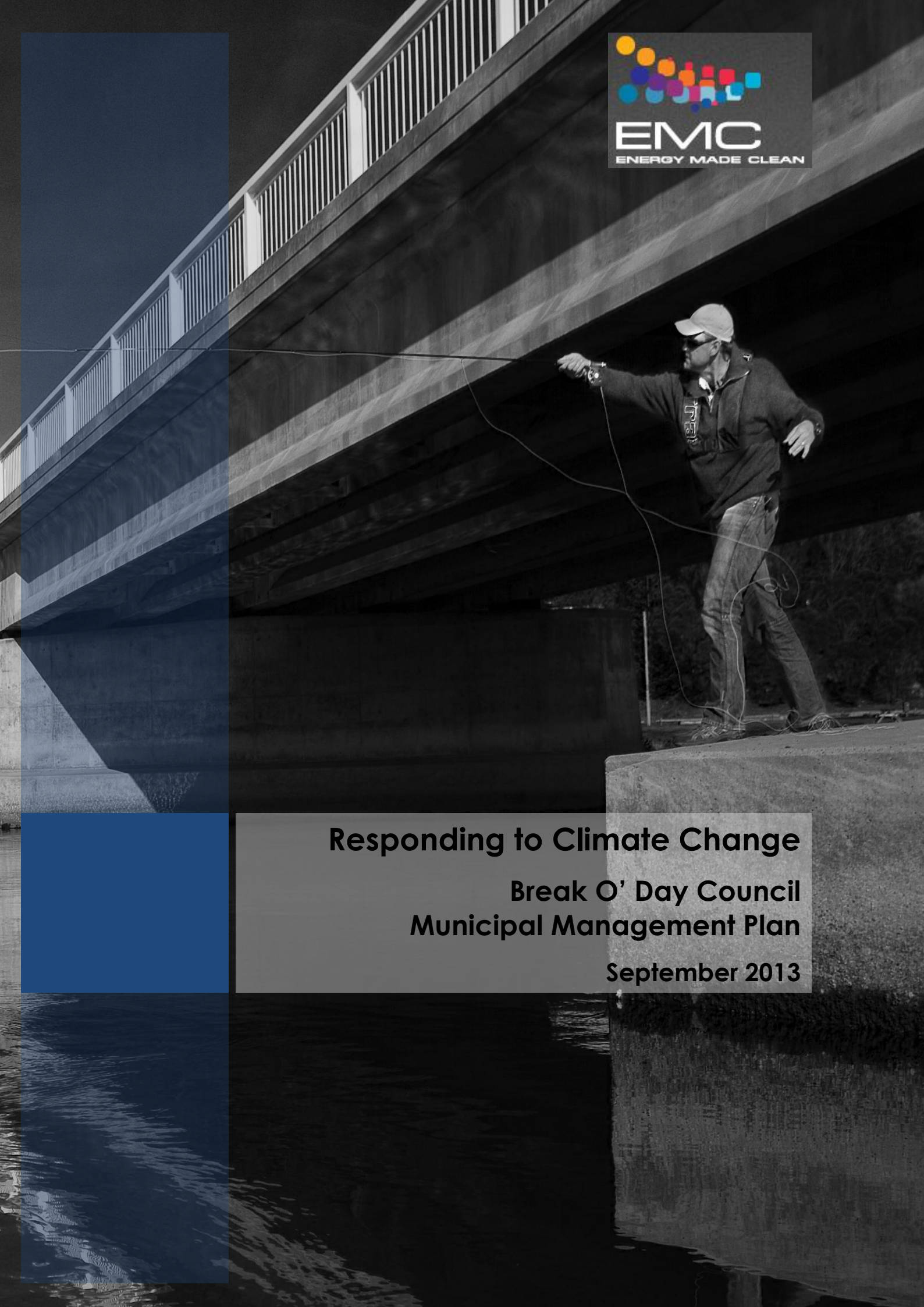

Responding to Climate Change

Break O' Day Council
Municipal Management Plan

September 2013

ENGINEERING

EMC
ENERGY MADE CLEAN

Break O'Day
COUNCIL

Break O' Day Council Municipal Management Plan – Climate Change Impacts

Report

PREPARED BY
EMC ENGINEERING
FOR
BREAK O'DAY COUNCIL

REFERENCE: 130827 BOD-MMP-RESPONDING TO CLIMATE CHANGE - REPORT.DOCX

Contents

1 Executive Summary

Significant work has already been done in Tasmania and the Break O'Day region to identify the likely changes in climate, the impact of those changes and how to respond. A selection of relevant reports is listed below.

1. Tasmanian Coastal Adaptation Pathways Project – Georges Bay
2. Climate Change Impacts On Clarence Coastal Areas – Final Report [1]
3. WRL Report – July 2011 Storm Event [2]
4. Climate Futures For Tasmania, Technical Report, Extreme Events [3]
5. Climate Futures For Tasmania, Technical Report, Climate Modelling [4]
6. Climate Futures For Tasmania, Technical Report, Impacts on Agriculture [5]
7. Tasmanian Government, Local Climate Profile, Break O'Day Municipality [6]
8. Australian Government, Potential effects of climate change on forests and forestry: Summary for Tasmania [7]
9. Climate Futures for Tasmania, Technical Report, Water and Catchments [8]
10. Indicative Mapping of Tasmanian Coastal Vulnerability to Climate Change and Sea-Level Rise: Explanatory Report 2nd Edition [9]
11. Climate Commission, The Critical Decade, Tasmanian Impacts and Opportunities [10]
12. Vulnerability of Tasmania's Natural Environment to Climate Change: An Overview[11]
13. Tasmanian Greenhouse Gas Emission Reduction Project - Understanding the Potential for Reducing Tasmania's Greenhouse Gas Emissions [12]
14. The east coast Tasmanian rock lobster fishery – vulnerability to climate change impacts and adaptation response options [11]
15. Break O'Day Council Georges Bay Coastal Inundation Vulnerability [13]

The report builds on the previous work and incorporates input from Council and the community to identify and quantify the risks that a changing climate poses to Break O'Day. Strategies have been suggested to reduce and manage those risks that are identified as high or extreme. These risks will change over time with regard to the likelihood and consequence of specific events. This means that risks will have to be re-evaluated regularly. The best way to ensure this occurs is to include climate change risks in BODC existing risk processes.

The key changes to climate within Break O'Day are:

- Annual average temperatures are projected to rise by between 1 to 1.5°C by 2070.
- The number of days per year above 25°C will double by 2100 and the temperature of very hot days will increase by 3-4°C.
- Summer and spring rainfall will decrease by up to 10% by 2070. Rainfall intensity and associated flooding may increase, and there may be longer periods between rain events.
- An increase in fire-weather risk is likely with warmer and drier conditions.
- East coast water temperatures are projected to increase by up to 2 to 3°C by 2070 relative to 1990 levels.
- By 2100, the sea level may have risen by as much as 76 cm relative to 2010 levels putting around 550 [14] homes at risk in Break O'Day.
- The number of days of frosts is expected to reduce substantially.

The key risks identified include:

- Temporary or permanent loss of access to towns and surrounding areas
- Changes to primary production both in terms of agriculture, fisheries and aquaculture
- Flooding of the pumps and ponds of the sewage treatment works in St Helens
- Sea level rise effecting the Bay of Fires and related tourism
- Inundation of homes and loss of property value.

A treatment option was proposed for each High and Extreme risk to reduce either the likelihood or consequence until the residual risk was acceptable. The treatment of each risk formed the basis of a climate change action plan. For the plan to be effective suitable resources need to be allocated and a person within BODC made responsible for maintaining and executing the plan. The climate change action plan will have a bearing on many parts of BODC business implying a team approach will be necessary. Resources are always in demand for local councils both in terms of people, finances and skills.

There is strong interest in the community to contribute to addressing climate change. Individuals and groups in the community combined with State and Federal organisations can be drawn on to reduce the burden on Council. These include:

- Tasmanian Department of Premier and Cabinet
- Tasmanian Department of Primary Industries, Parks, Water and Environment
- Tasmanian Climate Change Office
- The Antarctic Climate & Ecosystems Cooperative Research Centre
- Victorian Centre For Climate Change Adaptation Research (VCCCAR)
- International Council for Local Environmental Initiatives (ICLEI)
- National Climate Change Adaptation Research Facility (NCCARF)
- Institute for Marine and Antarctic Studies (IMAS)

Climate change may also bring opportunities to Tasmania. The changes to Tasmania's climate are less severe than those predicted for the rest of Australia. Tasmania may become a more desirable location, relative to the rest to other parts of the country, resulting in the relocation of people and businesses. Reductions in frost days may also improve the growing conditions for some crops.

2 Introduction

This report will be used as the Climate Change Impacts section of the Municipal Management Plan (MMP). It was developed using the following approach:

1. Develop an emissions profile for activities within the Break O' Day region by determining where emissions occur within the council, community and industry
2. Identify Abatement Opportunities – Determine what can be done to reduce the emissions through strategies such as improved energy efficiency, process and behaviour change, lower carbon sources of energy and potentially carbon offsetting activities
3. Adaptation Analysis – Apply understanding of community and industry sectors within Break O' Day to identify major risks that result from a changing climate
4. Workshop – The workshop was used to present the work already completed, validate assumptions and identify, analyse and develop treatment strategies for Break O' Day climate change risks and discuss emissions reductions opportunities.
5. Advise the Council on a priority of actions to most efficiently achieve the Councils climate change goals

3 Break O'Day's greenhouse gas emissions profile

The greenhouse gas emissions inventory for Break O'Day was developed through a per-capita analysis of the Tasmanian emissions inventory as reported in the National Greenhouse Gas Inventory [15].

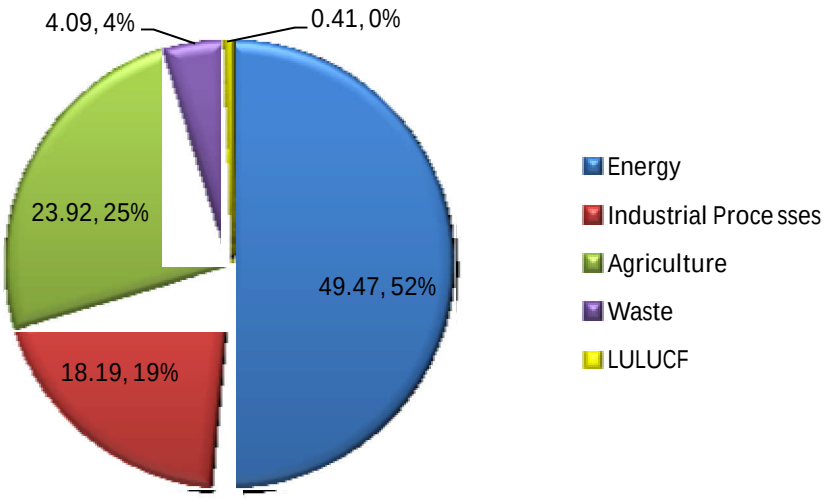

Figure 1: Break O'Day emissions profile

The sectoral breakdown of Break O'Day's greenhouse gas emissions is provided in Figure 1. The data labels are formatted to show the total CO_2-e emissions in thousands of tonnes followed by the percentage contribution to the total emissions.

Energy emissions in this case are dominated by fuels combusted for electricity generation (16% of total energy related emissions), manufacturing and combustion (27%) and transport fuels (43%).

Emissions attributed to Industrial Processes include those from cement and lime production, metal production, road paving with asphalt and consumption of halocarbons and SF6 in solvents, fire extinguishers and refrigerants.

57% of Agricultural emissions are from enteric fermentation which result from the digestive processes of ruminant live stock in this case primarily cattle.

Figure 2 shows a more detailed breakdown of the sector emissions for Break O'Day. The colour coding is the same as Figure 1. Land Use, Land Use Change and Forestry (LULUCF) makes a small contribution to the total emissions in Figure 1 because the emissions related to the conversion of land to grassland is offset by land converted to forest.

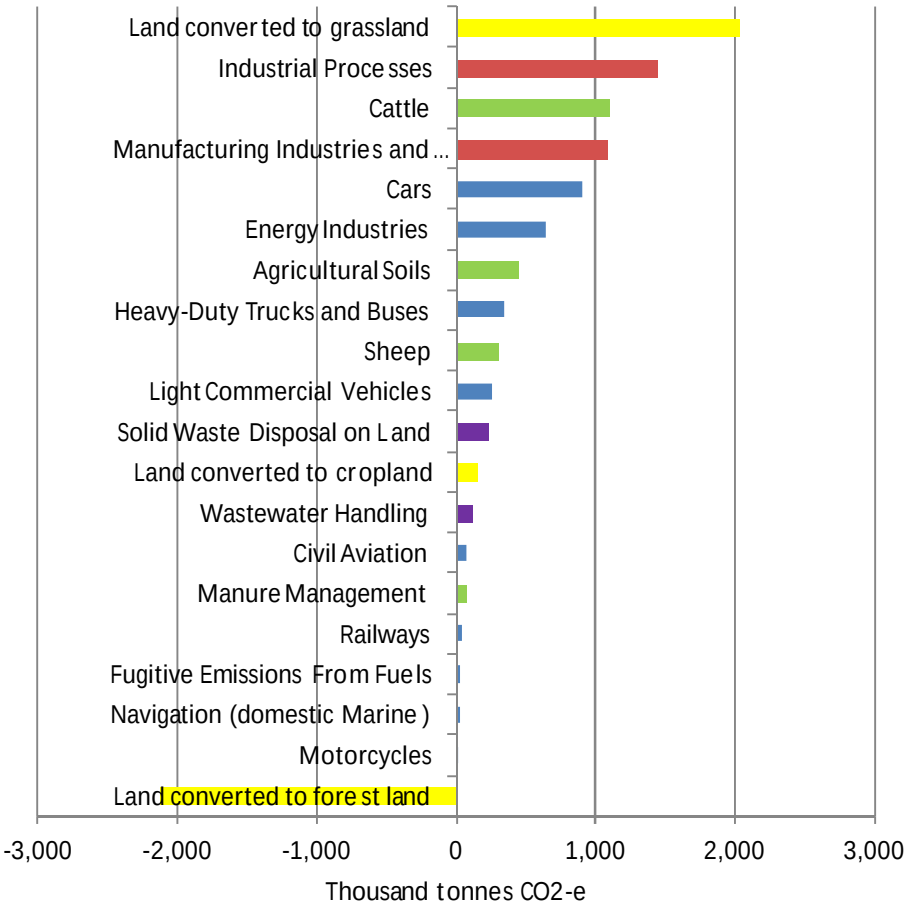

Figure 2: Details of Break O'Day sector emissions

4 Tasmania's changing climate

> Research overwhelmingly indicates that the earth is warming. Global warming is predicted to cause changes to climate variables such as rainfall, wind, evaporation, temperature and sea level. These changes are also likely to amplify other aspects of natural climate variability and result in more frequent extreme weather events in some areas.
>
> Climate Future for Tasmania [16]

The climate in Australia and Tasmania is measurably changing and this change is predicted to accelerate. The sections below discuss the changes that have been observed until now and the changes that are anticipated in the future for:

- Temperature
- Sea surface temperature
- Sea levels
- Rainfall

4.1.1 Temperature

The Australia Bureau of Meteorology has been tracking increases in temperatures in Tasmania for several decades. The changes measured are provided in Table 1. These show a greater increase in maximum temperatures than in minimum temperatures indicating that while temperatures in Tasmanian are increasing the range in temperatures experienced throughout the year is also increasing.

	1970 - 2011
Trend in mean temperature (°C/10 years) [17]	0.1 – 0.15
Trend in minimum temperature (°C/10 years)	0.05 – 0.10
Trend in maximum temperature (°C/10 years)	0.15 – 0.20

Table 1: Historical increases in Tasmanian temperature

These increases are predicted to accelerate with climate change. The Australia Bureau of Meteorology's predictions for future increases in the Break O'Day region are provided in Table 2. The letters L, M and H indicate the predictions under low, medium and high emissions profiles.

		Temperature Increase by 2030 (°C) [1]	Temperature Increase by 2070 (°C)
Annual	L	0.6 – 1.0	1.0 – 1.5
	M	1.0 – 1.5	1.5 – 2.0
	H	1.5 – 2.0	2.0 – 2.5
Summer	L	0.6 – 1.0	1.0 – 1.5
	M	1.0 – 1.5	1.5 – 2.0
	H	1.5 – 2.0	2.0 – 2.5
Autumn	L	0.6 – 1.0	1.0 – 1.5
	M	1.0 – 1.5	1.5 – 2.0
	H	1.5 – 2.0	2.0 – 2.5

[1] http://climatechangeinaustralia.com.au/tastemp23.php

		Temperature Increase by 2030 (°C) [1]	Temperature Increase by 2070 (°C)
Winter	L	0.6 – 1.0	1.0 – 1.5
	M	1.0 – 1.5	1.0 – 1.5
	H	1.5 – 2.0	1.5 – 2.0
Spring	L	0.6 – 1.0	1.0 – 1.5
	M	1.0 – 1.5	1.0 – 1.5
	H	1.5 – 2.0	2.0 – 2.5

Table 2: Future increases in Break O'Day region temperatures

Table 2 shows at least 1 to 1.5°C increase in temperatures by 2070 (low emissions profile) with a 1.5 to 2.5°C increase in temperature year round by 2070 more likely. The latest IPCC report states that the world is following a high emissions profile and heading for 2°C increase in global average temperatures by 2100 [18].

