DEPARTMENT OF PLANNING, INDUSTRY AND ENVIRONMENT

JUNE 2021

SNOWY SPECIAL ACTIVATION PRECINCT

KOSCIUSZKO NATIONAL PARK PLAN OF MANAGEMENT - CARRYING CAPACITY - FRAMEWORK DEVELOPMENT

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Snowy Special Activation Precinct
Kosciuszko National Park Plan of Management - Carrying Capacity - Framework Development

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TABLE OF CONTENTS

ABBREVIATIONS AND GLOSSARY VIII

EXECUTIVE SUMMARY X

1 INTRODUCTION 1

1.1 MASTER PLANNING 2

1.2 SNOWY MOUNTAINS SAP 3

1.3 STUDY AREA 4

1.4 PURPOSE OF THIS REPORT 4

1.5 STRUCTURE OF THIS REPORT 5

2 METHODOLOGY 6

3 LITERATURE REVIEW 7

3.1 WHAT IS CARRYING CAPACITY 7

3.2 EXISTING CARRYING CAPACITY FRAMEWORKS 7

3.3 CARRYING CAPACITY FRAMEWORK IMPLEMENTATION 8

3.3.1 AUSTRALIA 8

3.3.2 INTERNATIONAL 9

3.4 SUMMARY OF PUBLISHED FRAMEWORKS 13

4 REGULATORY AND ENVIRONMENTAL FRAMEWORK 15

4.1 ENVIRONMENT PROTECTION AND BIODIVERSITY CONSERVATION ACT 1999 15

4.2 NATIONAL PARKS AND WILDLIFE ACT 1974 15

4.3 ENVIRONMENTAL PLANNING AND ASSESSMENT ACT 1979 16

4.4 STATE ENVIRONMENTAL PLANNING POLICY (KOSCIUSZKO NATIONAL PARK – ALPINE RESORTS) 2007 16

4.5 KOSCIUSZKO NATIONAL PARK PLAN OF MANAGEMENT 17

4.5.1 MANAGEMENT ZONES 17

4.5.2 AREAS OF EXCEPTIONAL RECREATIONAL SIGNIFICANCE 18

4.5.3 ENVIRONMENTAL MANAGEMENT REQUIREMENTS 20

4.6 ENVIRONMENTAL PERFORMANCE INDICATORS 22

CONTENTS (Continued)

5 REVIEW OF EXISTING CAPACITY MECHANISM 26

5.1 EXISTING CAPACITY MECHANISM 26

5.2 NPWS BED LIMIT / CARRYING CAPACITY REVIEW 27

5.3 PLAN OF MANAGEMENT REQUIREMENTS FOR ANY MODIFICATION TO THE BED NUMBERS APPROACH TO CAPACITY 28

6 SUMMARY AND RECOMMENDATIONS 29

6.1 EARLY ASSESSMENT 29

6.2 OPPORTUNITIES AND CONSIDERATIONS 30

6.3 SPECIFIC IMPLEMENTATION CHALLENGES IN KOSCIUSZKO NATIONAL PARK 31

6.3.1 RESPONSIBILITIES, GOVERNANCE ARRANGEMENTS AND COMPLIANCE 31

6.3.2 ESTABLISHMENT OF MONITORING VALUES 31

6.3.3 ALIGNMENT WITH THE EXISTING KNP POM 32

6.4 THE NEXT STEP 32

7 A PROPOSED SAP CARRYING CAPACITY FRAMEWORK 33

7.1 STAGE 1 – CARRYING CAPACITY OBJECTIVES 34

7.2 STAGE 2 – IDENTIFICATION OF KNP VALUES AND OBJECTIVES 35

7.2.1 PROPOSED SAP VALUES 35

7.2.2 PROPOSED SAP VALUE OBJECTIVES 35

7.3 STAGE 3 – SAP PRECINCTS AFFECTED BY VISITORS AND PROPOSED STRUCTURE PLANNING 37

7.3.1 ALPINE RESORT AREAS 40

7.3.2 ALPINE RESORT STRUCTURE PLANS 41

7.3.3 TOURISM OPPORTUNITY AREAS 43

7.3.4 TOURISM OPPORTUNITY AREA STRUCTURE PLANS 45

7.4 STAGE 4 – SNOWY MOUNTAINS SAP PRECINCTS, VALUES AND CONSIDERATION OF CAPACITY CONSTRAINTS 49

7.4.1 CLIMATE CHANGE 49

7.4.2 FUTURE GROWTH PROJECTIONS 50

7.4.3 OVERNIGHT VISITATION 50

CONTENTS (Continued)

7.4.4 VISITOR EXPERIENCE / AMENITY 53
7.4.5 BIODIVERSITY 57
7.4.6 TRAFFIC, TRANSPORT AND ACCESS 63
7.4.7 SURFACE WATER / WATER QUALITY 68
7.4.8 GEOTECHNICAL 72
7.4.9 GROUNDWATER 73
7.4.10 ABORIGINAL CULTURAL HERITAGE 75
7.4.11 SHARED HERITAGE 80
7.4.12 INFRASTRUCTURE 82
7.4.13 SUSTAINABILITY 100

7.5 STAGE 5 – RECOMMENDED KEY STANDARDS, AND MECHANISM FOR VALUE PROTECTION 106

7.5.1 SNOWY MOUNTAINS SAP MASTER PLAN 106
7.5.2 SNOWY MOUNTAINS SAP ALPINE DCP 106
7.5.3 A SNOWY MOUNTAINS SAP EMS (ISO14,001) 107
7.5.4 SITE AREA MANAGEMENT 107

7.6 STAGE 6 – IMPLEMENTATION, MONITORING AND COMPLIANCE AND ADAPTIVE MANAGEMENT 120

7.6.1 DEVELOPMENT 120
7.6.2 OPERATIONS 120
7.6.3 ADAPTIVE MANAGEMENT AND REVIEW 120

8 CONCLUSION 122

9 LIMITATIONS 123

BIBLIOGRAPHY 124

LIST OF TABLES

TABLE 3.1 COMPARATIVE REVIEW OF CARRY CAPACITY FRAMEWORKS 13
TABLE 4.1 MANAGEMENT ZONES AS OUTLINED IN THE KNP POM 17
TABLE 4.2 SUMMARY OF ROLES AND RESPONSIBILITIES IN ALPINE MANAGEMENT UNITS 19
TABLE 4.3 ENVIRONMENTAL MANAGEMENT SYSTEM REQUIREMENTS 21
TABLE 4.4 EXISTING ALPINE MANAGEMENT UNIT ENVIRONMENTAL MANAGEMENT KEY PERFORMANCE INDICATORS 23
TABLE 5.1 KNP POM MAXIMUM BED NUMBERS BY AMU 26
TABLE 7.1 PROPOSED CARRYING CAPACITY MANAGEMENT OBJECTIVES 34
TABLE 7.2 GENERAL CLASSIFICATION AND VALUES REQUIRING PROTECTION 35
TABLE 7.3 SUMMARY OF PROPOSED SAP VALUE OBJECTIVES 35
TABLE 7.4 PROPOSED MODIFICATION TO BED LIMITS IN ALPINE RESORT AREAS 51
TABLE 7.5 PROPOSED MODIFICATION / ESTABLISHMENT OF BED LIMITS IN TOURISM OPPORTUNITY AREAS 51
TABLE 7.6 NUMBER OF DAYS WITH ACCESS SCANS WITHIN 15% OF PEAK (2015-2019) 55
TABLE 7.7 ASSESSMENT OF ALPINE RESORT AREA BIODIVERSITY OUTCOMES 61
TABLE 7.8 EXISTING PARKING AT ALPINE RESORTS 63
TABLE 7.9 ASSESSMENT OF ALPINE RESORT AREA TRAFFIC, TRANSPORT AND ACCESS CAPACITY 65
TABLE 7.10 PROPOSED INFRASTRUCTURE AND SERVICE IMPROVEMENTS (SPECIFIC TO KNP) 66
TABLE 7.11 CONSIDERATION OF WATER QUALITY CONSTRAINTS 70
TABLE 7.12 SUMMARY OF POSSIBLE GEOTECHNICAL RISKS 72
TABLE 7.13 SUMMARY OF OUTPUTS FROM REGIONAL SUSCEPTIBILITY ZONING MAPS 73
TABLE 7.14 CONSIDERATION OF GROUNDWATER CAPACITY CONSTRAINTS 74
TABLE 7.15 APPLICATION OF ESD PRINCIPLES TO THE SNOWY MOUNTAINS SAP (ABORIGINAL CULTURAL HERITAGE) 78
TABLE 7.16 SUMMARY OF HERITAGE RISK AREAS 80
TABLE 7.17 WATER INFRASTRUCTURE SUMMARY 84
TABLE 7.18 AVAILABE INFORMATION REGARDING WATER EXTRACTION FOR SNOWMAKING 87
TABLE 7.19 WASTEWATER INFRASTRUCTURE SUMMARY 88
TABLE 7.20 DISTRIBUTION SUBSTATION LOADING IN THE SNOWY MOUNTAINS SAP PRECINCTS IN KNP 91
TABLE 7.21 GAS NETWORK SUMMARY 91

LIST OF TABLES (CONTINUED)

TABLE 7.22 WASTE AND RESOURCE RECOVERY SUMMARY....92
TABLE 7.23 ASSESSMENT OF ALPINE RESORT AREA INFRASTRUCTURE CAPACITY....93
TABLE 7.24 FUTURE ELECTRICITY DEMAND....96
TABLE 7.25 RENEWABLE ENERGY DELIVERY CONSIDERATIONS FOR ALPINE RESORT AREAS....96
TABLE 7.26 SNOWY MOUNTAINS SAP INFRASTRUCTURE CONSIDERATIONS....98
TABLE 7.27 SUMMARY OF SUSTAINABILITY INITIATIVES BY ALPINE RESORT....100
TABLE 7.28 REVIEW OF ALPINE RESORT ESD IMPLEMENTATION....102
TABLE 7.29 SUMMARY OF KEY OPPORTUNITIES AND CONSIDERATIONS WITHIN THE SAP INVESTIGATION AREA....103
TABLE 7.30 SUMMARY OF KEY OPPORTUNITIES AND CONSIDERATIONS WITHIN THE SAP INVESTIGATION AREA....104
TABLE 7.31 SUMMARY OF PROPOSED VALUES, KPI AND PROPOSED MECHANISM FOR PROTECTION AND MANAGEMENT....108

LIST OF FIGURES

FIGURE 1.1 SNOWY MOUNTAINS SAP CORE PILLARS....1
FIGURE 1.2 LOCATION OF THE SNOWY MOUNTAINS SAP....4
FIGURE 2.1 SNOWY MOUNTAINS SAP CARRYING CAPACITY METHODOLOGY....6
FIGURE 3.1 EXISTING CARRYING CAPACITY FRAMEWORKS....7
FIGURE 4.1 SUMMARY OF KOSCIUSZKO NATIONAL PARK MANAGEMENT ZONE....18
FIGURE 4.2 LOCATION OF AREAS OF SIGNIFICANT RECREATIONAL SIGNIFICANCE – ALPINE RESORT AREAS....20
FIGURE 6.1 KEY FRAMEWORK REQUIREMENTS, CHALLENGES AND OUTPUTS....29
FIGURE 7.1 PROPOSED SIX STAGE CARRYING CAPACITY FRAMEWORK FOR KNP....33
FIGURE 7.2 SNOWY MOUNTAINS SAP SUB-PRECINCTS WITHIN KOSCIUSZKO NATIONAL PARK....38
FIGURE 7.3 SAP ALPINE RESORT AND TOURISM OPPORTUNITY AREAS....39
FIGURE 7.4 THREDBO VILLAGE – PROPOSED DEVELOPMENT AND BED LIMITS MODIFICATIONS....41
FIGURE 7.5 PERISHER (PERISHER VILLAGE) – PROPOSED DEVELOPMENT AND BED LIMITS MODIFICATIONS....42
FIGURE 7.6 PERISHER (SMIGGIN HOLE) – PROPOSED DEVELOPMENT AND BED LIMITS MODIFICATIONS....42

LIST OF FIGURES (CONTINUED)

FIGURE 7.7 CHARLOTTE – PROPOSED DEVELOPMENT AND BED LIMITS MODIFICATIONS....43

FIGURE 7.8 THREDBO RANGER STATION – PROPOSED DEVELOPMENT AND BED LIMITS ESTABLISHMENT 46

FIGURE 7.9 SPONARS CHALET – PROPOSED DEVELOPMENT AND BED LIMIT MODIFICATIONS....47

FIGURE 7.10 SKI RIDER – PROPOSED DEVELOPMENT AND BED LIMIT MODIFICATIONS....48

FIGURE 7.11 CREEL BAY – PROPOSED DEVELOPMENT AND BED LIMIT MODIFICATIONS....48

FIGURE 7.12 PERISHER (AND SURROUNDS) BED LIMIT VS PROPOSED GROWTH SCENARIO PROVIDED BY CIE (2020)....52

FIGURE 7.13 THREDBO (AND SURROUNDS) BED LIMIT VS PROPOSED GROWTH SCENARIO PROVIDED BY CIE (2020)....53

FIGURE 7.14 NUMBER OF 'BUSY' DAYS IN JULY FOR ALPINE RESORT AREAS BY GROWTH RATE....55

FIGURE 7.15 NUMBER OF 'BUSY' DAYS IN AUGUST FOR ALPINE RESORT AREAS BY GROWTH RATE....55

FIGURE 7.16 NUMBER OF 'BUSY' DAYS IN SEPTEMBER FOR ALPINE RESORT AREAS BY GROWTH RATE....56

FIGURE 7.17 THREDBO ARCHAEOLOGICAL POTENTIAL (SOURCE: OZARK, 2021) 76

FIGURE 7.18 GUTHEGA – ABORIGINAL CULTURAL HERITAGE ARCHAEOLOGICAL POTENTIAL (SOURCE: OZARK, 2021) 77

FIGURE 7.19 PERISHER – ABORIGINAL CULTURAL HERITAGE ARCHAEOLOGICAL POTENTIAL (SOURCE: OZARK, 2021) 77

FIGURE 7.20 ADOPTED FUTURE ADDITIONAL WATER DEMAND IN PERISHER DURING PEAK SEASON (AUGUST) 93

FIGURE 7.21 ADOPTED FUTURE ADDITIONAL WATER DEMAND IN THREDBO DURING PEAK SEASON (AUGUST)....94

FIGURE 7.22 ADOPTED FUTURE SEWERAGE FLOW AT PERISHER VALLEY STP 95

FIGURE 7.23 ADOPTED FUTURE ADDITIONAL SEWAGE FLOW AT THREDBO STP 95

FIGURE 7.24 ESD THEMES OF RELEVANCE TO THE SNOWY MOUNTAINS SAP 100

FIGURE 7.25 PROPOSED ENVIRONMENTAL MANAGEMENT SYSTEM INPUTS AND STAKEHOLDERS 107

FIGURE 7.26 PROPOSED SAP CARRYING CAPACITY IMPLEMENTATION, MONITORING AND COMPLIANCE PROCESS 121

LIST OF APPENDICES

APPENDIX A CARRYING CAPACITY LITERATURE REVIEW

APPENDIX B NPWS CARRYING CAPACITY REVIEWS

APPENDIX C EXISTING KNP MANAGEMENT OBJECTIVES

APPENDIX D ASSESSMENT OF CLIMATE CHANGE RISKS TO KOSCIUSZKO NATIONAL PARK VALUES

APPENDIX E ALPINE RESORT AND NPWS PERFORMANCE

ABBREVIATIONS AND GLOSSARY

Term	Definition
AEP	Annual Exceedance Probability. The probability that a design event (rainfall or flood) has of occurring in any 1-year period.
Alpine resort	One of the four Ski Resorts located within Kosciuszko National Park, as outlined in the Kosciuszko National Park Plan of Management
AMU	Alpine Management Unit
ANZECC	Australia and New Zealand Environment and Conservation Council
Alpine SEPP	*State Environmental Planning Policy (Kosciuszko National Park—Alpine resorts)* 2007
AUSRIVAS KNP	Australian River Assessment System for assessing water quality developed by the Co-operative Research Centre for Fresh Water Ecology for the streams and rivers in Kosciuszko National Park
APC	Activation Precinct Certificate
APCR	Activation Precinct Certificate Request
BC Act	*Biodiversity Conservation Act* 2016
Charlotte Pass	Charlotte Pass Alpine resort
CCF	Carrying Capacity Framework
cVPP	Community based virtual power plant
DPIE	NSW Department of Planning, Industry and Environment
DCP	Development Control Plan
EES	NSW Department of Environment, Energy and Science
EbD	Enquiry by Design
EP&A Act	*Environmental Planning and Assessment Act* 1979
EPBC Act	*Environment Protection Biodiversity Conservation Act* 1999
FFDI	Forest Fire Danger Index
High visitation areas	Management areas identified by the Kosciuszko National Park Plan of Management as 'areas of exceptional recreational significance'; and future management areas proposed by the Snowy Mountains SAP structure plans (Alpine resort areas and Tourism Opportunity Areas).
KNP	Kosciuszko National Park
KNP POM	Kosciuszko National Park Plan of Management
LGA	Local Government Area
LALC	Local Aboriginal Land Council

Term	Definition
Monero Ngarigo	Aboriginal linguistic group who traditionally occupied the eastern side of the Kosciuszko plateau and further north towards the Murrumbidgee River. The traditional custodians of the Snowy Mountains are the Monero Ngarigo people.
NPWS	NSW National Park and Wildlife Service
NPW Act	*National Parks and Wildlife Act* 1974
MNES	Matters of National Environmental Significance
NARCLiM	NSW/ACT Regional Climate Modelling
OEH	Former NSW Office of Environment and Heritage
Perisher	Perisher Alpine resort
POEO Act	*Protection of the Environment operations Act* 1997
Protected area	A clearly defined geographical space, recognised, dedicated and managed, through legal or other effective means, to achieve the long-term conservation of nature with associated ecosystem services and cultural values (IUCN Definition 2008)
Regional Growth NSW	Regional Growth NSW Development Corporation
SAP	Special Activation Precinct
Selwyn	Selwyn Alpine resort
SEPP	State Environmental Planning Policy
SIMP	Salt Impact Management Plan
SMP	Salt Management Plan
STP	Sewage Treatment Plant
TEC	Threatened Ecological Community
TfNSW	Transport for NSW
Thredbo	Thredbo Alpine resort
TOA	Tourism Opportunity Area

EXECUTIVE SUMMARY

SPECIAL ACTIVATION PRECINCTS

Special Activation Precincts (SAPs) are dedicated areas in regional NSW identified by the NSW Government to become thriving hubs. The SAP program facilitates job creation and economic development in these areas through infrastructure investment, streamlining planning approvals and investor attraction.

SNOWY MOUNTAINS SAP

The Snowy Mountains region is one of Australia's most iconic natural environments. In addition to hosting some of Australia's premier alpine destinations, the Snowy Mountains is home to over 35,000 people and Australia's highest peak, Mount Kosciuszko. The traditional custodians of the Snowy Mountains are the Monero Ngarigo people, in connection with the Walgalu, Ngunnawal and Bidhawal people.

Portions of the Snowy Mountains are within Kosciuszko National Park. Kosciuszko National Park is the central segment of the Australian Alps Bioregion containing the highest mountains in Australia and is the largest national park in NSW (NSW National Parks & Wildlife Service, 2006). The park possesses exceptional diversity of alpine plant communities, containing threatened ecological communities (TECs) and providing habitat for a number of rare and threatened species (NSW National Parks & Wildlife Service, 2006). The park contains most of the alpine endemic species found on the Australian mainland (NSW National Parks & Wildlife Service, 2006).

Today, the Snowy Mountains region plays a crucial role within the regional and state economy, with its local population swelling with an additional 1.4 million international and domestic visitors each year (Destination NSW, June 2020 report). The region's unique natural environment allows locals and visitors to participate in a diverse array of recreational activities year-round, with many visitors still experiencing the region through the peak winter season.

Priorities for the Snowy Mountains SAP are to capitalise on the unique cultural and environmental attributes which attract 1.4 million visitors annually to the region, revitalise the Snowy Mountains into a year-round destination, and reaffirm Australia's Alpine Capital (Destination NSW, June 2020 report). The revitalisation is to focus on year-round adventure and eco-tourism, improving regional transport connectivity, shifting towards a carbon neutral region, increasing the lifestyle and wellbeing activities on offer, and supporting Jindabyne's growth as Australia's national winter sports training base.

SAP STUDY AREA

The Snowy Mountains SAP Investigation Area encompasses 72,211 hectare of land and within this investigation area are several key areas called 'development opportunity areas':

- Jindabyne area:
  - growth opportunity areas: parcels of land located primarily to the south and west of the existing Jindabyne township, but also at East Jindabyne
  - Jindabyne centre opportunity areas: areas within the existing town of Jindabyne
  - tourism opportunity areas near the town of Jindabyne
- tourism opportunity areas within Kosciuszko National Park (which form the focus of this Plan of Management Carrying Capacity review).

THIS REPORT

This Kosciuszko National Park Plan of Management (KNP POM) Carrying Capacity Review has been prepared to address a specific aspect of the KNP POM. That is, to review the necessity for a carrying capacity framework in the Alpine resort areas and define a new approach should that be required.

The purpose of the report is to examine the current approaches, methodology, and propose improvements within KNP. Specifically, to propose improvements to the sustainable management of park visitors in Alpine resorts and other key recreational areas and to generate concepts for a carrying capacity approach that would be implemented by the proposed Snowy Mountains SAP framework.

The assessment methodology included.

- Analysis of the current best practice methodologies for carrying capacity assessments, with a focus on protected areas with similar characteristics, and uses to KNP.
- A review of the existing regulatory and environmental management framework and strategic studies that underpin planning and environmental management within KNP and specifically in relation to Alpine resort areas.
- A review of technical studies developed as part of the Snowy Mountains SAP Master Plan. The technical studies were used to inform the capacity constraints on key issues such as traffic and access, infrastructure, biodiversity, Aboriginal cultural heritage, bushfire risk and water quality.
- Ongoing consultation with key stakeholder and participation in Enquiry by Design (EbD) workshops relating to the Alpine resort areas in KNP.
- Development of a proposed CCF for implementation as part of the Snowy Mountains SAP Master Plan, Alpine DCP and ongoing environmental management of proposed SAP precincts in KNP.

KOSCIUSZKO NATIONAL PARK PLAN OF MANAGEMENT

The Kosciuszko National Park Plan of Management (KNP POM) is the principle document that provides the foundation of environmental management within the boundaries of the Kosciuszko National Park (KNP). The plan has been prepared to provide a framework of objectives, principles, and policies to guide the long-term management of the park and its values. It is mandatory for all operators within KNP to be consistent with the KNP POM, which describes several key provisions including management zones, units, and strategies to achieve the desired outcomes.

The KNP POM sets out a series of alpine management zones, which includes areas defined as having exceptional recreational significance. These areas are the Alpine resorts of Thredbo, Charlotte Pass, Perisher and Selwyn, and are the areas considered to have the greatest degree of visitor impacts.

To manage the impacts of visitor numbers in alpine resorts, the PoM uses two main methods. Firstly, the PoM sets limit on overnight accommodation in each alpine resort, by setting maximum bed limits. And Secondly, the PoM requires all operators prescribe to a series of general and site-specific provisions that relate to each area, along with requiring operators to develop and implement an Environmental Management System.

PROPOSED CARRYING CAPACITY FRAMEWORK

This report recommended a six-stage carrying capacity framework is incorporated into the future Snowy Mountains SAP precincts to manage the expected growth in visitor numbers to 2061 while protecting key environmental, social, and cultural values that are present in KNP. The recommendation notes, that many of the management tools or steps required for an effective carrying capacity framework are already in place, however these could be strengthened, and developed as part of the Snowy Mountains SAP master planning process.

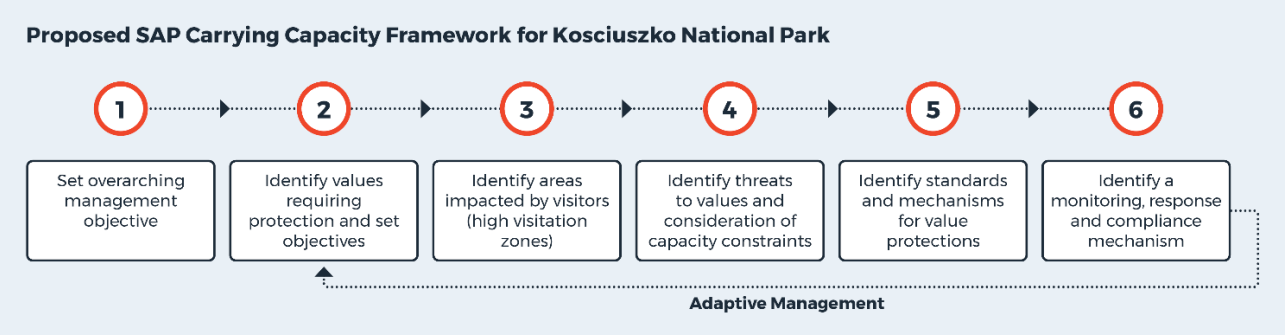


Figure ES.1 SAP CCF for Kosciuszko National Park

The report recommends and proposes a CCF that:

- Retains a bed limit to provide certainty for stakeholders, however, allows for modification of the existing bed limit to an appropriate level based on the constraints identified during the master planning and outlined in proposed structure plans and yield analysis.
- Considers how the impacts of day visitation is managed and use the Snowy Mountains SAP Master Plan to determine infrastructure requirements to manage those day visitors based on growth projections.
- Considers ski resort capacities and recommends a Comfortable Carrying Capacity or 'skiers at one time' analysis to determine the need for on mountain alpine resort developments, and to manage visitor experience, amenity, recreational activities.
- Establishes a tiered approach to the establishment of ongoing environmental protections including monitoring, compliance and response. That is includes:
  - The Snowy Mountains SAP Master Plan and a future Alpine DCP to set strategic and high-level expectations around development opportunities in proposed development areas, including concepts and footprints.
  - The requirement for Alpine resorts to implement and an ISO 14,001 Environmental Management System, as well as specific site area management requirements.
  - For smaller operators, include an alternate approach, utilising EMS with the aim of supporting and encouraging operators to implement an ISO 14,001 accredited EMS, or work towards the aims of the EMS to reduce environmental impacts in line with SAP expectations. Smaller operators would also develop Environmental Management Site Plans (EMSPs) in collaboration with NPWS to manage site specific requirements.
- Is agreed to as part of the conditions of development approval within the SAP framework, with ongoing performance linked to staged approvals in that process. This could be captured through model conditions included in the Alpine SEPP.
- Allows for changing circumstances and adaptive management. This may include set review timeframes to facilitate performance assessments and allow for the consideration of acceptable development standards and bed limits over time.

1 INTRODUCTION

Special Activation Precincts (SAPs) are dedicated areas in regional NSW identified by the NSW Government to become thriving hubs. The SAP program facilitates job creation and economic development in these areas through infrastructure investment, streamlining planning approvals and investor attraction.

The SAP program adopts a collaborative and integrated whole-of-government approach, bringing together the local Council and a range of other relevant State and local agencies.

SAPs are unique to regional NSW. By focusing on planning and investment, their goal is to stimulate economic development and create jobs in line with the competitive advantages and economic strengths of a region.

On 15 November 2019, the NSW Government announced its commitment to investigating the Snowy Mountains SAP, to revitalise the Snowy Mountains into a year-round destination and Australia's Alpine Capital, with Jindabyne at its heart. The Snowy Mountains SAP is being delivered through the $4.2-billion Snowy Hydro Legacy Fund.

Different components of each SAP are led by different teams within the NSW Government:

- The **Department of Regional NSW** assesses potential locations for inclusion in the program and considers government investment for essential infrastructure to service the SAPs.
- The **NSW Department of Planning, Industry and Environment** (the Department) is responsible for the planning of SAPs. The Department leads the master planning process, including community and stakeholder engagement, the technical studies required to inform the preparation of a master plan and development of the simplified planning framework for each Precinct.
- The **Regional Growth NSW Development Corporation** (Regional Growth NSW) is responsible for delivering and implementing Special Activation Precincts. This includes attracting investment, providing support to businesses, developing enabling infrastructure, and creating strategic partnerships to foster education, training and collaboration opportunities.

The five core pillars of the Special Activation Precincts are:

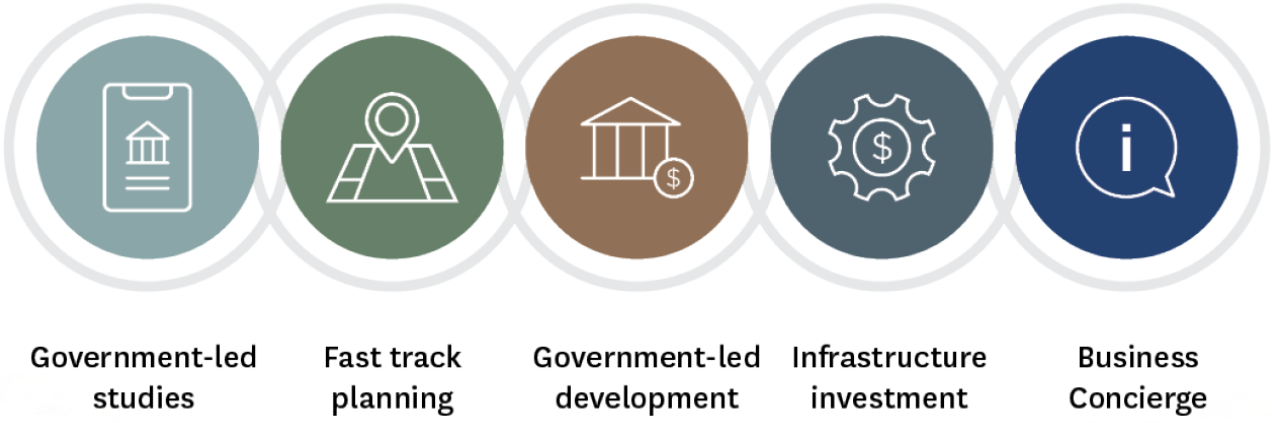


Figure 1.1 Snowy Mountains SAP core pillars

The planning framework for each Special Activation Precinct includes three key parts:

State Environmental Planning Policy (Activation Precincts) 2020

- Identifies each Special Activation Precinct.
- Requires that an Activation Precinct Certificate be sought prior to a development application or complying development certificate being issued, to ensure the development is consistent with the Master Plan and Delivery Plan.
- Provides zoning and land use controls for each Precinct.
- Identifies Exempt and Complying Development pathways for certain development.

Special Activation Precinct Master Plans

- Made by the NSW Department of Planning, Industry and Environment and approved by the Minister.
- Identifies the Vision, Aspirations and Principles for the Precinct.
- Provides more detailed land use controls where required.
- Identifies Performance Criteria at a Precinct-scale for amenity, environmental performance and infrastructure provision.
- Identifies the matters to be addressed as part of the Delivery Plan

Special Activation Precinct Delivery Plans

- Prepared by Regional Growth NSW and approved by the Planning Secretary.
- Identifies site-level development controls.
- Provides detailed strategies and plans for:
  - Aboriginal cultural heritage
  - Environmental protection and management
  - Protection of amenity
  - Infrastructure and services
  - Staging.
- Provides procedures for ongoing monitoring and reporting.

1.1 MASTER PLANNING

The master planning process for the SAPs adopts an evidenced based approach to determining the best outcome for the precincts. It is designed to ultimately provide a clear pathway for the right types of future development, in the right locations.

The process involves the engagement of a range of technical experts to investigate the study area and prepare technical studies (such as this report) to demonstrate their findings. Each of the technical studies are specifically designed and scoped for each SAP and tailored to the needs of the study area.

Importantly, the master planning process for the Snowy Mountains SAP will build on work already undertaken for portions of the study area as part of the Go Jindabyne master plan.

To achieve integrated and balanced planning outcomes, technical experts and other stakeholders work together at a series of enquiry by design workshops throughout the master planning process. At these workshops, opportunities and constraints are discussed and assessed to inform how the precinct should be shaped. This includes the evaluation of matters such as environmental impacts and benefits, transport opportunities, infrastructure capabilities, stormwater, economic viability and many others. These workshops are designed to give technical experts and decision makers a chance to ensure the identified vision, aspirations and principals for the precinct are guiding the outcomes.

The technical reports will ultimately inform the development of planning controls for the Snowy Mountains SAP to guide the precincts development. These controls will be contained in the master plan, Special Activation Precincts SEPP and delivery plan and will relate to important matters such as amenity, environmental performance and infrastructure provision.

Throughout the planning process, community, stakeholder and industry consultation takes place. Ongoing consultation provides an opportunity for community members and landowners to contribute and help shape the vision for the project.

1.2 SNOWY MOUNTAINS SAP

The Snowy Mountains region is one of Australia's most iconic natural environments. In addition to hosting some of Australia's premier alpine destinations, the Snowy Mountains is home to over 35,000 people and Australia's highest peak, Mount Kosciuszko. The traditional custodians of the Snowy Mountains are the Monero Ngarigo people, in connection with the Walgalu, Ngunnawal and Bidhawal people.

The Snowy Mountains are located in the south east of NSW. This region forms the northern part of the Australian Alps which extends south into Victoria. Predominantly the region is accessed from Canberra which is located approximately 150 kilometres to the north. To the south and west of this region is the sparsely populated high country. The township of Jindabyne situated on Lake Jindabyne provides a hub for the region, with opportunities for tourism and facilities supporting the regional catchment.

Jindabyne is located 175 km south of Canberra and 60 km south-west of Cooma. Jindabyne has evolved into the gateway to the Snowy Mountains and currently services 1.4 million visitors each year who travel to the region to enjoy its unique tourism and recreational offerings (Destination NSW, June 2020 report). There are approximately 35,500 residents of the Snowy Mountains, of which 3,500 residents live in Jindabyne (including Kalkite, East Jindabyne and Tyrolean Village).

Portions of the Snowy Mountains are within Kosciuszko National Park. Kosciuszko National Park is the central segment of the Australian Alps Bioregion containing the highest mountains in Australia and is the largest national park in NSW (NSW National Parks & Wildlife Service, 2006). The park possesses exceptional diversity of alpine plant communities, containing threatened ecological communities (TECs) and providing habitat for a number of rare and threatened species (NSW National Parks & Wildlife Service, 2006). The park contains most of the alpine endemic species found on the Australian mainland (NSW National Parks & Wildlife Service, 2006).

The Snowy Mountains region is home to the Monero Ngarigo people, the tribal homeland stretches from the western slopes of the coastal ranges to the eastern side of the Kosciuszko plateau and further north. Included in the Ngarigo land is the peak of Mount Kosciuszko and the Snowy Ranges. European settlers accessed the region in 1823, and between the late 1830s to 1957 the Monaro highland region was grazing by cattle and sheep. The original town of Jindabyne was settled in the 1840s on the banks of the Snowy River where the main river crossing took place. A bridge was constructed over the river in 1893, contributing to the success of the town. In 1949 the Snowy Mountains Scheme was introduced which consisted of plans to dam and divert water from the Snowy River. By 1964 the dam had created Lake Jindabyne and the township relocated to where it is today. The old town disappeared under Lake Jindabyne in 1967. Although losing much of its built heritage, Jindabyne, as we know it today, was rebuilt and has continued to steadily grow leveraging its tourist and agricultural offerings (Ozark Environment and Heritage, 2020).

Today, the Snowy Mountains region plays a crucial role within the regional and state economy, with its local population swelling with an additional 1.4 million international and domestic visitors each year (Destination NSW, June 2020 report). The region's unique natural environment allows locals and visitors to participate in a diverse array of recreational activities year-round, with many visitors still experiencing the region through the peak winter season.

Priorities for the Snowy Mountains SAP are to capitalise on the unique cultural and environmental attributes which attract 1.4 million visitors annually to the region, revitalise the Snowy Mountains into a year-round destination, and reaffirm Australia's Alpine Capital (Destination NSW, June 2020 report). The revitalisation is to focus on year-round adventure and eco-tourism, improving regional transport connectivity, shifting towards a carbon neutral region,

increasing the lifestyle and wellbeing activities on offer, and supporting Jindabyne's growth as Australia's national winter sports training base.

1.3 STUDY AREA

The Snowy Mountains SAP investigation area encompasses 72,211 hectares (ha) of land. Within this study area are several key areas called 'development opportunity areas', which include:

- Jindabyne growth opportunity areas: parcels of land located primarily to the south and west of the existing Jindabyne township, but also at East Jindabyne.
- Jindabyne centre opportunity areas: areas within the existing town of Jindabyne.
- Tourism opportunity areas: areas both near the town of Jindabyne and in the Kosciuszko National Park.

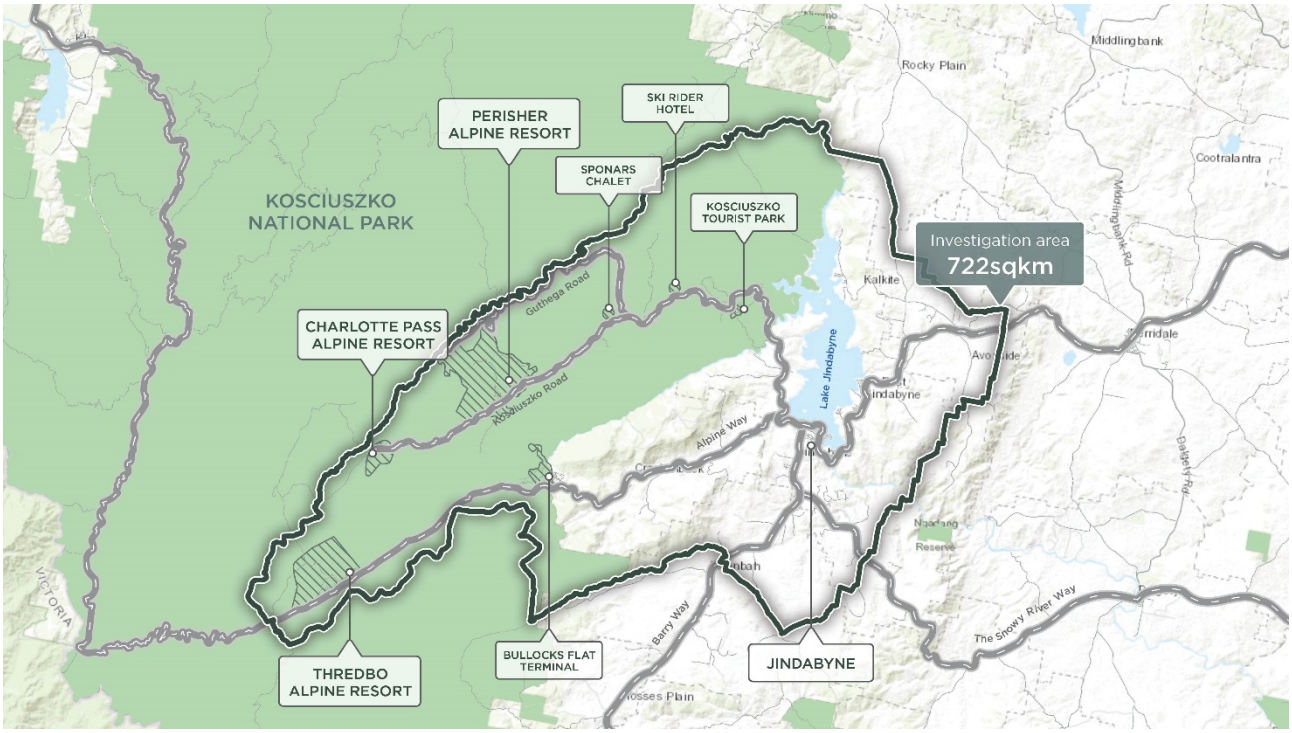


Figure 1.2 Location of the Snowy Mountains SAP

1.4 PURPOSE OF THIS REPORT

This Kosciuszko National Park Plan of Management (KNP POM) Carrying Capacity Review has been prepared to address a specific aspect of the KNP POM. That is, to review the necessity for a carrying capacity framework in the Alpine resorts and define a new approach should that be required.

The purpose of the report is to examine the current approaches methodology and propose improvements within KNP. Specifically, to propose improvements to the sustainable management of park visitors in Alpine resort and other key recreational areas and to generate concepts for a carrying capacity approach that would be implemented by the proposed Snowy Mountains SAP framework.

The aim of Chapters 1–6 is to:

- define carrying capacity and how it can be applied to protected areas
- provide examples of existing methodologies for the application of carrying capacity frameworks, and how they have been applied to protected areas in both Australia and internationally

- summarise the existing regulatory and environmental management framework which underpins planning, development, and ongoing management of key natural and cultural values within KNP, with a focus on the Alpine resort areas located in KNP
- recommend a future approach to managing visitor numbers within the context of the Alpine resorts within KNP and the Snowy Mountains SAP.

The aim of Chapter 7 is to build on the contents of the earlier chapters, analyse technical specialist reports developed for the SAP Master plan and develop a proposed carrying capacity framework (CCF) for implementation in the Snowy Mountains SAP Precincts of KNP.

The scope of the report is limited to high visitation zones of KNP, which generally covers Alpine Resort areas within the National Park.

1.5 STRUCTURE OF THIS REPORT

The remainder of this report is structured as follows:

- **Chapter 2** – Outlines the methodology to review the environmental visitor capacity issues within the Snowy Mountains SAP areas of KNP and establish a CCF for the monitoring and management of visitor impacts, after the implementation of the Snowy Mountains SAP Master Plan.
- **Chapter 3** – provides a literature review of the 'carrying capacity' concept and includes an in-depth analysis of published frameworks, examples of the implementation of carrying capacity frameworks in Australia and internationally, and outlines key limitations with framework methods and the use of monitoring indicators to guide performance.
- **Chapter 4** – Provides a summary of the existing regulatory and environmental management framework that underpins environmental and cultural value management in KNP (specifically the Alpine resort areas).
- **Chapter 5** – Provides a summary of the current carrying capacity mechanism used in KNP (Alpine resort areas), including the requirements under the KNP POM for considerations to the development limits imposed. This chapter also includes reference to previous work undertaken by NPWS in consideration of the appropriateness of the current mechanism for managing visitor numbers.
- **Chapter 6** – Provides observations and recommendations for the development of an appropriate CCF in the context of the existing environmental management framework and the proposed Snowy Mountains SAP.
- **Chapter 7** – Establishes a six-stage CCF for the Snowy Mountains SAP Precincts within KNP.
  - Stage 1 – makes recommendations on a management objective of the framework
  - Stage 2 – identifies environmental, social, and cultural values of KNP which require protection
  - Stage 3 – identifies the proposed SAP precincts of KNP as the areas which are most affected by visitors, and incorporates the proposed development opportunities developed throughout the master planning process into the framework
  - Stage 4 – identifies current and future threats to the values within each SAP Precinct, based on projected SAP growth scenarios and structure plans, while considering issues such as climate change. Stage 4 then proposes measures to mitigate these threats
  - Stage 5 – makes recommendations on the appropriate standards, conditions, and mechanisms for value protections
  - Stage 6 – considers a future implementation, monitoring and response mechanism for adaptive management the proposed framework.

2 METHODOLOGY

The following methodology has been undertaken in the preparation of a carrying capacity review of the PoM. The aim of the report is to inform the Snowy Mountains SAP Master Plan and develop an appropriate CCF in consideration of the proposed SAP SEPP.

The carrying capacity review methodology (shown in Figure 2.1) included:

- Analysis (by literature review) of the current best practice methodologies for carrying capacity assessments, with a focus on protected areas with similar characteristics, and uses to KNP.
- A review of the existing regulatory and environmental management framework and strategic studies that underpin planning and environmental management within KNP and specifically in relation to Alpine resort areas of Thredbo, Charlotte Pass, Perisher and Selwyn. This includes:
  - assessment requirements for the consideration of amendments to the accommodation limits in the alpine management units as per section 10.2.1(22) of the KNP POM
  - existing National Parks and Wildlife Service (NPWS) carrying capacity assessments
  - relevant documentation provided by DPIE with the view of assessing infrastructure and environmental management constraints for future growth in proposed SAP areas.
- A review of technical studies developed as part of the Snowy Mountains SAP Master Plan. The technical studies were used to inform the capacity constraints on key issues such as traffic and access, infrastructure, biodiversity, Aboriginal cultural heritage, bushfire risk and water quality.
- Ongoing consultation with key stakeholders including NPWS, Perisher Alpine Resort, Thredbo Alpine Resort, Charlotte Pass, DPIE, Regional Growth NSW and Regional NSW. Consultation included participation in Enquiry by Design (EbD) workshops relating to the Alpine resort areas in KNP.
- Development of a proposed CCF for implementation as part of the Snowy Mountains SAP Master Plan, Alpine Development Control Plan (DCP) and ongoing environmental management of proposed SAP in KNP. The framework is based on several technical studies undertaken to inform the Snowy Mountains SAP development.

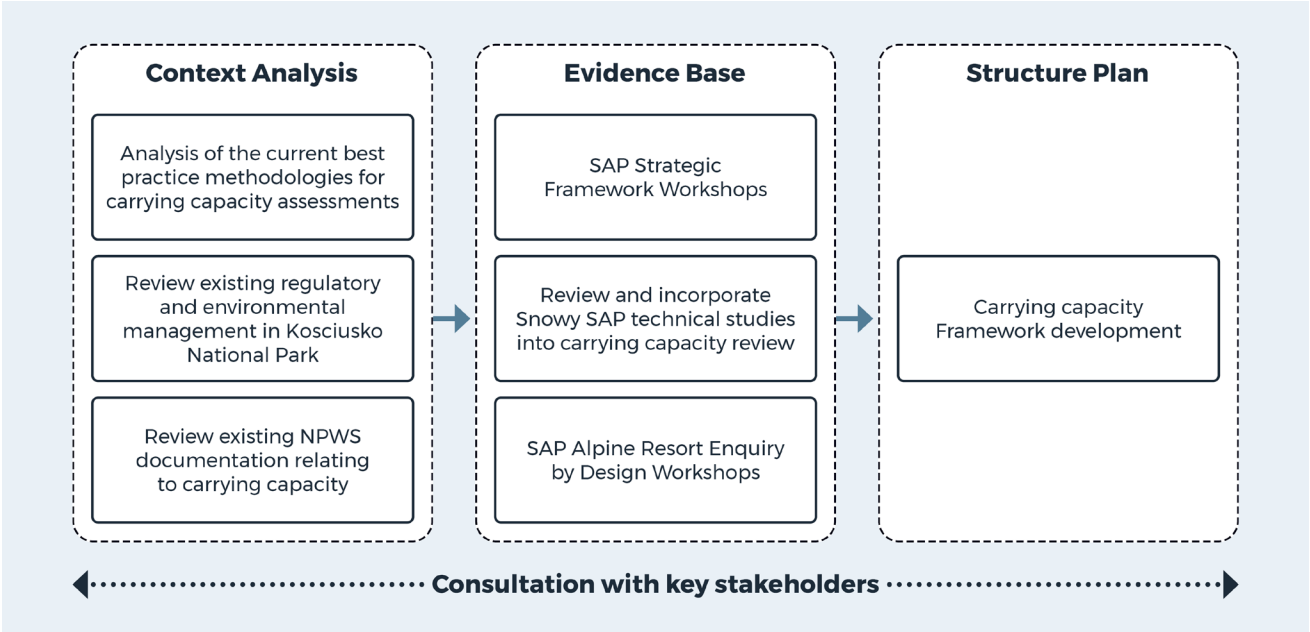


Figure 2.1 Snowy Mountains SAP Carrying Capacity methodology

3 LITERATURE REVIEW

3.1 WHAT IS CARRYING CAPACITY

The contemporary concept of carrying capacity was first developed in the US around the 1960s, as an approach to manage visitors within sensitive natural areas. It was established to address concerns about crowding and what is considered appropriate use of specific areas (Castley et al. 2008; Worboys et al. 2015).

Carrying capacity can be used in multiple different contexts and includes a focus on recreation, biophysical, managerial, and ecological factors, predominantly in natural landscapes (Prato 2009; Worboys et.al. 2015). In areas where recreation activities form a key component of land use, carrying capacity is often defined as the number of visitors an area can sustain without degrading natural resources and visitor experiences (Prato 2001). This definition allowed for the inclusion of both social and ecological factors to decide on an appropriate level of use.

As research into carrying capacity evolved, more recent definitions have become more holistic, and have focused on the acceptability of human, ecological and economic impacts, biophysical features, social factors, and management policies (Prato 2001, 2009). Carrying capacity has moved away from simply visitor numbers, to managing the outcomes of human activity below agreed condition thresholds, including physical environmental impacts and visitor experience.

The concept of carrying capacity has the potential to be integrated into and complement the environmental impact assessment (EIA) process. Its use could provide more information on ongoing prevention and management of those gradual cumulative and indirect impacts that are not captured during the development approval stage. Thus, potentially helping to achieve a more sustainable outcome (OEH, 2017, Lawrence 1997).

3.2 EXISTING CARRYING CAPACITY FRAMEWORKS

There is a large body of literature and case studies in the development and implementation of carrying capacity methodologies. The most widely cited and well known include Limits of Acceptable Change (LAC), Visitor Impact Management (VIM), Visitor Experience and Resource Protection (VERP), Recreation Opportunity Spectrum (ROS), Visitor Activity Management Processes (VAMP),the Tourism Optimisation Management Model (TOMM) and Comfortable Carrying Capacity (CCC) (Figure 3.1).

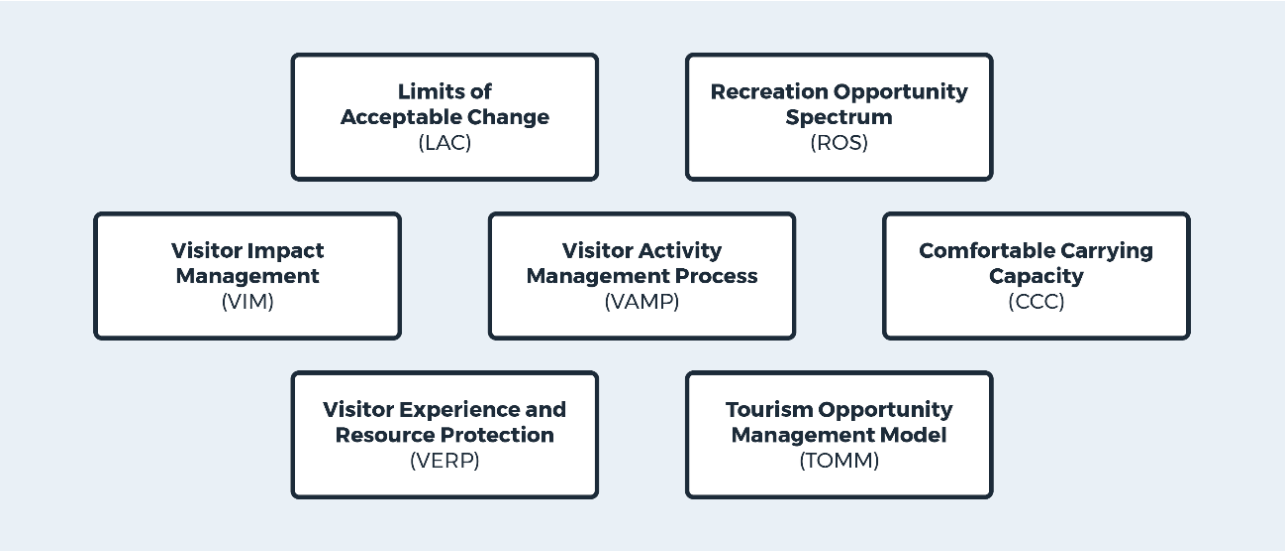


Figure 3.1 Existing Carrying Capacity Frameworks

Conceptually, most of these approaches do not differ greatly from one another as they all aim to answer the question of carrying capacity, appropriate visitor use, and impacts caused by their use. Individually they all place emphasis on a process or an issue. Such approaches are supported by the International Union for Conservation of Nature (Worboys et.al 2015).

Most of these carrying capacity methodologies share similar characteristics: (1) defining recreational opportunities; (2) defining the key resource/values to be protected; (3) establishing thresholds above which conditions must be maintained; (4) implementing management action if predetermined condition and social standards were not met (Castley et al. 2008).

A full literature review of each of the methodologies outlined in Figure 3.1 is included in Appendix A. The review includes:

- a summary of each established CCF
- a review of the limitations of using quantitate carrying capacity methods, and
- an explanation of the use of indicators to perform monitoring and evaluation of frameworks.

3.3 CARRYING CAPACITY FRAMEWORK IMPLEMENTATION

3.3.1 AUSTRALIA

3.3.1.1 NSW NATIONAL PARKS

There are many and varying examples of plans of management for NSW national parks and reserves that place 'hard' controls or ceilings on visitation rates. These can include specified visitor numbers, such as:

- group sizes allowed on a particular track or at a particular place
- timing of visitation, including seasonal or weather-dependent closures
- mode of travel, such as controls on vehicle or cycling use.

However, there are few examples of explicit decisions on park use and resource protection that are overseen via a framework that monitors and responds to adverse changes in resource condition. One example is the trial of horse riding in NSW wilderness areas. Building from Pickering (2008), in which biophysical variables were nominated for management of horse riding in Queensland protected areas, an adaptive management framework for the horse-riding trial was devised (OEH 2015). The specific aims of that framework were to:

- identify and agree on known or potential impacts on important park values which may arise during the trial
- agree on appropriate social, economic, and environmental indicators of change for each of the known or potential impacts
- develop a methodology for scientifically credible and practical monitoring, and analyse and report on the status and trends of the selected indicators
- agree on acceptable limits of change (i.e. thresholds or triggers) following the establishment of a baseline for each indicator
- agree on appropriate intervention options for when any unacceptable change or trends occur.

A structured decision-making approach was used in stakeholder and manager workshops to decide what indicators to monitor, what thresholds to apply and, ultimately, what corrective actions to take when thresholds were exceeded. Four locations were trialled with slightly different management approaches being used at each location. These trials ended in April 2016 (OEH 2017), and resulted in the amendment of relevant management plans to enable horse riding on trails that were part of the trial outcome.

The horse-riding trial in wilderness is a useful example of a tailored but straightforward approach. The horse-riding monitoring trials included stakeholder consultation, the selection of environmental conditions and indicators, standards and thresholds, a toolkit of management responses and adaption mechanisms to adjust the program in response to perverse outcomes or new information.

3.3.1.2 VICTORIAN ALPINE RESORTS

There is a total of six Alpine resorts in Victoria, including Mount Baw Baw, Mount Hotham, Falls Creek, Mount Buller, Mount Stirling, and Lake Mountain.

All the resort areas are located on permanent Crown land reserves, each managed by an Alpine Resort Management Board appointed under the Victorian Alpine resorts (Management) Act 1997. The Alpine Resort Management Boards are responsible for the development, promotion, management and use of each Alpine Resort. The Boards are required to carry out their functions in an environmentally sound way and in accordance with an approved strategic management plan. Each Board is represented on the Alpine resorts Coordinating Council which is a government agency that focuses on the strategic direction and sustainable growth for the resorts.

The management of the natural and social environment is guided by objectives in ski-area management plans and monitored against key performance indicators (KPIs) within the corporate plans of each board. The environmental KPIs are strategic rather than operational but do include a renewable energy target, a solid waste disposal target and a target for the number of habitat protection programs to be implemented. All KPIs are reviewed and reported on annually and each resort operates under an environmental management system (BiosisResearch 2012; NIEIR 2012).

An NPWS review found that although the Victorian resorts have many significant environmental management features, many of their objectives and KPIs are not directly measurable against clear standards; the required level of monitoring and reporting is not consistently achieved; and it is also often not clear how adverse outcomes are corrected and who is responsible for that correction.

The Alpine resorts Coordinating Council is currently working with boards and resorts to address this situation. Thus, Victoria is, in some ways, in a similar situation to New South Wales. The two states have previously had a biennial forum to exchange information and experiences to assist each other in improving the management of Australian Alpine resorts.

3.3.1.3 KANGAROO ISLAND, SOUTH AUSTRALIA

As discussed in Section A1.1.6, the TOMM was developed in 1997 as a community-based initiative responsible for monitoring and managing the long-term sustainability of tourism on Kangaroo Island in South Australia. It is unique in the fact that rather than being driven by a particular agency, the Kangaroo Island TOMM is fully funded through community, industry, and government partnerships. At the core of the model is a set of indicators that measure changes in economic, environmental, socio cultural and experiential environments. Based on information available, the indicators were last updated in 2009 and their assessment relies on measuring Kangaroo Island resident attitudes towards tourism and related activities. There are very few other examples of implementation of TOMM, locally in Australia or other parts of the world.

3.3.2 INTERNATIONAL

3.3.2.1 NEW ZEALAND DEPARTMENT OF CONSERVATION

The New Zealand Department of Conservation clearly identifies the potential need to limit visitor numbers in favour of conserving a park's natural or cultural values as a part of their longstanding visitor strategy:

- Protection of intrinsic natural and historic values may involve setting limits on visitor numbers, facilities, services and commercial activity; where the impacts of increasing visitor numbers to a site are unknown, the Department will adopt a precautionary approach until such time as it is clearly demonstrated that increasing numbers pose no significant problem.

A project was commissioned to create a knowledge basket – or 'kete' – for an integrated approach to support the implementation of this strategy, considering social, cultural, environmental, and economic planning, and management considerations (Warren et al. 2007).

In developing the kete, this project reviewed the practical implementation of biophysical carrying capacity concepts in New Zealand. This had most commonly occurred in the protection of specific fragile vegetation and soils; sensitive and threatened iconic wildlife species (especially marine mammals); and caves. For example:

- Considerable work on carrying capacity in relation to soils and vegetation near tracks had occurred. Some thresholds for the number of walkers before damage occurs were found, but these vary widely even within the same type of environment. Mitigation by track improvement had increased the biophysical carrying capacity, but managers rarely addressed social carrying capacity issues, such as visitor experience.
- A well-known example for wildlife protection is with the dusky dolphin (*Lagenorhynchus obscurus*) at Kaikoura. Researchers undertook detailed observations of dolphin behaviour and recognised that in the presence of tourist boats some significant changes occurred, including disruption to normal resting behaviour. Based on these observations, the researchers could establish rules for visitor numbers, behaviour, and buffer distances for viewing dolphins (Wursig, et.al, 2007).

The project found the concept of biophysical carrying capacity and absolute thresholds of use to be very appealing to many decision-makers, but the problems included:

- different sites and activities can have different carrying capacities
- measuring impacts on biological and physical resources may not directly help establish carrying capacity because a strong cause-and-effect relationship between the amount of use and impacts may not exist.

