2013 | SCIENCE POLICY PEOPLE

Victoria: STATE OF THE **ENVIRONMENT**

State Government Victoria

Commissioner *for* Environmental Sustainability Victoria

“As mounting research shows, the stable functioning of Earth systems - including the atmosphere, oceans, forests, waterways, biodiversity and biogeochemical cycles - is a prerequisite for a thriving global society. With the human population set to rise to 9 billion by 2050, definitions of sustainable development must be revised to include the security of people and the planet.”

David Griggs, Mark Stafford-Smith, Owen Gaffney, Johan Rockström, Marcus C. Öhman, Priya Shyamsundar, Will Steffen, Gisbert Glaser, Norichika Kanie and Ian Noble. *Sustainable development goals for people and planet. Nature*, 495: 305-307. (21 March 2013). 2013.

“It is *extremely likely [greater than 95% probability]* that human influence has been the dominant cause of the observed warming since the mid-20th century.

Continued emissions of greenhouse gases will cause further warming and changes in all components of the climate system. Limiting climate change will require substantial and sustained reductions of greenhouse gas emissions.”

IPCC (2013), Working Group I *Climate Change 2013: The Physical Science Basis. Summary for Policy Makers.*

Victoria: STATE OF THE **ENVIRONMENT**

MESSAGE FROM COMMISSIONER

A sustainable society is one that can persist over generations, one that is farseeing enough, flexible enough, and wise enough not to undermine either its physical or social systems of support.

D.H. Meadows, *Beyond the Limits*

I submit the **Victoria State of the Environment Report 2013, *Science Policy People*** (SoE 2013), in accordance with the requirements of the *Commissioner for Environmental Sustainability Act* 2003 (the Act). In my 2010 reporting framework* I undertook to produce this report in a manner which would:

> ***inform the Victorian community*** *about the health of the natural environment and* ***influence government*** *to achieve environmental, social, cultural and economic sustainability.*

To meet this undertaking the SoE 2013 was produced not only through research and data analysis, but also through consultation across sectors, including communities throughout the state.** The trends selected for analysis in Part A of this report are the standard matters considered in state of the environment reporting. The indicators used were selected with the assistance of academic and other experts.***

Discussion and informed narrative are a feature of this report, particularly in Part B. My choice of the goals discussed and recommendations presented was also influenced by the research and consultation undertaken by my office. The case studies and examples from Victoria, other Australian jurisdictions and also from overseas, document innovative solutions and 'best practice' approaches. The complexity of environmental issues is illustrated by the wide ranging discussions referenced in Part B.

In Part B I also detail my recommendations to the Victorian Government. The Act requires the government to table a response to my recommendations no later than the first sitting day 12 months after the SoE is tabled in parliament.

* Science, Policy, People State of the Environment Reporting 2013, Victoria, Commissioner for Environmental Sustainability Melbourne, Victoria, 2010
** Many Publics, Participation Inventiveness and Change, Commissioner for Environmental Sustainability Victoria, Melbourne, 2012
*** See http://www.ces.vic.gov.au/victorias-environment/state-of-environment-victoria-2009-2013

I recommend a number of organisational, regulatory and policy changes (see SoE 2013 at a Glance summary pages 20, 21). The recommendations I have made are well considered, based on research and consultation. They are strategic, and needed for the health of our ecosystems and the continued wellbeing of our community. The changes are necessary, they are generational choices – investments in our future, and they require leadership and foresight from us all.

Perspective

In my Foundation Paper One – Climate Change Victoria: *the science, our people and the state of play** I commented that:

> ***Independent statutory roles, such as mine, have a unique function in our system of government. They stand at a distance from government and, depending on their legislative accountabilities, undertake independent investigations or analysis and provide impartial reports. Governments can be greatly assisted in their regulatory and decision making processes by independent authorities who provide insights into community aspirations and instructive, balanced comment on the policy process.***

Reflecting on my time as Victoria's second Commissioner for Environmental Sustainability, as my office completed the SoE 2013, I was reminded of this 'unique' role of independent statutory bodies. As we all become more critically aware of the fact that ecosystem services not only sustain our way of life, but are integral to every facet of our well-being, the need for independent integrated ecosystem services and ecological processes reporting is imperative.

As population growth places ever increasing demands upon our natural resources and climate change creates additional stressors 'state of the environment reporting' can no longer be considered an exercise in linear reporting of biophysical environment trends. It requires a whole of system – social, economic and environmental – approach. It is a whole of government, whole of community endeavour.

To ensure that Victoria is well served by independent, integrated 'state of the environment reporting, it is my view that Victoria's next Commissioner for Environmental Sustainability should be funded directly from the state budget and not through a departmental grant. Furthermore, I am strongly of the view that to ensure a whole of government, whole of community reporting framework the next Commissioner for Environmental Sustainability should report to the Premier of the state. Ecosystem services, their protection and management, are integral to all strategic government policy considerations and implementation.

Key concepts of SoE 2013

Throughout the development process of the SoE 2013 a number of recurring themes became evident. These 'key themes' influenced my approach to this report, particularly with regard to making recommendations. Consequently each recommendation can be referenced to two or more of the following:

1. Ecosystem services – imperative for our well-being
2. Leadership – generational choices for government to make and community to influence
3. Alignment and integration – organisational and procedural for efficiency
4. Strategic Adaptive Management (SAM) – enables measurement of progress and supports resilience.