If the annual predicted temperature increases are graphed as in Figure 3 they show an increase of between 0.2 and 0.25°C per decade which is approximately twice the historic rate.

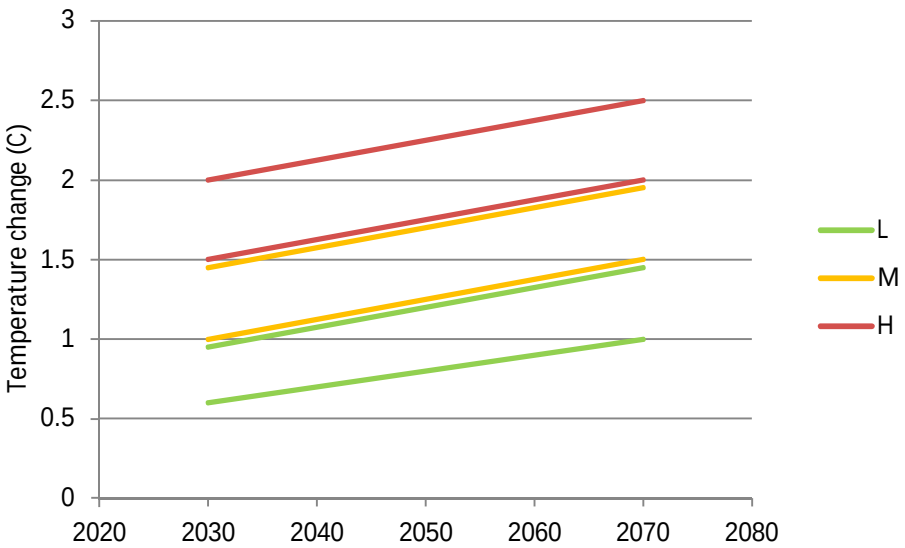

Figure 3: Trend in predicted annual average temperatures for Break O'Day region.

The projected change in average temperatures is only one view of temperature change. Climate Change will also bring changes in the frequency, intensity and duration of hot and cold extremes of temperature. Analysis conducted for St Helens under a high emissions scenario indicates that by 2100 [19]:

- The number of Summer Days (>25 °C) will increase from around 13 days per year to more than 25 days per year.

- The temperature of very hot days will increase more than the change in average temperature (by 3-4 °C in some locations in some seasons).
- The number of frost-risk days will decrease from around 7 per year to around 1 per year.
- Warm periods (days in a row where temperatures are in the top 5% of baseline levels) currently last around 5 days, are projected to last 6-10 days longer.

4.1.2 Rain fall

Figure 4 shows the trend in Tasmanian rainfall since 1970. The Break O'Day region has seen a 30 to 40 mm decrease in annual rain fall every 10 years.

To put this in perspective Fingal currently receives 607 mm per year while St Marys and at Goulds Country generally receive more than 1,000 mm per year [19].

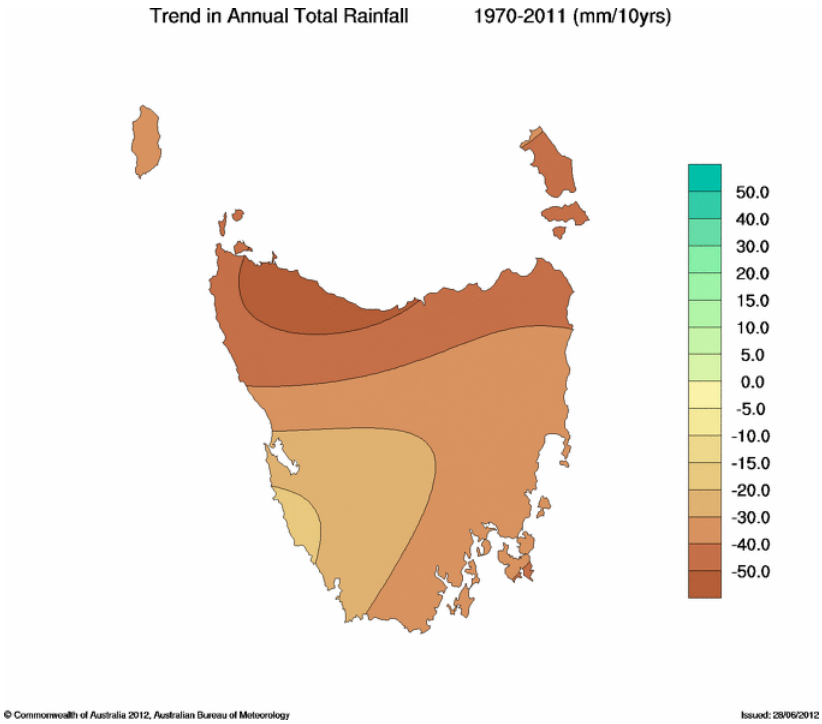

Figure 4: Trend in Tasmanian total rainfall [20]

The predicted changes to rain fall for 2050 and 2070 are provided in Table 3. L, M and H indicate low, medium and high emissions scenarios respectively. The latest IPCC report states that the world is tracking towards a high emissions scenario.

The greatest reductions are in summer and spring rains, with winter showing little or no reduction in rain fall.

		Change in annual rainfall by 2050 [21]	Change in annual rainfall by 2070 [22]
Annual	L	-2% to -5%	-2% to -5%
	M	-2% to -5%	-2% to -5%
	H	-2% to -5%	-5% to -10%
Summer	L	-2% to -5%	-5% to -10%
	M	-5% to -10%	-5% to -10%
	H	-5% to -10%	-10% to -20%
Autumn	L	-2% to +2%	-2% to -5%
	M	-2% to -5%	-2% to -5%
	H	-2% to -5%	-2% to -5%
Winter	L	-2% to +2%	-2% to +2%
	M	-2% to +2%	-2% to +2%
	H	-2% to +2%	-2% to +2%
Spring	L	-5% to -10%	-5% to -10%
	M	-5% to -10%	-5% to -10%
	H	-5% to -10%	-10% to -20%

Table 3: Future changes in Break O'Day region rainfall

The BoM predictions for rain fall changes in the Break O'Day Municipality differ from that provided by the Tasmanian Government in the 2007 Local Climate Profile – Break O'Day Municipality [23]. The Tasmanian Government report draws on the results of the Climate Futures for Tasmania study and shows an increase in summer rainfall and a slight decrease in winter rainfall for Break O'Day.

The Climate Futures for Tasmania study used the results of 6 different climate models including that used by the BoM. Each model's output varied in terms of the predicted future rainfalls for Break O'Day. The study combined the results to get a modal mean of all of their outcomes. The results showed a decrease in winter and spring rainfall of between 2 and 10 % by 2100 and an increase in summer and autumn rainfall of between 14 % and 25%. There was less agreement between the models in summer and autumn variations with 2 of the models showing a decrease in rain fall. This makes the Climate Futures for Tasmania predictions for these seasons less certain, as a result preference was given to the BoM predictions.

An increase in fire-weather risk is likely with warmer and drier conditions. It is likely that the fire season will lengthen, shifting periods suitable for prescribed burning toward winter [24].

4.1.3 Sea surface temperature

Sea surface temperatures (SST) are also increasing. The measured trend in SST in the Tasman Sea since 1970 is provided in Figure 5. It shows an increase of between 0.08 °C to 0.12 °C per decade for the sea off the coast of the Break O'Day region.

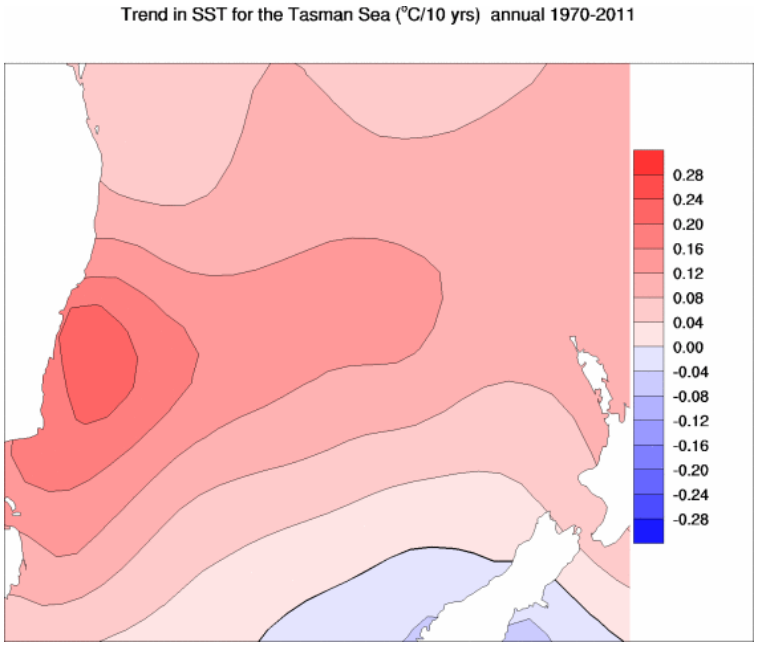

Figure 5: Trend in Sea Surface Temperatures for the Tasman Sea[25]

East coast water temperatures are projected to increase by up to 2 to 3°C by 2070 relative to 1990 levels [26].

4.1.4 Sea level rise

Figure 6 shows an increase in sea level approaching 6 cm measured between 1990 and 2006.

The Tasmanian Government has set the sea level rise planning allowance for Tasmania at 0.8 m by 2100 which represents the upper end of IPCC's 4th Assessment Report (AR4) A1FI projections and is in line with recent global emissions and observations of sea-level rise. [18]

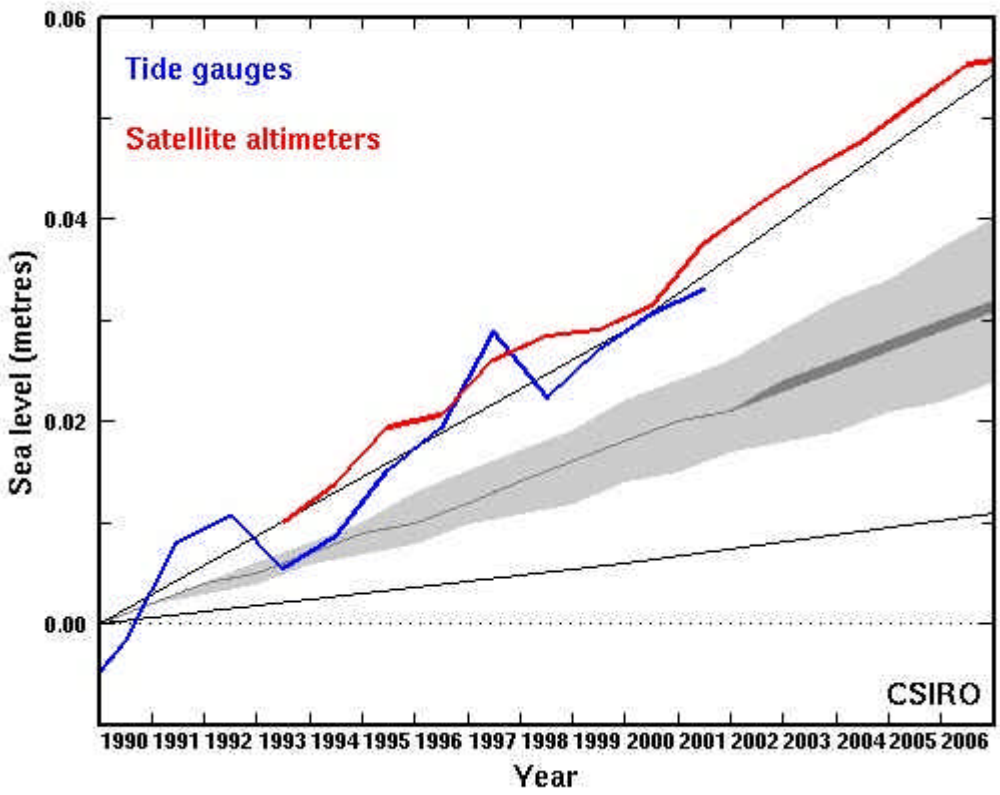

Figure 6: Measured sea level rise[2]

5 Effects of sea level rise

Increases in mean sea level are only one as aspect of the risks posed by sea level rise.

Figure 7 shows how the combination of storm surges and high tides will extend inundation and damaging waves further inland than would occur with just an increase in mean sea level. Increased wave action further inland will also increase coastal erosion which will impact on built infrastructure and natural ecosystems.

[2] http://www.cmar.csiro.au/sealevel/sl_proj_obs_vs_proj.html

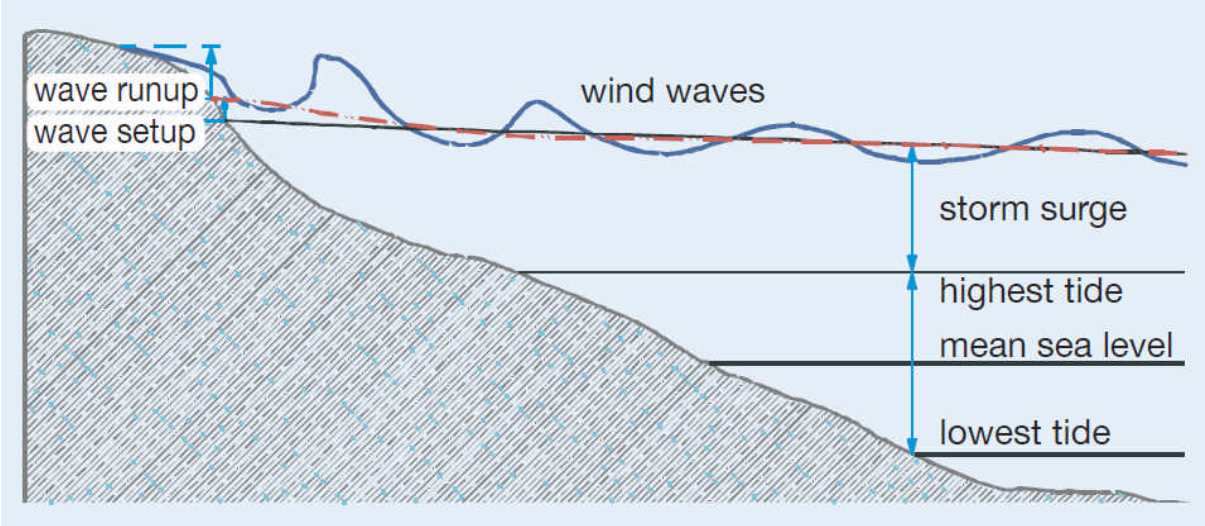

Figure 7: Effects of sea level rise[24]

On the northeast coast of Tasmania, the very high coastal surges contribute more to coastal inundation events than the very high tide height. For example in the Bicheno area the current 100-year storm tide event is around 1.0 m above average sea level. The current 100-year event in Spring Bay will be 1.56 m by 2100 under the higher emissions scenario. This means that the current 100-year event would be exceeded every 10 to 20 years by 2030, and more than once every 5 years in 2090 [23].

Figure 8 shows that this type of event would put around 1,000 residential properties at risk of inundation within the Break O'Day area.

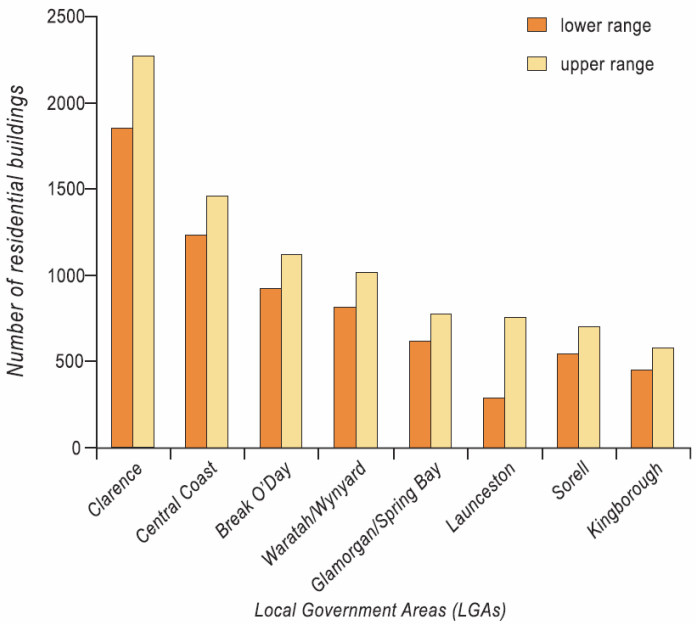

Figure 8: Estimated number of existing residential buildings in Tasmania at risk of inundation from a sea-level rise of 1.1 metres and a 1-in-100 storm tide [14].