One issue described was that, for less sensitive sites, carrying capacity may be determined by off-site factors (e.g. waste disposal at accommodation centres) or by on-site social factors (e.g. perception of overcrowding) long before any on-site biophysical effect becomes significant, highlighting the importance of incorporating value judgements such as park visitor enjoyment as well as biophysical factors.

3.3.2.2 PARKS CANADA

Ski areas are the largest commercial leaseholders in Canadian National Parks, and thus can form some perspective on the management of environmental impacts for KNP.

Parks Canada has the following three-tiered ski-planning system:

- ski-area management guidelines which provide a framework for consistent planning and management of national park ski areas
- site guidelines for development and use that are specific to each ski area, and
- long-term plans for each ski area.

Required environmental conditions and standards are broadly defined in the site guidelines for development and use, and are reviewed, adapted, and supplemented during a strategic environmental assessment of a proposed development or use in that ski area. The site guidelines and strategic environmental assessment are released for public comment before finalisation. The prescribed outcomes are then delivered in the long-term plan developed for individual ski areas (Parks Canada 2006).

Parks Canada and the resort operator work together to develop the site-specific guidelines for a ski area. Visitor capacity is initially set by the available ski terrain, as well as the capacity of infrastructure and utilities. The actual extent of resource use by a ski resort is generally determined in the site guidelines, with the assumption that mitigations can be implemented to reduce potential adverse ecological effects of the ski area for specific resources such as water and wildlife. In cases where potential impacts to resources are not known when the site guidelines are developed, there is a requirement for the resort to gather the information required to determine the potential impacts of a development proposal to determine if effective mitigation of potential effects are possible (e.g. expansion of the lift system and potential effects on a species at risk).

Interpretation and enforcement are ongoing issues. Parks Canada frontline staff resolve most compliance issues through good relationships and negotiation. In very serious cases of non-compliance, Parks Canada can withhold a ski resort's business licence until the identified deficiencies are remedied. Although this is very rarely done, the latent threat appears to help achieve compliance on most occasions (Golder Associates, 2016). There is also other legislation that could be drawn on to enforce compliance, including the *Canada National Parks Act* 2000 and legislation protecting aquatic, migratory bird, and threatened species.

Monitoring by the operator is usually required by the conditions of development approval. Some collaborative programs for landscape-scale or sensitive issues are undertaken with Parks Canada and universities. Monitored human behaviour is matched to monitored ecological responses before decisions on visitor restrictions are made. This relies on well-designed research aimed at robustly capturing these potential cause and effect relationships.

Two examples of condition thresholds widely used in Canada are the 90/10 rule for water extraction and the 50/50 rule for ski runs. Water extraction is limited to 10% of daily flow and 90% of an instantaneous flow index. New or upgraded ski runs may only be 50 metres wide with 50 metres of native vegetation retained between runs. This rule reduces impacts on wildlife and fits within the optimum parameters for snow groomers.

Parks Canada requires that ski areas contribute to a unique, memorable national park experience and promote public appreciation and understanding of the heritage values of the park to enhance the visitor experience. This, however, can be difficult to manage in that in many instances, factors that contribute to a unique and memorable experience may be at odds with biophysical objectives. For example, the opening of new ski runs for skier enjoyment at the expense of removal of vegetation communities.

A typical example is Marmot Basin Ski Area in Jasper National Park. Parks Canada used a collaborative approach with resort operators based on a partnership agreement in the development of the site guidelines for development and use (Parks Canada 2017).

There is extensive use of fully compliant environmental management systems within the resort areas in Canadian national parks. Parks Canada expects ski areas to be leaders in environmental management, stewardship, and best practice to meet agreed goals that include initiatives that complement land-use policies, and actions in the wider or adjoining park areas. In North America, the selection of a ski area by holiday makers is increasingly influenced by a resort's 'green' credentials or 'Green" claims.

Key aspects of the Parks Canada system for managing ski resorts within national parks includes:

- ski-area management guidelines being separated from the individual park management plan, allowing the guidelines to be reviewed and revised independently of the plan of management
- ski resorts are required to provide calculations of skier number capacity to justify infrastructure design and management requirements. Ski area plans are presented as a joint venture with a resort's chief executive officer and Parks Canada, with both parties' signatories to the proposals, and the outcomes they contain
- no allowance for new accommodation 'on slope' (with notable exceptions for expansions of existing resorts, such as Sunshine Village Resort in Banff National Park)
- no utilisation of community forums, social surveys, or steering groups to engage with the public and stakeholders, instead running a traditional program of community consultation at key planning milestones
- an allowance for ski resort operators to forgo lease areas of high environmental value in exchange for approval to develop new, and suitable ski areas outside their existing leases, to achieve a substantial net positive, environmental gains
- requiring ski resort operators to provide consultant expertise for complex environmental issues, but maintain oversight of their commitment to implementation
- the retaining of regulatory powers for all environmental conditions.

SUNSHINE VILLAGE, BANFF NATIONAL PARK

Sunshine Village Ski area is one of four long-standing internationally recognized ski areas in Banff and Jasper National Parks. Of similar nature to KNP, the resort is accessed via an 8-kilometre road, managed by Parks Canada. While the Ski resort has a capacity of 6,000 skiers, the area has insufficient infrastructure (transport/parking supply, ski out trails) to support these numbers (Parks Canada, 2018). Sunshine Village Ski area also experiences similar operational challenges as those in KNP, such as overcrowding, terrain constraints to parking space, impacts on sensitive environments and ecosystems, climate change, meeting wastewater management targets, strengthening links with indigenous groups and summer use of the resort.

The *Sunshine Village Ski Report Site guidelines* (Parks Canada, 2018) has identified desired outcomes relating to sustainable resort planning, visitor access and design capacity, visitor experience, ecological integrity, heritage resources and indigenous relationships.

With specific reference to determining limits to development and growth, Sunshine Village Ski resort analysed the resorts capabilities (potential ski terrain, densities and limitations, commercial space, lift capacity, private vehicle parking, and mass transit capacity) and comparted them against industry standards. The result was the identification of a set future ski capacity (skiers, commercial space, and ski terrain), on the provision of long-term proposals being submitted (with set limitations) to ensure all development was undertaken within environmental management guidelines.

This methodology sets the onus on the ski areas to develop their long-term strategic plans for a period of 5 to 15 years, through the existing statutory assessment process, and within the guidelines set in the Sunshine Village Ski Report Site guidelines.

3.3.2.3 US NATIONAL PARK SERVICE

YOSEMITE NATIONAL PARK

As identified in section A1.1.3, the application of VERP in Yosemite National Park represents perhaps the most complex in US National Parks history. Six visitor experience indicators, three natural indicators and one cultural indicator were selected for monitoring and management. These included: visitors' encounters with other groups while on walking tracks or on the river; track and scenery diversity; parking availability; riverbank erosion; water quality; and indigenous plant resource distribution.

VERP requires the development of a public involvement strategy. In the Merced River process, this included the initial workshops then quarterly meetings and a public outreach program incorporating volunteer monitoring of indicator variables. It was found that volunteer monitoring helped the community recognise, perhaps for the first time, the inherent trade-offs that must be made when attempting to balance resource protection and the provision of high-quality experiences in the park.

Over time, concerns have been voiced about a lack of funding and incomplete implementation of the Merced River VERP framework and its program. Bacon et al. (2006) suggested the success of the VERP program is contingent upon it losing its distinctive identity as a process or framework and becoming a routine part of everyday business.

There are several other examples of VERP being implemented in National Parks including Arches, Glacier and Yellowstone.

3.3.2.4 US AND CANADA SKI RESORTS

Several ski resorts in the US and Canada have incorporated the comfortable carrying capacity (refer to Section A1.1.7 in Appendix A) methodology into their impact assessment and master planning, including:

- Alpine Meadow Ski Area (SE Group, 2015)
- Diamond Peak Ski Resort (SE Group, 2014)
- Breckenridge Ski Resort (US Department of Agriculture, 2011)
- Loveland Ski Area (SE Group, 2013)

- Revelstoke Mountain Resort (Harry Measure + Associates, 2019)
- Squaw Valley Alpine Meadows (SE Group & Ascent Environmental, 2019)
- Big White Ski Resort (BHA, 2020).

3.4 SUMMARY OF PUBLISHED FRAMEWORKS

Table 3.1 provides a summary of the CCFs discussed in Section 3.2 and Appendix A.

Table 3.1 Comparative review of carry capacity frameworks

DETAILS	LIMITATIONS	APPLICABILITY
Limits of Acceptable Change (LAC)		
LAC is based on nine interrelated steps focusing on the selection of indicators and measures standards (acceptable limits) and follow-up monitoring. LAC has been applied worldwide and formed the basis for most protect area management planning in the US Forest Service, 50 wilderness area under the National Forest System, Finland, and Montana.	— framework is reactive due to lack of explicit linkages to overriding management objectives — does not identify root causes of impacts, and has a lack of strategic direction for management topics — only intermittent public involvement during the process — can be costly, and require time and technical expertise	LAC is widely accepted and well used; certain aspects of an LAC framework may be considered relevant for KNP.
Visitor Impact Management (VIM)		
VIM is a variant of LAC with aspects also incorporated into the VERP framework. VIM involves eight key steps including the specification of standards for key impact indicators and focuses on the importance of understanding the causal factors in identifying management strategies. Suitable for site-specific problems with less resources.	— not suitable for large-scale areas and wilderness planning — does not aim to assess potential impacts — poor linkages to identifying impact root cause — lack of public involvement	Aspects of this model have applicability, and it is often incorporated into VERP. It is most suited to assessing current impacts rather than potential impacts.
Visitor Experience and Resource Protection (VERP)		
VERP is a hybrid framework built on VAMP while adapting parts of LAC and VIM. It involves nine steps over four key phases with an emphasis on the quality of a resource and visitor experience. Initially tested and applied in Arches National Park then applied to other US national parks including Grand Canyon, Yosemite, and Glacier National Park. Also specifically applied to Yellowstone National Park to address snowmobile issues.	— operational structure requires sufficient training and leadership in the social dimensions of resource management — require a high level of technical expertise to monitor ecological components — require commitments from all management levels — require substantial investments	A modified VERP model has potential applicability to KNP given the existing frameworks and stakeholder commitments that exist in KNP (further discussed in section 4 and 5).

DETAILS	LIMITATIONS	APPLICABILITY
Recreational Opportunity Spectrum (ROS)		
ROS has been widely used in variety of wildland recreation planning processes from national to local recreational planning around the world. ROS is a management approach that identifies and determines the diversity of recreation opportunities that the protected and natural area settings can provide and consists of six steps to help determine the expected recreational opportunity.	— success is highly dependent on agreement made with protected area managers on opportunities spectrum, setting indicators and their criteria — requires an appropriate level of interpretation on standards and data — managers' misperception towards ROS as prescriptive rules — limited focus on ecological integrity	The aims of a ROS framework are not considered a primary issue in KNP and therefore ROS does not suit the requirement of this assessment.
Visitor Activity Management Process (VAMP)		
VAMP is built on ROS principles and could easily incorporate VIM, LAC and VERP principles. It adopts marketing and social science concepts and techniques with a strong emphasis on visitor opportunities and a focus on integrating heritage management with visitor management. It consists of seven general steps of the management planning process. Application has been limited to national parks Canada and not widely adopted in other countries.	— framework only well-developed at service planning level but not at management planning level — lack of technical capability in the park management planning process — less attention to ecological integrity or condition	While less suited to established areas, VAMP has potential applicability due to the opportunities created by the Snowy Mountains SAP regarding Strategic planning within the KNP.
Tourism Optimisation Management Model (TOMM)		
TOMM was initially developed as a community-based initiative responsible for monitoring and managing the long-term sustainability of tourism on Kangaroo Island. Emphasises on optimal performance, borrowing strengths from both VIM and LAC methodologies.	— fails to specifically mention management objectives — potential risk of compromising the underlying resources due to its focus on maximising tourism opportunities — lack of scientific rigour from expert knowledge	The TOMM model is not considered suitable for KNP.
Comfortable Carrying Capacity (CCC)		
CCC developed by some US ski resorts at the Environmental Impact Assessment or master planning level to enhance recreational experiences without overburdening resort infrastructure.	— requires several assumptions which can be subjective in nature — individual ski resorts have varying methodologies / models to determine / calculate the CCC. — focuses on the amenity of the ski resort for users, and not on the direct ongoing environmental outcomes and impacts.	There is potential to incorporate aspects of CCC to the Alpine resorts in KNP, particularly around the measuring and monitoring of resort amenity.

4 REGULATORY AND ENVIRONMENTAL FRAMEWORK

This chapter focuses on the overarching legislation that drives planning, development, and environmental management within KNP including the Alpine Resort areas.

4.1 ENVIRONMENT PROTECTION AND BIODIVERSITY CONSERVATION ACT 1999

The Commonwealth *Environmental Protection and Biodiversity Conservation Act* (EPBC Act) 1999 and *Regulations* 2000 provide the Commonwealth legislative framework for the protection of the Australian environment. Broadly, in relation to KNP, the Act objectives are to protect the environment and heritage, promote ecologically sustainable development and conservation of biodiversity and promote a co-operative approach to the protection and management of the environment with the government, the community, landholders, and indigenous peoples.

The National Heritage List established under the EPBC Act is Australia's list of natural, historic, and Indigenous places of outstanding significance to the nation. Listed places are protected from actions that have, will have or are likely to have a significant impact on the National Heritage values of a National Heritage place. The Australian Alps National Parks and Reserves were listed on the National Heritage List in 2008 as being part of a unique Australian mountainous region, and the alpine resort areas reside within this heritage listed area.

4.2 NATIONAL PARKS AND WILDLIFE ACT 1974

The principle legislation underpinning the management of Kosciuszko National Park is the NSW *National Parks and Wildlife Act 1974*. Under this act the Secretary of the Department of Planning, Industry and Environment (DPIE) is accountable for the management and control of all national parks in NSW.

The primary objectives of the act are:

1. The conservation of nature, including, but not limited to, the conservation of:
   - **a** habitat, ecosystems, and ecosystem processes, and
   - **b** biological diversity at the community, species, and genetic levels, and
   - **c** landscapes and natural features of significance including wilderness and wild rivers, and
   - **d** landforms of significance, including geological features and processes, and
2. The conservation of objects, places, or features (including biological diversity) of cultural value within the landscape, including, but not limited to:
   - **a** places, objects, and features of significance to Aboriginal people, and
   - **b** places of social value to the people of New South Wales, and
   - **c** places of historic, architectural, or scientific significance.
3. Fostering public appreciation, understanding and enjoyment of nature and cultural heritage and their conservation.
4. Providing for the management of land reserved under this Act in accordance with the management principles applicable for each type of reservation.

4.3 ENVIRONMENTAL PLANNING AND ASSESSMENT ACT 1979

Development within the Alpine Resort areas (existing Alpine Management Units (AMUs)) discussed further in Section 4.5.1, is subject to environmental impact assessment and approvals under the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act). The main planning instrument applicable to the AMUs is the *State Environmental Planning Policy (Kosciuszko National Park—Alpine resorts) 2007* (Alpine SEPP). The Minister for Planning and Public Spaces is the consent authority for most private proponent works (note that public authority works generally do not require consent). For any development, outside of the AMUs within Kosciuszko National Park must be approved by NPWS in accordance with the *National Parks and Wildlife Act 1974* and an environmental assessment under Part 5 of the EP&A Act.

4.4 STATE ENVIRONMENTAL PLANNING POLICY (KOSCIUSZKO NATIONAL PARK – ALPINE RESORTS) 2007

The aim of the Alpine SEPP is to protect and enhance the natural environment of the Alpine resorts, in the context of the park, by ensuring that development in those resorts is managed in a way that considers the conservation and restoration of ecological processes, natural systems and biodiversity, as well as other principles of ecologically sustainable development.

The Alpine SEPP applies to the ski resort areas in KNP. This includes major resort areas (Thredbo, Charlotte Pass, Mount Selwyn and Perisher Range) as well as minor resort areas (which provide accommodation only with no ski facilities (Ski Rider, Sponars Chalet, Kosciuszko Mountain Retreat) (further discussed in Section 4.5.1).

The objectives of the SEPP are:

1. To encourage the carrying out of a range of development in the Alpine resorts (including the provisions of services, facilities and infrastructure, and economic and recreational activities) that do not result in adverse environmental, social or economic impacts on the natural or cultural environment.
2. To put in place planning controls that contribute to and facilitate the carrying out of ski resort development in KNP that is ecologically sustainable in recognition of the fact that this development is of state and regional significance.
3. To minimise the risk of environmental hazards to the community, particularly geotechnical hazards, bushfire and flooding, but generally requiring development consent on land to which this Policy applies.

Under the Alpine SEPP, all development within resort areas must undergo environmental assessment as part of the development application to protect the unique alpine environment.

Clause 14 of the Alpine SEPP outlines matters to be considered by the consent authority including geotechnical, earthworks, stormwater drainage, visual impact and protection of native flora and native fauna. Perisher Range Resorts Master Plan and Perisher Blue Ski Resort Ski Slope Master Plan are listed in Clause 14 of the SEPP as matters for consideration. Clause 15 of the SEPP outlines assessment requirements to be considered for buildings, including building height, building setback and landscaped areas.

Assessment requirements are merit based, as there are no prescriptive development controls in Clause 14 and 15 of the Alpine SEPP and no development control plan (DCP) related to the SEPP. Assessment of developments is based on existing character, built form and amenity impacts such as privacy, overshadowing noise, and cultural heritage. It should be noted a draft DCP was prepared in 2019 to guide development within Alpine resorts, however the DCP is not complete.

4.5 KOSCIUSZKO NATIONAL PARK PLAN OF MANAGEMENT

The Kosciuszko National Park Plan of Management (KNP POM) is the principle document that provides the foundation of environmental management within the boundaries of the Kosciuszko National Park. The plan has been prepared in accordance with requirements of Part 5 of the *NSW National Parks and Wildlife Act 1974* (NPW Act) (refer to Section 4.2*)* to provide a framework of objectives, principles, and policies to guide the long-term management of the park and its values. In accordance with section 81(4) of the NPW Act it is mandatory for all operators within KNP to be consistent with the KNP POM, which describes several key provisions including management zones, units, and strategies to achieve the desired outcomes.

4.5.1 MANAGEMENT ZONES

Table 4.1 provides a summary of designated Management Zones as outlined in Chapter 5 of the KNP POM. A list and description of appropriate activities as they apply for each zone is included in Seclude 4 of the KNP POM (Appropriate Recreational Activities).

Table 4.1 Management Zones as outlined in the KNP POM

MANAGEMENT ZONE	DESCRIPTION
Wilderness Zone	Wilderness areas declared under the *wilderness Act 1987*.
Backcountry Zone	Areas of the park without public road access and not within the wilderness zone, with a focus on passive recreational activities such as camping, rock-climbing and ski touring.
Minor Road Corridors	Corridors along minor public roads and associated visitor developments.
Major Road Corridors	Corridors along major sealed and unsealed roads and associated visitor developments.
Visitor Services Zone	Alpine resorts of Perisher, Charlotte Pass, Thredbo, and Selwyn, and development nodes and operational centres including Diggers Creek, Wilsons Valley, Sawpit Creek and the Waste Point Precinct.

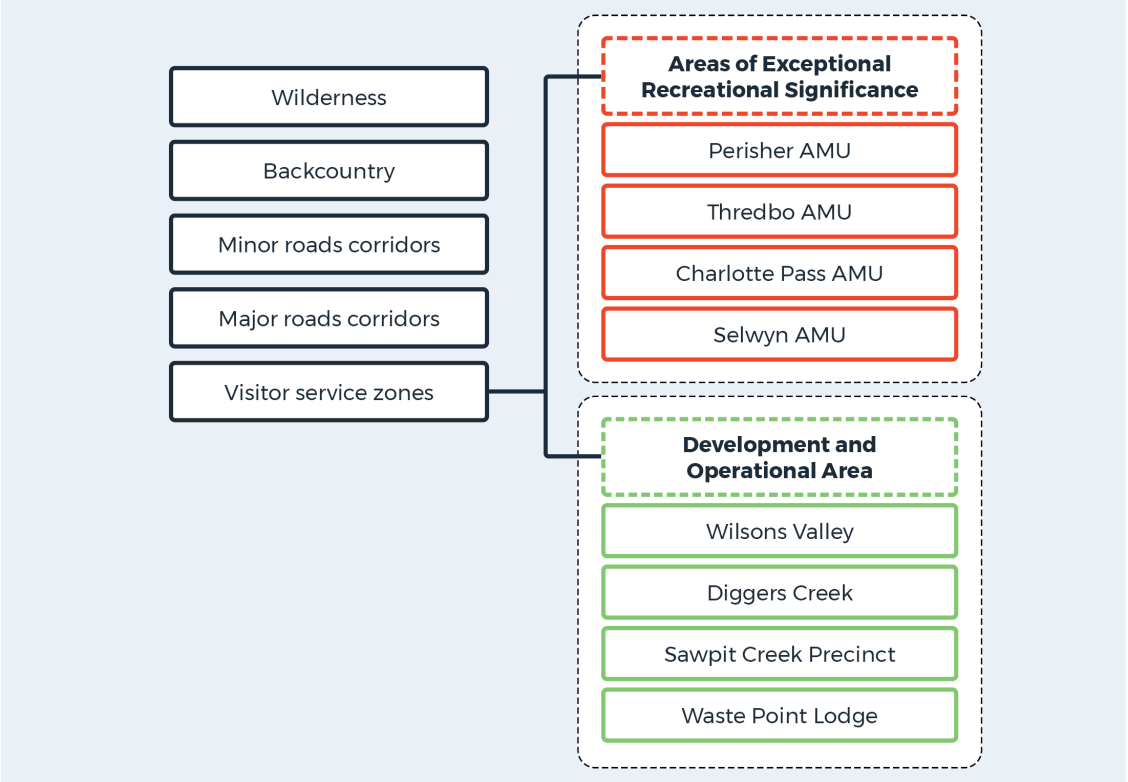


Figure 4.1 Summary of Kosciuszko National Park Management Zone

4.5.2 AREAS OF EXCEPTIONAL RECREATIONAL SIGNIFICANCE

In addition to the management zones outlined in Table 4.1, the KNP POM identifies seven management units which contain significant natural and cultural values that are highly vulnerable to human induced disturbance, and thus contain specific management measures to ensure their protection.

Four of these management units (as outlined in Chapter 10 of the KNP POM) are identified as 'Areas of Exceptional Recreational Significance'. These are the Alpine resort areas at Perisher, Thredbo, Charlotte Pass and Selwyn (Alpine Ski Resorts) (shown in Figure 4.2), which collectively make up around 27 square kilometres or 0.4% of KNP.

The 'Areas of Exceptional Recreational Significance' areas are primarily managed for snow-based recreation and are the most popular seasonal recreational destinations in the park. They also contain most of the recreational facilities, and are thus the most developed areas, containing ski lift infrastructure, a variety of retail outlets, sporting facilities and municipal services. Accommodation is also provided in three of the four areas (Thredbo, Perisher and Charlotte Pass). Outside of the winter season, some resorts (mainly Thredbo) attract visitors for non-snow-based activities including hiking, mountain biking and fishing.

The four Alpine resorts operate under a system of leases granted to private organisations in accordance with the NPW Act. Responsibilities for the administration and planning of the Alpine Ski Resort areas, known as Alpine Management Units (AMUs) lie with NPWS (DPIE) (leases, commercial agreements, some municipal services, natural and cultural values, public health etc) and Planning (DPIE), who control the strategic and statutory planning framework to guide development within these areas (refer to Chapter 4).

More specifically three of the four alpine resort areas operate under head lease with the NPWS and are responsible for all waste, water, and sewer management. The Perisher alpine resort does not currently operate under a head lease. Within this area, the NPWS Perisher Team provide municipal services such as waste, water, and sewer management. Many of the lodges and other commercial operations within the Perisher alpine resort are leased directly with NPWS and operate independently of the ski resort operator. The NPWS Perisher team is also responsible for municipal services within the Sawpit creek precinct as it contains a number of NPWS infrastructure.

Table 4.2 provides a full summary of the roles and responsibilities as outlined in chapter 10.2 of the KNP POM. Sections 4.5.2.1 to 4.5.2.4 describe the characteristics of each AMU.

Table 4.2 Summary of Roles and Responsibilities in Alpine Management Units

NPWS (DPIE)	PLANNING (DPIE)
Strategic operational planning for KNP	Strategic planning for the Alpine resorts e.g. DCPs
Protection of the Park's natural and cultural values	Responsibilities under the EP&A Act for all developments and building matters under Parts 3,4 &4A e.g. — Pre-application liaison — Referral of development applications — Advertised development — Land use permissibility — Accommodation capacity — Heritage conservation, and — Specific development control measures for each alpine resort.
Lease compliance e.g. environmental performance, rental and health inspections	
Responsibilities for environmental protection under the *Protection of the Environment Operations Act 1979 (*POEO Act)	
Law enforcement e.g. skidoo use	
Municipal services e.g. water, sewage, and waste disposal for articular resorts	
Public health e.g. pool/spa testing and kitchen/food stall inspections	
Responsibilities under the EP&A Act for certain activities carried out by, or on behalf of, public authorities under Part 5	

4.5.2.1 CHARLOTTE PASS ALPINE MANAGEMENT UNIT

The Charlotte Pass AMU covers 165 hectares and is located at the headwaters of Spencers Creek. The resort is accessed via Kosciuszko road, and consists of a small resort offering a village-type atmosphere. During the winter season, road access between Perisher and Charlotte pass is closed to the public, with access (for visitors, freight, and waste) to Charlotte Pass via an on-demand snow transport service from Perisher Valley Skitube terminal. The management unit contains significant cultural and natural values including the Kosciuszko Chalet and a number of threatened species habitats, including populations of Endangered mountain pygmy possums, *Burramys parvus* (TSSC, 2018).

4.5.2.2 THREDBO ALPINE MANAGEMENT UNIT

The Thredbo AMU covers an area of 960 hectares and provides year-round resort operations. The area is located adjacent to Alpine Way which provides a major sealed road through the park providing a link between NSW and Victoria. The Thredbo AMU provides for both day and overnight parking, in designated overnight parking areas. During the winter season, Thredbo offers a shuttle bus service to assist guests in moving around the village and accessing accommodation, ski lifts and parking areas. All resort operations, accommodations and services are managed under a single head lease agreement between NPWS and Thredbo.

4.5.2.3 SELWYN ALPINE MANAGEMENT UNIT

The Selwyn AMU covers an area of 203 hectares and is in the northern portion of the KNP. Its primary focus is to provide day visitors with low cost opportunities for skiing and snow activities. Due to its relatively low altitude and aspect, it is more likely to be impacted by climate change than other resorts. The Selwyn management unit does not contain accommodation, however, does contain other services such as food outlets and ski facilities. The Selwyn management unit was impacted by the 2020 bushfire season which severely damaged or destroyed much of the resort facilities and infrastructure.

4.5.2.4 PERISHER ALPINE MANAGEMENT UNIT

The Perisher AMU is the largest of the four management units, covering an area of 1598 hectares. It includes the resort areas of Perisher Valley, Smiggin Holes, Blue Cow, Guthega, and the Bullocks Flat Ski Terminal. All land occupied by club and commercial lodges, as well as resort operators within the management unit is managed under a system of leases and licences administered by the NPWS. Access to the Perisher AMU is via Kosciuszko Road, or the Skitube, which was established in 1988 to provide access to the Perisher Valley and Blue Cow Mountain from Bullocks Flat. The two-way train service (mostly underground) operates during the winter season and provides an alternative to driving up Kosciuszko Road from Jindabyne. As discussed above, no visitation data is available, however NPWS car counter data (2010-2018) shows peak access on Kosciuszko Road in the months of June – September, with uniform visitation outside these months.

The focus on the AMUs as part of this review is a result of provisions within the KNP POM which establish limits on visitor capacities. These limits are further discussed in Chapter 5. WSP notes there are additional management objectives that apply to the ski resort areas, however for this assessment, this section will focus on Chapter 10 of the KNP POM.

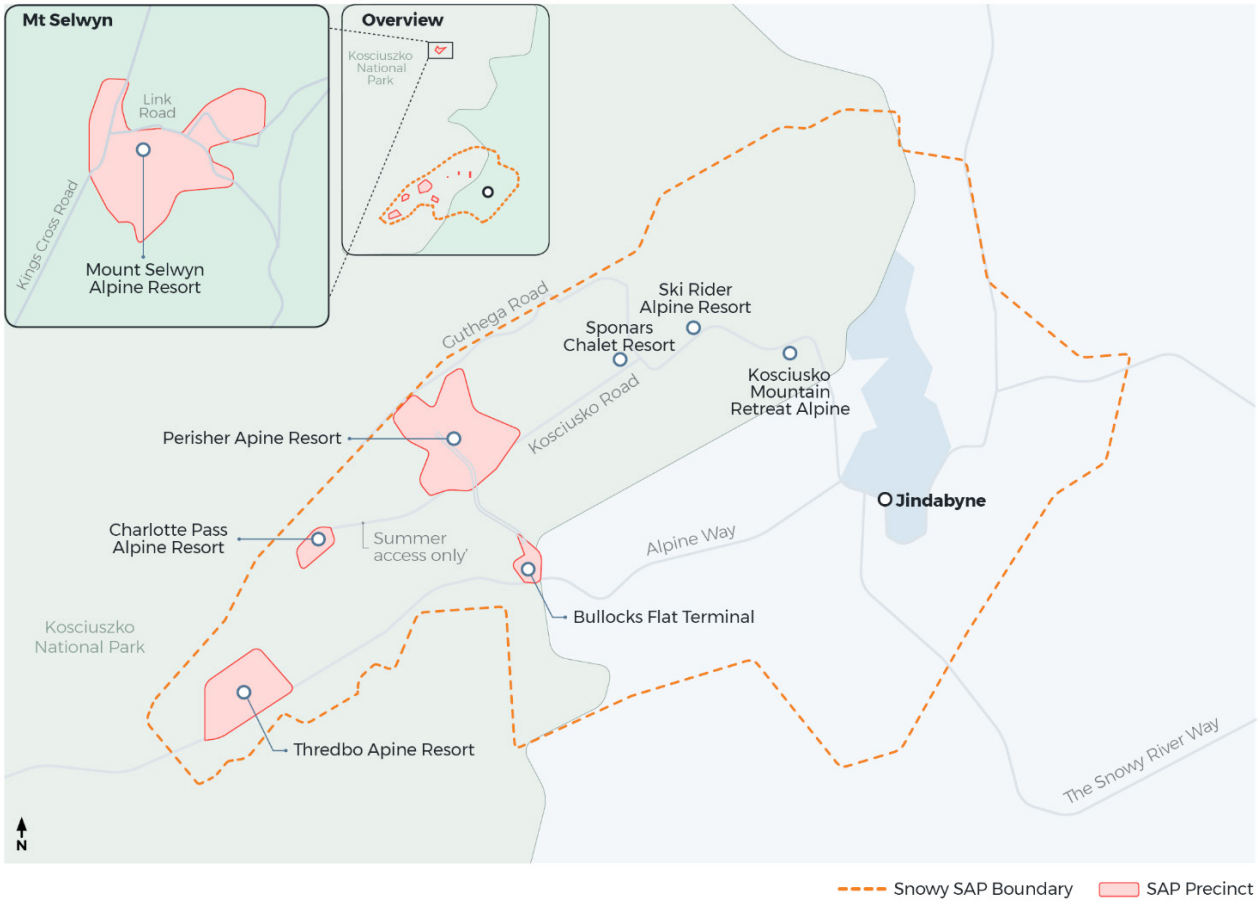


Figure 4.2 Location of areas of significant recreational significance – Alpine Resort Areas

4.5.3 ENVIRONMENTAL MANAGEMENT REQUIREMENTS

Chapter 10 of the KNP POM contains the general provisions that apply to all four of the AMUs, and site-specific prescription that relate to each area. In accordance with management objectives 10.3.1 to 10.6.1 of the KNP POM, each AMU is required to develop and implement an Environmental Management System (EMS). The requirements of which are outlined in Section 12.1 of the KNP POM and summarised in Table 4.3. Management objective 12.1.1 is the overarching objective that guides the development and maintenance of the EMS.

Table 4.3 Environmental Management System requirements

MANAGEMENT OBJECTIVE	
12.1.1	The Service, all operators and visitors demonstrate a commitment to improving environmental standards and are accountable for minimising the impact of their activities.
Policies and Actions	
1	Ensure all operations and authorised uses in the park are consistent with the provisions of this plan of management and are undertaken through a lease, license or other formal consent or agreement. Create and maintain a park register of all leases, licenses, and agreements.
2	Ensure all infrastructure located in the park is appropriately documented within the Service's geographic information system
3	Require all lessees, licensees and other authorities operating in the park to develop and implement an environmental management system for the management of their activities and infrastructure. All environmental management systems would be required to be approved by the NPWS.
4	Environmental management systems would include, but not be limited to: — all legislative requirements, and those stipulated in all relevant codes of practice and industry standards — relevant prescriptions as set out in the KNP POM — objectives, key performance indicators, ideal status goals and environmental targets for air, water and noise pollution — strategies and targets for water conservation, energy conservation, waste minimisation and reducing light spillage (as relevant) — communication and reporting protocols — monitoring regimes to measure performance against objectives, key performance indicators (KPIs) (refer to Section 4.6) and targets; and — training standards and schedules for relevant personnel.
5	Establish minimum environmental performance standards with the assistance of independent scientific advice commissioned by the Service, in association with its lessees and other relevant authorities.
6	NPWS and lessees/licensees would be accountable for annual environmental performance monitoring of their activities against performance standards.
7	Require all lessees and licensees to provide an annual report to the Service on their environmental performance
8	Report annually on environmental quality based on reporting associated with all environmental management systems that apply to the park. With respect to environmental quality, include in the report: — water quality monitoring results — measures applied to reduce air and noise pollution and improve scenic quality — water conservation, energy conservation, waste minimisation, reduction in light spillage and scenic quality enhancement results — human waste volumes treated at each of the sewage treatment plants in the park — quantities of rubbish and recyclable material collected and its ultimate destination — remediation progress at contaminated sites; and — information relating to the nature of pollution incidents, how they were managed, and the corrective action taken to prevent their recurrence.

MANAGEMENT OBJECTIVE	
9	The management of environmental quality in relation to all sites and operations of Snowy Hydro Limited would be in accordance with the Environmental Management Plan for the Snowy Mountains Hydro-electric Scheme (section 12.5)
10	Establishing means by which members of the community can be involved in a voluntary capacity in 'clean-up' or other environmental improvement programs in the park.

The EMS requirement also applies to all agencies that undertake essential operations within the park. These include agencies such as Transport for NSW (TfNSW) and Snowy Hydro Limited. In general, the activities of these agencies are outside the alpine management units, and therefore fall under their own EMS.

4.6 ENVIRONMENTAL PERFORMANCE INDICATORS

In accordance with the EMS system requirements outlined in Table 4.3, each alpine resort have developed their own, NPWS approved, individual EMSs. The current environmental performance measures, which are based on a total of 9 core objectives and 33 KPIs and were agreed to in 2012 between NPWS and alpine resort stakeholders.

The aim of this agreed framework was for NPWS to work collaboratively with resort operators to monitor key aspects that could lead to improved environmental outcomes and ensure environmental values remain an important consideration in ongoing resort operations and management. The result of this framework is a mix of both quantitative and qualitative indicators (such as those pertaining to cultural heritage), and varying levels of responsibilities and monitoring across both NPWS and individual Alpine resorts. Two examples of this include:

- small mammal threatened species monitoring is undertaken by NPWS, management can be co-ordinated with Alpine resorts, i.e. They undertake cat trapping.
- responsibilities for water quality between NPWS and Alpine resorts varies based on lease agreements and responsibilities for water management and sewage.

The results of KPI monitoring forms the basis of the Annual Environmental Performance Report (NPWS, 2017) which have been completed since 2012. Despite the requirements in the KNP POM (Management objective 16.0.1 (2) & (7) KPIs have not been set for the KNP in its entirety and are currently only used in the AMU areas.

A summary of existing key performance indicators used by NPWS to assess the performance of each AMU is included in Table 4.4. The table includes identification of quantitative indicators and where KPI targets are legislatively required or considered voluntary. It also provides an indication of where the responsibilities for each KPI sit. AMU refers to general resort areas, where specific responsibilities are present, specific resorts are named.

Table 4.4 Existing Alpine Management Unit Environmental Management key performance indicators

VALUE	OBJECTIVE	KEY PERFORMANCE INDICATOR	ID	REQUIREMENT	QUANTITATIVE	GENERAL RESPONSIBILITY
Water Quality	To protect the environmental health and aquatic ecosystems of alpine streams from resort activities.	Biological, physical, and chemical indicators of resort stream health compared to ANZECC guidelines (physical and chemical measurements) and AUSRIVAS KNP model (biological condition).	W1	Legislated	X	Thredbo / NPWS
		Compliance with water extraction licenses.	W2	Legislated	X	AMUs / NPWS Perisher Team[2]
		Water consumption in accommodation premises compared to industry benchmark (220 Litres/Visitor Night).	W3	Voluntary	X	AMUs / NPWS Perisher Team[2]
		Total water consumption.	W4	Voluntary	X	AMUs / NPWS Perisher Team[2]
Pollution prevention and incident management	To prevent and manage leaks, spills and unlicensed discharges of potentially harmful substances to the environment.	Timely management of environmental incidents in Alpine resorts.	P1	Legislated		AMUs / NPWS Perisher Team[2]
		Compliance with EPA discharge licenses for Sewage Treatment Plants (STPs).	P2	Legislated	X	NPWS Perisher Team[2]
		Compliance with POEO Act 1997, UPSS Regulation 2008.	P3	Legislated	X	AMUs / NPWS[1]
		Education of staff in environmental incident management and response.	P4	Voluntary		AMUs

VALUE	OBJECTIVE	KEY PERFORMANCE INDICATOR	ID	REQUIREMENT	QUANTITATIVE	GENERAL RESPONSIBILITY
Biodiversity	To protect flora, fauna and ecological communities, prevent loss of biodiversity and restore vegetation and ecosystem functions to previously disturbed areas.	Threatened species population: Mountain Pygmy Possum (MPP). (note: threatened species monitoring in the resorts is linked to broader monitoring programs in KNP)	B1	Legislated	X	NPWS
		Threatened species population: Broad-toothed Rat (BTR).	B2	Legislated	X	NPWS
		Small mammal management: — Mountain Pygmy Possum, *Burramys parvus* (Endangered) — Broad-toothed Rat, *Mastacomys fuscus* (Vulnerable) — Dusky Antechinus, *Antechinus swainsonii* — Agile Antechinus, *Antechinus agilis* — Southern Bush Rat, *Rattus fuscipes.*	B3	Legislated	X	AMUs / NPWS
		Pest control programs.	B4	Voluntary		NPWS / AMUs
		Loss of natural areas as a result of development (no net loss of biodiversity values).	B5	Voluntary		NPWS
		Weed management programs.	B6	Legislated		AMUs / NPWS
		Rehabilitation of previously disturbed areas.	B7	Voluntary		AMUs / NPWS
		Riparian restoration.	B8	Voluntary		AMUs / NPWS
		Natural heritage research projects supported, initiated or undertaken in Alpine resort areas.	B9	Voluntary		NPWS
		Environmental education and awareness programs.	B10	Voluntary		AMUs / NPWS
Cultural Heritage	To conserve and promote the cultural heritage values of the alpine resort areas	Education, awareness and promotion of resort cultural heritage values.	C1	Voluntary		AMUs / NPWS
		Protection of heritage sites, items and historic assets.	C2	Legislated		AMUs / NPWS

VALUE	OBJECTIVE	KEY PERFORMANCE INDICATOR	ID	REQUIREMENT	QUANTITATIVE	GENERAL RESPONSIBILITY
Air Quality and CO_2 Emissions	To improve local air quality and reduce or offset carbon dioxide (CO_2) emissions	Amount of CO_2 emissions.	A1	Voluntary	X	AMUs
		The percentage of renewable energy used.	A2	Voluntary	X	AMUs
		The percentage of visitors using the Skitube.	A3	Voluntary	X	AMUs
Energy Conservation	To improve the efficiency of energy consumption and increase the use of renewable energy.	Total energy consumption.	E1	Voluntary	X	AMUs
		Energy consumption in accommodation premises compared to 'EarthCheck' benchmark.	E2	Voluntary	X	AMUs
		Energy efficiency initiatives.	E3	Voluntary	X	AMUs
Waste Management	To minimise waste, maximise resource recovery and prevent environmental harm from waste disposal.	Amount of domestic waste.	G1	Voluntary	X	AMUs
		The percentage of domestic waste recycles including paper, cardboard, tins, glass and plastics.	G2	Voluntary	X	AMUs
		Waste composed – including the biosolids from Sewage Treatment Plants (STP).	G3	Voluntary	X	AMUs / NPWS Perisher Team[2]
Sustainable recreation	To ensure the recreational opportunities and facilities of the Alpine resorts are provided and managed sustainably.	Education, awareness and promotion of sustainable recreation in resorts.	R1	Voluntary		AMUs / NPWS
		Monitoring of key recreational activities — snow play at Selwyn — mountain biking and walking at Thredbo — snow tubing at perisher.	R2	Voluntary		AMUs / NPWS (downhill mountain biking only)
Resort Amenity	To conserve and enhance the existing amenity of the Alpine resorts.	Education, awareness and promotion of resort amenity.	Am1	Voluntary		AMUs
		Measures to protect the visual and acoustic environments within resorts and minimise impacts to the surrounding areas.	Am2	Voluntary		AMUs

1. NPWS are the regulatory authority under the POEO Act for all non-scheduled activities (all non-licenced activities) meaning some activities are self-regulating with oversight from the EPA for some matters. The responsibilities of the NPWS Perisher Team (Municipal Services) include the Perisher Valley Sewage Treatment Plant.

5 REVIEW OF EXISTING CAPACITY MECHANISM

Chapter 5 builds on the Regulatory and Environmental Management Framework chapters and provides a summary of the current capacity management mechanisms used in KNP to manage visitors in the Alpine Management Units. It includes a summary of recent OEH/ESS reviews on the capacity mechanism, and outlines considerations that are required for any future amendments to these limits.

5.1 EXISTING CAPACITY MECHANISM

The current mechanism for managing visitor numbers within each AMU is through the setting of limits on overnight accommodation via bed limits. Table 5.1 outlines the current maximum number of beds allowed for each AMU (10.2.1(14-24) of the KNP POM). This bed limit was set and modelled in consideration of key service infrastructure such as sewer, waste, and water capacities. The bed limits are also used by NPWS to determine market land value and leasing premiums across some resort areas.

Table 5.1 KNP POM maximum bed numbers by AMU

ALPINE MANAGEMENT UNIT	MAXIMUM BED NUMBERS
Perisher Range AMU	4,952[1]
Thredbo AMU	4,820[2]
Charlotte Pass AMU	611
Selwyn AMU	50[3]
TOTAL	**10,433**

1. Information provided by NPWS in June 2020 indicated that 863 beds remain unallocated
2. Information provided by NPWS in June 2020 indicated that 464 beds remain unallocated
3. Provision for staff accommodation only, no visitor accommodations are available in the Selwyn AMU

The KNP POM also identifies several additional visitor services zones (discussed in section 4.5.1) located nearby existing AMUs which provide accommodation services. The locations and bed limits are specified in schedule 8 of the KNP POM, and include:

- Wilsons Valley (Ski Rider Motel) – 339 beds
- Diggers Creek (Sponars Chalet) – 100 beds
- Sawpit Creek Precinct (Kosciuszko Mountain Retreat) – 72
- Waste Point Lodge (Creel Bay) – no bed limits established

The objective (section 8.19.1 of the KNP POM) of these zones is to limit visitor accommodations to existing capacities and levels specified in the existing leasing agreements. Thus, there is no provision for modifying these numbers as these beds are located outside the AMUs.

5.2 NPWS BED LIMIT / CARRYING CAPACITY REVIEW

Since 2016, OEH have completed several papers (two remain unpublished) in relation to the review of carrying capacity within KNP.

The initial background paper, (OEH, 2016) examined the appropriateness of the method of determining carrying capacity within the Alpine resorts of KNP. The review identified that while bed numbers were a straightforward and easily understood method for controlling the number of people within an area (overnight visitors only), and their impact. It did not necessarily provide a strong indication of overall environmental outcome of each resort operation. The review identified limitations of using a fixed bed number approach to manage visitor capacity (as supported by section of this report). The limitations identified included:

- it assumes a stable and unchanging natural system, and does not account for complex environmental, social and economic factors
- different carrying capacities may be required for different times and places, undermining the practical utility of using a single number as a cap
- in many recreational management situations, impacts may be more a function of visitor behaviour or type of infrastructure development than just numbers
- it is a technical approach to addressing issues rising from competing values, and may provide little scope for public engagement and understanding
- in a built environment, the relationship between visitation and environmental conditions is difficult to discern
- the bed number approach is not able to control the impacts of day visitors

The review highlighted the evolution of the combination of bed numbers and the tracking of key issues (such as water quality, pests, and threatened species) to measure and monitor impacts. Currently the ongoing day to day environmental impacts of operations are managed through resort areas implementing individual EMS (refer to Sections 4.5 and 4.6). The results of which are published in annual performance reports in line with the requirements of the KNP POM.

Potential shortcomings of the bed limit carrying capacity methodology were recognised during the development of the KNP POM in 2006, by including provisions for further investigations. These are highlighted in section 10.2.1 (6) of the KNP POM which identified the policy action to:

- *Coordinate a program designed to investigate alternative mechanisms for measuring and regulating carrying capacity of each resort. Liaise with DoP (Department of Planning), resort lessees and licensees and other relevant organisations on the design and implementation of the program.*

The OEH review identified the need for resorts to evolve, as new opportunities emerge, to provide a high-quality visitor experience, deliver enhanced economic outcomes, and meet current and future environmental standards and visitor expectations.

Follow up (unpublished) papers by OEH in 2017 and 2018 outlined several future options for the consideration of carrying capacity within the context of the existing KNP regulatory and environmental framework, including:

- developing a standalone CCF or a framework based on a published model, to be regulated from lease conditions
- developing strategic long-term visions to guide future development
- improving resort environmental management systems, with an environmental monitoring and response system
- continuing with the status quo of bed numbers with the addition of strengthening the existing system
- a combination of multiple options to achieve the best fit for purpose.

Most options included a modification to the existing visitor capacity management method of bed numbers and identified the need to consider the improved management of day visitation, which is currently unlimited and thus a potential source of environmental issues.

5.3 PLAN OF MANAGEMENT REQUIREMENTS FOR ANY MODIFICATION TO THE BED NUMBERS APPROACH TO CAPACITY

Management objective 10.2.1 (22) of the KNP POM outlines the following requirements for the consideration of an increase accommodation limits for AMU's.

- the potential impacts of the increase on the natural and cultural values of the park
- the impact of climate change on the proposed increase
- the consistency of the proposal with the Alpine SEPP and other relevant strategies and plans
- alternative measures of carrying capacity have been assessed
- there is demonstrated demand for additional overnight accommodation in the resort that cannot be provided elsewhere in the park or by adjacent communities
- the resort management unit where the accommodation increase is proposed has an environmental management system in place and can demonstrate improvements in environmental performance over a period of at least five years
- the physical capacity of existing infrastructure servicing the resort management units can meet the demand of additional visitors without adversely impacting on park values, and
- there is an economic benefit to local communities within and adjacent to the park.

Any proposal and resulting increase to bed numbers requires a formal amendment to the KNP POM in accordance with the statutory processes set out in Part 5 of the NPW Act.

As mentioned, NPWS have previously recognised short comings in this approach to changes in bed numbers, including a lack of a consistent guide on how the carrying capacity assessment should be undertaken. The KNP POM does not provide such guidance.

A summary of a draft coordinated approach considered by NPWS since the KNP POM publication in 2006 to address this issue is included in Appendix B. In additional Appendix B also includes a summary of NPWS recommendations to improve the existing report EMS. It should be noted that both these approaches were not formally adopted.

6 SUMMARY AND RECOMMENDATIONS

This chapter provides a summary of the carrying capacity review and makes recommendations on a proposed CCF considered suitable for implementation in KNP, under the provisions of the Snowy Mountains SAP Master planning process. This review is a culmination of our assessment as outlined in the early chapters of this report, consideration of the Snowy Mountains SAP technical studies, ongoing engagement with NPWS, DPIE, RGDC and the enquiry by design workshops undertaken in Thredbo in November 2020.

6.1 EARLY ASSESSMENT

Consistent with previous investigations undertaken by NPWS, the most relevant existing CCF considering the context of KNP is the VERP model. However, as discussed there is no 'one size fits all' approach, and the application of any CCF should be developed specifically for the protected area, or zone in which it is being applied. Thus, most frameworks implemented are hybrid frameworks where relevant steps and stages are incorporated to develop a 'fit for purpose' methodology.

Figure 6.1 provides a summary of the key inputs and preferred outcomes of any framework and the challenges involved in achieving effective results, and a high level of value protections.

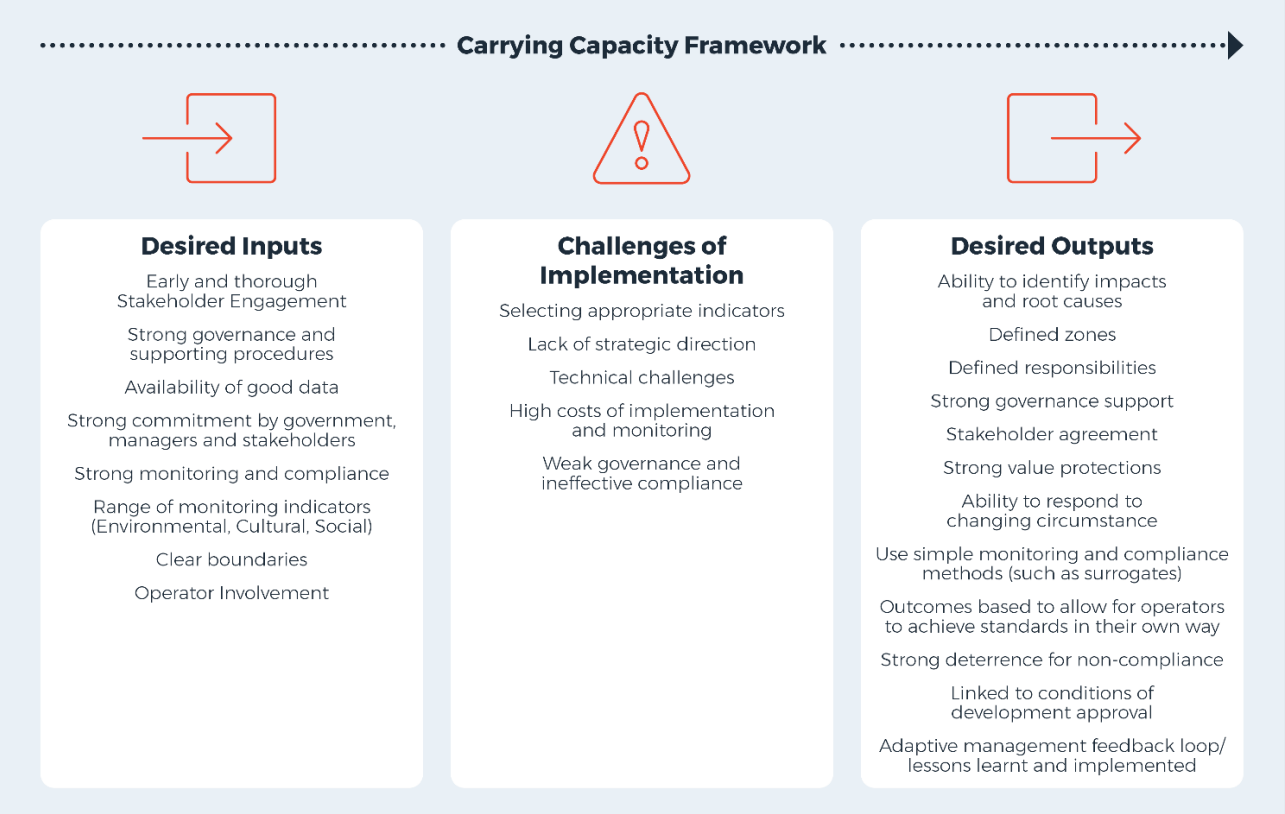


Figure 6.1 Key Framework requirements, challenges and outputs

6.2 OPPORTUNITIES AND CONSIDERATIONS

In consideration of the early assessment, existing regulatory and environmental framework, and coupled with the Snowy Mountains SAP process, an opportunity exists to develop and implement a CCF and methodology that uses these inputs to overcome common challenges involved in the establishment and operation of CCFs. For example:

- Many of the aspects of VERP framework are established or partly established through the details and operator requirements of KNP POM. These could be refined, enhanced, or modified as part of the snowy Mountains SAP master planning process, including:
  - the identification of key values and values objectives which are linked to the strategic direction of management topics, issues, or key processes
  - established EMS by key operators
  - established KNP zones where visitor impacts are most intensive, and
  - existing governance and supporting procedures though the Alpine SEPP and various legislation and guidelines.
- The Snowy Mountains SAP process has included extensive stakeholder engagement to allow for high level aspirations to be established, and concepts such as considering modifications to existing bed limits, or a new carrying capacity method to be introduced to the community, and key stakeholders. It has also allowed for a collaborative development process with NPWS, DPIE, Regional Growth NSW and technical specialists. There are also strong existing relationships between NPWS and Alpine resorts, along with a long history of co-operation and aligned understanding of issues and expectations of each.
- Frameworks can be costly to develop, implement and monitor, and can be limited by the availability of data and technical expertise. The combination of the existing technical expertise of NPWS, Alpine resort operators, and Snowy Mountains SAP lead technical specialists, can assist to overcome technical and cost associated challenges.
- NPWS, other government agencies, and operators have a long history of implementing environmental management requirements in KNP, which has generally resulted in positive environmental outcomes. There is therefore a strong commitment from operators and other stakeholders to maintain and protect key values of KNP. This commitment continues through the development of the Snowy Mountains SAP, and is likely to continue, especially as operators become more responsive to their social licences to operate.
- The Snowy Mountains SAP provides additional support to the use and expansion of existing strategic goals set out by the KNP POM. Particularly goals which have not traditionally been the focus of NPWS, such as establishing net zero emissions precincts or working towards establishing more climate resilient communities. It also allows the consideration of strategic master planning development, such as identifying areas considered most appropriate for future development opportunities.
- The Snowy Mountains SAP provides the ability to consider the physical capacity aspects that can be addressed by engineering (albeit with cost implications). i.e. the number of people that can be transported, sheltered, fed, and washed in a facility or area as per Australian guidelines. These features can be designed, costed, and fixed up-front in a development approval process. It also provides a process by which physical constraint issues such as areas of high biodiversity values, areas of bushfire risk, and buildings design (with aspirations around amenity) can be included. This allows for the front-end loading of some value protections in accordance with relevant legislation and guidelines.
- Consideration of the development of a Snowy Mountains SAP Precinct EMS to ISO,14001 standards to manage and regulate environmental management related issues. The EbD workshop identified the need to implement an additional amenity control. Consideration of a Comfortable Carrying Capacity should be incorporated into the CCF framework to manage and regulate some of these amenity values protections and guide any development opportunities which involve on-mountain activities.

6.3 SPECIFIC IMPLEMENTATION CHALLENGES IN KOSCIUSZKO NATIONAL PARK

There are still several challenges that remain regarding the implementation of an effective CCF in the Snowy Mountains SAP areas of KNP. This includes modifications or clarifications on responsibilities and governance arrangements, compliance, establishment of monitoring values, and alignment with the KNP POM.

6.3.1 RESPONSIBILITIES, GOVERNANCE ARRANGEMENTS AND COMPLIANCE

The following issues remain to be considered in a future Snowy Mountains SAP Precinct CCF:

- Currently, each AMU has individual governance arrangements, resulting in a complicated distribution of resources and responsibilities, which limits the capacity and influence of stakeholders in managing key values. Regulatory powers are split within AMUs. NPWS (DPIE) are responsible for compliance, and leasing under the NPW Act and regulations. Planning (DPIE) are responsible for development planning and consents, and various other NSW government agencies regulate specific items such as water resources. To address these complexities, a simplification of governance arrangements would be required for a CCF to function effectively in the Snowy Mountains SAP precincts in KNP. This has been further considered in the *Snowy Mountains SAP – Planning Recommendation Report* (Ramboll, 2021).
- A CCF requires strong monitoring, and compliance to work effectively, and result in a high level of value protections. It needs to be recognised that the Alpine resorts, have, and do comply with environmental standards, and it has always been in their best interest to maintain these standards to be competitive and profitable. More widely though there are times and events when good conditions are not maintained. Mostly these involve the difficulties of managing large numbers of visitors and their vehicles in winter, but also the technically complex situations associated with managing pests, weeds and erosion in a montane conversation setting. More productive partnerships and more consistent monitoring and compliance is required. An important aspect of the CCF is simply to standardise what good performance is, before going forward into any SAP development phase. Strong monitoring, and compliance is seen as important. This is a component of the public interest consideration required as an object of the NPW Act (s2A(3)(b))

6.3.2 ESTABLISHMENT OF MONITORING VALUES

The establishment of monitoring values and KPIs is one of the most challenging aspects of the CCF development.

- As discussed in section 6.2 and A1.3 monitoring indicators can be divided into physical, ecological / environmental and social. Physical indicators can generally be managed though engineering solutions whereas the ecological and social capacities are maintenance issues usually resulting from ‘wear and tear’ and over-use of resources. Although it is important to note that they are not mutually exclusive. Making a general distinction between classifying indicator types in this way recognises that the engineering and design aspects of a development’s impacts on the environment may be most effectively dealt with up front via the sustainability and environmental impact assessment requirements in a development approval process. Separating these indicators also makes it possible for the narrowing of the operational aspects of a CCF to one of maintaining environmental standards following post-development i.e. after the approval process has closed. This approach also enables possibilities of further narrowing the focus by putting aside environmental issues which are regulated by other statutes. Examples of these are impacts on threatened species cultural heritage, pollution, noise, and water extraction; requirements remain for operators and developers to continue to monitor these values and they continue to inform but are not the responsibility of the CCF.
- Resorts currently successfully work within the existing regulatory framework and may have concerns regarding any changes to their requirements. It will be important to consider operator inputs and for government and resorts to partner in the development of specific assessment, monitoring and response processes of values. Both these groups have significant experience in alpine resort management operations which should be capitalised on.

6.3.3 ALIGNMENT WITH THE EXISTING KNP POM

The KNP POM is a far-reaching and complex document. Consideration needs to be given to how to best align its management objectives and actions with Snowy Mountains SAP aspirations. In its current state, Chapter 10 of the KNP POM forms the basis of environmental management requirements, however, does not include all provisions which would apply to Resorts. A NPWS review has identified 159 PoM objectives/actions which could potentially apply to ski resort areas, some of which would appear to be redundant.

