

REPORT FOR THE
**CLIMATE CHANGE IMPACTS AND
ADAPTATION IN GIPPSLAND PROJECT**
A Regional Pilot Project
Initiating Gippsland's Response to Climate Change

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THE PATHFINDER NETWORK

FOR THE WEST GIPPSLAND CATCHMENT MANAGEMENT
AUTHORITY AND ITS PROJECT PARTNERS

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1. EXECUTIVE SUMMARY

"Problems cannot be solved by the same level of thinking that created them."

Albert Einstein

The impact of climate change on the activities, assets and communities (AACs) of Gippsland is pervasive, affecting almost every area of endeavour. It ranges from:

- the universal concerns about the availability (and use) of water for agriculture, industry, urban users and wildlife – both flora and fauna
 - the increased likelihood of days of extreme fire danger and the fires which may result
 - the increased risk of flooding, whether from heavy rain in severe storms, from storm surges and from higher sea levels or a combination of all of these
 - and the impact of warmer winters (lower snowfalls) on both wildlife and the skiing industry
- to more subtle effects, such as:
- the impact of fewer (or no) days of frost on the setting of fruit
 - the combined effects of high temperatures, less water, lower quality water and higher electricity demand (from a wider area) on electricity production
 - and the indirect impact on Gippsland of climate change in Melbourne, to which so much of Gippsland's water, power, oil, gas, agricultural and forestry produce is "exported" from the region.

Even if there is disagreement about the causes of climate change, there is almost no dissent about the actual changes already observed and their trend. The climate is changing and adapting to cope with these changes is prudent, if not a necessity.

The process of community engagement in this project consisted of many formal and informal conversations and three main (and well attended) events, to which as many as possible of Gippsland's leaders and technical specialists were invited:

1. A workshop (for leaders and technical specialists) to inform participants of the latest scientific work on climate changes, its causes, projected changes and likely major impacts – biophysical and socio-economic.
2. A workshop (for technical specialists) to assess systematically (using the CSIRO Climate Impact Matrix) the potential impacts of the main climate variables on each of the AACs in the region, to identify critical gaps in knowledge and to develop a regional picture of the main impacts and concerns
3. A meeting (for leaders and technical specialists) to absorb the overall picture of impacts on the region, identify the priorities for action, whether they be filling in gaps in knowledge, communicating the issues of climate change and its impacts, organising to adapt or taking adaptive action.

This work was well supported by the CSIRO, who presented their knowledge in the workshops, co-facilitated some of the work and prepared a detailed review of the available information on climate change and impacts in Gippsland, which was made available to participants. (Appendix 1)

The recommendations of this report fall into two main categories: *firstly* the specific proposals for research, studies, planning and action to adapt; and *secondly* those proposals concerned with enrolling and organising people to orchestrate a regional campaign of climate adaptation.

Some of the key recommendations are listed below:

Specific proposals:

- To ensure that the findings of this report are fed into planning processes across the region – for example, the Gippsland Sustainable Water Strategy
- To review the planning and zoning codes for Gippsland, to ensure that they reflect projected climate changes – particularly flooding and fire impacts
- To conduct a region-wide study on the management, control and emergency response to fire and its aftermath (impacts on water quality, water yield, wildlife, etc)
- To assess the ability of Gippsland to supply clean water in sufficient quantity to the power generation industry in times of prolonged drought coupled with hot weather

- To identify the climate induced critical thresholds of ecological vegetation classes (EVCs) and assess threats to these.
- To continue to improve accuracy in climate change forecasting
- To widen consultation in Agriculture and Fisheries to understand and fulfil their information needs
- To undertake a study to understand the interaction between plantation forests, carbon sinks/carbon credits, water yields and climate change impacts.

Enrolling and Organising:

- To fund and establish a regional coordinating function for Climate Change
- To establish a Regional Climate Change Forum in which participants have the conversations required to generate specific projects
- To develop a communications strategy to Gippsland's communities for the issues of climate change and so to develop the "authorising environment" for adaptation
- To develop a policy framework and authorising environment for control burning
- To develop a "Who's Who", regional diary and an organisational map for Gippsland
- To develop an agreed suite of principles, tools and models for decision making in climate change adaptation in Gippsland
- To establish a regional "operations/campaign room" for climate change adaptation in Gippsland and use this to:
 - map all adaptation activities, current and planned and
 - display a high level strategy for the region
- To continue to develop expertise in the use of planning tools in the region – e.g. scenario planning.
- To share the learning and experience with other regions and "compare notes".
- To continue to develop a resource/expertise for funding climate change adaptation projects
- To identify clearly the role of regional universities and research institutions in regional applied research so that they can be assessed and funded appropriately

The challenge of adapting effectively to climate change and realising the many consequent opportunities for Gippsland occurs on many different levels:

- The straightforward practical issues of solving technical problems
- The need to develop rapidly an understanding in the community of the subtle, but important, impacts which climate change will have on lives, livelihoods and the environment, in which they live, and the compelling requirement for action
- The need to develop community *and* consensus *and* cooperative action to balance many apparently opposing demands for resources, both inside Gippsland and beyond
- The need to develop coherent policies, principles, strategies and plans, within the logic of a Gippsland defined by its catchment boundaries, both for implementing and coordinating adaptations and for regional representation of Gippsland's needs and capabilities to other regions and to the State and Federal Governments

Gippsland is a leader in this endeavour and its leadership carries the prize of being able to contribute not only to its own communities, but also to others in Australia and beyond. Ultimately successful adaptation will depend on an effective response to climate change all around the world.

2. INTRODUCTION

This report is about **building the foundations for Gippsland’s response to the subtle but important changes occurring in its climate** and about all the research, communication, planning, and adaptation, which will follow. In turn the report’s foundation is built on *your* answers to some questions:

- What are the opportunities for us to adapt creatively to the inevitable changes in our climate?
- What can we do to adapt both as individuals and as a community?
- What sort of region and world will our children and grandchildren inherit from us, if we do this well?

Climate Change in Gippsland starts with simple effects¹: changes in temperature; in rainfall; in the frequency of severe weather (storms); and changes in sea level². These changes have an impact on almost every activity, asset and community (AAC)³ in Gippsland. Many of the potential impacts are already visible when Gippsland experiences the extremes of its current climate variability. Excepting Antarctica, Australia is the driest continent and also has the most variable climate, of the continents. There is an advantage in this variability: it allows us to glimpse what may become the norm in future, when we experience current extremes. There is also a disadvantage: that the change is subtle and slow to the human eye and the trends hidden beneath Australia’s exaggerated climate variability. Gippsland is also cooler and wetter than most other parts of mainland Australia and so can benefit from the earlier experience of other regions as warmer drier weather moves southward.