Half of Tasmania's coastline is made up of sandy shores backed by soft sediments which are potentially prone to significant erosion due to sea level rise. Figure 9 shows an example of erosion from a storm surge event that occurred Tasmania in 2011.

Figure 9: Erosion north of Bambra Reef in 2011 [27]

Throughout Tasmania there are approximately 6,100 residential buildings located within 110 metres of 'soft' erodible shorelines, of which approximately 1,800 are within 55 metres of soft coast [14].

As illustrated in Figure 10, Break O'Day has around 450 residential buildings within 110 m of 'soft' coast and approximately 100 within 55 m. In the absence of coastal protection measures or other adaptation responses, these buildings may be at risk of increased erosion with sea-level rise and storm surge due to their location and the nature of the shoreline [14].

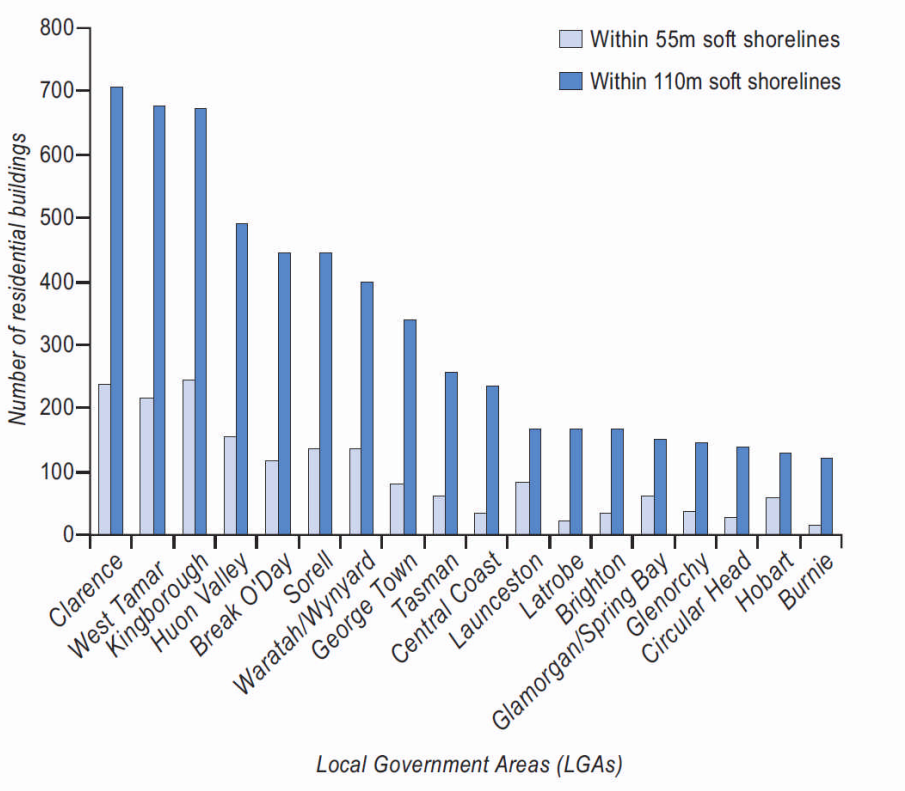

Figure 10: Number of residential buildings located within 55 metres and 110 metres of 'soft' shorelines in Tasmania[14].

In 2011 Pitt & Sherry studied the impact of sea level rise and storm surges in Georges Bay. The report modelled the effects of sea level rise, storm surge and wave action taking into account the reach across the Bay that is available for the development of waves.

Figure 11, Figure 12 and Figure 13 show the projected inundation levels for St Helens. The view is from Georges Bay looking north across the sewage treatment works and into the mouth of Mosquito Creek. Figure 12 shows that by 2050, the sewage treatment works is under threat from flooding which increases towards 2100 as shown in Figure 13. Also by 2100 the Binalong Bay Rd will be cut in the vicinity of Mosquito and Colchis Creeks.

Similar results were predicted in the Tasmanian Costal Adaptation Pathways Project report for Georges Bay [28]. Figure 17 shows the flooding levels around Georges Bay for a 0.9m increase in sea level.

The Tasmanian Coastal Adaptation Pathways Project for Georges Bay [28] identified 18 dwellings currently at risk from inundation which will increase to 22 by 2050 and 43 by 2100. These have a present day value of up to $1.4 million.

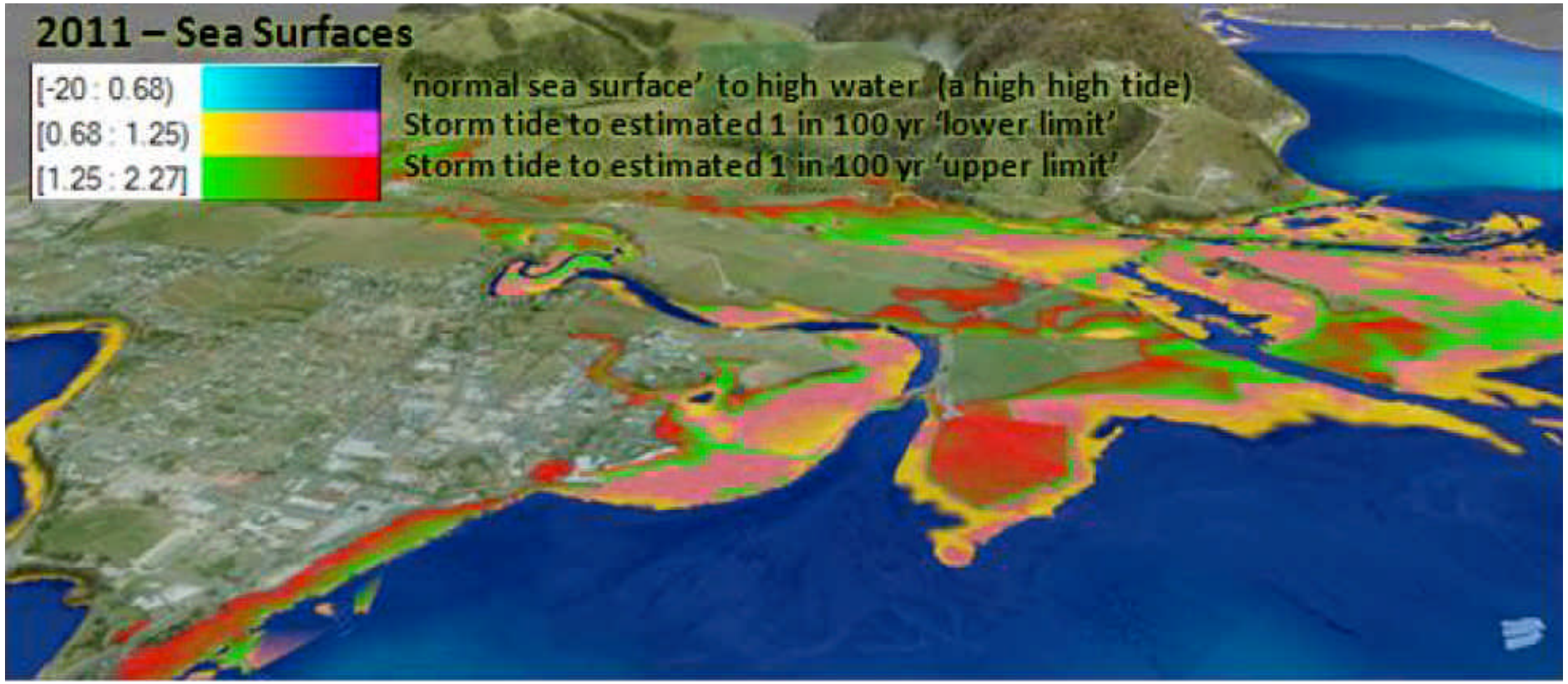

Figure 11: 2011 Inundation levels – St Helens

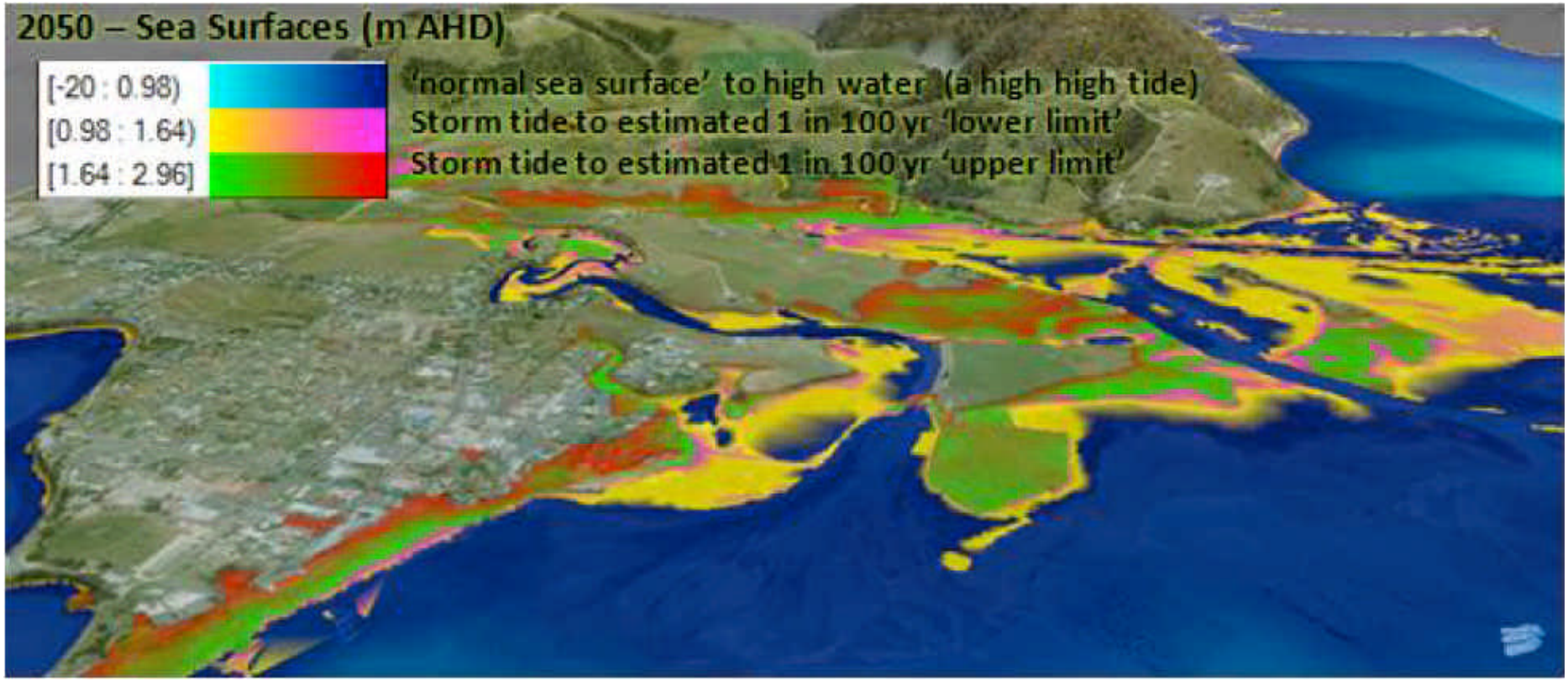

Figure 12: 2050 Inundation levels – St Helens

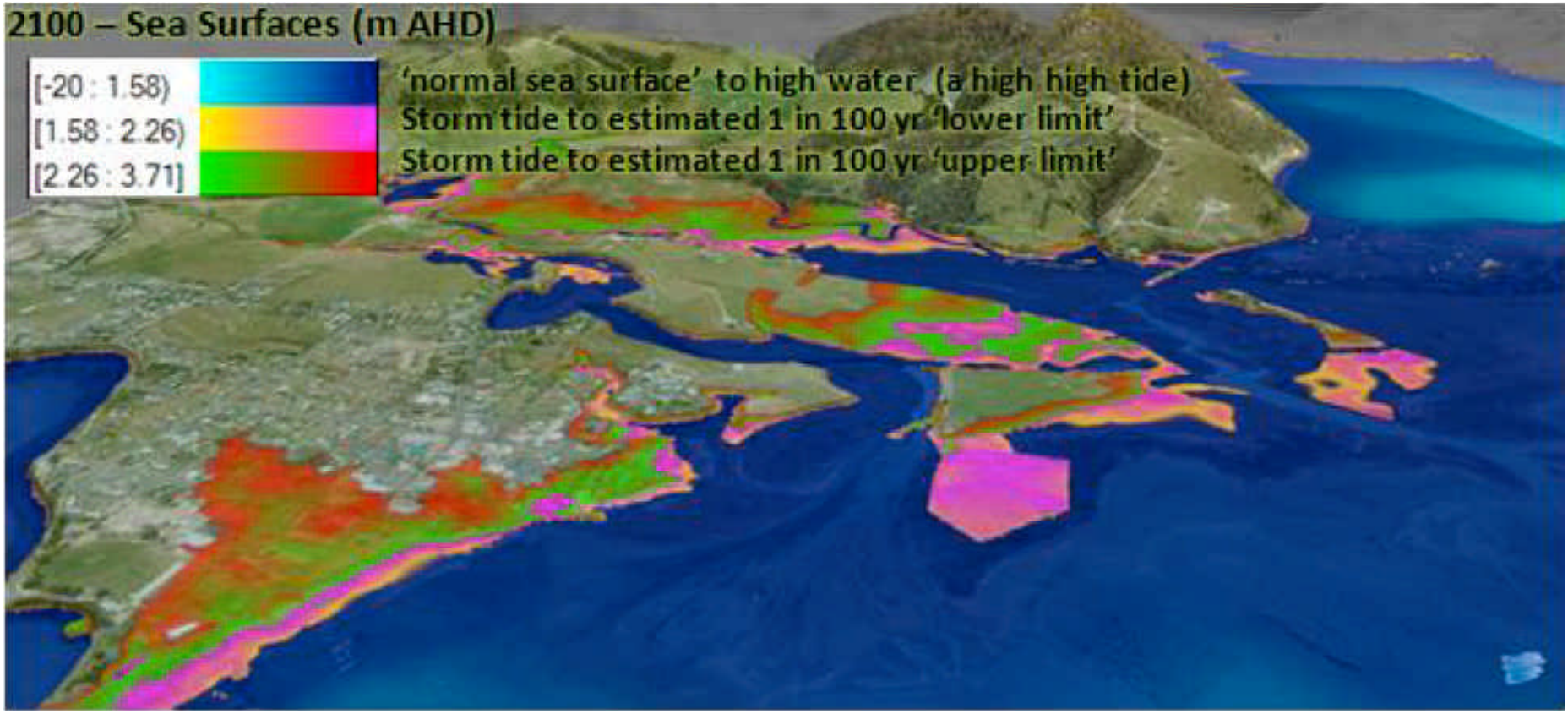

Figure 13: 2100 Inundation levels – St Helens

Figure 14, Figure 15 and Figure 16 show Georges Bay looking south towards the Tasman Highway and Airport.

St Helens Point Road becomes regularly flooded by 2050 and completely underwater at high tide by 2100. There is an increased risk of flooding of the Tasman Highway around the intersection of Falmouth St, houses in that area will also be permanently inundated by 2100.

