GLAMORGAN SPRING BAY COUNCIL CORPORATE ADAPTATION PLAN

April 2012

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Input to the Plan was provided by David Hunn and David Lovell, Joint Chief Executive Officers, Southern Tasmanian Councils Authority and representatives of the Regional Climate Change Initiative (RCCI).

Technical input into this Plan was provided by:

- Michael Grose - Municipal-scale climate change modelling projections from Climate Futures Tasmania
- David Taylor - Bushfire modelling based BRAM model (P&WS) augmented with Climate Futures data
- Tony Davidson - Sea level rise mapping from Climate Futures Tasmania and Tasmanian Planning Commission
- Shaun McElwaine - Legal comment
- Louise Gilfedder - Natural values at particular risk from climate change, specific to each municipality
- Workshop participants & Glamorgan Spring Bay Council

- Stakeholders engaged through consultation

Disclaimer

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Executive Summary

There is an expansive and growing body of scientific evidence indicating that the global climate is changing and that extreme weather events and sea level rise will increase in the 21st century. Local Government is well positioned to work with communities in managing and preparing for the impacts of climate change for a number of reasons, particularly, its local knowledge and experience, its understanding of community needs and vulnerabilities, and its key role in responding to emergencies.

Key climate change risks for the Glamorgan Spring Bay municipal area (by 2100) include the following:

- The temperature of very hot days to increase by up to 4°C.
- Extended heat waves and more extreme temperatures are likely to enhance the occurrence and intensity of bushfire.
- Rainfall trending towards heavier events interspersed by longer dry periods.
- Extreme rainfall events such as the 200-year average recurrence interval, 24-hour storm to increase in magnitude by up to 90%, or 110mm.
- Inundation along Glamorgan Spring Bay's coast to continue to increase in frequency and severity.
- The current 100-year storm tide event (0.9 to 1.4 m above average sea level) may become a 50-year event by 2030, and a 2 to 6-year event by 2090.

Key vulnerabilities for Glamorgan Spring Bay in relation to the climate change risks include the following:

- An increase in heat related illness and mortality, particularly in vulnerable demographics such as the elderly.
- New invasive weed species leading to loss of agricultural production and degradation of natural habitats.
- Large areas of low lying land becoming vulnerable to flood inundation as a result of increased intensity storms.
- Reduced capacity of Council's stormwater infrastructure leading to a need for greater expenditure in order to maintain current service levels.
- Severance of communities along Glamorgan Spring Bay's expansive coast due to sea level rise and storm surge, particularly around the Dolphin Sands area.
- Loss of life in major bushfire events as bushfire becomes increasingly frequent and severe across Glamorgan Spring Bay, especially in and around the Coles Bay Conservation Area.

In taking action to address Glamorgan Spring Bay's vulnerabilities a key overarching consideration is the potential liability exposure in relation to an adopted action, or inaction in particular circumstances. Advice to the Regional Councils Climate Change Adaptation Project is that councils will not be liable for existing use or development, nor will liability be incurred for

'no action' in response to climate impacts. Should council take action there could be liability if that action causes harm or damage. Council may also be found liable for operational advice such as in the assessment of planning applications and new developments.

This Adaptation Plan presents specific adaptation actions for each of Council's business areas. Council staff in relation to Glamorgan Spring Bay's priority climate change risks defined the actions. Many of the actions are not overly onerous on Council and involve implementation of policy or strategy into existing processes. For example, actions such as Implementation of new Council policy requiring proper consideration for climate change projections in the design and construction of new Council assets. A range of initiatives were also considered including new collaborative effort to manage invasive weeds with key stakeholders across the municipality and around the region.

In all, this Adaptation Plan proposes 27 actions to address priority climate change risks specific to Council business and aligned to Council's organisational structure. The Plan also recognises the significant body of work currently being undertaken by Council's 'stakeholders' across the community that contribute to meeting climate change adaptation objectives for Southern Tasmania. The Plan identifies stakeholder linkages to assist in identifying collaborative opportunities, resource sharing and to avoid duplication of efforts wherever possible. For example, Southern Water has raised the following points:

- Consideration for periodic and gradual inundation needs to be made when approving developments adjacent to the coast or flood prone areas to ensure an adequate setback for water and sewer infrastructure.
- Reduced water availability is identified as a key climate change risk and requires better collaboration in relation to setting growth boundaries around towns, so that population limitations are set within the sustainable yield profile of the drinking water catchment.
- Bushfire management is a key strategic risk as it has huge effects upon drinking water catchments, service provision, abnormal demand management spikes, hydrant performance, and power outages to water and wastewater infrastructure. Council and the Tasmania Fire Service could jointly help manage these risks with Southern Water in a number of ways, an area that would benefit greatly from further discussion.

This Adaptation Plan incorporates an approach to implementation, key components of which include: incorporation of key risks and adaptation actions into established Council documents and processes (e.g. risk register, strategic plan, asset management plans); identification of a mechanism to implement sub-regional and regional adaptation actions through advocacy or collaboration; and a mechanism for plan review and updating.

Glamorgan Spring Bay's Climate Change Snapshot

Tasmania is fortunate to have had the highest resolution climate modeling conducted in Australia. The recently completed Climate Futures for Tasmania project provides a sound knowledge base for identifying climate related risks at a local level and subsequently in informing appropriate decisions to manage the risks. Climate Futures for Tasmania prepared a detailed report specifically for Glamorgan Spring Bay municipality, this report is provided in Appendix A. The material provided below is a summary of key points from the report.

Current climate and recent trends

- Glamorgan Spring Bay has a temperate, maritime climate with relatively mild winters. Average temperatures have risen in the decades since the 1950s, at a rate of up to 0.1 °C per decade.
- Glamorgan Spring Bay receives around 600-700 mm of rainfall per year. There has been a decline in average rainfall and a lack of very wet years in the municipality since the mid 1970s, and this decline has been strongest in autumn.