* http://www.ces.vic.gov.au/victorias-environment/state-of-environment-victoria-2009-2013/climate-change

Strategic Adaptive Management

SAM is an iterative process of decision making that is intended to reduce uncertainty over time through robust monitoring and using the most up-to-date information to learn from experience. It is often adopted by natural resource managers as a valuable tool for managing complex systems with high levels of uncertainty.

SAM provides a framework for identifying desired management outcomes and the management actions required to achieve those outcomes. This framework also specifies thresholds for assessing progress towards desired outcomes are being achieved and guidelines for modifying actions if they are not being achieved.

Key SAM processes include:[1, 2]

- engage the relevant stakeholders in the decision making process
- identify the desired management outcomes
- specify assumptions about system responses to management and identify key uncertainties
- establish quantitative and/or qualitative baseline thresholds for desired outcomes
- identify checkpoint levels on path towards baseline thresholds
- determine management actions that will be taken in the future if a given checkpoint level is reached
- implement those actions if the checkpoints are reached
- evaluate, learn from, and re-assess management actions.

The SAM approach allows ecosystem managers to fully engage with communities that benefit from ecosystem services, setting the 'desired future condition' of managed areas. When fully integrated into the SAM process, this supports the position that communities should be given the opportunity to influence decisions that may affect them, and increases the likelihood of success in achieving outcomes by generating public 'buy-in'. In Victoria, this principle has been central to adaptive management of waterways at both state[3] and regional[4] levels.

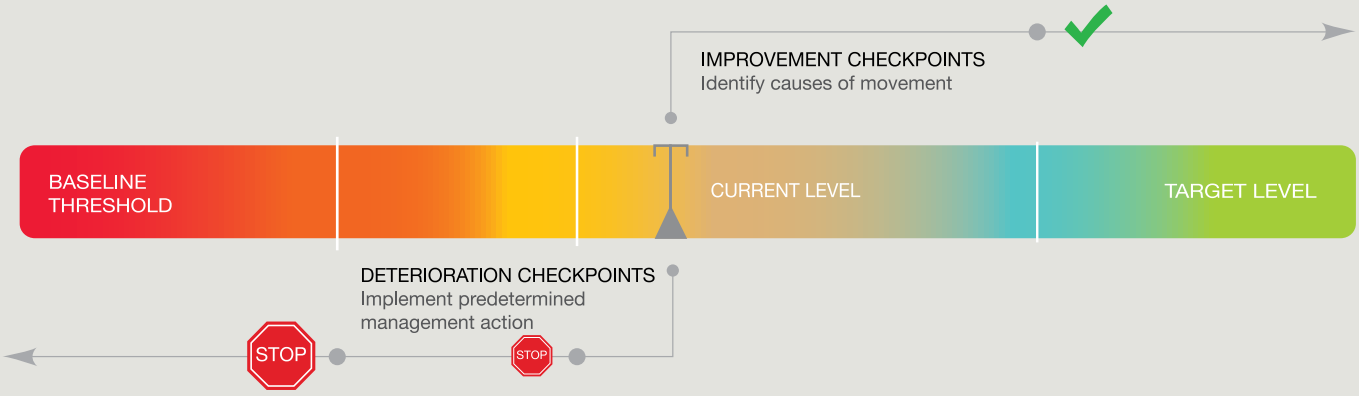

Figure M.1: Strategic Adaptive Management

In closing I would like to acknowledge the contribution made by communities across Victoria to the work of my office. The insights we gained were invaluable, and the efforts of communities and individuals, across sectors, to manage our natural resources are commendable and inspirational.

I would also like to note my appreciation to all the technical experts, academics, representatives of the business sector and local government representatives who contributed their time and expertise to the SoE 2013.

Finally, I would like to acknowledge representatives from across Victorian Government departments and authorities who provided policy background and insights throughout the process. The SoE 2013 benefited greatly from this level of cross-sectoral, multi-disciplinary contribution and commitment.

I present this report to the Victorian Government for action and invite the Victorian community to consider our recommendations.

Professor Kate Auty | PhD, MEnvSc, Dip Int Env Law (UNITAR), BA(Hons)LLB, GAICD

Commissioner for Environmental Sustainability

16 October 2013

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OVERVIEW

Accuse not nature: she hath done her part; do thou but thine.

(Milton, *Paradise Lost*)

The Story of the State of the Environment Report 2013

Ecosystems services and Leadership

Nature gifts us cultural regeneration and recreational possibilities: cerebral and physical delights. Natural systems provide us with clean air, potable water and soils which produce food, fuel and fibre 'through the role of organisms in energy and material cycles': fundamental necessities.[5]

Transformative shifts in our appreciation of the natural world are being encouraged. Internationally, the think tank *The Economics of Ecosystems and Biodiversity* (TEEB) urges us to consider how we 'value' the environment to encourage its protection. On wetlands, for example, TEEB suggests:

'… we should *transform* our approach to wetlands as wetlands *take care* of water [italics added]'.[6]

We need to broaden the general knowledge about the benefits of the environment. For instance, our drinking water – from New York to Melbourne[7] - comes from catchments in forested areas which require our care and consideration as they are vulnerable to fire, flood, drought, climate change[8] and over consumption.