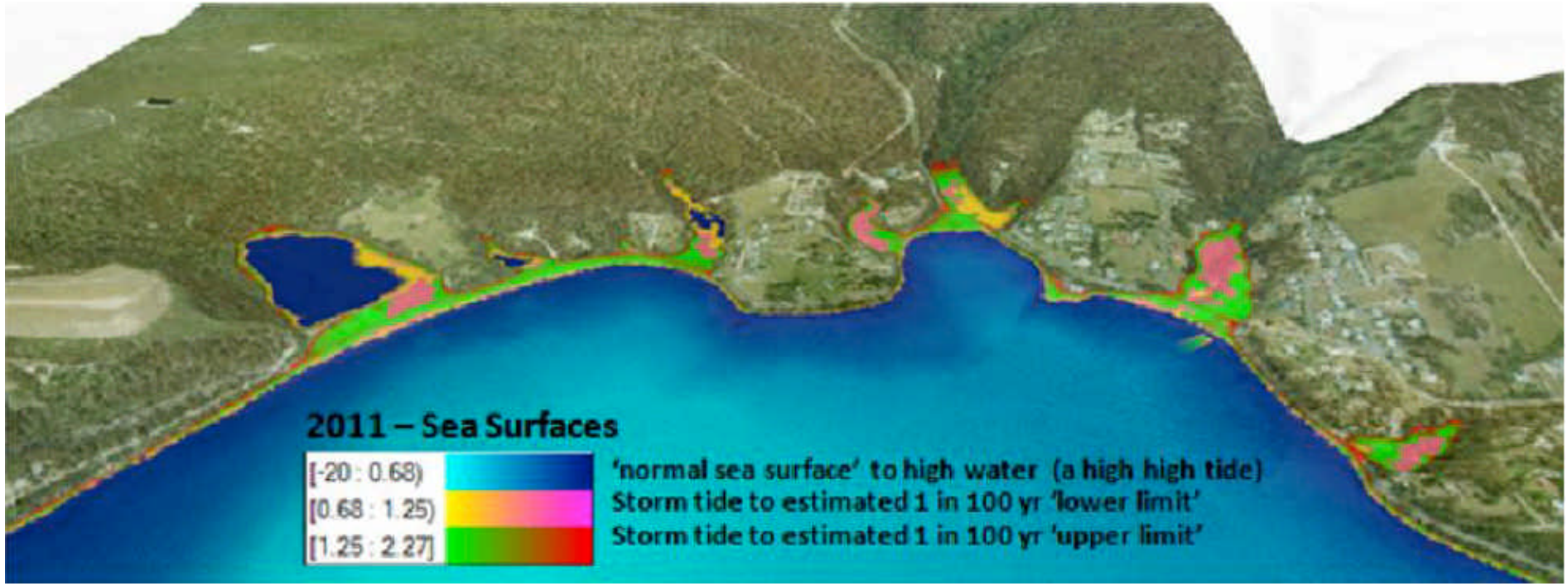

Figure 14: 2011 Inundation levels – Stieglitz turn off area

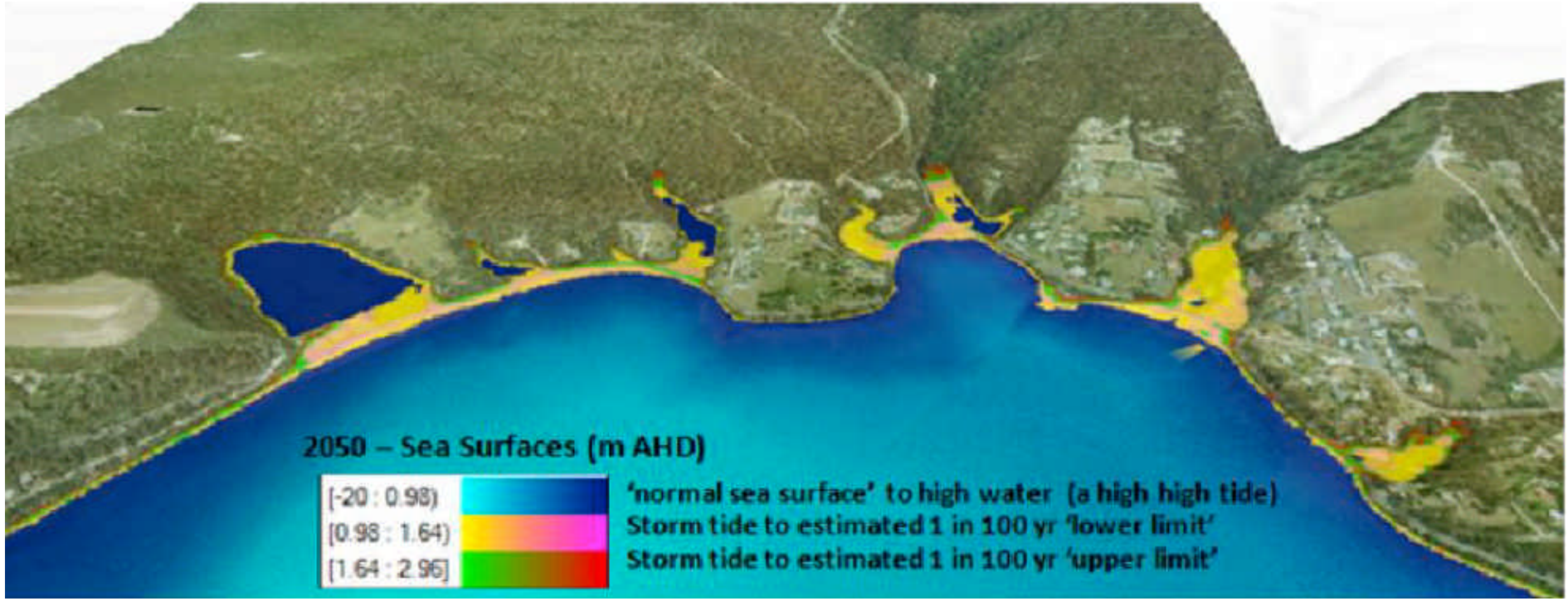

Figure 15: 2050 Inundation levels – Stieglitz turn off area

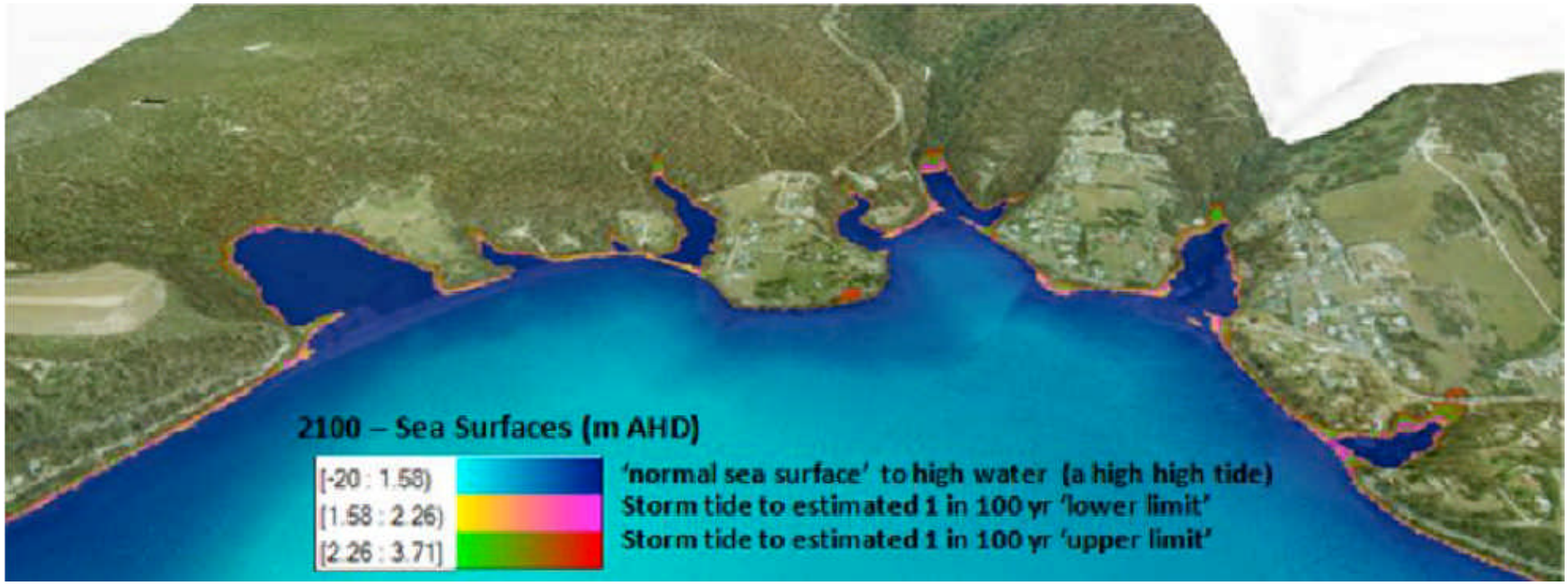

Figure 16: 2100 Inundation levels – Stieglitz turn off area

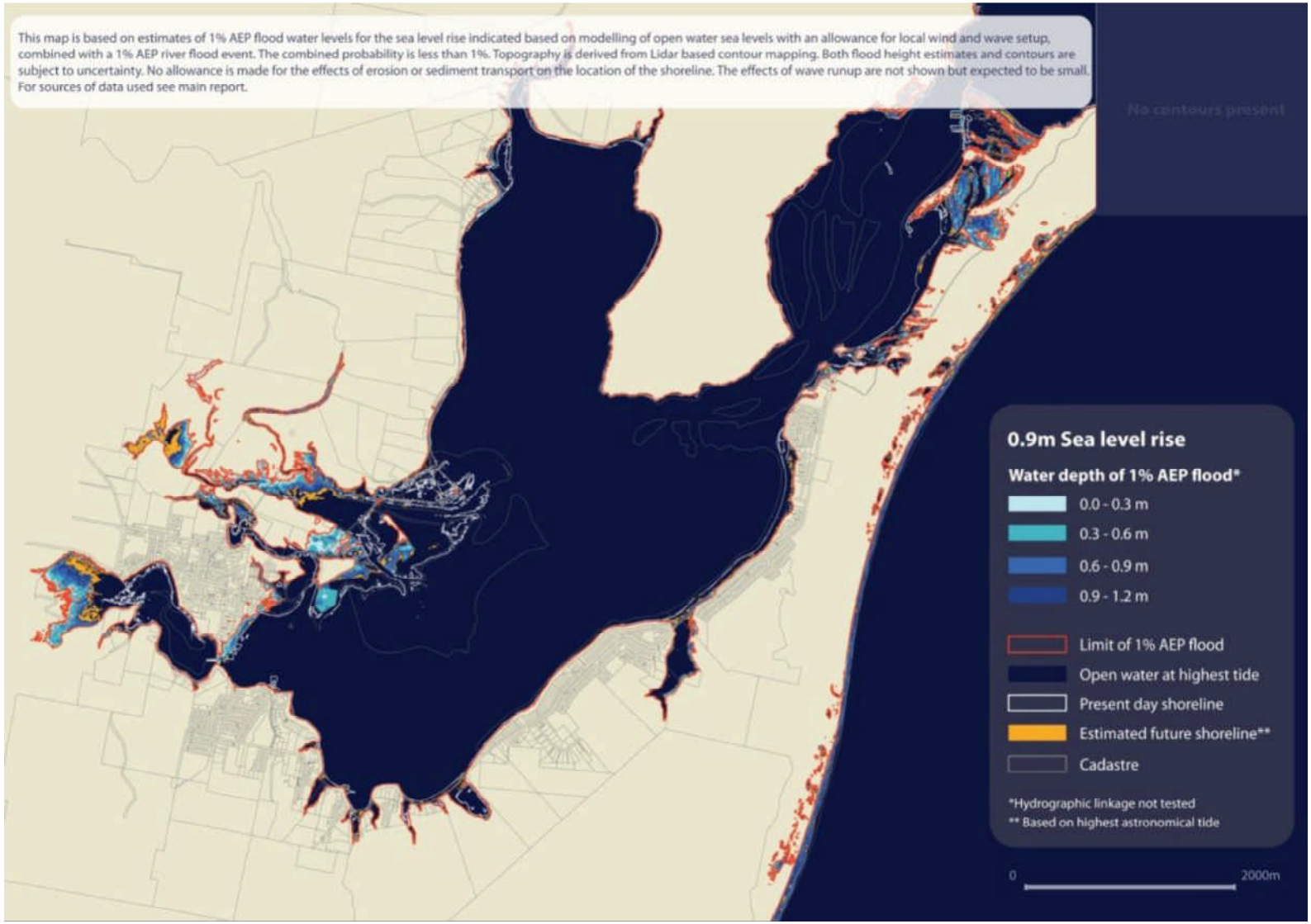

Figure 17: Tasmanian Coastal Adaptation Pathways Project Report for Georges Bay

6 Community impressions

An extensive community consultation process was undertaken during the development of the MMP. Stakeholders, community groups and focus groups were consulted on all aspects of the MMP. Four rounds of consultations were conducted that included focus groups, workshops, surveys, questionnaires and 'drop in sessions'. Details of the consultations and results are provided in a separate report and those sections relevant to climate change are reproduced below.

During Round 1 the need for break walls to reduce erosion was raised as an important issue.

For later consultation stages the MMP was available on the Council's web page and was also provided to attendees at the 'drop in 'sessions held in February 2013. The key statistics of the responses that are relevant to a changing climate were:

- 67 % of respondents have encountered flooding within the Break O' Day region.
- 86 % of respondents utilised the coastline within the Break O' Day area.
- 27% of respondents believed that wet weather impacted their business.

The survey contained 5 climate change specific questions. Table 4 summaries those questions and the responses as they were provided.

Question	Summary of responses
Have you noticed a change in weather patterns in the time that you have lived and/or been farming in the Break O' Day region?	o Warmer summers/daily temperature changes/ more extremes in weather o More frequent flooding of land and roads o More erratic weather patterns especially very heavy downpours o Bigger variations in temperatures within short periods o Stronger winds o Rising sea levels o Shifts in seasons- more hotter periods o Dune reduction south of river. Fires have caused the dunes not to stabilise and recover o Rain comes in big event
What changes have you noticed and if you are a farmer how has this affected the way you farm?	o (need to learn) How to develop/ improve pastures on higher ground o (increased) Fence to restrict stock access to lower areas o Reduced stock o Increase weed control o Reduced yield and cherry trees due to wet/dry fluctuations o Had to take preventative actions against soil erosion. o (increased) Use of Irrigation to lessen effects
What type of weather changes would have a positive or negative effect on the tourism	o Dry summers /high fire danger /extremes in weather o Fewer visitor numbers o Floods – accessibility to area /Not being able to cross

Question	Summary of responses
industry?	bridge to Binalong Bay due to flooding/Hospital flooded o More frequent storm events o Longer summers with less rain would be beneficial for the tourism industry o News agency- in rainy weather usually increases magazine sales o The view that mainland Australia will have more extreme weather than the Tasmanian East Coast
Over the time you have been living or fishing within Break O' Day have you noticed a change in weather patterns?	o Storms seen to be more frequent (intense and unseasonable) o Beaches are eroding o Change in water temperature.
Have these changes affected your recreational / fishing or business?	o Farm(ing) affected but fishing not

Table 4: Community Survey on Climate Change

Several Individual Submissions have been received from Break O'Day residents. The climate change related comments in those submissions were as follows:

Comment 5 - Climate Change

- Limit big development and foreign ownership especially land. Keep businesses local, small and individual in character within the region.
- Climate change must be a major factor in all development in the region.
- Extreme weather event experienced was a hailstorm held on the 31 January 2009. As a result the vegetable crops for that summer season were completely destroyed.
- Noticeable changes within the community of Gray. The area is renowned as one of the highest rainfall areas in Tasmania. The rain that would normally have been received from these clouds was now being deposited in St Mary's/Nicholas area.
- 2006 East Coast Tasmanian Bushfire- some observations of this fire was that the humidity on one occasion was recorded at being 8% and at one time it was believed to be so low that no reading was obtained.

Comment 6 - Emergency Services

- Extreme weather events and climate trends are becoming more prevalent, Australia will have to depend more on volunteer emergency workers.
- Provides ideas for preventing burn-out of volunteers including family support, additional recruitment and training; and employer support;

Comment 11- Upper Esk

- All the residents in the Upper Esk valley rely in rainwater tanks for their water

The input from the community is an indication of level of acceptance of the reality of climate change and its likely impact on Break O'Day. The responses to the survey questions and the individual submissions show that the community is observing the type of weather changes measured by the Bureau of Meteorology and the impact of those changes are already being felt.

7 Opportunities to reduce greenhouse gas emissions

In 2009 the Tasmanian Government published a study called the Tasmanian Wedges Project [12] to identify and cost options that would enable the Government to achieve its' greenhouse gas emissions reduction target of reducing the State's emissions to at least 60 per cent below 1990 levels by 2050.

Emissions of greenhouse gases can be abated by four methods:

- Reducing the level of activity causing emissions.
- Improving the efficiency of use of inputs that cause the emissions.
- Switching to inputs with low emission intensities.
- Switching to technologies with lower emissions.

The abatement options examined in the report were grouped as follows:

- Energy: Renewable energy – wind, solar thermal and solar PV, geothermal, biomass, wave and tidal, energy efficiency options, fuel switching from coal to gas, biomass or geothermal resources, cogeneration of heat and power using natural gas or biomass, substitution of biofuels for liquid fossil fuels in the manufacturing and commercial sectors.
- Transport: Switching to low emission vehicles, switching to biofuels as a fuel, improved vehicle fuel efficiency, improved freight efficiency, travel demand management and improved urban design, and air transport measures.
- Industrial processes: Aluminium industry measures (inert anodes), cement industry measures (limestone substitution, substitution of raw materials, substitution of cementitious materials, use of Tec-Kiln technologies), carbon capture and storage and substitution of biochar for coal as a reductant.
- Agriculture: Production efficiencies, fertiliser and soil management, gut microorganism management.
- Forestry and land use change: New forests, increased bio-sequestration in existing forests, and reversion of agricultural lands to native vegetation states.
- Waste: Flaring, waste to energy (including biofuels and biochar production), landfill emissions energy recovery and utilisation, wastewater emissions energy recovery and utilisation.

Not all of these actions are relevant to Break O'Day. A more local set of options was discussed at the climate change workshops. It was recognised that while everyone's contribution to reducing emissions is important the actual impact that a community of 600 people can have is limited.