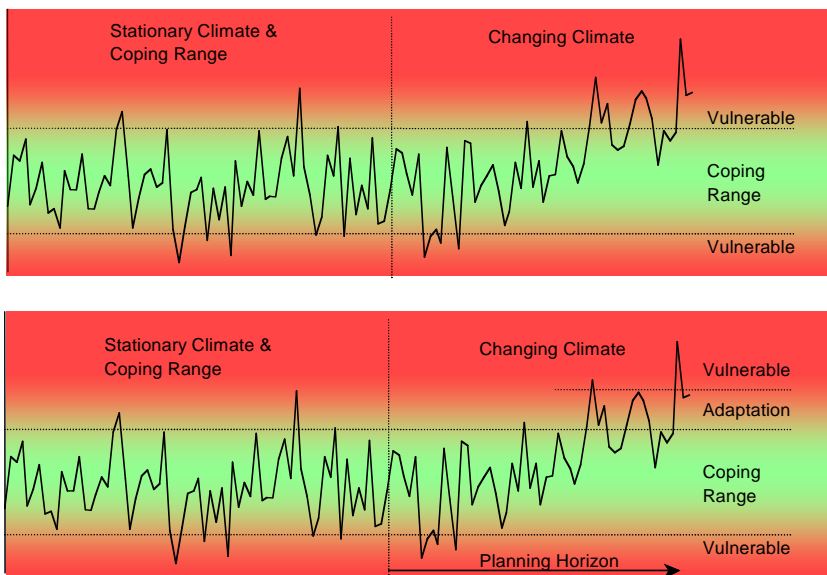


Figure 1. COPING AND ADAPTING TO CLIMATE CHANGE (Source CSIRO)

The ultimate aim of this project is to provide a platform for Gippslanders to adapt to and cope with the impacts of climate change.

The upper chart in Figure 1 shows a generic climate variable changing over time (e.g. temperature or rainfall). As the measure of climate increases, AAC’s, which were

previously coping, may become increasingly stressed as the climate moves out of the “coping range” and into the “vulnerable range”. At some stage, extremes of climate may push an AAC beyond a critical threshold, when it no longer survives/is viable. The pygmy possum is potentially such an example in Gippsland⁴.

¹ These climate changes, their impacts on Gippsland and gaps in our knowledge about the impacts are detailed in the CSIRO report of Phase B of the project, written by Dr. Cassandra Brooke, which forms an integral part of this report. It can be found in Appendix 1.

² The Gippsland Coastal Board has simultaneously commissioned a detailed study by the CSIRO on coastal impacts, which is to be the subject of a separate report - “Sea Level Change Implications For The Gippsland Coast”.

³ Activities include all our working and recreational activities. Assets include all things physical in Gippsland - the land, water, the sea off the coast of Gippsland, the flora and fauna, man-made assets, and all its other natural resources, above and below ground. Communities include all the people of Gippsland and their relationships with communities outside Gippsland.

⁴ <http://www.deh.gov.au/biodiversity/publications/nbccap/background.html>

In the lower chart, “adaptation” changes the way we do things (in our AACs) so that we: increase the range of climate in which we can cope; reduce stress on the AACs; and avoid crossing critical thresholds, beyond which viability or survival of the AAC is threatened. This project is **about adaptation to the changing climate not about mitigation**⁵ of climate change. This is important, because, even if we cause no further increases in the anthropogenic drivers of climate change, many thresholds will be crossed before the climate stabilises.⁶

3. THE PROJECT PROCESS

METHOD: The project method was partly defined in the project brief⁷ and further developed by the Steering Committee, The Pathfinder Network and the CSIRO. Two of the frameworks used were that of Community Engagement (Appendix 2) and the MERGe process (Monitoring, Evaluating and Reporting Framework for Gippsland – Appendix 3). A key phrase, which guided the process, was “Informed Communities”.

As such the process developed was:

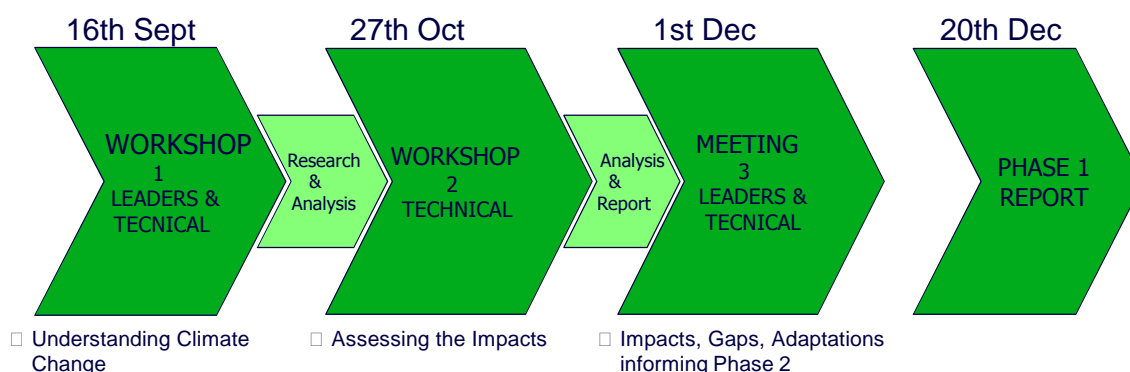


Figure 2. THE PROJECT PROCESS

WORKSHOP 1: The first workshop was designed to provide up to date and authoritative information about: global climate change and its impacts⁸; climate change and impacts in Australia and then specifically in Gippsland⁹, expanding on work already commissioned by the DSE from the CSIRO¹⁰; and finally insights into the larger social and economic impacts of climate change and ways to understand different futures¹¹. Both leaders and technical specialists were invited to the workshop and, having heard the presentations, were asked to express their main concerns about climate change and its impacts as a first inquiry into stakeholders’ needs and information requirements. The data from this inquiry collected on “impact cards¹²” was collated and fed into subsequent steps of the process (Workshop 2 and the CSIRO report).

Finally the participants were introduced to the CSIRO Climate Impacts Matrix (see Tools below) as a preview of the process to be used to cover the wide range of AACs in Gippsland and the effect of climate on these. While use of the matrix in such a large group (85-90 people) is cumbersome and

⁵ Mitigation of Climate Change is about moderating the factors which cause climate change, so that the variable (e.g. temperature or rainfall) no longer changes and so does not take AACs outside their coping ranges.

⁶ Climate Change: An Australian Guide to the Science and Potential Impacts Edited by Barrie Pittock.