Our responsibility is to value and care for the environment that provides us with these ecosystem services, even as we know that, beyond materiality, the environment has profound intrinsic value. We should all be leaders in this critical endeavour.

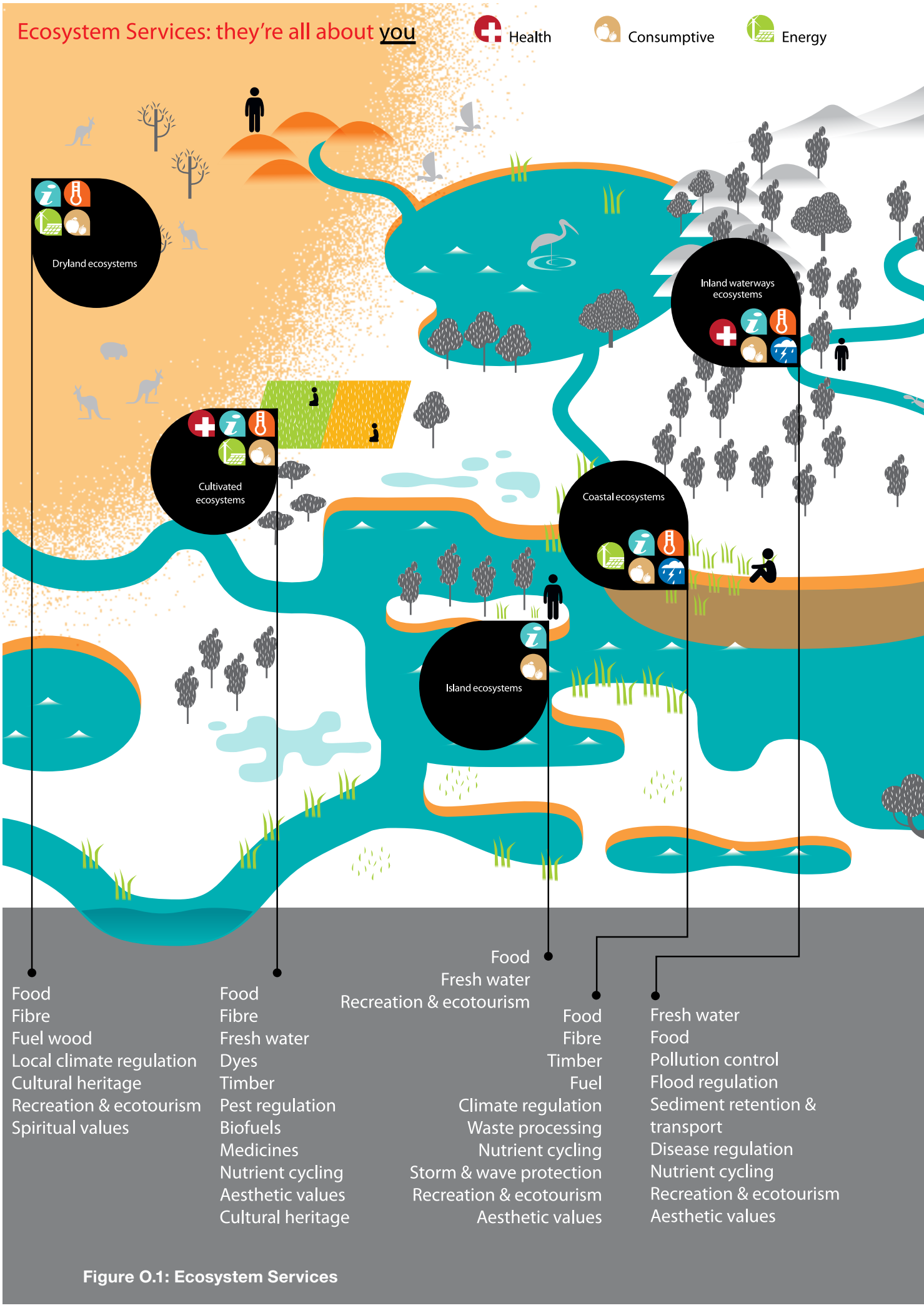
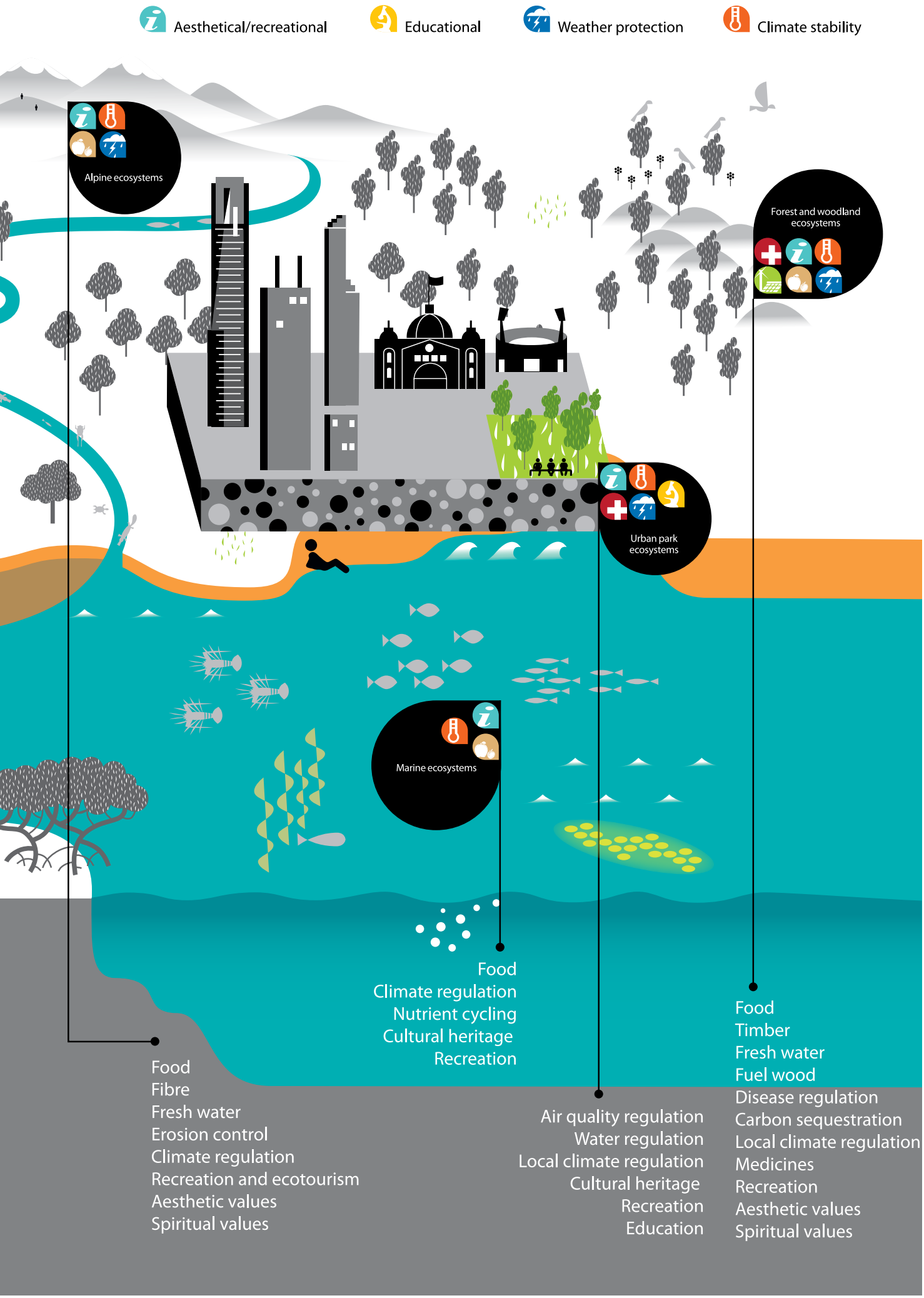