The greenhouse gas inventory was presented at the Climate Change workshop and used to identify carbon abatement opportunities. Figure 2 was used to illustrate where the greatest potential is for greenhouse reduction.

The opportunities identified at the workshop were:

- Reduce soil emissions through biodynamic and organic farming practices. Nitrous Oxide (NO_2) is a powerful greenhouse gas with 310 times the global warming potential of CO_2. NO_2 is released from soils after the use of nitrogen based fertilizers. Reducing the use of these fertilizers through changes in farming practices will reduce greenhouse gas emissions from farming soils.
- Introduce incentives for farmers to retain plantations. Plantations are a form of carbon sequestration, retaining them rather than harvesting will reduce emissions. There are opportunities for this type of initiative under the Federal Governments Clean Farming Initiative. Feedback during the workshop indicated that there are barriers preventing changes to farming practices such as:
    - Uncertainty about the options available and the perceived risks of change. Education and local trials of alternatives can reduce this barrier.
    - There is financial risks and limited access to capital to change cropping types and other farming practices that may require different plant and equipment.
- Reduced transport emissions. Salty Seas seafood processing company in St Helens uses six refrigerated trucks per week to ship seafood produce. There may be opportunities to consolidate trucks to reduce the number of partial loads and to export as airfreight from the St Helens airport to further reduce trucking. An end-to-end comparison of airfreight and trucking would need to be conducted to determine the benefits.
- Reduce transport emissions. There may be an opportunity for Council to facilitate car sharing for local trips and travel to Launceston to reduce the single occupant vehicle trips. There are currently two bus services a day to Launceston and one per week to Hobart. Demand may increase if more services were available.
- Reduce transport emissions. There may be opportunities to reduce the number of 4WD vehicles operated by council and replace some of them with smaller vehicles.
- Reduce transport emissions. When asked "What would make Break O' Day area an even better place to live and work?" as part of the community consultations undertaken as part of the development of the Municipal Management Plan (MMP) many of the responses suggested improvements that would also reduce transport emissions from Break O' Day such as:
    - Develop walking and cycling tracks
    - Improve the walkway so people don't have to walk on the road – the walkway along Georges Bay could be developed into a tourist attraction, with sculptures and signage depicting the history of St Helens
    - Bicycle paths along the coast and the hinterland
    - Walking and cycling trails /regular maintenance of walking tracks
    - Improved bus facilities
- Local small scale electricity generation. Bulk buying schemes for solar PV could be facilitated by council to reduce the costs to interested residents. There may also be bulk buy opportunities for energy efficient technology such as LED lighting.
- Local small scale electricity generation. Opportunities for micro hydro schemes exist in areas with permanent creeks such as Pyengana. This will require further investigation and financial analysis. Suitable electrical loads need to be located close to the micro hydro plant.

8 Adaptation analysis

> There is no doubt that we are already seeing and feeling the impacts of climate change, and that we face more profound changes in the coming decades. The impact of these changes on the Tasmanian landscape, our communities and the local economy will be significant. While there will be some major challenges, I genuinely believe that, as Tasmanians, we are a resilient island community. We can adapt and we can prosper in a low carbon economy.
>
> Cassy O'Connor MP
> Minister for Climate Change [26]

The approach used in the adaptation analysis was drawn from the Australia Government guide Climate Change Impacts & Risk Management A Guide for Business and Government [29] and is organised into the following phases:

- Establish the Context - Establish a common view of the how the climate is likely to change at Break O'Day.
- Identify Risks and Opportunities – Conduct a desktop study of existing research to determine the likely impacts that the changes to climate will have in Break O'Day.
- Analysis and Evaluation of Risks and Opportunities – Using existing BODC risk management processes.
- Development of Options and Action Plan
- Implementation of Action Plan and Review of Progress

8.1 Identify risks and opportunities

A climate change risk workshop was conducted in St Helens on 8 February 2013 to gain input from the Council and community into the risks that a changing climate poses the Break O'Day region.

The risk management approach used during the workshop was based on a combination of the Australian Standard for Risk Management (AS/NZS ISO 31000:2009) and the Australian Government Publication – Climate Change Impacts and Risk Management [30]. The process is shown in Figure 18.

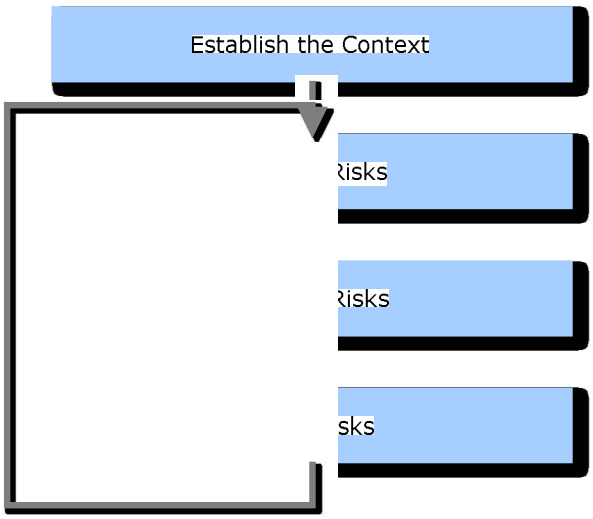

Figure 18: Risk management process

The contextual information described in Section 4 was used during the workshop to develop a common understanding of what climate change is, how the Tasmanian and Break O'Day climate has change and is expected to change and the likely impacts of those changes.

A structured brainstorming approach was used that looked at different locations within Break O'Day and considered the impact of climate change on a range of aspects such as natural environment, built infrastructure such as roads, housing, primary production, access and public amenity. This resulted in a comprehensive list of potential impacts which were then analysed in terms of probability and consequence to assign a risk level to each event.

8.2 Risks analysis

Risks are a combination of probability and consequence. What is the likelihood of an event occurring and what is the resulting impact if it does occur. This enables events that are very unlikely but that have disastrous outcomes to be compared with less serious events that occur more frequently. The thresholds for likelihood and consequence and the risk matrix that combines these two factors were drawn from the BODC risk process. This will enable BODC to compare the risks posed by climate change with other risks faced by BODC.

The combinations of likelihood and consequence used in this analysis are shown in risk matrix in Table 5.

		Consequence				
		Insignificant	**Minor**	**Moderate**	**Major**	**Catastrophic**
Likelihood	**Almost Certain**	Medium	Medium	High	Extreme	Extreme
	Likely	Low	Medium	High	High	Extreme
	Possible	Low	Medium	Medium	High	High
	Unlikely	Low	Low	Medium	Medium	Medium
	Rare	Low	Low	Low	Low	Medium

Table 5: Risk matrix

The likelihood of an event occurring was defined as shown in Table 6. Most of the risks in the risk register were classified using the recurrent risk definitions.

Likelihood	Recurrent risks	Single events
Almost Certain	Could occur several times per year	More likely than not (90-99 %.)
Likely	May arise about once per year	As likely as not (70-89%)
Possible	May arise once in ten years	Less likely than not but still appreciable (30-69%)
Unlikely	May arise once in ten years to 25 years	Unlikely but not negligible (10-29%)
Rare	Unlikely during the next 25 years	Negligible (1-9%)

Table 6: Risk likelihood

The complete set of consequences used by BODC to classify risk is provided in Table 14 at the end of this report. The most relevant to Financial and Environment & Sustainability, these are shown below in Table 7.

Consequence	OH & S	Financial	Local Economy & Growth	Environment & Sustainability
Insignificant	No injuries	Low financial loss < or equal to $5,000	Minor shortfall relative to current forecasts	No environmental damage
Minor	First aid treatment	Medium financial loss > or equal to $50,000	Individually significant but isolated areas of reduction in economic performance relative to current forecasts	Minor instances of environmental damage that could be reversed
Moderate	Medical treatment required	High financial loss > or equal to $500,000	Significant general reduction in economic performance relative to current forecasts	Isolated but significant instances of environmental damage that might be reversed with intensive efforts
Major	Extensive injuries	Major financial loss > or equal to $1m(~2.5% rate revenue)	Regional stagnation such that businesses are unable to thrive and employment does not keep pace with population growth	Severe loss of environmental amenity and danger of continuing environmental damage
Catastrophic	Death	Huge financial loss > or equal to $4m (~10% rate revenue)	Regional decline leading to widespread business failure, loss of employment and hardship	Major widespread loss of environmental amenity and progressive irrecoverable environmental damage

Table 7: Risk consequence

Guidance to responding to each risk is shown in Table 8.

Risk Level	
Extreme	Risks demand urgent attention at the most senior level and cannot be simply accepted as a part of routine operations without executive sanction.
High	Risks are the most severe that can be accepted as a part of routine operations without executive sanction but they will be the responsibility of the most senior operational management and reported upon at the executive level.
Medium	Risks can be expected to form part of routine operations but they will be explicitly assigned to relevant managers for action, maintained under review and reported upon at senior management level.
Low	Risks will be maintained under review but it is expected that existing controls will be sufficient and no further action will be required to treat them unless they become more severe.

Table 8: Risk response

The Climate change workshop was attended by representatives from local council and industry and identified more than 100 climate change related risks for Break O'Day. Each risk can be treated by either reducing the likelihood or the consequence of that risk with priority given to each risk according to its risk level. The aim is to identify treatments that will reduce all risks to either Medium or Low risk level.

An example of how this process is employed is shown in Table 9.

Risk		Analysis			Treatment	Post Treatment Analysis		
Risk Description	Description of consequence	Likelihood	Consequence	Risk Level	Treatment	Likelihood	Consequence	Risk Level
Flooding over entry into St Helens - cuts off town to residents south from city centre	Temporary restriction of access to services and employment	Almost Certain	Minor	Medium	Not required	Almost Certain	Minor	Medium
Flooding over entry into St Helens - cuts route to airstrip for Royal Flying Doctors access	reduced access to emergency medical treatment causing death or severe injury	Possible	Catastrophic	High	Develop alternate route to airstrip	Unlikely	Catastrophic	Medium

Table 9: Example risk treatment

8.3 Key risk areas

Discussion during the workshop and an analysis of the risks identified has highlighted the following key risk areas.

8.3.1 Loss of access to all towns and areas

The potential consequences for loss of or restrictions to access to town centres are:

- Supply limits on certain supermarket items causing inconvenience and potential price increases for residents. This is considered an inconvenience rather than anything more serious because more significant consequences that may be caused by chronic lake of food supplies or medication would be treated differently.
- Fuel cost increases – shortage of supplies for days to weeks could cause price increases
- Major impact on tourism – past experience from flooding and bushfires has shown that the impact on tourism is out of proportion to the actual event. Tourism fell off to St Helen's and Bay of Fires during the recent bushfires even though there were no fires in the immediate area. Visits to the area took some time to recover after flood waters had receded because the perception was that the area was still cut off or difficult to access.

Potential treatments for these risks include:

- In the case of access to St Helens – fix storm water drainage to reduce the incidence of localized flooding.
- St Mary's pass is susceptible to erosion and rock falls which are expected to increase with increased intensity rain events. A potential treatment is to improve drainage and work to straighten the road where practical.
- Treatments for permanent sea level rise include hardening the foreshore in St Helens to restrict the incursion of erosion through wave action and changes to planning guidelines to prevent increasing the number of properties at risk. Building standards for construction on

the foreshore should take into account the potential for flooding and seek to minimise the damage from flooding. The Tasmanian Coastal Adaptation Pathway report for Georges Bay [28] endorsed the introduction of three new codes into the planning scheme related to coastal vulnerability: the Landslip Zone, Flood Prone Area, and Coastal Code. The report also recommended including timeframes for sea level rise and specifying levels of unacceptable risk.

- In the medium term access can be improved by raising the causeway road and upgrades Rieds Road as an alternate access route.
- For Binalong Bay, and other at risk properties, in the longer term retreat options will need to be examined. Retreat, if necessary, will be a very difficult decision to accept both within Council and the community. Ideally a retreat would occur before major property damage but this would require long term planning and consultation to make it acceptable to the Council and residents.
- Impacts on tourism could be reduced by providing better information to the public through advertising, websites, word of mouth and positive stories in the media such as local recreational fishing stories etc.

The Tasmanian Coastal Adaptation Pathway report for Georges Bay [28] made similar adaptation recommendations specifically for the Georges Bay area.

8.3.2 Agricultural productivity

Frosts are projected to decrease significantly with a warming climate. Chilling affects the growth and flowering of berries, fruits and nuts. Accumulated chill hours are projected to decrease significantly in a warming climate, except in high-altitude sites where chilling will in fact increase (areas that are currently too cold).

There is a projected increase in Growing Degree Days (a measure of the heat to grow and ripen crops) of up to 100% or more by the end of the century [23].

Changing temperature and rain fall patterns will change the yield and potential types of crops grown. Reduced stock feed will reduce the productivity of dairy and other stock.

The identified treatments are to increase how well and how quickly farmers are able to adapt. The initial step would be to determine how adaptive farmers are to change and then to identify what if any measure are required to provide assistance.

Anecdotally there are significant barriers to change:

- Set up costs can be significant increasing the financial risks to the farmer.
- Trees and plantations have a long lead time before any income is realised.
- Some land is unsuitable for crops and change is not practical.

Some of these barriers can be addressed by Government actions such as research, trials and education about the alternatives.

There may also be a need to accept that cost of production and productivity may decrease that that farm gate prices will need to increase for the farms to remain viable.

8.3.3 Fisheries and aquaculture

The type and quantity of fish available will change with increase sea temperatures as evidenced by studies into the Rock Lobster colonies.

Aquaculture in the bay may be affected by more intense rain fall. There are periods after rain fall when it is not permissible to harvest oysters based on salinity levels in the bay. It is not clear what effect increased rain intensity will have on this. It may result in reduced frequency of closures but for longer periods.

Treatments for fisheries include adapting to different species. This is technically easier for fishers but the barriers to change are Government regulations such as species specific licenses and catch limits for species.

8.3.4 Sewage treatment

Studies indicate that the St Helens sewage treatment ponds are safe from permanent inundation but may become susceptible to storm tides from 2050. The pump for the current system is lower than the ponds and at risk of flooding. Floods of the sewage system currently shut down aquaculture in the bay for 28 days after each event.

A treatment option is to lift or waterproof current pumps and in the longer term to relocate the facility of use an alternate form of treatment.

Parts of Binalong Bay still use septic tanks which will be subject to overflow with increased flooding.

In the short term this could be treated by ensuring tanks are emptied regularly either through education or through a local council funded service.

In the longer term the risk could be removed through progressively removing septic tanks.

8.3.5 Bay of Fires

Permanent sea level rise will cause a loss of tourism to the Bay of Fires. Protection is not an option for entire section of coast line. Treatment may not be possible; however the level of impact on the Bay and the effect on resulting tourism needs to be determined.

8.4 BODC risk register

The risks detailed in the risk register were broadly grouped according to where the risks occur but there is overlap between the groups in terms of cause and impact. For example flooding risks occur at a number of locations. Flooding can result in damage to public and private infrastructure, temporary loss of access or impacts on primary production. The spread of risks across different locations is Figure 19.

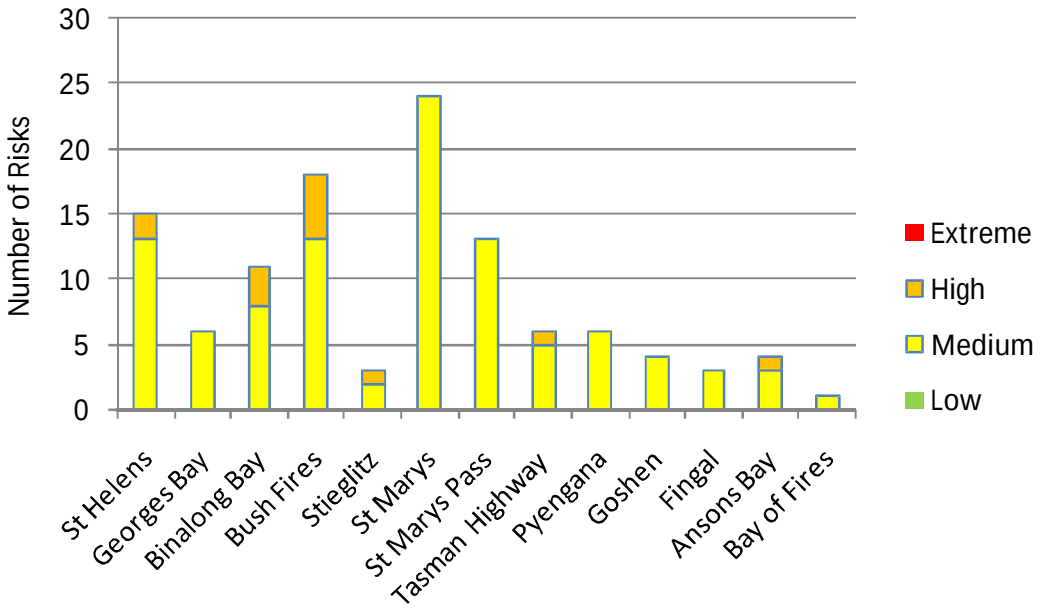

Figure 19: Summary of risks by grouping

The list of risks identified during the workshop and subsequent feedback from BODC was expanded to separate risks with multiple consequences. This appears to result in repetition in the register but is a necessary step since the risk level and treatment may be different for each combination of event and outcome.