Projected change in conditions by 2100 (A2 emissions scenario)

Table 1: Projected changes for Glamorgan Spring Bay by 2090 - 2099 relative to the baseline period (1980-1999)

	Change	**Relative change**
Temperature (annual average)	+2.6 to 3.3°C	
Summer days (>25°C)		+100%
Warm spells (days)	3-5 days longer	+90%
Hottest day of the year	+4°C	
Frost risk days/year		-90%
Rainfall	Increase in summer-autumn	Up to 20%
Rainfall (wettest day of the year)	+12 mm	+20%
Rainfall extreme (ARI-200)	Up to +110 mm	+90%
Evaporation		+19%
Runoff	Increase considerably in summer & autumn	+30%
River flows (Little Swan port)		+15%
Coastal inundation	100-year event becomes a 2 to 6-year event	

Extreme events

The changes in climate that are most likely to impact upon council's infrastructure, roads, and the local community and environment is a magnification in intensity of extreme events. Specific impacts on Glamorgan Spring Bay municipality are as follows:

- The temperature of very hot days to increase by up to 4°C. Warm spells (days in a row where temperatures are in their top 5%) currently last around 5 days and will increase by up to 5 days.
- Extended heat waves and more extreme temperatures are likely to enhance the occurrence and intensity of bushfires.
- High daily runoff events, including those that may lead to erosion or flooding, are likely to increase, particularly in summer and autumn. Seasonal flows in the Little Swan port River are likely to increase by as much as 45%. Rainfall volume in a 200-year average recurrence interval (ARI) event may increase by up to 110 mm (90%).
- Inundation along the coastline will increase. The current 100-year storm tide event is around 0.9 to 1.4 m above average sea level, and accounting for sea level rise (0.82 m), the current 100-year coastal inundation event may become a 50-year event by 2030, and a 2 to 6-year event by 2090.

Examples of location specific priority climate change risks for Glamorgan Spring Bay identified by council staff through the RCCAP engagement process are presented in figure 1.

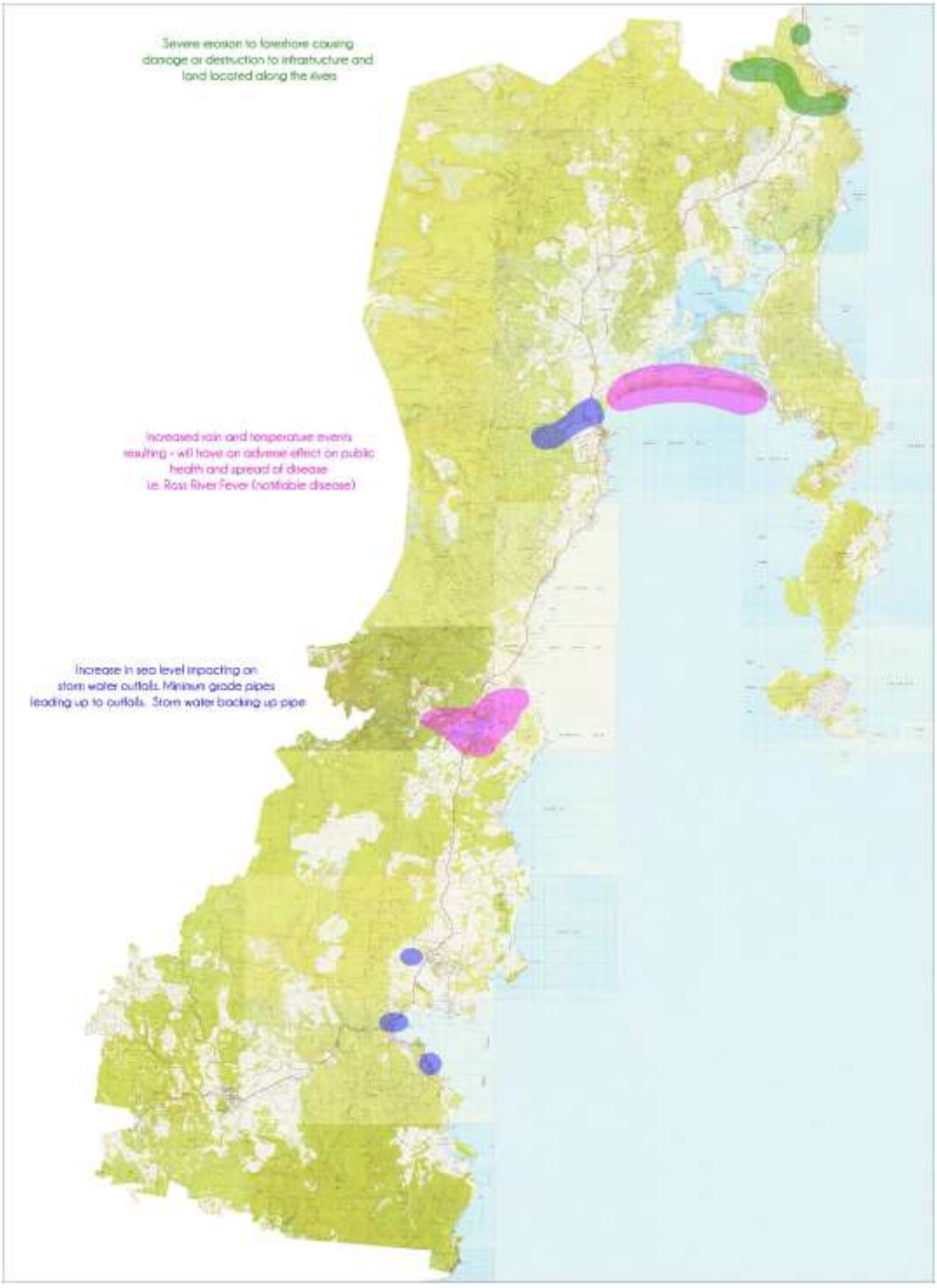

Figure 1: Examples of Glamorgan Spring Bay's priority climate change risk

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1. Introduction

1.1 Project Background

The Regional Councils Climate Adaptation Project (RCCAP) aims to improve the capability and resilience of Tasmanian councils to manage the risks of climate change. The 'pilot' phase of the project was conducted in Tasmania's Southern Region. The project's key outputs are:

- Council (corporate) Climate Change Adaptation Plans for each of the 12 southern councils;
- a Regional Climate Change Adaptation Strategy covering themes common to all councils; and
- a Climate Adaptation Toolkit for review of Council's Adaptation Plans and extension to Cradle Coast and Northern Councils.

