

Alpine Resort Futures Vulnerability Assessment (Social and Economic) Conceptual Model

Final Report

DELWP
August 2017



Independent insight.



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1 VULNERABILITY ASSESSMENT METHODOLOGIES

1.1 A conceptual model for the Alpine Resort Futures Climate Change Vulnerability Assessment (Social and Economic)

This section describes the key elements of vulnerability to climate change and how this relates to the alpine resorts sector in Victoria. This section begins with the introduction of key concepts of vulnerability (such as adaptive capacity, vulnerability, system and perturbation), followed by a description of the relations between the concepts. The final part of this section describes how we aim to identify, measure and document key concepts and assess the vulnerability of the alpine resorts in Victoria.

Key concepts

A number of concepts are essential to understanding and undertaking a vulnerability assessment and adaptation planning. The definitions of the key concepts are as follows:

Adaptation broadly can be described as planning to enable an activity or investment to be suited to the conditions it will face during the service period of that activity or investment. Climate is one of many influences of future conditions and it may not be the largest or the most urgent one.

Adaptive capacity is the capability of a system, sector or social group to adjust to change, to minimise harm, to act on opportunities, or to cope with the consequences. Adaptive capacity is related to how the system in its current state may adapt to possible future states. Adaptive capacity can be cultivated and improved over time to help a system advance to a desired possible future state. Adaptive capacity depends on the strengths, weaknesses and opportunities of the key social, economic and environmental values and assets in the system. Adaptive capacity of a system is further determined by:

- Expectations, or the understanding that as the climate continues to change, things will be different
- Confidence that the individuals and the overall system can act and respond adequately to perturbations
- Access to resources, either directly or indirectly, that enable the system to adapt
- Skills and expertise to govern action where required and to effectively implement options as required.

Exposure refers to the expected changes to climatic stimuli in a given location. For example, lower altitude resorts are subject to loss of natural snow to a greater extent than higher altitude resorts, at least initially.

Sensitivity is the degree to which a system or species is affected, either adversely or beneficially, by climate variability or change. The effect may be direct (for example lack of snow due to warmer temperatures) or indirect (for example, visitation numbers in response to snowfall).

Vulnerability is the degree to which a system, sector or social group is susceptible to the adverse effects of climate change; vulnerability depends on the nature of the climate changes to which the system is exposed, its sensitivity to those changes and its adaptive capacity.

The concept has been used in various ways but there is no academic consensus on its meaning. This definition describes the condition of the entire system, as it refers to exposure, sensitivity and adaptive capacity. The understanding of a system's vulnerability enables the identification of ways to adapt using the strengths of the system.

Perturbation is an internal or external process that interacts with the system with the potentiality of inducing changes in the system, be it slow or sudden. External stresses can be in the form of shocks, major spikes, extreme events, or gradual change.

This study focuses on climate change impacts as perturbations, of which changes in temperature, precipitation and snow fall are identified as the main external stresses that impact on the alpine resorts. These changes will impact on depth, extent and duration of snow cover (among other things).

There can also be multiple, interacting perturbations at the same time. Apart from the impacts of climate change, the system may simultaneously be undergoing changes driven by other internal and external factors. As part of the scope of this study relevant changes taken into account are:

- Demographic and socio-economic trends such as ageing of population and intergenerational change
- Changing visitor patterns and tourism behaviour
- trends in snowsports
- Other yet unidentified changes.

A system consists of interactive and mutually dependent components. The system of the alpine resorts sector consists of a range of social, economic, environmental and cultural values and assets (components) that may be impacted on by climate change. The components also interact, and as a result sensitivity to climate perturbations may be indirect. The components may be expressed in monetary and economic terms (i.e. dollar value of infrastructure and the remaining economic lifetime) or more qualitative values especially when it concerns social and cultural values.

A threshold is a point in a condition or process that once passed triggers some kind of change. Thresholds may represent the limits on the system (and its individual components), and the assets or values. Thresholds may be regulatory, social, technical, environmental or economic. For instance, tourism operators require minimum visitor spending in order to remain operational. Thresholds can change over time. Crossing thresholds can lead to impacts on the adaptive capacity, sensitivity and vulnerability by changing the strengths, weaknesses, threats and opportunities of components that then propagate through the entire system.