<http://www.greenhouse.gov.au/science/guide/index.html>

⁷ Available from Jo Caminiti, WGCMA

⁸ Dr. Barrie Pittock, previously of the CSIRO, Presentation -

<http://www.greenhouse.vic.gov.au/impacts/Global%20Perspective%20Pittock.pdf>

⁹ Kevin Hennessy and Dr. Cassandra Brooke,

<http://www.greenhouse.vic.gov.au/impacts/Aus%20climate%20change%20Hennessy.pdf>

<http://www.greenhouse.vic.gov.au/impacts/Gippsland%20climate%20change%20Brooke.pdf>

¹⁰ http://www.greenhouse.vic.gov.au/impacts/media/East_Gippsland.pdf

http://www.greenhouse.vic.gov.au/impacts/media/West_Gippsland.pdf

¹¹ Mike Waller, <http://www.greenhouse.vic.gov.au/impacts/Economic%20and%20Social%20Impacts%20Waller.pdf>

¹² Appendix 4 and accompanying compilation of responses, available electronically.

not recommended for practical use of this tool, it did serve to introduce both leaders and technical specialists to the process and allowed broad endorsement of the next step in the project.

During the workshop, participants were asked to observe the distinction between those who live and or work in the region and their ownership of the project and those from outside the region, who were there as guests and contributors to Gippsland's climate change project.

WORKSHOP 2: This workshop was designed to gather a detailed and systematic picture of the specific impacts of different climate variables on identified AACs in Gippsland using the CSIRO Climate Impacts Matrix¹³. Participants could choose to contribute to the matrix analysis discussion of any one of three sectors groups run concurrently in the morning and/or a further three in the afternoon:

- AM
 - **WATER, RIVERS AND COASTS** (urban water supply/demand, industrial, irrigation, waste management, flood management)
 - **AGRICULTURE AND FISHERIES** (dairy, horticulture, viticulture, grazing, apiaries)
 - **BIODIVERSITY** (native forests, aquatic, pests and diseases, habitat)
 -
- PM
 - **INDUSTRY AND COMMERCE** (Manufacturing, Service businesses, Tourism, etc)
 - **FORESTS AND FIRE MANAGEMENT**
 - **COMMUNITIES, INFRASTRUCTURE AND SERVICES** (health, emergency services, indigenous people, settlements, transport, communication, buildings, planning)

Each group was asked to work through the matrix, element by element, assessing the potential strength of the climate impacts on the AACs. The results of this exercise are described below. When the matrix was completed, participants were asked to respond to specific questions to draw together a regional overview of the results of this analysis.¹⁴

This detailed work is best done in relatively small groups, not more than 15 people, and depends on technical specialists, with considerable depth of knowledge and experience, to be present for each AAC. A total of about 60 individuals attended these sessions, with about 15 people attending two sessions. Numbers in the groups varied between 5 for Industry and Commerce and 18 for Water, Rivers and Coasts.

MEETING 3: The meeting had several design criteria. It was designed to: familiarise the participants with the large array of information collated from the previous two workshops; give them time to assimilate this both individually and in conversation (in small and larger groups); assess the importance and priorities of various impacts, gaps in knowledge and potential adaptations; and finally develop statements of their main priorities, in their working roles. Detailed notes of this process are contained in Meeting 3 Notes¹⁵ and many of the "learnings", priorities and suggestions for action (to fill gaps in knowledge and for adaptation in this report) are drawn from this meeting. About 45 people attended the meeting.

LEARNINGS AND RECOMMENDATIONS FROM THE PROCESS:

- One of the essentials in such a process is to be able to invite a broad range of leaders and representatives of business, government and community to participate. Because Gippsland as a whole has not been organised as a region before, no such complete list of people is available, though there are many lists of parts of the region.

13 This tool was first used in a study in the Hunter Valley in 1999, (*Climate change impacts in the Hunter Valley, Stakeholder workshop synthesis, Roger N. Jones and Kevin J. Hennessy, CSIRO Atmospheric Research*), though it was not followed through with a further phase of adaptation.

14 The output of this workshop accompanies this report as Appendix 5 and is available electronically

15 The report of this meeting accompanies this report as Appendix 6 and is available electronically

- ***Who's Who: A recommendation for Gippsland, and any other region undertaking such a project, is to compile such a list of people and of organizations – business, government, voluntary, NGOs, community etc - so that they can be invited to participate in the process.***
 - ***It is also recommended that an "organisational map" of the region be developed with an understanding of the links between organisations and the way their different planning processes relate to one another.***
- In such a project, enrolling key people (leaders, strategists and technical specialists) into the process is where much valuable effort can be made. Developing a regional consensus and momentum depends on a critical number of people hearing the message and having time to discuss it. For all sorts of reasons not everyone is enrolled immediately (if they were, it would suggest that an emergency is already upon us). Leaders already committed to the process are best placed to enrol leaders not yet involved.

As was noted by one of the speakers in Workshop 1 the time given to the project set a "punishing schedule". With directed organizations, where the CEO can require participation in a particular project, much more rapid progress is possible. With a project like this, with voluntary participation, much longer timescales are to be expected and much more attention to enrolling people and organizations is required.

- Attendance of the workshops was in general very good – exceeding expectations. It could be further improved by:
 - enrolling those not yet engaged
 - addressing the issue of "overload" of such workshops
 - addressing the issue of clashes with other meetings, requiring attendance by many of the same people.

It is recommended that a regional diary of such meetings/workshops be kept for all to access, so that meetings can be planned to fit with the availability of relevant people.

The absence of representatives of various AACs, for the above reasons, meant that coverage of all the impacts and gaps in knowledge for the region was not comprehensive – a natural consequence of a process of community engagement. However, this did not prevent many of the critical issues from being revealed.

- In WORKSHOP 1 it was very helpful to have such authoritative speakers. ***It is recommended that Gippsland continue to seek out the leading thinkers in each aspect of adapting to climate change.***
- Making time was a limiting factor throughout the project. While this affected the depth and thoroughness with which participants were able to examine climate changes, impacts, gaps in knowledge and potential adaptations, for such a "pilot project" this may not have been a disadvantage, giving participants enough of an understanding of the issues to be well placed to identify next steps.
- While about 15 people attended all three events (WS1, WS2 and M3) most people attended only one or two of the events and there were new people at each one. It was an important part of the design to include newcomers and bring them up to date on the work done so far, either with written material, prior to the event, such as the Interim Report prepared by Dr. Cassandra Brooke, or as part of the process of the event. ***It is recommended that the design of future community engagement processes reflect this inclusive approach*** (see "Operations Room" below).

factors/pervasive impacts

Figure 3 is the matrix generated for agriculture and fisheries in Workshop 2. The notes, which accompany this, are available in the proceedings of the workshop¹⁷.

It is important to note that there was some confusion in using the matrix, when choosing how to assess the impact of a climate variable. The choice was between using the specific predicted values of a climate variable to assess the impact on each AAC *or* assessing, in general terms, if a climate variable, whatever its size/direction of change, has an important impact on an AAC. The latter choice was made, though the general predictions of drier, warmer, stormier weather and higher sea levels were always in mind. The reasons for using a general approach at first pass are:

- not to miss impacts about which we are not yet sure of the size/direction of change
- not to miss impacts where we may have got the direction wrong
- to cover the situation where the direction is one way in one part of the region and another way in a different part of the region

Such a general approach is useful at first, but, for planning adaptation, it needs to be followed with an assessment based on specific projections of the variable.