RCCAP was funded by the Australian Government's Local Government Reform Fund (LGRF), administered by the Department of Regional Australia, Local Government, Arts and Sport. The Hobart City Council also provided a financial contribution of 20% of the overall project funds.

The project was delivered by the Southern Tasmanian Councils Authority (STCA) in partnership with the Tasmanian Climate Change Office and the Local Government Association of Tasmania.

The project was initiated by the Southern Tasmanian Councils Authority's Regional Climate Change Initiative, a working group with representatives from each of the 12 Southern councils.

1.2 Project Context

There is an expansive and growing body of scientific evidence that the global climate is changing and that extreme weather events and sea level rise will increase in the 21st century[1]. It is now recognised that there are a range of potential future climate scenarios dependent upon the scale of effort achieved in reducing greenhouse gas emissions. Even if the composition of today's atmosphere was fixed (which would imply a dramatic reduction in current emissions), surface air temperatures

[1] IPCC, 2011: Summary for Policymakers. In: Intergovernmental Panel on Climate Change Special Report on Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation [Field, C. B., Barros, V., Stocker, T.F., Qin, D., Dokken, D., Ebi, K.L., Mastrandrea, M. D., Mach, K. J., Plattner, G.-K., Allen, S., Tignor, M. and P. M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

would continue to warm by up to 0.9 ºC[2]. Under a 'best case scenario' where significant reductions in greenhouse gas emissions are achieved it is still pertinent to initiate an adaptation response in order to minimise climate change impacts associated with the warming climate on infrastructure, economy, community and the environment.

In Australia, it is recognised by all tiers of government that it is appropriate and effective to manage climate change at a 'local' scale. The Australian Government recognises that Local Governments will be key actors in adapting to the local impacts of climate change and their engagement will be a critical part of any national reform agenda[3]. It has produced publications aimed at assisting local government manage climate change risk[4] and implement adaptation actions[5]. The Tasmanian Climate Change Office also works in a collaborative manner to support local government in climate change adaptation projects.

Scope is also afforded to Tasmanian councils to address climate change under the *Local Government Act* (Tas) 1993, which describes the role of councils to provide for the health, safety and welfare of the community; as well as represent and promote the interests of the community; and provide for the peace, order and good government of its municipal area.[6]

In managing and preparing for the impacts of climate change, Local Government is well positioned to work with communities due to its:

- core function to directly support and assist local communities;
- local knowledge and experience;
- understanding of community needs and vulnerabilities;
- key role in responding to emergencies;
- role in infrastructure design, construction and maintenance;
- role in review and update of planning schemes (in relation to identified local impacts and threats); and
- ability to effectively disseminate information and provide support to the community.

Pioneering work undertaken by Clarence City Council with its community identified local government as the most trusted tier of government with regards to information on climate change[7].

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[2] IPCC, 2007: Climate Change, 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Solomon, S., D. Qin, M. Manning (eds.)].

[3] Department of Climate Change, 2010: Adapting to climate change in Australia, an Australian Government Position Paper

[4] Australian Greenhouse Office, 2006: Climate Change Impacts and Risk Management – a Guide for Business and Government.

[5] Department of Climate Change, 2009: Climate Change Adaptation Actions for Local Government.

[6] *Local Government Act* (Tas) 1993.Section 20 Function and Powers.

[7] SGS Economics and Planning, July 2007: Socioeconomic Assessment and Response for the climate change impacts on Clarence's Foreshore, for the Clarence City Council

Local experience, in combination with relevant scientific data and technical expertise, provides the key inputs for undertaking a well informed 'risk management' approach to climate change. Moreover, effective adaptation requires a portfolio of actions, ranging from fortifying infrastructure, building capacity (individual and institutional) to advocacy and collaboration. There is also an appreciation that managing current and future risks in relation to climate change can have benefits (such as improving human well-being and protecting biodiversity) regardless of the magnitude of climate change that occurs. It is in this context that the RCCAP is based.

1.3 Legal Implications of Climate Change Action

Councils are at the forefront of responding to climate change impacts and increasingly local communities are looking to their councils to provide solutions to adapt to, manage, transfer or share the risks associated with climate change impacts[8]. A key consideration of councils in the face of climate change is potential liability that they are exposed to through their various statutory roles, powers and functions.

To this end the RCCAP engaged Shaun McElwaine + Associates (SMA) to provide advice on the legal context within the impacts of climate change reside and how they relate to local government as a whole. Councils are encouraged to consider the advice in full.

Overall the advice is consistent with the legal comments provided to Clarence City Council and the Australian Local Government Authority:

- Legal issues for local government in addressing coastal erosion risks, A research report for Clarence City Council, Dr. Jan McDonald, 18 March 2011 (McD); and
- Local Councils Risk of Liability in the Face of Climate Change Resolving Uncertainties; a report for the Australian Local Government Association, Baker and McKenzie, 22 July 2011 (B&K).

The main 'legal' concern for councils is the potential liability that they are exposed to through their adopted action or inaction in particular circumstances. The advice established that overall councils will not be liable for existing use or development, nor will they incur liability for 'no action' in response to climate impacts, however should they take action they could be liable should that action cause harm or damage. It also considered that councils might be found liable for operational advice such as the assessment of planning applications and new developments. It contained three options for councils to pursue, with the State Government (1 & 2 below) and in their own capacity (point 3 below) 3, to reduce their exposure and potential liability:

[8] Baker and McKenzie; 22 July 2011, 'Local Council Risk of Liability in the Face of Climate Change – Resolving uncertainties' A report for the Australian Local Government Association

1. Amendment to LGA to insert equivalent to s733 LGA NSW.

2. Review State Coastal Policy 1996 – needs to be more specific about what is required i.e.:

   - how planning schemes must deal with the impacts of climate change;
   - specific recommendations and guidelines to manage climate change impacts; and
   - set prescribed levels for seal level rise in developed coastal regions throughout the State.