Tipping points are critical points, specific thresholds, which once crossed shift the system radically and potentially irreversibly into a different equilibrium state. It may be difficult if not impossible to reverse the change after a tipping point has been crossed. Not all thresholds are tipping points but we will focus on those that are.

Ecosystem goods and services are the benefits that humans obtain from the ecosystem. Ecosystem services are grouped into four broad categories: **provisioning**, such as the production of food and water; **regulating**, such as the control of climate and disease; **supporting**, such as nutrient cycles and crop pollination; and **cultural**, such as spiritual and recreational benefits.

Recent research by the Antarctic Climate and Ecosystems Cooperative Research Centre (ACE CRC) and others has shown that increasing temperatures and changes in precipitation have and will continue to impact on two important ecosystem services¹ in the Victorian alpine region: recreation and management of bush fire risk.

¹ Of the total 23 types of ecosystem services as defined by the National Oceanic and Atmospheric Administration (part of the U.S. Department of Commerce). See <http://www.habitat.noaa.gov/about/habitat/ecosystemservices101.html> for full list.

Ecosystem services relevant to the alpine industry include:

- **Recreation** (a cultural service): snow cover delivers opportunities for outdoor recreation, sports and eco-tourism. When snow cover diminishes or disappears, this ecosystem service is no longer delivered, and the human system will need to provide the service or provide alternative recreation options. Changes in the recreation services have consequences for visitation and visitor spending in the alpine areas, with obvious flow-on effects to the local economies and communities. Recreation may also be adversely affected by changes in vegetation due to climate change (due to bush fires and impacts on ecosystems) and the impact on the uniqueness and amenity of an area
- **Management of bush fire risk** (a regulating service): snow cover delivers a service referred to as 'disturbance prevention' as it reduces the risk of bush fire. When snow cover diminishes or even disappears, this ecosystem service is no longer provided, and the human system will need to manage bushfire risk and respond with alternatives. Higher temperatures and lower precipitation increase bushfire risk. Increased bush fire risk has consequences for recreation opportunities in the seasons when the risk occurs (mostly November to April)
- **Water supply:** (provisioning) precipitation and snow cover provide a means to retain and store fresh water for consumptive use such as drinking water, irrigation, snow-making or household water
- **Water regulation:** (regulating) snow cover provides a means to regulate runoff
- **Aesthetic meaning:** (cultural) snow cover can provide attractive landscapes and enjoyment of scenery.
- **Cultural and artistic meaning:** (cultural) snow cover also shapes and influences the culture and way of life of local communities connected to the alpine areas. These values may not easily be substituted or replaced by the human system
- **Spiritual and historic meaning:** (cultural) snow cover may also have a spiritual and historic meaning to local communities and provide a sense of identity and sense of place.

Ecosystem services may be subject to tipping points. A tipping point is when a slow, reversible change becomes irreversible, often with dramatic consequences. Examples might include increased wildfire changing the vegetation character so that the original vegetation communities cannot re-establish or reduction in snow days bringing visitor numbers below financially sustainable levels leading to lack of reinvestment and decline of assets.

Adaptation planning can assess complementary and mutually reinforcing adaptation actions implemented as required over time. Planning can explore how an area may adapt over time and what the impacts of adaptation are. Different approaches may be equally valid and possible ways to respond to the changing conditions, but their implications in terms of implementation costs, community values, natural values, economic impacts and infrastructure and service provision vary significantly. Adaptation pathways is one possible analytical approach that can support decision makers to identify, explore and sequence possible adaptation decisions and actions over time (CSIRO, 2017).

Based on experience from coastal adaptation, and other alpine areas, some of the possible planning directions² for alpine resorts could include (not limited to): technological adaptation to maintain winter sports industry, tourism diversification which maintains a consolidated snow sports sector, tourism diversification moving away from the alpine snow sports industry, and/or managed retreat from alpine tourism, both summer and winter.