To address this, NPWS will be undertaking an amendment of the KNP POM in response to its review and to simplify the document and enable the SAPs whole of government proposals and policies. The review of the KNP PoM should consider the recommendations of this report and align with the Snowy Mountain SAP master plan and a future Alpine DCP.

6.4 THE NEXT STEP

In consideration of this assessment, and the specific requirements identified for an effective CCF suitable for the Snowy Mountains SAP precincts of KNP, this report suggests that the key aspects for a CCF already exist or are in development. With some additional actions and control mechanisms, an effective framework could be established that optimises development and environmental objectives and provides certainty into the future. This report recommends a CCF should be developed that:

- Retains a bed limit, to provide certainty for stakeholders, but allows for modification of the existing bed limit to an appropriate level based on the physical constraints identified during the master planning. Establishing new bed limits based on these physical constraints requires a series of assumptions on aspects such as accessibility, the ability to provide the infrastructure required to accommodate these new limits, and the design and amenity of any future development.
- Considers how the impacts of day visitation is managed and uses the Snowy Mountains SAP Master Plan to determine infrastructure requirements to manage those day visitors based on future growth projections.
- Considers ski resort capacities and recommends a CCC or ‘skiers at one time’ analysis to determine the need for on mountain alpine resort developments, and to manage visitor experience, amenity, and recreational activities. This could also consider requiring alpine resorts to publish daily on their website their ‘comfortable carrying capacity’ index for previous days and the expected index result for the current day. This is to make visitors aware of the crowding situation on the mountain before they travel.
- Requires resorts and/or authorities to submit travel time situation reports (for parking, train, or bus) for the previous days and the expected situation for the days ahead.
- Establishes a tiered approach to the establishment of ongoing environmental protections including monitoring, compliance, and response. This includes:
  - The Snowy Mountains SAP Master Plan and a future Alpine DCP to set strategic and high-level expectations around development opportunities in proposed development areas, including concepts and footprints.
  - The requirement for Alpine resort operators to implement and an ISO 14,001 Environmental Management System, as well as specific site area management requirements.
  - For smaller operators, include an alternate approach, utilising EMS with the aim of supporting and encouraging operators to implement an ISO 14,001 accredited EMS, or work towards the aims of the EMS to reduce environmental impacts in line with SAP expectations. Smaller operators would also develop EMSPs in collaboration with NPWS to manage site specific requirements.
- Uses monitoring and compliance methods (such as utilising surrogates and select KPIs regulated through the Alpine SEPP or by lease and license conditions) that are easy to implement and understand.
- Allows for changing circumstances and adaptive management. This may include set review timeframes to facilitate performance assessments and allow for the consideration of acceptable development standards and bed limits over time.
- Is based on outcomes to allow flexibility in how operators achieve standards.
- Must be agreed to as part of the conditions of development approval within the SAP framework, with ongoing performance linked to staged approvals in that process.

7 A PROPOSED SAP CARRYING CAPACITY FRAMEWORK

This chapter provides details of a proposed six stage CCF. The CCF is an attempt to utilise the SAP master planning process and existing KNP environmental management framework, to concurrently build a custom CCF and assess the current and future capacity constraints in the proposed Snowy Mountains SAP Precincts in KNP.

A visual representation of the six-stage CCF is shown in Figure 7.1.

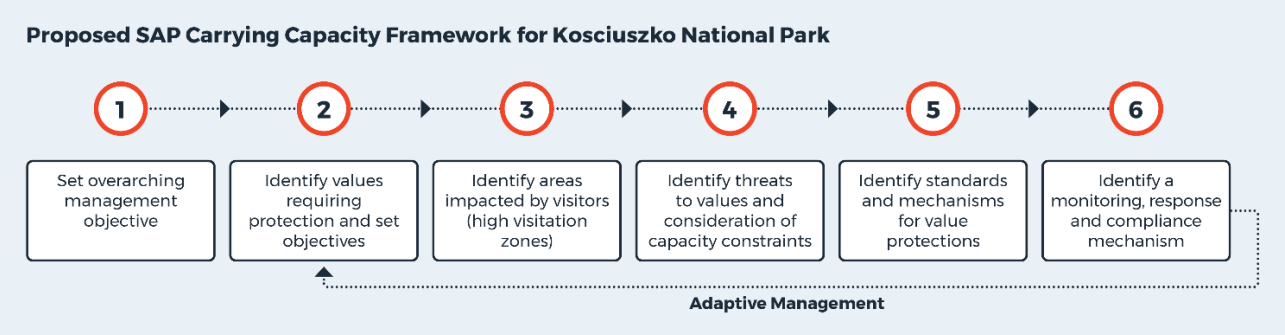


Figure 7.1 Proposed six stage carrying capacity framework for KNP

The structure and details of the CCF are based on the information provided in Chapters 1 through 6, engagement with key NSW government agencies and stakeholders, results of the Snowy Mountains SAP technical specialist studies and the outcomes of the Enquiry by Design workshops held in Thredbo in November 2020.

This CCF is structured as follows:

- Section 7.1 outlines Stage 1 by establishing proposed management objectives that would underpin the proposed CCF.
- Sections 7.2 outlines Stage 2 by identifying the values of KNP which require protection and proposes a series of high-level objectives for each value.
- Section 7.3 outlines Stage 3 by reviewing the draft structure plans, which set out the locations of proposed development opportunities (and thus identifies areas were visitor management is required). This section also provides a summary of proposed modifications to bed limits to set the context and guide infrastructure and management recommendations in 'key outcomes' sections of Stage 4.
- Section 7.4 outlines Stage 4 which includes several key steps of the CCF. These include:
  - identifying climate change risks to key values in KNP
  - identifying the existing conditions in relation identified values protections, and where possible capacity constraints
  - examining future projections and considerations to ensure values are protected and managed appropriately
  - a summary of key outcomes as they relate to value protections (i.e. what needs to happen to allow for additional development in KNP)
- Section 7.5 outlines Stage 5 by recommending key standards (where appropriate) and identifying the most appropriate mechanism for the protection of KNP values within the SAP master planning process.
- Section 7.6 outlines Stage 6 and identifies a proposed monitoring and response mechanism for the CCF.

7.1 STAGE 1 – CARRYING CAPACITY OBJECTIVES

The purpose of this section is to consider a SAP lead approach to establishing overarching management objectives for managers and operators in the SAPs of KNP. Table 7.1 contains a proposed approach to SAP-wide carrying capacity objectives for the Snowy Mountains SAP precincts of KNP.

Table 7.1 Proposed carrying capacity management objectives

PROPOSED CARRYING CAPACITY OBJECTIVES	
1	The master planning and preparation of the Alpine DCP undertaken under the Snowy Mountains SAP will define for each new or existing development area an upper limit on overnight accommodation as relevant to the site constraints identified during the SAP Master planning assessment - up to the end date of the SAP, currently 2061 (40 years).
2	Bed limits would be based on the constraints identified by the SAP master planning process and outlined in the draft structure plans to manage the impacts of overnight visitation.
3	At each stage of the expansion of a development opportunity area, the remaining available beds would be re-assessed and re-published for that development area, to ensure public and other supporting infrastructure does not exceed design limits.
4	Any significant future review of the master plan and or the sub precinct Alpine DCP will trigger stakeholder and public re-consultation including re-exhibition of the adjusted plans.
5	Prior to the granting of construction certificates for new developments, all required infrastructure upgrades would need to be included in the plans, and solutions to existing impacts from day visitation such as transport and access would need to be addressed.
6	All Alpine resort operators will operate under an Environmental Management System that meets ISO 14,001 and enables ongoing improvement of standards. The EMS will include KPIs representing the full set of legislated, locally regulated, and voluntary standards for environmental conditions applicable to each resort. Alpine resort operators would be required to show positive EMS performance prior to the granting of any additional bed limits in development precincts. In addition, a precinct wide EMS will apply to all operators. This will be part of the SAP approval framework and apply to all operators.
7	A carrying capacity approach is being applied via the Snowy Mountains SAP process, the Alpine SEPP and the KNP POM. Steps 1 through 4 outlined above is mostly inherent in the infrastructure design process. The carrying capacity framework detailed in this report is mostly limited to those specific elements not already expressed in the PoM or SAP framework or managed by other legislation. These being Step 5 – the establishment of standards, Step 6 – monitoring and response including the monitoring and regulation of key local environmental conditions to established standards, and the definition of adaptive processes to enable ongoing learnings.
8	Bed numbers for development opportunity areas would be defined by the master plans and detailed in the Alpine DCP for each development stage. The PoM would be revised to include the maximum bed numbers by sub precinct for the life of the SAP (i.e. 2061).
9	Day visitation will be managed through the structure plan, Alpine DCP and the Alpine SEPP, and include the requirement for consideration of amenity controls such as comfortable carrying capacity and the provision of infrastructure solutions to existing capacity constraints.
10	The plan of management will be amended by NPWS to ensure alignment with the final Snowy Mountains SAP and Alpine SEPP requirements.
11	All operators and visitors in the SAP Precincts of KNP demonstrate a commitment to protecting and enhancing the environmental, social, and cultural values of KNP, and will be held accountable for achieving standards and minimising impacts of visitor use. This will be achieved by ensuring all operations and authorised uses in the park are consistent with the SAPs carrying capacity objectives and the carrying capacity framework.

7.2 STAGE 2 – IDENTIFICATION OF KNP VALUES AND OBJECTIVES

7.2.1 PROPOSED SAP VALUES

In consultation with NPWS, DPIE, and building on existing work undertaken by NPWS, we have identified the following values or attributes that require protection or management under a future CCF. Table 7.2 outlines a high-level summary of values identified within EMS requirements of the KNP POM, and those recommended by the proposed CCF.

Table 7.2 General classification and values requiring protection

CATEGORIES	EXISTING MANAGEMENT VALUES STRUCTURE IN THE ALPINE MANAGEMENT UNITS	PROPOSED VALUE STRUCTURE
Environmental	Water quality, pollution prevention & incident management, biodiversity, cultural heritage, air quality & CO_2 emissions, energy conservation, waste management	Water quality (including alpine wetlands and riparian areas), water resources, biodiversity (including aquatic biodiversity), landscape (including soil resources), sustainability, climate change (CO_2 emissions and energy conservation, climate resilience, leadership).
Social	Sustainable recreation, resort amenity.	Sustainable recreation and community involvement, resort amenity & visitor experience, resort access / mobility.
Cultural	Cultural heritage	Aboriginal cultural heritage (sense of place, connection to land), built cultural heritage

7.2.2 PROPOSED SAP VALUE OBJECTIVES

This stage of the proposed CCF sets out the value objectives that will guide the KPIs and value protections. Where previous objectives remain appropriate in the new framework they have been retained.

Table 7.3 provides a summary of the proposed SAP Value management objectives. These objectives are based on the existing EMS KPIs and have been modified or added to where necessary to capture all values identified in the section above. Appendix C provides a summary of the environmental management objectives as they relate to the alpine resort EMS KPIs, which was used to identify any gaps in previously used management objectives.

Table 7.3 Summary of Proposed SAP Value Objectives

VALUE	OBJECTIVES
Water quality	Proposed water quality objectives include to: — protect the environmental health and aquatic ecosystems of alpine streams from development and visitor activities — protect, preserve, and enhance riparian and alpine wetland areas to ensure the protection of ecosystem functions, and water quality values — ensure the environmental condition of all watercourses and waterbodies is maintained or improved.

VALUE	OBJECTIVES
Water Resources	Proposed water resources objectives include to: — ensure the sustainable use of water resources in KNP and protect water resources from overuse — ensure all operators demonstrate a commitment to improving environmental standards and are accountable for minimising the impact of their activities — prevent and manage leaks, spills, and unlicensed discharges of potentially harmful substances to the environment.
Biodiversity	Proposed biodiversity objectives include to: — protect flora, fauna, and ecological communities to prevent loss of biodiversity — restore, maintain, and enhance vegetation and ecosystem functions in existing and previously disturbed areas — implement threat management actions to protect flora, fauna, and ecological communities
Landscape	Proposed landscape objectives include to: — prevent and manage leaks, spills, and unlicensed discharges of potentially harmful substances to the environment — ensure all environmental accidents, pollution events and contamination are responded to rapidly and effectively to protect park values and visitor safety — minimise waste, maximise resource recovery and prevent environmental harm from waste disposal.
Sustainability	Proposed sustainability objectives include to: — the Snowy Mountains SAP to be a national leader in environmental resilience and sustainability — invest in renewable energy, green infrastructure, and carbon sequestration — aim for a carbon negative future — develop opportunities to connect with nature — continue protections of the vulnerable alpine environment of KNP
Climate change	Proposed climate change objectives include to: — improve, reduce, or offset carbon dioxide (CO_2) emissions — ensure all operators and new developments consider future climate change — improve the efficiency of energy consumption and increase the use of renewable energy — ensure all operations and activities are undertaken in ways that minimise the production of greenhouse gas emissions.
Sustainable recreation and community involvement	Proposed recreation and community involvement objectives include to: — ensure the recreational opportunities and facilities of the Alpine resorts are provided and managed sustainably — ensure a range of recreational activities are available to suit — encourage community cooperation and involvement in the management of KNP values.
Resort amenity	Proposed resort amenity objectives include to: — conserve and enhance the existing amenity of the Alpine resorts and surrounding areas — ensure scenic quality within the KNP SAP Precincts is maintained and, wherever possible, enhanced.

VALUE	OBJECTIVES
Visitor experience	Proposed visitor experience objectives include to: — ensure visitors to the Alpine resorts have an enjoyable and safe experience. — ensure visitors have a range of recreational activities available.
Aboriginal cultural Heritage	Proposed Aboriginal cultural heritage objectives include to: — conserve and promote the aboriginal cultural heritage values of the alpine resort areas, including promoting and enhancing sense of place and connection to country. — identify, protect, and manage aboriginal heritage sites
Built cultural heritage	Proposed built cultural heritage objectives include to: — conserve and promote built cultural heritage values — identify, protect, and maintain built cultural heritage sites

7.3 STAGE 3 – SAP PRECINCTS AFFECTED BY VISITORS AND PROPOSED STRUCTURE PLANNING

As part of the Snowy Mountain SAP master planning, a series of draft structure plans have been developed by Jensen Plus (2021) (draft structure plans). The draft structure plans are a key input into the developing the draft master plan for the precinct, including areas of KNP.

The structure plans for KNP focus on infill and improvement of facilities in the existing Alpine resort areas of Thredbo, Charlotte Pass and Perisher, as well as locations with potential developable areas. It should be noted, no structure plans have been developed for Selwyn due to the ongoing recovery from the 2020 bushfires. The identification of these areas is key component of the CCF, as these are considered the areas which have the greatest potential for impacts associated with visitor use and require the greatest level of management response.

The structure plans have been developed with consideration of key design principles aimed at preserving key values of each area. To do this the plans focus on:

- Touching the ground lightly by:
  - limiting development to disturbed areas to limit cumulative impacts
  - moving towards resort consolidation and renewal
  - delivering on ecological sustainable design principles.
- Focusing on the creation al alpine villages as community and visitor focus points, with defined gateways and connectivity.
- Strengthening alpine resort areas and other locations for year-round activities and ensuring improvements and diversity of accommodation (including appropriateness for year-round activation).
- Ensuring design elements are appropriate with the alpine setting and conditions, and distinct to precinct characteristics.
- Planning for new infrastructure to support the existing and future visitation, including new transport and access choices.

Figure 7.2 and Figure 7.3 shows the proposed Snowy Mountains SAP sub-precincts located within the boundary of KNP.

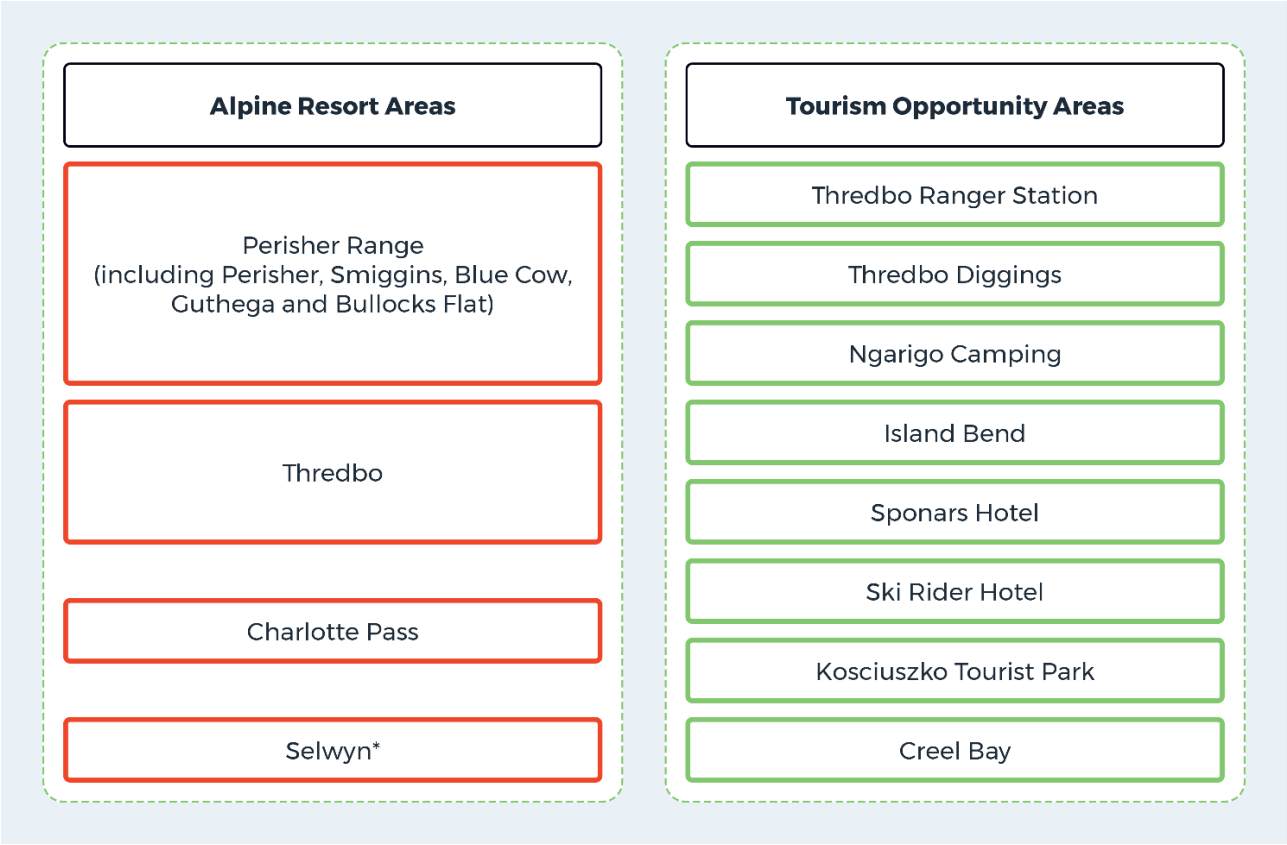


Figure 7.2 Snowy Mountains SAP Sub-Precincts within Kosciuszko National Park

* No structure plan has been proposed for Selwyn. There are no proposed changes to the existing capacity for the Selwyn Mountain report area.

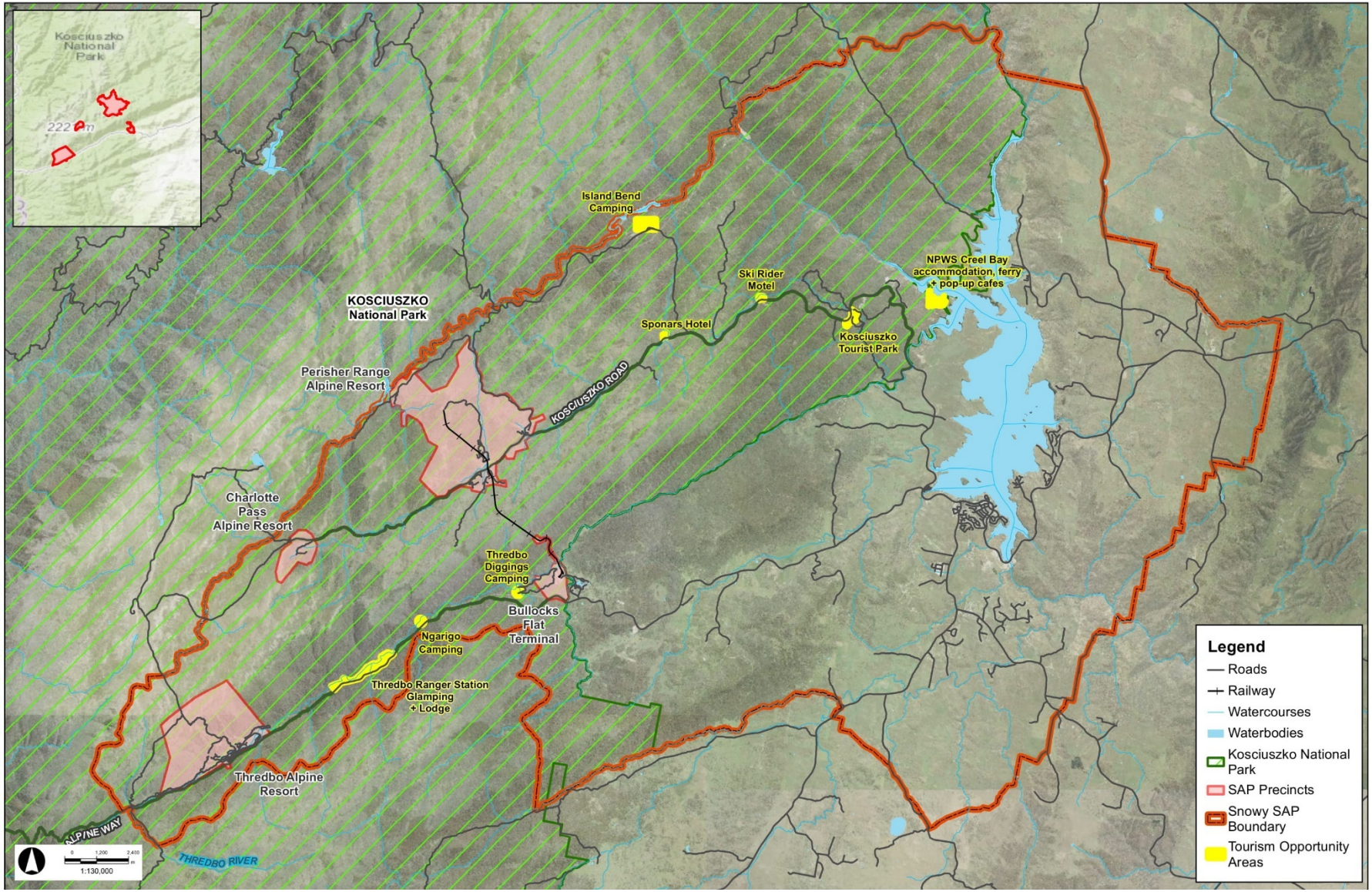


Figure 7.3 SAP Alpine resort and Tourism opportunity areas

7.3.1 ALPINE RESORT AREAS

7.3.1.1 THREDBO

Based on this carrying capacity review and other technical specialist reports, the following key attributes require protection or consideration for any proposed development in the Thredbo alpine resort area.

- The Thredbo village is the only true alpine village located in NSW, it contains a high level of amenity value and provides a key route for backcountry access, including direct access (via chairlifts and walking trails) to the Kosciuszko walk and access to the main range.
- The Thredbo River is the key waterway that traverses Thredbo. The river has a catchment for around 34 km2 upstream of the Thredbo village, and 52 km2 downstream. The river contributes around 69% of the average annual flow into Lake Jindabyne.
- Thredbo is a key summer destination in KNP, attracting visitors and offering alternative recreational activities such as an extensive network of downhill mountain bike trails (with chairlift access), and several summer events.
- Cultural significance including built environment and all alpine rivers.
- The presence of ecological communities and threatened species, including the inclusion of the Thredbo River as part of the Snowy River Endangered Ecological community.

7.3.1.2 PERISHER RANGE

Based on this carrying capacity review and other technical specialist reports, the following key attributes require protection or consideration for any proposed development in the Perisher Range resort area.

- Key waterways adjacent to the main alpine resort areas include Perisher Creek, Pipers Creek, Spencers Creek, while the key waterway adjacent to Bullocks Flat is the Thredbo River. These waterways contain a high level of catchment value for both quantities and quality for downstream users including hydro-electrical generation. All the tributaries of the Snowy River form part of the Snowy River Endangered Ecological community.
- The area also contains many alpine peat and bogs in lower areas of the Alpine resorts and adjacent to roadways, accommodations and parking areas which contain a high level of ecosystem value.
- The Perisher Alpine Resort is one of Australia's largest resort areas and contains some of the highest alpine accommodation numbers in NSW.
- Bullocks Flat provides unique non-vehicle access to Perisher and Charlotte Pass resort areas.
- The presence of ecological communities and threatened species

7.3.1.3 CHARLOTTE PASS

Based on this carrying capacity review and other technical specialist reports, the following key attributes require protection or consideration for any proposed development in the Charlotte Pass resort area.

- Ecosystems associated with the upper catchment wetlands.
- Key waterways located downstream and adjacent to the Charlotte Pass alpine resort include Spencers Creek and the Snowy River. These waterways contain a high level of catchment value for both quantity and quality for downstream users including hydro electrical generation. All the tributaries of the Snowy River form part of the Snowy River Endangered Ecological community.
- Items of cultural heritage significance.

- A small village atmosphere which contains several ski clubs, is set in the highly aesthetic Spencers Creek valley with significant landscape elements (and value) and is the only Alpine resort in Australia that does not have road vehicle access during the winter.
- Key access route for backcountry skiers and hikers including the Mount Kosciuszko summit walking trail.

7.3.2 ALPINE RESORT STRUCTURE PLANS

7.3.2.1 THREDBO

The draft Structure plan for the Thredbo aims to build on the existing village character with a focus on infrastructure improvements for pedestrian connectivity, as well as long term public transport accessibility. The main development opportunities include significant infill development the main village area, and some low-density expansion in the west of the village. It is based on a total developable area of 9.03 hectares and would allow for an increase to the Alpine resort area bed limit to a maximum of 6,444 beds, and increase in commercial space of 2,035m^2 (Figure 7.4).

Further information, including detailed illustrations are included in section 8.17 of the *Draft Structure Plans* (Jensen Plus, 2021).

Figure 7.4 Thredbo Village – Proposed development and bed limits modifications

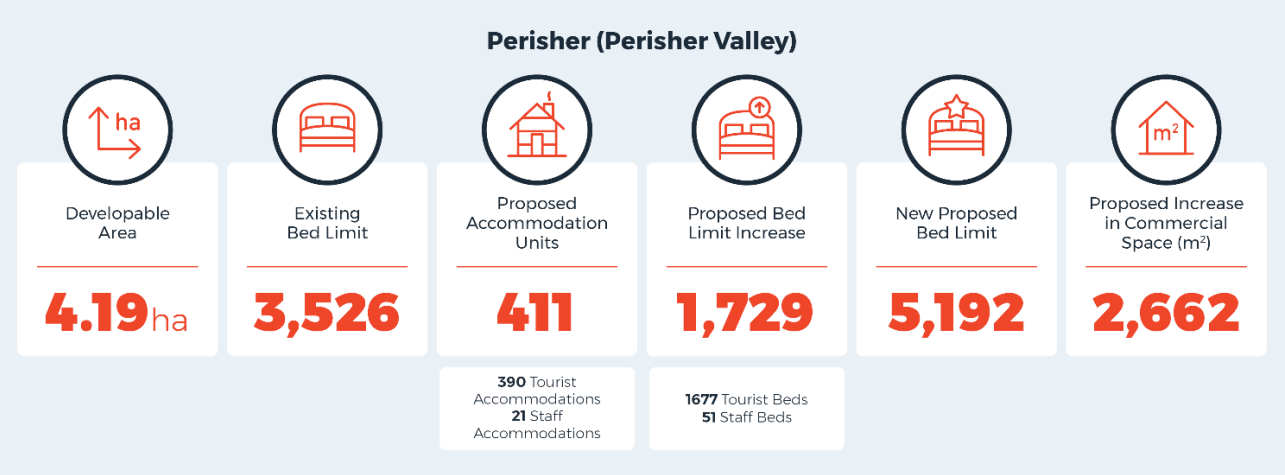
7.3.2.2 PERISHER

The draft structure plan for perisher has been divided into individual precincts within the overall Perisher Alpine resort area. Individual areas where developments are proposed include Perisher Valley, Smiggin Holes, Bullocks Flat and Guthega. No preferred developments have been identified at Blue cow, which has been excluded from the draft structure plan.

PERISHER VALLEY

The draft structure plan has identified a series of development opportunities in the Perisher Valley, which forms part of the Perisher alpine resort area. The development opportunities are based on a total development area of 4.19 hectares and would allow for increases in the existing bed limit to a maximum of 5,192 beds, and an increase in commercial space of 2,662 m^2 (Figure 7.5).

Further details are included in section 8.7 of the *Draft Structure Plans* (Jensen Plus, 2021).



Note: Perisher Range (floating bed limits) have been included in this figure.

Figure 7.5 Perisher (Perisher Village) – Proposed development and bed limits modifications

SMIGGIN HOLES

The draft structure plan has identified a series of development opportunities at Smiggin Holes, which forms part of the Perisher alpine resort area. The development opportunity is based on a total development area of 0.23 hectares and would allow for an increase in the existing bed limit to a maximum of 1,095 beds, and an increase in commercial space of 1,200 m^2 (Figure 7.6).

Further details are included in section 8.9 of the *Draft Structure Plan* (Jensen Plus, 2021).

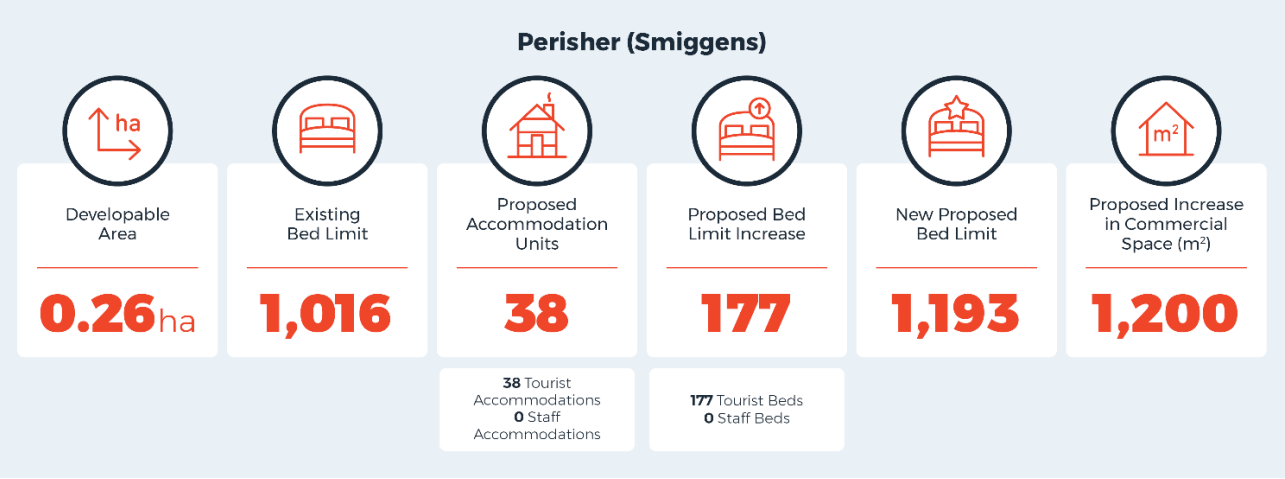


Figure 7.6 Perisher (Smiggin Hole) – Proposed development and bed limits modifications

GUTHEGA

The draft structure plan has identified a small-sale development opportunity at Guthega, which forms part of the Perisher Alpine Resort area. The development opportunity focuses on the re-development of camping facilities.

There is no provision for the modification of existing bed limits at Guthega. Camping facilities would be designed to meet capacity requirements of the proposed number of camping sites. The area available for development would be confirmed on completion of all Snowy Mountains SAP technical studies.

Further details are included in section 8.10 of the *Draft Structure Plan* (Jensen Plus, 2021).

7.3.2.3 CHARLOTTE PASS

The draft structure plan has identified development opportunities at Charlotte Pass, with a key aim of developing the alpine village as a key summer node. The development opportunities are based on the availability of 0.46 ha of developable land (including some re-developments) and would allow for an increased bed limit up to 845 beds, and an additional area of commercial space of 2,010m^2 (Figure 7.7).

Further details are included in section 8.4 and 8.5 of the *Draft Structure Plan* (Jensen Plus, 2021)

Figure 7.7 Charlotte – Proposed development and bed limits modifications

7.3.2.4 SELWYN

No structure plan has been established for Selwyn. There are no proposed changes to the existing capacity for the Selwyn Mountain report area.

7.3.3 TOURISM OPPORTUNITY AREAS

The Snowy Mountains SAP master planning process has identified the following Tourism opportunity areas (TOAs). These areas have been selected as TOAs based on several factors, including, but not limited to, existing land use, level of existing disturbance, location and proximity to Alpine resort areas, and visual amenity.

7.3.3.1 THREDBO RANGER STATION, THREDBO DIGGINGS & NGARIGO CAMPING

The Thredbo Ranger Station, Thredbo Diggings and Ngarigo camping areas are three proposed TOAs located along Alpine Way between Bullocks Flat and the Thredbo Village.

- The Thredbo Diggings Campground is located adjacent to the Thredbo River and contains unmarked sites and basic camping facilities including non-flushable toilets. The sites are accessible by 2WD vehicles and open year-round. There are opportunities for continued use as a camping area with an improvement to existing facilities rather than any large expansion.
- The Ngarigo Campground located adjacent to the Thredbo River contains unmarked and unpowered sites with picnic tables, BBQ facilities and toilets. The sites are open year-round. There are opportunities for continued use as a camping area with an improvement to existing facilities rather than any large expansion.
- The Thredbo Ranger Station is an area of buildings used by NPWS for general operations activities. There is currently no public access to the site. The site has strong potential for development. Its proximity to the Thredbo River, existing mountain biking and walking trails, direct access to the Alpine way, and existing buildings could provide for several development opportunities.

Based on this carrying capacity review and other technical specialist reports, the following key attributes require protection or consideration for any proposed development in these three areas:

- the proximity to the Thredbo River, and their potential to impact water quality
- the availability of a suitable source of water and limitations of extraction licences
- transport and access considerations (in both summer and winter)
- amenity and biodiversity considerations of the Thredbo Valley
- the provision of adequate infrastructure to service any anticipated increase in capacity.

7.3.3.2 ISLAND BEND

Island Bend is a disturbed area currently utilised as a campground located around 17 km from Perisher Village. The campground, located adjacent to Guthega Road and the Snowy River, contains 30 sites with picnic tables, barbecue and toilet facilities. 4WD access can be required during wet weather to access the lower portion of the campground. The site offers the greatest potential for an expansion of existing camping facilities in KNP. The site also has historic potential as the former camping grounds for the Snowy Hydro Scheme.

The following key attributes of Island Bend require protection or consideration in any proposed development:

- the proximity to the Snowy River, and potential to impact water quality
- the availability of a suitable source of water and limitations of extraction licences
- infrastructure capacities associated with any increase in camping capacity
- transport and access considerations (in both summer and winter)
- amenity and biodiversity considerations.
- The built cultural heritage significance including former worker camps in the area associated with the early Snowy Hydro works.

7.3.3.3 SPONARS CHALET

The Sponars Chalet is located on Kosciuszko Road around 9 km from the Perisher Village. The area is located at an altitude of 1500 metres and provides additional accommodation in KNP outside of the key alpine resort areas. The KNP POM currently allows a total of 100 beds in the hotel. The site is located adjacent to Diggers Creek. The site is currently popular in winter due to its proximity to Perisher, and its affordable rates. However, the potential for summer development is considered limited due to its location away from key recreational areas.

The following key attributes of the Sponars Chalet area require protection or consideration in any proposed development:

- the proximity to Diggers Creek, alpine wetlands, and the potential to impact water quality
- infrastructure requirements associated with any increase the hotel capacity
- winter transport and access considerations
- amenity and biodiversity considerations of the Thredbo Valley
- any potential heritage value of the existing facilities.

7.3.3.4 SKI RIDER HOTEL

The Ski Rider Hotel is located on Kosciuszko Road around 13 km from the Perisher Village. The hotel provides additional accommodation in KNP outside of the key alpine resort areas, with a free shuttle bus service to access Perisher and Smiggin Holes. The hotel is a full-service hotel, offering accommodation, food, entertainment, and onsite ski equipment hire. The KNP POM currently allows a total of 339 beds in the hotel. The site is located adjacent to Sawpit Creek and the surrounding areas are heavily vegetated with native bushland. As with Sponars Chalet the site is currently popular in winter due to its proximity to Perisher, and its affordable rates. However, the potential for summer development is considered limited.

The following key attributes of the Ski Rider Hotel require protection or consideration in any proposed development:

- the proximity to Sawpit Creek, and potential to impact water quality
- infrastructure requirements associated with any changes to the hotel capacity
- winter transport and access considerations
- biodiversity constraints associated with native vegetation communities located around the site.

7.3.3.5 KOSCIUSZKO TOURIST PARK

The Kosciuszko Tourist Park is located on Kosciuszko Road around 17.5 km from the Perisher Village and 16 km from Jindabyne. The park contains multiple accommodation options including chalets, cabins, caravan sites and camping facilities, with the KNP POM currently allowing for a total of 72 beds (Kosciuszko Mountain Retreat). As with Sponars Chalet and Ski Rider, the park provides additional accommodation in KNP outside of the key resort areas. It is also the only campsite in KNP that provides shower, indoor cooking, and communal areas. The site is set among native bushland, adjacent to Sawpit Creek.

The following key attributes of the Kosciuszko Tourist Park require protection or consideration in any proposed development:

- the proximity to Sawpit Creek, and potential to impact water quality
- infrastructure requirements associated with any changes to the chalet, cabin, caravan or camping sites
- winter transport and access considerations
- biodiversity constraints associated with native vegetation communities located around the site.

7.3.3.6 CREEL BAY

Creel Bay is located within KNP around 24 km from Perisher via Kosciuszko Road. NPWS have recently expanded existing cottage style accommodations providing additional year-round opportunities adjacent to Lake Jindabyne. There is good opportunity for further year-round development at this location.

The following key attributes of the Creel Bay require protection or consideration in any proposed development:

- the proximity to Lake Jindabyne and potential to impact water quality
- infrastructure requirements associated with any changes to accommodation capacity
- winter transport and access considerations
- biodiversity constraints associated with native vegetation communities located around the site.

7.3.4 TOURISM OPPORTUNITY AREA STRUCTURE PLANS

The SAP structure plans outlines several development opportunities within areas identified as TOAs. These areas have been identified as the most appropriate sites for development within KNP.

7.3.4.1 THREDBO RANGER STATION

The draft structure plan for Thredbo Ranger Station supports the re-development of the area as a small eco-tourist destination with potential options including a fishing lodge and associated nature based sustainable tourism, including glamping accommodations. Specifically, it supports:

- redevelopment of the site as an ‘exclusive’ trout fishing lodge and/or glamping tents (nature-based tourism), with a maximum of 20 lodge rooms, and 30 glamping sites/cabins
- site remediation and revegetation of cleared areas. Further detailed analysis will be required to define specific developable areas
- re-establishment of the site, and removal of non-endemic species
- reuse and upgrade of the existing main building (subject to feasibility analysis)
- upgrades to site access.

The Thredbo Ranger Station development opportunity would allow for the establishment of a new TOA bed limit of 100 beds and is based on a developable (eco-tourism) area of 5.6 hectares (Figure 7.8). Given the type of development opportunity proposed, there is no provision for new commercial space at the TOA, however the Draft structure plan notes an onsite restaurant/lounge may be an option.

Further information, including detailed illustrations are included in section 8.18 of the *Draft Structure Plan* (Jensen Plus, 2021).

Figure 7.8 Thredbo Ranger Station – Proposed development and bed limits establishment

7.3.4.2 THREDBO DIGGINGS AND NGARIGO CAMPING

The draft structure plan does not provide a provision for the establishment of bed limits at Thredbo Diggings or Ngarigo Camping areas. Upgraded camping facilities would be designed to meet capacity requirements of the proposed number of camping sites.

Basic details including areas considered suitable for campground improvements are shown in section 8.19 and 8.20 of the *Draft Structure Plan* (Jensen Plus, 2021).

7.3.4.3 ISLAND BEND

The draft structure plan for Island bend supports the development and expansion of camping and associated nature-based uses and facilities. Specifically, the plan provides:

- additional camping areas
- opportunities for tourist cabins
- lookouts and walking loops
- bushfire safety retreat or bunker
- rehabilitation of the former old town camp
- emphasis on low impact development with minimal clearing or other environment impacts.
- development of connections to the Snowy valley walk.

There is no provision for the establishment of bed limits at Island Bend camping area. Upgraded camping facilities would be designed to meet capacity requirements of the proposed number of camping sites. The area available for development would be confirmed on completion of all Snowy Mountains SAP technical studies.

Further information, including detailed illustrations are included in section 8.15 of the *Draft Structure Plan* (Jensen Plus, 2021).

7.3.4.4 SPONARS CHALET

The draft structure plan for Sponars Chalet supports the development which focuses on upgrading the existing facilities and allowing for potential future expansion of new buildings and accommodation options. Specifically, the plan provides:

- a re-development area has been identified which covers the existing building footprint and surrounds
- a new potential development area has been identified, extending to the south and west of the existing building footprint and re-development area
- establishment of walking tracks
- development of a watercraft landing or jetty
- modification of the existing bed limit to a maximum 222 beds for tourist accommodations
- development opportunity for an additional 500m2 of commercial space.

The Sponars Chalet development opportunity would allow for an increase to the TOA bed limit to a maximum 222 beds, an increase in commercial space of 500m^2 and is based on a total developable area of 3.15 hectares (Figure 7.9).

Further information, including detailed illustrations are included in section 8.12 of the *Draft Structure Plan* (Jensen Plus, 2021).

Figure 7.9 Sponars Chalet – Proposed development and bed limit modifications

7.3.4.5 SKI RIDER

The draft structure plan for Ski Rider supports the development which focuses on changes to the existing motel and improvements to the supporting infrastructure. Specifically, the plan supports:

- a new staff accommodation block
- improved and expanded accommodation though height increases
- refurbishment of the existing building (bar, bistro, accommodation units)
- upgrades to roads and amenities
- upgrade or replacement of the existing STP
- improvements to the entry and exit of the resort.

The Ski Rider development opportunity is based on a developable area of 1.4 hectares, it does not allow for a modification of the existing bed limits or an expansion of commercial space (Figure 7.10).

Further details are included in section 8.13 of the *Draft Structure Plan* (Jensen Plus, 2021).

Figure 7.10 Ski Rider – Proposed development and bed limit modifications

7.3.4.6 CREEL BAY

The draft structure plan supports future development that aligns with existing master planning at the site. It includes a developable area of 8.16ha and supports additional cottages, camping sites, and day use areas on lake Jindabyne. The structure plans would also allow for the activation of waterfront areas on the lake (Figure 7.11).

Further details are included in section 8.16 of the *Draft Structure Plan* (Jensen Plus, 2021).

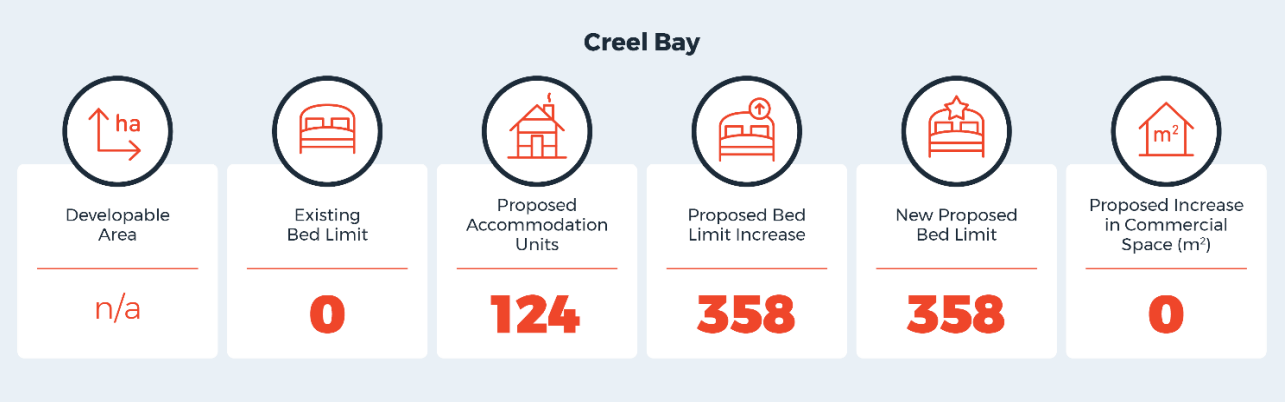


Figure 7.11 Creel Bay – Proposed development and bed limit modifications

7.3.4.7 KOSCIUSZKO TOURIST PARK

The structure plan for Kosciuszko Tourist Park provides for improvements and expansion of the existing area to include:

- new three-star accommodation
- upgrades to the existing education centre
- connection and return to country opportunities
- establishment of park and ride facilities
- links to walking trails.

Section 8.14 of the *Draft Structure Plan* (Jensen Plus, 2021) provides additional details including a visual representation of the structure plan.

7.4 STAGE 4 – SNOWY MOUNTAINS SAP PRECINCTS, VALUES AND CONSIDERATION OF CAPACITY CONSTRAINTS

Stage 4 of the CCF provides an assessment of the potential impacts of the proposed Snowy Mountains SAP on the values of high proposed SAP precincts in KNP. specifically, this section:

- identifies climate change risks to key values in KNP
- identifies the existing conditions in relation identified values protections, and where possible capacity constraints by key factors.
- examining future projections and considerations to ensure values are protected and managed appropriately
- provides a summary of key outcomes as they relate to value protections (i.e. what needs to happen to allow for additional development in KNP).

7.4.1 CLIMATE CHANGE

Climate change poses a significant challenge to the NSW Alpine Region. WSP completed an assessment of the climate change impacts as related to the KNP carrying capacity review (Appendix D). The assessment (included the following three tasks:

- A summary of the climate change projections produced as part of the NSW/ACT Regional Climate Modelling (NARCLiM).
- A climate change risk assessment (Table E.2 in Appendix D) to highlight the key climate change risks that have the potential to impact the carrying capacity of the KNP.
- An assessment of the implications of climate change on snowmaking and the flow-on impacts for energy and water consumption.

7.4.1.1 CLIMATE PROJECTIONS

In 2018/2019 the DPIE carried out a detailed study of models produced as part of the NSW/ACT Regional Climate Modelling (NARCLiM) project. The purpose of the study was to provide annual, monthly and seasonal future climate projections specifically for the Alpine Region and surrounds.

Key observations from the projections include:

- increase in mean maximum temperatures in the near (2030) and far future (2070) across all seasons
- large decreases in the number of cold nights (-2ºC) and increases in mean minimum temperatures
- more dry days with large reductions in precipitation in winter and spring
- projected reduction in precipitation is greatest in winter and spring and significant reductions in natural snowfall are expected during the snow season
- increases in the annual mean Forest Fire Danger Index (FFDI).

A full summary of climate change projections is included in Table D.1 in Appendix D.

7.4.1.2 CLIMATE CHANGE RISK ASSESSMENT

To inform the development of a CCF, WSP completed a preliminary climate change risk identification process to highlight the ways in which climate change may affect the carrying capacity of KNP in the future. These risks have then been linked to the existing EMS KPIs discussed in Section 4.6.

The purpose of this process is to highlight how these climate change risks could influence existing KPIs, either by altering KPI baselines or influencing the ability for these KPIs to be achieved by alpine resort management and/or

NPWS. This process would assist in driving a more detailed consideration of climate change impacts in the establishment of future guidelines for managing visitor impacts and the carrying capacity of KNP.

In summary climate change impacts and related responses in KNP has the potential to impact water quality, energy conservation, resort amenity, air quality and CO_2 emissions, biodiversity and recreational activities. A detailed summary of these potential impacts is included in Table D.2 in Appendix D, and where applicable have been incorporated into the relevant specialist areas in Sections 7.4.5 to 7.4.13.

7.4.1.3 CLIMATE CHANGE & ARTIFICIAL SNOWMAKING

Artificial snowmaking is currently used in Australia and around the world to complement natural snowfall and extend the ski season. Typically, artificial snowmaking in the alpine resort areas of KNP commences in early May and continues through to August. Snowmaking may continue into September depending on snow coverage and weather conditions.

Snowmakers generally operate from late afternoon through to the early morning, during periods when optimal ambient snowmaking conditions occur (below -2ºC wet bulb). Snowmakers may run 24 hours a day if required.

Snowmaking is an energy and water intensive process and makes up a significant amount of winter energy and water demand at Perisher, Thredbo and Selwyn resorts. The increased requirement for artificial snowmaking would result in additional demand for water and energy. This increase in demand is discussed in Section 7.4.12.

7.4.2 FUTURE GROWTH PROJECTIONS

Future population forecasts were provided by the Centre for International Economics (CIE) in their Context Report "Strategic economic context for the Snowy Special Activations Precinct" (CIE, 2020) and revised forecasts of visitation and population (CIE, 2020a). To assess the potential impacts of the future growth in visitor numbers sections of the assessment of this assessment (where appropriate) have considered growth in peak overnight visitors (in the month of August) will change from 18,275 in 2020 to 30,860 in 2039 and then a decline to 24,655 by 2061 – an increase of 3.2 per cent per annum between 2020 and 2039. These numbers have been used to determine where any exceedances to capacity constraints exist, and where possible, the likely infrastructure requirements to manage visitors and protect key values.

7.4.3 OVERNIGHT VISITATION

7.4.3.1 EXISTING CONDITIONS AND PROPOSED MODIFICATIONS

As discussed in Chapter 5, the existing mechanism for managing overnight visitors in KNP is based on the establishment of bed limits in each Alpine resort area, and surrounding support areas. As part of the proposed CCF and based on the inputs of the draft structure plan, there are a number of development opportunities which would allow for a modification to the existing bed limits.

Table 7.4 provides a summary of the proposed modifications to bed limits in the Alpine resort areas.

Table 7.5 provides a summary of the proposed establishment and/or modifications to bed limits for TOA's.

The proposed modifications have been informed by the Snowy Mountains SAP technical studies, Alpine resort EbD workshops, as well as consultation with the community, relevant government agencies, commercial entities, and technical consultants.

Table 7.4 Proposed modification to bed limits in Alpine Resort areas

SNOWY MOUNTAINS SAP PRECINCT (ALPINE RESORTS)	EXISTING BED LIMIT	PROPOSED INCREASE IN BED LIMIT	PROPOSED NEW BED LIMIT
Perisher Range	**4937**	**1906**	**6780**
Mt Blue Cow	25	0	25
Bullocks Flat	40	0	40
Guthega	330	0[1]	330
Smiggin Holes	1016	177	1193
Perisher Village	3526	1729	5192
Perisher Range (Floating beds)[3]	*174*	*0*	*174*
Thredbo	**4810**	**1634**[2]	**6444**
Charlotte pass	**607**	**238**	**845**
Selwyn	**50**	**0**	**50**
Total	**10,404**	**3,778**	**14,119**

Source: Structure Plan, Yield Analysis, Jensen Plus, 2021

1. No additional beds limit proposed, additional basic camping only assigned – no bed limit adjusted.
2. Assumes 1126 new beds from development
3. Excluded from totals

Table 7.5 Proposed modification / establishment of bed limits in Tourism opportunity areas

SNOWY MOUNTAINS SAP PRECINCT (TOURISM OPPORTUNITY AREAS)	EXISTING BED LIMIT	PROPOSED INCREASE IN BED LIMIT	PROPOSED NEW BED LIMIT
Thredbo Ranger Station[3]	0	100	100
Ski Rider	339	0[2]	339
Sponars chalet	100	122	222
Thredbo Diggings / Ngarigo Camping/ Island Bend[1]	0	100	100
Creel Bay[4]	0	358	358
Kosciuszko Tourist Park	72	50[1]	122
Total	**511**	**730**	**1241**

Source: Structure Plan, Yield Analysis, Jensen Plus, 2021

1. Bed limits are assigned to additional cabin or camping beds
2. Assumes redevelopment, but no additional dwellings.
3. Bed limits are assigned to lodges and glamping/cabins
4. Beds are assigned accommodation dwellings with 62 camp sites and 46 cottage beds.

7.4.3.2 CAPACITY CONSTRAINTS AND FUTURE CONSIDERATIONS

The projected growth in visitor bed night demand vs the existing bed limit as outlined in the KNP POM and proposed bed limit uplift for Perisher (and accommodation providers along Kosciuszko Road) is shown on Figure 7.12. The figure shows a theoretical increase in the bed limit (in line with the proposed uplift) in 2024.

The proposed bed limits at these locations total 530. The results show that based on the proposed uplift in the bed limit, demand would exceed the availability of beds by 2032. Beyond this period, any additional demand for overnight accommodation would need to be provided outside of KNP.

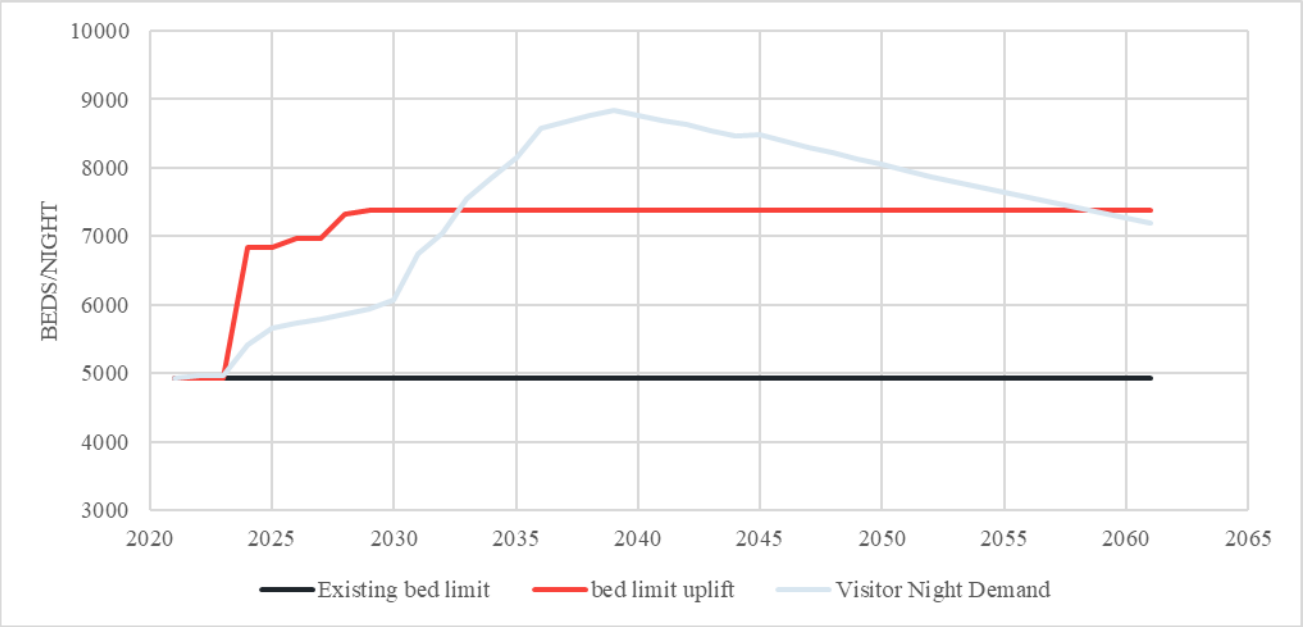


Figure 7.12 Perisher (and surrounds) bed limit vs proposed growth scenario provided by CIE (2020)

It should be noted that proposed uplift or the establishment of new bed limits along Kosciuszko Road (Sponars chalet, Creel Bay or Kosciuszko National Park) has also been included (and for the purpose of this figure, staged between 2026 and 2029). The results show that based on the proposed uplift in the bed limit, demand would exceed the availability of beds by 2032. Beyond this period, any additional demand for overnight accommodation in the Perisher Valley would need to be provided outside of KNP.

Figure 7.13 shows the projected growth in visitor bed nights vs the existing and proposed bed limit uplift for Thredbo. The figure shows a theoretical increase in the bed limit (in line with the proposed uplift) in 2024.

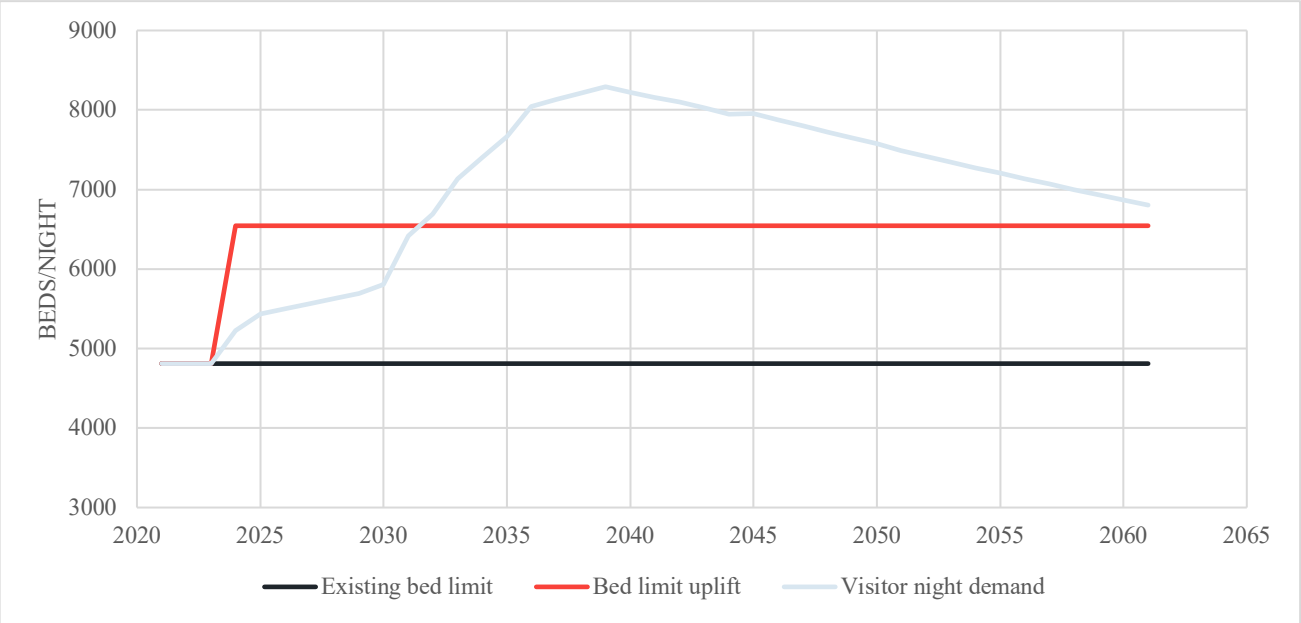


Figure 7.13 Thredbo (and surrounds) Bed limit vs proposed growth scenario provided by CIE (2020)

It should be noted that proposed uplift or the establishment of new bed limits along Alpine way (Thredbo Ranger Station - 100) has also been included (excluding proposed camping sites as these are less likely to be occupied during winter months). The results show that based on the proposed uplift in the bed limit, demand would exceed the availability of beds by 2032. Beyond this period, any additional demand for overnight accommodation in the Thredbo Valley would need to be provided outside of KNP.