3. Formulation of statewide code to deal with climate change impacts (Outcome achieve uniform set of provisions across the State) that:

   - is measureable i.e. contain specific development controls;
   - removes decision making from planning authorities;
   - not require risk analysis; and
   - sets prescribed levels for seal level rise in developed coastal regions throughout the State.

Refer to Section 3.5.1 for more specific information regarding the state of play in regard to a 'coastal hazards code'.

The advice also noted that whilst the development and adoption of a [council's CCAP] 'climate risk plan and/or action/s' was positive it would also set the standard for the discharge of the duty of care. Thus if a council did not take the climate risk plan and or action/s into consideration when making operational decisions it may become liable for the consequences of the operational decision.[9]

Disclaimer

The purpose of the advice is for local government generally and an individual council should not rely upon it. No liability is accepted for the content of the advice, or for the consequences of any actions taken on the basis of the information provided. If an individual council wishes to rely upon the advice it is recommended that they seek their own advice prior to doing so.

1.4 Purpose and scope

This adaptation plan aims to improve the capability of Glamorgan Spring Bay Council to manage the risks associated with climate change.

The development of this plan was based upon council-specific, climate projection data provided by the Antarctic Climate and Ecosystems Cooperative Research Centre (ACE CRC) 'Climate Futures for Tasmania'. Detail of the climate projections for

[9] **McElwaine, 2011, p.24**

Glamorgan Spring Bay Council is given in Section 2, with reference to the local climate profile developed specifically for the Glamorgan Spring Bay municipal area[10]. The plan identifies potential climate change risks within the context of currently available climate change data. Scientific research and modelling of climate change is continually evolving. Therefore, there is a potential that future climate change projection data may require reassessment of the risks, actions and timeframes identified in this Plan.

Specific outputs from the modelled climate scenario for Glamorgan Spring Bay, such as future rainfall patterns, extreme events, bushfire likelihood and projected sea level rise formed the basis of 'risk management' and 'adaptation action' workshops held with council staff in development of this plan. Workshops were conducted in a manner consistent with the International Organisation for Standardisation (ISO) 31000:2009 Standard for Risk Management as well as the Australian Government publication *Climate Change Impacts and Risk Management: A Guide for Business and Government*. Full details of the project methodology are documented in Appendix B.

Outputs of the workshops conducted with council staff underlie the content of this plan. The plan is structured so that prioritised adaptation actions have been allocated to specific business units within Council. Each priority action has associated roles, responsibilities and timeframes.

The plan also presents adaptation actions to manage risks that are within council's sphere of influence, but are the responsibility, to some degree, of other organisations (such as State Government Agencies, Community Groups and Private Corporations). The primary purpose of the 'stakeholder' section of this plan is to ensure there is: clear understanding of roles and responsibilities; clarity as to where partner organisations are at in managing climate change risk; and identification of collaborative opportunities for managing risks that are relevant to local communities.

This adaptation plan incorporates an 'implementation plan' to ensure there is:

- a consistent process for plan endorsement by all councils of the region;
- a logical way for incorporation of key local risks and adaptation actions into council documents and processes such as risk registers, strategic plans, annual plans or asset management plans;
- an appropriate mechanism to implement sub-regional and regional adaptation actions either through advocacy or collaboration; and
- a mechanism for plan review and updating.

[10] Michael Grose, Antarctic Climate and Ecosystems Cooperative Research Centre, Nov 2011 *Local Climate Profile: Glamorgan Spring Bay Municipality* (Using material from the set of technical reports of the Climate Futures for Tasmania project)

2. Climate Change and Council's Corporate Risks

The present section considers climate change projections for each of the key climate impacts. The findings for priority climate change risks, as identified by Council representatives through Glamorgan Spring Bay's risk assessment workshop, are presented along side the science. The identified risks provide the basis for adaptation actions outlined in Section 3 of this plan.

2.1 Heat

Climate Change Projections

HEAT

(A2 emission scenario)

By 2100 in Glamorgan Spring Bay:

- Annual average temperature projected to increase by 2.6 to 3.3°C
- Warm spells are projected to increase by 3 to 5 days
- The hottest day of the year is expected to increase by 4°C
- 90% fewer frost risk days per year

(Antarctic Climate and Ecosystems Cooperative Research Centre, Nov 2011)

Rising average temperatures and more frequent extreme hot days have the potential to cause a variety of impacts on Council and the community. Such impacts include heat related illness and mortality, particularly in vulnerable demographics such

as the elderly, impacts on council's infrastructure and property as well environment degradation. Furthermore, extended heat waves and more extreme temperatures are likely to enhance the occurrence and intensity of bushfires in the area.

Vulnerabilities

HEAT

Changes to average and extreme temperatures in Glamorgan Spring Bay may result in:

- New invasive weed and pathogen species leading to loss of agricultural production and natural habitats
- An increase in heat related illness and mortality, particularly in vulnerable demographics such as the elderly
- Greater frequency and intensity of bushfires

An interesting priority climate change risk identified by Council staff, relating to an increase in average temperature, was the potential for increased water temperatures and ocean acidification, triggering impacts on aquatic biodiversity as well as on the local aquaculture industry.