Risk is the likelihood of an event (gradual change or extreme, sudden events) occurring combined with the likely consequences of the event when it occurs. The likelihood of an event occurring changes over time, and risks are best expressed using a timescale. For instance, in coastal adaptation planning, risks are identified across a number of points in time such as: present day, 2030, 2070 and 2100. Risks may be expressed, depending on the quality of information available, in terms of low, moderate, high and extreme.

² These are expressed in broad terms. A detailed exploration of adaptation planning options for Victorian resorts will be undertaken as Stage 2 of the program. Other alternatives may be identified.

1.2 Systems analysis

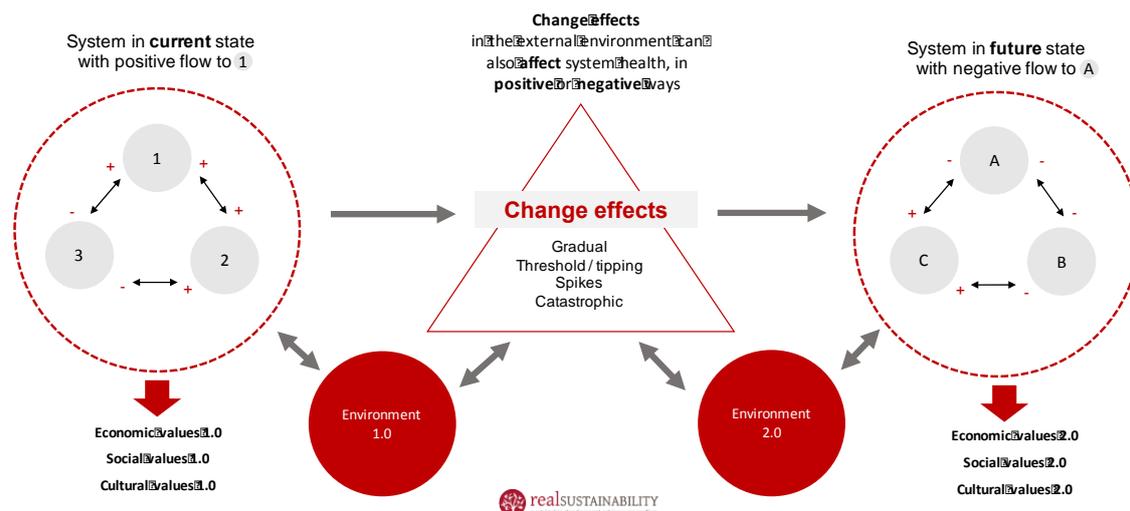
A systems approach - or systems thinking - lends itself to thinking through complex, dynamic challenges that have a web of interconnected elements. Systems thinking is a practice through which we can go beyond immediate or obvious problems to work with complexity and discover underlying or hidden patterns and relationships. This method can reveal new ways through which we can leverage a system, and support dynamic learning and adaptation.

Key systems thinking mindsets include:

- Seeking the ongoing health of a system, as opposed to a fixed goal or end state
- Seeing patterns in systems, not just problems
- Unlocking and managing change in ways that can support system health
- Planning to adapt as we observe and experience the system, as opposed to setting and staying a fixed course.

Figure 1 provides a conceptual representation of a system and system health concepts. The figure shows how interacting elements produce values, and how these values can change as a system's health shifts because of change effects that directly impact the system or the environment within which a system lives.

FIGURE 1. SYSTEM AND SYSTEM HEALTH CONCEPTS



Rationale for a systems analysis approach

In the face of a major change effect like climate change, thinking through the future of the alpine resorts sector is a complex, dynamic challenge that systems thinking can support. Systems analysis is recommended when:

- The problem is not fully understood, let alone the solution
- There is significant diversity of opinion and/or conflict among stakeholders and experts about what to do
- There are many diverse and dynamic interconnections between the problem and the broader environment, which itself is unstable and dynamic (political, social, and economic)
- There is a plan to make sustained change at a broad scale.