Figure O.1: Ecosystem Services


Aesthetical/recreational
Educational
Weather protection
Climate stability
Alpine ecosystems
Forest and woodland ecosystems
Urban park ecosystems
Marine ecosystems
Food
Climate regulation
Nutrient cycling
Cultural heritage
Recreation
Food
Fibre
Fresh water
Erosion control
Climate regulation
Recreation and ecotourism
Aesthetic values
Spiritual values
Air quality regulation
Water regulation
Local climate regulation
Cultural heritage
Recreation
Education
Food
Timber
Fresh water
Fuel wood
Disease regulation
Carbon sequestration
Local climate regulation
Medicines
Recreation
Aesthetic values
Spiritual values

Reporting on the environment – rationale and sources of data, knowledge and information

Ambitious as we need to be to care for the natural world, one of the significant mechanisms for describing and explaining environmental processes and evaluating and improving our level of care is regular reporting about the *state* of our environment.[9]

To achieve the best science communication and to enable the exploration, explanation and understanding of ***natural capital***, reports concerned with the state of the environment need to reflect data, knowledge and information and blend this ***knowledge capital*** into coherent and useful guides and narratives.

Case studies in real places where the environment is important to people and where information is useful across many sectors provide insights into how we should collect, use and share knowledge. They are also instructive about the meaning and value of ecosystem services.[10] A Goulburn Broken Catchment Management Authority Case Study,[11] studies at Inverloch and Sandy Point[12] and in the North Central CMA area,[13] and the work of Landcare, Greening Australia, Conservation Volunteers and Friends groups across the state (from Brunswick and Boroondara, Bass Coast and Branxholme, to Bruthen, Bendigo and Benalla) illustrate the depth of the potential sources of information and the commitment to caring for the environment. In a range of ways this commitment confirms the environment as the *axis* in our lives and the efforts of these groups exemplify leadership.

Social scientists increasingly contribute to the study of the environment and improve science communication, bringing newer, different, disciplinary perspectives to the reporting process. Their insights and research help us to understand intersections between the natural and built environment,[14] our motivations, and the role of partnerships and less formal collaborations in attaining improved environmental outcomes.[15]

Biophysical scientists scrupulously collect, examine and provide the data upon which state of the environment reports are based. This monitoring and field work may span decades and promote and reflect community partnerships. Their research insights can drive innovative ways of considering the implications of the loss of natural capital and suggest methods for protecting natural capital. They may also involve 'outsiders' in finding and improving solutions. We see this in the collaborative work of the Arthur Rylah Institute and the Yorta Yorta people about the impacts of drought on long neck turtle populations along the Murray (Tungala) River and in the Barmah National Park. Innovative government agency responses can facilitate this work.[16]

Raw data provided by the Australian Bureau of Statistics and the Australian Bureau of Meteorology comprises fundamental building blocks to inform our understanding of the environment and the needed remedial actions.