Table 2: Priority risks associated with an increase in average temperature for Glamorgan Spring Bay Council

Risk Code	Risk Statement	Success criteria	Risk Level	Council services primarily affected	Other stakeholders
AT1	Increased water temperatures and ocean acidification leading to changes in fish species / diversity etc. with possible consequence for aquaculture and biodiversity issues. An increased demand on Council's NRM activities.	Environmental	Extreme	Natural Resource Management	Industry Groups – Fisheries, Department of Primary Industries, Parks, Water and Environment
AT2	Increased water temperatures and ocean acidification leading to changes in fish species / diversity etc. with possible consequence for aquaculture resulting in community financial issues	Reputation	Extreme	Natural Resource Management	Industry Groups – Fisheries, Department of Primary Industries, Parks, Water and Environment

2.2 Rainfall

Climate Change Projections

RAINFALL

(A2 emission scenario)

By 2100 in Glamorgan Spring Bay:

- Rainfall is expected to trend towards heavier events interspersed by longer dry periods
- The wettest day of the year is projected to increase by 12mm or 20%
- Extreme rainfall events (24 hour duration, 200ARI) are projected to increase by 110mm or 90%
- Flows in Little Swan Port are projected to increase by up to 15%
- Runoff across the municipal area is projected to increase by up to 30%

(Antarctic Climate and Ecosystems Cooperative Research Centre, Nov 2011)

Projected changes in rainfall, runoff and river flows for the period 2090-2099, presented in summary in the box above, have the potential to impact significantly on Glamorgan Spring Bay Council and its community. Some of the most severe impacts may include flooding of infrastructure and property, issues around water security and environmental degradation across the area.

Vulnerabilities

RAINFALL

Changes in rainfall in Glamorgan Spring Bay may result in:

- Large areas of low lying land becoming vulnerable to flood inundation as a result of increased intensity storms
- Reduced capacity of Council's stormwater infrastructure leading to a need for greater expenditure in order to maintain current service levels
- Health risks due to more frequent inundation of Southern Water's sewer network resulting in contaminated spills

Climate change is projected to bring about increased rainfall variability for the Glamorgan Spring Bay region, which could include reduced annual and seasonal rainfall combined with more frequent and intense peak rainfall events. The priority risks associated with these climate change impacts tended to reflect mainly the environmental health concerns of Council staff. For example, the risk to public health associated with the spread of disease vectors, which may result from more frequent flooding events. The psychological impact on community as a result of loss of agricultural viability was also identified as a key risk to Council.

Table 3: Priority risks associated with increased rainfall variability

Risk Code	Risk Statement	Success criteria	Risk Level	Council services primarily affected	Other stakeholders
Community and Health					
RV1	Increased rainfall leading to an increase in stormwater loading on local beaches, resulting in lower water quality and a possible increase in spread of disease.	Reputation	High	Environmental Health	EPA
RV2	Increased rainfall and temperature variability leading to a need for changes in a variety of crops and agricultural management practices, resulting in financial and psychological impacts on landholders and rural communities.	Community and lifestyle	High	Environmental Health	Rural Support Network Tasmania, NRM South, Industry Groups - Agriculture
Environment					
RV3	Increased rainfall and temperature variability leading to changes in a variety of crops and agricultural management practices, resulting in possible new detrimental impacts on the environment.	Environmental	High	Natural Resource Management	NRM South, Industry Groups - Agriculture

With an average annual cost of $6.7 million between the years 1967 to 1999, flooding is considered the second most costly natural disaster impacting on Tasmania and Tasmanian lifestyles (wildfire being the first). This was recognised by Council staff with a number of flood related risks assessed as priority. These risks included impacts on infrastructure, such as roads and stormwater, inappropriateness of current land use planning and development controls, and community health issues associated with disease vectors.

Table 4: Priority risks associated with increased flooding

Risk Code	Risk Statement	Success criteria	Risk Level	Council services primarily affected	Other stakeholders
Community Health and Safety					
FL1	Inundation of low lying areas for extended periods triggering disease vectors (e.g. sewer related diseases) resulting in impacts on community health	Public Safety	High	Environmental Health	Department of Health and Human Services
Flooding of Council Assets					
FL2	Flooding of infrastructure assets (e.g. road asset network, stormwater, walking tracks, parks) resulting in impacts on council budgets, particularly where assets are not insured	Financial	Extreme	Infrastructure and Property	Insurance provider
FL5	Increased flooding causing degradation of road networks/bridges resulting in increased ongoing maintenance costs or reduced level of service	Service Delivery	High	Infrastructure and Property	-
Flooding of Private Infrastructure					
FL3	Increased risk of flooding resulting in an increased danger to low lying homes. Changes to Council's planning regulation and decisions leading to public confusion and an in increase in complaints	Reputation	Extreme	Planning	-
FL4	Increased flooding may result in a need to change land use planning zones which may trigger community dissatisfaction and litigation due to potential impacts on property values	Financial	High	Planning	-
FL6	Increased extent of residential properties in low lying areas subject to flooding, resulting in increased frequency of litigation action	Financial	High	Corporate Services	-

2.3 Sea Level Rise and Storm Surge

Climate Change Projections

Sea Level Rise and Storm Surge

(A2 emission scenario)

- The current 100-year coastal inundation event may become a 50-year event by 2030, and a 2 to 6-year event by 2090
- Inundation events are projected to increase in frequency and impacted area along the extent of Tasmania's east coast.

Sea levels around the Tasmanian coastline have risen 18 centimetres over the past 100 years. This trend is projected to continue with inundation along Glamorgan Spring Bay coastal frontage expected to increase.

The current 100-year storm tide event is around 0.9 to 1.4 m above average sea level, and accounting for sea level rise (0.82 m) and high river flows, the current 100-year coastal inundation event may become a 50-year event by 2030, and a 2 to 6-year event by 2090.

Changes in gradual sea level combined with more extreme storm surge events will trigger a range of impacts on Glamorgan Spring Bay Council such as encroachment of wetlands onto residential properties, degradation of stormwater and road infrastructure and impacts on residential property assets.