Adopting systems analysis will allow us to create a comprehensive map of the current alpine resorts sector system. This systems map will reveal:

- The elements of the system, including a defined system boundary
- The interrelationships and interdependencies between elements in the system and how these influence the elements

- The interrelationships and interdependencies between the system and the broader environment and how these influence system health
- How the interactions between elements within the system and with the broader environment produce the current suite of economic, social and cultural values within the alpine resorts sector

Once the systems map is established, this can be used as a platform for understanding how climate change (and other foreseeable changes) will affect elements, relationships and values in the alpine resorts sector. Options for future adaptations that will change the system can be tested to analyse their potential effects, helping to choose which elements and relationships provide the best potential leverage for maintaining future system health.

Systems analysis method

The systems analysis will be informed by knowledge and experience drawn from engagement with those stakeholders closest to the alpine resorts sector, and from further technical analysis of current elements, relationships and economic, social and cultural values.

To conduct the analysis, an approach based on The Omidyar Group’s guide to systems practice will be applied (The Omidyar Group, 2017). For this project, the key stages of the approach are:

1. **Launching:** Planning a best fit system mappings process and setting goals
2. **Gaining clarity:** Exploring forces, analysing causes and effects, creating loops, discovering deep structure and patterns, building the map, crafting the system narrative, and socialising and further iterating the systems map.

The next phase of the Alpine Resort Futures Climate Change Adaptation project (planning and preparing for adaptation) will include subsequent stages of the systems analysis approach:

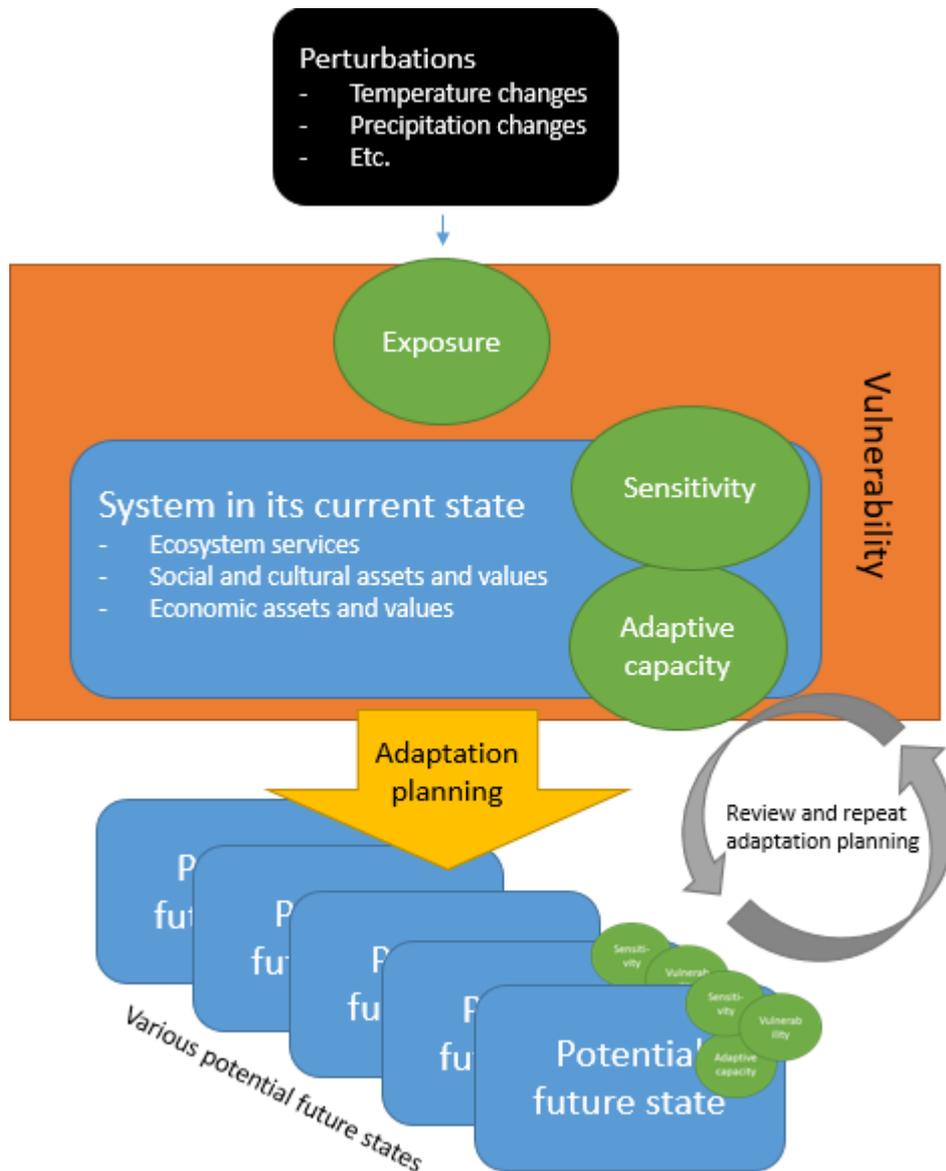
3. **Finding leverage:** working with opportunities, exploring how these may leverage future system health, and evaluating feasibility / potential for impact / fit
4. **Acting strategically:** maximising leverage and setting up to monitor / track performance
5. **Learning and adapting:** watching and working with the system as it changes to continually learn from and adapt to system change.