These 'knowledges', interlinking and sustaining each other, all form the basis of a state of the environment report for our modern, complex, 'wicked problem' times.

Multiple collaborations for biodiversity protection

Emblematic of the issues and the need for multiple voices and a combination of actions, biophysical scientists working alongside the community (sometimes over long periods of time)[17] tell us that two Victorian state emblems are under threat.

Leadbeater's Possum, no more than 40 cm in length, monogamous, related to but 'more primitive' than the sugar glider, has already confounded our belief in its extinction once, after the 1939 Victorian fires.[18] The most recent Victorian fires and forestry practices elevate the level of threat.[19]

Concern was expressed about this possum by the *Land Conservation Council* in 1994,[20] and in 1995 an Action Statement under the *Flora and Fauna Guarantee Act* 1988 (Action Statement no 62)[21] was formulated as was a *Recovery Plan* in 1997.[22] Its status on The IUCN Red List is 'Endangered'.[23]

Leadbeater's possum

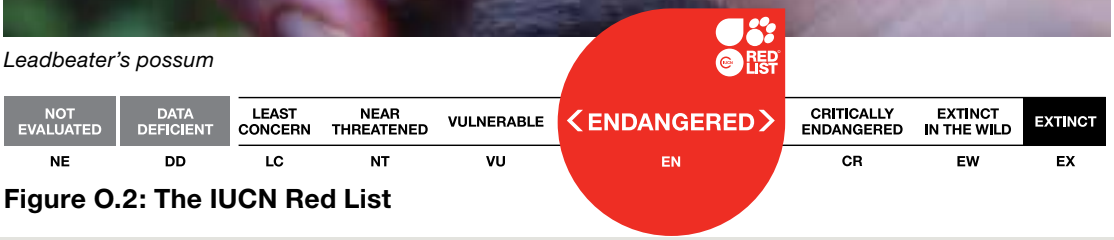


Figure O.2: The IUCN Red List

> **'This species is endemic to Australia, where it has a limited distribution (<3,500 km²) near the western limit of Victoria's eastern highlands from 500-1,500 m asl. There is a small, isolated population that occupies swamp forest at Yellingbo Conservation Nature Reserve at around 80 m (Smith and Harley 2008).'[24]**

Victorian efforts will determine its survival –

> **Leadbeater's Possum is the only member of the genus Gymnobelideus and wild populations are confined to Victoria. This means that the survival of the species in the wild is totally dependent on conservation measures undertaken in Victoria.[25]**

A committee involving Zoos Victoria has been tasked with determining the best means of protecting this possum. Captive breeding programs are a consideration.

Our state bird emblem – the helmeted honeyeater, *Lichenostomus melanops cassidix* – a small bird with a big voice – is variously described as 'threatened' (Schedule 2 FFG Act 1988), 'endangered' (EPCA Act 1999) or 'Critically Endangered' (The IUCN Red List).[26] Three 'small semi-wild populations' continue 'in remnant streamside swamp forest to the east of Melbourne'.[27] Its:

> **'population comprises about 20 breeding pairs and their recent offspring. Fourteen breeding pairs inhabit the Yellingbo Nature Conservation Reserve with a small re-introduced colony of 23 individuals, including 6 breeding pairs, at a site in Bunyip State Park, 30 km south-east of Yellingbo. There are also currently 15 pairs held in captivity at two locations – Healesville Sanctuary, 18 km north of Yellingbo, and Taronga Zoo, Sydney.'[28]**

The *Flora and Fauna Guarantee Act* 1988 Action Statement Number 8 was published in 1992 and 'remains current'.[29] The 2008 National Recovery Plan prepared pursuant to the *Environment Protection and Biodiversity Conservation Act* 1999 is also current.[30]

Monitoring and independent studies commissioned by organisations such as the Port Phillip and Western Port CMA demonstrate the level of ongoing concern and action.[31]

The build up of knowledge and responses has not only, however, been reflected in the work of biophysical scientists. The Victorian Environment Assessment Council in its 2013 Yellingbo investigation[32] had this to say about the input of others –

> **'An enormous volunteer contribution has been dedicated to the preservation of this bird over more than 50 years. The Friends of the Helmeted Honeyeater, for example run an indigenous nursery to provide plants for revegetation and habitat improvement, and the total volunteer contribution has been estimated to be worth at least $80,000 per year'.**

While the Victorian Government has been actively pursuing the conservation of the Helmeted Honeyeater since 1965, Menkhorst suggests that community interest and activity commenced in the early 1900s.[33]

Honeyeater

It is clear we need collaborations and careful scientific and policy interventions to improve environmental outcomes. State of the environment reporting is one of the levers intended to generating solutions. It is also clear that, given the range of protagonists, any report on the environment needs to speak to a wide audience.