MODELS: The above climate impact matrix (Figure 3) was the main tool used to organise understanding and thinking about climate change. A number of other simple, well known, but nonetheless powerful distinctions also proved valuable.

In assessing priorities the table shown in Figure 4 was helpful in identifying immediate priorities. Some important issues, while not appearing urgent, do in fact require urgent action, because of the long lead times required to adapt. These lead times may be long not only for physical adaptations, for example growing trees, but also long when large scale changes in community perception and behaviour are required, not least the understanding that climate change and its impacts are likely to affect everyone. This is particularly important in the clear call for creating a receptive "authorising environment" for climate change adaptation, described below.

	NOT URGENT	URGENT
IMPORTANT	STRATEGY	DO NOW
NOT IMPORTANT	WASTING RESOURCES	SPINNING WHEELS

Figure 4. Prioritising

Another model useful in considering the authorising environment is shown in Figure 5. This table considers whether a community is enrolled in/aware of the issue and actively responding to it (vertical axis) and the nature of its response/adaptation (on the horizontal axis). The quadrants are:

- Not Engaged/Individual – like the often quoted

	INDIVIDUAL	COLLECTIVE
ENGAGED	DEVIL TAKE THE HINDMOST	COMMUNITY, AWARE AND PURPOSEFUL
NOT ENGAGED	FROG GRADUALLY HEATED UP IN WATER	FROGS ALL HOLDING HANDS GRADUALLY HEATED UP IN WATER

Figure 5. Responding

¹⁷ Appendix 5, available electronically

experiment of putting a frog in a pan of water and gradually raising the temperature. The change is slow and subtle and the frog cooks without leaping out of the pan.

- Not Engaged/Collective – here the frogs are all together, but still not aware of the slow and subtle threat to their existence and they too perish.
- Engaged/Individual – Here people, who are aware of the impending changes, act individually to adapt, with their own resources, and leave others to do the same. Those, who are unaware or unable to adapt, perish, economically or perhaps literally. (e.g. in New Orleans)
- Engaged/Collective – in this case there is a concerted effort to raise awareness right across the community, creating the “authorising environment”, and the whole community is involved and included in planning and adapting to climate change. Often this sort of behaviour is seen in response to emergencies, such as the Indian Ocean Tsunami in 2004.

Many of the most important debates in this process are likely to be around agreeing (or not) to act cooperatively in the face of issues, which will threaten livelihoods, businesses, communities and homes. These discussions will not only be between people and communities within Gippsland, but between Gippsland and the communities/regions with which it works – particularly Melbourne.

Because the change in climate is slow and subtle (in its onset and often in its impact e.g. in the extinction of species) and is also difficult to communicate, **it is recommended that much effort be devoted to developing a communication strategy that makes the changes real to Gippslanders and explains clearly the potential threats, while showing the opportunities for successful adaptation** (see Figure 6 below).

It is also recommended that the whole climate change initiative in Gippsland develop an agreed suite of principles, tools and models, which are available for use in decision making.

A useful framework for designing the process of adaptation to change, by identifying the barriers to change and the facilitators of change, is shown in Figure 6:

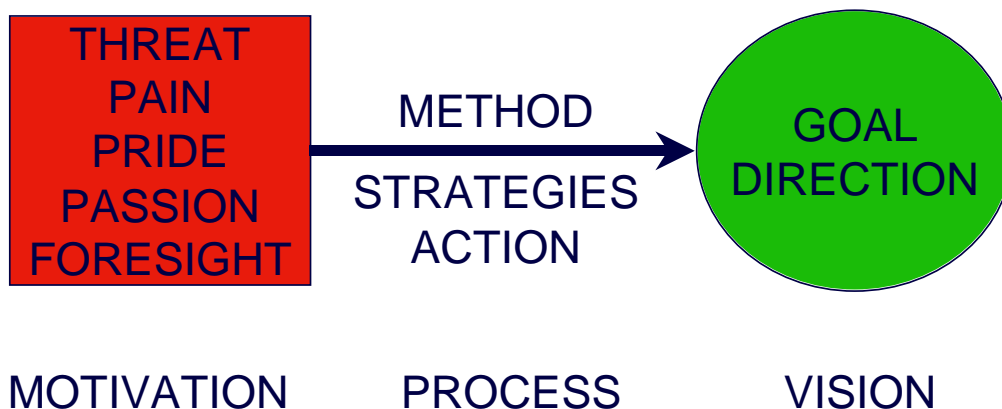


Figure 6. FRAMEWORK FOR ADAPTATION

All three factors (motivation, process, vision) shown in Figure 6, must be present for *purposeful* change to occur. At the current stage in the process of adapting to climate change some discomfort is felt, but there is no general understanding in the wider Gippsland community of the threats or even consensus that they are real. We are in the early stages of developing a process of adaptation and it is unlikely to be clear for some time what a vision of the future, acceptable to the Gippsland community, will look like.

For this reason, the many suggestions about developing the “authorising environment” support purposeful action:

- Developing a broad campaign of communication and discussion to develop a consensus that the impacts are real
- Creating a forum where the conversation about climate change is actively promoted and from which action is generated
- Creating an accessible repository of information about the climate, the impacts, adaptations and strategies for implementing them.
- Using early projects, which make sense, even in the current climatic conditions, to develop capability, confidence and then consensus around the need for further action.
- Using small projects, which develop our sense of possible futures, to help define and support a broader vision.

5. CHANGES, IMPACTS, GAPS, AND RECOMMENDATIONS

CLIMATE CHANGES: The climate changes as summarised in the DSE brochures for East and West Gippsland¹⁸ are:

SUMMARY OF PROJECTED CLIMATE CHANGES FOR EAST GIPPSLAND

Temperature

- annual warming of 0.3 to 1.6°C by 2030 and 0.8 to 5.0°C by 2070
- day time maximum temperatures and night time minimum temperatures will warm at a similar rate
- warming will be similar throughout the seasons
- a 10 to 40% increase in the number of hot summer days (over 35°C) by 2030 and a 30 to 400% increase by 2070
- a substantial reduction in the number of frost days by 2030 and a possible loss of all frost days by 2070 in coastal areas

Precipitation

- annual precipitation change uncertain (annual changes of +10 to -10% by 2030 and +25 to -25% by 2070)
- extreme heavy rainfall events may become more intense

Drought

- dry conditions that currently occur on average one in every three years may halve in frequency or as much as double in frequency by 2070, depending on average rainfall changes
- when droughts do occur, they are likely to be more intense due to hotter conditions

Water resources and fire

- the total alpine area with an average of at least one day of snow cover per year is expected to decrease by 10 to 39% by 2020, and 22 to 85% by 2050. Areas with at least 30 days of snow cover are expected to decrease by 14 to 54% by 2020, and 30 to 93% by 2050. Areas with at least 60 days of snow cover are expected to decrease by 18 to 60% by 2020 and 38 to 96% by 2050
- increased evaporation rates
- drier soil likely, even if precipitation increases
- decreased average run-off in streams
- hotter, drier conditions likely to increase bushfire risk