Figure 7.12 and Figure 7.13 assumes available beds would not be filled immediately. However, based on known vacancy rates at Alpine resorts, it would be expected that any available bed space is filled immediately during peak winter months. As a result, these number should be viewed in terms of overall capacity vs growth projections to assist in development of the SAP Master Plan and understanding the physical capacity constraints associated with SAP precincts in KNP.

7.4.3.3 KEY OUTCOMES

The assessment of bed limits and bed limit uplifts in KNP, shows that based on proposed growth scenarios (CIE, 2020), the demand for overnight accommodation would exceed the supply. Given the low vacancy rates in Alpine resorts during winter months, this is likely to occur in the short term (rather than the 2032 outlook provided). The proposed bed limit uplifts are based on known constraints which have been identified during the Snowy Mountains SAP master planning process, and thus provide an upper limit on the development potential in KNP.

It is therefore recommended that bed limits outlined in the draft structure plan form the basis of development within the proposed SAP precincts. Any additional development to meet the expected visitor growth demand should be managed by providing accommodation outside KNP and ensuring a suitable mass transit system is developed into any future planning.

7.4.4 VISITOR EXPERIENCE / AMENITY

The management of visitor experience and overall visitor enjoyment is a key aspect of any CCF. Providing high quality recreational experiences for the public is a key objective of NPWS and ski resort operators in KNP. It is also one of the most difficult aspects of a CCF to manage. Visitor experience and visitor perceptions of enjoyment and amenity are formed by many complex factors which vary between individuals or groups. One individual's positive experience does not necessarily represent other's view.

Factors and considerations which are likely to influence visitor experience / amenity in KNP include:

- economic (overall costs – lift tickets, national park access fees, accommodation, food and service prices, and perceived values for money)
- environmental (snow quality, weather, available terrain, visual amenity, nature-based experience)
- social/recreational (the availability and quality of recreational opportunities, travel times, travel comfort, convenience, waiting times at ski lifts, ticket windows and food and service locations, and crowding).

As the factors listed above are variable, subjective, and difficult to quantify, the assessment of the impacts of future growth on visitor experience / amenity has been completed using ski lift ticket scans from one of the Alpine resorts located in KNP. The data has been provided for the period 2015-2019 and represents the number of individuals passing though chair lift access gates. It shows the distribution of visitors throughout the year, and by days of the week, thus providing an indication of visitor numbers during a 'busy' day which can be forecast forward using specific growth scenarios.

While this assessment does not meet the requirements of a comfortable carrying capacity assessment (discussed in section A1.1.7 in Appendix A) it does provide an indication on the level of growth for which agencies and operators need to plan for and be able to manage appropriately.

Limitations of the assessment include.

- data provided is of commercial sensitivity, and therefore is unable to be published.
- detailed data has not been provided for all alpine resort areas, which does not allow for a detailed assessment across all Alpine resorts.
- some publicly available data was published in 2004, however it is not considered representative of the current environment (due to upgrades to resorts and infrastructure up to 2021).
- data does not include visitors who do not access the alpine resort chair lift facilities.
- data does not allow for the consideration of the impact of snow conditions on visitation and visitor experience.

The assessment is based on the following assumptions.

- a direct link exists between access scans in alpine resort areas and the perceived level of visitor experience / amenity. This assumes a higher number of visitors accessing the resort area would result in a diminished level of amenity, and a lower experience outcome.
- the assessment focuses on the months of July, August and September (as the peak winter period where capacity constraints are known to occur).
- a 'busy' day has been defined as a day when the number of visitors fall within 15% of the 'peak visitation'
- 'Peak visitation' is based on the peak daily visitor numbers for the month of August between 2015 and 2019.
- Projections of visitor growth (2021-2038) are based on annual growth rates of 1%, 2% and 3% as well as projections provided by CIE (refer to Section 7.4.2).
- projected growth rates beyond 2038 represent an equal annual decline of 1%, 2% and 3% as well as CIE projections. This acknowledges a projected drop in visitor numbers due to the impacts of climate change (discussed in section 7.4.1).
- no allowance has been made for changes in visitor numbers based on weather conditions, such as poor snow years.
- data used in the assessment was provided by a single alpine resort area, however, it is considered to generally represent all alpine resort areas in KNP. The assumptions are general in nature and based on analysis of defined 'busy' days. These days should not vary greatly between alpine resort areas. A more detailed analysis would require access data from all operators.

7.4.4.1 EXISTING CONDITIONS

Table 7.6 provides a summary of the number of 'busy' days across the alpine resort area (2015-2019).

A review of the data indicates that in general 'busy' days are confined to each Saturday in July, and Saturdays and Sundays in August. No days defined as 'busy' using this methodology were noted in September and no weekdays (in July, August, or September) were defined as 'busy' by this assessment.

Table 7.6 Number of days with access scans within 15% of peak (2015-2019)

YEAR	NUMBER OF DAYS WITH ACCESS SCANS WITHIN 15% OF PEAK (2015-2019)		
	JULY	AUGUST	SEPTEMBER
2015	0	0	0
2016	4	4	0
2017	0	9	0
2018	4	9	0
2019	4	4	0

7.4.4.2 FUTURE PROJECTIONS AND CONSIDERATIONS

Figure 7.14, Figure 7.15 and Figure 7.16 highlight the number of days Alpine resorts in KNP can expect to reach the 'busy' criteria set out in this report. The figures show the number of projected 'busy' days during the months of July, August, and September.

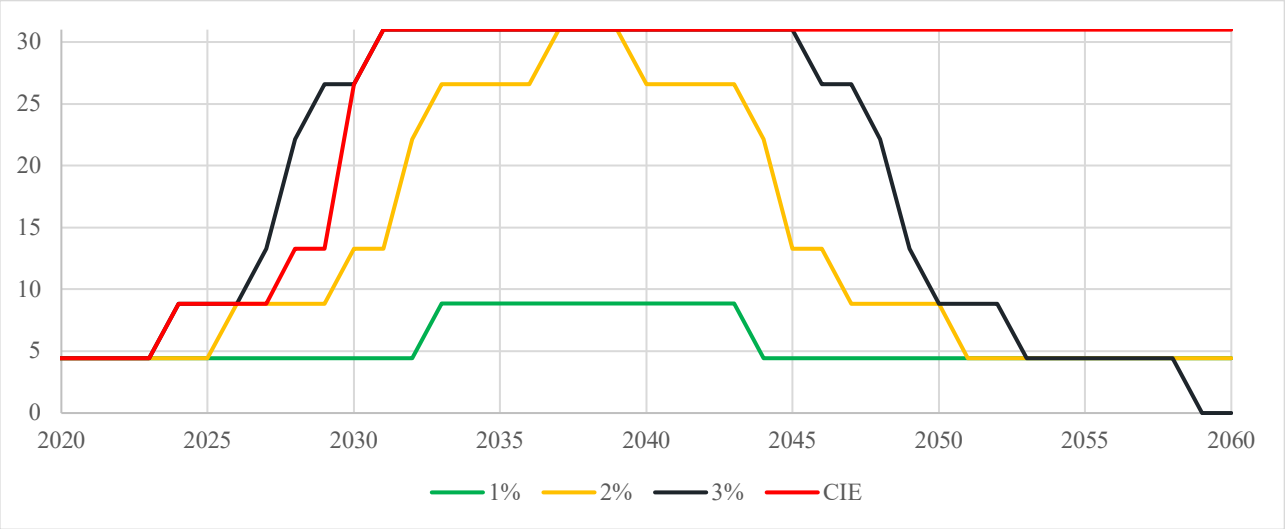


Figure 7.14 Number of 'busy' days in July for alpine resort areas by growth rate

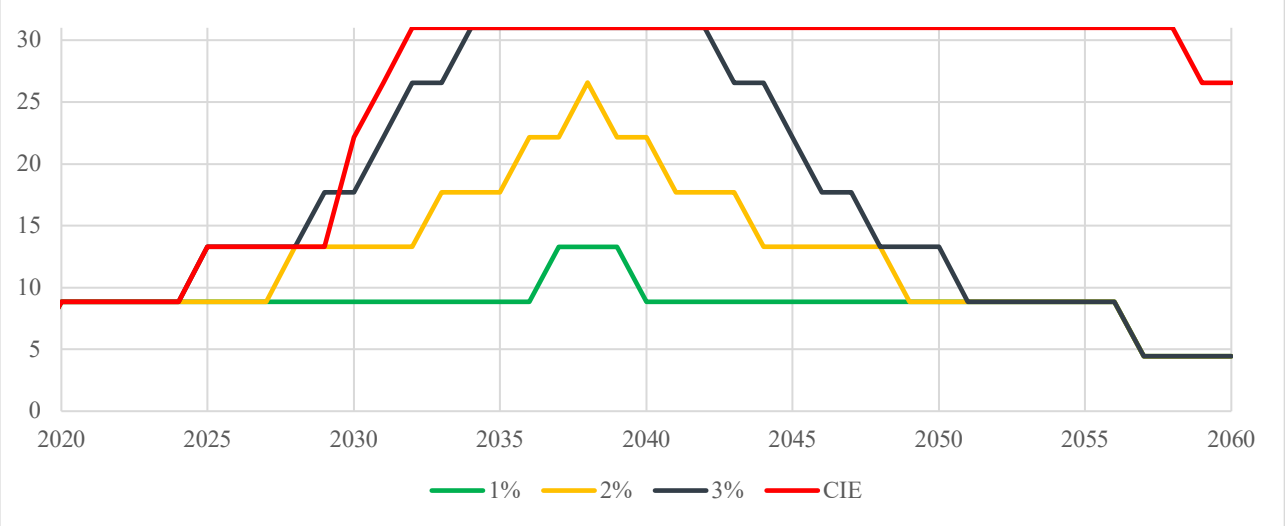


Figure 7.15 Number of 'busy' days in August for alpine resort areas by growth rate

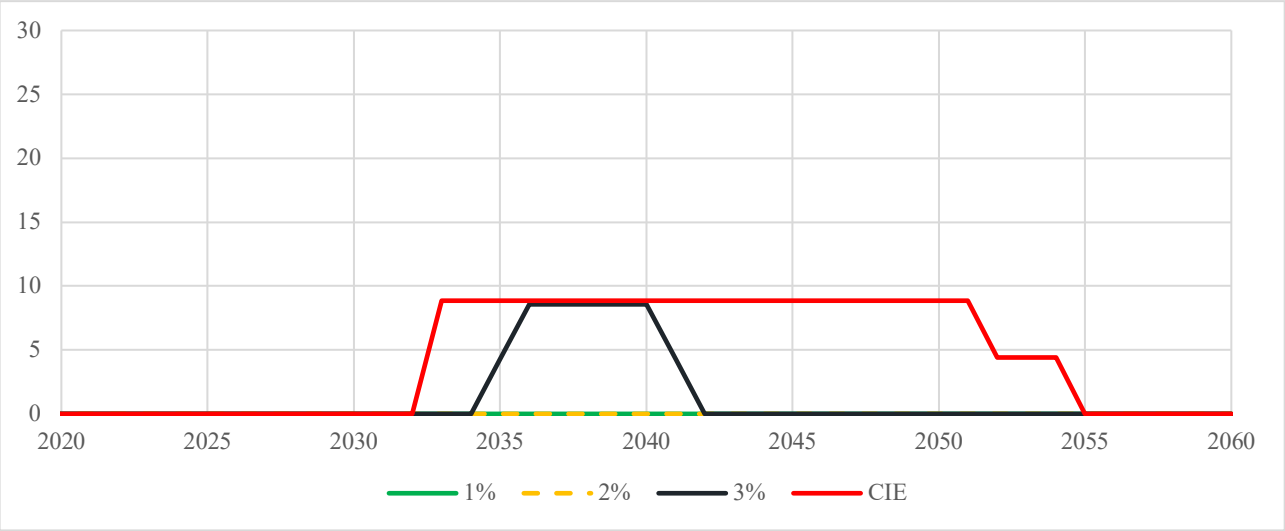


Figure 7.16 Number of 'busy' days in September for alpine resort areas by growth rate

In summary:

- Under a 1% growth scenario, there would be an increase in the number of' 'busy' days to a peak (in 2038) of around 9 days for the month of July, 13 days for the month of August, and no days for September. A review of the data indicates that access scans would peak at 117% above existing levels by 2038.
- Under a 2% growth scenario, there would be an increase in the number of' 'busy' days to a peak (in 2038) of 31 days for the month of July, 27 days for the month of August, and no days for September. A review of the data indicates that access scans would peak at 141% above existing levels by 2038.
- Under a 3% growth scenario, there would be an increase in the number of' 'busy' days to a peak (in 2038) of around 31 days for the month of July, 31 days for the month of August, and 9 days for September. A review of the data indicates that access scans would peak at 169% above existing levels by 2038.
- Under the CIE projections, there would be an increase in the number of' 'busy' days to a peak (in 2038) of 31 days for the month of July, 31 days for the month of August, and 9 days for September. A review of the data indicates that access scans would peak at 179% above existing levels by 2038. Under these projections, the number of monthly peak days remain for both July and August until 2060.
- A review of the data suggests that the number of access scans across the month of July is more consistent throughout the week and do not result in the same drop in numbers during the weekdays, as experienced in August. This is likely due to school holidays falling in this month and weekdays in July having generally higher numbers of visitors (closer to the defined 'busy' days). As a result, July presents as the month with the greatest increase additional 'busy' days. August remains the peak in terms of access scan numbers, however they are more heavily skewed to weekends.

7.4.4.3 KEY OUTCOMES

The results of the assessment show significant growth beyond what would be considered a comfortable carrying capacity. This would not only apply to the main recreational areas of Alpine resorts (in terms of on mountain comfort), but also to many other aspects of capacity constraints in KNP, where exceedances of similar magnitude would be expected.

For example, using CIE growth forecasts, visitor numbers peak at 179% above existing levels. And while this assessment focuses on the surrogate measures of 'busy' days, and would require operators to improve their ability to manage visitor access on the mountain and in village areas, it also provides a view to other physical capacity constraints in KNP which require addressing, such as:

- the availability of visitor accommodation in alpine resort areas and how to manage overflow requirements outside alpine resort areas, within TOAs or outside of the national park

- the capacity of infrastructure and infrastructure requirements and the constraints associated with upgrades to meet demand
- the capacity of transport and access solutions to allow for the safe and efficient movement of visitors to and from alpine resort areas.

Addressing these physical impacts is one aspect of visitor experience / amenity. It also needs to consider the quality of the experience which can be influenced by (among other factors) village amenity, the quality and value of accommodations, water quality, recreational activities, biodiversity quality, nature-based opportunities, and sustainability

To address these key issues, the Snowy Mountains SAP master planning process has investigated key aspects with relation to development within the SAP precincts in KNP, which would ultimately influence visitor experience.

The outcomes as related to KNP are summarised in the draft structure plans (Jensen Plus, 2021) discussed in Sections 7.3.2 (Alpine resort areas) and 7.3.4 (Tourism opportunity areas).

The draft structure plans include proposed bed limit uplifts across the SAP areas of KNP, which have been developed based on the key constraints in each area. It should be recognised that these bed limit uplifts represent capacity constraints in themselves based on developable space, urban design, and biodiversity constraints. The assessment of visitor experience, and the significant exceedance of visitors over existing levels, shows that even with the uplift to bed limits, the demand for accommodation within KNP would be much greater than availability.

To address and understand any residual capacity constraints this assessment recommends on mountain factors (such as ski slopes, chair lifts, mountain biking, hiking trails, etc) should be the subject of Alpine resort specific CCC assessments and these should be undertaken as part of the development of the Alpine DCP. The outcomes of these assessments would allow for a refinement of the CCF approach and be considered in any future amendment of the KNP PoM and Alpine SEPP.

More information regarding the proposed solutions to key factors which influence visitor experience / amenity is included in technical reports.

- Biodiversity (WSP, 2021a), Section 7.4.5
- Traffic, transport, and access (WSP, 2021b), Section 7.4.6
- Surface water and water quality (WSP, 2021c), Section 7.4.7
- Aboriginal cultural heritage and Shared Heritage (Ozark, 2021), Section 7.4.10 and 7.4.10
- Infrastructure (WSP, 2021g), Section 7.4.12
- Sustainability (DSquared, 2021), Section 7.4.13, and
- Tourism opportunities (Stafford Strategy, 2021)

7.4.5 BIODIVERSITY

This section has been informed by the *Snowy Special Activation Precinct – Biodiversity Assessment* (Biodiversity Assessment*)* (WSP, 2021a) and discussions with NPWS in relation to the existing biodiversity management, monitoring and collaboration with Alpine resorts in KNP.

- The purpose of the Biodiversity Assessment was to present the ecological opportunities and constraints analysis of the SAP investigation areas based on desktop review and field survey of key sites identified during the SAP master planning process as being most suitable appropriate for development opportunities. The biodiversity assessment should be read in conjunction with this report and development of a CCF for the SAP precincts in KNP.
- Discussions with NPWS were undertaken to provide an understanding of the current management framework as it relates to the ongoing management of threatened species, communities, specific requirements of NPWS and collaborations on the management of biodiversity values with alpine resort areas.

7.4.5.1 EXISTING CONDITIONS

KNP is National Heritage listed as part of the Australian Alps National Parks and Reserves. The Park contains the highest mountains in Australia and is the largest national park in NSW. KNP contains significant biodiversity and it known to provide habitat for approximately 300 vertebrate fauna species, over 800 plant species and high numbers of invertebrates, particularly for high altitude cold-climate specialists which require alpine and subalpine habitats, including numerous endemic and threatened species.

The lower altitude tourism areas are dominated by the Grassy Woodlands from the Subalpine Woodlands vegetation class dominated by stands of *Eucalyptus pauciflora* (Snow Gum)*, Eucalyptus dalrympleana* (Mountain Gum) and *Eucalyptus stellulata* (Black Sallee) with occasional *Eucalyptus delegatensis* (Alpine Ash). As altitude increases at Sponars Resort, Perisher, Charlottes Pass and Guthega, the vegetation changes to the lower Subalpine Woodlands dominated by *Eucalyptus niphophila* (Alpine Snow Gum) and tall heathy shrublands. At Charlottes Pass, the Alpine Complex is dominant with the presence of Alpine Heaths (including boulder fields) and Alpine Bogs and Fens (Upland Bog and Valley Bog complexes). Six Plant Community Types were mapped within the surveyed areas.

THREATENED ECOLOGICAL COMMUNITIES

The biodiversity assessment identified one Plant Community Type (PCT), Alpine and sub-alpine peatlands, damp herbfields and fens, South Eastern Highlands Bioregion and Australian Alps Bioregion (PCT 637) within the development opportunity areas of Kosciuszko Tourist Park, Guthega, Perisher and Charlottes Pass. This PCT is consistent with the Threatened Ecological Communities (TEC):

- Montane Peatlands and Swamps of the New England Tableland, NSW North Coast, Sydney Basin, South East Corner, South Eastern Highlands and Australian Alps bioregions is listed as an Endangered Ecological Community under the BC Act.
- Alpine Sphagnum Bogs and Associated Fens is listed as an Endangered Ecological Community under the EPBC Act.

THREATENED SPECIES

KNP contains significant biodiversity and is known to provide habitat for approximately 300 vertebrate fauna species.

Threatened species and significant habitat known to occur in the SAP precinct include:

- A significant population of Mountain Pygmy Possum (*Burramys parvus*) which is known to occur at Blue Cow and at Charlottes Pass. This species is restricted to alpine and subalpine zones
- Broad-toothed Rat (*Mastacomys fuscus*) has been recorded within all of the resort areas and is restricted in NSW to areas above 1000 m
- Guthega Skink (*Liopholis guthega*) is known to occur at Charlottes Pass, Thredbo and Perisher Range Alpine Resort areas
- Sphagnum bogs and fens area important components of the Alpine Complex. Bog and Fen communities offer breeding sites for many threatened and Migratory fauna which occur in the area, including the Alpine Tree Frog, Alpine Water Skink, Latham's Snipe and Broad-toothed Rat
- Habitat for numerous other threatened fauna species including Olive Whistler, Guthega Skink, Mountain Galaxias, Eastern False Pipistrelle, Large Bent-wing Bat, Greater Glider, Eastern Pygmy Possum, Smoky Mouse, Spotted-tailed Quoll, Koala, Gang-gang Cockatoo, Flame Robin, Scarlet Robin, Pink Robin, Diamond Firetail, Brown Treecreeper and Powerful Owl.

In addition, habitat for two species listed under the *Fisheries Management Act 1994* (FM Act) has been mapped within the study area of the biodiversity assessment. These are the:

- Alpine Redspot Dragonfly (*Austropetalia tonyana)*, listed as Vulnerable under the FM Act which only occurs amongst rocks, logs and moss within the splash zone of waterfalls or in the nearby stream edge. Distribution includes Thredbo River and riparian areas throughout the Alpine precinct
- River Blackfish (*Gadopsis marmoratus*), in which the Snowy River population is listed as Endangered. Distribution includes Thredbo River and Mowamba River.

REVIEW OF THE KNP POM

Species identified by the biodiversity assessment generally corresponds with following key protected species identified in the KNP POM and some of which are included in ongoing monitoring in alpine resort areas in KNP.

The following biodiversity values are known to exist in the Thredbo alpine resort area:

- Twenty plant communities have previously been recorded within the Thredbo resort area.
- Potential habitat for the Mountain Pygmy Possum (*Burramys parvus*).
- Potential habitat for the Broad-toothed Rat (*Mastacomys fuscus*), scats were recorded in 2002
- Upland Bog, Stream Complex and Short Alpine Herbfields and known and potential habitat for threatened Alpine Water Skink (*Eulamprus kosciuskois*).
- Habitat for Anemone Buttercup (*Ranunculus anemoneus*).
- Habitat for Guthega Skink (*Liopholis guthega*).
- Habitat the Alpine She-oak Skink (*Cyclodomorphus praealtus*).
- Habitat for Spotted-tailed Quoll (*Dasyurus maculatus*).

The following biodiversity values are known to exist in the Charlotte Pass alpine resort area:

- Fourteen plant communities have previously been recorded within the Charlotte Pass Alpine Resort area.
- Perisher Range is the highest intact area of sub-alpine woodland vegetation not impacted by the 2003 wildfires containing old-growth Snow Gum (*Eucalyptus niphophila*) forest/ woodland.
- Habitat for Anemone Buttercup.
- Major population of Mountain Pygmy-possum.
- Habitat for Broad-toothed Rat and Alpine She-oak Skink (*Cyclodomorphus praealtus*).
- Habitat for Guthega Skink.

The following biodiversity values are known to exist in the Perisher Valley alpine resort area:

- Eighteen plant communities have previously been recorded within the Perisher Resort area.
- Perisher Range is the highest intact areas of sub-alpine woodland vegetation not impacted by the 2003 wildfires containing old-growth Snow Gum forest/woodland.
- One of the two largest populations of threatened Mountain Pygmy Possum in the Park is located at Mount Blue Cow, key habitats are Podocarp Heath on periglacial block streams (Community 4.0) and Rocky Outcrop Health (Community 3.0).
- Upland Bog and Valley Bog Complex, streams and soaks are habitat for the threatened Alpine Water Skink *(Eulamprus kosciuskoi).*
- Habitat for the threatened Broad-toothed Rat.
- Habitat for the threatened Alpine She-oak Skink and Guthega Skink.
- Known habitat for Anemone Buttercup and Perisher Wallaby-grass (*Rytidosperma vickeryae*).

The following biodiversity values are known to exist in the Perisher – Bullocks Flat area:

- Four plant communities have previously been recorded at Bullocks Flat.
- The Thredbo River is a part of the Endangered Ecological Community of the Snowy River Catchment in NSW listed under the FM Act.

The following biodiversity values are known to exist in the Selwyn alpine resort area:

- Eight plant communities have previously been recorded at Mount Selwyn Alpine Resort.
- Habitat for Broad-toothed Rat.
- Twenty plant communities have previously been recorded within the Thredbo resort area.
- Potential habitat for the Mountain Pygmy Possum.
- Potential habitat for the Broad-toothed Rat.
- Upland Bog, Stream Complex and Short Alpine Herbfields and known and potential habitat for threatened Alpine Water Skink.
- Habitat for Spotted-tailed Quoll.

7.4.5.2 CURRENT BIODIVERSITY CAPACITY / CONSTRAINTS

To consider biodiversity as a key value within the CCF, the existing conditions of biodiversity values can be viewed on two scales; at a landscape level, where resort operators have minimal opportunities for impacting and influencing values such as species population numbers and habitat protections; and at the resort level, where resorts have a degree of responsibility for managing biodiversity aspects such as pests, weeds, encroachment into high value areas, and direct impacts to some threatened species.

At a landscape scale key biodiversity concerns of NPWS are mainly focused around the threats to ecosystem processes based on:

- Impacts from pest species (including horses, deer, foxes, rabbits, cats and weeds):
  - heavy and increasing impacts to steep slopes and moist soil profiles
  - degrading biodiversity functionality though extensive loss of vegetation.
  - Impact to native plants and vegetation communities
  - Impacts to native animal populations.
- Impacts associated with climate change, drought, increased fire intensity / changes to fire regimes, and ability of ecosystems to recover. Recovery is still ongoing after the 2003, 2010 and 2019-2020 fires.

WSP has undertaken interviews with DPIE, and reviewed documents on these issues and reached the following conclusions regarding potential responsibilities for biodiversity management within resorts. For this exercise, we have considered biodiversity constraints against those which alpine resort areas have some level of influence and responsibility (see Table 7.7). For example, resorts have minimal influence over horse and deer populations, which are subject to wider landscape scale factors, and thus have been excluded.

The table uses a traffic light system to assess the level of capacity; **green** – no current capacity issues / positive biodiversity outcomes; **orange** – partial or unclear outcomes / opportunity for improvement; **red** – poor outcomes.

Table 7.7 Assessment of Alpine Resort area biodiversity outcomes

ALPINE RESORT AREA	ALPINE RESORT AREA OUTCOMES						
	Threatened Species Populations (Mountain Pygmy Possum)	Threatened Species Populations (Broad Toothed Rat)	Small Mammal Management	Weed Management	Pest Management	Loss of Natural Areas	Rehabilitation of previously disturbed areas
Thredbo							
Perisher							
Charlotte Pass							
Selwyn	N/A	N/A	N/A	N/A	N/A	N/A	N/A

7.4.5.3 FUTURE OPPORTUNITIES & CONSIDERATIONS

The mechanisms for protection of biodiversity values under the SAP master planning process can be assessed in two ways. Firstly, through front end loaded technical assessments such as the *Biodiversity assessment* prepared for the SAP Precincts, and secondly through the ongoing requirements for operators to implement appropriate EMS and EMSPs (with specific measures) in collaboration with NPWS.

Overall, the Snowy Mountains SAP and the biodiversity certification assessment provides a unique opportunity to protect biodiversity and environmental values and improve engagement with the unique environment of the region. Within KNP, there are opportunities to improve visitor experiences to allow greater engagement with the unique environment, these include:

- low impact sustainable development
- focussing development within already disturbed areas as far as possible
- locating development near to existing infrastructure to limit the need for additional impacts associated with creation of infrastructure and services (e.g. roads and utilities)
- co-locating (and infill) developments as to minimise the spread of impacts on biodiversity values
- biodiversity offset arrangements within the Kosciuszko National Park that are tailored to deliver appropriate outcomes for this unique sensitive environment. The potential for biodiversity offset arrangements within the Kosciuszko National Park requires further consultation and investigation with National Parks and Wildlife Service, and the DPIE.

The general principle to minimise impacts to biodiversity, should in order of consideration, endeavour to:

- avoid impacts on biodiversity through the planning process
- minimise impacts on biodiversity through the planning process
- mitigate impacts on biodiversity though the use of a range of mitigation measures
- offset residual impacts.

The provision of an ISO 14,001 certified EMS as well as EMSPs aimed at protecting and enhancing biodiversity values in each SAP precinct would assist to maintain biodiversity values and allow NPWS to set target and implement programs to monitor biodiversity loss while engaging with operators to support biodiversity improvement programs. It would also allow NPWS to set requirements on the management of key species and values for which they have key interests in. This would include ongoing monitoring of key threatened species, management of weeds and pest species and rehabilitation of disturbed areas.

7.4.5.4 KEY OUTCOMES

The following approach requirements for the protection of biodiversity values should be part of the delivery of the CCF as a requirement for allowing modifications (increases) to the current capacities (bed limits) within the KNP. The aims of the Snowy Mountains SAP master planning process should be to avoid, conserve and enhance biodiversity values of the region, specifically to:

- preserve the Precinct's landscape and biodiversity values
- avoid or minimise impacts to threatened ecological communities, threatened species and their habitats
- minimise impacts within undisturbed areas of KNP
- minimise the removal of existing native vegetation wherever possible
- preserve and rehabilitate natural waterways, which contribute to the area's character and biodiversity
- improve water quality and reduce stormwater run-off through passive landscape design.

When considering the development location and impacts it is important to consider all the elements required including associated infrastructure (e.g. roads, utilities) as well as asset protection zones.

With a focus on avoiding and minimising impacts on biodiversity, development is therefore best suited to areas that are already disturbed including areas of existing development, cleared areas, and areas supporting exotic vegetation. It is acknowledged however that some disturbed areas may still contain constraints such as threatened fauna habitat and hydrological functions important for surrounding vegetation communities which may require avoidance or minimisation/mitigation.

Where possible, development should be located close to existing infrastructure as to limit the additional impacts associated with establishing supporting infrastructure (e.g., roads and utilities). This is of particular importance in areas within Kosciuszko National Park given its significance as a conservation area which supports a number of high biodiversity values.

The following considerations should be made to minimise impacts to biodiversity as far as reasonably practicable:

- development within Tier 1 and 2 (as outlined in section 4.2 of the Biodiversity Assessment) should be avoided or minimised and offset
- any development within Alpine Precinct of Kosciuszko National Park should be low impact sustainable development and would need to consider the impacts of bushfire asset protection zones
- focussing or keeping development within already disturbed areas as far as possible (Tier 3 and 4)
- locating development nearby existing infrastructure to limit the need for additional impacts associated with creation of infrastructure and services (e.g. roads and utilities)
- maintaining a buffer between high ecological constraints (Tier 1 and 2) and development
- co-locating (and infill) developments as to minimise the spread of impacts on biodiversity values.

Residual impacts to biodiversity values would be assessed under the Biodiversity Assessment Methodology and require biodiversity offsetting in accordance with the NSW Biodiversity Offset Scheme. This scheme provides a transparent and scientific methodology to assess suitable offset types and quantum and provides a mechanism for long-term protection and management of offsets for conservation. In the Alpine region, the potential to deliver biodiversity offset arrangements will require further investigation with both NPWS and DPIE due to the unique environment of the Alpine area.

Residual impacts to biodiversity listed under the EPBC Act would require assessment including the need for a referral to the Commonwealth Department of Agriculture, Water and the Environment.

7.4.6 TRAFFIC, TRANSPORT AND ACCESS

This section has been informed by the *Snowy Special Activation Precinct Technical Study Report: Engineering – Transport* (SAP Transport Study*)* (WSP, 2021b) and aims to summaries the existing environment, current capacity constraints, future transport and access projection, and considered approaches to alleviate transport, traffic and access capacity during the peak winter season. This section provides a summary of access to Alpine Resort areas in KNP.

7.4.6.1 EXISTING CONDITIONS

ROAD NETWORK

The road network within the Snowy Mountains SAP and specifically within KNP relies on two key roads (Kosciuszko Road and Alpine Way) which provide direct winter and summer access to the two largest Alpine resort areas (Thredbo and Perisher). Key details of the road network include:

- Vehicles are required to pay a national parks access fee to enter KNP on both roads.
- Private vehicle access to Charlotte Pass is only available outside the winter season and relies on over-snow transport from Perisher Valley during the winter months.
- Roads are frequently affected by poor weather conditions with snow chains required to be carried and fitted during poor conditions.
- The months of July and August are considered the peak season, with daily traffic volumes of around 3500 (Kosciuszko Road) and 2500-3000 (Alpine Way) entering and leaving KNP.
- NPWS data indicates that year to year visitation is increasing at 3% per annum (2010-2018).
- Alpine Way (Kosciuszko Road to Bullocks Flat) and Kosciuszko Road (Alpine Way to Sawpit Creek) are operating close to their theoretical capacity in the winter weekend peak and above the Level of Service E threshold. However, it is noted that this is a short peak.

A full summary of the existing road network is included in section 3.3 of the *SAP Transport Study* (WSP, 2021b).

SKI RESORT PARKING

Ski resort parking is focused on three main locations, with parking in high demand from both day visitors and overnight guests. There are currently approximately 8,000 parking spaces (Table 7.8) in the KNP and nearby areas, including approximately 2,700 spaces within Perisher ski resort area (of which ~820 is informal overflow parking along Kosciuszko Road), 3,700 spaces at Bullocks Flat (Skitube access) and 2,500 at Thredbo (including private off-street parking).

Table 7.8 Existing parking at Alpine resorts

LOCATION	DAY PARKING	OVERNIGHT PARKING	TOTAL
Perisher	2,576 including: 1,185 at Perisher Village 820 informal overflow (alongside Kosciuszko Road to Pipers Gap, Prussian Creek chain bay and Dainers Gap chain bay), 471 at Smiggin Holes, 100 at Guthega	119 including: 65 at Perisher Village, 29 at Smiggin Holes 25 at Guthega	2,695 including: 1,250 at Perisher Village 820 informal overflow (alongside Kosciuszko Road to Pipers Gap, Prussian Creek chain bay and Dainers Gap chain bay), 500 at Smiggin Holes, 125 at Guthega
Bullocks Flat	1,973	1,727	3,700
Thredbo	1,136	506 plus 858 private	2,500
Total	**5,685**	**2,352 plus 858 private**	**8,037 plus 858 private**

Source: National Parks and Wildlife Service, aerial photography, reports

Parking within the Alpine resorts is increasingly becoming an issue, especially as parking extends away from the resort to the side of the road as formal car parks reach capacity. There are also occurrences of chain bays being utilised for car parking. Parking outside of these formalised areas presents a road safety risk within the National Park.

On good snow days, the overflow parking on the side of Kosciuszko Road at Perisher is not always available due to safety concerns and snow clearing. If car parking is full at the resort, TfNSW implements its Traffic Management Plan to close the road and redirect traffic to Bullocks Flat. There is evidence that also on these peak snow days that parking at Bullocks Flat is filling up and that some overflow parking is occurring along the Alpine Way before entry into Thredbo.

During the snow season (June long weekend to October long weekend) there is no vehicle access to Charlotte Pass and no dedicated parking at Perisher, an issue which has been raised by Charlotte Pass Resort. In summer, there is an informal parking at the turn around end of Kosciuszko road which is often at capacity.

A full summary of the existing alpine resort parking is included in Section 3.4 of the *SAP Transport Study* (WSP, 2021b).

SKITUBE

The Skitube was commissioned in 1987 to address the emerging problem of road access to resorts becoming inadequate for the steadily increasing demand. The Skitube route was to provide a short connection from Bullocks Flat under Rams Head Range to Perisher then across to Blue Cow.

Common operation of the Skitube is a two or three carriage shuttle between Perisher and Blue Cow and a three or four car service between Bullocks Flat and Perisher. A passing loop just outside the first tunnel allows additional capacity on the Bullocks Flat to Perisher section. At Perisher, there is a loop around the island platform that allows trains to pass. However, current common operation is to run separate services (no passing required).

Travel times are approximately 10 minutes from Bullocks Flat to Perisher and approximately 5 minutes from Perisher to Blue Cow[1]. The platforms have been constructed with sufficient length to accommodate four carriages. With a maximum capacity of 225 people per carriage, it has a claimed maximum capacity of 4,500 people per hour.

Anecdotal evidence suggests that some visitors find these ticket prices too high, and instead try to hitch-hike up to the Alpine resorts along Kosciuszko Road. In addition, for family and friend groups, the relative economy of driving and paying the NPWS entry charges soon outweighs the cost of buying individual Skitube tickets.

Further details on the Skitube are included in section 3.5.5 of the *SAP Transport Study* (WSP, 2021b).

PUBLIC TRANSPORT

Besides the Skitube and internal resort shuttles. Public transport does not have a significant profile with visitors as a reliable and convenient form of transport within the Snowy Mountains SAP. A full summary of public transport access to the Snowy Mountains SAP is included in section 3.5 of the *SAP Transport Study* (WSP, 2021b).

7.4.6.2 CURRENT CAPACITY

Table 7.9 provides a summary of the existing traffic, transport and access capacity constraints within the alpine ski resort areas. It should be noted that the information is based on the peak winter demand, as it has been identified a key constraint to access capacities in the alpine resort areas.

[1] Perisher Web Site: https://www.perisher.com.au/plan-your-trip/new-to-perisher/skitube

The table uses a traffic light system to assess the level of capacity; **green** – no current capacity issues; **orange** – partial or unclear of capacity issues; **red** – capacity exceeded.

Table 7.9 Assessment of Alpine Resort area traffic, transport and access capacity

ALPINE RESORT AREA	ALPINE RESORT CAPACITIES[1]		
	RESORT PARKING	ROAD ACCESS	SKITUBE
Thredbo[3]			N/A
Perisher			
Charlotte Pass[2]		N/A	N/A
Selwyn	N/A	N/A	N/A

1. The assessment of transport capacities is based on winter peak demand.
2. Traffic, transport and access capacity is not constrained during other times of the year except for resort parking at Charlotte Pass in summer.
3. It should be noted that there is some capacity constraints associated with some busy summer days or days when events are being held in Thredbo.

7.4.6.3 FUTURE PROJECTIONS & CONSIDERATIONS

The ability of the road network within the SAP and KNP to respond to the increase in car travel to and from the Alpine resorts will heavily influence several environmental and social values associated with the KNP, and thus form a significant indicator of the capacity of visitors to the areas.

This section provides a summary of future transport projections for KNP and Alpine Resort areas and is based on the assessment provided in the SAP Transport Study.

ROAD NETWORK

- Alpine Way (Kosciuszko Road to Bullocks Flat) is already operating close to its theoretical capacity. This is forecast to become worse and expand in the future. This constraint combined with parking at Thredbo Alpine resorts will require consideration of other ways of moving people between Jindabyne and Thredbo alpine resort.
- Kosciuszko Road (Alpine Way to Sawpit creek) is already operating close to its theoretical capacity. This is forecast to become worse and expand in the future. This constraint combined with parking at Perisher Alpine resorts will require consideration of other ways of moving people between Jindabyne and Perisher / Charlotte Pass alpine resort areas.
- To meet future demand and get everyone from Jindabyne to Alpine resorts a mass transport system is recommended
- To improve connections between Jindabyne and Alpine resorts a southern connector road is recommenced within Jindabyne (refer to section 6.5.2 of the Transport Study).
- Review of the design of chain bays along Alpine way and Kosciuszko Road, and prohibit overflow parking to improve safety outcomes.

RESORT PARKING

Visitor numbers are expected to increase by 35 % by 2031, 70 % by 2041 and 35 % by 2061, subject to the wider capacity of the National Park. If current behaviour is maintained, these increases would translate to an additional: 2,300 parked cars in 2031, 4,650 parked cars in 2041 and 2,300 parked cars in 2061. Increasing the amount of overnight accommodation and parking at Thredbo, Perisher and Bullocks Flat would have the advantage of relieving the pressure on the daily travel to and from the National Park.

Given the environmental impacts of increasing the footprint of parking within the Kosciuszko National Park and the cost of providing multi-storey and basement parking, as well as the constrained road capacity on Alpine Way and

Kosciuszko Road, it is recommended that building additional day parking at Thredbo and Perisher beyond what has already been approved is not the preferred transport solution. It is proposed that parking at the Alpine resorts be capped at the existing levels plus approved changes, with the following changes described below. Further investigations will be undertaken as part of the preparation of the Alpine DCP.

7.4.6.4 KEY OUTCOMES

The Snowy Mountains SAP has investigated the need for and recommends the implementation of a carrying capacity framework within the SAP sub precincts in KNP. This would allow the current bed limits of the PoM to be raised to meet SAP requirements and implement a means to manage day visitation. The following approaches for traffic, transport and access should be considered as part of the delivery of the CCF as a requirement for allowing modifications (increases) to the current capacities (bed limits) within the KNP.

INTEGRATED TRANSPORT NETWORK, TIMING AND DELIVERY

A full summary of assessed approaches to alleviate traffic and access constraints is included in Chapter 6 of the *SAP Transport Study* (WSP, 2021b) with a summary of proposed infrastructure and service improvements specific to providing solutions to access to Alpine resorts from Jindabyne included in Table 7.10. A full version of this table (showing proposed SAP wide infrastructure and service improvements is included in chapter 10 of the Transport Study.

Table 7.10 Proposed infrastructure and service improvements (specific to KNP)

SOLUTIONS		AREA	TIMEFRAME	AGENCY RESPONSIBLE	COMMENTARY
Access Initiatives					
A.9	Infrastructure – Improved public transport facilities (road priority, stop infrastructure, etc.)	Access to KNP	Short to Medium-term	Transport for NSW	Coordinated with revision of bus network
A.10	Services – Create a frequent and rapid Mountain Shuttle service linking key destinations	Access to KNP	Short-term	Transport for NSW	Coordinated with Southern Connector Road and Park and Ride
A.11	Infrastructure – Implement real time information to manage parking capacity	Access to KNP	Short-term	Transport for NSW, NPWS	Coordinated with Park and Ride and Shuttle Bus service
A.12	Infrastructure – Introduce ITS to alert drivers to conditions and improve road safety	Access to KNP	Short-term	Transport for NSW	Introduced early to gain maximum benefit from project
Place Initiatives					
P.2	Infrastructure – Create new roadside lookouts	Access to SAP	Short to Medium-term	Transport for NSW, SMRC	Road safety, tourism
P.4	Infrastructure – Create bus hub in town at Information centre	Access to Jindabyne	Short-term	Transport for NSW, SMRC	Supports Shuttle Bus service and network review
P.5	Infrastructure – Improved place making at transport hubs both in KNP and at hubs including Jindabyne	Access to KNP	Short-term	SMRC, NPWS, Perisher, Thredbo	Supports Shuttle Bus service

SOLUTIONS		AREA	TIMEFRAME	AGENCY RESPONSIBLE	COMMENTARY
Sustainability Initiatives					
S.1	Infrastructure - Upgrade parts of Kosciuszko Road between East Jindabyne and the Jindabyne Dam	Access to SAP	Short-term	Transport for NSW	Addresses existing issues and provides for future growth

Notes Short-term = before 2031, Medium-term = before 2041, Due to peak population by 2039, no long-term projects

SHUTTLE BUS

The shuttle bus service is a key element of the travel demand management strategy. Early delivery will assist create a convenient service that attracts people back to use it each year.

- Shuttle bus to be operational within 4 years with Jindabyne to Thredbo and Perisher implemented first. Headway of 10 minutes to each of Thredbo and Perisher, 60 minutes to Guthega, and a fleet of 24 buses.
- By 2031 Headway of 1.9 minutes to each of Thredbo and Perisher, 30 minutes to Guthega, and a fleet of 116 buses
- By 2039 (peak) Headway of 0.9 minutes to each of Thredbo and Perisher, 30 minutes to Guthega, and a fleet of 238 buses.
- Following the peak, services can be matched to changes in passenger demand. After each year, passenger numbers should be reviewed to tailor the balance of Perisher, Thredbo and Guthega services.

PARK AND RIDE

It is recommended that the land for the Park and Ride be secured The Park and Ride can be built in one go or staged to meet the changing demand, providing the land is secured initially. The delivery of the Park and Ride facility should be timed in combination with the shuttle bus service and the Southern Connector Road. Provided the current number of parking spaces are retained at Bullocks Flat, the anticipated number of spaces required is:

- 120 spaces by 2024
- 370 spaces by 2031
- 740 spaces by 2039.

Following 2039, demand for the park and ride and shuttle bus is expected to decrease. If this does eventuate, some of the parking area could become redundant and could be repurposed. A Park and Ride facility with 740 spaces is likely to require in the order of requiring 30,600 sqm, including the bus interchange and turning area.

SKITUBE

The current lease for the land on which the Skitube operates is due to expire in year 2030. This provides a useful horizon for an investigation and decision for the continuation of the service. Planning for the Skitube should commence well before the 2030 lease expiry to provide sufficient time for investigation, design and procurement of any system upgrades.

If patronage grows with Perisher visitation, it is estimated that 2,200 passengers during the peak hour (2039) can be achieved by running 4 car sets with a 15 minute headway with existing rolling stock or upgrade rolling stock based on design life. Further liaison is required with Vail Resorts to confirm that the increase from the existing capacity can be achieved.

A review of ticket prices in combination with NPWS park access fees should be undertaken in conjunction with planning for the shuttle bus service.

7.4.7 SURFACE WATER / WATER QUALITY

The Information contain in this section has been informed by engagement with NPWS and the following documents:

- *Snowy Special Activation Precinct Technical Study Report: Engineering – Flooding and Water Quality* (Flooding & WQ Technical Study) (WSP, 2021c)
- *Snowy Mountains Special Activation Precinct – Salt Impact Management Plan* (SIMP) (WSP, 2021d), and
- *Climate Change impacts on the Kosciuszko National Park Carrying Capacity and Artificial Snowmaking at NSW Alpine resorts* (Climate Change Report) (Appendix D); and
- *NSW Alpine resorts Environmental Performance Report 2014–16*, (NPWS, 2017)

This section aims to summarise the existing surface water/water quality environment, provide an assessment of the current capacity constraints, future use projections and key considerations, and proposed approaches to mitigate impacts to water quality in key alpine waterways within KNP.

7.4.7.1 EXISTING CONDITIONS

The Snowy Mountains SAP lies at the top of the Snowy river catchment with several tributaries which contribute to its flow including the Thredbo River which contributes around 69% of the flow into Lake Jindabyne. A summary of the surface water environment including catchments, climate, topography, and land use and soil is included in Chapter 3 of the *Flooding & WQ Technical Study*.

WATER QUALITY

Water quality and biological health monitoring of the rivers and streams in KNP has been undertaken since 2004. The data is summarised in *Kosciuszko National Park, Resorts Water Quality and River Health Monitoring Sites reports* (some annual and some quarterly), with a focus on the Perisher and Thredbo areas. Sampling sites have been selected to provide an undisturbed reference site upstream of villages.

Water quality varies across the study area and is largely dependent on the contributing surface water catchment. The management of effluent from sewage treatment plants associated with the Alpine resorts and other high use sites has resulted in a constant but mild pollution source into some streams in the KNP.

The stormwater management plans prepared for the Alpine villages of Thredbo and Perisher indicate that stormwater quality has been poor, and management of stormwater runoff is critical to maintaining the pristine nature of downstream waterways. A study by the Cooperative Research Centre for Freshwater Ecology identified potential sources of stormwater pollution from the Perisher Resort Carpark to be:

- salt from de-icing activities during the winter period
- sediment from unsealed roads result in elevated suspended solids and the overflowing of silt traps
- oils and trace metal runoff from parking areas
- rubbish (gross pollutants).

Additional threats to water quality at a landscape level in KNP include:

- ongoing disturbances associated with catchment modification from past grazing and mining activities
- increased sediment loads from road and walk track erosion after fire events.
- road / highway de-icing during winter.
- nutrient enrichment and diseases (giardiasis, cryptosporidiosis, etc.) from feral animals

With reference to the use of salt on roads and in resorts, the water quality monitoring program indicates that existing electrical conductivity (EC) in alpine streams is generally very low, as low salt concentrations are a typical characteristic of KNP's fresh flowing waters. High EC may inhibit plant and animal growth and prolonged exposure to elevated salts can lead to decline or changes in macroinvertebrate communities. More recent research (unpublished papers), however has indicated that elevated electrical conductivity immediately downstream of the roads and carparks where salt is being

applied is having an impact. Salt use is described below in section 3.6.6 and the Salt Impact Management Plan (WSP 2021d) Section 5.1.1 identified impacts to aquatic systems as follows:

- Watercourses that receive salt-impacted runoff from a dense network of roads and highways have been found to have the greatest impacts.
- Studies conducted on Kosciuszko Road from 1995-1998 (Allen, N.D.) on the efficacy of road salting techniques found that the dilution of salt was high enough in the area to have little or no water quality outcomes in roadside streams. Potential issues with wetland areas were noted.

PERISHER AND CHARLOTTE PASS

The current monitoring regime in the Perisher Valley includes bi-annual monitoring at 18 sites along Spenser's, Rock, Perisher, Pipers, Smiggins, Sawpit and Farm Creeks. Additional fortnightly sampling is carried out during winter and spring at a further nine sites along Perisher, Diggers and Sawpit Creeks. The sampling locations are shown on *Figure 3.10* of the *Flooding & WQ Technical Study.*

Overall, the results indicate persistent elevated levels of nutrients, i.e. Total Nitrogen (TN) and Total Phosphorus (TP), and poor ratings for macroinvertebrates (an indicator of ecological health) across all the watercourses in the Perisher Valley. Elevated EC was isolated to Sawpit, Smiggin and Pipers Creeks and occurred both in Autumn and Spring.

High salt levels in Sawpit Creek may be related to use of salt for de-icing roads and may be temporally and spatially cumulative through the catchment as salt, that has been applied to roads in previous years and washed off with surface runoff, may be accumulating and slowly leaching through the landscape over time.

For a more detailed summary of water quality results in the Perisher and Charlotte Pass water catchments refer to *section 3.6.1* of the *Flooding & WQ Technical Study*.

THREDBO

Water quality monitoring is carried out quarterly at four locations on the Thredbo River. The sampling locations are shown on *Figure 3.11* of the *Flooding & WQ Technical.* While the results are highly variable over seasons and years, the following trends are noted:

- The sampling sites downstream of the village and the STP showed consistently elevated levels (outside guideline levels) of TN, nitrates and nitrites during most sampling events, with the exception of November. While the sites upstream and immediately below the village also showed elevated levels of nitrates and nitrites in the May and August sampling periods.
- Nutrients (specifically TP and nitrates) fluctuate over the reporting period at the three sites downstream of the village likely due to their proximity to the village and location of the lower 2 sites downstream of the STP.
- EC was generally below guidelines levels except in 2017 where it was above guideline levels in both February and August downstream of the STP. In 2018 all sites both above the village and below recorded EC values above guideline levels.
- pH and turbidity varied throughout the report periods, with fluctuations over all four monitoring sites occurring.
- Macroinvertebrate levels are an indicator for ecological health of the waterway and they tended to be significantly impacted downstream of the village but were not considered impacted upstream of the village.

Overall, the results indicate persistent elevated levels of nutrients, particularly TN and TP across all the watercourses in the Thredbo Valley.

SELWYN

No water quality monitoring occurs at Selwyn Ski Resort as there are no Sewage Treatment Plants (STP) on site, with all wastewater managed through a septic system and adsorption trench system. There are no permanently flowing streams with sufficient volume to enable monitoring within or immediately adjacent to the resort area.

FLOODING

Hydraulic modelling undertaken for the *Flooding & WQ Technical Study* shows that flood behaviour within the extended SAP area is primarily confirmed to the existing defined watercourses with very little area exhibiting widespread surface flooding. Even in the extreme events such as the probably maximum flood (PMF) event, no major overbank areas were inundated and only a relatively minor increase in flood extent was exhibited beyond the existing watercourses.

In summary:

- The majority of Thredbo Village remained relatively immune to flooding up to the PMF level event, however some public open space areas along Friday Drive and both buildings and carparks along Chimneys Way were flooded to some extent in the 10% AEP flood and above.
- The majority of the Snowy Mountains SAP precinct for Bullocks Flat remains unflooded in up to the 0.5% Annual Exceedance Probability (AEP) storm event, with a minor area surrounding the Skitube track flooding in all events modelled. No alignment levels for the Skitube rail were available for the model to confirm flood immunity of the service. Widespread flooding throughout this area was present for the PMF flood event in particular in the north and the east areas of the SAP Precinct near Bullocks Flat Terminal.
- Perisher Valley has a smaller upstream catchment then the other sites and the creeks running through the village appeared to overtop at an earlier stage then the other locations within the SAP. It is expected that the site will exhibit flooding events that are shorter and faster to peak then in other locations. In particular it was noted that Kosciuszko Road was immune to flooding in up to the 0.5% AEP flood event and that most major buildings and carparking infrastructure was relatively flood free up to the 1% AEP Climate Change 2090 condition.

7.4.7.2 CAPACITY CONSTRAINTS

Table 7.11 provides a summary of the existing water quality constraints in/to the Alpine resort areas. It should be noted that further discussions on water supply, extraction and waste water management, that also has the potential to influence water quality is included in section 7.4.12.

The table uses a traffic light system to assess water quality conditions; **green** – no or minimal guideline exceedances, **orange** – some guideline exceedances / unknown issues; **red** – guideline exceedances / poor water quality outcomes.

Table 7.11 Consideration of Water Quality constraints

ALPINE RESORT AREA	CONSIDERATION OF ALPINE RESORT AREA IMPACTS / CONSTRAINTS		
	WATER QUALITY (ELECTRICAL CONDUCTIVITY)	WATER QUALITY (ANZECC GUIDELINES)	FLOODING
Thredbo			
Perisher			
Charlotte Pass			
Selwyn	N/A	N/A	N/A

7.4.7.3 FUTURE PROJECTIONS & CONSIDERATIONS

WATER QUALITY

The Snowy Mountains SAP aspirations highlight the need to ensure stormwater runoff is managed to minimise impacts to the natural environment of the KNP and to ensure Lake Jindabyne and its tributaries continue to be suitable for recreational uses and water supply for the urban areas. Water is a key feature of many aspects of the Snowy Mountains SAP. Water is used for recreation (as snow for snow sports, as water for lake uses) and power generation across the Snowy Mountains SAP precincts and therefore its quality should be considered equal to the quantity

The 16 years of water quality data has provided a good understanding of the existing water quality conditions downstream of Thredbo Village and the Perisher Valley Ski resorts and the monitoring should continue to be able to identify impacts of future development in the KNP. The monitoring data could be used to adjust KNP Management practices in the future to further reduce the impact to the KNP.

Future climate projections indicate a reduction in mean annual rainfall across the Snowy Mountains SAP study area. Snow precipitation is also predicted to decrease due to future climate changes which will impact cloud seeding. Overall, a reduction in rainfall leads to a reduction in stormwater runoff but this is offset to some degree by the higher concentration of pollutants carried by the water.

It is assumed that the development of future growth areas will result in larger impervious surfaces across the Snowy Mountains SAP study area. This is likely to result in an increase in pollutant generation which may to some extent be offset by a reduction in runoff volume. This increase in pollutant concentrations, along with an increase in the visitor population resulting in an increase in annual total loads of pollutants will need to be designed for

FLOODING

The flood modelling indicates the waterways are largely incised and flooding is generally confined to narrow floodplains, which means, the narrow floodplain widths are unlikely to pose any constraints on future development.

Climate change projections have less rainfall/snow annually but potential increases in summer/autumn rainfall and increases in rainfall intensity. The understanding of projected changes in rainfall can be used to inform future infrastructure planning across the SAP precincts and subsequently build resilience to future flooding events.

7.4.7.4 KEY OUTCOMES

The Snowy Mountains SAP has investigated the need for and recommends the implementation of a carrying capacity framework within the SAP sub precincts in KNP. This would allow the current bed limits of the PoM to be raised to meet SAP requirements and implement a means to manage day visitation. The following approaches for surface water management should be part of the delivery of the CCF as a requirement for allowing modifications (increases) to the current capacities (bed limits) within the KNP.

- Integrated water cycle management – collection of stormwater, treatment of stormwater and more natural flow release, capture of rainwater and reuse, stormwater is a resource.
- Rainwater tanks – ensure piping and pumps are protected from freezing, provide information on tips to manage rainwater tanks during freezing temperature periods.
- Point source pollution control – as best as possible manage stormwater runoff at the source, such as along the edges of road and carparks, within new developments use the green spaces to treat stormwater runoff.
- Climate change projected rainfall – reusing stormwater through capture and reuse on site will reduce the dependence on potable water supplies which in turn could ensure more water is available in Lake Jindabyne for hydro power and Snowy River environmental flow releases.
- Stipulate flood compatible building design – including types of materials and fencing types around overland flow paths.
- Maintain flood planning conditions as per the Snowy River LEP Clauses 7.1, 7.2 and 7.3.
- Define and maintain riparian zones around all waterways.
- An Operational Salt Management Plan (SMP) should be considered for all operators undertaking de-icing activities in both the SAP Alpine resort areas as well as the TOAs (where applicable). The SMP should be based on the options, recommendations and Salt Management Policy outlined in the SMP.
- Due to a likely increase in the need for snowmaking technologies such as ‘Snow factories’, an assessment of their potential impacts due to the addition of salt in the process should be undertaken.

The key outcomes have been incorporated into Section 7.5 – Stage 5 of the CCF.

7.4.8 GEOTECHNICAL

The section has been informed by the *Snowy Mountains SAP Technical Study Report – Engineering – Geotechnical* (Geotechnical Study (WSP, 2021e), and aims to summarise the existing environment, current capacity constraints, future opportunities and considerations.

7.4.8.1 EXISTING CONDITIONS

Table 7.12 provides a summary of existing geotechnical risks in the Snowy Mountains SAP study area. A full summary of existing geotechnical conditions is included in the *Geotechnical Study*, including a summary of regional geology, soils and landscape, groundwater, and slope analysis.