The evolving reporting framework

Victorian *State of the Environment Reports* have over time (since SoE 1986) examined the biophysical *state* of the environment and the impacts of humanity on the environment. Environmental reporting has always collected data, described trends and recommended improvements in monitoring and research.

Early environmental reporting adhered to a template of *pressure, state, response* (PSR). As our understanding of complicated, subtle, shifting and intersecting environmental issues has become increasingly sophisticated the reporting template has evolved. Reporters have added *drivers* and

impacts to PSR, producing the Drivers Pressures State Impacts and Responses reporting model. This model has itself been re-evaluated and described as linear, and unresponsive to the inherent interconnections of the social with the environmental and economic in determining the triple bottom line which drives ecologically sustainable development.[34] Reporting which will be real and relevant will avoid a linear representation of the complex interplay of environmental issues.

This 2013 State of the Environment Report responds to the new reporting framework, *Science Policy People*, tabled in the Victorian Parliament in October 2010.[35] The SoE 2013 builds on the work we produced in our climate change risks and vulnerability, private land and biodiversity and water sensitive urban design foundation papers (2012-2013).[36]

Changes are taking place in reporting across the environmental spectrum. The Intergovernmental Panel on Climate Change (IPCC), established by the United Nations Environment Programme and the World Meteorological Organisation in 1988 to provide the world with *a clear scientific view on the state of knowledge of climate change* and its potential environmental and socio-economic impacts, has also evolved its reporting framework.[37] The 5th IPCC Assessment Report Five (AR5) is being released progressively between September 2013 and October 2014.

Shared Socioeconomic reference Pathways (SSPs)

Unlike the emissions scenarios used for AR4, the RCPs do not provide information on underlying socioeconomic or policy conditions that are generating greenhouse gas emissions. For AR5, the research community is developing scenarios that can be used with the RCPs to create integrated assessments of climate change impacts. These scenarios will:

> **'supply quantitative and qualitative narrative descriptions of potential socioeconomic and ecosystem reference … the defining socio-economic conditions of these scenarios have been designated Shared Socioeconomic reference Pathways (SSPs)'[38]**

The SSP development process is expected to allow researchers to develop tailored scenarios that may include alternative socioeconomic driving forces, alternative technology development regimes, alternative realisations of Earth system science research, alternative stabilisation scenarios including traditional 'not exceeding' scenarios, 'overshoot' scenarios, and representations of regionally heterogeneous mitigation policies and measures, as well as local and regional socioeconomic trends and policies.[39]

This process is being led by the IPCC Working Group II, who are developing 5 Shared Socioeconomic reference Pathways (SSPs) that span a range of challenges for mitigation and adaptation (Figure O.1).

Figure O.3: 5 SSPs for which basic narratives were developed in 2011[40]

Variations in socioeconomic models are called narratives (or storylines) by the IPCC and they are expected to form a key plank of on-going investigation into the best way to address climate change. The 'Impacts, Adaptation and Vulnerabilities' part of AR5 is scheduled for release in March 2014 and it will report on new 'shared socioeconomic pathways' (SSPs).

Science communication

As the *framework* developed to guide the SoE 2013, this office joined a science communication community seeking more effective environmental reporting methods to both reflect and guide the work of a wide range of stakeholders.[42] Science communicators have been engaged in critical self-scrutiny in the past few years, striving to describe climate change impacts and adaptation strategies, biodiversity and the role and value of ecosystem services like clean air, fresh water, soils, and the cultural and recreational enjoyment the environment provides.[43]

The task is vast. Our *Foundation Papers* captured specific issues. Those papers emerged out of the scholarship and responded to and involved consultation with the community, scientists, local government and a broad spectrum of organisations and agencies. Public consultation efforts are explained in our report *Many Publics. Participation, Inventiveness and Change.* This report should be read as an adjunct to this larger work, as it outlines:

- the breadth of community commitment and leadership to doing better for the environment
- the public interest in reporting being accessible
- concerns about policy and organisational alignment and integration.

Not only is reporting on the state of the environment a deep and broad research endeavour, the task is also urgent. Organisations such as the World Bank,[44] OECD,[45] the UN,[46] TEEB for Business Coalition,[47] the World Business Council for Sustainable Development,[48] the World Economic Forum with its references to Sustainable Consumption and Creating a Low Carbon Economy,[49] and many authoritative others, have joined the IPCC to record concerns and promote immediate and aggressive remedial action. Increasingly reports and analysis reflect the need to undertake interdisciplinary work to more effectively communicate the deepening crisis we face as a function of climate change and biodiversity loss.[50] Australia's recent submission to the IPCC 2013 review stated the need to survey end users about the utility of reports and suggested those surveyed should include the research community, authors and government, but also observer groups and 'the wider society'.[51]

Reports and reporters are part of this ever expanding field and in this State of the Environment report we endeavour to capture and reflect this unfolding dialogue.

Science, Policy, People

As the triple pillars of environmental, social and economic considerations come into play to generate conditions conducive to ecologically sustainable development[52] environmental reporting is clearly infinitely more than the straight forward recitation of existing or accessible biophysical data.

Environmental reporting is increasing in importance. Its role is to actively encourage decision makers and the community to increase efforts to care for, protect and preserve the environment – not only because it has intrinsic value – but because it is fundamental to our *real* standard of living.