Linkages and conceptual model

Using a systems thinking perspective, and for the purpose of undertaking this project, it is important to understand and define the relations between these concepts and how they affect the system. These linkages are expressed in the following conceptual model, which is based on a literature review and practical experience in adaptation planning.

A model of the way in which observed and projected changes are impacted in the alpine resorts sector is provided in Figure 2.

FIGURE 2. CONCEPTUAL MODEL OF CLIMATE CHANGE VULNERABILITY IN THE ALPINE RESORTS SECTOR



The observed and projected changes in the climate (Perturbations) are having, and are expected to have, impacts on the alpine resorts sector in their current state (System in its current state) due to their exposure (Exposure) to these changes. Apart from climate change, there can be other internal or external perturbations which exert influence on the system as well. Exposure can be expressed in terms of likelihood across a timescale. For instance, the likelihood of a snow free winter at present may be extremely low, while this likelihood will increase and may progress towards extreme likelihood by 2050.

In addition to exposure, the extent to which the system is subject to change (*Vulnerability*) depends on the sensitivity of the system's assets and values (*Sensitivity*) and their adaptive capacity (*Adaptive capacity*)³. Assets and values may be subject to damage as a result of an extreme event or a slow change (*Sensitivity*). **Vulnerability** can be either direct, through direct exposure to the perturbation, or indirect via the interdependencies of assets and values in the system.

³ Risk is the result of exposure and sensitivity if the system *does not* adapt. This risk can be greatly mitigated by adaptive capacity, i.e. *doing something*. Residual risk is what is faced in spite of adaptation.

The system in its current state will adapt and change over time. The system will move among one of several possible trajectories (*Adaptation pathways*) to arrive in its future state (*Potential future state*). Planned adaptation involves interventions to deliberately move the system to a new future state. Change that is not planned or poorly planned may result in maladaptation, where the response to the change only serves to make the change worse (e.g. increasing CO₂ emitting energy consumption to run air conditioning as the climate warms).

The scope and range of vulnerability also determines the scope and range of possible and realistic adaptation pathways and possible future states. Some pathways may be outside of the capacity of a community to progress. For example, while building a sea wall to protect a remote, small and ageing community from storm surges and erosion is possible, the community may not have the funds.

Adaptation is a process not an event; the system will continue to adapt over time. The system's potential future state will one day be its new current state from which it will evolve further depending on a range of internal and external influences or perturbations.

In the model provided in Figure 2 the following interconnections are noted:

- Exposure is an attribute of the relationship between the system and the perturbation, rather than of the system itself
- Sensitivity is an attribute of the system, existing prior to the perturbation, and separate from exposure. The system may become less sensitive over time as it learns and adapts based on past experiences
- Capacity of response is an attribute of the system that exists prior to the perturbation, but can be modified over time and may be based on historic experiences with perturbations
- The concept of vulnerability has been used in various ways but there is no academic consensus on its meaning. It mostly describes the condition the entire system is in, as it refers to exposure, sensitivity and adaptive capacity.