Table 7.12 Summary of possible geotechnical risks

POSSIBLE GEOTECHNICAL RISKS	DESCRIPTION
Increased exposure to geotechnical risks	Increased population, both permanent and tourists, is likely to increase the exposure to key geotechnical risks
Steep sloping ground	In areas where future development transects high angle slopes (i.e. foundation excavations, road alignments, utility alignments), the ground may become unstable or be susceptible to erosion during and after construction. This may impact roads, hiking trails, cycleways/trails within these areas.
Deep and variable weathering	This includes subsurface corestones, which may result in slope instability and poor founding conditions for future construction works.
Faults	Where urban expansion follows existing fault lines, highly fractured rock associated along the fault scarp may pose a risk to excavations or long-term slope instability
Earthquakes	There is a history of minor earthquakes within the site investigation area which with increased population may impact a greater populous. It is unlikely that a significant earthquake would occur in this area.
Acid Sulfate Soils	there are no known occurrences of Acid Sulfate soils in the SAP Alpine areas.
Radon gas	Increased population in these areas is likely to expose more people to radon gas particularly during the construction phase of future development.

7.4.8.2 FUTURE OPPORTUNITIES & CONSIDERATIONS

There are opportunities for future development in areas mapped as low susceptibility with a lower potential for landslides as development will be less influenced by geotechnical hazards. Table 7.13 provides a summary of results from the regional susceptibility zoning maps.

Table 7.13 Summary of outputs from regional susceptibility zoning maps

ALPINE RESORT	GEOTECHNICAL RISKS (LOW, MEDIUM AND HIGH SUSCEPTIBILITY)
Alpine Management Unit	
Thredbo	Majority of Thredbo is in high susceptibility area with higher potential for landslides.
Charlotte Pass	Charlotte Pass is in mix of low and medium susceptibility areas with lower and moderate potential for landslides.
Perisher Range	Majority of the Perisher Range is in medium susceptibility area with moderate potential for landslides. Majority of Bullocks Flat Terminal is in high susceptibility area with high potential for landslides.
Selwyn	Majority of Selwyn is in high susceptibility area with high potential for landslides.
Other resorts	
Sponars Chalet	Majority of Sponars Chalet is in medium susceptibility area with moderate potential for landslides.
Ski rider	Ski Rider is mainly located in mix of low and medium susceptibility area with lower and moderate potential for landslides
Kosciuszko Mountain Retreat resorts	Majority of Kosciuszko Mountain Retreat resorts is in a mix of low and medium susceptibility areas with lower and moderate potential for landslides.

7.4.8.3 KEY OUTCOMES

Based on the geotechnical features and associated risks, several mitigation options have been identified in the Snowy Mountains SAP Geotechnical Report, they are based on priority projects identified during the SAP structure planning such as the development of park and ride facilities at Thredbo, Perisher and Bullocks Flat, Water Treatment Pland and STP facilities at Perisher Village, and expansion and infrastructure works at Thredbo Ranger Station, Perisher village and Island bend. In general risks are low and can be adequately mitigated.

Further mitigation of geotechnical risks would be required depending on type and location of the proposed development.

7.4.9 GROUNDWATER

This section has been informed by the *Snowy Special Activation Precinct Technical Study Report: Hydrogeology (*Hydrogeology Study*)* (WSP, 2021f) and aims to summarise the existing environment, current capacity constraints, future use projections, and considered approaches to alleviate impacts to groundwater in KNP.

7.4.9.1 EXISTING CONDITIONS

The underlying geology of the Snowy Mountains SAP area is largely comprised of igneous granite units with low primary porosity. Groundwater flow is largely dependent on physical defects (fractures, faults, joints, and deformities) that provide a pathway for groundwater to flow. In summary:

- Groundwater resources in the alpine region are poor, with difficulty in finding a reliable and sufficient source. This is reflected in the Groundwater sharing plan – which still has allocation/availability, and only 5 bores (of a total of 77) having a reported yield of above 2L/s.
- There are currently no groundwater extraction bores located in KNP.
- There are many Groundwater Dependent Ecosystems located in KNP and Alpine areas where groundwater bores are prohibited due to potential impacts.

7.4.9.2 CURRENT CAPACITY

Table 7.14 provides a summary of the groundwater availability (physical and licenced) constraints associated with the alpine resort areas. The table uses a traffic light system to assess the level of capacity; **green** – no current capacity/constraint issues; **orange** – partial or unclear of capacity / constraint issues; **red** – capacity exceeded / major constraints.

Table 7.14 Consideration of groundwater capacity constraints

ALPINE RESORT AREA	CONSIDERATION OF ALPINE RESORT CAPACITIES	
	GROUNDWATER AVAILABILITY	GROUNDWATER AVAILABILITY (WATER SHARING ALLOCATIONS)
Thredbo		
Perisher		
Charlotte Pass		
Selwyn	N/A	N/A

7.4.9.3 FUTURE PROJECTIONS & CONSIDERATIONS

Given the groundwater characteristics of the Alpine resort areas, there are no current projections for the use of groundwater resources in KNP. Any consideration of future extraction or use, should consider the following:

- If additional raw water resources are required, surface water should be first considered
- Groundwater should only be considered if all other water sources/efficiencies savings are deemed insufficient to meet demand estimates.
- Success in obtaining a suitable groundwater resource for water supply is dependent on favourable geological conditions.
- If a suitable groundwater resource is determined, there are several rules around the installation of new water supply bores near sensitive environmental areas such as groundwater dependent ecosystems, which may prevent new bores from being installed in alpine areas.
- Groundwater yield is insufficient to consider groundwater use for snowmaking activities.
- Implications of climate change and changes in alpine rainfall snowfall of groundwater recharge.
- The impacts of road salt use on groundwater resources is not considered a high risk. The solubility of salt is dominated by surface water runoff, with pooling and evaporation concentrating and precipitating into the soil profile only, with low infiltration into local groundwater.

7.4.9.4 KEY OUTCOMES

Given the poor groundwater resource in the Alpine regions, no further assessment on future approaches to groundwater has been considered. It is recommended that any operator intending to progress evaluation or development of groundwater as a water source consider the financial and hydrogeological risks and seek technical advice to identify and mitigate risks where possible.

7.4.10 ABORIGINAL CULTURAL HERITAGE

The section has been informed by the *Aboriginal Cultural Heritage Assessment Report* (Aboriginal heritage report) (OzArk, 2021) and the *Aboriginal Cultural Values Assessment final draft Report* (Donaldson, S, 2021). The aim of the report was to identify opportunities to conserve significant aboriginal cultural heritage values in the development opportunity areas, and at detailed site level, to devise strategic mapping to allow planning options to be included in the master plan.

7.4.10.1 EXISTING CONDITIONS

ABORIGINAL PEOPLE OF THE SAP INVESTIGATION AREAS

The Snowy Mountains SAP is within the land of the Monaro Ngarigo People, which extends from the western slopes of the coastal ranges to the eastern side of the Kosciuszko plateau and further north, between the coastal ranges and the mountains on the banks of the Murrumbidgee River. The tribal boundaries also include the peaks of Mount Kosciuszko and the Snowy ranges.

IDENTIFIED CULTURAL HERITAGE VALUES

Based on a small sample set of interviews with Ngarigo men and women (Appendix 2 of the *Aboriginal cultural heritage report),* some community members have a contemporary connection to the landscape of the area and that there are known tangible places connected to ceremonial or historical landscapes in the area (including in KNP). A full summary of identified cultural heritage values is included in the *Aboriginal cultural values assessment report.*

ABORIGINAL SITES AND ARCHAEOLOGICAL SURVEY

Three sites have been previously recorded in the KNP survey areas. All three sites were inspected during the survey. Identified sites include:

- a Potential Archaeological Deposit (61-3-0097) at Guthega
- an Artefact (61-6-0104) at Friday flat in Thredbo
- a Potential Archaeological Deposit (61-3-0112) at Perisher.

The locations and details of the sites is included in figures 7.13, 7.14 and 7.15 and section 7.6.1.1 of the *Aboriginal heritage report*.

7.4.10.2 CURRENT CONSTRAINTS

A review of the archaeological potential for each development opportunity area is shown in Figures 8.1 to 8.7 in the *Aboriginal heritage report*. The details of the categories are:

- **High potential areas**: Following the survey it was determined that the only landforms designated as having ‘high potential’ are either those where sites have been previously recorded or landforms that are flat, close to water, and close to known sites. There are limited areas of ‘high potential’ within the survey areas although this categorisation suggests that further Aboriginal objects are likely.
- **Moderate potential areas**: Landforms with a gentle gradient either close to a waterway or along an elevated landform such as a spur overlooking a waterway. There are generally limited areas of ‘moderate potential’ within the survey areas although this categorisation suggests that further Aboriginal objects are possible.

- **Low potential areas**: Generally, consist of sloping landforms or elevated landforms distant to water. As a result of the survey it was determined that these landforms are unlikely to contain significant sites, although there is a low potential for low density artefact scatters or isolated finds to be present.
- **Disturbed lands**: This includes landforms that have been modified in a clear and observable manner either through earthworks or through building/car park construction. As per the Due Diligence Code of Practice for the Protection of Aboriginal Objects in NSW, areas classified as 'disturbed land' do not require further assessment. Aboriginal objects, however, may still be present in 'disturbed lands' and any chance finds should be managed by an unanticipated finds protocol.

It should be noted that survey areas in KNP generally have low archaeological potential as they are located within landforms with moderate to steep slopes. Those areas that are flatter have generally been previously disturbed by development. Some small areas, particularly adjacent to the Thredbo River (Figure 7.17) have a moderate to high archaeological potential and small areas at Guthega (Figure 7.18) and Perisher (Figure 7.19) have high potential due to the previous recording of sites. No other development opportunity areas have areas of high archaeological potential.

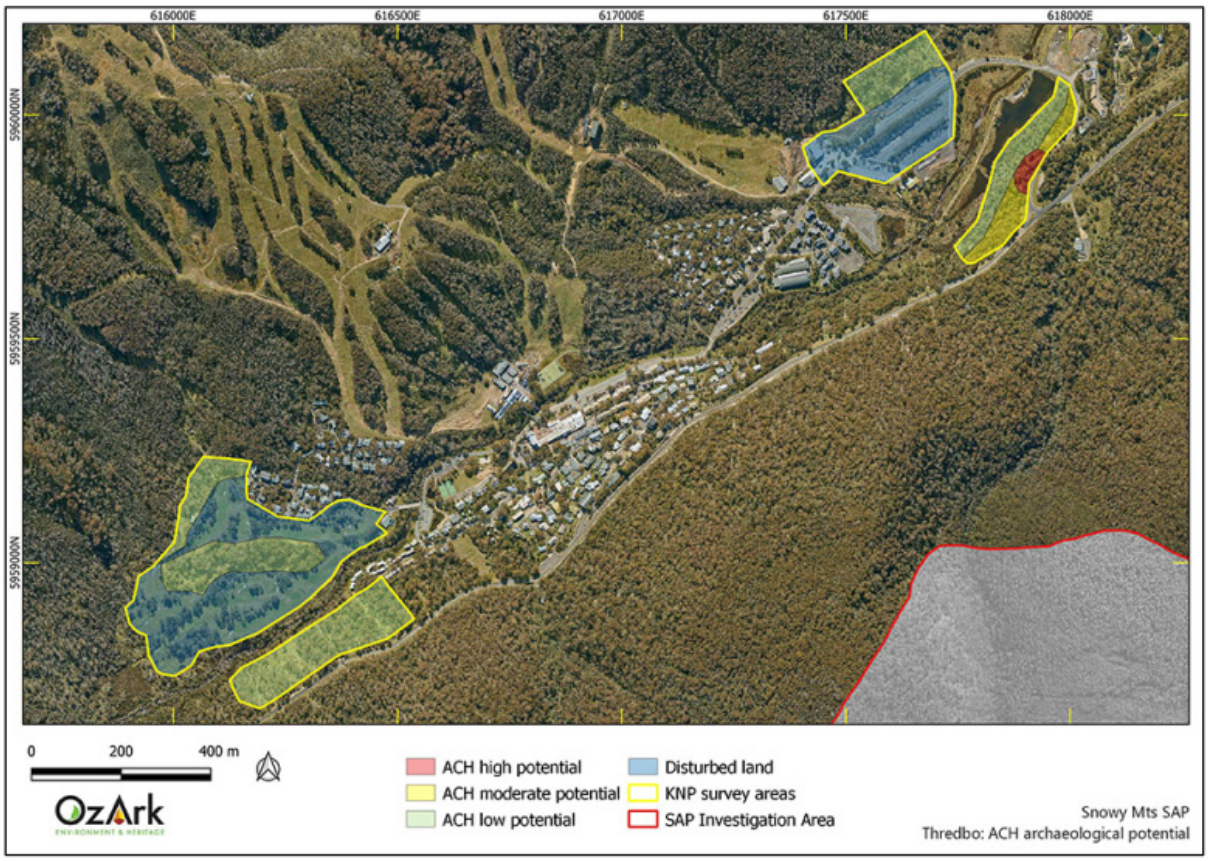


Figure 7.17 Thredbo Archaeological potential (source: Ozark, 2021)

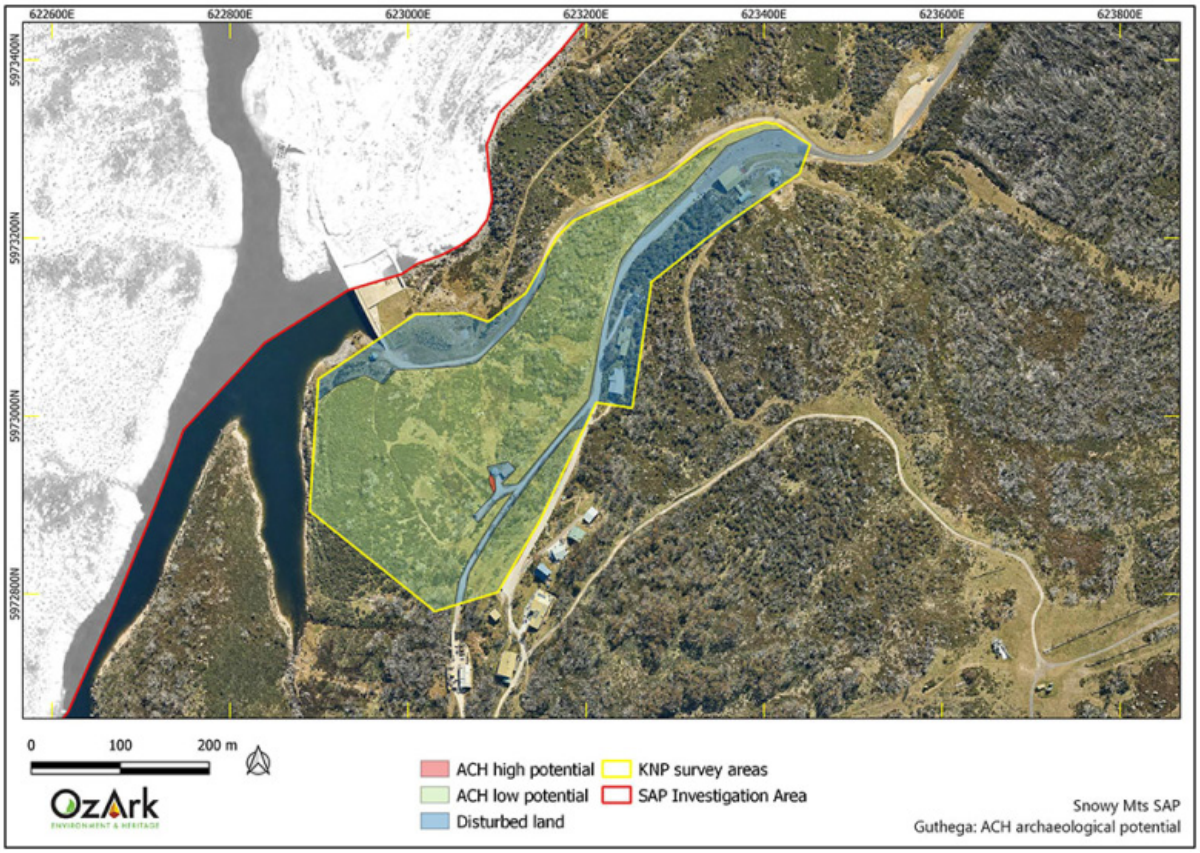


Figure 7.18 Guthega – Aboriginal cultural heritage archaeological potential (source: Ozark, 2021)

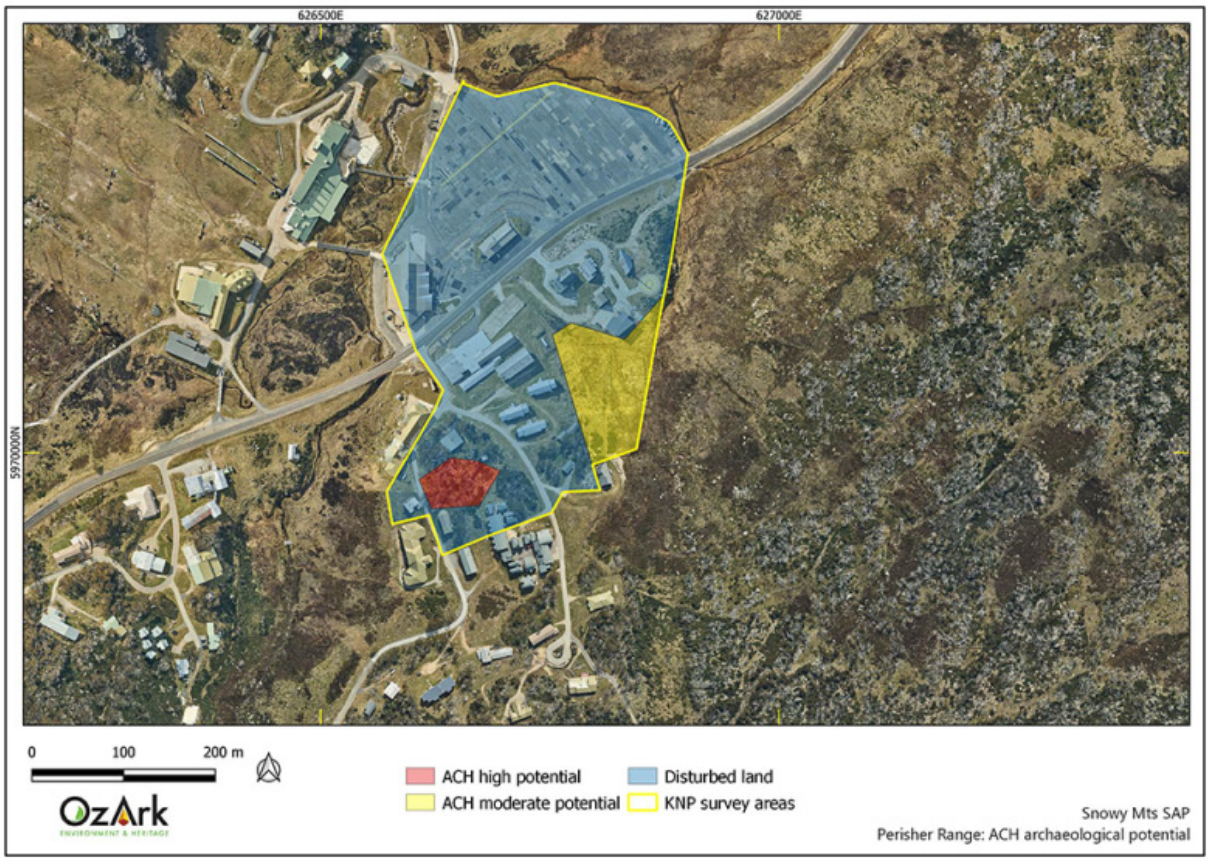


Figure 7.19 Perisher – Aboriginal cultural heritage archaeological potential (source: Ozark, 2021)

7.4.10.3 FUTURE OPPORTUNITIES & CONSIDERATIONS

There is a very low impact to Aboriginal cultural heritage values as very few Aboriginal sites were recorded, and no intangible heritage values have been identified within the survey areas. As has been previously noted, this statement is based on surface survey only and the undertaking of test excavation may alter the potential impact to Aboriginal cultural heritage values. However, at this stage of the investigation, the results of the surface survey indicate that significant Aboriginal cultural heritage values will not be harmed within the survey areas.

Table 7.15 examines the application of ESD principles to the Snowy Mountain SAP with reference to Aboriginal cultural heritage.

Table 7.15 Application of ESD principles to the Snowy Mountains SAP (Aboriginal cultural heritage)

ESD PRINCIPLE	RESPONSE
Avoiding and minimising harm	As appropriate management of aboriginal cultural heritage values is primarily determined based on their assessed significance, as well as the likely impacts of the proposed development. As precise impacts are unknown at this stage, the following management options are general principles in terms of best practice. — *Avoid impact* – by altering the development proposal or avoiding impacts to an aboriginal site. — *Minimise harm* – if impacts are unavoidable then approval to disturb sites under the authority of an approved permit must be sought. Very few Aboriginal sites were recorded during the survey, so site avoidance may be possible.
The integration principle	The Snowy Mountains SAP Masterplan presents a strong case for the broader environmental benefits arising from environmentally responsible development. The environmental consequences of future development will be further assessed when those impacts are known.
The precautionary principle	The Snowy Mountains SAP heritage investigation has followed the precautionary principle though undertaking a robust Aboriginal cultural heritage assessment to ensure that harm to Aboriginal objects and values is minimised. The survey adopted a precautionary principle when it came to describing and assessing landforms within the survey areas.
The intergenerational equity principle	It is assessed at this stage, and without undertaking test excavation, that the Snowy Mountains SAP will not harm significant Aboriginal cultural heritage values and that there will be a manageable diminution of intergenerational equity should the sites recorded here be harmed.

Source: Ozark, 2021

7.4.10.4 KEY OUTCOMES

The Snowy Mountains SAP has investigated the need for and recommends the implementation of a carrying capacity framework within the SAP sub precincts on KNP. This would allow the current bed limits of the PoM to be raised to meet SAP requirements and implement a means to manage day visitation. The following approaches requirements for Aboriginal cultural heritage should be part of the delivery of the CCF as a requirement for allowing modifications (increases) to the current capacities (bed limits) within the KNP.

Based on the results of the survey and the updated Aboriginal cultural heritage mapping, some general recommendations have been advanced. No specific impacts are known at this stage and it is not known how the Alpine SEPP, that may be amended, will manage harm to Aboriginal objects in the KNP survey areas, or how the Alpine DCP for the SAP precincts at Jindabyne will consider heritage impacts under current legislative regimes.

It is recommended that an Aboriginal Cultural Heritage Management Pan (ACHMP) be developed to manage aboriginal cultural heritage in the Snowy Mountains SAP precincts. The ACHMP would be the primary instrument to conserve

Aboriginal cultural heritage within the precincts, as well providing the statutory mechanism to manage Aboriginal cultural heritage should impacts to Aboriginal objects be unavoidable.

Development controls relating to heritage in the ACHMP should ideally follow the heritage conservation objectives set out in Section 26 of the Alpine SEPP. These objectives should include:

- If development is planned on land in which an aboriginal object is located, a heritage impact assessment should be prepared that assesses the extent to which the proposed development would harm aboriginal objects. If impact to an Aboriginal object is unavoidable, the procedures contained in the ACHMP would be followed. The ACHMP procedures would include further consultation with the Aboriginal community if aboriginal objects were to be harmed.
- A proposed development in the survey areas should be assessed against the mapped zones of archaeological potential:
  - Development within areas defined as 'disturbed land' (as defined by Section 58 of the National Parks and Wildlife Regulation 2019) can generally proceed without further Aboriginal cultural heritage investigation. However, the 'disturbed lands' would require a due diligence assessment to determine if the need to undertake test excavation has been completely removed by previous development. As Aboriginal objects are still possible in 'disturbed lands' any work in these areas should follow an unanticipated finds protocol to manage the unlikely event that Aboriginal objects are noted during work. This would include a 'stop work' provision and the requirement to assess the significance of the find with the Aboriginal community.
  - Development within areas defined as 'low ACH potential' should be assessed at a time when the impacts are known by following the appropriate assessment guidelines, currently the Due Diligence Code of Practice for the Protection of Aboriginal Objects in NSW. This assessment may involve a visual inspection of the impact area, test excavation if warranted, and the involvement of the Aboriginal community.
  - Development within areas defined as 'moderate ACH potential' or 'high ACH potential' should have an impact assessment undertaken. This assessment would include a visual inspection, possibly test excavation if warranted, and participation from the Aboriginal community. At the two previously recorded PADs (61-3-0097 and 61-3-0112) test excavation would be required to determine the nature of the subsurface deposits.
  - Any aboriginal objects recorded because of further investigation would be managed through the ACHMP

The archaeological recommendations which relate to KNP state:

- Aboriginal consultation is a critical element in the protection of Aboriginal heritage. Although done with the best of intentions, Local Aboriginal Land Council (LALC) boundaries stablished under the NSW Aboriginal Land Rights Act 1983 do not recognise the Ngarigo people. Although in Ngarigo country, much of the Snow Mountains SAP area is within LALCs with offices on the coast, and with strong connections to the coast. Since it is unlikely that LALC boundaries will be changed, consideration should be given to either renaming the land councils that extend from the coast to the highlands to include Ngarigo or form a Ngarigo representative group.
- After decades of investigations in the Snowy Mountains SAP Investigation Area, the archaeological heritage is well researched and well known; however, this is not reflected in any of the populist or academic literature. If areas of archaeological significance are to be identified and set aside for the future, a detailed synthesis of all the literature should be carried out, from which would emerge a new set of questions to guide future investigations. The collated information could also be useful for production of brochures and interpretive material about the Aboriginal heritage of the region.
- Avoid and protect all burial grounds (known and yet to be discovered).
- Ensure archaeological investigations are inclusive of Ngarigo people (who may not be a Registered Aboriginal Party or members of a LALC).

- Complete the inventory of the artefact collections held in the old NPW office at Sawpit Creek and liaise with Ngarigo people regarding potential repatriation or use of the artefacts in displays in a potential cultural centre.

7.4.11 SHARED HERITAGE

The section has been informed by the *Historic Heritage Assessment* (Historic Heritage Assessment) (OzArk Environment & Heritage,2021) and aims to summarise the existing environment, current capacity constraints and future projections, and key outcomes for the protection of historic heritage values in the Snowy Mountains SAP precincts in KNP. The assessment specifically focuses on development areas within each precinct.

7.4.11.1 EXISTING CONDITIONS

Skiing in Australia is thought to have commenced in the Snowy Mountains on the gold fields of Kiandra in the early 1860s. The first accommodation specifically associated with skiing was the construction of Hotel Kosciuszko at Diggers Creek in 1909, this was accompanied by the construction of the 51km road from Jindabyne to the summit to Mount Kosciuszko. By the 1920s knowledge of better snow conditions at higher elevations and a series of events lead to the construction of the chalet just below Charlotte Pass.

In 1944 the Kosciuszko State Park Trust (KSPT) was established under the *Kosciuszko State Park Act* of 1944 (KSPA Act. The act vested KSPT with the care, control, and management of 1.3 million acres of the park. This was followed by the establishment of the Snowy Mountains Hydro electrical authority in 1949 which oversaw the construction works on the Snowy mountains hydro scheme and resulted in significant impacts on the state park. In 1952 the KSPA Act was amended to allow the leasing of land within the park for the purpose of accommodation hotels, and the removal of prohibition of private holdings, which opened the way for the development of ski accommodation.

The Perisher Valley was the first of the ski resorts to be built in 1952, and after 1959 the Perisher Valley developed rapidly, and by the mid-1950s was considered the main centre for ski clubs. The impetus for the development push into the Thredbo valley was the construction of the Alpine Way in 1954, with the first chair lift officially opened in 1958 along with the first ski club. The village was extended to the east in 1964.

The Kosciuszko State Park became the Kosciuszko National Park in 1967.

A detailed history of the Alpine Areas is detailed in Chapter 3 of the *Historic Heritage Assessment*, including a list of notable buildings at Thredbo, Perisher and Charlotte pass (included in section 3.2 and 3.3), and a full summary of heritage listings in the wider SAP area (section 3.4).

7.4.11.2 CURRENT CONSTRAINTS

There are a number of known heritage items within the alpine resort areas of KNP and the proposed SAP precincts. The *Historic Heritage Assessment* focused on the proposed development opportunity areas of each Precinct. Table 7.16 provides a summary of the heritage values of each development area.

Table 7.16 Summary of heritage risk areas

AREAS	DETAILS OF HIGH/MODERATE/LOW RISK HERITAGE AREAS
Thredbo Village	There are no known heritage values or constraints at any of the four potential development areas at Thredbo. There are however a number of heritage items identified on the Alpine SEPP in the Thredbo Village.
Thredbo Ranger Station	The station itself is listed on the NPWS Historic Heritage information management System (HHIMS), as is the site of a chairlift that has been removed. The area marked for the site of the chairlift was inspected, and although it is in thick scrub, no visible remains were noted. It is unlikely that there would be archaeological remains associated with the chairlift. Therefore, apart from the existing Thredbo Rangers Station, there are no further historic heritage values at this area.

AREAS	DETAILS OF HIGH/MODERATE/LOW RISK HERITAGE AREAS
Bullocks Flat Terminal	There are no heritage values or constraints in this area as the area is currently occupied by a car park. The location marked on the HHIMS as items associated with 'Little Thredbo Hut' are not visible and any potential archaeological remains would have been removed during the construction of the car park.
Guthega	Two of the three buildings in this survey area are listed on the HHIMS: the Guthega Ski Centre and the Tiobunga lodge. Otherwise, there are no other identified heritage values in this area.
Charlotte Pass Alpine Resort	The survey area at Charlotte Pass essentially includes the resort where 14 of the buildings have been listed on the HHIMS. Further research would be necessary to determine the heritage significance of each of these buildings. It would need to be determined when precise impacts are known as to whether development would have a deleterious impact on nearby items with heritage significance
Perisher Range Alpine Resort	The survey area at Perisher Village includes most of the resort where 19 of the buildings have been listed on the HHIMS. Further research would be necessary to determine the heritage significance of each of these buildings. It would need to be determined when precise impacts are known as to whether development would have a deleterious impact on nearby items with heritage significance.
Island Bend	The eastern portions of this area have high archaeological potential for items associated with the construction and use of the Snowy Mountains Scheme workers' village. The visible and archaeological remains in this area may have state heritage significance given the ability of this area to contribute to our knowledge about the people who helped build the Snowy Mountains Scheme.

7.4.11.3 FUTURE PROJECTIONS & CONSIDERATIONS

Many of the structures currently within the KNP survey areas have been identified on the HHIMS, however, a specific heritage study of these buildings is over 25 years' old. In order to determine current heritage significance, these building should be assessed for heritage significance, not only within the survey areas, but also on a broader level to determine the representativeness of the buildings within the survey area.

There is also the opportunity to promote the historic cultural heritage values of the activity areas as a part of the multi-faceted visitor experience that the Snowy Mountains SAP seeks to promote.

7.4.11.4 KEY OUTCOMES

Based on the results of the survey and the updated historic heritage mapping, this section provides recommendations to conserve heritage values in the KNP areas of the Snowy Mountains SAP. These recommendations are considered high-level, as specific impacts are not known at this stage. The management of historic heritage is expected to be via the amended Alpine SEPP.

Development controls relating to heritage, in either the Alpine SEPP or in the Alpine DCP, should ideally follow the heritage conservation objectives set out in Section 26 of the Alpine SEPP. These objectives should include:

- A heritage impact assessment should be undertaken if development activity (other than except activities as defined by Section 26 (3) of the Alpine SEPP) is proposed

  (a) on which a heritage item is situated, or
  (b) that is a heritage item, or
  (c) within the vicinity of land referred to in paragraph (a) or (b),

It is emphasised that development adjacent or near a listed heritage item can also have a detrimental impact on the heritage values of the listed item and these impacts require assessment (as per paragraph (c)) prior to the development proceeding.

- The NSW Heritage Council must be informed of any development that plans to demolish an item on the NPWS s170 Heritage & Conservation Register.
- It is recommended that targeted heritage studies be undertaken, to identify heritage values. Such a study would help inform the recommendations set out in this section by identifying and documenting the heritage value of individual buildings.
- The strategic mapping presented in Section 5 of the *Historic Heritage Assessment* should be used as a guide for future development. The following principles should be followed:
  - Development in areas defined as 'disturbed land' can proceed without further historic cultural heritage investigation.
  - Development in areas defined as 'low potential' should be assessed at a time when the impacts are known. This assessment may involve a visual inspection of the impact area and due diligence research to ensure historic heritage values will not be harmed
  - Development in areas defined as 'high risk' or 'moderate potential' or 'high potential' requires further heritage assessment where the development is likely to materially have a major effect on a heritage item of its value.
  - Development in areas defined as 'high risk' or moderate risk' requires further heritage assessment where the development it likely to materially have a minor effect on a heritage item or value.
  - Activities which do not harm the heritage values of an item in areas defined as 'high risk' or 'moderate risk' would not require further assessment.
  - Where development is likely to materially have a major effect on a heritage item or value, further heritage assessment is required. This may include an archaeological assessment or the preparation of a statement o heritage Impact.
  - Where development will have a minor effect on a heritage item or value, a heritage assessment may be required.
  - A heritage assessment for any development that is likely to have a material ly majopr or minor effect on a heritage item of its value must:
    - identify the impacts
    - demonstrate the need for the impact and how alternatives to the impact have been considered
    - demonstrate how the adverse impacts will be minimised or mitigated.
  - Development within areas defined as having 'archaeological potential' should have an impact assessment undertaken at a time when the impacts are known. This assessment would include a visual inspection and could be informed by targeted archaeological excavation. The assessment should primarily consider the likelihood of significant archaeological deposits being harmed.

These key outcomes have been incorporated into Section 7.5 – Stage 5 of the CCF.

7.4.12 INFRASTRUCTURE

This section of the report has been informed by the following documents:

- *Snowy Special Activation Precinct Technical Study Report – Engineering – Infrastructure* (Infrastructure Study) (WSP, 2021g)
- *Snowy Special Activation Precinct Technical Study Report – Engineering – Renewable Energy* (Renewable Energy Study) (WSP, 2021h)
- *Snowy Mountains Special Activation Precinct Ecologically Sustainable Development (ESD): Context Analysis and Technical Report* (ESD Report) (DSquared, 2021), and
- *Climate Change Impacts as related to the KNP Carrying Capacity review* (Climate Change Report) Appendix D.

It aims to provide a summary of the existing infrastructure, future projections, constraints in relation to the infrastructure capacity and considered approaches to alleviate infrastructure capacities with projected future growth. This section focuses only on infrastructure related to the alpine resort areas and areas within the boundaries of KNP.

7.4.12.1 EXISTING CONDITIONS

WATER SUPPLY AND USE

Table 7.17 provides a summary of water infrastructure within the Snowy Mountains SAP Precincts of KNP. It includes water infrastructure under the responsibility of NPWS as well as private operators, and outlines the location of the system, an overview of the water source and capacity of items of note. These systems provide potable water to the resort facilities unless otherwise noted (i.e. for snowmaking). A summary of water used for snowmaking is included in Table 7.18 and section E1.2.4 of Appendix D.

A full summary of potable water supply infrastructure is included in Section 4.1.1 of the *Infrastructure Study*.

Table 7.17 Water infrastructure summary

SYSTEM	OVERVIEW	PERFORMANCE / CAPACITY ITEMS OF NOTE
Perisher Valley	Water sourced from Rock Creek under Water Allocation License (WAL) 10WA119556 & WAL 38550 Extraction limit is 160 ML/year	Current extraction is approx. 121 ML/year (DPI license data) Detailed asset performance unknown, however, no major issues identified in initial discussion with NPWS Treatment capacity details not sighted
Smiggin Holes	Water sourced from Piper's Creek under WAL 119564 Extraction limit is 45 ML a year	Current extraction is approx. 20 ML/year (DPI license data) The supplementary supply from Perisher into Smiggin Holes has not been required to operate Asset performance unknown Treatment capacity details not sighted
Guthega	Water sourced from Farm Creek under WAL 38564 Extraction limit is 25 ML a year	Current extraction is approx. 7 ML/year (DPI license data) Asset performance unknown Treatment capacity details not sighted
Kosciuszko Mountain Retreat resort and tourist park	Water sourced from Sawpit Creek under License WAL 38557 Extraction limit is 12 ML a year	Current extraction is approx. 5 ML/year (DPI license data) Asset performance unknown Treatment capacity details not sighted
The Blue Cow Resort	Water sourced from Perisher Creek under WAL 10 SL 55290 & 10 AL 119557) Extraction limit is 5 ML a year System historically operated by NPWS but has recently been transferred to Perisher Blue Pty Ltd.	Current extraction is approx. 3.5 ML/year (DPI license data) Asset performance unknown Treatment capacity details not sighted

SYSTEM	OVERVIEW	PERFORMANCE / CAPACITY ITEMS OF NOTE
Kosciuszko Thredbo	System operated by Kosciuszko Thredbo Pty Ltd Water sourced from Merritts Creek under WAL41294 and WAL39986. The entitlement under WAL41294 is currently subject to negotiations between Kosciuszko Thredbo Pty Ltd and WaterNSW/DPI/NRAR Extraction limit is 41 ML a year for domestic purposes Significantly larger amounts of water used for snowmaking (via separate systems/licenses)	Current extraction is approx. 367 ML/year (DPI license data). This significantly exceeds the license allocation Asset performance unknown Treatment capacity details not sighted
Charlotte Pass	Operated by Charlotte Pass Snow Resort Pty Ltd Water sourced from Upper Snowy River under WAL41294 Extraction limit is 16 ML Separate license / system for snowmaking water WAL38563 (25 ML/year)	No details sighted Asset performance unknown Understood to have limited reliability due to lack of reservoir storage and source reliability. Treatment capacity details not sighted
Bullocks Flat	Operated by Perisher Blue Pty Ltd System services Skitube terminal and carpark area Water sourced from Thredbo River under Water Licences 10SL45363 and 10AL119673 Extraction limit is 28 ML a year	Current extraction is approx. 15 ML/year (DPI license data). Asset performance unknown Treatment capacity details not sighted
Sponars Chalet	Operated by Ski Sponars Pty Ltd Water sourced from Rainbow Lake	No details sighted Asset performance unknown Treatment capacity details not sighted
Ski Rider	System services Ski Rider Resort (Motel accommodation) Operated by resort owner/s Water is sourced from Sawpit Creek (WAL 10FL055357) via weir Resort does not open in summer – operates late June to September typically	No details sighted Asset performance unknown Treatment capacity details not sighted

SYSTEM	OVERVIEW	PERFORMANCE / CAPACITY ITEMS OF NOTE
Selwyn Snow Resort	Operated by Selwyn Snowfields Pty Ltd Water sourced from Clear Creek under WAL39347 Extraction limit is 50 ML a year for domestic use Water used for snowmaking sourced from Clear Creek and Three Mile dam when required (license arrangements unknown)	Current extraction is approx. 44 ML/year (DPI license data). Asset performance unknown Treatment capacity details not sighted
Island Bend	No water supply at location	N/A
Thredbo Ranger Station	Rainwater capture with a 2000 litre storage tank.	Facilities require testing to understand condition and operational capacity

Source: WSP, 2021g & Appendix D

Table 7.18 Availabe information regarding water extraction for snowmaking

LICENCE NAME / NUMBER	ANNUAL EXTRACTION LIMIT (ML)[1]	ANNUAL AVERAGE USAGE RECORDED BY DPIE (2016-2019) (ML)[1]	ESTIMATED USAGE PROVIDED BY ALPINE RESORT (ML)
Perisher			
Snowmaking Pump Station 3 (10 SL 57228 / WAL 38553)	137	120	unknown
Smiggin Creek/snowmaking (10 SL 57193)	50	15	unknown
Perisher Range Aqueduct (10 SL 57220)	710	315	unknown
Total	**897**	**450**	**790**[2]
Thredbo			
Snowmaking pumping plant (WAL 39982)	260	250	unknown
Diversion channel snowmaking (WAL41189)	345	Not provided/unknown	unknown
Total	**605 ML**	**250 ML**	**290 ML**[3]
Grand total	**1502 ML**	**700 ML**	**1080 ML**

1. Alpine resorts' water extraction/access licenses and usage (2016-2019) data provided by DPIE
2. Indicative annual water usage for snowmaking provided by Perisher alpine resort for a typical year (refer above carrying capcaity report for source details)
3. Annual average water usage for snowmaking provided by Thredbo Alpine resorts for financial years 2017/2018 and 2018/2019

WASTEWATER

Table 7.19 provides a summary of wastewater infrastructure within the Snowy Mountains SAP of KNP. It includes wastewater infrastructure under the responsibility of NPWS as well as private operators, and outlines the location of the system, an overview of the water source, performance / capacity items of note, and EPL non-compliances.

A full summary of wastewater infrastructure is included in Section 4.1.1.2 of the *Infrastructure Study*.

In summary, peak wastewater loading occurs in winter due to both the high seasonal pullulation and visitation, and the increased stormwater inflow and groundwater infiltration to reticulated systems. As a result, there have been several non-compliances with Environmental Protection Licences (EPLs) across KNP suggesting wastewater treatment systems are beyond their operational capacities. Data collection and extraction license management are areas currently lacking and key areas that the SAP should be able to generate improvements in.

Table 7.19 Wastewater infrastructure summary

SYSTEM	OVERVIEW	DETAILS OF NOTE	EPL NON-COMPLIANCES
National Parks and Wildlife Service (NPWS) Managed System			
Perisher Valley	— Servicing Perisher Valley resort, Smiggin Holes, Blue Cow and Guthega resorts — Discharge to Perisher Creek under EPA Licence No. 1797, discharge limit is 2000 kL/day — STP and network assets in good condition generally	— STP is snow bound in winter with access restricted to over snow vehicles only — High ammonia loading due to day visitors challenges the treatment process and constrains capacity to around the current loading. — Operational challenges with sludge management at the STP due to snow conditions requiring full season storage — Low rising main from Blue Cow	— During 2016-2019 report period, there were 18 non-compliances with EPL: — 6 instances relating to the exceedance of concentration limits, and sewage overflow from non-licensed points (2016-2017) — 6 instances relating to elevated ammonia and total nitrogen levels in 2017 — 4 instances of concentration limits to phosphorus exceeded in 2018-2019 — 5 instances of daily discharge limit exceeded
Sawpit Creek	— Servicing the Kosciuszko Mountain Retreat/ Caravan Park — Discharge to an absorption trench system under EPA License No. 447	— Sawpit Creek absorption trench disposal system is nearing the end of its design life and has issues with hydraulic loading in peak winter loading/conditions. — Treatment capacity details not sighted	— During 2016-2019 report period, there were 8 non-compliances with EPL: — 1 instance of concentration limit of nitrogen exceeded — 5 instances of total suspended solids exceeded — 2 instances of concentration limit of phosphorus exceeded
Private Systems			
Thredbo Village	— Servicing Thredbo Village — Operated by Kosciuszko Thredbo Pty Ltd — Discharge to Thredbo River, discharge limit is 1610 kL/d under EPA Licence 1599	— The system is designed for the approved bed limit (4820 beds)	— During 2016-2019 report period, there were 11 non-compliances with EPL: — 2 instances of phosphorous limit exceedance — 2 instances of load limit for suspended solids exceeded — 1 instance of total nitrogen exceedance — 3 instances of daily discharge limit exceeded — 3 instances of concentration limit of nitrogen exceeded — There were no non-compliances during 2019-2020.

SYSTEM	OVERVIEW	DETAILS OF NOTE	EPL NON-COMPLIANCES
Charlotte Pass	— Servicing Charlotte Pass resort — Operated by Charlotte Pass Snow Resort Pty Ltd under Licence no. 1591 — Discharge to an intermittent stream joining Spencers Creek, discharge limit is 233 kL/day	— STP is snow bound in winter with access restricted to over-snow vehicles only — No details sighted — Asset performance unknown — Treatment capacity details not sighted	— During 2016-2019 report period, there were 203 non-compliances with the EPL: — 1 instance of pH limit exceedance — 4 instances of faecal coliform concentration limit exceeded — 1 instance of discharge limit exceeded due to major storm event — 1 instance of mishandling of samples, and 3 of unfulfilled monitoring — 1 instance of BOD exceedance — 38 instances of Phosphorus exceedance — 150 instances of Nitrogen/total Nitrogen exceedance — 1 instance of concentrations of suspended solid exceedance.
Bullocks Flat	— Servicing Bullocks Flat terminal and nearby areas — Operated by Perisher Blue Pty Ltd under Licence no. 2274 — Discharge to Thredbo River, discharge limit is 3750 kL/day	— No details sighted — Asset performance unknown — Treatment capacity details not sighted	— A total of 75 non-compliances in relation to various exceedances of concentration limits of water qualities during 2016-2018 report periods — 9 administrative non-compliances during 2018-2019 report period
Sponars Chalet	— Servicing Sponars Chalet resort — Operated by Ski Sponars Pty Ltd under Licence no. 3113 — Discharge to an evaporation pond and monitored at Diggers Creek, discharge limit is 50 kL/day	— No details sighted — Asset performance unknown — Treatment capacity details not sighted	— During 2016-2019 report period, there were 7 non-compliances with EPL: — 5 occasions in relation to exceedance of nitrogen or ammonia limits — 1 instance of mishandling of samples — 1 instance of failing to monitor daily discharge — There were no non-compliances during 2019-2020.

SYSTEM	OVERVIEW	DETAILS OF NOTE	EPL NON-COMPLIANCES
Ski Rider Resort	— Services Ski Rider resort	— Has no treated wastewater discharge license and relies on pumping out of effluent, which could constrain future expansion of bed numbers — Asset performance unknown — Treatment capacity details not sighted	— Not applicable
Selwyn Snow Resort	— Services the Selwyn Snow resort	— No details sighted — Asset performance unknown — Treatment capacity details not sighted	— Not applicable
Island Bend	Site not investigated	— No details available	— No details available
Thredbo Rangers Station	Site not investigated	— No details available	— No details available

Source: WSP, 2021g

ELECTRICITY AND GAS

Table 7.20 provides a summary of the electricity infrastructure loading within and to the Snowy Mountains SAP Precincts of KNP. A full summary of Electricity and Gas supply is included in section 5 of the *Infrastructure Study*.

Table 7.20 Distribution Substation loading in the Snowy Mountains SAP Precincts in KNP

SUBSTATION SWITCHING STATION NAME	INSTALLED CAPACITY (MVA)	AVAILABLE CAPACITY FOR THE YEAR 2021 (MVA)
Blue Cow Substation (supplied by Munyang Substation)	1 x 8 MVA	1.9 MVA
Smiggins Switching Station	-NA-	-NA-
Perisher (supplied by Munyang Substation)	2 x 10 MVA	8.7 MVA
Bullocks Portal (supplied by Munyang Substation)	1 x 6.25 MVA	5.15 MVA
Bullocks Flat (supplied by Munyang Substation)	1 x 6.25 MVA	5.25 MVA
Thredbo (supplied by Munyang Substation)	2 x 16 MVA	17.7 MVA

Source: WSP, 2021g

Gas supply to the Snowy Mountains SAP precincts is set up as small localised networks in specific areas such as Perisher, while other areas rely on distribution by onsite storage tanks of cylinders. Gas supply in Alpine regions are managed by Elgas. Elgas has a small depot in Cooma and cylinder swap in Jindabyne, however larger orders, such as Thredbo and Perisher, are trucked from Port Botany in Sydney or alternativity can be brought in from Victoria if required. During winter, there are additional cost for clearing snow to access supply tanks that is completed by the property owner.

Table 7.21 provides a summary of the gas network in alpine resort areas or areas within the KNP boundary.

Table 7.21 Gas network summary

AREA	USAGE (LITRES)	OVERVIEW
Perisher	Not Supplied	Small network supplying the resort
Thredbo Village	729,739 (2018-2019)	Onsite Storage Tank
Charlotte Pass	Not Supplied	Small network supplying the resort
Bullocks Flat	Not Supplied	
Sponars Chalet	Not Supplied	Gas delivery weekly – higher capacity for gas if trucks can't get to the resort. Gas for kitchen, commercial laundry and staff quarters for hot water.
Ski Rider Resort	16,339 (2019)	Gas delivery is weekly, however there is a higher capacity on site for gas – if trucks can't get to resort. Gas is used in resort kitchen, commercial laundry and staff quarters for hot water.
Selwyn Snow Resort	Not Supplied	Onsite Storage Tank

Source: WSP, 2021g

TELECOMMUNICATIONS

An assessment of existing telecommunication services in the Snowy Mountain SAP area of KNP is included in section 5.3 of the *Infrastructure Study*. In summary, there are issues with the limited availability of NBN broadband, and mobile services at various locations, including a lack of service at some resort areas, and while telecommunications at Alpine resorts is generally adequate, a number of the TOAs have reported that telecommunications is unreliable and detrimental to business.

WASTE AND RESOURCES RECOVERY

Jindabyne landfill has limited airspace available within its existing landfill cell. The resorts and accommodation waste are typically serviced through a private waste collection company. Charlotte Pass, Perisher and Thredbo Village resorts all dispose the waste at Jindabyne Landfill, and it is currently unclear where Selwyn transports its waste.

Snowy Monaro Regional Council is currently developing a waste management strategy and is also considering three different options to address the limited life of the landfill: a second lift above the existing cell, a new cell within the quarry area and an expansion of transfer station area.

Current incentives implemented in the Snowy Mountain SAP study area include:

- Waste sludge from STPs (managed by NPWS) such as Charlotte and Thredbo, is being transported and land applied in Berridale:
  - Currently Snowy Monaro Regional Council re-use the green waste taken to landfills as compost.
  - A separate organics waste stream (predominantly kitchen waste) is collected in Perisher Valley and Smiggin Holes during winter, with the product processed at Sawpit Creek to produce a compost product that is utilised in rehabilitation projects within park.
  - Snowy Monaro Regional Council are considering capture and crushing of glass for use as a sand or gravel replacement in council construction projects.

Table 7.22 provides a summary of waste and resource recovery in the Alpine resorts.

Table 7.22 Waste and resource recovery summary

AREA	DETAILS
Perisher and Charlotte Pass	— Perisher and Charlotte Pass waste is managed by NPWS through the waste transfer station located at Perisher. It is disposed of at Jindabyne Landfill. — Recycling is collected by a licenced waste contractor and taken to their materials recovery facility in Canberra, ACT. — In Perisher Valley and Smiggin Holes an organic waste collection service operates in winter with this material being transported to Sawpit Creek for processing into compost. — Waste from Blue Cow is managed directly by Perisher ski resort and is transported via Skitube to Bullocks Flat, then to landfill. Co-mingled recycling and organics waste is collected by Snowy Monaro Regional Council. — There are also systems in place in Perisher to recycle waste generated by staff, including electronic waste, mobile phones and printer cartridges.
Thredbo Village	— Waste is disposed of at Jindabyne Landfill. — Recycling is transported to a commercial recycler and processed to market. Scrap metal is collected and either reused on site or transported to Cooma for recycling. — Some food organics are composted on site with the current organics recycling program targeting village restaurants and lodges with commercial kitchens.
Selwyn	— Unclear where Selwyn waste is disposed.

Source: DPIE, 2020

7.4.12.2 CURRENT INFRASTRUCTURE CAPACITY

Table 7.23 provides a summary of the existing infrastructure capacity (water availability, wastewater treatment, and supply of electricity and gas, and waste) in the Alpine Resort areas.

The table uses a traffic light system to assess the level of capacity; green – no current capacity issues; orange – partial or unclear of capacity issues; red – capacity exceeded.

Table 7.23 Assessment of Alpine Resort area infrastructure capacity

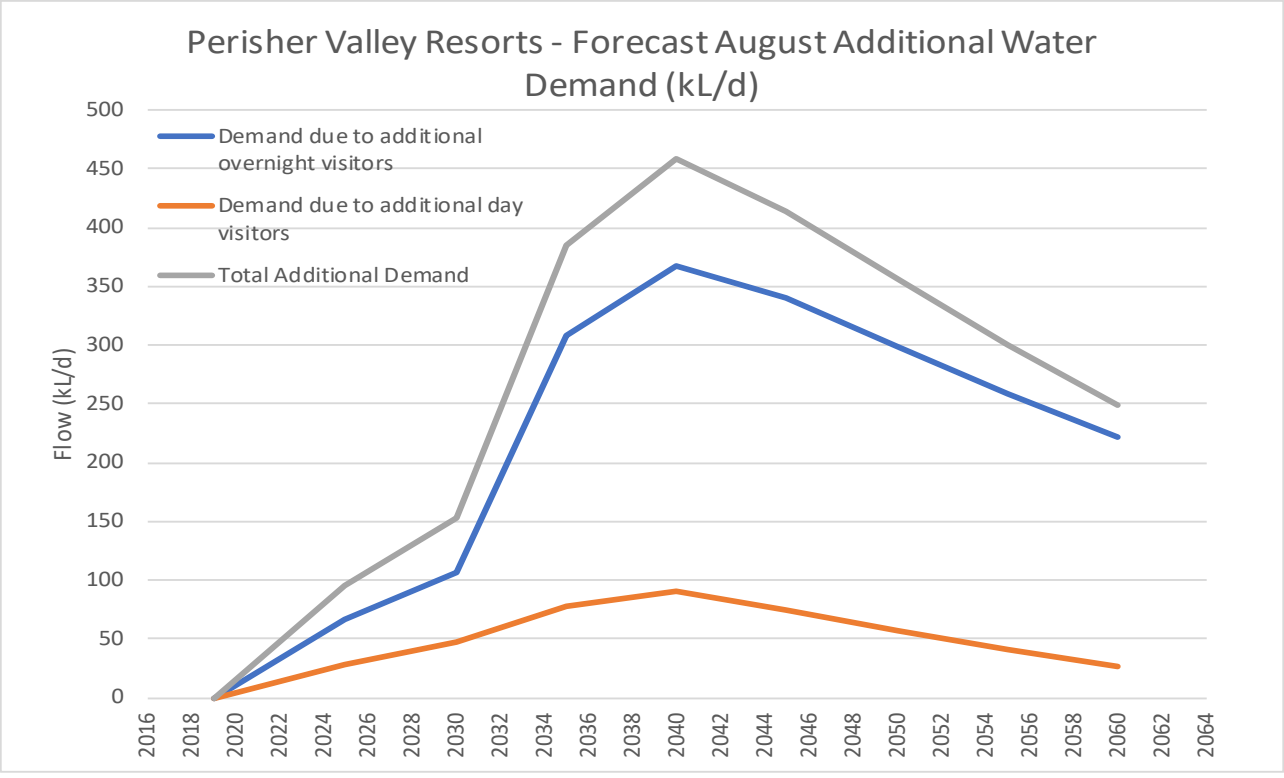
ALPINE RESORT AREA	ALPINE RESORT INFRASTRUCTURE					
	WATER AVAILABILITY / EXTRACTION	WASTE WATER TREATMENT	ELECTRICITY SUPPLY	GAS SUPPLY	WASTE	TELECOMMUNI-CATIONS
Thredbo						
Perisher						
Charlotte Pass						
Selwyn	N/A	N/A	N/A	N/A	N/A	

7.4.12.3 FUTURE PROJECTIONS & CONSIDERATIONS

This section outlines the future projections related to infrastructure, and the potential impacts to values without mitigation.

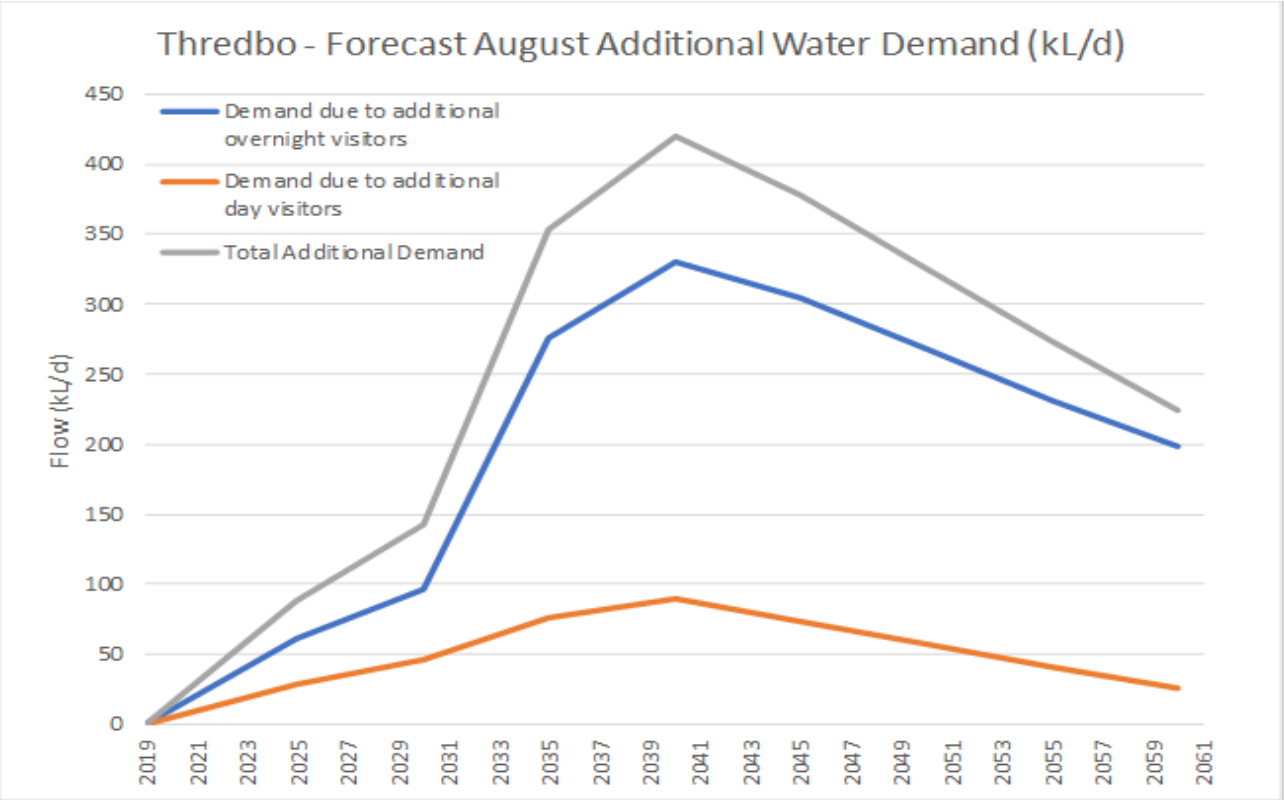
WATER USE AND SUPPLY

With the projected increase in the visitor growth for Alpine resort areas. The forecast additional water demand during the peak August period for the Perisher Valley Resorts and Thredbo shows a significant increase in peak demand of around 450kl/day and 400kl/day respectively (refer to Section 6.1 in the *Infrastructure Study*).