Winds, storms and sea level rise

- winds are likely to intensify in coastal regions of Victoria, particularly in winter as a result of more intense low pressure systems. Low pressure systems off the east coast of Australia may become more frequent
- sea level rise of 7 to 55cm by 2100 (0.8 to 8.0cm per decade)

¹⁸ http://www.greenhouse.vic.gov.au/impacts/media/East_Gippsland.pdf
http://www.greenhouse.vic.gov.au/impacts/media/West_Gippsland.pdf

SUMMARY OF PROJECTED CLIMATE CHANGES FOR THE WEST GIPPSLAND

Temperature

- annual warming of 0.2 to 1.4°C by 2030 and 0.7 to 4.3°C by 2070
- day time maximum temperatures and night time minimum temperatures will rise at a similar rate
- warming will be similar throughout the seasons
- a 10 to 100% increase in the number of hot summer days (over 35°C) by 2030 and a 30 to 400% increase by 2070
- a substantial reduction in the number of frost days by 2030 and a 40 to 100% decrease in frost days by 2070.

Precipitation

- annual precipitation decreases likely (+3 to -10% by 2030 and +10 to -25% by 2070)
- extreme heavy rainfall events may become more intense

Drought

- droughts are likely to become more frequent and longer, particularly in winter-spring
- dry conditions that currently occur on average one in every five winter-springs may increase to up to one in three years by 2030
- due to hotter conditions, droughts are also likely to become more intense

Water resources and fire

- the total alpine area with an average of at least one day of snow cover per year is expected to decrease by 10 to 39% by 2020, and 22 to 85% by 2050. Areas with at least 30 days of snow cover are expected to decrease by 14 to 54% by 2020, and 30 to 93% by 2050. Areas with at least 60 days of snow cover are expected to decrease by 18 to 60% by 2020 and 38 to 96% by 2050
- increased evaporation rates
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- hotter, drier conditions likely to increase bushfire risk
- decreased average run-off in streams

Winds, storms and sea level rise

- winds are likely to intensify in coastal regions of Victoria, particularly in winter as a result of more intense low pressure systems. Low pressure systems off the east coast of Australia may become more frequent
- sea level rise of 7 to 55cm by 2070 (0.8 to 8.0cm per decade)

"A warming of 1.5°C and a 15% decrease in annual rainfall (a moderate scenario for 2070) would make the climate of Wonthaggi more like the current climate of the Adelaide Hills in South Australia."¹⁹

These summaries give a high level view of the changes and it is strongly recommended that readers read the full CSIRO report, which also has some refinements in these projections and more detail.

IMPACTS, GAPS AND RECOMMENDATIONS : While the initial intention of this pilot project was to cover all aspects of climate change in Gippsland, given its resourcing and the community engagement process, which was dependent on voluntary participation, it has covered most areas at a relatively high level and has not covered some areas at all. This is a natural consequence of the project design. However, a number of key paths have been identified by participants.

The details of the impacts are contained in the CSIRO report²⁰. In each area gaps in knowledge were identified and these were reported as part of Meeting 3²¹. Some of the most important are listed below and lead to particular recommendations.

¹⁹ http://www.greenhouse.vic.gov.au/impacts/media/West_Gippsland.pdf

²⁰ Accompanying Report: Climate Change and Impacts in Gippsland, Dr. Cassandra Brooke, Nov 2005.

²¹ Appendix 6

AGRICULTURE AND FISHERIES: The vast range of activities in this sector, types of land, soil, water sources, weather, etc. mean that broad generalisations are not easily made. Water is, however, a concern in almost all areas and should be addressed in the Sustainable Water Strategy for Gippsland.

One of the main concerns is how to get an accurate picture of the range of expected climate changes and much emphasis was placed on filling gaps in our ability to predict this. The CSIRO is actively engaged in refining its models, both to produce more accurate predictions and also to provide probabilities for variables, such as rainfall, stream-flow and runoff falling below specific percentages of the average²². The models are being developed to produce typical time series of weather events and to predict extremes, variability and their probability.

Because of the range of different activities in the sector, it is likely that each activity will need to be assessed locally (perhaps down to the scale of the individual paddock). Centrally developed adaptations are unlikely to be effective in this situation and ***it is recommended that primary producers be consulted on the type of "database" they would need in order to be able to make informed decisions about adaptation.***

A suggestion was also made to develop expert teams to go out to individual producers and advise them of climate, changes, potential impacts and possible adaptations.

INDUSTRY AND COMMERCE: One impact in this sector, which came out in discussion as being both urgent and important, and may require urgent action, is associated with the interaction between water and power generation.

If there is a prolonged period of drought in South Eastern Australia in conjunction with a heat wave, then the following factors all feed back and may tip power production capabilities beyond a threshold:

- In hot weather the thermodynamic efficiency of the power stations is reduced, so that their peak capacity is reduced
- In hot weather peak demand is high because of the increasing use of air-conditioning
- In times of drought/hot weather, water demand is higher and availability lower
- In times of drought/low water availability, water quality is worse and causes operational problems in the power stations
- In hot weather there is greater risk of fire in the brown coal mines themselves and consequent higher demand for water to mitigate this risk
- The interconnection of the grid between the southeastern states, means that the demand on Gippsland's brown coal power stations can be even greater.

All these factors could together conspire to reduce capacity/overload the system and threaten power supplies, both in Gippsland and beyond. Initial inquiries suggest that there is no study or contingency/disaster plan yet covering these circumstances, and it is recommended that this gap be filled. For Gippsland the questions concern the supply of sufficient high quality water to the power stations and the risk of power shortages within Gippsland.

If these circumstances were to be exacerbated by a fire in the catchments, which supply the power stations, then the problems, particularly of water availability and quality will be magnified.

Another concern expressed in several sectors including Industry and Commerce was the allocation of water supplies between all its users in times of low availability. It is assumed that the Sustainable Water Strategy for Gippsland will be addressing this issue.

²² Average is used here as a general term. Whether means or medians are chosen will depend on the precise study.

FORESTS AND FIRE MANAGEMENT: During the course of the project there was an often repeated concern about the threat of major fires and their impacts and the need to have a comprehensive regional study and emergency plans within an agreed policy regime, both for fire fighting and for the use of fire in forest management (control burns etc.). A highly politicised background to the issue was also acknowledged with "deep seated sociological issues related to the 'natural' state of the environment" and with rewards for putting fire out, but barriers to prescribed burns.

It was recommended to develop the authorising environment for a control burn strategy and, in particular, to develop an acceptance that control burns carry some risks - that not all will go according to plan - but that they are nonetheless important in reducing the catastrophic impacts of major fires.