In the Commonwealth's 2011 *State of the Environment Report*[53] this is simply expressed –

Australians cannot afford to see themselves as separate from the environment.

Our overarching reporting objectives are that this SoE 2013 will reflect the ***science***, aid in the development of ***policy***, and speak to ***people*** at a time when our environmental indicators tell us we need to commit to and actively implement change – aggressively and as a matter of urgency.

SoE 2013 – *In summary*

Organising environmental data, knowledge and information[54] to meet statutory objectives[55] and accountabilities[56] and provide a cogent and compelling narrative in a State of the Environment Report is a complex task, compounded by the persistent observation that environmental monitoring is inadequate.[57]

External drivers such as climate change, population growth and economic growth[58] impose even greater complexity on the reporting task. Changes in data, demographics and development and jurisdictional imperatives increase the range of countervailing positions.

In the face of these challenges we have endeavoured to make this report accessible, readable and its information manageable, by producing it in two parts.[59]

Guide to the SoE 2013

The SoE 2013 contains two main parts and an epilogue.

Part A *Trends and Analysis*

Trends and Analysis of key indicators in the following categories to:

- Climate change and air quality[60]
- Biodiversity and land[61]
- Inland waters[62]
- Marine and coastal environments[63]
- Human settlements.

The reported Indicators inform us of the current condition and trends apparent for Victoria's environment, and also provide insight into the effectiveness of environmental management policies and activities.

Part B *Goals and Recommendations*

Goals for protecting and enhancing Victoria's ecosystems and our community's continued prosperity. The goals are:

- Resilient ecosystems
- Sustainable natural resources
- Sustainable energy
- Sustainable communities
- Understanding the environment

Recommendations for action are detailed across the goals in Part B. The recommendations are presented along with attributes for implementation to guide community discussion and the Victorian Government's consideration of the actions proposed.

Epilogue

The SoE 2013 concludes with an ***Epilogue,*** which considers how we might better measure well-being to ensure we capture the environmental, economic and social constituents of an equitable and prosperous society and build community resilience.

Leadership, the key

Compilation of environmental trend data is not just an exercise for the satisfaction of academics, scientists and agency staff. The public have a vital interest in the work. Our consultations across the state and in metropolitan settings illustrated this.*

The research and consultation this office has conducted (2009-2013) underscores the need for:

- Improved **dialogue** between policy makers and the research community
- **Alignment** across agencies and **integration** of policy
- **Leadership** from government.

These issues play out in any discussion of the trends in environmental quality in Part A and they are explicitly discussed in Part B. Figure 3 provides a summary view of the SoE 2013, its recommendations and the inextricable way in which they all work to preserve the ecosystem service and the health and prosperity of our community.

* See our public consultation report *Many Publics. Participation inventiveness and change* found at www.ces.vic.gov.au for an extensive outline of the work the community is engaged in in respect of environmental issues.

Figure O.4: SoE 2013 at a glance

Resilient Communities

INCENTIVES
RECOMMENDATION **4** biolinks development
RECOMMENDATION **11** sustainable farming incentives
RECOMMENDATION **14** material reclamation

TARGETS
RECOMMENDATION **2** ecosystem targets
RECOMMENDATION **6** environmental water targets

REVIEW AND REPORTING
RECOMMENDATION **8** planned burning outcomes
RECOMMENDATION **9** appropriate fire suppression
RECOMMENDATION **12** urban food production
RECOMMENDATION **30** environmental monitoring audit

INFORMATION PROVISION
RECOMMENDATION **16** LCA tools
RECOMMENDATION **20** urban development awareness
RECOMMENDATION **32** environmental data portal
RECOMMENDATION **33** environmental scenarios

METHODOLOGY
RECOMMENDATION **18** Blueprint for a Modern Energy System Plan

RESEARCH
RECOMMENDATION **28** research emissions impacts
RECOMMENDATION **34** benchmarking vulnerability and adaptive capacity

As we completed this SoE 2013, the IPCC commenced its release of AR5. A summary of findings is provided below. The impacts of climate change are a significant environmental concern and require considered, strategic leadership and community engagement.

Rural Women Leading Change, Bendigo Forum with Commissioner 2011

IPCC Working Group I – 5th Assessment Report Release

WORKING GROUP 1 REPORT

The first part of the IPCC 5th Assessment Report (AR5) is the Working Group 1 Report*: Climate Change 2013 The Physical Science Basis*. This was **released on Friday 27th September.**

It is available from: www.climatechange2013.org

WORKING GROUP 1 – KEY FINDINGS[64]

- Human influence has been detected in warming of the atmosphere and the ocean, in changes in the global water cycle, in reductions in snow and ice, in global mean sea level rise, and in changes in some climate extremes. This evidence for human influence has grown since AR4. It is *extremely* likely that human influence has been the dominant cause of the observed warming since the mid-20th century.
- Continued emissions of greenhouse gases will cause further warming and changes in all components of the climate system. Limiting climate change will require substantial and sustained reductions of greenhouse gas emissions.
- **Global surface temperature change for the end of the 21st century is likely to exceed 1.5°C** relative to 1850 to 1900 for all RCP scenarios except RCP2.6. It is likely to exceed 2°C for RCP6.0 and RCP8.5, and more likely than not to exceed 2°C for RCP4.5.
- Cumulative emissions of CO_2 largely determine global mean surface warming by the late 21st century and beyond. **Most aspects of climate change will persist for many centuries even if emissions of CO_2 are stopped**. This represents a substantial multi-century climate change commitment created by past, present and future emissions of CO_2.
- **Limiting the warming caused by anthropogenic CO_2 emissions alone** … **will require cumulative CO_2 emissions from all anthropogenic sources to stay [*below 880 GtC*].** An amount of 531 … GtC, was already emitted by 2011.