The final list of risks is provided in Table 10. The likelihood and consequence ratings applied to the risks are how they were assessed under current circumstance but it is important to note that they will change over time. What is classified as "unlikely" today (may arise once in 10 years to 25 years) will become "possible" (May arise once in 10 years) and even "Likely" (May arise about once per year) as climate change progresses. This has already been seen in St Helens with what were once considered 1 in 100 year flood events occurring more frequently.

The risk register was also provided to Council in the BODC risk template as table 019. This will enable climate change risks to be incorporated in the Council's risk management and review processes.

Of the 101 risks analysed 86% were Medium level risks and 14% High level. No extreme risks were identified. In accordance with BODC guidance, High and extreme risks require treatment.

BODC Risk Number	Risk Description	Description of outcome	Likelihood	Consequence	Risk Level
1	Flooding over southern entry into St Helens - cuts off town to residents south from city centre	Temporary restriction of access to services and employment	Almost Certain	Minor	Medium
2	Flooding over southern entry into St Helens – cuts route to airstrip for Royal Flying Doctors access	Reduced access to emergency medical treatment causing death or severe injury	Possible	Catastrophic	High
3	Flooding over southern entry into St Helens - restricts commercial activity in town	Loss of business revenue	Almost Certain	Minor	Medium
4	Flooding over southern entry into St Helens – limits tourist activity in the short and medium term	Loss of tourist revenue	Almost Certain	Minor	Medium
5	Increased intensity of rainfall on hard surfaces such as roofs and roadways in St Helens	Increases the risk of flooding by overloading designed drainage capacity. Restricted infrastructure and access to community services	Likely	Minor	Medium
6	Flooding effects salinity and pollution levels in Georges Bay which impacts on oyster farming	Reduced aquaculture production leading to reduced revenue and employment	Likely	Minor	Medium
7	Increased sea temperatures increases salinity and decreases Ph in Georges Bay, reduces fish stocks and shellfish species availability	Reduced viability of commercial fishing, reduced employment	Possible	Moderate	Medium
8	Increased sea temperatures increases salinity and decreases Ph in Georges Bay, reduces fish stocks and shellfish species availability	Collapse of commercial fishing industry	Unlikely	Catastrophic	Medium

BODC Risk Number	Risk Description	Description of outcome	Likelihood	Consequence	Risk Level
9	Increased sea temperatures increases salinity and decreases Ph in Georges Bay, reduces fish stocks and shellfish species availability	Reduced tourism for recreational fishing	Possible	Minor	Medium
10	Sea level rise and storm surge causing foreshore erosion in St Helens.	Resulting in loss of public amenity	Possible	Moderate	Medium
11	Sea level rise and storm surge causing foreshore erosion in St Helens.	Resulting in a reduction in tourism in St Helens	Possible	Moderate	Medium
12	Sea level rise and storm surge causing foreshore erosion in St Helens.	Floods sewage pumps causing them to shut down and sewage treatment stops	Possible	Moderate	Medium
13	Increased rain intensity increasing the risk of landslides at St Helens Point Road and Atlas Drive	Resulting in reduced access and property damage	Possible	Moderate	Medium
14	Flooding of St Helens CBD	Requiring the hospital to be evacuated	Possible	Major	High
15	Sea level rise around Georges Bay causes shifts in suitable habitat areas for flora and fauna	Causing loss of salt marsh, beach and riparian vegetation communities and fauna habitat and ecosystem services	Unlikely	Moderate	Medium
16	Projected sea level rise and increased storm intensity may result in more sand entering Georges Bay.	Navigation into Georges Bay will become more dangerous and The Barway will be navigable on fewer occasions. Causing reduced recreational and commercial fishing.	Possible	Moderate	Medium
17	Flooding to Binalong Bay access causeway - cuts off town to residents south from St Helens	Temporary restriction of access to services and employment	Almost Certain	Minor	Medium

BODC Risk Number	Risk Description	Description of outcome	Likelihood	Consequence	Risk Level
18	Flooding to Binalong Bay access causeway – cuts route to airstrip for Royal Flying Doctors access	Reduced access to emergency medical treatment causing death or severe injury	Unlikely	Catastrophic	Medium
19	Flooding to Binalong Bay access causeway – limits tourist activity in the short and medium term	Loss of tourist revenue	Almost Certain	Minor	Medium
20	Flooding to Binalong Bay alternate access route (causeway closed too)- cuts off town for residents north of St Helens	Temporary restriction of access to services and employment	Likely	Minor	Medium
21	Flooding to Binalong Bay alternate access route (causeway closed too) – cuts route to airstrip for Royal Flying Doctors access	Reduced access to emergency medical treatment causing death or severe injury	Unlikely	Catastrophic	Medium
22	Flooding to Binalong Bay alternate access route (causeway closed too) – limits tourist activity in the short and medium term	Loss of tourist revenue	Likely	Minor	Medium
23	Sea level rise and storm surge in low lying areas of Binalong Bay, especially Grants Lagoon	Housing inundation and loss of property value around Grants Lagoon possibly affecting 35 properties	Possible	Major	High
24	Sea level rise and wave erosion in Binalong Bay	Permanent damage of Binalong Bay Road, resulting in major road works and reconstruction	Possible	Major	High
25	Sea level rise and wave erosion in Binalong Bay	Permanent effect housing footing, displacing residents and loss of property value.	Possible	Major	High
26	Intense rain events increase storm water flooding in Binalong Bay	Causing damage to homes in storm water flow path	Possible	Moderate	Medium

BODC Risk Number	Risk Description	Description of outcome	Likelihood	Consequence	Risk Level
27	Intense rain events increase storm water flooding in Binalong Bay	Causing septic tank overflow requiring clean up and repair	Possible	Moderate	Medium
28	Increased temperatures and reduced summer rainfall increase fire risks	Disrupts electricity supply – the consequence will depend on the length of the outage	Possible	Moderate	Medium
29	Increased temperatures and reduced summer rainfall increase fire risks	Homes destroyed	Possible	Catastrophic	High
30	Increased temperatures and reduced summer rainfall increase fire risks	Disrupts access to Break O'Day causing reduction in tourism and other economic activity	Possible	Moderate	Medium
31	Increased temperatures and reduced summer rainfall increase fire risks	Lives lost	Unlikely	Catastrophic	Medium
32	Increased temperatures increasing bush fire risk and incidence	Increased bush fires causing loss of homes	Possible	Major	High
33	Increased temperatures increasing bush fire risk and incidence	Increased bush fires cutting electricity supply, St Marys is supplied by a single 110kV feeder from Palmerston through Avoca	Possible	Moderate	Medium
34	Increased temperatures increasing bush fire risk and incidence	Increased bush fires destroying schools	Possible	Major	High
35	Increased temperatures increasing bush fire risk and incidence	Increased bush fires damaging or destroying hospitals	Possible	Major	High
36	Increased temperatures increasing bush fire risk and incidence	Increased bush fires killing wildlife and destroying habitat	Likely	Moderate	High

BODC Risk Number	Risk Description	Description of outcome	Likelihood	Consequence	Risk Level
37	Increased temperatures increasing bush fire risk and incidence	Increased bush fires limiting access and reducing business activity and tourism	Likely	Minor	Medium
38	Increased temperatures increasing bush fire risk and incidence	Increased bush fires causing loss of agricultural income and property damage such as fences	Possible	Moderate	Medium
39	Increased temperatures increasing bush fire risk and incidence	Increased bush fires causing fires in coal mines	Unlikely	Major	Medium
40	Increased temperatures increasing bush fire risk and incidence	Causing serious injury and loss of life	Unlikely	Catastrophic	Medium
41	Sea level rise and storm surge in low lying areas of Stieglitz	Housing inundation and loss of property value possibly affecting more than 30 properties	Unlikely	Major	Medium
42	Sea level rise and storm surge in low lying areas of Stieglitz	Permanent damage of St Helen's Point Road requiring major rebuild or relocation	Possible	Major	High
43	Sea level rise and storm surge in low lying areas of Stieglitz	Permanent effect housing footing, displacing residents and loss of property value.	Unlikely	Major	Medium
44	Increased flooding of South Esk River in St Marys	Limits access to and from coast isolating residents and the businesses.	Possible	Minor	Medium
45	Increased general flooding of South Esk River in St Marys	Erosion of river banks reducing land available for farming.	Possible	Moderate	Medium
46	Increased general flooding of South Esk River in St Marys	Causing increased stock losses	Possible	Minor	Medium
47	Increased rain fall intensity around St Marys causing increased erosion of road ways	Temporary restriction of access to services and employment	Possible	Minor	Medium

BODC Risk Number	Risk Description	Description of outcome	Likelihood	Consequence	Risk Level
48	Increased rain fall intensity around St Marys causing increased erosion of road ways	Loss of business revenue	Possible	Minor	Medium
49	Increased rain fall intensity around St Marys causing increased erosion of road ways	Loss of tourist revenue that may extend beyond actual loss of access because of public mis-conceptions	Possible	Minor	Medium
50	Increased rain fall intensity around St Marys causing increased erosion of road ways	Reduced access to RFDS and other emergency medical treatment causing death or severe injury	Unlikely	Catastrophic	Medium
51	St Marys Rivulet and associated creeks – flash flooding in St Marys	Causing damage to local property	Possible	Moderate	Medium
52	St Marys Rivulet flooding and undermining Story Road near the recreation ground	Reduced access to recreation ground and clean up and repair costs for council	Possible	Minor	Medium
53	St Marys Rivulet flooding Esk Highway dividing St Marys and restricting access to town and further east	Restricted access to community infrastructure and health care causing serious injury or death	Unlikely	Catastrophic	Medium
54	Increased flooding of Esk Highway between Avoca and St Marys	Loss of tourist revenue that may extend beyond actual loss of access because of public mis-conceptions	Likely	Minor	Medium
55	Droughts around St Marys Pass reduces plant cover reduces stability and Increases landslips restricting access	Temporary restriction of access to services and employment	Possible	Minor	Medium
56	Droughts around St Marys Pass reduces plant cover reduces stability and Increases landslips restricting access	Incurring road repair costs	Possible	Moderate	Medium

BODC Risk Number	Risk Description	Description of outcome	Likelihood	Consequence	Risk Level
57	Droughts around St Marys Pass reduces plant cover reduces stability and Increases landslips restricting access	Loss of business revenue	Possible	Minor	Medium
58	Droughts around St Marys Pass reduces plant cover reduces stability and Increases landslips restricting access	Loss of tourist revenue that may extend beyond actual loss of access because of public mis-conceptions	Possible	Minor	Medium
59	Droughts around St Marys Pass reduces plant cover reduces stability and Increases landslips restricting access	Reduced access to RFDS and other emergency medical treatment causing death or severe injury	Unlikely	Catastrophic	Medium
60	Increased risk of bushfires in St Marys Pass, cutting access between St Helens and St Marys	Temporary restriction of access to services and employment	Possible	Minor	Medium
61	Increased risk of bushfires in St Marys Pass, cutting access between St Helens and St Marys	Loss of business revenue	Possible	Minor	Medium
62	Increased risk of bushfires in St Marys Pass, cutting access between St Helens and St Marys	Loss of tourist revenue that may extend beyond actual loss of access because of public mis-conceptions	Possible	Minor	Medium
63	Increased rain fall intensity around St Marys causing increased rock fall in St Marys pass	Temporary restriction of access to services and employment.	Possible	Minor	Medium
64	Increased rain fall intensity around St Marys causing increased rock fall in St Marys pass	Road and embankment repair costs	Possible	Moderate	Medium
65	Increased rain fall intensity around St Marys causing increased rock fall in St Marys pass	Loss of business revenue	Possible	Minor	Medium

BODC Risk Number	Risk Description	Description of outcome	Likelihood	Consequence	Risk Level
66	Increased rain fall intensity around St Marys causing increased rock fall in St Marys pass	Loss of tourist revenue that may extend beyond actual loss of access because of public mis-conceptions	Possible	Minor	Medium
67	Increased rain fall intensity around St Marys causing increased rock fall in St Marys pass	Reduced access to RFDS and other emergency medical treatment causing death or severe injury	Unlikely	Catastrophic	Medium
68	Sea level rise and storm surge causing erosion to Tasman Highway north of Scamander restricting access north.	Temporary restriction of access to services and employment	Possible	Moderate	Medium
69	Sea level rise and storm surge causing erosion to Tasman Highway north of Scamander restricting access north.	Incurring road repair costs	Possible	Moderate	Medium
70	Sea level rise and storm surge causing erosion to Tasman Highway north of Scamander restricting access north.	Loss of business revenue	Possible	Moderate	Medium
71	Sea level rise and storm surge causing erosion to Tasman Highway north of Scamander restricting access north.	Loss of tourist revenue that may extend beyond actual loss of access because of public mis-conceptions	Possible	Minor	Medium
72	Sea level rise and storm surge causing erosion to Tasman Highway north of Scamander restricting access north.	Reduced access to RFDS and other emergency medical treatment causing death or severe injury	Unlikely	Catastrophic	Medium
73	Sea level rise and storm surge causing erosion to Tasman Highway north of Scamander restricting access north.	Causes damage to settlements incurring repair costs and affecting property prices	Possible	Major	High
74	Increased flooding of the George River at Pyengana	Causing road closures and reduced access	Possible	Minor	Medium

BODC Risk Number	Risk Description	Description of outcome	Likelihood	Consequence	Risk Level
75	Increased flooding of the George River at Pyengana	Incurring road repair costs	Possible	Minor	Medium
76	Increased flooding of the George River at Pyengana	Causing erosion to river banks and farm land, reducing land available for farming, reducing ease of access, reducing production and farm value	Possible	Moderate	Medium
77	Increased flooding of the George River at Pyengana	Increase clean up costs for farmers and council	Possible	Minor	Medium
78	Increased rainfall around Pyengana	Increased landslips reducing access and farm land, reducing production and farm value	Possible	Moderate	Medium
79	Increased periods of drought at Pyengana	Reduced agricultural production particularly dairy, reduced water supply.	Unlikely	Moderate	Medium
80	Increased flooding at Goshen of the George River, Ransom River and associated creeks	Causing road closures and reduced access	Possible	Minor	Medium
81	Increased flooding at Goshen of the George, Ransom and associated creeks	Causing erosion to river banks and farm land, reducing land available for farming, reducing ease of access, reducing production and farm value	Possible	Moderate	Medium
82	Increased flooding at Goshen of the George, Ransom and associated creeks	Increase clean up costs for farmers and council	Possible	Minor	Medium
83	Increased rainfall around Goshen	Increased landslips reducing access and farm land, reducing production and farm value	Possible	Moderate	Medium
84	Increased flooding of the South Esk River in Fingal	Causing damage to homes and roads increasing repair and clean up costs	Possible	Minor	Medium

BODC Risk Number	Risk Description	Description of outcome	Likelihood	Consequence	Risk Level
85	Increased flooding of the South Esk River in Fingal	Flooding the waste water treatment plant in Stieglitz Street.	Possible	Moderate	Medium
86	Reduced rain fall in Fingal region	Reduced town water supplies resulting in water restrictions	Possible	Minor	Medium
87	Increases in sea level and storm surges causing shoreline erosion in Ansons Bay	Causing damage to homes and roads increasing repair and clean up costs. Affecting property values. Dozens of properties at risk.	Possible	Major	High
88	Increased flooding of Ansons River cutting off access to Ansons Bay for the 371 residents	Temporary restriction of access to services and employment	Possible	Minor	Medium
89	Increased flooding of Ansons River cutting off access to Ansons Bay for the 371 residents	Reduced access to medical treatment causing death or severe injury.	Unlikely	Catastrophic	Medium
90	Increased bush fire risk at Ansons Bay	Isolated community with limited access to fire fighting and evacuation places the community and property at greater risk.	Possible	Moderate	Medium
91	Increase in temperature of several degrees making Tasmania a suitable habitat for termites.	Termites causing damage to homes and buildings	Unlikely	Major	Medium
92	Increased sea level and storm surge causing erosion along Bay of Fires	Resulting in erosion events undermining and threatening camping areas, houses and Gardens Road (Taylors Beach), Binalong Bay beach & village, impacting residents, visitors & tourism, habitats, visitor infrastructure	Possible	Moderate	Medium
93	Changes to temperature and rainfall intensity improve conditions for invasive plant species	Affecting ecology of existing species	Possible	Moderate	Medium

BODC Risk Number	Risk Description	Description of outcome	Likelihood	Consequence	Risk Level
94	Changes to temperature and rainfall improve conditions for invasive plant species	Reducing agricultural production	Possible	Moderate	Medium
95	Increased maximum temperature and length of hot spells.	Affecting health through heat stress of elderly residents	Likely	Moderate	High
96	Extreme seasonal variations reducing agricultural production	Causing reduced revenue to farmers	Possible	Moderate	Medium
97	Increased temperatures increase suitability for fruit fly	Reduced fruit production and reduced income for orchard operators	Unlikely	Moderate	Medium
98	Decline in demand for coal due to response to climate change – secondary impact	Reduced employment and business activity	Unlikely	Major	Medium
99	Sea level rise and storm surge causing foreshore erosion in St Helens.	Resulting in erosion events undermining and threatening infrastructure (SW path-sewage main, roads at Moulting Bay, O'Conners Beach, Boggy Creek	Unlikely	Moderate	Medium
100	Sea level rise and storm surge causing foreshore erosion in St Helens.	Floods shut down sewage treatment service and sewage overflow for more >2 days	Rare	Catastrophic	Medium
101	Flooding to Binalong Bay access causeway - cuts off town to residents south from St Helens	Prolonged closed access to services and employment, and Reids Road is closed at the same time	Possible	Moderate	Medium

Table 10: BODC Climate Change Risks

8.5 Risk treatment

The risks posed by particular events can be managed by reducing either the likelihood or the consequence of the event. The aim is to employ a range of treatment strategies to reduce either of these to bring the risk to an acceptable level.