1.3 Vulnerability dashboard

This project uses a Vulnerability Dashboard to identify and describe the components of the system, their individual vulnerabilities and their interrelations.

A vulnerability dashboard is based on the concepts previously discussed and considers the interrelations between them at the individual asset/component level but also at more aggregated levels (sub-categories and categories).

System components and their interrelations

The assets and values that make and shape a system, consist of economic, social, cultural, infrastructural and environmental or natural elements (e.g. ecosystem services). These categories can be further refined into sub-categories. For the purpose of this study the following sub-categories have been identified:

Ecosystem services

- Natural snow, snow making conditions, flora and fauna, and setting for recreation (bike riding, snow sports)
- Bush fire management related to temperature and precipitation and snow cover
- Water (quantity/storage)

Economic assets and values

- Businesses particularly tourism related to white season (snow based recreation) and green season activity
- Employment
- Private infrastructure – such as ski lifts, snow making and accommodation
- Public infrastructure – roads

Social assets and values

- Recreation – especially alpine based activities (snow sports culture)

Cultural assets and values

- Communities in the resorts and in the surrounding towns and area

Ecosystem services are directly exposed to climate change perturbations. Within the system, social, economic and cultural assets and values are indirectly exposed to climate change perturbations.

Each of the sub-categories consist of various assets and values in each alpine community, and each will have different levels of vulnerability (i.e. combination of exposure, sensitivity and adaptive capacity). The vulnerability dashboard – where possible – provides a rating for each asset / value (for each alpine resort and the communities that depend on them) for the variables listed in the table below. The table provides information on the variables, their applicability and the data sources.

Variable	Description	Applicability and data sources
Name of asset / value	The name of the specific asset or value	
Description	A more detailed description of asset or value	
Ownership	Asset owner(s)	Public, private, collective
Thresholds	Limits on the asset or value, which may be regulatory, social, technical, environmental or economic.	The sources of information were socio-economic data, literature and/or consultation.
Tipping point	Irreversible change to an ecosystem service	Applies to ecosystem services and other assets/activities. The sources of information were environmental data, literature and/or consultation.
Value	The social, cultural, ecosystem or even economic value of the asset where it cannot be expressed in monetary terms.	Significant input from stakeholder workshops. Strengths, weaknesses, opportunities and threats helped identify scope for adaptation. Other sources of information were socio-economic data and literature.
Remaining asset life	The remaining productive lifetime of the asset.	Where applicable in years / in \$ where possible. The period that remains until the asset needs to be replaced, and invoke a capital investment. The sources of information can be socio-economic data, literature and/or consultation.
System interdependencies	Interrelations and interdependencies with other assets and values	Mapped through a systems mapping process
Exposure	The level of exposure to climate perturbations	Depending on geographic location, type of activity, can be indirect depending on interrelations with other assets or values that experience direct exposure. The sources of information can be socio-economic data, literature and/or consultation.
Sensitivity	The degree to which the asset or value is affected, either adversely or beneficially	Depending on geographic location, type of activity, can be indirect. The sources of information can be socio-economic data, literature and/or consultation.
Adaptive capacity	The capability to adjust, to minimise harm, to act on opportunities, or to cope with the consequences	The sources of information can be socio-economic data, literature and/or consultation.
Vulnerability	The overall susceptibility to climate change	The vulnerability score is a combined function of exposure, sensitivity and adaptive capacity.

The vulnerability dashboard can be assessed at different levels:

- the individual asset
- the sub-category
- the category
- the overall system (how dependencies flow from one element to another)

The dashboard is done for each resort and summarised for the alpine region overall.

The conceptual model provides direction to the method of ‘scoring’ or ‘calculating’ the vulnerability indicators by evaluating exposure, sensitivity, adaptive capacity and vulnerability of each element. The dashboard is designed in such a way that it provides a clear oversight of the vulnerability of assets and services, sub-categories, categories and the system as a whole via an easy **traffic light scores** ranging from very low vulnerability (dark green), moderate vulnerability (light green), significant vulnerability (yellow), major vulnerability (orange) to extreme vulnerability (red).