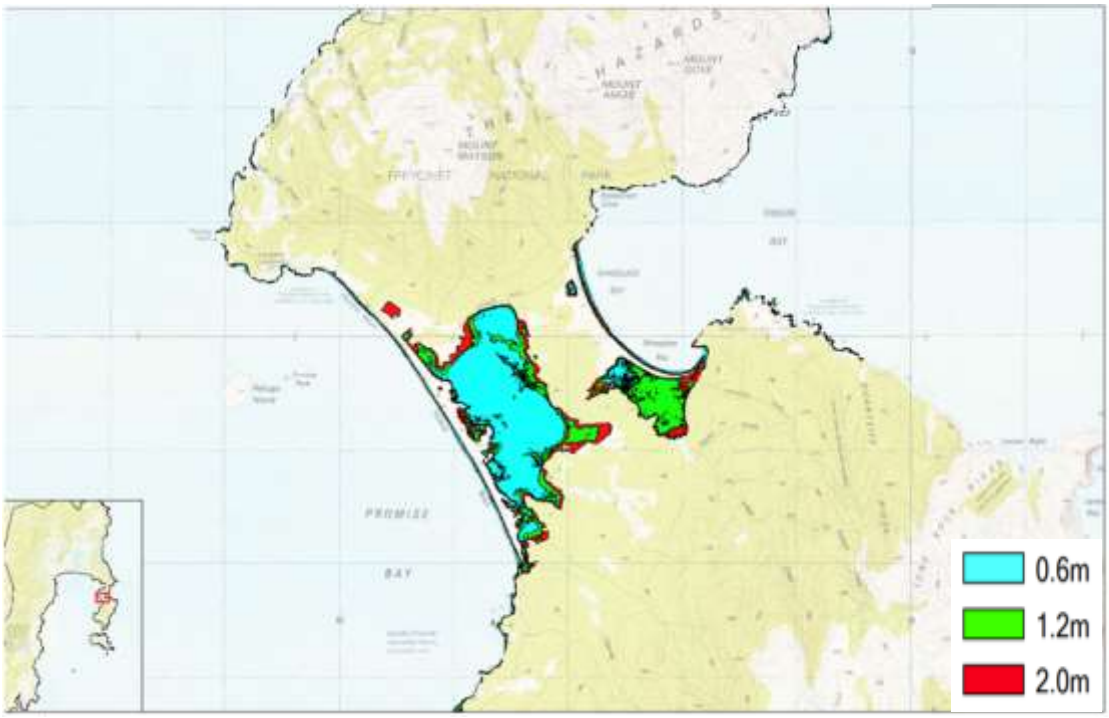
Sea level rise mapping overlays were produced by 'LiDAR' digital elevation modelling (DEM) as part of the Tasmanian Coastal Inundation Mapping Project (A component of Climate Futures for Tasmania project). The DEM is currently limited to about a third of the Tasmania coast including most of the populated areas. Sea level rise mapping for Glamorgan Spring Bay is

presented in Figure 2.

The sea levels modelled under the project were at set heights above the National Tidal Centre (NTC) high water mark and were: 0.2, 0.4, 0.6, 0.8, 1.0, 1.2, 1.6 and 2.0 metres. The landward edge of the mapped sea level rise 'footprints' indicates the potential location of the 'back of the beach' or upper part of the shore in the future. **These height values were set by the Tasmanian Planning Commission to enable visualisation of these heights and evaluation of the impact of such sea levels.**

Limitations

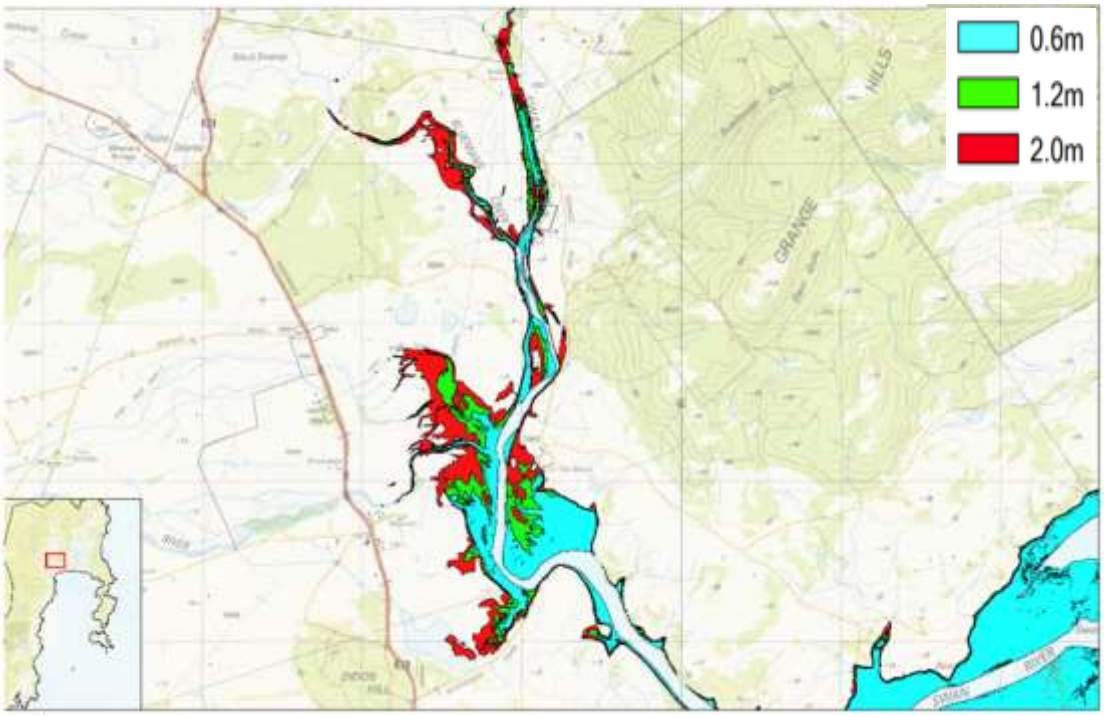
The 'permanent sea level rise' approach makes use of a simple geographic modelling method that includes a limited set of the contributing factors to inundation of the shoreline. This 'bathtub' method is essentially a passive model and assumes a calm sea surface. The method does not account for the complexity of the full range of interacting factors and forces that actually occur on the shoreline such as erosion, soil types, wave climate, wind, freshwater flooding or event timing and clustering.