While fire is a concern that is present even without climate change, the added concern, frequently repeated, was the increased threat of a fire in the major catchments with their current high fuel loads, built up since the last major fires in 1939. The concerns are about the immediate impact on, for example, forests, wildlife, water quality and then subsequent impact on water yield in the slowly regenerating forest – slow, because Mountain Ash does not survive hot fires and its forests take much longer to regenerate than species which can survive fires. Increasing temperature and decreasing rainfall make such fires more likely.

There was a strong recommendation, from participants in the project that such a study and the resultant planning be initiated as a matter of urgency (See Notes of Meeting 3). The supporting studies to include:

- ***Pre-European fire regimes and their impact on biodiversity***
- ***Current fire management***
 - ***Control burns***
 - ***Fire suppression***
 - ***Wildfires***
- ***Changing risk of fire***
- ***Impacts of fire and managing these impacts on***
 - ***People***
 - ***Water***
 - ***Flora and Fauna***
- ***A planning framework***

The related recommendation from the CSIRO is:

Fire forum

Fire emerged as a crucial variable for many activities in Gippsland, but fire management is potentially an area with a number of institutional barriers to adaptation. A regional forum on climate change and fire could use climate change as a catalyst for knowledge-sharing on fire regimes for different ecological communities.

In relation to forestry it was recommended that a study be undertaken to understand the interaction between plantation forests, carbon sinks/carbon credits, water yields and climate change impacts.

BIODIVERSITY: Two impacts were of particular importance when considering biodiversity:

- Contraction of species ranges and possible extinctions, caused by human activities and exacerbated by climate change
- Changes to the demand for and success of revegetation activities

There are many gaps in our knowledge about critical thresholds for extinctions and particularly for entire ecological vegetation classes (EVCs). Participants were concerned not only with the practical

value of these EVCs to ecosystem services and the danger of replacing them with poorer systems (resource sustainability), but also with fundamental philosophical and spiritual questions, such as “Do extinctions matter?”

It is recommended that a systematic approach be developed to understanding these thresholds and to developing adaptation strategies. Dr. Cassandra Brooke, CSIRO, has already expressed an interest in this work.

Another gap identified is the lack of understanding of cycles of disturbance by, for example, fire, whether naturally occurring or in a control burn, and the relationship between them.

In addition, exploration of such questions as “Do extinctions matter?” by the community, may lead to clearer and stronger motivation to adapt.

The related recommendations from the CSIRO are:

Revegetation, landscape interactions, and climate change

There are a number of landscape-level interactions surrounding revegetation in Gippsland that need to be understood in the context of climate change. These are:

- the changing need for revegetation (for biodiversity, or on marginal land);
- species selection and the success of plantings (including evaluation of past efforts);
- implications of carbon sequestration initiatives;
- the feedback effects on water resources; and
- the coordination of and capacity for revegetation across the region.

Critical thresholds for biodiversity

Basic knowledge is needed on the effects of climate variables on biota at the ecological vegetation class (EVC) level. What are the safe ranges and critical thresholds that might cause the EVC to become a different type?

WATER RIVERS AND COASTS: The availability of clean water, for agriculture, for towns, for industry and for the environment and its ecosystem services was expressed as an important concern in every sector.

In particular, participants want to fill in the gaps in knowledge and sharpen predictions about:

- The changes in yield to be expected from the catchments (being aware of the experience of south western Australia)
- Any impacts on water quality from reduced yields, increased fires or erosion, which may affect urban, industrial, agricultural and environmental uses.
- The magnitude of intense rainfall events and consequent flooding and infrastructure damage, including storm surges exacerbated by sea level rise.
- The geo-morphological impacts on coastal dunes

The Gippsland Sustainable Water Strategy and the coastal study for the Gippsland Coastal Board²³ provide a framework for all of these questions and it is recommended that they be coordinated with climate change adaptation strategies, so that the full impacts of projected climate change on quality and quantity of surface waters and groundwater are assessed in the SWSs - both Central and Gippsland.

These was also a request from participants

- ***To examine thinking and assumptions of current management frameworks to make sure that there is flexibility to adapt and***

²³ “Sea level change implications for the Gippsland Coast” project by the Gippsland Coastal Board

- ***To "work through contingencies and scenarios so we can understand where our risks and options lie"***

In addition a specific recommendation from the CSIRO is:

Climate and land use change implications for water resources

One area that requires further research is that of forestry impacts on water yield/quality in the Gippsland catchments and their interactions with climate change. The preliminary work that has been done by CSIRO on runoff in Victorian catchments does not take land use and land use change into account. Understanding the likely feedbacks and thresholds is vitally important to a number of key activities.

COMMUNITIES, INFRASTRUCTURE AND SERVICES: Gaps were identified in a number areas and suggestions made to understand impacts and develop adaptations:

- In planning and response to emergencies – particularly associated with severe weather and fire.
- Supporting the bodies responsible for developing planning and building codes appropriate to the changing climate, particularly in coastal areas and those prone to flood and in areas vulnerable to fire. Another concern expressed about the planning regime was the zoning of productive agricultural land for urban development.
- Modelling demographics and the consequent infrastructure needs
- Reconnecting individuals and communities with the impact of their use of resources on ecosystem services and so changing community expectations and behaviour in the use of resources.
- It was also noted that there is little available information on the possible impacts of climate change on public health

Many of these gaps relate to issues in other areas and require integration with other plans, for example a fire study and the Gippsland Sustainable Water Strategy. ***It is recommended that a high level regional strategy be developed so that individual adaptations can be seen in context and related to each other. This can start as a regional "map" of actual and planned activities in the absence of enough information or the authorising environment to develop consensus about a strategic direction*** (see "Operation Room" below).

In addition the steering committee confirmed the need for planning and zoning codes to reflect the impacts of climate change as soon as possible and it is recommended that a comprehensive review of these codes be undertaken.

A related recommendation from the CSIRO is:

Risk assessment for extreme events

Extreme events, especially fire and flood, have the capacity to impact a number of natural and built assets in the region. Thorough risk assessments are needed for extreme events, including detailed projections, probabilities and mapping. A related issue is coordination of emergency services, and their capacity for scenario planning.

AUTHORISING ENVIRONMENT: Participants in the project recognised a large and critically important gap in the "authorising environment", which is represented by all three factors in the framework in Figure 6, but initially mostly "MOTIVATION". As yet, understanding in the Gippsland community of the climate changes is growing, but is not yet systematically measured and impacts or the opportunities for adaptation are still at the early stages of development.