Source: WSP, 2021g

Figure 7.20 Adopted future additional water demand in Perisher during peak season (August)



Source: WSP, 2021g

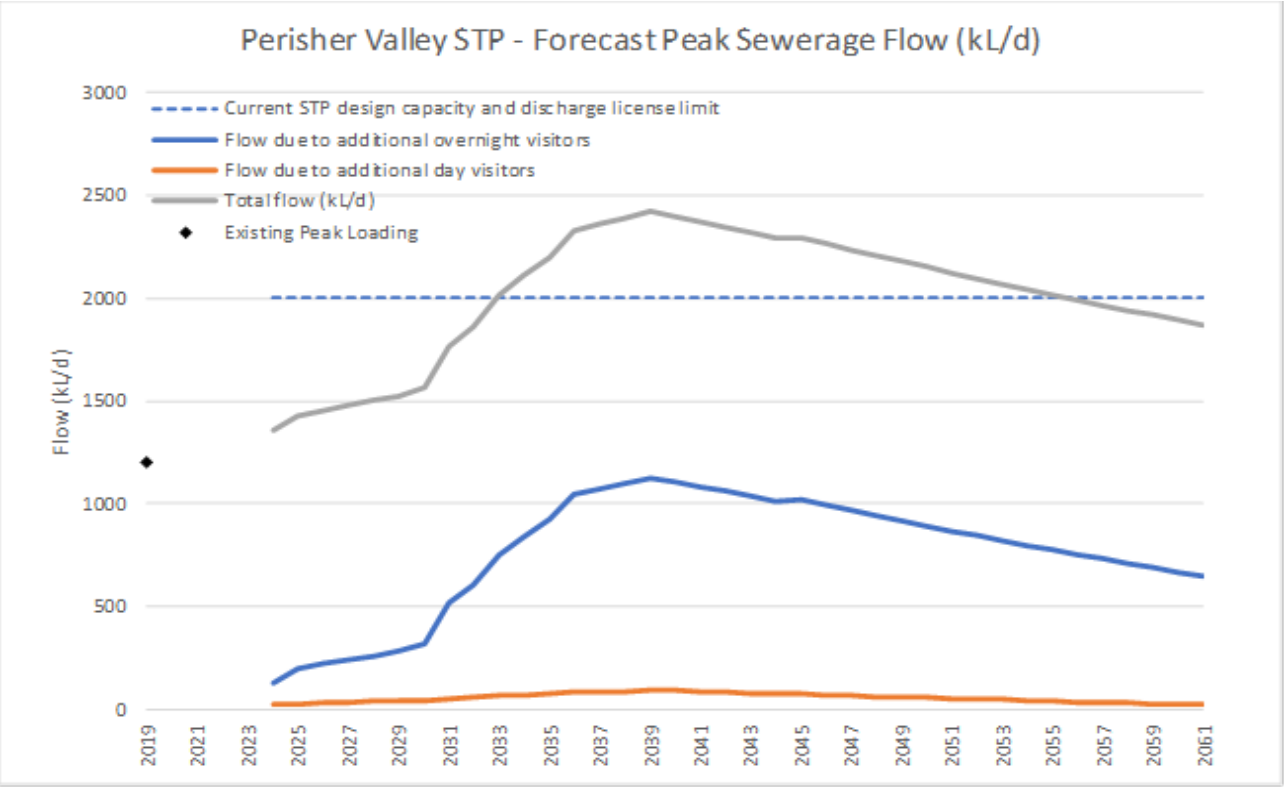
Figure 7.21 Adopted future additional water demand in Thredbo during peak season (August)

If not properly managed the increase in demand would result in increased likelihood of exceeding extraction limits. Although details of the treatment capacity are unclear, this increase in water demand would also result in increasing pressure of the treatment capacity of the infrastructure.

The demand for water is likely to be exacerbated by the need for artificial snowmaking to complement natural snowfall and extend the ski season. Typically, artificial snowmaking commences in early May and continues through to August. Coinciding with the peak winter visitor demand. An analysis of the impacts of climate change on water demand (refer to Appendix D) shows an increase of 7% by 2030, and 42% by 2070. Based on current licencing conditions, demand would significantly exceed extraction licencing at perisher by 2039. Based on current data, the extraction licence limit at Thredbo would not be reached. It should be noted there are a number of discrepancies in extraction data, which make an accurate assessment difficult.

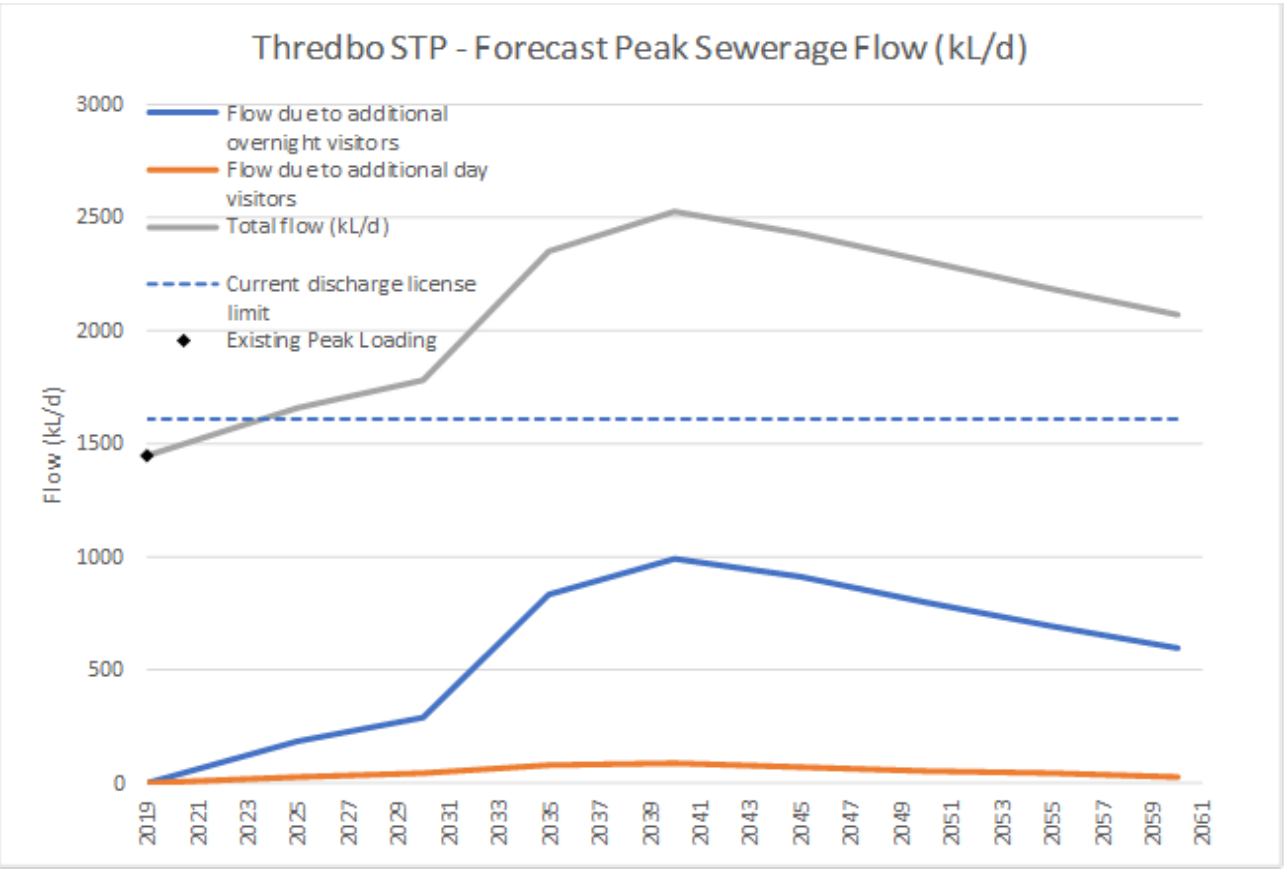
WASTEWATER

With the projected increase in the visitor growth, it is likely that the existing wastewater system would be under high pressure. The various existing ageing asset and performance issues could potentially pose challenges in taking such increase due to their limitation in treatment capacity. The forecast additional wastewater demand during the peak August period for the Perisher Valley Resorts and Thredbo shows a significant increase in peak demand flow of around 2400kl/day and 2500kl/day respectively (vs current discharge licence limits of 1600kl/day and 2000kl/day respectively).



Source: WSP, 2021g

Figure 7.22 Adopted future sewerage flow at Perisher Valley STP



Source: WSP, 2021g

Figure 7.23 Adopted future additional sewage flow at Thredbo STP

ELECTRICITY

Table 7.24 provides a summary of the calculated electricity demand for the Snowy Mountains SAP Precincts. Based on the growth projections, upgrades would be required at three of the four substations supplying electricity to the areas.

Table 7.24 Future electricity demand

SNOW MOUNTAINS SAP PRECINCTS	SUBSTATION	ADDITIONAL LOAD ESTIMATE (MVA)	AVAILABLE CAPACITY (MVA)
Charlotte Pass, Thredbo Ranger Station, Thredbo Village	Thredbo Substation	21.98	17.70
Perisher Village, Smiggen Holes Resort	Perisher Substation	14.085	8.70
Sponars Chalet, Ski rider, Guthega, Kosciuszko Tourist Park, Island Bend / Thredbo Diggings / Ngarigo	Snowy Adit Substation	1.20	9.90
Bullocks Flat	Bullocks Flat Substation	2.37	5.3

Source: WSP, 2021g

Consideration of the provision of energy, the Snowy Mountains SAP has the strong renewable energy aspirations that should be considered as part of any future development or use in the SAP Precincts in KNP.

These aspirations are outlined in the Renewable Energy Technical Study (WSP, 2021h) and include '*A renewable future'* and '*Climate Positive and Carbon negative'*.

Table 7.25 identifies the shortlisted energy deliverable opportunities in or to supply the Snow Mountains SAP Precincts in KNP. A detailed summary of all options considered is included in Section 3 of the Renewable Energy Technical Study (WSP, 2021).

Table 7.25 Renewable Energy delivery considerations for Alpine Resort areas

ENERGY DELIVERY CONSIDERATIONS	APPLICABILITY FOR SNOWY MOUNTAINS SAP PRECINCTS IN KNP
Large-scale Solar	There is potential for the development of a large-scale solar farm in the greater SAP area.
Small-scale Solar	The carparking areas of Alpine resorts including Perisher Valley, Bullocks flat, and Thredbo, have been identified as an opportunity for the installation of solar PV systems.
Distributed Generation - Alpine resorts, Hotels and Accommodation	There is the potential for distributed rooftop energy generation at Alpine resorts, resorts, hotels, fire station and accommodations in Perisher Valley, Charlotte Pass, and Thredbo.
Geothermal Heat Pumps (GSHP)	There is potential for several buildings at Perisher Valley, Charlotte Pass and Thredbo to be suitable for GSHP.
Hydrogen	There is potential for the development of a centralised hydrogen plant located near Jindabyne substation within the SAP area. The hydrogen plant could provide hydrogen fuel for either passenger vehicles, buses or trucks which could be replaced by hydrogen fuel cell vehicles as the SAP develops. To be considered a renewable energy source, it would have to be coupled with a renewable energy power source such as solar or wind.
Battery Energy Storage System (BESS)	There is potential for BESS integrated with the Solar PV Farm(s), Solar Car Park(s) and roof top solar PV system(s).

ENERGY DELIVERY CONSIDERATIONS	APPLICABILITY FOR SNOWY MOUNTAINS SAP PRECINCTS IN KNP
Renewable Energy Power Purchase Agreements	Thredbo Alpine Village, Perisher Ski Resort and Charlotte Pass Snowy Resort have been identified to have the opportunity to organise a Power Purchase Agreement (PPA) with Snowy Hydro (or any other renewable energy generator).
Community based virtual power plant (cVPP)	There is the potential for a cVPP to optimise the gap in real time capability of demand-supply and integrate distributed energy generation with the energy storage systems and the electricity grid.

Source: WSP, 2021h

TELECOMMUNICATIONS

Future demand for telecommunications has not been undertaken. It is expected that upgrades to telecommunications networks are required at most Snowy Mountains SAP precincts in KNP.

GAS

Future gas demand has not been calculated. The gas infrastructure servicing the NPWS area can be scaled up to meet increased demand through the delivery agreements established with Elgas. It is not recommended for any backbone or reticulated network to supply the area.

A detailed SWOC analysis of electricity and gas infrastructure is included in section 4.2 of the Infrastructure Report.

WASTE AND RESOURCES RECOVERY

It is expected that the area will experience a 5% annual growth in waste disposal. A detailed breakdown of waste streams is included in section 7.3.2 of the *Infrastructure report*.

7.4.12.4 KEY OUTCOMES

The Snowy Mountains SAP has investigated the need for and recommends the implementation of a carrying capacity framework within the SAP sub precincts in KNP. This would allow the current bed limits of the PoM to be raised to meet SAP requirements and implement a means to manage day visitation. Based on the proposed growth scenarios, the proposed SAP development would result in significant exceedances of infrastructure capacities and wastewater discharge allowances under licences. Additional water allocation may also be required, including the need for additional water allocation to meet snowmaking demands.

A full summary of assessed approaches to alleviate infrastructure capacity constraints is included in Section 9 of the *Infrastructure study* and summarised in Table 7.26.

Table 7.26 Snowy Mountains SAP Infrastructure considerations

	THREDBO	PERISHER	OTHERS
Water Infrastructure	— Upgrade the existing water treatment plant to increase capacity from an approximate 481kl/d peak day demand to of 911kl/d, considering practicality, economics and environmental feasibility. — Significant network upgrades will also be required to extend the network services to the new development areas within Thredbo.	— Upgrade the existing water treatment plant to increase capacity from an approximate 352.6kl/d peak day demand to of 821.6kl/d — Significant network upgrades will also be required to extend the network services to the new development areas within Perisher.	— It is understood (based on anecdotal information only) that Charlotte Pass has no reservoir storage and relies on storage in the weir/river source, which is unreliable in summer. It is recommended that a new storage reservoir is installed to enable the expansion of Charlotte pass in both Winter and Summer season. (note, the feasibility of this has not been investigated)
Wastewater infrastructure	— Major upgrade (assumed complete replacement) of the existing STP and amendment of effluent discharge license arrangements is required to cater for the proposed level of growth. Investigation is required to understand the required timing for this this upgrade and possible staging. — Significant network upgrades will also be required (subject to further investigation). — Use of recycled water for snowmaking should be considered (refer to section 7.1.3.3 of the *Infrastructure Study*). — Consider privatisation of wastewater treatment facilities	— The current discharge license limit and STP capacity of 2000 kL day will be reached. Upgrades required (constrained by space) — Significant network upgrades will also be required (subject to further investigation). — Use of recycled water for snowmaking should be considered (refer to section 7.1.3.3 of the *Infrastructure Study*). — Consider privatisation of wastewater treatment facilities	— Sawpit creek (Kosciuszko tourist Park requires new discharge to be created direct to Sawpit Creek (subject to EPA approval) — Charlotte Pass STP is aging and requires further assessment or replacement — Ski Rider resort requires onsite STP — Consider privatisation of wastewater treatment facilities

	THREDBO	PERISHER	OTHERS
Stormwater Infrastructure	— Sealing of unsealed roads with concrete pavement. — Develop plan to increase the amount of kerbed road, and construct piped drainage system	— Continuation of the sealing of all internal roads between resort areas — Develop plan to increase the amount of kerbed road, and construct piped drainage system	— Sponars Chalet, Kosciuszko tourist park and Island bend require an additional 1.6 MVA to support development.
Electricity	— Additional 1x5 MVA transformer to provide capacity for future demands. — New 11 kV reticulation will likely be required to the new growth areas as the capacity of these distribution feeders are unknown at this stage. — Consideration of renewable energy technologies.	— Additional 1x20 MVA transformer to provide capacity for future demands. — Expansion of substation to accommodate a new transformer. — Potential new 11 kV feeder to the development site of the car park. — Relocation of 11 kV line at car park to accommodate development proposal or location of solar farm. — Replacement of existing switchgear in the substation by September 2022. — Consideration of renewable energy technologies.	— Sponars Chalet, Kosciuszko tourist park and island bend require an additional 1.6 MVA to support development. — an upgrade of 5MVA to the distribution transformer to accommodate the additional demand at the Bullocks flat substation — Consideration of renewable energy technologies
Gas	— No upgrades have been proposed.	— No upgrades have been proposed.	— No upgrades have been proposed.
Telecommunications	— No upgrades have been proposed.	— No upgrades have been proposed.	— Fibre connection to be established throughout the SAP area targeted towards growth areas.

7.4.13 SUSTAINABILITY

This section of the report has been informed by the *Snowy Mountains Special Activation Precinct Ecologically Sustainable Development (ESD): Context Analysis and Technical Report* (ESD Report) (DSquared, 2021). The purpose of the ESD report was to summaries the ESD opportunities identified for the Snowy Mountains SAP for consideration and integration through the planning stages. This section of the report aims to provide a summary of the existing ESD outcomes of the KNP, current Alpine Resort ESD initiatives, and consideration of future ESD initiatives in the Snowy Mountains SAP Precincts of KNP.

Figure 7.24 outlines the ESD themes considered due to their importance for the SAP.

Theme	Relevance
Climate Resilience	Climate resilience is critical to ensure that the community understands and can respond to a changing climate.
Emissions	The SAP vision is to be carbon negative, offsetting more emissions than are produced in the region.
Energy	Delivery of secure, affordable, low carbon energy to support a carbon negative region.
Environment	The natural alpine environment needs to be conserved and enhanced for all to enjoy.
Society	Prioritise health, wellbeing and liveability for the benefit of the local community and to attract new tourism.
Mobility	Active and sustainable transport can create a new transport model to and from the region.
Circular Economy	Embedding a circular economy approach to maximise resource efficiencies and reduce waste generation.
Water	Green infrastructure is developed to support the natural water cycle.
Leadership	Demonstrate leadership in sustainable development with an internationally recognised sustainability framework.

Source: DSquared, 2021

Figure 7.24 ESD themes of relevance to the Snowy Mountains SAP

For a full summary of the ESD opportunities refer to the ESD report.

7.4.13.1 EXISTING ESD INITIATIVES

Table 7.27 provides a summary for the environment theme on the existing environmental initiatives and activities for individual resort. The existing context and condition for sustainability including each of the ESD themes has been documented in the ESD Report (DSquared 2020). It should be noted that the ESD report contains existing conditions for several ESD themes including climate resilience, emissions, energy, health and wellbeing, mobility, circular economy, water and leadership. A summary of these themes has been excluded from the table below and can be reviewed in the ESD report.

Table 7.27 Summary of sustainability initiatives by Alpine resort

RESORT	ENVIRONMENTAL INITIATIVES AND ACTIVITIES
Thredbo Resort	Thredbo was the first Australian ski resort to have its major operations powered by renewable energy, through a contract for 100% renewable energy with Red Energy and Snowy Hydro. Thredbo resort lists the following environmental initiatives and activities: — Organics recycling machine: composting food waste via a closed loop system. — Plastic reduction plan: removing single-use plastic products. — Rehabilitation: stabilising soil and providing habitats for native animals as part of the mountain bike trail development. — Repurposing materials: building materials have been reused in landscaping.

RESORT	ENVIRONMENTAL INITIATIVES AND ACTIVITIES
	— Greenfleet: since 2009, Thredbo has partnered with Greenfleet to offset resort vehicle emissions including all fuel used to run snow groomers and shuttle buses. — Carbon offset: a voluntary forestry carbon offset program for guests, enabling them to purchase a tree for $4 when buying lift products. — EarthCheck: Thredbo measures its environmental performance using the EarthCheck benchmark, achieving a silver certification for three consecutive years. — Keep it cool: a local non-profit based in Jindabyne who work to support environmental initiatives in the Snowy Mountains. — Environmental week: a week dedicated to driving awareness about environmental initiatives with the broader community. — Biodiversity Management: in partnership with the NSW National Parks and Wildlife Service, Thredbo acts to protect native flora and fauna within the resort. This includes fauna crossings and planting of native flora. — Energy Management: Energy efficient equipment (Gondola, lifts, snow-making machines, heat pumps and lighting) and solar PV installations have reduced energy and utilised renewable energy. — Waste Management: multiple separation and recycling initiatives are practiced for common and more challenging waste streams at the resort. — Water Management: water use is reduced through water efficient appliances and fittings and water quality is monitored.
Perisher Resort	Perisher has implemented environmentally sustainable activities as part of the Vail Resorts network who share a commitment to net zero operating footprint. This includes: — Improving waste diversion across all operational areas, including a focus on organics composting — Removal of waste bins in staff areas to encourage better utilisation of centralised waste separation stations — Replacing single-use plastic straws with compostable alternatives — Removal of single-use plastic products like condiments and implementing reusable crockery and cutlery across various operational areas — Increased the number of water stations to encourage BYO drink bottles and reduce single-use plastic bottles — Incorporating habitat connectivity features in development proposals, with three new fauna crossings installed in the last 2 years — Using innovative construction techniques to avoid or minimise disturbance to biodiversity — Campaigning to reduce litter and holding clean-up activities Perisher are members of the CERES Business for Innovative Climate and Energy Policy as well as RE100. The resort engages with vendors and suppliers to identify and collaborate on opportunities to reduce emissions and impacts. Information is published with progress shared in their annual report. Vail Resorts measures GHG footprint and in 2016, calculated a per skier footprint of 0.0127T CO2 per visit

RESORT	ENVIRONMENTAL INITIATIVES AND ACTIVITIES
Charlotte Pass Resort	There are efforts to improve access with shared car parking and group transport proposed at Sawpit Creek and/or revival of a chairlift. The resort has a local wastewater treatment plant which discharges to Spencers Creek Bog. The 10-year master plan notes upgrades to this facility, including roofing over tanks, recladding of buildings and automated programmable logic controllers. Charlotte Pass aims to monitor stormwater and increase investment in energy saving initiatives, as well as developing waste programs to raise awareness. The area around the resort is primarily disturbed vegetation but the area supports important biodiversity. The resort is compact with buildings within close proximity allowing pedestrian access.
Selwyn	Selwyn was destroyed in the 2020 wildfires and is being rebuilt. There is currently no specific environmental initiatives and activities available for Selwyn Resort.

7.4.13.2 ESD INITIATIVES OF ALPINE RESORTS

Table 7.28 provides a review of the existing sustainability initiatives implemented in the resort areas. This review is based on the information obtained through the ESD report and NPWS annual performance reports (2012-2020). This section differs from other sections in that it is not applicable to consider the 'capacity constraints' or performance on the themes examined. Rather we have qualitatively reviewed the level of engagement / implementation of specific ESD values.

The table uses a traffic light system to review the level of ESD engagement / implementation; **green** – Positive or well implemented actions; **orange** – partial or uncertain implementation; **red** – room for improvement.

Table 7.28 Review of Alpine Resort ESD implementation

ALPINE RESORT AREA	ALPINE RESORT ESD IMPLEMENTAION[1]					
	CLIMATE RESILIENCE ENERGY & EMISSIONS	ENVIRONMENT	SOCIETY	MOBILITY	CIRCULAR ECONOMY	LEADERSHIP
Thredbo						
Perisher						
Charlotte Pass						
Selwyn	N/A	N/A	N/A	N/A	N/A	N/A

1. It should be noted that the ESD theme 'water' has been excluded from this table as it is included in Section 7.4.4.

7.4.13.3 FUTURE OPPORTUNITIES & CONSIDERATIONS

Table 7.29 provides a summary of key opportunities and considerations within the KNP SAP.

Table 7.29 Summary of key opportunities and considerations within the SAP Investigation Area

ESD THEMES	KEY OPPORTUNITIES AND CONSIDERATIONS
Climate resilience	Climate change is well understood with projections data and resources available, however these need detailed interrogation to plan for a resilient future.
Emissions	There are significant opportunities with multiple pathways to transition to low and zero emissions energy and transport options while improving resilience and supporting development growth
Energy	Existing renewable energy in the region generates more energy than the SAP's current demand, however supply is not guaranteed for the SAP. There are opportunities to secure a zero-emissions electricity supply via a combination of new renewable energy installations and a Power Purchase agreement (PPA) with Snowy Hydro
Health and wellbeing	There are health and wellbeing opportunities in the alpine regions, sport and adventure tourism facilitating a wide range of active lifestyles and wellness activities
Mobility	Transport is the highest source of GHGs, and capacity is a constraint, but there are opportunities to improve this.
Environment	The natural resource is a resource that must be respected.
Circular Economy	New waste infrastructure and services are needed to transition to the circular economy.
Water	Water is abundant but its use is prioritised elsewhere.
Leadership	A world leadership position is a near future reality, and a key component of this would be the implementation of an overarching ISO 14,001 EMS which connects to the Alpine DCP and references other frameworks and rating system, and links to the proposed CCF.

7.4.13.4 KEY OUTCOMES

The Snowy Mountains SAP has investigated the need for and recommends the implementation of a carrying capacity framework within the SAP sub precincts on KNP. This would allow the current bed limits of the PoM to be raised to meet SAP requirements and implement a means to manage day visitation. The following approaches requirements for Sustainability should be part of the delivery of the CCF as a requirement for allowing modifications (increases) to the current capacities (bed limits) within the KNP.

Table 7.30 provides a summary of the key ESD outcomes of the SAP Structure plan. Due to the characterises of the ESD themes, some themes are covered in greater detail in other sections of this report.

Table 7.30 Summary of key opportunities and considerations within the SAP Investigation Area

ESD THEMES	ESD OPPORTUNITIES INCLUDED IN THE STRUCTURE PLAN
Climate Resilience	The following ESD opportunities are included in the Structure Plan: — Climate change impacts and climate resilience and adaptation opportunities are embedded into the design of infrastructure and services. — The structure plan has identified development areas and resorts most impacted by climate change and snow reductions (e.g. those at lower altitudes), to allow development to transition these areas to alternative activities over time. — An analysis of snow conditions, coverage, depth and snow making data has been undertaken and all relevant disciplines have incorporated the impact into projections.
Emissions	To ensure carbon emissions are accurately measured, avoided and where possible reduced over time, the following EDS opportunities have been incorporated into the structure plan: — An emissions boundary is incorporated into the structure plan to accurately account of the SAP wide emissions. — A framework for reducing emissions is developed with options for energy efficiency, renewable energy and circular economy opportunities incorporated. — A carbon neutral target and timeframe is confirmed to ensure the SAP can become carbon neutral in a viable manner. — Opportunities to reduce emissions in the Alpine DCP and Precinct design guidelines are explored.
Society	The following Key ESD opportunities (as related to the KNP SAP precincts) are included in the Structure Plan: — Recognising and celebrating history and heritage, including the new Snowy Discovery Centre — The Structure Plan includes expansion of existing and development of new sports and tourism developments, focussing on the wellbeing of the community, visitors and tourists. — SAP design guidelines are to be developed which will including requirements to design buildings and community spaces for wellness.
Energy	The Following key ESD opportunities are included in the Structure Plan: — A renewable Power Purchase Agreement (PPA) is negotiated with Snowy Hydro to supply 100% renewable energy to the SAP. — The integration of solar PV and battery storage systems on a smaller scale to support individual developments where viable — Integrate energy efficiency and productivity into development design guidelines, which both embodied energy and lifecycle emissions considered.
Mobility	The following key ESD opportunities are included in the Structure Plan: — Zero-emission transport options are being developed to support passenger and mass transport options around the SAP. This includes electric vehicle charging stations and zero emission shuttles. — Public transport is prioritised as the preferred method of transport around the SAP area, as per the Transport study. This is part of a a fully integrated transport model which provides a seamless service across the SAP areas.

ESD THEMES	ESD OPPORTUNITIES INCLUDED IN THE STRUCTURE PLAN
Environment	The following key ESD opportunities are included in the Structure Plan: — 'Touch the ground lightly' is the overarching theme for new developments. — Green infrastructure to be embedded into urban design. — Develop existing buildings in previously developed sites. All the recommended development in KNP is within existing tourism and development areas. — Develop design guidelines for all new infrastructure and buildings in accordance with the sustainability frameworks. — Integrate a CCF (this report) with the SAP EMS requirements.
Circular Economy	The following key ESD opportunities are included in the Structure Plan: — Support waste management and recycling infrastructure to improve waste separation and diversion. — Develop circular economy relationships between SAP business. — Explore opportunities to align the SAP Structure Plan, future Alpine DCP and Precinct Design Guidelines with circular economy initiatives.
Water	The following key ESD opportunities are included in the Structure Plan: — New water infrastructure and urban planning to incorporate water sensitive urban design — Wastewater treatment systems in the alpine areas to be upgraded to closed loop systems with no pollution to alpine streams. — Build capture and reuse infrastructure for all new developments. — Build infrastructure to capture alternative and sustainable natural water supply sources, including recycled water and rainwater.
Leadership	It is recommended the following precinct frameworks and rating tools are incorporated into the structure Plan: — A precinct 6-star Green Star community rating which demonstrates leadership in the development of sustainable communities. — The one living planet framework is embedded in the accredited ISO 14,001 EMS. — Aligning the EMS to support the KNP POM, CCF and Resort EMS.
ESD Destination	The majority of these ESD destination ideas have been integrated into the Structure Plan, including: — Focus on year-round outdoor activities, sports and wellbeing. — Tourism opportunities in eco and wellbeing opportunities, including increased camping, multi-day walking routes and mountain biking activities. — Transitioning to public transport and zero emissions options over time.

These key outcomes have been incorporated into Section 7.5 – Stage 5 of the CCF.

7.5 STAGE 5 – RECOMMENDED KEY STANDARDS, AND MECHANISM FOR VALUE PROTECTION

There is a suite of values within the proposed Snowy Mountain SAP Precincts of KNP (Alpine resort areas and TOAs) which require protection, enhancement, and monitoring. The Snowy Mountains SAP process allows for a reconsideration of how these values are protected and what mechanism is used to provide that protection. The proposed mechanisms include:

- The Snowy Mountains SAP Master Plan
- The Snowy Mountains SAP Alpine Development Control Plan (DCP)
- A certified precinct ISO 14,001 Environmental Management System (EMS)
- Site area management

This section provides a brief description of the proposed mechanisms, and Table 7.31 outlines a summary of proposed values and KPIs (where appropriate) and identifies where in the SAP process their protection and management would be addressed.

7.5.1 SNOWY MOUNTAINS SAP MASTER PLAN

As outlined in Chapter 1 of this report, The Snowy Mountains SAP master plan is the statutory planning document that would support the new SEPP (Activation Precincts) 2020. It would outline the vision and principles for the precinct and provide details on land use provisions for each identified SAP precinct (Alpine resort areas and TOAs).

From the perspective of carrying capacity, the Master Plan is the first step in the protection of KNP values. It will establish performance criteria for environmental considerations such as noise, biodiversity, and water management, and identify matters to be addressed in the Alpine DCP. It is also the guiding document where specific landscape value protections are most appropriate. The master plan will include a structure plan for each precinct setting out its strategic environmental impact protection and development aspirations. It can ensure appropriate development types are planned for in suitable areas, these are important to ensure the protection of values such as biodiversity, visual amenity and riparian sites.

7.5.2 SNOWY MOUNTAINS SAP ALPINE DCP

As outlined in Chapter 1 of this report, the Snow Mountains SAP Alpine DCP is the second stage of the SAP process and will follow the adoption of the master plan. The purpose of the Alpine DCP (in support of the Master Plan) is to identify site level development controls to guide the preferred development in each SAP precinct. It would provide detailed strategies for certain value protections (where appropriate) such as Aboriginal heritage, environmental and amenity, infrastructure and service requirements and the staging of developments. It is also where the provisions sit for establishing procedures for ongoing monitoring and reporting.

From the perspective of the carrying capacity, the Alpine DCP is the second step in the provision of value protection in KNP and sets out a series of plans to address how certain values should be protected in each SAP precinct. For example, it would set out the details of the design and function of new infrastructure requirements such as the replacement or upgrading of STPs or water treatment infrastructure, thus providing protection of water quality values in KNP.

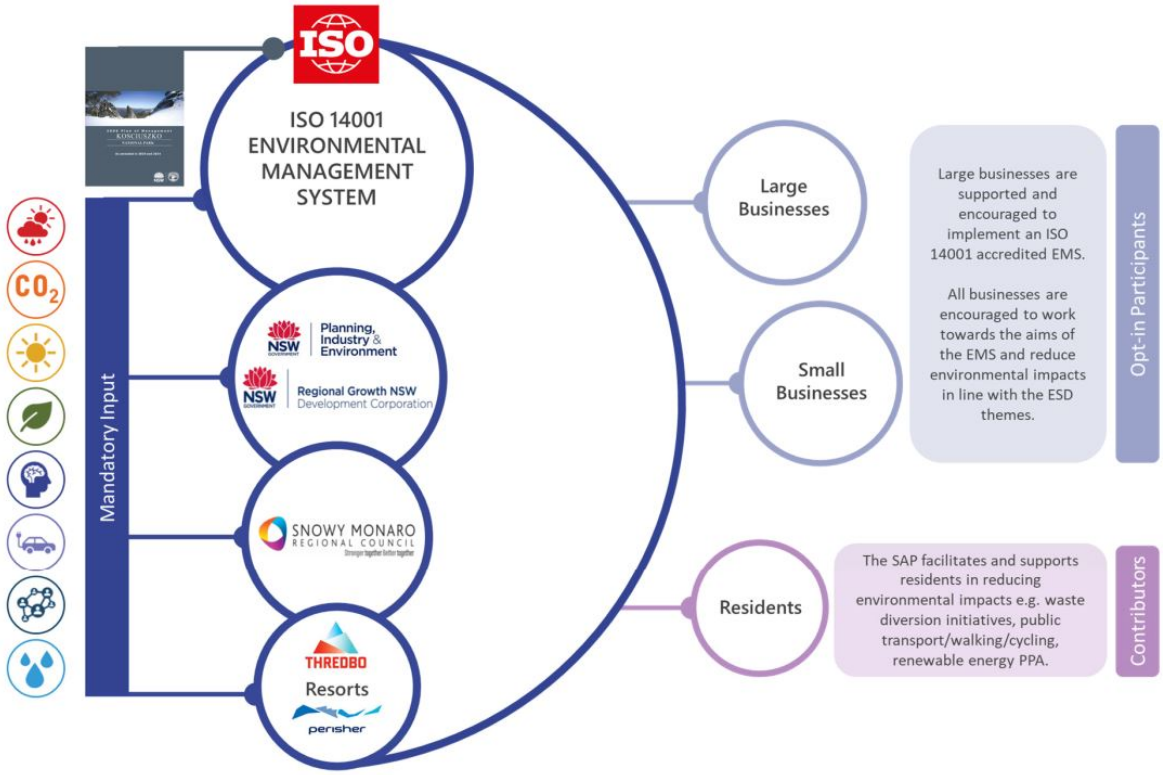
The Alpine DCP can also be used to manage values such as resort amenity. This could be achieved by establishing specific building or development design details for specific precincts and require international and nationally recognised precinct rating tools such as the Green Building Council – 6 Star Precincts, and/or by requiring resort areas to implement comfortable carrying capacity assessments to manage resort balance and ensure crowding is managed appropriately. There is also an opportunity to link any future resort development to comfortable carrying capacity assessment.

7.5.3 A SNOWY MOUNTAINS SAP EMS (ISO14,001)

The third proposed step in the process would be the implementation of a certified precinct ISO Environmental Management System certified to ISO14,001. This would embed a holistic framework which serves to integrate the CCF and the KNP POM. The purpose of the EMS is to manage those ongoing performance matters such as those caused by visitor impacts and infrastructure impacts in the SAP precincts.

It has been recognised that the ability of operators to achieve 14,001 compliance varies depending on several factors. It is recommended that mandatory input and compliance would be required from Alpine resorts (Thredbo, Perisher and Charlotte Pass) while other operators are supported and encouraged to implement an ISO 14,001 accredited EMS, or work towards the aims of the EMS to reduce environmental impacts in line with SAP expectations (refer to Figure 7.25)

A summary of proposed inputs and stakeholder requirements is included in Table 12 in the *ESD report* (DSquared, 2021).



Source: DSquared, 2021

Figure 7.25 Proposed Environmental Management System inputs and stakeholders

In support of the EMS there are also precinct rating tools which can be incorporated to support the value protections and simplify the assessment, monitoring and compliance processes. An analysis of these rating tools against ESD themes is included in Section 11.7 of the *ESD Technical Study* (DSquared, 2021). The ESD report recommends the 'One Planet Living' framework is embedded into the ISO 14,001 EMS.

7.5.4 SITE AREA MANAGEMENT

An important element of the EMS, and the final step in the value protection mechanisms, are specific monitoring and management requirements. These are required to protect values which traditionally may not be possible to captured in the predevelopment planning and approval stages steps above. These are however of importance to land managers, which under the existing environmental management framework is the NPWS. These management requirements may be built and managed through the into an EMS framework requirement or managed though an alternative mechanism such as leases or licenses (where the requirement may be a EMSP). It would allow for value protections on issues such as pest and weed management, litter and general amenity, water quality, rehabilitation works, and community involvement.

Table 7.31 Summary of Proposed Values, KPI and proposed mechanism for protection and management

VALUES	SNOWY MOUNTAINS SAP MASTER PLAN	SNOW MOUNTAINS SAP ALPINE DCP	OPERATOR EMS	SAP SITE MANAGEMENT
Water resources and water quality	The Master Plan would: — Explore opportunities for integrated water cycle management to quality and quantity aspects of water management. — Ensure a sustainable use of water involving a fully integrated water cycle that supports the needs of the precinct and the environment — Explore opportunities to improve water quality and reduce stormwater run-off (e.g. through passive landscape design) — Identify appropriate supporting provisions relevant to water resources and quality (e.g. a stormwater management strategy) to be developed as part of the Alpine DCP. — Define riparian zones around all waterways.	The Alpine DCP would: — Upgrade wastewater treatment systems in alpine areas to closed loop systems with no pollution to alpine streams — Ensure water capture and reuse infrastructure is installed for all new developments. — Ensure point source pollution controls are implemented (such as along roads, carparks, new developments) and require the use of green space to treat stormwater runoff. — Ensure the establishment of a SAP-wide Water Quality Monitoring Program (WQMP) including monitoring for impacts of applied salt in KNP (roads and resorts) — Ensure future snowmaking technologies are appropriate and all potential impacts have been assessed and mitigated prior to development or use.	The EMS (14,001) would require the operator to: — Comply with a SAP-wide WQMP and identify site specific compliance and responsibilities. — Ensure compliance against water extraction licencing **(KPI)** — Track and report water consumption and explore opportunities for water savings and measures to improve efficiency **(KPI)** — Track and report water consumption for snowmaking — Ensure compliance against a water quality monitoring program.	Site specific management actions would require operators to: — Comply with the requirements of the WQMP which would be developed to ensure site specific compliance and compliance for biological, physical and chemical indicators of resort stream health compared to ANZECC guidelines (physical and chemical measurements) and AUSRIVAS KNP model (biological condition). **(KPI)**

VALUES	SNOWY MOUNTAINS SAP MASTER PLAN	SNOW MOUNTAINS SAP ALPINE DCP	OPERATOR EMS	SAP SITE MANAGEMENT
Pollution prevention and incident management	The Master Plan would: — Explore opportunities for integrated water cycle management for quality and quantity aspects of water management	The Alpine DCP would: — Explore opportunities to design and implement additional sewage treatment capacity (refer to - *water resources and water quality*) — Identify relevant performance criteria related to discharge of wastewater and contaminated stormwater **(KPI)**	The EMS (14,001) would require the operator to: — Ensure 100% of staff are inducted and have undertaken training in environmental incident management and response training **(KPI)** — Implement procedures to report all pollution incidents to relevant authorities in a timely manner — Ensure compliance with EPA discharge licenses for sewage treatment plans (ST's) **(KPI)** — Ensure compliance with POEO Act 1997, UPSS Regulations 2008 **(KPI)**	

VALUES	SNOWY MOUNTAINS SAP MASTER PLAN	SNOW MOUNTAINS SAP ALPINE DCP	OPERATOR EMS	SAP SITE MANAGEMENT
Biodiversity	The Master Plan would: — map and protect areas of high biodiversity value — preserve the precinct's landscape and biodiversity values — preserve and protect habitat corridors — identify appropriate supporting biodiversity provisions to be developed as part of the Alpine DCP (e.g. location or habitat specific provisions that promote biodiversity values throughout the precinct) — identify relevant biodiversity provisions including suitable performance criteria (KPI) — identify the location of threatened species populations and communities.	The Alpine DCP would: — identify location or habitat specific provisions that promote biodiversity values throughout the precinct — consideration of connectivity and crossing structures.	The EMS would require the operator to: — establish pest and weed management requirements with NPWS — collaborate with NPWS on species management actions. — Undertake a rehabilitation plan to manage existing disturbed areas — Maintain existing areas of native vegetation	Site specific management actions would require operators to: — ensure no encroachment of vehicles into areas of high biodiversity value such as short cutting, vehicle crowding or passage — ensure no encroachment of impacts into BAM areas and reference sites following detailed mapping
Riparian and wetland areas	The Master Plan would: — identify strategies for greening the precinct through revegetation, connecting habitat and greening riparian corridors — identify relevant performance criteria related to preservation and revegetation of riparian corridors where possible (KPI) — identify relevant performance criteria related to maintaining or improving the ecological condition of waterbodies and riparian corridors in relevant catchments (if applicable) (KPI).	The Alpine DCP would: — develop a landscape and vegetation plan to manage and protect riparian and wetland areas.	The EMS (14,001) would require the operator to: — assist relevant agency (as required) to protect Riparian and wetland areas in accordance with *Biodiversity Conservation Act* 2016 and The *Environmental Protection and Biodiversity Conservation Act 1979*.	Specific site management requirements would include: — Require rehabilitation of riparian areas.

VALUES	SNOWY MOUNTAINS SAP MASTER PLAN	SNOW MOUNTAINS SAP ALPINE DCP	OPERATOR EMS	SAP SITE MANAGEMENT
Cultural Heritage	The Master Plan would: — promote and enhance the cultural heritage of the Snowy Mountains region and ensure the unique culture and history of the regions is celebrated — acknowledge the First Nations people and country — protect heritages, items and historic assets — identify provisions on ensuring Aboriginal culturally significant places and artefacts are protected, maintained and enhanced — identify built form provision on non-Aboriginal heritage (e.g. retaining non-Aboriginal heritage items and encourage changes to occur away from significant elements or sections of heritage items) — promote, maintain and enhance connection to country.	The Alpine DCP would: — promote development and Precinct design that recognises its connection to country — include strategies for the reuse of heritage listed buildings, and principles for the design of the heritage curtilage — prepare an Aboriginal Cultural Heritage Management Plan. — prepare a vegetation and landscape plan that incorporates an Aboriginal heritage interpretation strategy presented in consultation with the local land council — protection of existing built heritage during construction or redevelopment works in accordance with relevant legislation. — incorporate the principle of promoting cultural awareness through design of Country that can enhance senses of culture, and diverse, rich differences. — explore opportunities to deliver Aboriginal cultural experience.	The EMS (14,001) would require the operator to: — assist relevant agencies (as required) to protect heritage sites, items and historic assets in accordance with *Heritage Act 1977*. — assist relevant agencies (if required) to help protect non -Aboriginal heritage sites, Aboriginal Heritage sites and places in accordance with relevant legislation.	

VALUES	SNOWY MOUNTAINS SAP MASTER PLAN	SNOW MOUNTAINS SAP ALPINE DCP	OPERATOR EMS	SAP SITE MANAGEMENT
Energy conservation	The Master Plan would: — set targets for the SAP to achieve the SAP aspirations for 100% renewable energy supply — explore opportunities to increase energy supply of the Precinct from renewable opportunities — identify performance criteria on built form to ensure building bulk, orientation and design contributes to the energy efficiency of buildings — support the delivery of innovative renewable energy solutions to reduce carbon emissions and energy costs across the precinct and establish relevant performance criteria (KPI)	The Alpine DCP would: — consider energy availability for hydrogen development — explore opportunities to incorporate mandatory energy efficiency and building performance requirements — explore opportunities to incentivise the relevant business accreditation on energy such as Earth Check for Business — explore opportunities to incorporate new artificial snowmaking technologies to improve energy efficiency.	The EMS (14,001) would require the operator to: — track and report energy use — improve transparency of energy usage data and reporting requirements (e.g. public publishing of data) — ensure compliance with proposed SAP energy targets **(KPI)**	

VALUES	SNOWY MOUNTAINS SAP MASTER PLAN	SNOW MOUNTAINS SAP ALPINE DCP	OPERATOR EMS	SAP SITE MANAGEMENT
CO_2 Emissions	The Master Plan would: — explore opportunities for Precinct to achieve a carbon neutral target and timeframe to ensure the SAP can become carbon negative in a viable manner — identify relevant performance criteria (KPI) — support the delivery of innovative renewable energy solutions to reduce carbon emissions and energy costs across the precinct — develop an emissions boundary in line with Structure Plan to accurately account for the SAP's emissions. — Set targets for the SAP to achieve the SAP aspirations for Net Zero.	The Alpine DCP would: — ensure all development is carbon neutral certified in line with the Climate Active Precinct Standard (or equivalent) — ensure GHG emissions data is reported annually by all operators — explore opportunities for reducing emissions in line with the master aspirations. — explore opportunities to incorporate mandatory energy efficiency and building performance requirements — explore opportunities to incorporate new artificial snowmaking technologies to improve energy efficiency. — explore opportunities to support the transition to lower GWP refrigerants for buildings	The EMS (14,001) would require the operator to: — track and report scope 1 and 2 emissions — improve transparency of energy usage data and reporting requirements (e.g. public publishing of data) — ensure compliance with proposed emissions performance criteria (KPI)	

VALUES	SNOWY MOUNTAINS SAP MASTER PLAN	SNOW MOUNTAINS SAP ALPINE DCP	OPERATOR EMS	SAP SITE MANAGEMENT
Climate Resilience	The Master Plan would: — explore opportunities to ensure the SAP areas are adaptable and resilient to climate change impacts	The Alpine DCP would: — Prioritise developments that focus on alternatives to snow-based tourism — Implement building design, infrastructure and building design guidelines to increase climate resilience — Require operators to develop a climate change adaptation plan to identify risk and opportunities and provide a transition plan for adapting to climate change.	Not applicable	Not applicable

VALUES	SNOWY MOUNTAINS SAP MASTER PLAN	SNOW MOUNTAINS SAP ALPINE DCP	OPERATOR EMS	SAP SITE MANAGEMENT
Waste management	The Master Plan would: — support the expansion of resource recovery and recycling industries and embed circular economy principles into planning and operations — align master plan with circular economy initiatives — investigate opportunities to adopt a sustainability framework that connects organisation, processes and resources in a circular economy to gain efficiencies and minimise waste — build and grow on established connections businesses have with national and global circular economies and further expand sustainability initiatives to ensure the Precinct is future proofed — identify appropriate supporting provisions related to waste regeneration and recycling — establish relevant provisions on hazardous development to ensure potentially hazardous wastes are appropriately managed to protect human health and the biophysical environment.	The Alpine DCP would: — investigate further opportunities for new development to ensure waste is reduced and synergies are realised to benefit businesses and community — explore opportunities to align the Alpine DCP with circular economy initiatives — support expansion of resource recovery and recycling facilities (e.g. waste infrastructure and processing centres to facilitate increased waste diversion and recycling rates).	The EMS (14,001) would require the operator to: — implement waste education programs to reduce waste generation, increase waste separation and reduce waste to landfill — require operators to aim for a zero-waste-to-landfill policy, and follow the waste management principles of diverting as much waste from landfill as possible — monitor and report waste disposal on an annual basis.	Site specific management actions would require operators to: — manage litter and general resort amenity to established standards.

VALUES	SNOWY MOUNTAINS SAP MASTER PLAN	SNOW MOUNTAINS SAP ALPINE DCP	OPERATOR EMS	SAP SITE MANAGEMENT
Sustainable recreation & community involvement	The Master Plan would: — ensure development maximises sustainability opportunities that aims to achieve enhanced social performance — ensure local community is involved and consulted on the Master Plan and have opportunities for involvement in the design, implementation, and ongoing management of the SAP. — promote and maintain an enhancement of sense of place.	The Alpine DCP would: — ensure the local community is involved and consulted on the Snowy Mountains SAP Master Plan. They have opportunities for involvement in the design, implementation, and ongoing management of the SAP.	The EMS (14,001) would require the operator to: — ensure the community have opportunities to participate in community environmental initiatives.	

VALUES	SNOWY MOUNTAINS SAP MASTER PLAN	SNOW MOUNTAINS SAP ALPINE DCP	OPERATOR EMS	SAP SITE MANAGEMENT
Alpine resort amenity	The Master Plan would: — ensure growth and economic activity while minimising impacts through initiatives that 'touch the ground lightly' — identify relevant aims to ensure appropriate amenity and outlook for visitors and communities (e.g. to ensure that the Precinct delivers excellent amenity for workers and businesses) — protect, maintain, and enhance visual amenity through the selection of key development sites in appropriate locations	The Alpine DCP would: — provide detailed strategies for protection of amenity — ensure all developments are appropriately located and designed for the desired KNP amenity — ensure all development are constructed and maintained for the desired KNP amenity — explore opportunities to minimise impacts of development on air quality and amenity — require Alpine resorts to undertake comfortable carrying capacity analysis to ensure resorts are well balanced and crowding is managed appropriately.	The EMS would require operators to: — implement an amenity management system or monitoring program to ensure the protection of visitor experience and amenity values within the operator areas, — be responsible for education, awareness, and promotion of resort amenity. The EMS would include actions for general amenity maintenance	Site specific management actions would require operators to: — ensure daily litter run to agreed scope — regular downstream, down wind and off-site inspections 4 times per year including transects in identified problem areas — run daily litter check on problem areas — run education programs for visitors — minimise volume moving off site — regular maintenance of gross pollutant traps.

VALUES	SNOWY MOUNTAINS SAP MASTER PLAN	SNOW MOUNTAINS SAP ALPINE DCP	OPERATOR EMS	SAP SITE MANAGEMENT
Visitor experience	The Master Plan would: — establish performance criteria on maximising opportunities for recreation by communities and visitors to the Precinct (KPI) — ensure a range of activities are available for visitors	The Alpine DCP would: — ensure development controls protect key visitation values of KNP — ensure travel times to key resort areas are acceptable — explore opportunities to use plantings to create a pleasant environment for walking and cycling, for workers, visitors, and the community — require Alpine resorts to undertake comfortable carrying capacity analysis to ensure resorts are well balanced and crowding is managed appropriately, and to set baseline information.	The EMS would require operators to: — implement an amenity management system or monitoring program to ensure protection of visitor experience and amenity values within the operator areas. — Ensure records of public complaints are kept and reviewed annually.	

VALUES	SNOWY MOUNTAINS SAP MASTER PLAN	SNOW MOUNTAINS SAP ALPINE DCP	OPERATOR EMS	SAP SITE MANAGEMENT
Alpine Resort Transport and Access	The Master Plan would: — ensure a fully integrated transport model is developed which provides a seamless transport service between Jindabyne and Alpine Resort areas — ensure the establishment of improved place-making at transport hubs in KNP and associated hubs in Jindabyne — promote KNP as a year-round destination to reduce issues with seasonality peaks — encourage a modal transport shift away from cars and support travel demand management Implement equitable access to KNP for all with competitive pricing for sustainable modes — target transport solutions that provide employment in the region.	The Alpine DCP would: — ensure improved public transport facilities are developed to improve access to alpine resort areas and TOAs — ensure the creation of a frequent and rapid zero emission vehicle shuttle service linking key destinations — implement real time information to manage parking capacity — Introduce ITS to alert drivers to conditions and improve road safety — establish a cap on existing parking supply at existing / approved levels. — Provide priority access to zero emissions shuttles and other high occupancy vehicles.	The EMS would require operators to: — ensure records of traffic volumes and over capacity parking at high visitation nodes including Skitube, were centralised and reported on regularly	Not applicable
Land Management	The Master Plan would: — identify and select areas of development in appropriate locations that minimises the potential for land management issues and seeks to improve land management outcomes. — explore opportunities to avoid areas with higher potential for landslide	The Alpine DCP would: — ensure adequate engineering consideration on areas of medium to high geological risk. — develop a landscape and vegetation plan to manage the recreational activities that require earth works.	The EMS would require operators to: — ensure minimum snow coverage guidelines are followed — ensure all earthworks (such as development of seasonal mountain bike trails) are undertaken in accordance with relevant guidelines.	Site specific management actions would require operators to: — achieve original development approvals, delivery on rehabilitation plan — ‘no bare earth’ except for tracks, building curtilages under eaves, defined hardened areas

7.6 STAGE 6 – IMPLEMENTATION, MONITORING AND COMPLIANCE AND ADAPTIVE MANAGEMENT

The establishment of an implementation, monitoring, response, and compliance process for the CCF is the final stage and a vital component to managing the cumulative impacts it seeks to protect. This can be examined in two ways, development, and operations.

7.6.1 DEVELOPMENT

New developments in Snowy Mountains SAP precincts would require an Activation Precinct Certificate (APC):

- For an activation precinct certificate (APC) to be issued, the proposed development must be consistent with the SAP Master plan / Alpine DCP (as an exempt, complying or activated development application), and the proponent or operator must have an annually certified ISO 14,001 EMS in place, with all environmental risk factors associated with their operations adequately addressed.
- If the proposed development is not consistent with the SAP Master plan / Alpine DCP, the traditional development application pathway would be applied. This pathway would require the proponent to demonstrate a high amenity and environmental outcome, and ongoing compliance with an annually certified ISO 14,001 EMS. If the proponent is unable to demonstrate the high amenity and environmental outcomes, and / or EMS compliance, an activation precinct certificate would not be issued.

Figure 7.26 provides a visual representation of the proposed implementation, monitoring and compliance process for the Snowy Mountains SAP CCF.

7.6.2 OPERATIONS

For ongoing operations:

- All major operators (Alpine resort areas) undertaking activities in KNP would be required to maintain a certified EMS (ISO14,001) which connects to the SAP Alpine DCP and other frameworks and rating systems. The EMS would require annual reporting and independent auditing, and a 5-year review period.
- All smaller operators, undertaking activities in KNP, would be required to maintain site specific EMP as well as an EMSPs as agreed with NPWS (where required). These plans, as above would connect to the SAP Alpine DCP (including EMS requirements) and other frameworks and rating systems (where appropriate), require annual reporting to NPWS and a 5-year review period.

7.6.3 ADAPTIVE MANAGEMENT AND REVIEW

The setting of a review period is the first step in the establishment of an adaptive management program. This review would include engagement with NPWS and stakeholders, as well as a steering group to be established and headed by an independent chair to guide any future decision making.

The proposed review would allow for the assessment of performance, identify ongoing issues with any non-conformance, and facilitate any required modifications to targets, goals and management decisions previously implemented. It would also consider the acceptability of development standards and bed limits in SAP precincts in KNP over time. The adaptative management process is a fundamental component of this final stage of the CCF and maintaining the desired value conditions set out in Stage 5. Further development of this stage would be undertaken prior to the final establishment of any CCF.

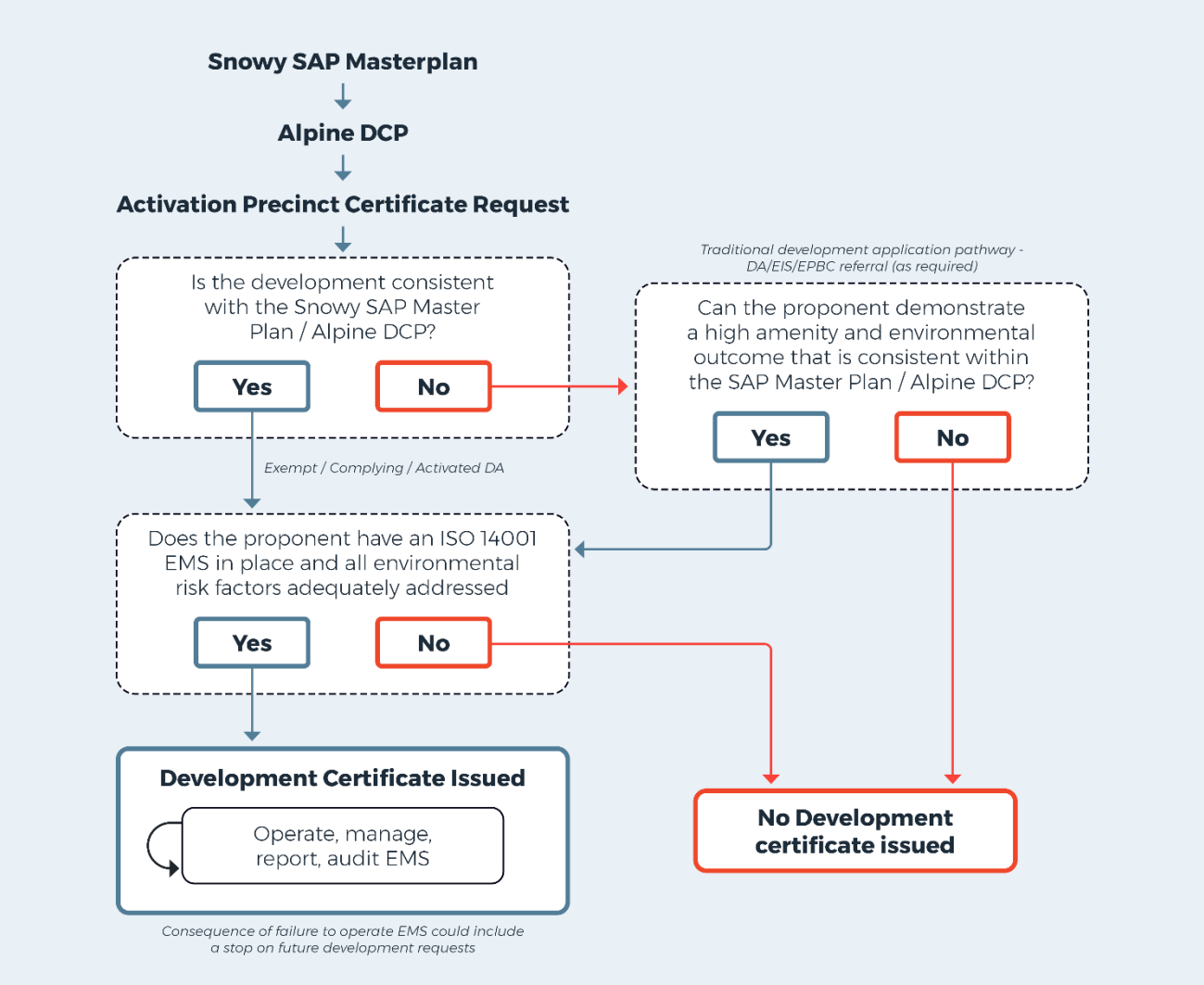


Figure 7.26 Proposed SAP Carrying Capacity implementation, monitoring and compliance process

8 CONCLUSION

This report recommended a six-stage carrying capacity framework is incorporated into the future Snowy Mountains SAP precincts to manage the expected growth in visitor numbers to 2016 while protecting key environmental, social and cultural values that are present in KNP. The recommendation notes, that many of the management tools or steps required for an effective carrying capacity framework are already in place, however these could be strengthened, and developed as part of the Snowy Mountains SAP master planning process.