The Commonwealth Government's guide to Climate Change Impacts & Risk Management [29] provides an overview of different types of possible measures that can be adopted as risk treatments that is shown in Table 11.

Treatment Type	Description and examples
Spread risk	Insurance and diversification strategies: o Use of financial products that off-lay the risk o Geographical diversification
Structural and technological	Prevent effects through engineering solutions and changed practices: o Increase reservoir capacity o Implement energy demand management measures o Scale up coastal protection measures o Change design of storm-water systems o Build more resilient housing o Install more efficient irrigation systems o Create wildlife corridors
Regulatory and institutional	Prevent or mitigate effects through revised regulations and planning: o Adopt integrated planning approaches o Amend local planning schemes to give greater weight to flood risk o Revise guidance notes for urban planners o Amend building design standards o Increase resources for coastal planning o Factor climate change into criteria for designation of species or ecosystems requiring increased protection o Improved contingency and disaster planning o Lengthen strategic planning horizons (from say 5-10 years to 20-30 years)
Avoidance	Avoid or exploit changes in risk: o Grow new crops o Migration of people way from high risk areas o Change location of new housing developments o Improve forecasting systems to give advance warning of extreme climate events
Research	Research to improve understanding of relationship between climate change and risk: o Improve knowledge of relationship between past and present variations in climate and performance of economic, social and environmental systems o Improve modelling of regionally-based climate change impacts o Improve knowledge of the probability of frequency and magnitude of changes to extreme climate events and other climate variables under climate change o Improve understanding of the relationship between changes to frequency and magnitude of extreme events and critical thresholds for individual risks
Education, behavioural	Educate and inform stakeholders about the risks of climate change: o Increase public awareness about the potential impacts of climate change and about climate change adaptation measures o Educate and inform management and personnel about climate change risks and adaptation measures

Table 11: Risk treatment options

The particular treatment options for sea level rise are often classed as either:

- Protect

- o Accommodate or
- o Planned retreat.

Each of these is described in more detail in Appendix A – Sea Level Rise Adaptation Options.

There were 14 risks requiring treatment all of these were classified as high level risks. These along with suggested treatments and residual risks are shown in Table 12.

BODC Risk No.	Risk	What can happen?	Risk Rating Before treatment	Treatment	Risk Rating After treatment
2	Flooding over southern entry into St Helens – cuts route to airstrip for Royal Flying Doctors access	Reduced access to emergency medical treatment causing death or severe injury	High	Identify alternate route to airstrip, determine when it will be necessary to quarantine land from other uses	Medium
14	Flooding of St Helens CBD	Requiring the hospital to be evacuated	High	Quantify flooding risk and examine protection options such as levies	Medium
23	Sea level rise and storm surge in low lying areas of Binalong Bay, especially Grants Lagoon	Housing inundation and loss of property value around Grants Lagoon possibly affecting 35 properties	High	Identify at risk properties, examine protection methods, and examine insurance implications. Develop longer term resettlement plan	Medium
24	Sea level rise and wave erosion in Binalong Bay	Permanent damage of Binalong Bay Road, resulting in major road works and reconstruction	High	Identify alternate route or methods of raising and hardening causeway	Medium
25	Sea level rise and wave erosion in Binalong Bay	Permanent effect housing footing, displacing residents and loss of property value.	High	Identify at risk properties, examine protection methods, and examine insurance implications. Develop longer term resettlement plan	Medium
29	Increased temperatures and reduced summer rainfall increase fire risks	Homes destroyed	High	Reduce risk by preparing properties at risk. Educate population about risks and insurance options	Medium
32	Increased temperatures increasing bush fire risk and incidence	Increased bush fires causing loss of homes	High	Reduce risk by preparing properties at risk. Educate population about risks and insurance options	Medium

BODC Risk No.	Risk	What can happen?	Risk Rating Before treatment	Treatment	Risk Rating After treatment
34	Increased temperatures increasing bush fire risk and incidence	Increased bush fires destroying schools	High	Reduce risk by preparing properties at risk. Ensure that insurance is adequate	Medium
35	Increased temperatures increasing bush fire risk and incidence	Increased bush fires damaging or destroying hospitals	High	Reduce risk by preparing properties at risk. Ensure that insurance is adequate. Identify alternate facilities.	Medium
36	Increased temperatures increasing bush fire risk and incidence	Increased bush fires killing wildlife and destroying habitat	High	Identify at risk species, develop strategies to reverse environmental damage	Medium
42	Sea level rise and storm surge in low lying areas of Stieglitz	Permanent damage of St Helen's Point Road requiring major rebuild or relocation	High	Identify alternate route or methods of raising and protecting roadway	Medium
73	Sea level rise and storm surge causing erosion to Tasman Highway north of Scamander restricting access north.	Causes damage to settlements incurring repair costs and affecting property prices	High	Identify at risk properties, examine protection methods, and examine insurance implications. Develop longer term resettlement plan	Medium
87	Increases in sea level and storm surges causing shoreline erosion in Ansons Bay	Causing damage to homes and roads increasing repair and clean up costs. Affecting property values. Dozens of properties at risk.	High	Identify at risk properties, examine protection methods, and examine insurance implications. Develop longer term resettlement plan	Medium
95	Increased maximum temperature and length of hot spells.	Affecting health through heat stress of elderly residents	High	Identify at risk residents, identify refuge areas such as library and public air-conditioned buildings	Medium

Table 12: Summary of risk treatments

8.6 Opportunities

Warming climate and reduced climate impacts relative to other states may present opportunities for Tasmania and Break O'Day. For example they could result in:

- increased tourism as other destinations become less attractive as they become relatively hotter and dryer,
- increased crop yields through reduced frost days,
- increased migration from other states to Tasmania,

- increased forestry production,
- greater potential for biofuels production,
- greater farm gate prices if yields decrease in interstate agricultural areas,
- increased suitability for some grape varieties, and
- increased property prices due to decreases in mainland production.

8.7 Action Plan

The development of a climate change action plan will an ongoing part of the implementation of the Municipal Management Plan.

An initial set of recommended actions are summarised in Table 13. These were developed from the mitigation options and key risks identified during the climate change risk workshop and the risk treatments in Table 12. This list is not exhaustive; many of the later actions will be driven by the results of internal risk reviews and allocation of resources. Each action has a recommended completion date and a suggested person responsible from BODC to implement the action. Each action also identifies what is within the Councils ability to influence or control and considers activities currently planned or underway as listed in the Break O'Day Council Strategic Plan 2011 – 2015, the Annual Plan 2012/2013 and the Annual Report 2011 – 2012.

Later items in this list should be seen as suggestions. There are however, actions that should be undertaken now to ensure that addressing climate change becomes part of the BODC normal business activities.

In General these actions fit within the BODC Strategic Plans goal of Environment and Planning and in particular Strategy 6. Minimise the impacts of climate change. Other relevant activities and plans of Council are listed with particular actions in Table 13.

Action	Person Responsible	Suggested Completion date
Management		
Appoint a person responsible for climate change risk management in BODC.	General Manager	2013
Incorporate climate change risks into BODC risk process. This within the Strategic Planning goal of Leadership and Governance and in particular Strategy 7 which incorporates risk management processes.	Corporate Services Manager	2013
Validate climate change risk events, likelihoods and consequences. This should be completed by the BODC risk management team but the Corporate Services Manager is ultimately responsible.	Corporate Services Manager	2013 – ongoing
Risk factors, adaptation methods and mitigation options will change over time as technology develops and as the impacts of climate change continue to emerge. The risk register will need to be reviewed at least annually. Probability and consequence levels for existing risks will need to be re-	BODC risk management team	2013 – ongoing

Action	Person Responsible	Suggested Completion date
evaluated in the light of better quality information.		
Establish relationships with community organisations and state and commonwealth government agencies to leverage existing resources and reduce direct burden on BODC. This could be incorporated into the Strategic Planning goal of Community Building in particular Strategy 2. Provide opportunities for people to come together and develop connections and networks.	Climate Change Manager appointed by the General Manager	2013
Cost and prioritise each treatment option at least to a high level budgetary. Leverage work already done by organisations like Victorian Centre For Climate Change Adaptation Research (www.vcccar.org.au), The National Climate Change Adaptation Research Facility (www.nccarf.edu.au) and Antarctic Climate & Ecosystems CRC.	Climate Change Manager	2014
Amend Break O'Day Planning Scheme in accordance with the recommendations in the Tasmanian Coastal Adaptation Pathways report for Georges Bay [28]. In particular to introduce timeframes for sea level rise and to identify the levels of unacceptable risks for flood prone. Consider the impact of climate change on all new developments.	General Manager	2013
Mitigation		
Agricultural emissions. Several options were presented at the workshop that would reduce soil emissions by changing farm practices. Agricultural emissions are dominated by enteric emissions from livestock. Soil emissions represent 6% of total emissions from Break O'Day. Any effort to reduce these emissions would only have a marginal effect on total emissions and there are state and federal Government programs in place to address emissions from agriculture. BODC action is to monitor these programs for relevance to Break O'Day.	Development Services Manager, NRM Facilitator	Ongoing
Retain plantations – Land converted to forest land and land converted to grassland are the two largest contributors to Tasmania's greenhouse gas emissions profile. The first results in sequestration of carbon and the second in emissions of greenhouse gases. These two factors largely balance each other out in the inventory leaving a small overall contribution to the total. Minor changes to each can have a significant impact on emissions, effecting this change are largely out of BODCs control. It is assumed that changes to State	Development Services Manager, NRM Facilitator	Ongoing

Action	Person Responsible	Suggested Completion date
Government policy are already monitored by BODC for their impact on Break O'Day.		
Transport emissions – consolidate trucking. The increase in fuel consumption between a partially and fully loaded truck or van is marginal. Trucks should wherever possible be fully loaded. This is a particular challenge with time critical deliveries such perishable goods. Anecdotal evidence from Salty Seas is that they have collections from around 6 trucks per week which are not all fully loaded. Assuming this means an extra two commercial van trips to Launceston per week then over 10 tonnes of CO2-e could be mitigated if these trips were avoided. BODC could facilitate a freight distribution centre was established to consolidate freight into and out of St Helens.	Works and Infrastructure Manager	2014
Transport emissions – car sharing to Launceston. At 11.5 thousand tonnes a year car emissions make up 54% of Break O'Day's transport emissions and 12% of total emissions. A return trip to Launceston in a midsized car results in approximately 50kg of CO_2-e. Avoiding 10 trips per week through car sharing would reduce emissions by 26 tonnes CO_2-e per annum. Council could facilitate car sharing through information and education. This could be incorporated into the Strategic Planning goal of Community Building in particular Strategy 2. Provide opportunities for people to come together and develop connections and networks.	Community services Manager	2013
Transport emissions – reduce number of council 4WD vehicles. A small car like a Mazda 3 produces 40% less greenhouse gases than a large 4WD. Assuming an average of 30,000km per year, replacing a 4WD with a smaller vehicle would reduce annual emissions by 2.7 tonnes (and fuel consumption by 1,120 litres) for each vehicle. Council should establish a policy of choosing smaller cars by default and use 4WD only where necessary.	General Manager	2013
Transport emissions – encourage cycling and walking to reduce vehicles kilometres travelled. A small car will produce around 145 grams of CO_2-e per km. A 4WD will produce at least twice that. The length of the average trip in Break O'Day will be longer than that in cities such like Launceston but there is still an opportunity to reduce vehicle trips by making it safer and more convenient to walk and cycle. Cycle and foot paths should be included in any new development and	Works and Infrastructure Manager	2014

Action	Person Responsible	Suggested Completion date
considered for existing roads.		
Encourage small scale renewables. The electricity supply in Tasmania is has the lowest carbon intensity of any state in Australia. Electricity generation accounts for only 16% of energy emissions and 8% of emissions overall. However, there are benefits to small scale renewables such as domestic solar PV. They raise the general awareness and understanding of energy and encourage energy efficiency. They are a direct way for residents to take action on climate change and reduce their energy costs. Council can play a role in encouraging small scale renewable by facilitating bulk buy schemes and by taking a leadership role by installing renewables on council buildings. This could be incorporated into the Strategic Planning goal of Environment and Planning and in particular Strategy 4. Adopt environmental sustainability principles in undertaking Council activities.	Works and Infrastructure Manager	2014
Primary Production		
Identify alternate crops for a warmer and dryer climate. This work will primarily be done by the State Government Department of Primary Industries, Parks, Water and Environment. BODC should establish relationships with this department where they don't already exist so that they can advise local farmers what options and information is available and to ensure that any studies or trials meet the needs of Break O'Day.	Development Services Manager, NRM Facilitator	2013
Commercial and recreational fishing is an important aspect of Break O'Days' economy. Identifying new species for harvest and changing fishing regulations is outside the power of BODC. BODC should work with organisations such as RedMap (http://www.redmap.org.au/region/tas/) and the Institute for Marine and Antarctic Studies (http://www.imas.utas.edu.au/) to quantify risks for fisheries and adaptation options.	Development Services Manager, NRM Facilitator	2015
Heat stress		
Identify cool havens for residents susceptible to heat stress, such as the elderly. These may be libraries or council buildings.	Community Services Manager	2013
Break O'Day residents may not be as accustomed to heat waves as people in more northern parts of Australia. It may	Community Services	2016

Action	Person Responsible	Suggested Completion date
be necessary to run an awareness program to educate residents on what to do and options available during heatwaves. This could include information about cool havens.	Manager	
Flooding - Access		
Access to RFDS services during flooding was raised several times during the workshops. The current route along the Tasman Highway and St Helens Point Road is subject to flooding and is vulnerable to sea level rise and storm surges. By the end of the century parts of St Helens Point Road will be under water at high tide. To reduce the risk of reduced access causing injury or death because of poor access to RFDS services it will be necessary to identify an alternate route to the aerodrome. This could be incorporated into the Strategic Planning goal of Environment and Planning and in particular Strategy 1. Provide a sound framework for strategically planned and orderly future development by updating and improving Land Use Strategy and Planning Scheme.	Works and Infrastructure Manager	2014
If necessary protect the land required for an alternate route to the aerodrome through planning restrictions.	Works and Infrastructure Manager	2105
Binalong Bay Road is the main route between Binalong Bay and St Helens. It is already subject to periodic flooding and this will increase with increased rain intensity, rising sea levels and increased storm intensity. To reduce the risks of this lack of access it is necessary to identify an alternate route to Binalong Bay such as bitumising Mount Pearson State Reserve Road or identify methods of raising and hardening Binalong Bay causeway. Annual budget estimates for these options are provided in Tasmanian Coastal Adaptation Pathways Project for Georges Bay [28]. These options need to be investigated so that their costs can be included in future budgets. This falls under the Strategic Planning Goal of Asset Management and in particular Strategy 2. Develop and implement a 10 year asset management plan for all classes of assets.	Works and Infrastructure Manager	2014
Once an option for alternate access to Binalong Bay has been determined it will be necessary to determine which financial year it will need to be budgeted for.	General Manager, Works and	2015