A wide range of suggestions to develop this were made, which included:

- Using press, radio and television to communicate clearly the changes

- A campaign to communicate climate change issues to selected leaders and engage regional leadership
- Developing a clear and coherent message for these campaigns
- Special effort to develop ways of engaging people with what appears initially to be an imprecisely defined problem, well into the future and not easy to picture.
 - The Gippsland Coastal Board is developing a computer view of the coast, inundated to various levels, which allows people to see the flooding as if from a helicopter
 - Impacts, which may not be clear to Gippslanders, can be communicated by finding an example somewhere else in the world of the same impact, telling the story here and simulating the same impact locally. *It is recommended that a library of impacts found elsewhere in the world be developed to illustrate the predicted impacts on Gippsland and potential responses (e.g. the lessons from New Orleans).*
- Clearly defining roles and direction (for adaptation strategies) so that these too can be communicated to Gippslanders
- Developing a clear regional strategy, so that one is not imposed from outside the region
- Communicating the findings of this report to Gippslanders and to other regions.

It is recommended that a systematic campaign be developed to create the authorising environment and to encourage the champions of climate change adaptation, starting with a communications strategy to communities in Gippsland.

ADDITIONAL RECOMMENDATIONS:

Integration and prioritisation across sectors: Many of the impacts stretch across most if not all the sectors and require an integrated approach, particularly for local government – for example in planning codes. This will require a coordinated approach between many agencies. With this in mind the following are recommended:

Getting started: Under Communities Infrastructure and Services above, it is recommended that “a high level regional strategy be developed so that individual adaptations can be seen in context and related to each other.”

It has become clear that the magnitude of adapting to climate change is such that developing one big plan and executing it is not practicable. Therefore the whole process of adapting to climate change starts with many smaller initiatives that make sense in this broad context. A number of these initiatives and projects are already under way.

It is suggested that developing a climate change strategy can start as a regional “map” of actual and planned activities (before a large scale coherent strategy has been developed). In other words, the current strategy is, de facto, what we are doing now and keeping track of it, allows us to understand and integrate the pieces of a strategy as it emerges – for example such a map would provide a way of tracking the social and economic process. An “operations room” is recommended for this purpose.

“Operations/Campaign” Room: Whenever an important and complex activity is to be planned or coordinated, such as the running of a refinery or power plant, the management of a rail network, the planning and coordination of a military campaign or an emergency response to a natural disaster, when both planning and operational decisions are required, an operations/strategy room is used to display all the relevant information. A comprehensive display in a room like this allows individuals and teams to absorb complex situations/plans and understand all the relevant inter-relationships to make decisions that take into account the whole picture. Such displays also:

- Allow rapid updating of people entering the room, whether completely new to the activity or merely refreshing their knowledge.

- Allow an open sharing of information, encouraging cooperative behaviour
- Provide a clear and constant reminder of objectives and the principles which guide action
- Give constant reinforcement of the task at hand.

The GINRF report card is an excellent example of such a display in miniature.

It is recommended that a campaign room be identified and the necessary displays be developed to support the regional project of Adapting to Climate Change in Gippsland.

A related recommendation from the CSIRO is:

Integrated regional impact assessments

Most impact studies have considered sector-specific impacts, e.g. water, fire, or snow. Few have attempted to integrate impacts across sectors for a given region, including interactions and feedbacks. Given the amount of information available for various sectors in some parts of Gippsland, it may be possible to do an integrated assessment.

Planning methods: Suggestions have been made to use planning tools (which vary from facilitated futures conversations, through scenario planning and on to the more complex computer based approaches of the Rand Corporation described by Mike Waller in Workshop 1²⁴) in order to explore different futures and to develop a vision, in which Gippsland is both resilient to climate change and sustainable. **Continued support is recommended for the assessment of these planning/strategy tools and their use to build competence within the region.** (GINRF is currently active in this assessment.)

Inter-regional evaluation and shared learning: ***It was recommended by the project steering committee that a plan be developed to share the learning gained from this project with other regions and compare and evaluate different regional approaches to climate change and adaptation.***

Applied Research: Much applied research will be required to fill in the gaps in Gippsland's knowledge and understanding about the climate impacts and potential adaptations. Regional universities are potentially well placed to share in this work (with for example the CSIRO, DPI Ellinbank and the Bureau of Meteorology) and help build competence and expertise in the region. They are, however, under increasing pressure with a new system of assessing research funding (The [Federal] Research Quality Framework). They are being assessed within the same framework as the large universities in the metropolitan centres and on globally competitive largely "blue sky" research, rather than regionally relevant applied research. The problem is not necessarily with the assessment system, but that provincial universities are not seen as having different and additional functions in regional/rural communities. These functions need to be understood and defined and then the research funding assessed on criteria appropriate to their function. This is clearly a political issue, but should be addressed before provincial universities are left without research funding, close down departments and that later have to be rebuilt when the need is reassessed.

It is recommended that the role of Regional Universities and Research Institutions in regional applied research be clearly identified, so that they can be assessed and funded appropriately.

Socio-Economic Impact Assessment: an additional recommendation from the CSIRO is:

Socio-economic risk assessments

Few impact studies have gone beyond assessment of biophysical impacts. Socio-economic risk assessments are more complex but carry greater influence amongst decision-makers.

²⁴ Shaping the Next One Hundred Years: New Methods for Quantitative, Long-Term Policy Analysis, Robert J. Lempert, Steven W. Popper, and Steven C. Bankes

Methods exist for undertaking socio-economic assessments. Greatest scope for such work exists in the water, infrastructure, coastal and agricultural sectors, with limited scope for biodiversity.

Communicating key indicators: It is said the “people without information cannot take action and people with information cannot but take action”. “Informed communities” are a fundamental principle of this process, endorsed by the State Government.

A simple and effective way to develop an understanding of some of the key impacts would be to use the broadcast media to publish regular data as is already being done with water: e.g.

- ***Water storages***
- ***Water use – inside Gippsland/exported***
- ***Environmental flows***
- ***Electricity use – inside Gippsland/exported***
- ***Area of forest - old growth/cleared/planted***
- ***Sea level***
- ***Severe weather events***
- ***Fuel consumption***
- ***Aquifers – measure?***
- ***Species extinctions***
- ***Proportions of land use in Gippsland – farmland designated for urban use***
- ***Waste dumped***
- ***Waste sites***
 - ***capacity used***
 - ***capacity available***
 - ***percentage of types of waste***
- ***Etc.***

Broadcasting these indicators serves specifically to reconnect people with the consequences of the way we live and allows us to take informed action to adapt to climate impacts.