The report recommends and proposes a CCF that:

- Retains a bed limit to provide certainty for stakeholders, however, allows for modification of the existing bed limit to an appropriate level based on the constraints identified during the master planning and outlined in proposed structure plans and yield analysis.
- Considers how the impacts of day visitation is managed and use the Snowy Mountains SAP Master Plan to determine infrastructure requirements to manage those day visitors based on growth projections.
- Considers ski resort capacities and incorporate CCC or 'skiers at one time' analysis to determine the need for on mountain alpine resort developments, and to manage visitor experience, amenity, recreational activities.
- Establishes a tiered approach to the establishment of ongoing environmental protections including monitoring, compliance, and response. That is:
  - utilising the Snowy Mountains SAP Master Plan and a future Alpine DCP to set strategic and high-level expectations around development opportunities in proposed development areas, including concepts and footprints
  - for Alpine resort operators, include the requirement of an ISO 14,001 EMS
  - for smaller operators, include an alternate approach, utilising EMS with the aim of supporting and encouraging operators to implement an ISO 14,001 accredited EMS, or work towards the aims of the EMS to reduce environmental impacts in line with SAP expectations. Smaller operators would also develop EMSPs in collaboration with NPWS to manage site specific requirements.
- Is agreed to as part of the conditions of development approval within the SAP framework, with ongoing performance linked to staged approvals in that process. This could be captured through model conditions included in the Alpine SEPP.

9 LIMITATIONS

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BIBLIOGRAPHY

- Arup, 2011, Perisher Village Stage 1 Development Application: Traffic and Parking Report REP0001.
- Bacon, J, Roche, J, Elliot, C & Nicholas, N, 2006, VERP: putting principles into practice in Yosemite National Park, *Visitor Impact Monitoring*, vol.23 no. 2, pp 73-83.
- Brent Harley and associates, 2019, All Season Resort Guidelines – Chapter II: Mountain Resorts, prepared for Mountains Resorts Branch, Ministry of Forests, Lands and Natural Resource Operations. British Columbia, Canada.
- Brent Harley and associates, 2020; Big White Ski Resort, Draft Master Plan; Prepared for Big White Ski Resort, October 2020.
- Brown, G, Koth, B, Kreak, G, & Weber, D 2006 'Managing Australia's protected areas: A review of visitor management models, frameworks and processes', *Cooperative Research Centre for Sustainable Tourism*.
- Biosis Research 2012, Mount Buller and Mount Stirling Alpine resorts Environmental Management Plan, 2013–2017, prepared for the Mount Buller and Mount Stirling Alpine resorts Management Board, Biosis Research Pty Ltd, Melbourne.
- Castley, JG, Hill, W, Pickering, C, Hadwen, W & Worboys, G 2008, 'An integrated framework for developing ecological indicators of visitor use of protected areas', *Cooperative Research Centre for Sustainable Tourism*, Gold
- Centre for International Economics, 2020, Strategic economic context for the Snowy Special Activation Precinct, (June 2020 and revised December 2020).
- Donaldson, S, 2021, *Snow Mountains SAP, Preliminary Aboriginal Cultural Vales Assessment Draft Report.*
- DPIE, 2020, Summary of the condition of the values of Kosciuszko National Park 2006-2016, Department of Planning, Industry and Environment, Sydney, 2020.
- DSquared, 2020, Snowy Mountains Special Activation Precinct Ecologically Sustainable Development: Draft Context Analysis and Technical Report. For the NSW Department of Planning, Industry and Environment, Sydney NSW 2020.
- Erkkonen, J. & Itkonen, P.J. 2006, Monitoring Sustainable Natural Tourism in Practice – Experiences from Pyha-Luosto National Park, Finland. In *Proceedings of the Third International Conference on Monitoring and Management to visitor Flows in Recreational and Protected Areas*, September 2006.
- Farrell, T & Marion, J. 2002, 'The Protected Area Visitor Impact Management (PAVIM) Framework: A Simplified Process for Making Management Decisions', *Journal of Sustainable Tourism*, vol. 10, no. 1, pp. 31-51.
- Fefer, J, De Urioste-Stone, S.M, Daigle, J & Silka, L 2018, 'Understanding the perceived effectiveness of applying the visitor experience and resource protection (VERP) framework for recreation planning: A multi-case study in US National Parks', *The Qualitative Report*, vol. *23, no. 7*, pp.1561-1582.
- Golder Associates. 2016. Parks Canada Agency's approach to ski resort development and use planning. Technical Memorandum, September 2016.
- Golder Associates. 2017. Review of 'Carrying Capacity' in the Alpine Reports of Kosciuszko National Park: Options and Future Directions. Technical Memorandum, February 2017.
- Harry Measures + Associates. 2019 Revelstoke Mountain Resort Master Plan update 2019. Revelstoke Mountain Resort.
- Hof, M & Lime DW 1997, 'Visitor Experience and Resource Protection Framework in the National Park System: Rationale, Current Status, and Future', in SF McCool & DN Cole, *Proceedings--limits of Acceptable Change and*

Related Planning Processes: Progress and Future Directions: from a Workshop Held at the University of Montana's Lubrecht Experimental Forest, pp. 29-36.

- Jiricka, A., Salak, B. Arnberger, A. & Probstl-Haider, U. 2014. *VV-TOMM:* Capacity building in remote tourism territories through the first European transnational application of the Tourism Optimization Management Model. Conference paper. *Sustainable Tourism*, 2014. Vol 187.
- Jones, G, 2009, The adaptive management system for the Tasmanian Wilderness World Heritage Area — linking management planning with effectiveness evaluation, Chapter 13 in Allan, C. and Stankey, G. (eds), Adaptive Environmental Management. A Practitioners Guide. Co-published by Springer and CSIRO Publishing, Dordrecht The Netherlands, and Collingwood Australia.
- Jovicic D 2011, *The environmental management Systems and contemporary tourism development*, in Toruismos: An international multidisciplinary journal of tourism, Volume 6, number 2, Autumn 2011 pp377-391.
- Lawrence, DP 1997, Profile: Integrating Sustainability and Environmental Impact Assessment", *Environmental Management*, vol. 21, no. 1, pp.23-42.
- Lindberg, K, McCool, S, & Stankey, G 1997, 'Rethinking carrying capacity', *Annals of tourism research*, vol. 24, no. 2, pp.461-465.
- Manning, RE 2002, 'How much is too much? Carrying capacity of national parks and protected areas', paper presented at the *Monitoring and management of visitor flows in recreational and protected areas. conference proceedings,* pp.306 -313.
- McArthur, S 2000, 'Visitor management in action: An analysis of the development and implementation of visitor management models at Jenolan Caves and Kangaroo Island*'*, Doctoral dissertation, University of Canberra.
- McCool, SF & Lime, DW 2001, 'Tourism carrying capacity: tempting fantasy or useful reality?', *Journal of sustainable tourism*, vol. *9*, no. 5, pp. 372-388.
- McCool, SF 1996, 'Limits of acceptable change: a framework for managing national protected areas: Experiences from the United States', presented at Workshop on Impact Management in Marine Parks in Kuala Lumpur.
- McCool, SF 2007, An assessment of frameworks useful for public land recreation planning (Vol. 705), US Department of Agriculture, Forest Service, Pacific Northwest Research Station.
- Nilsen, P & Tayler, G 1997, 'A comparative analysis of protected area planning and management frameworks', in SF McCool & DN Cole, *Proceedings--limits of Acceptable Change and Related Planning Processes: Progress and Future Directions: from a Workshop Held at the University of Montana's Lubrecht Experimental Forest*, pp. 49-58.
- NIEIR, 2012, The Economic Significance of the Australian Alpine resorts: Winter season 2011, summary report, a report by the National Institute of Economic and Industry Research for the Alpine resorts Coordinating Council, the Australian Ski Areas Association, the NSW National Parks and Wildlife Service and the Tasmanian Government, Alpine resorts Coordinating Council, Victorian Government, Melbourne.
- NPWS, 2006, *Kosciuszko National Park Plan of Management 2006*, NSW National Parks and Wildlife Service, Department of Environment and Conservation (NSW), Sydney.
- NPWS 2017, NSW Alpine resorts Environmental Performance Report 2014–16, NSW National Parks and Wildlife Service, Office of Environment and Heritage, Sydney.
- NSW Government, 2020, *Draft review of the condition of the values of Kosciuszko National Park 2006-2016,* for internal review, Department of Planning, Industry and Environment, May 2020.
- OEH, 2016, Carrying Capacity in the Alpine resorts of Kosciuszko National Park: Background Paper, Office of Environment and Heritage, Sydney
- OEH, 2015, Monitoring Framework for Wilderness Horse Riding Trial, Office of Environment and Heritage, Sydney

- OEH 2017, Horse Riding in Wilderness Trial Monitoring Program: Final report, Office of Environment and Heritage, Sydney
- OEH, 2017a, Carrying Capacity in the Alpine resorts of Kosciuszko National Park: Options & Future Directions.
- OEH, 2018 Major Development in the Alpine resorts: National Park and Wildlife Service Development assessment and Plan of Management Amendment Coordination Guideline.
- OEH, 2018a, Climate Change Impacts in the NSW Alpine Region – Projected Climate in the NSW Alpine Region. Office of Environment and Heritage, Sydney, 2018.
- OEH, 2018b, Climate Change Impacts in the NSW Alpine Region – Water availability. Office of Environment and Heritage, Sydney, 2018.
- OEH, 2018c, Climate Change Impacts in the NSW Alpine Region – Impacts on biodiversity. Office of Environment and Heritage, Sydney, 2018.
- OEH, 2019, Climate Change Impacts in the NSW Alpine Region – Projected changes in snowmaking conditions. Office of Environment and Heritage, Sydney, 2019.
- OzArk Environment & Heritage, 2021, Aboriginal Cultural Heritage Assessment Report, Snowy Mountains special Activation Precinct, For the NSW Department of Planning, Industry and Environment, Sydney NSW 2020.
- Parks Canada, 2006, Ski area management guidelines, Jasper National Park, Parks Canada Agency, Jasper, Alberta Canada.
- Parks Canada, 2017, Marmot Basin Ski area site guidelines for development and use, Jasper National Park of Canada.
- Parks Canada, 2018, Site Guidelines for Development and Use Sunshine Village Ski Resort, Banff Alberta. Banff National Park.
- Perez-Verdin, G, Lee, ME & Chavez, DJ 2008, 'Use of the recreation opportunity spectrum in natural protected area planning and management', in DJ Chavez, PL Winter, JD Absher (eds)*, Recreation visitor research: studies of diversity,* Gen. Tech. Rep. PSW-GTR-210. Albany, CA: US Department of Agriculture, Forest Service, Pacific Southwest Research Station, pp.23-38.
- Pickering CM 2008, Literature Review of Horse-Riding Impacts on Protected Areas and a Guide to the Development of an Assessment Program, Environmental Protection Agency, Brisbane, Queensland.
- Prato, T 2001, 'Modelling carrying capacity for national parks', *Ecological economics*, vol. 39, no. 2, pp. 321-331.
- Prato, T. 2009, 'Fuzzy adaptive management of social and ecological carrying capacities for protected areas', *Journal of Environmental Management*, vol. 90, no. 8, pp. 2551-2557.
- SE Group. 2013, Loveland Ski Area Master Plan.
- SE Group. 2014, Diamond Peak Master Plan, Incline Village Lake Tahoe.
- SE Group. 2015, Alpine Meadow Ski Area 2015 Master Plan, USDA Forest Service Tahoe National Forest.
- SE Group & Ascent Environmental. 2019, Squaw Valley Alpine Meadows Base to Base Gondola EIS/EIR.
- Sharma, K. 2004, Tourism and Regional Development, *Economic Development*, Sarup & Sons 2004, p264.
- Skoric, S. 2012, Planning the level of accommodations capacities in winter sports destinations, University of Zagreb.
- Stafford Strategy, 2021, Snowy Mountains SAP tourism Development Study, For the NSW Department of Planning, Industry and Environment, Sydney NSW 2020.
- Stankey, G.H., McCool, S.F. and Stokes, G.L., 1984. Limits of acceptable change: a new framework for managing the Bob Marshall Wilderness complex. *Western Wildlands*, *10*(3), pp.33-37.

- Toews, V, 1999, 'A backcountry visitor impact management strategy for Riding Mountain National Park', *practicum*, University of Manitoba.
- US Department of Agriculture. 2011, Draft Environmental Impact Statement for the Breckenridge Ski Resort Peak 6 Project
- Wilson, E, Neilson, N, Buultjens, J 2008. Benefits and challenges of managing tourism partnerships within protected Areas: A case study of five commercial leases in New South Wales National Parks, *CAUTHE 2008 Conference, Where the Bloody Hell Are We?* February 2008, Gold Coast, QLD Australia.
- WSP, 2020, Snowy Activation Precinct: Draft Ecological desktop of key potential development *areas*. For the NSW Department of Planning, Industry and Environment, Sydney NSW 2020.
- WSP, 2021a, Snowy Activation Precinct: Biodiversity Assessment Report – BAM Stage 1. For the NSW Department of Planning, Industry and Environment, Sydney NSW 2020.
- WSP, 2020b, Draft Snowy Special Activation Precinct Technical Study Report: Engineering – Transport. For the NSW Department of Planning, Industry and Environment, Sydney NSW 2020.
- WSP, 2020c, Snowy Special Activation Precinct Technical Study Report: Hydrology and Water Quality. For the NSW Department of Planning, Industry and Environment, Sydney NSW 2020
- WSP, 2021d, Snowy Mountains Special Activation Precinct, Salt Impact Management Plan, Kosciuszko National Park. For the NSW Department of Planning, Industry and Environment, Sydney NSW 2020
- WSP, 2020e, Snowy Special Activation Precinct Technical Study Report: Geotechnical. For the NSW Department of Planning, Industry and Environment, Sydney NSW 2020
- WSP, 2020f, Snowy Special Activation Precinct Technical Study Report: Hydrogeology. For the NSW Department of Planning, Industry and Environment, Sydney NSW 2020
- WSP, 2021g, Snowy Special Activation Precinct Draft Technical Study Report –Infrastructure. For the NSW Department of Planning, Industry and Environment, Sydney NSW 2020.
- WSP, 2021h, Snowy Special Activation Precinct Draft Technical Study Report –Renewables. For the NSW Department of Planning, Industry and Environment, Sydney NSW 2020.
- Worboys, GL, Lockwood, M, Kothari, A, Feary, S & Pulsford, I 2015, Protected Area Governance and Management, 2015 edn, ANU Press, Canberra.
- Wursig, B, Duprey, N, Weir, J 2007 Dusky Dolphins (*Lagenorhyncus obscurus*) in New Zealand Waters: Present Knowledge and research goals, *a Department of Conservation research and development series* 270. Wellington, New Zealand.
- Wynveen, CJ, Schneider, IE, Arnberger, A, Cottrell, S & von Ruschkowski, E 2020, 'Integrating Place Attachment into Management Frameworks: Exploring Place Attachment Across the Recreation Opportunity Spectrum', *Environmental management*. https://doi.org/10.1007/s00267-020-01292-7.

APPENDIX A

CARRYING CAPACITY LITERATURE REVIEW

A1 CARRYING CAPACITY LITERATURE REVIEW

A1.1 EXISTING CARRYING CAPACITY FRAMEWORKS

A1.1.1 LIMITS OF ACCEPTABLE CHANGE

Limits of acceptable change (LAC) was first developed by Stankey, McCool and Stokes (1984) to manage the increasing use and pressure on the Bob Marshall Wilderness Complex in the US. The LAC focused on attempts to determine what resource and social conditions are appropriate or acceptable, and how those conditions would be obtained. More simply, what is an appropriate level of use, and impact associated with that use? (McCool 1996). The approach focused on managing for desired conditions (Stankey, McCool & Stokes 1984).

The LAC framework is based on nine interrelated steps which focus on the selection of indicators and measurable standards (acceptable limits) and follow-up monitoring (Casteley et al. 2008; Worboys et al. 2015). Such process allows the monitoring of both ecological and social conditions to provide strategic management alternative (Castley et al., 2008). Another key feature of LAC is high stakeholder involvement throughout the whole decision-making process (Casteley et al. 2008; Stankey, McCool & Stokes 1984; McCool 2008; Worboys et al. 2015).

LAC has been applied worldwide and often at a landscape scale such as large reserves and protected area (Castley et al. 2008; Worboys et al., 2015), with the framework forming the basis for most of the protected area management planning in the US Forest Service (McCool, 1996), and in approximately 50 wilderness area under the National Forest System (McCool, 2008). Erkkonen and Itkonen (2006) has reported the use of LAC in national park planning framework in Finland. The LAC also forms the basis for the General Management Plan for Glacier National Park in Montana (McCool, 1996). Based on the wide use of LAC on the protected area in the United States, McCool (1996) has summarised that a few factors that would contribute to the success of LAC including a clear understanding of the LAC principles and concepts by the protected area managers, an intimate public participation, good understanding of LAC implementation by field level personnel and an appropriate bureaucratic procedure.

Despite the worldwide application of the LAC, there are some limitations within decision-making framework. LAC is reactive as there are no explicit linkages to overriding management objectives and does not identify the root causes of impacts (Castley et al. 2008). There is also only intermittent public involvement during the process (Brown et al., 2006). The whole process can also be costly and require time to implement especially on challenging task that require technical expertise (Brown et al., 2006; Worboys et l., 2015). Another limitation is there might be a lack of strategic direction for management topics if there are no current issues or concerns as the process focuses on issues and concerns that guide subsequent data collection and analysis (Nilsen & Tayler 1997).

A1.1.2 VISITOR IMPACT MANAGEMENT (VIM)

Visitor Impact Management (VIM) was developed from a collaboration between researchers and the American-based National Parks and Conservation Association (Nilsen & Tayler, 1997; Worboys et al., 2015). VIM is variant of LAC and has also been incorporated into the Visitor Experience and Resource Protection process (Worboys et al., 2015).

VIM involves eight key steps including the specification of standards for key impact indicators and focuses on the importance of the understanding the causal factors to identifying management strategies (Nilsen & Tayler, 1997; Worboys et al., 2015). The VIM addresses the three basic issues related to impacts: problematic conditions, potential causal factors and potential management responses (Castley et al. 2008; Nilsen & Tayler, 1997; Worboys et al., 2015). Thus VIM is reactive and more suitable for site-specific problems with less resources (Castley et al. 2008; Nilsen & Tayler, 1997; Worboys et al., 2015).

Unlike LAC, the focus of VIM is oriented to sites and localised impact problems whereas LAC applies to areas and large-scale wilderness planning (McCool, 2008; Toews, 1999). VIM does not aim to assess potential impacts and has poor linkages to identifying impact root causes (Castley et al., 2008; McCool, 2008). During the process of developing a strategy for Riding Mountain National Park (RMNP) in Canada, Toews (1999) has pointed out that the lack of public involvement in VIM is a potential issue as public involvement is a large part of the decision making in RMNP.

A1.1.3 VISITOR EXPERIENCE AND RESOURCE PROTECTION (VERP) (VISITOR ACTIVITY AND RESOURCE PROTECTION IN THE SKI RESORT)

The Visitor Experience and Resource Protection (VERP) was developed by the US National Park Service (NPS) in the early 1990s to help manage visitor use and carrying capacity in the national park system (Toews 1999; Manning 2002). The VERP is compatible with the NPS General Management Planning process and built on the Visitor Activity Management Process experience while adapting parts of LAC and VIM (Nilsen & Tayler 1997; McCool 2008). This framework emphasises on the quality of resources and visitor experiences by formulating indicators and standards of quality for desired future conditions of park resources and visitor experiences (Nilsen & Tayler 1997; Manning 2002). The process comprises a total of nine steps over four key phases: (1) framework foundation, (2) analysis, (3) prescriptions, and (4) monitoring (Manning 2002). A primary component of VERP is that the management actions would depend on the prescribed conditions for each established management zone (Toews 1999).

VERP was initially tested and applied in Arches National Park in response to the general management plan (Nilsen & Tayler 1997; Toews 1999; McCool 2008; Fefer et al. 2018). Since then, VERP has been revised and applied to the general management planning processes of several other US national parks including Grand Canyon, Yosemite and Glacier National Park (Manning 2002; McCool 2008). VERP was also applied at the Yellowstone National Park to address the specific issue of snowmobiles encountered within the park (Manning 2002).

To understand the perceived effectiveness of applying the VERP framework in the US National Park system (Acadia, Glacier and Denali National Parks), a 2018 study (Fefer et.al. 2018) showed that closely following framework procedures, and having quality partnerships with internal and external agencies to facilitate planning efforts was essential to achieving desired outcomes. Ensuring early stakeholder engagement has been shown to improve acceptance and uptake of various conservation initiatives. The study also identified that the success of VERP could be limited by a lack of training and leadership in the social dimensions of resource management, and suggested that operational structures within the VERP framework rather than the framework itself was a key limitation.

Other limitations of VERP include the level of support required from management agencies to ensure there is a high level of technical expertise to monitor the ecological components (Castley et al. 2008). Thus, commitment from all management levels and substantial investments are required (Hoff & Lime, 1997).

A1.1.4 RECREATION OPPORTUNITY SPECTRUM (ROS)

Recreation Opportunity Spectrum (ROS) was initially implemented by the Bureau of Land Management and US Forest Service in response to the planning legislation during the mid-1980s (Nilsen & Tayler 1997; McCool 2008). ROS has been widely used in a variety of wildland recreation planning process from national to local recreational planning around the world (Castley et al. 2008; McCool 2008; Perez-Verdin, Lee & Chavez et al. 2008, Wynveen et al. 2020). Outside of the US, ROS has been used to manage recreation resources in Australia, New Zealand and Japan (Perez-Verdin, Lee & Chavez et al. 2008). The ROS is a management approach that identifies and determines the diversity of recreation opportunities that the protected and natural area settings can provide (Worboys et al. 2015; Wynveen et al. 2020). The underlying principle for ROS is that the provision of a range of opportunities could best assure recreation quality as visitors seek a variety of activities, settings and experience (Perez-Verdin, Lee & Chavez et al. 2008; Worboys et al. 2015). The recreation opportunities comprise three attribute types within the area setting: biophysical, social and managerial (McCool 2008; Perez-Verdin, Lee & Chavez et al. 2008; Worboys et al. 2015; Wynyeen et al. 2020). The ROS framework involves six processes which aim to determine the expected recreational opportunity in each setting, experience indicators and management parameters and guidelines (Nilsen & Tayler 1997; Toews 1999).

The ROS framework provides guidance to protected area managers when creating creational opportunities to visitors while striving to preserve ecological integrity (Toews 1999). The emphasis on diversity in ROS also provides flexibility to mitigate any potential changes or disturbances to the recreation system such as demographic changes or technological advancement (Worboys et al. 2015).

Although ROS has been widely adopted around the world, there are still certain weaknesses within this framework. The success of ROS hugely depends on protected area managers agreeing on the spectrum of opportunities, the setting indicators and their criteria before any decision can be made (Nilsen & Tayler 1997; Toews 1999). Any disagreement could potentially affect the rest of the planning program (Nilsen & Tayler 1997). A rigid interpretation of standards or lack of appropriate data could also lead to failure of ROS. Managers also often perceive ROS as a tool that provides prescriptive rules instead of a framework supported by data and analysis (McCool 2008). ROS also has an overemphasis on recreational opportunity with limited focus on ecological integrity (Castley et al. 2008).

A1.1.5 VISITOR ACTIVITY MANAGEMENT PROCESS (VAMP)

The Visitor Activity Management Process (VAMP) was created by Parks Canada as a companion process to the Natural Resource Management Process and to assist with the development of Management Plans for the national parks (Nilsen & Tayler 1997; Brown et al. 2006; Golder Associates 2016). VAMP is built on the ROS principle and could easily incorporate the VIM, LAC and VERP principles (Nilsen & Tayler 1997; Brown et al. 2006; Worboys et al. 2015). The VAMP strongly emphasises visitor opportunities while adopting concepts and techniques from marketing and social science (Nilsen & Tayler 1997; McArthur 2000; Brown et al. 2006; Worboys et al. 2015). Such an approach is particularly useful for making strategic and operational decisions about target markets and market positions (Nilsen & Tayler 1997; Worboys et al. 2015). There are seven general steps of the management planning process including analysis of visitor information such as type, number and diversity of visitors (Nilsen & Tayler 1997; Brown et al. 2006). Through appropriate educational and recreational activities, the VAMP aims to create a management plan focusing on the selection and creation of opportunities for visitors to experience a park's heritage settings (Brown et al. 2006).

A key feature of VAMP is the focus of the integrating heritage management with visitor management, allowing heritage managers to determine what people they want, and market specific experiences to match the demand, further minimising the potential conflicts and tensions between visitors, heritage and heritage managers (McArthur 2000).

Since the late 1980s, majority of VAMP implementation has been limited to national parks in Canada and has not been widely adopted in other countries with almost no application in Australia (McArthur 2000; Moore 2010; OEH). By the late 1990s, many of Canada's park management agencies have acknowledged that they had abandoned VAMP and returned to ROS and other frameworks to achieve goals that VAMP was designed for (Toews 1999; McArthur 2000).

The limited number of VAMP applications is due to some key weaknesses within the framework. These weaknesses include; VAMP is only well-developed at the service planning level but not at the management planning level, partly because the definition of "opportunities for experience" had not been built into management plans (Nilsen &Tayler 1997). This might have a huge impact on implementation of VAMP as management planning process is its focus (McArthur 2000). Most importantly, VAMP inputs could not be expressed spatially because there was no technical capability in the park management planning process (Brown et al. 2002). There was also a loss of momentum and management commitment during 1990s partly because the approach was viewed as complicated and time consuming (Toews 1999). McArthur has also questioned how much VAMP can shift or change the culture of heritage management organisations to a more market centred approach as the success of implementing VAMP partly depends on how much culture change the organisations are prepared to adopt. VAMP also devotes less attention to ecological integrity or condition and focus much stronger on visitor opportunities (Castley et al. 2008).

A1.1.6 TOURISM OPTIMISATION MANAGEMENT MODEL (TOMM)

The TOMM was first developed by Mandis Roberts Consultants in 1997 as a community-based initiative responsible for monitoring and managing the long-term sustainability of tourism on Kangaroo Island in South Australia. Initially a LAC methodology was proposed as a suitable model for Kangaroo island, however the consultation process identified concerns over the perceived 'limiting' of tourism development on the island. Therefore, rather than set limits on activity,

the model emphasis optimal performance, borrowing strengths from both the VIM and LAC methodologies. This allowed for key fields to be broadened to link with the tourism industry and local community (Sharma, K, 2004), aligning with its overriding objective of maximising tourism opportunity.

This methodology results in both strengths and weakness to its effectiveness as an overarching methodology to assess 'carrying capacity'. Its strengths lie in its ability to recognise the social and political constraints, as well as its extensive community and stakeholder engagement (Castley, 2008). Its weaknesses lie in its failure to specifically mention management objectives (Castley 2008) and also potentially focus around maximising tourism opportunity at the risk of compromising the underlying resource base upon which this depends. European based applications identified questions over its scientific rigor due to a lack of expert knowledge (Jiricka, et al 2014). These weaknesses, along with funding requirements for community-based organisations and challenges around broad opinions and views may from a significant barrier to implementation, and answer the question as to why TOMM is often cited in literature, however its application is not widespread, as noted by McCool (2008).

A1.1.7 COMFORTABLE CARRYING CAPACITY

The most common methodology used to determine ski area capacities is Comfortable Carrying Capacity (CCC). CCC is a method used, among other applications, to determine the optimum number of skiers that can utilise ski area facilities per day, such that their skiing experience expectations are being met while maintaining the physical and social environment (Skoric, 2012). The application of CCC methodologies has been identified as of particular importance to the development of winter sports resorts to ensure resort infrastructure is not overburdened and pleasant recreational experiences are provided to visitors, it also helps ensure balanced capacities across resort facilities and provided certainty that facilities can meet anticipated demand (SE Group & Ascent Environmental, 2019) The calculation of a CCC figure is based on factors such as the spatial characteristics of terrain, the physical capacities of resort infrastructure (including ski lifts, food service and retail space), and acceptable slope densities (the number of skiers per hectare) (Skoric, 2012).

The CCC methodology has been used a key component of ski resort master planning processes in the United States and Canada, with the most recent example being the Big White Ski resort in British Columbia, Canada (BHA, 2020). CCC was used to inform the master plan by identifying an oversupply of certain types of terrain and helping to determine a balanced resort capacity.

An accurate CCC estimation is the single most important planning criteria for the resort as other related skier service facilities are planned around the mountain's estimated capacity, including parking, base lodge seating and other guest service facilities (SE Group, 2013). An accurate estimation, It is more likely that the resorts can deliver a more well-balanced outcome and further enhance guest experience by satisfying guest expectations for a quality recreation experience (SE Group & Ascent Environmental, 2019).

While CCC is well established in ski resort planning, several limitations remain as a developed carrying capacity methodology, particularly for the purposes of protecting certain values.

- Firstly, the output from the calculation should be considered as a dynamic number and many ski area consultants and large ski resorts have designed their own spreadsheets or models to produce the CCC. As a result, it is difficult to compare the outputs and report replication might lead to consistently wrong or insignificant results (Von Allmen & Salzmann, 2007).
- CCC is a planning figure and does not represent a regulatory cap on visitation (US Department of Agriculture, 2011). For example, the Draft Environmental Impact Statement on Breckenridge Ski Resort (BSR) Peak 6 Project in the United States showed it is typical for ski areas to experience peak days where skier visitation exceeds the CCC by as much as 25 percent. However, this would result in degradation of the resort's recreational experience as trails become crowded, lift-line wait times are longer and food service facilities are over capacity.
- CCC as a concept is important in the initial planning of a pre-defined area, however is not considered a framework (as per the other examples provided) as it does not include mechanism value identification or for ongoing value management, or compliance.

- CCC concepts are difficult to comprehend as virtual densities are used, which cannot be directly measured.
- Previous Environmental Impact Statements on ski resorts has also pointed out the calculation of CCC often contains numerous key assumptions and by its nature is partially subjective (SE Group & Ascent Environmental, 2019).

A1.2 LIMITATIONS OF QUANTITATIVE CARRYING CAPACITY METHODOLOGIES

The concept of carrying capacity is a simple easy concept to understand and thus has been widely adopted worldwide to manage the visitors in protected area, national parks and conservation areas (Castley et al. 2008; Prato, 2009; Worboys et. al., 2015; Prato, 2001; McCool, 1996). However, there are multiple key limitations when adopting a quantitative approach based on numerical values (e.g. number of visitors).

The use of a numerical carrying capacity approach assumes that the human-environmental systems are stable and unchanging (Worboys et al. 2015; McCool & Lime, 2001). However, biological and social systems are often highly dynamic, complex and filled with uncertainties, thus capacities would vary under different social and environmental conditions caused by climate, fire and floods (Worboys et al. 2015; McCool and Lime, 2001, Prato 2009). Hence, such approach would only be suitable in a static environment. Multiple carrying capacities are likely to be required for different times and places in response to the dynamic nature of a natural system (McCool and Lime, 2001).

A numerical focus approach may not consider other potential underlying causes of impact because of its overemphasis on the importance of amount of use and therefore fail to provide any useful direction for managers (Farrell and Marion, 2002). Carrying capacity is comprised of at least two components: a biophysical component concerning visitors' impacts on the natural resources, and a social element related to visitors' type and quality of experience during their visit (McCool, 1996; Farrell and Marion, 2002). The amount of use by visitors might only be one of the many factors that contribute to impacting the above two elements (Farrell and Marion, 2002). Visitor behaviour, type of use, development actions and other variables may have greater impacts than visitor numbers (Farrell and Marion, 2002; Worboys et al. 2015, McCool and Lime, 2001, Lindberg, McCool & Stankey, 1997). The use of a numerical approach might overlook more appropriate and effective management actions by drawing resource managers' attention away from a broad range of management strategies (Farrell & Marion, 2002).

A numerical focus on levels or numbers of visitors might also lead to misguided simplicity (Lindberg et al. 1997). Management objectives of protected areas typically relate to the conditions of natural environment than number of visitors. It is unlikely for a numerical approach to achieve the management objectives especially if there is not a known relationship between use levels and impacts for what needs to be achieved (Lindberg et al.,1997). In some cases, carrying capacity has been misapplied to set visitor number without considering how the numbers can achieve the management objectives (Farrell & Marion, 2002).

These key limitations have therefore led to a shift in focus from asking the question "how many is too many?" to "what are the desired conditions?" and led to the development of alternative planning and management frameworks based on carrying capacity (Castley et al. 2008; Farrell & Marion, 2002; Lindberg, et al., 1997; McCool 1996; McCool & Lime, 2001).

A1.3 USE OF MONITORING INDICATORS WITHIN CARRYING CAPACITY FRAMEWORKS

The shift to asking the question "*what are the desired conditions*?" shows that most of the existing carrying capacity frameworks such as VERP, LAC and VIM have a focus on maintaining condition thresholds, with a strong emphasis on outcomes rather than limiting inputs (e.g. visitor number limits). During the implementation of these carry capacity frameworks, it is important to understand that there is no one size fits all model and approaches will often need to be tailored to fit the relevant context and circumstances. Hybrid models that adopt some but not all features from published

carrying capacity frameworks are often used by conservation agencies, and can be essentially viewed as a 'toolbox' approach from which methods are picked to suit circumstances (OEH, 2016).

A1.3.1 ROLE OF MONITORING INDICATORS

A key element shared by carrying capacity frameworks is the development and the use of environmental monitoring indicators (Brown et al. 2006). Different frameworks have various level of emphasis placed on these indicators (Nilsen & Tayler 1997) and most commonly rely on these and standards developed during the process to perform ongoing monitoring and evaluation when standards and quality have not been met (Brown et al. 2006). Suitable environmental indicators are usually first chosen to reflect the state of the desired conditions, then supported by monitoring plan and measures to be implemented in response to adverse outcomes. It is also important however to note that not all environmental conditions can be monitored and managed as many conditions are too difficult to measure or subjected to wider landscape influences.

The use of adaptive management processes ensures results are being measured, rather than just carrying out actions to achieve objectives, and allows informed decisions and adjustments to be made to help achieve objectives and deliver desired outcomes (Jones 2009).

Figure A.1 illustrates the process of how management responds to declines in selected monitoring indicators until standards are re-achieved. It should also be noted that the same process can be applied to social indicators such as visitor enjoyment, or traffic congestion.

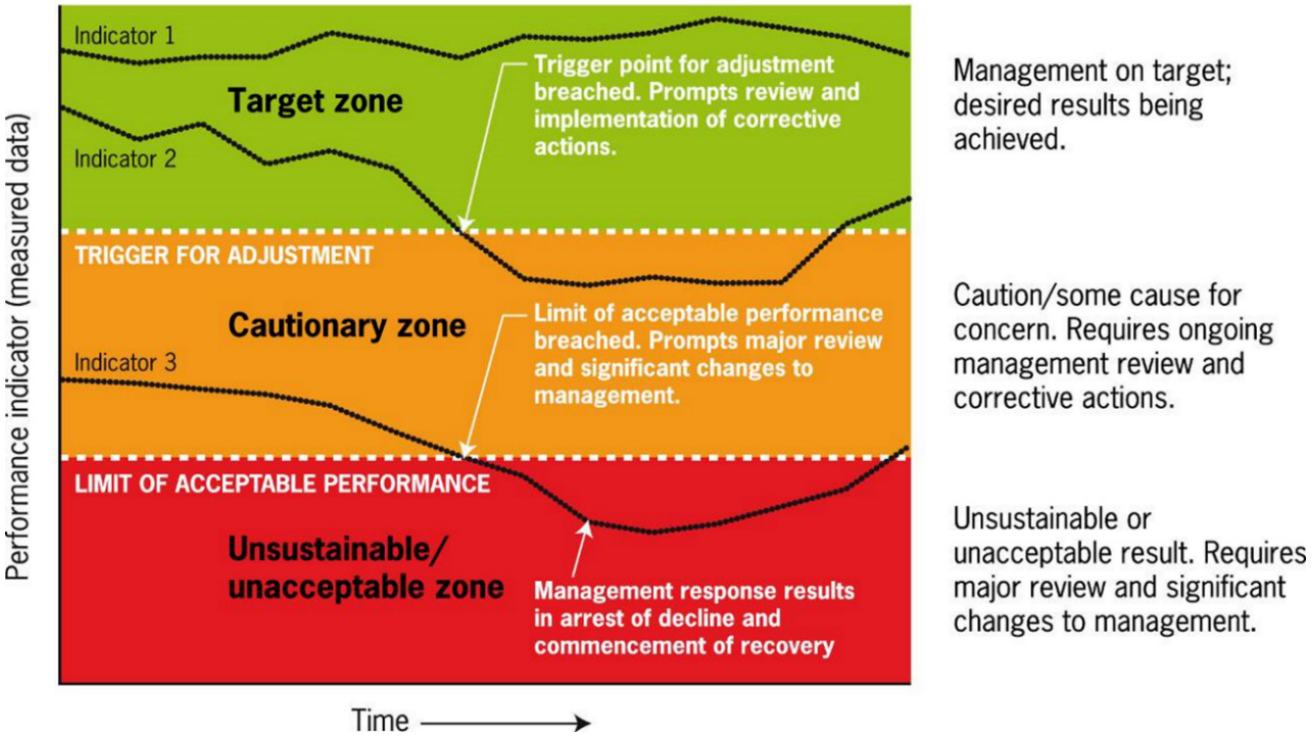

Figure A.1 Carrying Capacity performance indicator guide (Source: Jones, 2009)

A1.3.2 MONITORING INDICATORS DEVELOPMENT OPPORTUNITIES

As discussed, there are often opportunities for land managers to develop a hybrid framework by adopting different existing framework features including implementing new environmental and social monitoring indicators to maximise the outcome for specific site. On top of being able to represent the general conditions, there are opportunities for new type of environmental and social indicators to be developed and implemented to help fulfil legislative requirements or even help achieve certain international environmental standards.

Historically, some carrying capacity frameworks such as ROS are developed in response to changes in planning legislative frameworks (McCool 2008). Hence, the selected indicators should be clear enough to be able to address and

comply with the relevant mandatory legislative requirements in the area. In most cases where legislative requirements or guidelines influence indicators, quantitative methodologies determining compliance are far more straight forward and can be used, for example, water extraction against licence conditions.

The development of new indicators will also need to consider site complexities, especially if part of the protected area is operated under a public-private partnership agreement with existing lease agreements. The selected indicators will ideally be developed specific to the private business and incorporated as part of the commercial lease, for example, litter presence, weed presence and perceptions of crowding. This type of indicators aims to maintain the existing environment and avoid the potential over-commercialisation of the protected area, one of the biggest concerns when public authorities partnering with private business (Wilson, Nielsen & Buultjens 2008).

At a smaller scale, specific entities or private businesses might have their own Environmental Management Systems (EMS) or are required to have an EMS by the protected area management plan. This provides opportunities for the selected indicators to be developed in certain way which can be incorporated and strengthens the existing entity's EMS. These types of indicators can be related to elements like water consumption, extent of recycling and waste reduction that are related to international standards for EMS (e.g. ISO 14,001) (Jovicic 2011).

For a complex site with multiple parties of different interest, it is likely that the most suitable carrying capacity framework would be a hybrid model comprises of indicators with above elements to fulfil the legislative framework, avoid over-commercialisation and maximise the environmental and social outcomes. These indicators are also likely to be a mix of quantitative, ensuring its analytical rigour and qualitative to capture elements that are more difficult to quantify such as visitor behaviour.

APPENDIX B

NPWS CARRYING CAPACITY REVIEWS

B1 DEVELOPMENT ASSESSMENT AND PLAN OF MANAGEMENT COORDINATED GUIDELINE

In response to a lack of clarity on the assessment requirements to modify bed numbers, and in anticipation of the bed number continuing to be the main method of limiting capacity in AMUs, NPWS prepared the unpublished *Development Assessment and Plan of Management Coordination Guideline* (NPWS, 2018). The purpose of which was to facilitate a consistent approach in the documents prepared to support major development proposals, particularly around increases to accommodation. The document aimed to promote a coordinated approach with relevance to both the KNP POM and the Alpine SEPP, by assisting applicants in:

- understanding the relevant requirements of the KNP POM and the Alpine SEPP
- understanding the assessment processes undertaken by both NPWS and DPIE
- preparing documentation that can support both an application to amend the KNP POM and the development application required under the Alpine SEPP or the State Environmental Planning Policy (State and Regional Development) 2011 (SRD SEPP)
- identifying any other approval, permit, licence, authority or consent from another government body that may apply.

Table B.1 provides a summary of the guidance provided in the document in relation to the assessment required to enable NPWS to allow modifications to bed number limits (ahead of standard EIA process). Any future modification to the bed limits should consider these assessment requirements. Guidance has only been provided for four of the eight assessment considerations identified in Section 5.3.

Table B.1 Modification to bed limits – assessment requirements

ASSESSMENT	CONSIDERATIONS	RELEVANT LEGISLATION & GUIDELINES
Natural and cultural values of the park	Consideration under the Alpine SEPP — potential impacts on natural and cultural values The EA should clearly outline the following: — impact of the development ton the natural human and built environment — the methodology used to identify impacts — the measures outlined to protect the environment or reduce potential environmental harm.	— *EP&A Act National Parks and Wildlife Act* 1974 — *Biodiversity Conservation Act* 2016 — *Heritage Act* 1977 — Alpine SEPP — Kosciuszko National Park Plan of Management 2006 — Guidelines for Developments Adjoining Lands Managed by the Office of Environment and Heritage (NPWS 2013) — Guidelines for Preparing a Review of Environmental Factors: How to assess the environmental impacts of activities within national parks and other reserves (Section 3 only) (NPWS 2016)

ASSESSMENT	CONSIDERATIONS	RELEVANT LEGISLATION & GUIDELINES
Infrastructure and services	The proposal must ensure: — it is consistent with industry best practice — provisions of mechanisms to reduce emissions, energy, waste, and water — an EMS is in place Consideration under the Alpine SEPP — impacts of the proposal on both natural and built environments, and social and economic impacts in the locality — impacts of the development on capacity of existing transport, effluent management systems, waste disposal and water supply.	— Alpine SEPP — *EP&A Act* 1979 — KNP POM — Guidelines for Developments Adjoining and Managed by OEH
Climate change	The assessment should consider the impacts of projected climate change conditions including operational impacts associated with reductions in snowfall, diversification of activities and future flora and fauna species. The proposal should also consider the minimisation of greenhouse gasses. Consideration under the Alpine SEPP — cumulative impacts of the development — precautionary principle and intergenerational equity — principles of ecologically sustainable development.	— KNP POM Guidelines for Developments Adjoining Lands Managed by the OEH, which outline NPWS policy position to increase the resilience of the area to counter potential impacts of climate change
There is an economic benefit to local communities within and adjacent to the park	The proposal should consider: — quality of the economic activity in both summer and winter — quantity of regional benefits — identification of broader social and recreational benefits to the Alpine resorts. Consideration under the Alpine SEPP — impacts of the proposal on both natural and built environments, and social and economic impacts in the locality — encouragement of a range of development types — extent of development connected to a significant increase of activities outside ski season.	— *EP&A Act* — Alpine SEPP — KNP POM

Source: OEH, Unpublished 2018

B2 IMPROVING THE EXISTING ENVIRONMENTAL MANAGEMENT SYSTEM

One potential pathway for modifying the capacity methodology, as identified by OEH reviews outlined in Section B1, was to strengthen the existing EMS. As a part of their capacity reviews, NPWS outlined an initial working list of environmental conditions for a future system. The list flagged several themes and conditions, and their potential for inclusion in a monitoring and response system, or improved EMS to support a modified carrying capacity methodology. Table B.2 outlines the working list as provided by NPWS.

Table B.2 Working list of environmental conditions and potential for inclusion in a monitoring and response system

THEME	CONDITION	POSSIBLE INDICATOR CANDIDATE	WHY	HOW
Soil	Soil disturbance – ski slopes	Soil disturbance – ski slopes	Hard to define and manage a measurable standard	Ensure minimum snow cover guidelines are followed in non-super groomed areas
Vegetation	Condition of zones – native	Condition of zones – native	Native vegetation is critical for NP context and habitat connectivity	Basic plots/transects
Vegetation	Condition of zones – natural	Condition of zones – natural	Native vegetation is critical for NP context and habitat connectivity	Basic plots/transects
Vegetation	Overall weediness	Overall weediness	Native vegetation is critical for NP context and habitat connectivity	Biannual walk over
Pests	Rabbit presence	Rabbit presence	Rabbit numbers are elevated in cleared areas, ski runs and footprints	Needs to be flexible for seasonal variations
Pests	Foxes	Foxes	Resorts can attract foxes, but this is a landscape issue also	EMS/NPWS & Resort partnership
Pests	Cats	Cats	Resorts attract cats, but this is a landscape issue also	“see a cat catch a cat” continues in built areas with NPWS support
Amenity	Cleanliness	Cleanliness	Resort visitors are the main source of litter within resorts areas	Prevention, collection, education, fines?
Water	Quality	Abiotic/ biotic conditions	Directly relate to resort impacts, monitoring already occurring	Look at long term trend, choose appropriate standards, biotic only

THEME	CONDITION	POSSIBLE INDICATOR CANDIDATE	WHY	HOW
Threatened species	Plants – Bog & Snowpatch EECs/ Other spp.	Veg condition (link to veg zone management)	Some areas can be defined, but many factors involved	Delineate no-go areas and monitor.
Visitor experience	Staff have ability to respond to issues	% of all resort staff enviro trained	Fundamental way of protecting and promoting park values	Already happening mostly. Resorts are self-reliant, NPWS can value-add
Resource efficiency	Waste & recycling	Level of recycling; volume	Standard mostly already exists, behaviour is the biggest issue	EMS reporting
Resource efficiency	Biosolid removed from STP water	% of removal of bio-solids	Already agreed, already happening so should be straight forward	EMS reporting

APPENDIX C

EXISTING KNP MANAGEMENT OBJECTIVES

Table C.1 Summary of existing KNP POM management objectives and their relevance to existing KPIs

VALUE	POM MANAGEMENT OBJECTIVE AND DESCRIPTION	POM KEY PERFORMANCE INDICATOR	KPI#	RELEVANCE OF KPI
Water Quality	*11.6.1 Management Objective* Environmental quality is maintained or improved.	Biological, physical and chemical indicators of resort stream health compared to ANZECC guidelines (physical and chemical measurements) and AUSRIVAS KNP model (biological condition).	W1	This objective address multiple policies and actions around water quality including utilising water quality monitoring results to inform decision making. The KPI aligns with the objective which is aimed at protecting the environmental health and aquatic ecosystems of alpine streams from resort activities. The essential nature of this value and the long and consistent history of data capture makes this an important KPI to regulate. The standards are from guidelines not regulations, so legislation is unable to provide the protection required.
Water Quality	*6.6.1 Management Objective* The environmental condition of all watercourses and waterbodies is maintained or improved. Policies and actions (No. 19) *12.1.1 Management Objective* The Service, all operators and visitors demonstrate a commitment to improving environmental standards and are accountable for minimising the impact of their activities.	Compliance with water extraction licenses.	W2	The water extraction licenses compliance requirement on the resorts is a way to ensure the environmental condition of watercourses are maintained and demonstrate their accountability for minimising impacts to watercourses. This KPI therefore aligns with these two objectives. For statutory KPIs the EMS is only required to ensure the required actions are triggered and does not set standards nor choose the methods not the penalty as these are already set by regulations.

VALUE	POM MANAGEMENT OBJECTIVE AND DESCRIPTION	POM KEY PERFORMANCE INDICATOR	KPI#	RELEVANCE OF KPI
Water Quality	*6.6.1 Management Objective* The environmental condition of all watercourses and waterbodies is maintained or improved. Policies and actions (No. 19)	Water consumption in accommodation premises compared to industry benchmark (220 Litres/Visitor Night).	W3	One of the policies and actions of this management objectives is to ensure the ongoing protection of watercourses through the implementation of EMS for all operations. This aligns with the KPI as this KPI focuses on keeping track of water consumption in accommodation premises which help maintain the environmental condition of waterbodies. Water consumption is a simple and straight forward calculation and meets both sustainability as well as biological objectives. The standard is a guideline and the issue is critical for environmental flows.
Water Quality	*6.6.1 Management Objective* The environmental condition of all watercourses and waterbodies is maintained or improved. Policies and actions (No. 19)	Total Water consumption.	W4	Policies and actions of this management objectives include ensuring the ongoing protection of watercourses through the implementation of EMS for all operations. This aligns with the KPI as this KPI focuses on keeping track of water consumption of total water consumption in resorts which help maintain the environmental condition of waterbodies. Water consumption is a simple and straight forward calculation and meets both sustainability as well as biological objectives. The standard is a guideline and the issue is critical for environmental flows.
Pollution prevention and incident management	*11.6.2 Management Objective* Environmental accidents, pollution events and contamination are responded to rapidly and effectively to protect park values and visitor safety.	Timely management of environmental incidents in Alpine resorts.	P1	The goal of this KPI is to ensure resorts manage any pollution incidents rapidly and effectively which aligns with this objective. All statutory compliances are critical. The role of the EMS is to ensure ongoing management and reactive actions are triggered to avoid an event. In this case the standard would be zero pollution events.

VALUE	POM MANAGEMENT OBJECTIVE AND DESCRIPTION	POM KEY PERFORMANCE INDICATOR	KPI#	RELEVANCE OF KPI
Pollution prevention and incident management	*12.1.1 Management Objective* The Service, all operators and visitors demonstrate a commitment to improving environmental standards and are accountable for minimising the impact of their activities.	Compliance with EPA discharge licenses for Sewage Treatment Plants (STPs).	P2	Being compliant with discharge licenses shows the commitment of resort operators to minimising impacts of their activities. This KPI aligns with the objective. It should be noted the designation of responsibly to the Perisher NPWS team in the Perisher AMU. All statutory compliances are critical. The role of the EMS is to ensure ongoing management and reactive actions are triggered to avoid an event. In this case the standard would obviously be zero non compliances. In this case the standard would be zero breaches of license.
Pollution prevention and incident management	*11.6.1 Management Objective* Environmental quality is maintained or improved.	Compliance with POEO Act 1997, UPSS Regulation 2008.	P3	The goal of this KPI is to prevent any leaks, spills and unlicensed discharges of substances potentially harmful to the environment, thus aligning with the objective to maintain environmental quality.
Pollution prevention and incident management	*12.1.1 Management Objective* The Service, all operators and visitors demonstrate a commitment to improving environmental standards and are accountable for minimising the impact of their activities	Education of staff in environmental incident management and response.	P4	Educating resort staff about environmental incident management and response helps raise staff awareness on reporting and managing incidents. This shows the resorts' commitment to minimise impacts of their activities by educating staff on the potential impacts and management of potential impacts. A measure of the adequacy of staff training would be easy to obtain and include in the EMS. Regulation of this KPI may not be justified as it is likely to be a shared objective of NPWS and resorts.

VALUE	POM MANAGEMENT OBJECTIVE AND DESCRIPTION	POM KEY PERFORMANCE INDICATOR	KPI#	RELEVANCE OF KPI
Biodiversity	*6.2.2 Management objective* The effects of all other threats on plant and animal species and communities under stress from climate change are minimised. Policies and Actions (1,2)	Threatened species population: Mountain Pygmy Possum (MPP). Threatened species population: Broad-toothed rat (BTR).	B1 B2	This objective aims to address the threats from climate on animal species and plant communities. The threatened Mountain Pygmy Possum and Board toothed rat populations are likely to be under threat from climate change in the future. With increasing climate change it is important that all suitable habitat and connectivity between habitat is maintained and ongoing threats such as fire and pests which may be exacerbated by climate change are well managed. Other threatened species are present and could/should be included as KPIs e.g. those added in the next column. Where specialist skills are required for monitoring this is the domain of NPWS programs but with contributions from resorts in the AMU being essential. A measurable KPI around this issue is difficult to develop. Direct impacts on threatened species and their habitat are regulated under the BC Act. Indirect impacts are more difficult to allocate responsibility for since populations go up and down routinely for many and various reasons some of which are unknown and some of which are because of universal conditions.

VALUE	POM MANAGEMENT OBJECTIVE AND DESCRIPTION	POM KEY PERFORMANCE INDICATOR	KPI#	RELEVANCE OF KPI
Biodiversity	Section 6.8 PoM including 7 management objectives around native animals. 6.8.1 – Viable populations of all native animal species that currently occur in the park are maintained or restored. 6.8.2 – Viable populations of all native animal species that currently occur in the park are maintained or restored. 6.8.3 – The cultural values of native animal species are identified, assessed and managed appropriately. 6.8.4 – Research informs the management of the native animals of the park. 6.8.5 – The diversity of native species found in the park is maximised at a regional scale. 6.8.6 – Visitors and other stakeholders appreciate the values of the native animals of the park and their responsibilities in protecting them. 6.8.7 – Community support and involvement in wildlife conservation measures are strengthened.	Small mammal management: — Mountain pygmy possum, *Burramys parvus* (Endangered) — Broad-toothed rat, *Mastacomys fuscus* (Vulnerable) — Dusky antechinus, *Antechinus swainsonii* — Agile antechinus, *Antechinus agilis* — Southern bush rat, *Rattus fuscipes.*	B3	Objectives under Section 6.8 relating to resorts are to: — Minimise harm to animals by using non-harmful control techniques within resort dwellings e.g. Elliot Traps. — Minimise impacts the threatened species habitats within and adjoining the resorts such that local populations are not impacted. — Increase biodiversity awareness with resort visitors Where specialist skills are required for monitoring this is the domain of NPWS programs but with contributions from resorts in the AMU being essential.

VALUE	POM MANAGEMENT OBJECTIVE AND DESCRIPTION	POM KEY PERFORMANCE INDICATOR	KPI#	RELEVANCE OF KPI
Biodiversity	*12.2.1 Management objective* Service operations are undertaken in ways that minimise adverse impacts upon park values. Policies and Actions (No. 17,24)	Pest animal control programs.	B4	Most management objectives related to pest control are at a landscape scale achieving strategic level outcomes. Relevance to AMUs comes in the form of strict waste management (to reduce attractants) and feral animal control measures in high use areas. Management objectives related to AMUs could be strengthened and be more specific to AMU expectations. The two policies and actions under this objective focus on maintaining a trail system for pest species management and the use of horses for introduced animal control programs. These are related to some of the pest control work targeted cat, fox and rabbit undertaken by NPWS in coordination with resort lessees. For example, the 'see a cat catch a cat' program. Smaller species with a smaller home range such as rabbits and cats and to a lesser extent foxes are seen as a responsibility of resorts, whereas larger more widely roaming species such as horses, deer and pigs much less so.
Biodiversity	*6.7.1 Management objective* Native plant species and communities are maintained and/or rehabilitated and include a representative range of successional stages and age classes. *10.2.1 Management objective* The Alpine resorts provide for a range of principally snow-based recreational opportunities that promote enjoyment, understanding and appreciation of the natural and cultural values of the park.	Loss of natural areas as a result of development (no net loss of biodiversity values).	B5	Objective 6.7.1 relates to rehabilitation which is usually addressed during the development approval. Objective 10.2.1 lists out the conditions required for activities which involves the provision of visitor facility or services. These are usually being captured during the development approval. Therefore, the applicability and actions from these management objectives need reconsideration or strengthening specifically for AMUs. For example, further protection of TEC bogs within resort boundaries is warranted high use areas adjacent to bogs are quite problematic

VALUE	POM MANAGEMENT OBJECTIVE AND DESCRIPTION	POM KEY PERFORMANCE INDICATOR	KPI#	RELEVANCE OF KPI
Biodiversity	*13.2.1 Management objective* Encourage community cooperation and involvement in the management of the park.	Weed Management programs.	B6	Weeds and pests in the resort areas are key issues. As a core component of addressing this KPI is the collaboration between NPWS staff, community volunteers, NGO and other stakeholders during weed management. However, ultimately resorts need to be responsible for their contribution. Simple survey methods and standards are available. The early reporting and intervention on new weeds could be a KPI along with various standards set for existing weed presences. There are various simple measures of weediness that could be applied. Pests can be more complex and potentially resorts fair financial contribution to NPWS programs is a suitable approach.
Biodiversity	*6.3.2 Management Objective* Rehabilitation and construction works are undertaken in ways that protect significant rocks, landforms and geological processes. *10.2.1 Management Objective* The Alpine resorts provide for a range of principally snow-based recreational opportunities that promote enjoyment, understanding and appreciation of the natural and cultural values of the park.	Rehabilitation of previously disturbed areas.	B7	These two KPI (B7, B8) involves rehabilitating previously disturbed area such as mountain bike trails, rabbit eroded areas and the restoring riparian vegetation to ensure habitat connectivity for small mammals. Both these two objectives are relevant as objective 6.3.2 involves rehabilitation and objective 10.2.1 involves element of development application including the potential impacts of certain development. New development is unlikely to be made responsible for repair work that is not a result of that development. If areas from past related resort developments have not been ameliorated and cannot be addressed in the conditions of approval, then a KPI in the EMS may be useful for addressing this situation. Noting that a standard could be difficult to apply. Previously damaged riparian areas are of interest to NPWS.

VALUE	POM MANAGEMENT OBJECTIVE AND DESCRIPTION	POM KEY PERFORMANCE INDICATOR	KPI#	RELEVANCE OF KPI
Biodiversity	As B7 above	Riparian restoration.	B8	As B7 above
Biodiversity	*15.1.1 Management Objective* Research contributes to the effective and strategic management of the values of the park.	Natural heritage research projects supported, initiated or undertaken in Alpine Resort Areas.	B9	Objective is applicable to KPI as both relate to environmental research within KNP. Resorts generally pay a levy for research or provide access and information to researchers. It could be difficult to apply a standard to this value.
Biodiversity	*13.1.1 Management Objective* Engender appreciation, enjoyment and understanding of the park's values and support for their ongoing protection. *13.2.1 Management Objective* Encourage community cooperation and involvement in the management of the park.	Environmental education and awareness programs.	B10	These two objectives are applicable to the KPI as the focus on both objectives is around communication and cooperation around park values. It could be difficult to apply a standard to this value.
Cultural Heritage	*12.1.1 Management Objective* The Service, all operators and visitors demonstrate a commitment to improving environmental standards and are accountable for minimising the impact of their activities. *7.0.6 Management Objective* Staff, visitors and other stakeholders understand and appreciate the cultural heritage values of the park and their responsibilities in helping to protect those values.	Education, awareness and promotion of resort cultural heritage values.	C1	The cultural awareness training run by each resort helps promote the cultural heritage values of the alpine resort areas, demonstrating a commitment to conserving cultural heritage values, which align with the objective to improving environmental standards. It could be difficult to apply a standard to this value.
Cultural Heritage	*7.0.6 Management Objective* Staff, visitors and other stakeholders understand and appreciate the cultural heritage values of the park and their responsibilities in helping to protect those values.	Protection of heritage sites, items and historic assets.	C2	Impacts to areas of significance are dealt with in the planning stage of projects and managed throughout the works to ensure the protection of cultural heritage values, align with this objective.