1.4 Stakeholder engagement

The purpose of stakeholder engagement and analysis was to draw the knowledge and experience of the alpine resorts sector into the information base being developed to support the Alpine Resort Futures Climate Change Vulnerability Assessment (Social and Economic). Stakeholder identification was targeted for this project, using the Department’s database of key sector stakeholder contacts. This database was updated periodically to track new stakeholders, contact, engagement steps and participation.

Stakeholder mapping

A stakeholder map will be produced. The purpose of this map is to provide the Department with a living resource that tracks stakeholders in terms of:

- their key interests in the alpine resorts sector and their balance of focus
- their key connections to and within the alpine resorts sector
- their area of focus (strategic or operational) and / or their expertise (subject matter)
- whether and how they have participated in the Alpine Futures Climate Adaptation Project
- their potential to champion of the Alpine Futures Climate Adaptation Project
- their potential to enable or inhibit progress.

The map will include key stakeholders as selected from the Department's master list of sector stakeholders. The Kumu mapping software will be used as the platform for creating and managing the map. The map will exist in both visual and tabular form.

Types of engagement

1. Interviews

- A series of 14 one on one interviews with selected key stakeholders and influencers from with the sector
- Using a formal questionnaire based around the following themes of enquiry:
 - Background, introductory & profile information
 - Organisational linkages
 - Sensitivity and levels of vulnerability to climate change exposure
 - Assessing alpine sector capacity for adaptation & taking up new opportunities
 - Data collection.

2. Workshops

- A series of 13 structured workshops held across the Alpine region (one at each resort and in five nearby communities), and in Melbourne (one targeting Victorian Government agencies and two generally open to Melbourne-based stakeholders), involving a targeted selection of stakeholders from with the sector
- Using the following themes of exploration:
 - Perceptions of the current economic, social and cultural values of the sector and the relative vulnerability of these to climate change
 - Perceptions of the current adaptive capacity of the sector in terms of opportunities for adaptation, and the relative strengths and weaknesses of the sector in the pursuit of adaptation

- With perceptions tracked according to the following broad classification of stakeholder interests:
 - Alpine Resort Management Boards
 - Business
 - Community
 - Environment Groups
 - Government.

- 3. Victorian Traditional Owner discussions
 - A series of engagements with Victorian Traditional Owner organisations and representatives
 - Targeting the following representational entities with lands in or connected to the Victorian alpine resorts:
 - The Federation of Victorian Traditional Owner Corporations
 - The Taungurung Clans Aboriginal Corporation
 - The Gunaikurnai Traditional Owner Land Management Board
 - The Wurundjeri Tribe Land Compensation and Cultural Heritage Council Incorporated
 - The Monaro Peoples
 - Discussing the following key themes:
 - Traditional owner perspectives on opportunities for partnership with the Department and the alpine resorts sector around climate change adaptation planning and implementation
 - Traditional owner perspectives on climate change impacts and land management on alpine country
 - Traditional owner perceptions of the economic, social and cultural values of the alpine resorts sector
 - Traditional owner perceptions of opportunities, strengths and weaknesses for adaptation on Alpine country
 - Adopting flexibility in timing and format to best suit the needs and interests of Traditional Owners.

Communication and information sharing

The Alpine Resort Futures site on the Engage Victoria platform was used as the central point for communications and information sharing. That site was used as the place for developing information and sharing resources – as material was produced and finalised, stakeholders could access it and can be encouraged to continue to engage with it.

This was supported by direct interpersonal communication via face to face discussion, telephone discussion and email, as necessary and appropriate.

Documenting and reporting

All formal engagement has been documented and reported in the following ways:

- Interview responses were collated in electronic format, subjected to a thematic analysis by stakeholder perspective, and reported with key observations highlighted
- Workshop output was collated in electronic format, subjected to a detailed analysis of expression by stakeholder perspective, and reported at both the individual workshop, resort and sector-wide levels
- Traditional Owner discussions were collated in electronic format, subjected to thematic analysis and reported at the Traditional Owner group level.

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