All direct quotes except in [square brackets].

ABORIGINAL ACKNOWLEDGEMENT

Canoe Tree, Moodie Swamp

Recognition of Aboriginal people's prior occupation and continuing cultural connection

We start this Victorian State of the Environment Report (2013) with an acknowledgement.

Aboriginal people have occupied, enjoyed and understood Victorian landscapes in cultural and practical ways for millennia. Aboriginal people have practised sustainable environmental management in deeply cultural ways, and this relationship persists, even if altered due to colonial occupation.

The complexity of Aboriginal people's patterns of sustainable occupation may have been divided in ways which looked something like this:*

Figure AA.1: Aboriginal tribal boundaries (Tindale)

We now recognise this connection in other ways, including native title.

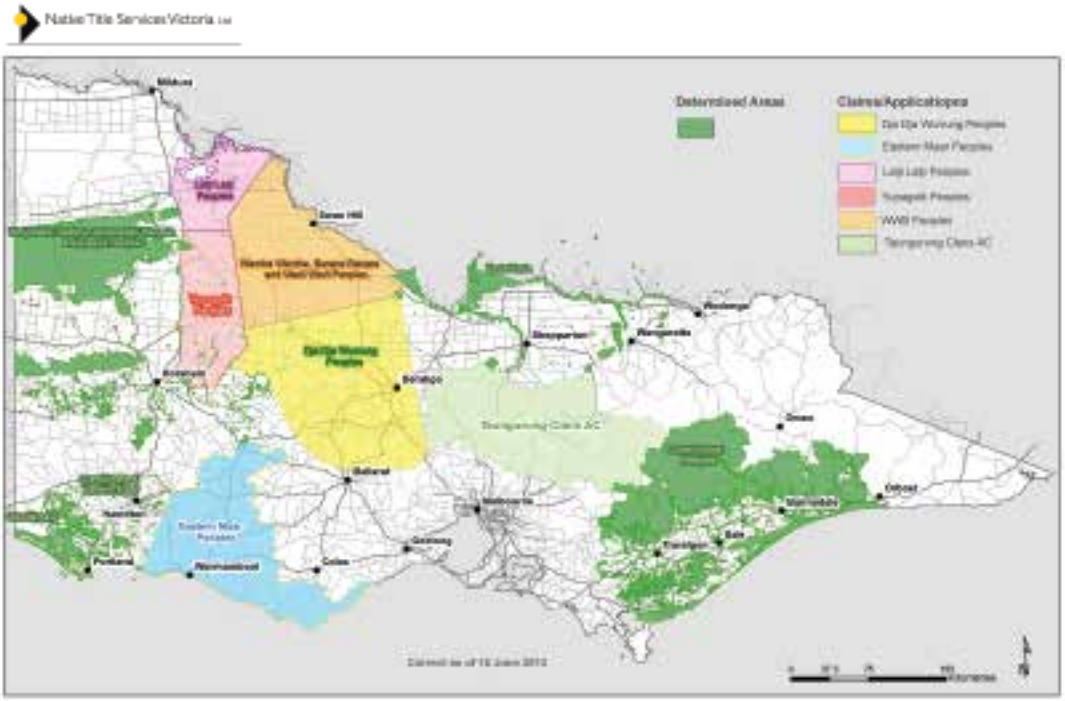


Figure AA.2: Native Title Claims/Determinations and Traditional Owner Settlement Act Applications in Victoria

* N.B. Tindale, 1974, *Aboriginal Tribes of Australia. Their Terrain, Environmental Controls, Distribution, Limits, and Proper Names*, Australian National University, Canberra. South East Australia Map – tribal boundaries. It should be noted that many Aboriginal people contest these boundaries and they cannot be used with confidence.

Aboriginal people shared their deep appreciation of the country. They told early Europeans about good country, water resources and biodiversity, medicinal plants, and, more prosaically, fishing places, river crossings and sheltering spots.

Aboriginal and western knowledge continue to meet and develop insights, together. Archaeologists,* drawing on long held narratives, now assure us that the western biophysical data we have collected generations later reflects Aboriginal people's knowledge, observations and oral traditions about matters as significant as sea level rise and retreat in Port Phillip Bay.

Among their considerable achievements Aboriginal people have conducted highly complex aquaculture.

Joseph Saunders demonstrates a traditional eel trap, Lake Condah

* Ian McNiven, 2011, *Aboriginal people's environmental understandings: Victoria*, paper prepared for the CfES see www.ces.vic.gov.au

Further, in contemporary contexts, Aboriginal women and men continue to concern themselves with old and new challenges: the age old issue of floods and, now, climate change.

Auntie Rochelle Patten, Yorta Yorta Elder, Barmah Forest National Park