VALUE	POM MANAGEMENT OBJECTIVE AND DESCRIPTION	POM KEY PERFORMANCE INDICATOR	KPI#	RELEVANCE OF KPI
Air Quality and CO_2 Emissions	*6.2.4 Management Objective* All operations and activities associated with the park are undertaken in ways that minimise the production of greenhouse gas emissions.	Amount of CO2 emissions.	A1	This KPI helps track resort CO2 emissions which contributes to reducing CO2 emissions. This aligns with the objective. A general level of emissions will be estimated in the development proposal but after approval a KPI may be required to ensure such an achievement is continued.
Air Quality and CO_2 Emissions	*6.2.4 Management Objective* All operations and activities associated with the park are undertaken in ways that minimise the production of greenhouse gas emissions.	The percentage of renewable energy used.	A2	This KPI helps track percentage of renewable energy used which contributes to minimising the production of greenhouse gas emissions. This aligns with the objective. A general level of emissions will be estimated in the development proposal but after approval a KPI may be required to ensure such an achievement is continued.
Air Quality and CO_2 Emissions	Unclear	The percentage of visitors using Skitube.	A3	N/A. Date has not been provided due to commercial sensitivities. Alternative measures should be considered to gain information.
Energy Conservation	*12.1.1 Management Objective* The Service, all operators and visitors demonstrate a commitment to improving environmental standards and are accountable for minimising the impact of their activities. Policies and action (No.8)	Total Energy consumption.	E1	This KPI directly addresses the annual reporting requirement related to energy conservation as stated in the policies and action (no.8) under the objective. A general level of energy consumption will be estimated in the development proposal but after approval a KPI may be required to ensure this achievement is continued.
Energy Conservation	*12.1.1 Management Objective* The Service, all operators and visitors demonstrate a commitment to improving environmental standards and are accountable for minimising the impact of their activities. Policies and action (No.8)	Energy consumption in accommodation premises comparted to 'EarthCheck' benchmark.	E2	This KPI directly addresses the annual reporting requirement related to energy conservation as stated in the policies and action (no.8) under the objective. A general level of energy consumption will be estimated in the development proposal but after approval a KPI may be required to ensure this achievement is continued.

VALUE	POM MANAGEMENT OBJECTIVE AND DESCRIPTION	POM KEY PERFORMANCE INDICATOR	KPI#	RELEVANCE OF KPI
Energy Conservation	*12.1.1 Management Objective* The Service, all operators and visitors demonstrate a commitment to improving environmental standards and are accountable for minimising the impact of their activities. Policies and action (No.8)	Energy efficiency initiatives.	E3	This KPI directly addresses the annual reporting requirement related to energy conservation as stated in the policies and action (no.8) under the objective.
Waste Management	*10.2.1 Management Objective* The Alpine resorts provide for a range of principally snow-based recreational opportunities that promote enjoyment, understanding and appreciation of the natural and cultural values of the park. Policies and actions (No. 27, 28)	Amount of domestic waste.	G1	This KPI tracks the amount of domestic waste in order to help minimise waste produced by each resort. These align with the two policies and actions aiming to manage the disposal of waste and develop waste avoidance target.
Waste Management	*10.2.1 Management Objective* The Alpine resorts provide for a range of principally snow-based recreational opportunities that promote enjoyment, understanding and appreciation of the natural and cultural values of the park. Policies and actions (No. 27, 28)	The percentage of domestic waste recycles including paper, cardboard, tins, glass and plastics.	G2	This KPI tracks the percentage of domestic waste recycles which help achieve the policy and actions aiming to develop waste avoidance and resource recovery targets for each alpine resort management unit.
Waste Management	*10.2.1 Management Objective* The Alpine resorts provide for a range of principally snow-based recreational opportunities that promote enjoyment, understanding and appreciation of the natural and cultural values of the park. Policies and actions (No. 29)	Waste composted – including the biosolids from Sewage Treatment Plants (STP).	G3	This KPI helps manage the discharge effluent and wastewater which align with the objective of effluent, wastewater and stormwater management.
Sustainable recreation	*12.1.1 Management Objective* The Service, all operators and visitors demonstrate a commitment to improving environmental standards and are accountable for minimising the impact of their activities.	Education, awareness and promotion of sustainable recreation in resorts.	R1	Environmental educations are carried out by resorts to ensure the recreational opportunities and facilities of the Alpine resorts are managed sustainability. This aligns with the objective of showing a commitment to minimise potential impacts of activities.

VALUE	POM MANAGEMENT OBJECTIVE AND DESCRIPTION	POM KEY PERFORMANCE INDICATOR	KPI#	RELEVANCE OF KPI
Sustainable recreation	*8.1.1 Management Objective* Opportunities are provided for visitors to undertake a wide range of recreational activities at places and in ways that optimise the quality of the experiences available, while minimising adverse impacts upon the values of the park and conflicts with other users.	Monitoring of key recreational activities — snow play at Selwyn — mountain biking and walking at Thredbo snow tubing at perisher.	R2	This KPI aims to monitor the key recreational activities which help identify issues such as erosion and drainage, weeds, vegetation damage etc. This aligns with the objective to minimise the adverse impacts upon the values of the park.
Resort Amenity	*11.6.3 Management Objective* Scenic quality within the park is maintained and, wherever possible, enhanced.	Education, awareness and promotion of resort amenity.	Am1	Resorts staffs are trained to raise awareness towards promoting resort amenity and reduce environmental impacts. This aligns with the objective to help maintain scenic quality within the park.
Resort Amenity	*11.6.3 Management Objective* Scenic quality within the park is maintained and, wherever possible, enhanced.	Measures to protect the visual and acoustic environments within resorts and minimize impacts to the surrounding areas.	Am2	This KPI helps conserve and enhance existing amenity of the Alpine resorts by ensuring potential visual impacts have been addressed during development approval stage. This aligns with the objective.

APPENDIX D

ASSESSMENT OF CLIMATE CHANGE RISKS TO KOSCIUSZKO NATIONAL PARK VALUES

D1 BACKGROUND

Climate change is projected to create significant challenges for the NSW Alpine Region, some of which may contribute to strains on the carrying capacity[2] of the Kosciuszko National Park (KNP) within the Snowy Mountains SAP region. The purpose of this Appendix is to:

- Summarise relevant climate change projections for Snowy Mountains SAP Region and KNP.
- Identify climate change risks that may impact the carrying capacity of the KNP and analyse how these might influence existing Environmental Management System (EMS) Key Performance Indicators (KPIs).
- Investigate the implications of changes in climate variables, such as increases in temperature and reduced natural snowfall, on the demand for artificial snowmaking and estimate flow on impacts to energy and water demand of Alpine resorts where snowmaking is conducted.
- Provide recommendations for how climate change and its potential impacts could be considered in the development of future guidelines for managing visitor impacts and the carrying capacity of KNP.

D2 CLIMATE CHANGE PROJECTIONS

In 2018/2019 the NSW Department of Planning, Industry and Environment (DPIE) carried out a detailed study of models produced as part of the NSW/ACT Regional Climate Modelling (NARCLiM) project. The purpose of the study was to provide annual, monthly and seasonal future climate projections specifically for the Alpine Region and surrounds.

Climate projections are based on different scenarios reflecting how future anthropogenic greenhouse gas emissions may change over time. The NARCLiM simulations align with the Intergovernmental Panel on Climate Change (IPCC) *Fourth Assessment Report* (AR4, published in 2007) which was the latest set of emissions scenarios at the time NARCLiM commenced in 2010. The NARCLIM project adopted a single emissions scenario, the Special Report on Emission Scenarios (SRES) A2 scenario, to inform their simulations. This scenario was considered the most likely scenario based on the trajectory of global emissions.

The more recent *IPCC Fifth Assessment Report* (AR5) uses Representative Concentration Pathways (RCPs) to illustrate different emissions scenarios. For the latter half of the 21st century SRES A2 has a similar trajectory to that of the high emissions scenario, RCP 8.5, which aligns most closely with the current trajectory of global emissions (Adapt NSW, 2020).

Table D.1 summarises the climate change variables relevant to this assessment, as well as baseline conditions (average over years 1990-2009, i.e. 2000), and projections for the near future (2030) and far future (2070) for the Snowy Mountains SAP Region. This data has been collated from written content and the interpretation of mapping within the DPIE Climate Change Impacts in the NSW Alpine Region reports. Ranges in baseline and projection data have been provided due to the spatial extent and variability in altitude within the region, which influences baseline and projection data.

Further detail on the projections are available from the listed source reports.

[2] The definition of carrying capacity can be found in Section 3.1 of the Kosciuszko National Park Plan of Management – Carrying Capacity – Framework Development.

Table D.1 Climate Change Projections for the Snow SAP Region

CLIMATE VARIABLE	BASELINE (2000)	NEAR FUTURE (2030)	FAR FUTURE (2070)
Temperature			
Mean Maximum Temperature (ºC) – Annual[1]	10 to 13	+ 0.5 to 1	+2 to 2.5
Mean Max Temperature (ºC) – Summer[1]	16 to 20	+0.5 to 0.75	+2 to 2.5
Mean Max Temperature (ºC) – Autumn[1]	10 to 14	+ 0.5 to 0.75	+2 to 2.5
Mean Max Temperature (ºC) – Winter[1]	< 8	+ 0.5 to 0.75	+2 to 2.5
Mean Max Temperature (ºC) – Spring[1]	10 to 14	+ 0.5 to 0.75	+ 2.5 to 3
Days over 35 ºC[1]	0 to 5	0 to 1	+0 to 2
Mean minimum temperatures (ºC) [1]	< 2	+ 0.5 to 0.75	+1.5 to 2
Cold nights (below -2 ºC) [1]	>110 days	- 13	-20
Precipitation and Snowfall			
Mean Precipitation Change (%) – Annual[1]	1200 to 1800 mm	0 to -5	-5 to -10
Mean Precipitation Change (%) – Summer[1]	300 mm	0 to -5	-5 to 5
Mean Precipitation Change (%) – Autumn[1]	250mm	0 to 5	+5 to 10
Mean Precipitation Change (%) – Winter[1]	>450 mm	0 to -10	-10 to -20
Mean Precipitation Change (%) – Spring[1]	400mm	-5 to -10	-20
Snowfall (%)[2]	2-5mm/d	-13	-60
Fire			
McArthur Forest Fire Index (FFDI) (%)[3]	0 to 2 (unitless)	+5	+ 5 to 10
Wind			
Mean maximum daily wind speeds (%)[1]	>20m/s	0 to -4	0 to -6

1. DPIE, 2018a, Climate Change Impacts in the NSW Alpine Region – Projected Climate in the NSW Alpine Region. Department of Planning, Industry and Environment, Sydney, 2018.
2. Di Luca, A. Evans, J. Ji, F. Australian Snowpack: NARCLiM ensemble evaluation, statistical correction and future projections, Climate Change Research Centre, UNSW, Sydney, 2017.
3. DPIE, 2019, Climate Change Impacts in the NSW Alpine Region – Impacts on fire weather. Department of Planning, Industry and Environment, Sydney, 2019.

Key observations from Table D.1 include:

- increase in mean maximum temperatures in the near and far future across all seasons
- large decreases in the number of cold nights (-2ºC) and increases in mean minimum temperatures
- more dry days with large reductions in precipitation in winter and spring
- projected reduction in precipitation is greatest in winter and spring and significant reductions in natural snowfall are expected during the snow season
- increases in the annual mean Forest Fire Index.

D3 CLIMATE CHANGE RISKS TO KOSCIUSZKO NATIONAL PARK VALUES

To inform the development of a carrying capacity Framework for the Kosciuszko National Park Plan of Management – Carrying Capacity, WSP has carried out a preliminary climate change risk identification process to highlight the ways in which climate change may affect the carrying capacity of the KNP in future. These risks have then been linked the existing Environmental Management System (EMS) Key Performance Indicators (KPIs) used to manage environmental, social and cultural impacts from visitor use of Alpine Resort Areas.

The purpose of this process is to highlight how these climate change risks could influence existing KPIs, either by altering KPI baselines or influencing the ability for these KPIs to be achieved by alpine resort management and/or National Parks and Wildlife Services (NPWS). This process would assist in driving a more detailed consideration of climate change impacts in the establishment of future guidelines for managing visitor impacts and the carrying capacity of KNP.

The following documents have been used to inform this process:

- DPIE, 2019, Climate Change Impacts in the NSW Alpine Region – Projected changes in snowmaking conditions. Department of Planning, Industry and Environment, Sydney, 2019.
- DPIE, 2019, Climate Change Impacts in the NSW Alpine Region – Impacts on fire weather. Department of Planning, Industry and Environment, Sydney, 2019.
- DPIE, 2018a, Climate Change Impacts in the NSW Alpine Region – Projected Climate in the NSW Alpine Region. Department of Planning, Industry and Environment, Sydney, 2018.
- DPIE, 2018b, Climate Change Impacts in the NSW Alpine Region – Water availability. Department of Planning, Industry and Environment, Sydney, 2018.
- DPIE, 2018c, Climate Change Impacts in the NSW Alpine Region – Impacts on biodiversity. Office of Environment and Heritage, Sydney, 2018.
- DPIE, 2020, Summary of the condition of the values of Kosciuszko National Park 2006-2016, Department of Planning, Industry and Environment, Sydney, 2020.
- Note it was not the aim of this process to conduct an overarching climate change risk assessment for the KNP in accordance with *AS5334:2013 Climate change adaptation for settlements and infrastructure—A risk based approach*. This forms part of the Ecologically Sustainable Development (ESD) analysis being undertaken by DSquared Consulting.

Table D.2 Climate change risks to Kosciuszko National Park values

RISK IDENTIFICATION				TIMEFRAME FOR IMPACT			POTENTIAL FOR IMPACT TO CARRYING CAPACITY KEY PERFORMANCE INDICATORS	
Risk ID	**Climate Variable or Hazard**	**Impact Category**	**Summary of Climate Related Risk**	**Current**	**Near Future**	**Far Future**	**Relevant Carrying Capacity Indicator (s)**	**Description of potential impact on carrying capacity**
1	Temperature	Economic / financial	Increased temperatures, particularly in winter, and changes to precipitation patterns are projected to result in reduced natural snowfall. To maintain the existing ski season conditions, substantially more artificial snow will need to be produced, resulting in increased water and energy demand, as well as increased greenhouse gas emissions associated with the energy source.	X	X	X	Water quality and aquatic ecosystem (KPI W 2,4 related to water consumption and extraction)	An increase in alpine resort water consumption could result in extraction license limits being breached.
							Energy conservation (KPI E1 related to total consumption of energy)	An increase in Alpine resorts' energy consumption would likely occur. This increases the importance of monitoring energy consumption in the region. New KPI with associated targets could be developed to drive energy efficiency.
							Resort amenity (KPI Am2 related to visual impacts)	Reduced snowfall is likely to have a negative impact on visual amenity which would impact the baseline of Am2.
							Air Quality and CO_2 Emissions (KPI AQ1 related to CO_2 emissions)	CO_2 emissions associated with Alpine resorts would likely increase, unless renewable energy sources are used to meet additional snowmaking requirements. New renewable energy KPI with associated targets could be developed to drive emission reductions.

RISK IDENTIFICATION				TIMEFRAME FOR IMPACT			POTENTIAL FOR IMPACT TO CARRYING CAPACITY KEY PERFORMANCE INDICATORS	
Risk ID	**Climate Variable or Hazard**	**Impact Category**	**Summary of Climate Related Risk**	**Current**	**Near Future**	**Far Future**	**Relevant Carrying Capacity Indicator (s)**	**Description of potential impact on carrying capacity**
2	Temperature	Tourism/visit or experience	Increased temperatures may impact the numbers of hours per year where artificial snowmaking can occur. Current technology can make snow at slightly warmer temperatures; however, at an increase in energy demand, cost and impact to snow quality.		**X**	**X**	Energy conservation (KPI E2,3,4 related to energy consumption and energy efficiency initiative) Air quality and CO2 emissions (KPI 2 related to renewable energy)	As per risk 1 above
3	Precipitation	Ecosystems and biodiversity	Changing precipitation patterns are projected to result in a decrease in surface runoff and groundwater recharge, particularly in the alpine region, predominantly during the winter and spring months. This could result in reduction in water levels in waterways.		**X**	**X**	Water quality and aquatic ecosystems (KPI W1 related to resort stream health and biological conditions of waterway)	Changes to water levels could alter waterway flow rates, impacting water quality and biological conditions and the baseline of W1.
4	Precipitation	Water availability	Changing precipitation patterns are projected to result in a decrease in surface runoff and groundwater recharge particularly in the alpine region, this could impact the amount of water available for extraction for agriculture, snowmaking and industrial, commercial and domestic water supply.		**X**	**X**	Water quality and aquatic ecosystems (KPI W2, W4 related to water extraction licences and water consumption)	Extraction licenses may need to be reduced over time due to reduced water availability which could impact Alpine resorts' ability to produce enough artificial snow to meet their needs. Reduction in extraction licenses could also restrict potential to accommodate future developments.

RISK IDENTIFICATION				TIMEFRAME FOR IMPACT			POTENTIAL FOR IMPACT TO CARRYING CAPACITY KEY PERFORMANCE INDICATORS	
Risk ID	**Climate Variable or Hazard**	**Impact Category**	**Summary of Climate Related Risk**	**Current**	**Near Future**	**Far Future**	**Relevant Carrying Capacity Indicator (s)**	**Description of potential impact on carrying capacity**
5	Precipitation	Ecosystems and biodiversity	The alpine areas of NSW are typically considered to have low or very low salinity levels. Changing rainfall patterns, resulting in less runoff, may result in lower salinity dilution, especially in the alpine region.		**X**		Water quality and aquatic ecosystems (KPI W1 related to resort stream health and biological conditions of waterway).	Increased salinity levels could impact baseline salinity levels in waterways.
							Biodiversity (KPI B8 related to riparian restoration)	The increased salinity could potentially impact the success of riparian restoration projects.
6	Precipitation	Ecosystems and biodiversity	The projected decrease in surface runoff due to changing rainfall patterns could increase the vulnerability of NSW's Alpine wetlands such as Blue Lake, which is a Ramsar listed wetland.		**X**	**X**	Water quality and aquatic ecosystems (KPI W1 related to resort stream health and biological conditions of waterway). There is no existing Biodiversity KPI that deals with wetlands or certain native vegetation communities.	The potential impacts of reduced surface run-off on wetland could be captured either as an additional element of existing KPI or development of new KPI.

RISK IDENTIFICATION				TIMEFRAME FOR IMPACT			POTENTIAL FOR IMPACT TO CARRYING CAPACITY KEY PERFORMANCE INDICATORS	
Risk ID	**Climate Variable or Hazard**	**Impact Category**	**Summary of Climate Related Risk**	**Current**	**Near Future**	**Far Future**	**Relevant Carrying Capacity Indicator (s)**	**Description of potential impact on carrying capacity**
7	Temperature	Ecosystems and biodiversity	Increasing average and extreme temperatures and other secondary effects may cause a shift in vegetation species composition in alpine areas (a 21% to 70% change in composition is anticipated). High altitude species are expected to decrease in area with low altitude species considered likely to expand into high altitude areas.		**X**	**X**	Biodiversity (KPI B1, B2, B3 related to threatened species population and small mammal management). *There is no existing Biodiversity KPI that deals with specific native vegetation communities.	This risk would likely reduce habitat availability for several endangered and threatened fauna species and could cause other species to become threatened. This would impact the ability to protect species listed under B1, B2 and B3 and could cause more species to be added to this list, therefore management approaches to protect these species should be reviewed. Additional element under existing KPI or new biodiversity KPI could also be developed if required.
8	Temperature	Ecosystems and biodiversity	Increases in temperatures may result in some species and their habitats migrating to higher altitudes. This may result in fauna species competing for resources as they migrate into areas already inhabited by high altitude species that are unable to migrate further.		**X**	**X**	Biodiversity (KPI B1, B2, B3 related to threatened species population and small mammal management). *There is no existing Biodiversity KPI that captures species migration or vegetation species and communities.	This could impact the ability to protect species listed under B1, B2 and B3 and could cause more species to be added to this list, therefore management approaches to protect these species should be reviewed. Additional element under existing KPI or new biodiversity KPI could also be developed if required.

RISK IDENTIFICATION				TIMEFRAME FOR IMPACT			POTENTIAL FOR IMPACT TO CARRYING CAPACITY KEY PERFORMANCE INDICATORS	
Risk ID	**Climate Variable or Hazard**	**Impact Category**	**Summary of Climate Related Risk**	**Current**	**Near Future**	**Far Future**	**Relevant Carrying Capacity Indicator (s)**	**Description of potential impact on carrying capacity**
9	Temperature	Ecosystems and biodiversity	Increases in temperatures may result in some species and their habitats migrating to higher altitudes. The rate of change is projected to be slower for alpine areas compared to other parts of NSW, which would provide species more time to adapt and migrate. However, for some species, increased clearing for new roadways, accommodation and other facilities may reduce connectivity corridors required to enable the migration.		**X**	**X**	Biodiversity (BPI B1, B2, B3 related to threatened species population and small mammal management and KPI B5 related no net loss of biodiversity value as a result of development). *There is no existing Biodiversity KPI that captures species migration and protection of connectivity corridors.	Future developments/infrastructure proposed for the SAP region could result in loss of biodiversity value. Additional elements under existing KPI 5 or new development controls could be developed to address maintenance of connectivity corridors.

RISK IDENTIFICATION				TIMEFRAME FOR IMPACT			POTENTIAL FOR IMPACT TO CARRYING CAPACITY KEY PERFORMANCE INDICATORS	
Risk ID	**Climate Variable or Hazard**	**Impact Category**	**Summary of Climate Related Risk**	**Current**	**Near Future**	**Far Future**	**Relevant Carrying Capacity Indicator (s)**	**Description of potential impact on carrying capacity**
10	Temperature/ Rainfall/ Bushfire	Ecosystems and biodiversity	Warmer and drier conditions are projected to increase the severity and frequency of bushfires within low altitude species such as Grassy Woodlands and Dry Sclerophyll Forests.		**X**	**X**	Biodiversity (KPI B1, B2, B3 related to threatened species population and small mammal management). B1 and B2 have the potential to capture post-fire recovery trends. *There's no existing Biodiversity KPI that deals with specific native vegetation communities. There's no existing KPI that deals directly on bushfire.	Damage to habitat and connectivity corridors for native fauna species could impact the ability to protect species listed under B1, B2 and B3 and could cause more species to be added to this list, therefore management approaches to protect these species and their habitats should be reviewed. KPI B1 and B2 have the potential to capture post-fire recovery trends. An additional element under existing KPI or new biodiversity KPI could be developed to capture impacts related to fauna and flora resilience to bushfire conditions.
11	Temperature	Ecosystems and biodiversity	Climate change is considered likely to exacerbate the presence of weeds, pests and feral animals that impact natural values of the park.		**X**	**X**	Biodiversity (KPI B4, B5 related to pest animal control program and weed management program).	KPI B4 and B5 may need to be strengthened in both frequency and intensity of monitoring and control program.

RISK IDENTIFICATION				TIMEFRAME FOR IMPACT			POTENTIAL FOR IMPACT TO CARRYING CAPACITY KEY PERFORMANCE INDICATORS	
Risk ID	**Climate Variable or Hazard**	**Impact Category**	**Summary of Climate Related Risk**	**Current**	**Near Future**	**Far Future**	**Relevant Carrying Capacity Indicator (s)**	**Description of potential impact on carrying capacity**
12	Temperature/ Precipitation	Tourism/visit or experience	Increasing temperatures and changing rainfall patterns that alter and degrade the natural value of the KNP (vegetation, wildlife and waterway health) may reduce the aesthetic value of the KNP and surrounds.			**X**	Resort amenity (KPI Am2 related to visual impacts) *There is no existing KPI that explicitly focuses on visitor experience.	This risk could negatively affect visitor experience across all seasons and in the long term may influence whether tourists continue to return to the area. If required, a new KPI focusing on visitor experience could be developed to monitor negative impacts in relation to aesthetic values.
13	Temperature/ Rainfall/ Bushfire	Tourism/visit or experience	Increased risk of bushfire may result in changes to development approval requirements, restricting what can be built and the proximity to wilderness areas.			**X**	Resort Amenity (Am2 related to visual impacts) *There is no existing KPI that explicitly focuses on visitor experience. There is no existing KPI that directly deals with bushfire risk.	In addition to approvals implications, many visitors to the reason specifically seek accommodation in close proximity to vegetation. Changes to requirements for safety clearance zones could affect the ability to provide for this visitor preference. If required, a new KPI related to visitor experience and consideration of bushfire risk on development approval requirements could be prepared.

RISK IDENTIFICATION				TIMEFRAME FOR IMPACT			POTENTIAL FOR IMPACT TO CARRYING CAPACITY KEY PERFORMANCE INDICATORS	
Risk ID	**Climate Variable or Hazard**	**Impact Category**	**Summary of Climate Related Risk**	**Current**	**Near Future**	**Far Future**	**Relevant Carrying Capacity Indicator (s)**	**Description of potential impact on carrying capacity**
14	Temperature	Alignment with policy or legislation	State and local council targets to transition towards net zero carbon emissions place more pressure on industries to improve energy efficiency, reduce reliance on fossil fuels and explore opportunities to generate energy. Increased temperatures are likely to result in increased greenhouse gas emissions associated with energy demand for artificial snowmaking in the winter (as discussed above), and cooling for tourist accommodation, local residents and facilities in the summer.		**X**	**X**	Energy conservation (KPI E2,3,4 related to energy consumption and energy efficiency initiative)	An increase in energy consumption in the region would affect the region's ability to achieve net zero targets. New KPI with associated targets could be developed to drive energy efficiency.
							Air quality and CO_2 emissions (A2 related to renewable energy)	CO_2 emissions within the SAP region would likely increase, unless renewable energy sources are used to meet additional snowmaking requirements.
15	Temperature/ Precipitation	Tourism/visit or experience	Increased temperatures and reduced rainfall could result in more temperate and clear days for summer tourism activities such as mountain biking, kayaking, bushwalking, birdwatching.		**X**	**X**	Sustainable recreation (KPI R1, R2 related to promotion of sustainable recreations and monitoring of key recreational activities)	Increased temperatures and reduced rainfall could extend the summer tourist season into the shoulder seasons, increasing economic growth during the currently quiet times of the year. KPI R1 and R2 are likely to be able to capture the changes; however, there might be a need to update details to capture more of the summer tourism activities.

RISK IDENTIFICATION				TIMEFRAME FOR IMPACT			POTENTIAL FOR IMPACT TO CARRYING CAPACITY KEY PERFORMANCE INDICATORS	
Risk ID	**Climate Variable or Hazard**	**Impact Category**	**Summary of Climate Related Risk**	**Current**	**Near Future**	**Far Future**	**Relevant Carrying Capacity Indicator (s)**	**Description of potential impact on carrying capacity**
16	Increasing atmospheric carbon emissions	Alignment with policy or legislation	Emissions from transportation comprise a significant percentage of NSW's greenhouse gas emissions. The most common current approach to accessing the SAP involves travelling significant distances by private vehicle, which are currently predominately fuelled by fossil fuels.		**X**	**X**	Air quality and CO_2 emissions (A1 related to amount of CO_2, A2 related to renewable energy and A3 relates to use of ski bus).	Vehicle emissions may become increasingly incompatible with NSW's shift to net-zero greenhouse gas emissions by 2050. It is difficult to predict how this risk will play out in the future due to a range of competing factors, such as the rate of technological advancement (e.g. electric; hydrogen fuel cells), oil prices, and future policy settings. New KPI with associated targets could be developed to drive measures that enable emission reduction, such as electric vehicle charging infrastructure.
17	Increasing atmospheric carbon emissions	Alignment with policy or legislation	Emissions from transportation comprise a significant percentage of NSW's greenhouse gas emissions. In the absence of significant technological advances, encouraging additional air travel by the construction of an airport in Jindabyne would likely increase transportation CO_2 emissions.		**X**	**X**	Air quality and CO_2 emissions (A1 related to amount of CO_2).	The additional air travel may not align with NSW's planned shift to net-zero greenhouse gas emissions by 2050.

Table D.2 illustrates that a range of climate change risks have the potential to influence the carrying capacity of the KNP, as well as relevant existing EMS KPIs that have been prepared to manage environmental, social and cultural impacts from visitor use of Alpine Resort Areas. There is the potential to integrate more detailed consideration of climate change impacts in the establishment of future guidelines for managing visitor impacts and the carrying capacity of KNP. Key areas of focus for future guidelines could include:

- increased focus on monitoring energy, water, CO_2 emissions and use of renewable energy, with the potential to implement additional KPIs that introduce reduction targets
- additional biodiversity KPIs that address the protection of native vegetation communities, protection of connectivity corridors and resilience of ecosystems to bushfire risk
- stronger focus on KPIs that relate to pest and weed management
- additional focus on the impacts of climate change on visitor/user experience
- consideration of bushfire risk on future development approval
- consideration of alignment with policy and legislation aimed at driving the transition towards net zero carbon emissions.

D4 IMPLICATIONS OF CLIMATE CHANGE ON SNOWMAKING AND FLOW-ON IMPACTS FOR ENERGY AND WATER CONSUMPTION

D4.1 SUMMARY OF SNOWMAKING PRACTICES

Artificial snowmaking is currently used in Australia and around the world to complement natural snowfall and extend the ski season. Typically, artificial snowmaking in the alpine resort areas of KNP commences in early May and continues through to August. Snowmaking may continue into September depending on snow coverage and weather conditions (Thredbo Resort, pers. comm. 19 August 2020).

Snowmakers generally operate from late afternoon through to the early morning, during periods when optimal ambient snowmaking conditions occur (below -2ºC wet bulb). Snowmakers may run 24 hours a day if required (Perisher Resort, pers. comm. 20 August 2020).

- Snowmaking is an energy and water intensive process and makes up a significant amount of winter energy and water demand at Perisher and Thredbo resorts. The most common snowmaking technologies currently used at NSW Alpine resorts are air/water guns, lance guns and fan guns. A description of each technology and discussion of energy efficiency is outlined below:

- **Air/water gun:** Pressurised air is used to break a stream of water into fine particles that are then propelled into the air and freeze due to the pressure change as they come in contact with ambient cold air. Useful for producing bulk snow as it produces more concentrated snow. Air/water guns are considered the least energy efficient.

- **Lance gun:** Uses the same process as air/water guns with an advanced nucleator head to create smaller droplets and a long boom/lance that increases the amount of time the droplets are in the air, allowing more time to freeze prior to falling to the ground ('hangtime'). Lance guns are typically better to use in more marginal conditions, where an increase in hangtime assists in the freezing process. Lance guns can be up to ten times more efficient than traditional air/water guns (Perisher Resort, pers. comm. 20 August 2020).

- **Fan gun:** A stream of water is fed into an airflow that is produced by a fan that breaks the water into fine particles that are then propelled into the air. Fan guns produce snow across a more dispersed area; however, this can be more difficult to manage on windy days. Fan guns have a longer throw length that increases the hangtime of droplets. These are therefore typically better for use in marginal conditions. Fans guns tend to be more energy efficient that air/water and lance guns.
- Thredbo Alpine Resort currently has 321 automated lance guns, 163 manual hydrants that can take a variety of type of guns and four fan guns in operation (Thredbo Resort, pers. comm. 16 August 2020).
- Perisher Alpine Resort has a mixture of 236 snow guns (Perisher Resort, pers. comm. 20 August 2020) – a breakdown to technologies was not provided.

D4.2 HOW COULD CLIMATE CHANGE INFLUENCE SNOWMAKING?

Projected increases in temperature and changes to precipitation patterns are projected to reduce the amount of natural snowfall in the NSW Alpine Region, as outlined in Table D.1. A reduction in natural snowfall has already been observed and the rates of snowfall are projected to continue to decline in the near and far future, presenting an existential threat to the future of Alpine resorts in the Snowy Mountains SAP Region. Maintaining existing snow conditions in NSW's Alpine Region would require a significant increase in artificial snow, which may drive an increase in energy and water demand. The snowmaking technologies described above are reliant on ambient temperatures and therefore their performance is susceptible to the effects of climate change.

Figure D.1 illustrates the main climate change influences, identified through desktop review and correspondence with ski fields, that may affect artificial snowmaking and the anticipated flow-on impacts to water and electricity demand.

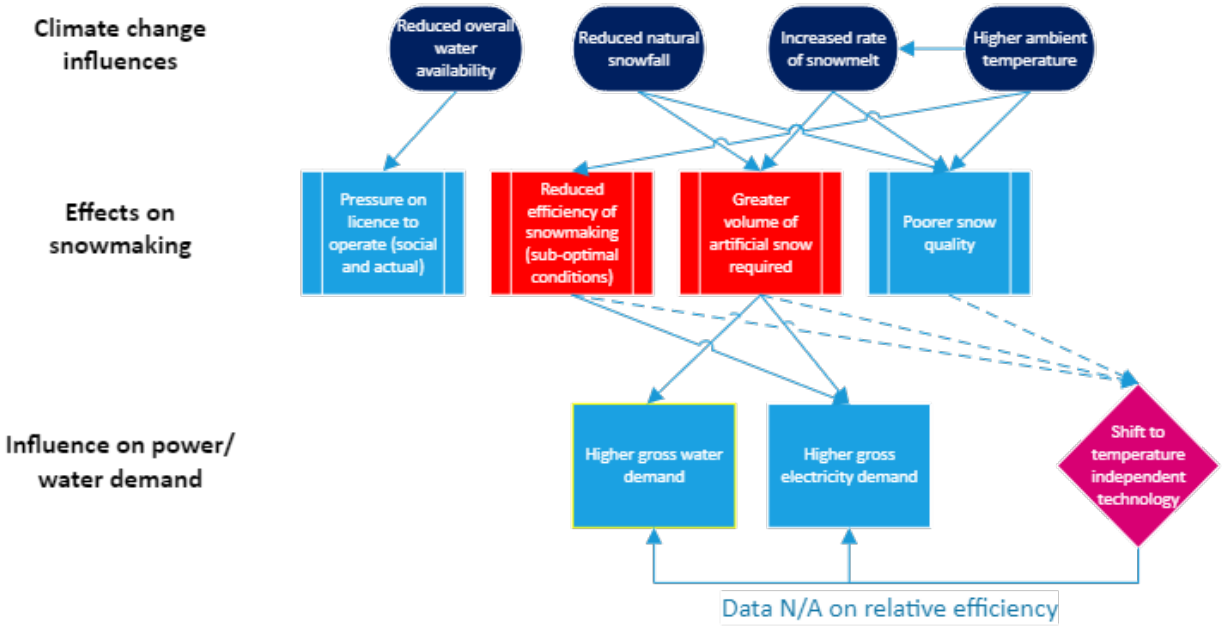

Figure D.1 Key climate change influences that may impact artificial snowmaking (developed by WSP)

The following sections provide some additional detail on the key effects on snowmaking shown above.

D4.2.1 GREATER VOLUME OF ARTIFICIAL SNOW REQUIRED

A reduction in natural snowfall and an increase in snowmelt caused by projected increased ambient temperatures is likely to drive an increase in artificial snowmaking to replace the lost natural snow cover and maintain conditions expected by resort users.

Snowpack, which refers to the mass of snow that is compressed and hardened as snow falls in high altitude regions, forms the foundation of all ski fields. Deluca, Evans and Ji (2017) have calculated projected changes in snowpack based on NARCliM projections. They found that reduced rates of natural snowfall and accelerated snowmelt due to increased temperatures are projected to reduce snowpack conditions including snowpack cover, depth and snow season duration by approximately 20% in the near future (2030) and 60% in the far future (2070) from a baseline period of 1990 to 2009 (2000).

These projections form the basis for calculations of future energy and water demand from snowmaking provided in Section D4.3. However, it should be noted that these snowpack projections are averages for the alpine region – elevation changes can significantly influence climatic factors such as temperature and rainfall. Research by Deluca, Evans and Ji suggests that more significant decreases in snowfall and snowpack may occur in lower elevations. Ski resorts or sections of ski resorts at lower elevations may see more significant reductions in snowfall and snowpack than the averages provided.

D4.2.2 REDUCED EFFICIENCY IN SNOWMAKING EQUIPMENT

Projected temperature increases are anticipated to reduce the number of hours for optimal snowmaking. Below -2ºC (wet bulb) is considered the optimal temperature for artificial snowmaking (DPIE, 2019). Increased temperatures are projected to result in more than a 20% reduction in optimal snowmaking conditions is projected by 2030 and more than 60% by 2070 compared to a 2000 baseline (DPIE, 2019). As with projected changes in snowfall, artificial snowmaking conditions can also vary with elevation, with larger absolute decreases projected in higher elevations due to climate change, whereas larger relative decreases are projected at lower elevations (DPIE, 2019).

Current technology can make snow at slightly warmer temperatures; however, this reduces the efficiency of the snowmakers as the ratio of compressed air to water increases. The creation of compressed air causes the largest energy demand in the snowmaking process. Therefore, increased demand for compressed air increases energy consumption and, depending on the capacity of the compressor network, may limit the number of snow guns that can operate at the same time. The quality of snow is also impacted when producing snow at warmer temperatures using existing technologies (Perisher Resort, pers. comm. 20 August 2020).

A DPIE study outlines that if snow could be made at -1ºC in near future and 0.5ºC in the far future, opportunities for snowmaking may be able to be maintained at baseline (2000) levels (DPIE, 2019). From correspondence with ski field operators, snowmaking at warmer temperatures typically only occurs under extenuating circumstances due to impacts to efficiency and poor snow quality. It is therefore considered unlikely that existing snowmaking technologies will be viable in the far future to replace the projected reductions in natural snowfall with artificial snow.

Note there is a lack of data from manufacturers or Alpine resorts on the actual impact on water and energy efficiency of operating at higher temperatures. As such, this factor has been excluded from calculations of future energy and water demand from snowmaking in Section D4.3).

D4.2.3 FUTURE SHIFT IN SNOWMAKING TECHNOLOGIES

Research and development into temperature independent snowmaking technologies, such as the ‘Snowfactory’ produced by TechnoAlpin, has increased in recent years with the aim of improving the reliability of snow cover at ski resorts. The Snowfactory uses refrigerant technology where a heat exchanger cools the water down to freezing point and breaks the ice into the desired particle size. This technology has been installed at Mt Buller and Mt Baw Baw in Victoria and a development application has been submitted for the implementation of one at Perisher. TechnoAlpin reports that the Snowfactory technology is designed to complement traditional snowmaking technologies, rather than replace them (Techno Alpin, 2020) and can be used to make ‘wet snow’, a denser snow that lasts longer and is typically used as the foundation of ski fields (Perisher Resort, pers. comm. 20 August 2020).

Data was unavailable to compare the water and energy use of the Snowfactory with technologies described in Section D4.1. Industry research is currently being conducted into the feasibility of recovering the heat energy that is produced by heat pumps used in the refrigerant system of temperature independent snowmaking technologies, which

could then be used to heat nearby buildings. This recovered heat could be used to offset some of a resort's energy demands (Noguera, 2018).

An additional consideration for the use of Snowfactory technology is the reported use of salt to increase electrical conductivity in the snowmaking process. The NSW National Parks and Wildlife Service has raised concerns over the potential environmental impacts of this salt being discharged into the environment as this snow melts. It is understood that trials in New Zealand have shown that Calcium-Magnesium Acetate (CMA) to be a viable alternative (NSW National Parks and Wildlife Service per. comms. 24 July 2020).

Given the temperature constraints for the technologies described in Section 3.1, NSW Alpine resorts are likely to adopt temperature independent snowmaking technologies in future, particularly as costs decrease (Perisher Resort, pers. comm. 20 August 2020). Further technological advancements and improvements in capital and operational costs will determine whether temperature dependent and temperature independent snowmaking technologies will be viable to maintain existing snow conditions into the future.

D4.2.4 WATER AVAILABILITY AND PRESSURE ON SOCIAL LICENCE TO OPERATE

In alpine regions, both rainfall and snowmelt are key influences on seasonal waterway levels and recharge of aquifers. Commercial, industrial and residential consumers are heavily reliant on water extracted from waterways and aquifers, with ski resorts extracting a significant amount of water during the autumn and winter months for snowmaking purposes.

Table D.3 outlines the water extraction licenses, annual extraction limits and annual average usage recorded by DPIE for extraction licenses associated with snowmaking at NSW's two largest ski resorts – Perisher and Thredbo. The table also shows total estimated annual water usage for snowmaking as provided by the resorts; note there are some discrepancies between these figures and data recorded by DPIE.

Table D.3 Water extraction license limits and annual water usage for snowmaking

LICENCE NAME / NUMBER	ANNUAL EXTRACTION LIMIT (ML)[1]	ANNUAL AVERAGE USAGE RECORDED BY DPIE (2016-2019) (ML)[1]	ESTIMATED USAGE PROVIDED BY ALPINE RESORT (ML)
Perisher			
Snowmaking Pump Station 3 (10 SL 57228 / WAL 38553)	137	120	unknown
Smiggin Creek/snowmaking (10 SL 57193)	50	15	unknown
Perisher Range Aqueduct (10 SL 57220)	710	315	unknown
Total	**897**	**450**	**790**[2]
Thredbo			
Snowmaking pumping plant (WAL 39982)	260	250	unknown
Diversion channel snowmaking (WAL41189)	345	Not provided / unknown	unknown
Total	**605 ML**	**250 ML**	**290 ML**[3]
Grand total	**1502 ML**	**700 ML**	**1080 ML**

1. Alpine resorts' water extraction/access licenses and usage (2016-2019) data provided by DPIE
2. Indicative annual water usage for snowmaking provided by Perisher alpine resort for a typical year (Perisher Resort, pers. comm. 20 August)
3. Annual average water usage for snowmaking provided by Thredbo Alpine resorts for financial years 2017/2018 and 2018/2019 (Thredbo Resort, pers. comm. 16 August 2020).

As shown in Table D.3, if adopting the water usage estimates provided by the alpine resort, Perisher already consumes a significant portion of its annual water extraction license. Similarly, Thredbo's snowmaking pumping plant (WAL 39982) also uses a significant portion of its water extraction license and was recorded as exceeding this in 2018-2019 (refer to Table 4-1, Technical Study Report: Engineering – Infrastructure (WSP, 2020)).

A study conducted by DPIE on climate change impacts to water availability in the NSW Alpine Region outlines that surface runoff and groundwater recharge in the high alpine regions is projected to reduce in the future. An estimated reduction of 40mm/year in surface runoff and 100mm/year in groundwater recharge is projected for the far future (2070) (DPIE, 2018b). These reductions have the potential to create a strain on the natural environment as well as on water available for extraction.

The majority of the water consumed for snowmaking returns to the environment as runoff; however, extracting a significant amount of water over a short period of time, particularly on already strained waterways and aquifers, can result in negative environmental impacts. In the mid- to far-future, there is a risk that resorts could lose their social licence to undertake snowmaking if other uses (e.g. agriculture) are seen as more essential.

While future water availability and social licence to operate are important considerations for resorts, they are not considered in future energy and water demand calculations in Section D4.3 below.

D4.3 FUTURE CHANGES TO ENERGY AND WATER DEMAND

Table D.4 outlines the existing annual energy and water demand associated with snowmaking at NSW's two largest ski resorts – Perisher and Thredbo – and provides a high-level estimate of near future and far future demands to replace the reduction of natural snowfall with artificial snow. This is based on a simplified assumption that the projected reduction in snowpack equates to the amount of artificial snow that would need to be produced, with a commensurate increase in energy and water demand to create the required artificial snow. The calculations also assume no change in use of snowmaking technology over this period. For the purposes of this assessment the more conservative water usage estimates (data provided by the Alpine resorts outlined in Table D.3) have been used to inform this analysis.

The baseline for the above projections is the year 2000. For the purposes of this analysis it has been assumed that a linear reduction in snowpack would occur over time and therefore 20 years of snowpack reduction has already occurred since the baseline period of 2000 to 2020, resulting in a remaining 7% reduction in snowpack to occur by 2030 and 42% reduction by 2070.

Table D.4 Existing and projected energy and water demand associated with artificial snowmaking at NSW's two largest ski resorts (using self-reported data from resorts)

	CURRENT*	PERCENTAGE INCREASE FROM 2020 (%)	NEAR FUTURE (2030)	PERCENTAGE INCREASE FROM 2020 (%)	FAR FUTURE (2070)
Energy Demand (MWh)	7,230	7%	7,710	42%	10,270
Water Demand (ML)	1,080	7%	1,150	42%	1,530

*Current estimates are based on present day energy and water consumption data provided by Perisher and Thredbo Alpine resorts.

As shown above, NSWs two largest ski resorts report using approximately 7,200MWh of energy and 1,100ML of water for snowmaking during the ski season. Based on these simplified assumptions, it is estimated that energy and water demand associated with snowmaking could almost double in the far future. This would also result in an exceedance of the two resorts combined current water extraction license limits for snowmaking.

D4.4 RECOMMENDATIONS

Future guidelines for managing visitor impacts and the carrying capacity of KNP could assist in creating a framework to monitor and encourage the implementation of measures to improve energy and water efficiency. These measures could include:

- Undertaking more detailed research into factors influencing future energy and water demand from snowmaking that could not be quantified in this report due to a lack of data. This includes the influence of temperature on operating efficiency, as well as the efficiency of Snowfactories compared to conventional approaches. This would require collaboration with equipment providers such as TechnoAlpin.
- Mandating the reporting of:
  - Energy demand for artificial snowmaking and other sources of demand.
  - The amount of energy supplied by renewable sources (either on site or purchased).
  - Water demand for artificial snowmaking and other sources of demand against extraction license requirements. As shown in Table D.3 there appears to be some discrepancies between estimated water usage for snowmaking by the Alpine resorts and extraction license data provided by DPIE.
- Setting targets for energy and water usage, as well as the uptake of renewable energy to assist in NSW's transition to net-zero greenhouse gas emissions by 2050.
- Tracking data over time to identify trends and areas for improvement.
- Requiring detailed energy and water balances to be undertaken prior to the implementation of new snowmaking technologies to drive continual improvement.

D5 REFERENCES

- Adapt NSW, 2010, About NARCLiM, viewed 10 September 2020, <https://climatechange.environment.nsw.gov.au/Climate-projections-for-NSW/About-NARCliM>
- Di Luca, A. Evans, J. Ji, F. *Australian Snowpack: NARCLiM ensemble evaluation, statistical correction and future projections*, Climate Change Research Centre, UNSW, Sydney, 2017.
- DPIE, 2019, *Climate Change Impacts in the NSW Alpine Region – Projected changes in snowmaking conditions*. Department of Planning, Industry and Environment, Sydney, 2019.
- DPIE, 2019, *Climate Change Impacts in the NSW Alpine Region – Impacts on fire weather*. Department of Planning, Industry and Environment, Sydney, 2019.
- DPIE, 2018a, *Climate Change Impacts in the NSW Alpine Region – Projected Climate in the NSW Alpine Region*. Department of Planning, Industry and Environment, Sydney, 2018.
- DPIE, 2018b, *Climate Change Impacts in the NSW Alpine Region – Water availability*. Department of Planning, Industry and Environment, Sydney, 2018.
- DPIE, 2018c, *Climate Change Impacts in the NSW Alpine Region – Impacts on biodiversity*. Department of Planning, Industry and Environment, Sydney, 2018.
- DPIE, 2020, *Summary of the condition of the values of Kosciuszko National Park 2006-2016*, Department of Planning, Industry and Environment, Sydney, 2020.
- Noguera, A. *2018 Studying the feasibility of installing a temperature independent snowmaking system with heat recovery,* University of Gavle, Faculty of Engineering and Sustainable Development, Sweden

APPENDIX E

ALPINE RESORT AND NPWS PERFORMANCE

Table E.1 Existing AMU environmental management performance

VALUE	KEY PERFORMANCE INDICATOR	ID	GENERAL RESPONSIBILITY	OPERATOR PERFORMANCE	COMPLIANCE CONSIDERATION
Water Quality	Biological, physical and chemical indicators of resort stream health compared to ANZECC guidelines (physical and chemical measurements) and AUSRIVAS KNP model (biological condition).	W1	Thredbo AMU / NPWS /	General compliance, some conditions are consistently elevated above guidelines	
	Compliance with water extraction licenses.	W2	AMUs / NPWS Perisher Team[2]	Resorts are in general compliance, however… monitoring by the agency is poor and some are non-metered making compliance unclear. Resorts generally don't extract groundwater (CC meeting).	
	Water consumption in accommodation premises compared to industry benchmark (220 Litres/Visitor Night).	W3	AMUs	Varies between resorts because of lack of data. Some resorts could not provide the data (e.g. Selwyn only provides day-use facilities and Charlotte Pass resort does not have water meters on overnight accommodation) (OEH, 2017). Perisher potentially achieves 180L per person (CC meeting).	
	Total Water consumption.	W4	AMUs / NPWS Perisher Team[2]	There have been water conservation campaigns launched by resorts. Thredbo and Perisher have implemented initiatives including low flow showers installation. Thredbo also participated in Waterwise program.	
Pollution prevention	Timely management of environmental incidents in Alpine resorts.	P1	AMUs / NPWS Perisher Team[2]	Resorts are compliant with requirements	

VALUE	KEY PERFORMANCE INDICATOR	ID	GENERAL RESPONSIBILITY	OPERATOR PERFORMANCE	COMPLIANCE CONSIDERATION
and incident management	Compliance with EPA discharge licenses for Sewage Treatment Plants (STPs).	P2	AMUs / NPWS Perisher Team	Multiple non-compliances by resorts in particular Perisher STP. Number of reviews have been conducted by NPWS in response to Perisher poor performance (EES, 2020). Between 2016 – 2019, there has been multiple STP incidents Thredbo Sewage STW, Perisher STP, Bullocks's Flat STP, Sawpit Creek STP, Charlotte Pass STP (EES, 2020).	
	Compliance with POEO Act 1997, UPSS Regulation 2008.	P3	AMUs / NPWS[1]	Unknown	
	Education of staff in environmental incident management and response.	P4	AMUs	Resorts are generally doing quite well and this is always in their interest to do so. However, sometimes there are contractors that do not comply when delivering building services (CC meeting).	

VALUE	KEY PERFORMANCE INDICATOR	ID	GENERAL RESPONSIBILITY	OPERATOR PERFORMANCE	COMPLIANCE CONSIDERATION
Biodiversity	Threatened species population: Mountain Pygmy Possum (MPP).	B1	NPWS	Resorts are generally highly involved; however, it is still NPWS responsible for implementing any controls (CC meeting).	
	Threatened species population: Broad-toothed rat (BTR).	B2	NPWS	Resorts are generally highly involved; however, it is still NPWS responsible for implementing any controls (CC meeting).	
	Small mammal management: — Mountain pygmy possum, *Burramys parvus* (Endangered) — Broad-toothed rat, *Mastacomys fuscus* (Vulnerable) — Dusky antechinus, *Antechinus swainsonii* — Agile antechinus, *Antechinus agilis* — Southern bush rat, *Rattus fuscipes.*	B3	AMUs / NPWS	Resorts are generally highly involved; however, it is still NPWS responsible for implementing any controls (CC meeting).	
	Pest control programs.	B4	NPWS	Resorts have local responsibilities. It is NPWS responsibility to reduce populations across landscape and controlling pest, which is of concern at a landscape scale. Between 2014 -2016, Thredbo, Perisher and Charlotte Pass have provided assistance with cat trapping in resort areas (OEH, 2017).	
	Loss of natural areas as a result of development (no net loss of biodiversity values).	B5	NPWS	All developments within the resorts are required to go through a development approval stage before any developments. This KPI is captured as part of the development approval process.	

VALUE	KEY PERFORMANCE INDICATOR	ID	GENERAL RESPONSIBILITY	OPERATOR PERFORMANCE	COMPLIANCE CONSIDERATION
	Weed Management programs.	B6	NPWS	There are records of Alpine resorts weed management control efforts reported in 2014 -2016 (OEH, 2017).	
	Rehabilitation of previously disturbed areas.	B7	AMUs / NPWS	Resorts should have this resolved during the development approval stage.	
	Riparian restoration.	B8	AMUs / NPWS	Resorts should have this resolved during the development approval stage.	
	Natural heritage research projects supported, initiated or undertaken in Alpine Resort Areas.	B9	NPWS	Resorts generally pay a levy for research. Thredbo also provides access and information to researchers. This is more NPWS responsibility.	
	Environmental education and awareness programs.	B10	AMUs / NPWS	Staff induction has dropped out of reporting framework for now and has not been included from 2016 onwards. Currently unclear on reporting.	
Cultural Heritage	Education, awareness and promotion of resort cultural heritage values.	C1	AMUs / NPWS	Each resort has their own cultural awareness training and is usually part of the staff induction training (OEH, 2017). NPWS responsibility to establish the best way for acknowledgement of country and first nation people (CC meeting).	
	Protection of heritage sites, items and historic assets.	C2	AMUs / NPWS	No significant Aboriginal heritage sites were identified for protection or threatened by disturbance during 2014- 2016 period (OEH, 2017). No data available from the 2016-2019 Environmental Performance Report. This is more of a development approval process.	
Air Quality and CO2 Emissions	Amount of CO2 emissions.	A1	AMUs	Thredbo have partnered with 'GreenFleet' to offset carbon emissions generated by the resort (EES, 2020). Perisher also aims to manage air quality through continuous improvements to heating, lighting and EMS throughout the resort (EES, 2020).	
	The percentage of renewable energy used.	A2	AMUs	Perisher and Thredbo both purchased 'GreenPower' (OEH, 2017).	

VALUE	KEY PERFORMANCE INDICATOR	ID	GENERAL RESPONSIBILITY	OPERATOR PERFORMANCE	COMPLIANCE CONSIDERATION
	The percentage of visitors using Skitube.	A3	AMUs	Date has not been provided due to commercial sensitivities.	
Energy Conservation	Total Energy consumption.	E1	AMUs	Between 2015- 2016, Perisher, Thredbo, Charlotte Pass and Selwyn all increased energy consumption during the reporting period (a decline in performance trend compared to 2014-2015).	
	Energy consumption in accommodation premises comparted to 'EarthCheck' benchmark.	E2	AMUs	No data available	
	Energy efficiency initiatives.	E3	AMUs	Ski resorts have put in place a large range of energy conservation measures, displaying their commitment to reducing energy consumption into the future (EES, 2020). There are opportunities to launch more energy efficiency initiatives as snowmaking is likely to increase in the future.	
Waste Management	Amount of domestic waste.	G1	AMUs	The amount of waste generated by resort generally fluctuates every year between 2014 -2019 (OEH, 2017; EES, 2020). Each resort reports and monitors their waste production including the final destination of waste produced.	
	The percentage of domestic waste recycles including paper, cardboard, tins, glass and plastics.	G2	AMUs	Between 2016 -2019 (EES, 2020) — Perisher and Charlotte Pass Resorts: amount of comingled recycling waste from increase each year. Perisher and Charlotte Pass waste is managed by NPWS through the waste transfer station located at Perisher. — Thredbo: amount of comingled recycling fluctuates throughout — Selwyn: amount of comingled recycling fluctuates throughout	

VALUE	KEY PERFORMANCE INDICATOR	ID	GENERAL RESPONSIBILITY	OPERATOR PERFORMANCE	COMPLIANCE CONSIDERATION
	Waste composed – including the biosolids from Sewage Treatment Plants (STP).	G3	AMUs / NPWS Perisher Team[2]	The biosolids produced by each STP between 2016 -2019 (EES, 2020): — Increases for Charlotte Pass STP: — Decreases in Perisher STP — Increases in Sawpit Creek STP — Decreases in Bullocks Flat STP — Fluctuates for both Thredbo Village STP and Selwyn STP.	
Sustainable recreation	Education, awareness and promotion of sustainable recreation in resorts.	R1	AMUs / NPWS	Between 2014-2016, Consistent performance with promotion of sustainable recreation. All resorts except Charlotte Pass continued to provide pre-winter environmental induction training for their staff. Promotion of environmental values is incorporated into several programs (OEH, 2017).	
	Monitoring of key recreational activities — snow play at Selwyn — mountain biking and walking at Thredbo — snow tubing at perisher.	R2	AMUs / NPWS (downhill mountain biking only)	Insufficient data — Consistent performance. Impacts of key recreational activities were monitored across Perisher, Thredbo, Selwyn resorts (OEH, 2017).	
Resort Amenity	Education, awareness and promotion of resort amenity.	Am1	AMUs	Between 2014-2016: consistent performance. Education and awareness programs were implemented by Thredbo, Perisher and Selwyn. No data available from Charlotte Pass.	

VALUE	KEY PERFORMANCE INDICATOR	ID	GENERAL RESPONSIBILITY	OPERATOR PERFORMANCE	COMPLIANCE CONSIDERATION
	Measures to protect the visual and acoustic environments within resorts and minimize impacts to the surrounding areas.	Am2	AMUs	This happens more often during a Development Approval stage. Consistent performance. All resorts implement measures to protect visual and acoustic environment between 2014 – 2016 (OEH, 2017). **Scenic quality** — All resorts when making development applications need to consider any visual impact by the proposed development and particularly when viewed from the Main Range. **Noise pollution** — All outdoor events such as concerts or festivals, require a Noise Management Statement as part of the planning process (EES, 2020).	

ABOUT US

WSP is one of the world's leading engineering professional services consulting firms. We are dedicated to our local communities and propelled by international brainpower. We are technical experts and strategic advisors including engineers, technicians, scientists, planners, surveyors, environmental specialists, as well as other design, program and construction management professionals. We design lasting Property & Buildings, Transportation & Infrastructure, Resources (including Mining and Industry), Water, Power and Environmental solutions, as well as provide project delivery and strategic consulting services. With 43,600 talented people in more than 550 offices across 40 countries, we engineer projects that will help societies grow for lifetimes to come.