Action	Person Responsible	Suggested Completion date
	Infrastructure Manager	
Flooding – Property damage		
This study has identified areas that will be at risk from sea level rise and storm surges. Further work is required to quantify flooding risk in terms of number and value properties at risk for different sea levels. Aspects of this work are being conducted under the Storm Water Management Plan as part of the MMP.	Works and Infrastructure Manager	2014
The flooding risks to properties and how those risks are managed will vary depending on whether the flooding risk is due to sea level rise or increased rainfall intensity. It is necessary to identify properties at risk in terms temporary flooding, permanent inundation and erosion risks. The Tasmanian Coastal Adaptation Pathways Project for Georges Bay [28] identified 18 dwellings currently at risk from inundation which will increase to 22 by 2050 and 43 by 2100. These have a present day value of up to $1.4 million.	Works and Infrastructure Manager, Development Services Manager	2014
The Council may be liable for future flooding events if they approve developments in areas that have been identified in this and other studies. It will be necessary to review planning restrictions to reduce the number of new properties being exposed to future risks.	Development Services Manager	2014
There are measures that can be taken to reduce flooding risks from storm water. Risk areas have been identified but it is necessary to examine protection measures for those areas such as levies.	Works and Infrastructure Manager,	2015
Areas in Ansons Bay, Grants Lagoon, Binalong Bay and Georges Bay have been identified as at risk of permanent inundation due to future increases in sea level. Protection is impractical for most of those sites and it will be necessary to develop a longer term resettlement plan for properties at risk of permanent inundation. The long term options for St Helens as detailed in the Tasmanian Coastal Adaptation Pathways Project for Georges Bay [28] are to protect with levees or dykes or to evacuate the site and relocate the CBD. The introduction of dykes or levees may reduce the aesthetic values of the town that levees are seeking to protect. Long term relocation may be more difficult but most appropriate option. Retreat and relocation will be contentious decision and will required long	General Manager, Works and Infrastructure Manager, Development Services Manager	2016

Action	Person Responsible	Suggested Completion date
term planning and consultation to achieve a consensus within Council and the community. Preliminary work to examine the options should begin as soon as possible. This falls under the Strategic Planning Goal of Asset Management and in particular Strategy 2. Develop and implement a 10 year asset management plan for all classes of assets.		
The sewage treatment works in St Helens is a risk from flooding. In medium term risk is for flooding of the sewage treatment pumps. In the longer term the ponds themselves are at risk from high tides and simultaneous storm surges. These will need to be sealed as recommended in the Tasmanian Coastal Adaptation Pathways Project for Georges Bay [28] or relocated. The pumps will need to be raised or somehow protected and in the longer term the treatment works will require protection through levy banks or relocation to another site.	Works and Infrastructure Manager,	2014
Opportunities		
Investigate opportunities identified during the workshop and incorporate into the economic development plan. This falls under the Strategic Planning Goal of Economic Development and in particular Strategy 1. Develop and implement initiatives to attract people to live, work and invest in the Council area.	General Manager, Development Services Manager	2013
Fire Risks		
Aspects of managing bush fire risks are within the control of the State Government agencies such as the Tasmanian Fire Service, Department of Infrastructure, Energy Resources and the Department of Primary Industries, Parks, Water and Environment. There are areas that Council can influence such as raising awareness in the community to increased risks and working with the CFA to identify properties at risk from bush fires. This falls under the Strategic Planning Goal of Building Community and in particular Strategy This falls under the Strategic Planning Goal of Economic Development and in particular Strategy 5. Minimise the impact of disasters by improving community and Council's preparedness.	Works and Infrastructure Manager, Corporate Services Manager	2013
Assess how well prepared at risk properties are in terms of physical protection and fire plans as well as adequate	Community Services	2013

Action	Person Responsible	Suggested Completion date
insurance cover.	Manager	
Work with the Tasmanian Department of Primary Industries, Parks, Water and Environment to identify any threatened, vulnerable and endangered species. Develop a set of local actions to reduce the risks to these species.	Development Services Manager	2013

Table 13: Action plan

9 Conclusions

A significant amount of work has already been completed by Commonwealth, State and Local Governments to identify and quantify the changes to climate that have already occurred and that are expected to occur in the Break O'Day region. These include:

- Increasing average and peak temperatures
- Decreasing rain fall particularly in summer
- Increasing rain fall intensity and storm intensity
- Increasing sea temperatures
- Increasing sea levels

Measurements by the Bureau of Meteorology and other agencies have shown that these changes are occurring now and are likely to accelerate in the future. These changes to climate will have an impact on Break O'Day.

Consultation with the community has identified a set of 101 climate change related risks. These risks were classified using BODC risk templates and processes. 86% were found to be Medium level risks and 14% High level. The High Level risks were primarily related to:

- Reduced access due to flooding
- Property damage due to storm water, sea level rise and erosion
- Increased bush fire risk and
- Effects on primary production

A treatment method for each High Level risk has been suggested and this formed the basis for an Action Plan. It is important to note that even though the worst effects of climate change are in the future it critical that action is taken now to prepare for an reduce the impact of future changes.

Council may be making planning decisions now that could be increasing the likelihood of future climate change impacts such as flooding of new developments, location of roads and other infrastructure that may place them at higher risk and designing the capacity of stormwater systems to cope with increased rain fall intensity and rising sea levels. Climate change related risks need to be incorporated into the Councils normal business processes including risk management to ensure that future changes in climate are taken into account in council decisions. This may require the allocation of personnel and resources. Risk factors, adaptation methods and mitigation options will change over time as technology develops and as the impacts of climate change continue to emerge. The risk register will need to be reviewed at least annually. Probability and consequence levels for existing risks will need to be re-evaluated in the light of better quality information and new risks added. These changing risks will drive changes in the treatment methods and action plans.

There may also be positives for Break O'Day from a changing climate. The detrimental effects of climate change in Tasmania are likely to be less severe than those experienced in other parts of Australia. This could place Tasmania at a relative advantage presenting opportunities such as:

- In increased tourism as other destinations become less attractive as they become hotter and dryer.
- Increased crop yields through reduced frost days.
  Increased migration from other states to Tasmania.
- Increased forestry production.
- Greater potential for biofuels production.
- Greater farm gate prices if yields decrease in interstate agricultural areas.
- Increased suitability for some grape varieties.
- Increased property prices due to decreases in mainland production.

While not the focus of this report these opportunities deserve investigation.

10 References

1. SGS Economics and Planning Pty. Ltd., Climate change impacts On Clarence coastal areas – Final Report. 2009: Tasmania.
2. Miller, B., Inspection of Clarence City Beaches following Winter 2011 Storm Events, C.C.C. P Watson, PO Box 96, Rosny Park TAS 7018, Editor. 2011.
3. White CJ, G.M., Corney SP, Bennett JC, Holz GK, Sanabria LA, McInnes KL, Cechet RP, Gaynor SM & Bindoff NL, Climate Futures for Tasmania - Technical Report - Extreme Events. 2010.
4. Corney SP, K.J., McGregor JL, Grose MR, Bennett JC, White CJ, Holz GK, Gaynor SM & Bindoff NL, Climate futures for tasmania - Technical Report - Climate Modelling. 2010, Antarctic Climate & Ecosystems Cooperative Research Centre.
5. Holz GK, G.M., Bennett JC, Corney SP, White CJ, Phelan D, Potter K, Kriticos D, Rawnsley R, Parsons D, Lisson S, Gaynor SM and Bindoff NL, Climate Futures for Tasmania - Impacts on Agriculture Technical Report. 2010, The Antarctic Climate & Ecosystems Cooperative Research Centre.
6. Tasmanian Government, Local climate profile Break O'Day Municipality, T. Government, Editor. 2011.
7. Australian Bureau of Agricultural and Resource Economics and Sciences, Potential effects of climate change on forests and forestry: Summary for Tasmania. 2011, ABARES: Canberra.
8. Bennett JC, L.F., Graham B, Grose MR, Corney SP, White CJ, Holz GK, Post DA, Gaynor SM & Bindoff NL, Climate Futures for Tasmania Water and Catchments Technical Report. 2010, Antarctic Climate & Ecosystems Cooperative Research Centre: Tasmania.
9. Sharples, C., Indicative Mapping of Tasmanian Coastal Vulnerability to Climate Change and Sea-Level Rise: Explanatory Report 2nd Edition 2006.
10. Climate Commission, The Critical Decade - Tasmanian impacts and opportunities. Climate Commission.
11. Pecl G, F.S., Gardner C, Haward M, Hobday A, Jennings S, Nursey-Bray M, Punt A, Revill H, van Putten and I, The east coast Tasmanian rock lobster fishery – vulnerability to climate change impacts and adaptation response options. 2009, Australian Government.
12. MMA, Tasmanian Greenhouse Gas Emission Reduction Project - Understanding the Potential for Reducing Tasmania's Greenhouse Gas Emissions. 2009.
13. Rand, S., Break O'Day Council Georges Bay Coastal Inundation Vulnerability. 2011, Pitt & Sherry.
14. Australian Government, Climate Change Risks to Australia's Coast - A First Pass National Assessment. 2009, Department of Climate Change.
15. Australian Government. National Greenhouse Gas Inventory - Kyoto Protocol Accounting Framework. 2012 [cited 2012 November 2012]; Available from: http://ageis.climatechange.gov.au/.
16. Grose MR, B.-K.I., Corney SP, White CJ, Holz GK, Bennett JB, Gaynor SM and Bindoff NL, Climate Futures for Tasmania: general climate impacts technical report. 2011, Antarctic Climate & Ecosystems Cooperative Research Centre: Hobart, Tasmania.
17. Bureau of Meteorology. Australian climate variability & change - Trend maps. 2012 [cited 2012 October]; Available from: http://www.bom.gov.au/cgi-bin/climate/change/trendmaps.cgi?map=tmean&area=tas&season=0112&period=1970.
18. Intergovernmental Panel on Climate Change. Reports. 2007 [cited 2012 July]; Available from: http://www.ipcc.ch/publications_and_data/publications_and_data_reports.shtml#1.
19. Tasmanian Government, Local climate profile - Break O'Day Municipality. Antarctic Climate and Ecosystems CRC.
20. Bureau of Meteorology. Trend in annual total rainfall. 2011 [cited 2011 Nov]; Available from: http://www.bom.gov.au/web01/ncc/www/cli_chg/trendmap/rain/0112/tas/1970/latest.gif.

21. Australian Government. Tasmania Rainfall Change 2050 50th Percentile. Australia's Future Climate 2012 [cited 2012 November]; Available from: http://climatechangeinaustralia.com.au/tasrain20.php.

22. Australian Government. Tasmania Rainfall Change 2070 50th Percentile. Australia's Future Climate - Tasmania Rainfall Change 2012 [cited 2102 November]; Available from: http://climatechangeinaustralia.com.au/tasrain23.php.

23. Tasmanian Government. Local climate profile - Break O'Day Municipality. 2011 [cited 2012 October]; Available from: http://www.dpac.tas.gov.au/__data/assets/pdf_file/0007/160990/Break_O_Day.pdf.

24. CSIRO, Climate Change in Australia - Technical Report. 2007, CSIRO.

25. Bureau of Meteorology. Sea Surface Temperatures for the Tasman Sea. 2011 [cited 2011 Nov 2011]; Available from: http://www.bom.gov.au/web01/ncc/www/cli_chg/trendmap/sst/0112/tas/1970/latest.gif.

26. Tasmanian Government, Adapting to Climate Change in Tasmania - Issues paper. 2012, Tasmanian Climate Change Office.

27. The University of New South Wales, Inspection of Clarence City Beaches following Winter 2011 Storm Events. 2011, The University of New South Wales: Sydney.

28. SGS Economics and Planning Pty. Ltd., Tasmanian Coastal Adaptation Pathways Project - Georges Bay. 2012: Hobart.

29. Australian Government, Climate Change Impacts & Risk Management A Guide for Business and Government, D.o.t.E.a. Heritagee, Editor. 2006, Australian Greenhouse Office: Canberra.

30. Government, T.A. Climate Change Impacts & Risk Management - A Guide for Business and Government. Climate Change, 2006.

Appendix A – Sea Level Rise Adaptation Options

Adaptation Reponses to sea level rise will be classed as Protect, Accommodate or Retreat as discussed below [14].

Protect

Protection of the shoreline typically involves the construction of seawalls or other defences to maintain coastal assets in their current location. It includes the repeated nourishment of beaches with sand and engineering works, such as tide gates, to constrain flooding.

Many protection works will have a decadal life, as they will be constructed to a particular standard that will be exceeded over time with climate change. As indicated in Chapter 2, the effectiveness of beach nourishment will decrease over time as beaches switch from being stable to eroding.

Areas where ongoing coastal protection is a long-term option include highly developed urban areas with a long history of protection, and areas where there is a need to preserve irreplaceable cultural, Indigenous and heritage values.

The public will often call for protection when private property is threatened by coastal erosion. However, the use of protective structures can also lead to a false sense of security and encourage greater development in areas behind protective structures, than for similar locations that do not have protective barriers. Protection should only be considered as a long-term option as part of a wider management plan for the area.

Costs	Benefits
• Construction and ongoing maintenance costs could be high • Expectations that area will continue to be protected can limit the flexibility of retreat options in the future • Costs are likely to be much higher if structures fail, because their construction encourages development in protected areas compared with similar but unprotected areas • Impacts on areas upstream or downstream of protective works include loss of coastal and marine habitats	• Avoided damages or loss of land and structures • Continued public access to beaches and other recreational areas • Improved public safety

Accommodate

Accommodation includes a range of usually minor works to allow continued or extended use of at-risk areas. Measures include elevated floor requirements, increased setback requirements, and preparation of emergency evacuation plans.

Accommodation measures are often cost-effective in a transitional strategy. They are suitable for areas with modest to higher value assets where exposure to climate change risk is low to medium. An example is The Honeysuckles, Ninety Mile Beach, Victoria where new residents are required to provide a response plan to climate change, identifying how structures would deal with possible

flooding and storms for the next 60 years, and a caveat is included on the property title to warn future owners of risk. While accommodation strategies may also generate a false sense of security, they do start to signal restricted access or development requirements and begin a difficult task of managing private ownership development expectations.	
Costs	Benefits
• Marginal additional construction costs • Costs from loss or damage that may occur if measures not adequate • Possible reduction in investment values	• Continued use of land and infrastructure • Generally less impact on surrounding environment than protection measures • Generally cheaper than protective measures • Increased public safety • Promotes risk management

Planned retreat	
Planned or managed retreat involves a decision to withdraw, relocate or abandon assets that are at high risk of being affected by climate change hazards in the coastal zone. In the longer term, planned retreat often provides the most cost-effective approach to managing risks to medium to high-value assets exposed to inundation or erosion risk. Planned retreat, which can occur on a range of scales, can involve increased setback provisions, relocation of structures within properties, and rezoning of land (for example, to constrain ribbon development in high risk areas or to provide for horizontal migration of wetlands). It can include buyouts of properties. At present there have been few experiences with planned retreat to deal with climate change, with the exception of Byron Bay. Lessons can also be learned from property relocations caused by the construction of new dams. In some areas, early community consultation suggests that there could be opposition to the early adoption of planned retreat. Options for implementing planned retreat would probably include a mix of regional planning, constraints on property title, financial instruments and insurance incentives.	
Costs	Benefits
• Lost value of land, infrastructure, and social, economic and environmental values • Potential compensation costs for loss of land or infrastructure • Management costs associated with retreat plan (for example, removal of septic tanks as houses retreat)	• Increased public safety • Significantly lower ongoing maintenance costs than for protection measures • Reduced need for costly adaptation measures in future, should risks increase • Potentially allows for greater space for ecosystems to horizontally adapt

Appendix B – Table of Risk Consequences

Consequence	OH & S	Public Safety	Financial	Local Economy & Growth	Community & Lifestyle	Environment & Sustainability	Public Administration
Insignificant	No injuries	Appearance of threat but no actual harm	Low financial loss < or equal to $5,000	Minor shortfall relative to current forecasts	Minor areas in which municipality unable to maintain current services	No environmental damage	Minor instances of public administration being under more than usual stress but it could be managed
Minor	First aid treatment	Serious near misses or minor injuries	Medium financial loss > or equal to $50,000	Individually significant but isolated areas of reduction in economic performance relative to current forecasts	Isolated noticeable examples of decline in services	Minor instances of environmental damage that could be reversed	Isolated instances of public administration being under severe pressure
Moderate	Medical treatment required	Small number of injuries	High financial loss > or equal to $500,000	Significant general reduction in economic performance relative to current forecasts	General appreciable decline in services	Isolated but significant instances of environmental damage that might be reversed with intensive efforts	Public administration would be under severe pressure on several fronts

Consequence	OH & S	Public Safety	Financial	Local Economy & Growth	Community & Lifestyle	Environment & Sustainability	Public Administration
Major	Extensive injuries	Isolated instances of serious injuries or loss of lives	Major financial loss > or equal to $1m(~2.5% rate revenue)	Regional stagnation such that businesses are unable to thrive and employment does not keep pace with population growth	Severe and widespread decline in services and quality of life within the community	Severe loss of environmental amenity and danger of continuing environmental damage	Public administration would struggle to remain effective and would be seen to be in danger of failing completely
Catastrophic	Death	Large numbers of serious injuries or loss of lives	Huge financial loss > or equal to $4m (~10% rate revenue)	Regional decline leading to widespread business failure, loss of employment and hardship	The municipality would be seen as very unattractive, stagnant and unable to support its community	Major widespread loss of environmental amenity and progressive irrecoverable environmental damage	Public administration would fall into decline and cease to be effective

Table 14: Risk consequence