsons Peppermint - Apple Box riverine very tall open forest of the NSW South Western Slopes Bioregion and South Eastern Highlands	2.28	30	13.14
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	3.46	770	222.79
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	2.69	59	21.95
PCT 303 – Black Sally grassy low woodland in valleys in the upper slopes sub-region of the NSW South Western Slopes Bioregion and western South Eastern Highlands Bioregion	2.78	1261	454.12
PCT 311 – 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	4.63	213	45.98
PCT 637 – Alpine and sub-alpine peatlands, damp herbfields and fens, South Eastern Highlands Bioregion and Australian Alps Bioregion	2.42	45	18.61
PCT 639 – Alpine Ash - Snow Gum shrubby tall open forest of montane areas, South Eastern Highlands Bioregion and Australian Alps Bioregion	2.25	230	102.39
PCT 644 – Alpine Snow Gum - Snow Gum shrubby woodland at intermediate altitudes in northern Kosciuszko NP, South Eastern Highlands Bioregion and Australian Alps Bioregion	2.41	1685	700.27
PCT 679 – Black Sallee - Snow Gum low woodland of montane valleys, South Eastern Highlands Bioregion and Australian Alps Bioregion	3.26	2	0.61
PCT 729 - Broad-leaved Peppermint - Candlebark shrubby open forest of montane areas, southern South Eastern Highlands Bioregion and South East Corner Bioregion	4.10	569	138.91
PCT 953 – Mountain Gum - Snow Gum - Broad-leaved Peppermint shrubby open forest of montane ranges, South Eastern Highlands Bioregion and Australian Alps Bioregion	2.92	253	86.76
PCT 999 - Norton's Box - Broad-leaved Peppermint open forest on footslopes, central and southern South Eastern Highlands Bioregion	4.36	320	73.34
PCT 1191 – Snow Gum - Candle Bark woodland on broad valley flats of the tablelands and slopes, South Eastern Highlands Bioregion	4.49	370	82.49
PCT 1196 - Snow Gum - Mountain Gum shrubby open forest of montane areas, South Eastern Highlands Bioregion and Australian Alps Bioregion	2.36	3281	1391.67
PCT 1224 – Sub-alpine dry grasslands and heathlands of valley slopes, southern South Eastern Highlands Bioregion and Australian Alps Bioregion	3.91	2890	739.32

Table B.1 Summary of credits generated per hectare and consequent areas to be managed to offset residual impacts arising from Snowy 2.0 Main Works

PCT	Credits generated per ha	Credits required	Hectares required to offset impacts
PCT 1225 – Sub-alpine grasslands of valley floors, southern South Eastern Highlands Bioregion and Australian Alps Bioregion	3.99	250	62.59
TOTAL		**12927**	**4383.85**

B.2 PCTs and associated management groups

Table B.2 PCTs and associated management groups

PCT	Management group
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	Montane dry sclerophyll forests and woodlands
PCT 296 – Brittle Gum – Peppermint open forest of the Woomargama to Tumut region, NSW South Western Slopes Bioregion	Montane dry sclerophyll forests and woodlands
PCT 299 – Riparian Ribbon Gum - Robertsons Peppermint - Apple Box riverine very tall open forest of the NSW South Western Slopes Bioregion and South Eastern Highlands	Montane dry sclerophyll forests and woodlands
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	Montane dry sclerophyll forests and woodlands
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	Montane dry sclerophyll forests and woodlands
PCT 303 – Black Sally grassy low woodland in valleys in the upper slopes sub-region of the NSW South Western Slopes Bioregion and western South Eastern Highlands Bioregion	Subalpine woodlands
PCT 311 – 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	Montane dry sclerophyll forests and woodlands
PCT 637 – Alpine and sub-alpine peatlands, damp herbfields and fens, South Eastern Highlands Bioregion and Australian Alps Bioregion	Subalpine grasslands, bogs and fens
PCT 639 – Alpine Ash - Snow Gum shrubby tall open forest of montane areas, South Eastern Highlands Bioregion and Australian Alps Bioregion	Subalpine tall forests
PCT 644 – Alpine Snow Gum - Snow Gum shrubby woodland at intermediate altitudes in northern Kosciuszko NP, South Eastern Highlands Bioregion and Australian Alps Bioregion	Subalpine woodlands
PCT 679 – Black Sallee - Snow Gum low woodland of montane valleys, South Eastern Highlands Bioregion and Australian Alps Bioregion	Subalpine woodlands
PCT 729 - Broad-leaved Peppermint - Candlebark shrubby open forest of montane areas, southern South Eastern Highlands Bioregion and South East Corner Bioregion	Montane dry sclerophyll forests and woodlands
PCT 953 – Mountain Gum - Snow Gum - Broad-leaved Peppermint shrubby open forest of montane ranges, South Eastern Highlands Bioregion and Australian Alps Bioregion	Subalpine tall forests

Table B.2 PCTs and associated management groups

PCT	Management group
PCT 999 - Norton's Box - Broad-leaved Peppermint open forest on footslopes, central and southern South Eastern Highlands Bioregion	Subalpine tall forests
PCT 1191 – Snow Gum - Candle Bark woodland on broad valley flats of the tablelands and slopes, South Eastern Highlands Bioregion	Montane dry sclerophyll forests and woodlands
PCT 1196 - Snow Gum - Mountain Gum shrubby open forest of montane areas, South Eastern Highlands Bioregion and Australian Alps Bioregion	Subalpine tall forests
PCT 1224 – Sub-alpine dry grasslands and heathlands of valley slopes, southern South Eastern Highlands Bioregion and Australian Alps Bioregion	Subalpine tall forests
PCT 1225 – Sub-alpine grasslands of valley floors, southern South Eastern Highlands Bioregion and Australian Alps Bioregion	Subalpine grasslands, bogs and fens