0.6m
1.2m
2.0m
MOUNT STACEY
STATE
GLAMORGAN
CENTRAL
Picnic Island
COLES BAY
COLES
BAY


0.6m
1.2m
2.0m


0.6m
1.2m
2.0m
SWANSEA
Waterloo Beach
Waterloo Point
SWANSEA AND COSWELL BEACH
COASTAL RESERVES


0.6m
1.2m
2.0m
GRANGE
HILLS

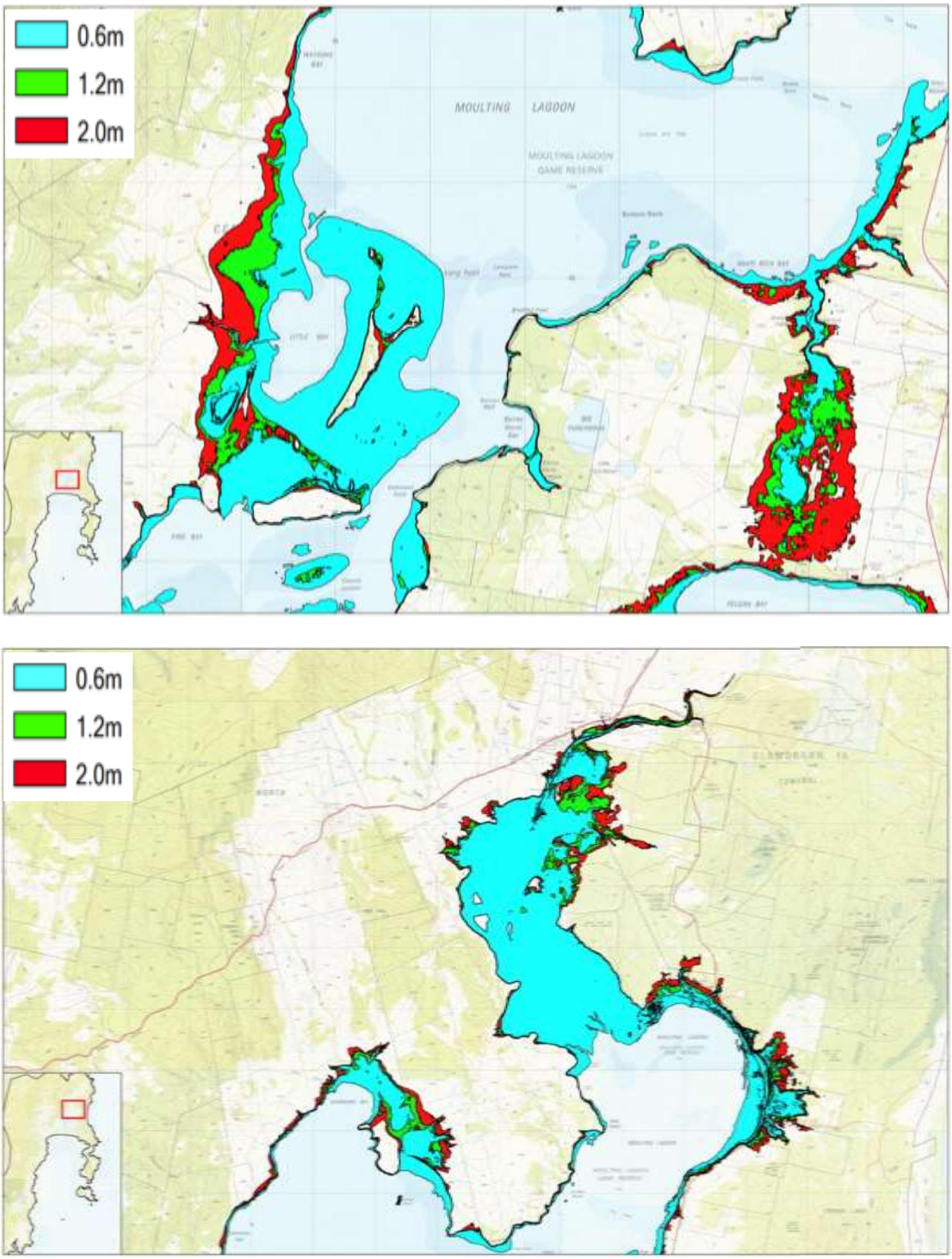


Figure 2: Sea level rise inundation mapping for Glamorgan Spring Bay Council

Vulnerabilities

Sea Level Rise and Storm Surge

Sea level rise and storm surge in Glamorgan Spring Bay may result in:

- Severance of communities during inundation events
- A financial impact on council due to more rapid degradation of low lying roads and stormwater assets
- Vulnerable natural values such as wetlands and other vegetation communities along the coast due to

Sea level rise and storm surge was viewed as the most significant impact associated with climate change for Glamorgan Spring Bay Council, accounting for 10 (40%) of risks assessed as priority. A wide range of potential impacts where identified including environmental issues such as inundation of estuarine and salt marsh communities, impacts on property and infrastructure, as well as inappropriate land use planning, which may not properly account for the physical impacts of sea level rise and storm-surge.

Table 5: Priority risk associated with sea level rise and storm surge

Risk Code	Risk Statement	Success criteria	Risk Level	Council services primarily affected	Other stakeholders
Community Health					
SL1	The loss of coastal property may trigger psychological impact due to high levels of uncertainty and anxiety leading to reputational impacts on Council	Reputation	High	Environmental Health	-
SL2	Risk to community health due to inundation of low lying areas for extended periods triggering disease vectors (e.g. wastewater related diseases)	Reputation	High	Environmental Health	Department of Health and Human Services
Financial Impact on Council					
SL3	Planning decisions which do not consider the potential for increased frequency of storm surge events, which may ultimately lead to litigation due to impacts of storm surge and erosion on private assets	Financial	High	Planning	-
SL4	Inundation of stormwater outfalls resulting in upstream flooding affecting sewer networks and other infrastructure. Increased costs associated with maintenance, retrofitting or replacement in order to ensure capacity of stormwater network	Service Delivery, Financial	Extreme	Infrastructure and Property	Southern Water
Environment, Natural Resource Management					
SL5	Inundation of saltmarsh and associated estuarine communities (e.g. Baudin's Sea Lavender in Triabunna) resulting in decreased habitat extent and associated biodiversity impacts	Environmental	Extreme	Natural Resource Management	Community Groups, NRM South, Department of Primary Industries, Parks, Water and Environment

2.4 Bushfire

Climate Change Projections

Bushfire

(A2 emission scenario)

- An increase is projected in bushfire likelihood across the region, particularly in highland areas central to the state.
- The most major increase in bushfire likelihood in Glamorgan Spring Bay is in the Coles Bay conservation area.