6. FUNDING AND RESOURCES

A key factor in adapting to Climate Change is getting the funding to support projects. Several strategies are possible:

- **DSE/State Government:** The DSE has funded this project and is showing continued support. It is likely to remain a source of funds for well framed projects, possibly part funded locally and part by the DSE/Victorian Government. Climate change adaptation remains one of the important strategic outcomes for the DSE.
- **Piggyback on major urgent projects:** there are major projects, which are both important and urgent, such as the Sustainable Water Strategies. These will undoubtedly include Climate Change as part of their brief. Without “padding them out” in any way, there will be many opportunities to fill gaps in knowledge and implement adaptations as part of these strategies.
- **Companies in the region:** Companies in the region have an interest in adapting to Climate Change, like all other AACs, and exploration of their interests can provide opportunities to initiate Climate Change research projects and resulting adaptations. Large companies in the region may be in a position to lead with both influence and resources. There may also be significant benefits to such companies from involvement in adaptation projects (e.g. Carbon Credits).
- **Insurance Companies:** It is in the interests of the large re-insurers to avoid the high cost of claims for natural disasters, which account for a high proportion of their losses. In

practice, prudent disaster planning and effective emergency response should attract lower premiums. It is recommended that this be explored with the companies (e.g. MunichRe and SwissRe). Reducing costs to the region can provide a justification for investment in projects.

- **Research Institutions:** Many of the projects, which stem from adapting to climate change, will be about filling in gaps in knowledge to inform decisions on adaptation. Identifying good questions to be answered and presenting them systematically to the Universities and other research organizations can attract high quality researchers, who can in turn apply for funds through their funding sources.
- **Routine planning processes** – e.g. in local government, the CMAs etc: Climate Change is already being included in the planning process of a number of organizations in Gippsland. The simple inclusion of Climate Change in these processes will naturally generate projects and their funding within these organizations.
- **Federal Government:** The Federal Government is a potential source of funds for this work. Until recently money for such projects was available through the Sustainable Regions Programme²⁵, though this may not be renewed in future. The Australian Greenhouse Office may also be a source of funds²⁶.
- **Free support:**
 - Media: Well briefed media can provide great assistance in creating:
 - the authorising environment to support expenditure on projects
 - individual and community action
 - open public debate and consensus buildingMuch of this can be achieved within the current news and current affairs framework. “Your ABC” is an appropriate catchphrase in this context.
 - Voluntary organizations: There are many outstanding voluntary organizations (e.g. Landcare), which care deeply about the natural assets and communities of the region. Mobilising their support in a coordinated fashion and possibly providing them with selective funding to do their work will add to the resources available.
- **Self Funding:** Many of the above sources require finding someone with funds, identifying their interest and asking them to provide funds to support a project²⁷ - a top down approach. There is also a bottom up approach, which is to start with the “low-hanging fruit” and use these to generate funds so that the process becomes self-funding.
- **Collective funding:** via collaboration of partners brought together in a forum such as GINRF
- **Coordinating function:** *A key recommendation of the steering committee is to apply as soon as possible for funding for a coordinating activity/resource for an ongoing climate change programme in Gippsland.*
 - *Developing stakeholder engagement*
 - *Identifying specific projects*
 - *Providing a focus for regional adaptation*

The whole approach to funding can benefit a central “clearing house” to hold information about sources of funds for past projects, current potential sources of funds and processes/strategies for

²⁵ <http://www.gippslandacc.com.au/Projects/?Programme=3>

²⁶ <http://www.greenhouse.gov.au/agriculture/pubs/rdplan-prospectus0607.pdf>

²⁷ Incidentally, it may prove more effective to identify the interest of a possible source of funds and propose a project, which meets that interest, than to identify a project independently and then look for someone to fund it. This requires a balance with the need to do projects, which genuinely meet the set direction of a Climate Change Adaptation Strategy for Gippsland.

obtaining funds and/or resourcing projects. This clearing house is not a place to organise and obtain funding, but a place where people can learn about different sources of funding and how to approach them. It can also provide a way for Gippsland to cooperate on funding applications, both to strengthen the applications and to identify what will benefit Gippsland as a whole.

7. FURTHER OBSERVATIONS

Gippsland As A Region

There is an increasing logic in Gippsland and its catchments being considered as a whole. As we run into the limits of the natural world to support our activities and lifestyle, we are forced to consider how best to live in balance with these "ecosystem services". Systems of management and associated decision making processes are, of necessity, going to be designed around the natural boundaries of these "services" as testified by the importance of the CMAs.

In addition, the impact of climate change *on* Gippsland is not just the impact of climate change *in* Gippsland. Such is the demand for water, electricity, gas and oil, forest and agricultural products from outside the region, in particular Melbourne, that climate change impacts on Melbourne, must also be considered as part of the impacts on Gippsland.

One of the critical balances, which has emerged in considering the region as a whole is the supply and demand of resources between Gippsland and Melbourne – particularly water and power – and the added stresses that are placed on this balance when affected by Climate Change. At the moment, Gippsland does not have a single coherent regional voice, with which to represent itself to Melbourne and other regions. This voice is needed, not to fight its corner and compete for resources, but to work cooperatively with Melbourne (and other regions) in order to make use of a limited resource and help Melbourne (and other regions) to understand the precise consequences of its decisions and the best way to manage these joint resources.

An example of this is in The Central Region SWS, about which many involved in this project expressed serious concerns about the lack of detailed consultation in Gippsland about the potential allocation of water in Gippsland to other regions of Victoria. Gippsland needs to be able to help those in the State Government understand the consequences of the Central Region SWS by having a coherent voice and a coherent strategic analysis, so that the best balance of resources can be made for the benefit of all Victorians

Only Gippslanders, as stewards, custodians and owners of the land, have the detailed local knowledge to work through the impacts of climate change, policy frameworks and strategies to present a coherent assessment of proposed actions and to help those outside the region to understand how to get the best out of Gippsland – sustainably. It is therefore valuable to have a forum in which such a coherent voice can be developed, recognising that "another level of Government is that last thing we need or want", and at the same time, that the natural boundaries of the catchments represent a valuable framework within which to understand and work within our natural environment, which ultimately supplies our needs.

Two bodies have been suggested as starting points for this – the Gippsland Integrated Natural Resources Forum, which has already taken up Climate Change as one of its key "conversations", and the State Government Regional Managers Forum.

Economic Instruments:

While economic incentives/instruments are not the only tools with which to meet the impacts of climate change and protect and rebuild our ecosystem services, they are important and very powerful. There is no doubt that the prices of fuel, water and food are not currently sufficient to protect and rebuild these services. We are living off capital. If something is not priced at a reasonable value, its use will be abused – the tragedy of the commons. While influencing these prices is largely outside the control of Gippsland, it is important for Gippslanders to have a

coherent view about this and to exert influence on State and Federal Governments to develop the authorising environment for changes in pricing policies.

Coordinating Adaptation In Gippsland:

One model for organising to adapt to climate change in Gippsland, without creating an all-embracing adaptation project with resources and executive authority, is to use a forum which "holds" the conversation and is populated by member organizations, with resources and executive authority, who make decisions as individual organizations or as groups of organizations to undertake specific projects based on the conversations they have in the forum. GINRF is such an organization, though it does not cover all of Gippsland's AACs, but those of natural resources management.

Such a forum has the advantage that it can be developed using existing organizations.

A KEY QUESTION:

How will Gippslanders assess any planned adaptation to ensure that it will in itself be sustainable and not add further to climate change?