(Tasmanian Parks and Wildlife Service, 2011)
(Antarctic Climate and Ecosystems Cooperative Research Centre, Nov 2011)

Climate change may result in increased bushfire risk in Glamorgan Spring Bay Council, particularly when considering planned changes in land use activities. Bushfire modelling has been conducted for the Southern Region using the Tasmanian Bushfire Risk Assessment Model (BRAM), developed by the Tasmanian Parks and Wildlife Service specifically for the RCCAP. Weather data from the Climate Futures for Tasmania Project (A2 scenario) was entered into the BRAM to enable modelling of bushfire scenarios for periods defined as: baseline (1969-1990); near future (2010-2039); mid-century (2040-2069); and end of century (2070-2099).

The following past and projected data (for December to March) was used for modelling each period: 90th percentile temperature; 90th Percentile wind speed; and 10th percentile relative humidity. It is believed that the alignment of conditions of high temperature, high wind speed and low humidity would adequately frame the BRAM outputs of interest such as 'fire behaviour' and 'bushfire likelihood'.

A summary of the key inputs and outputs of the BRAM model for the Regional Climate Change Adaptation Project is provided in Figure 3.

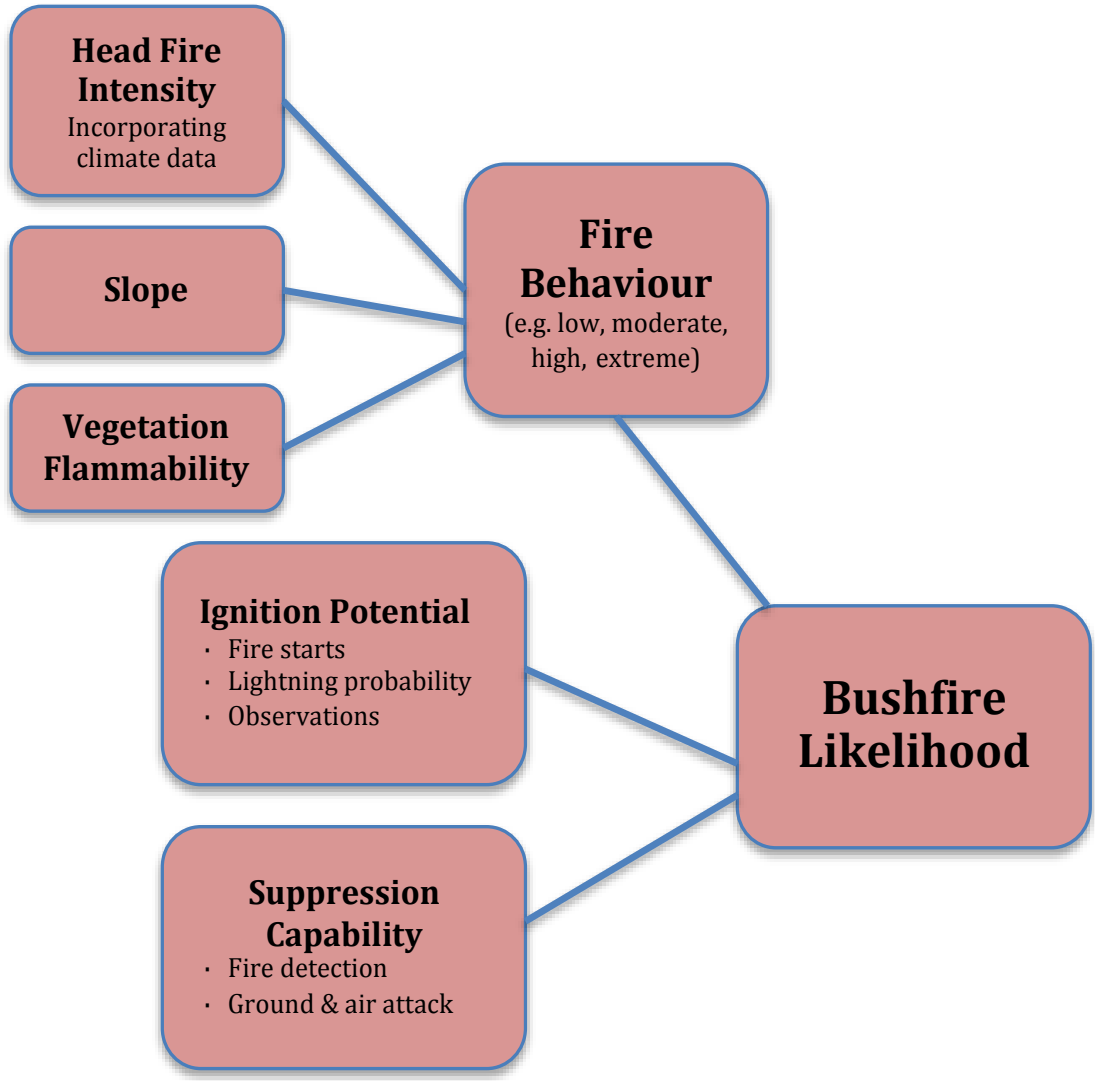


Figure 3: Inputs and outputs of BRAM model

The modeled near future (2010-2039) 'bushfire likelihood' output for Glamorgan Spring Bay is shown in figure 4 over page.

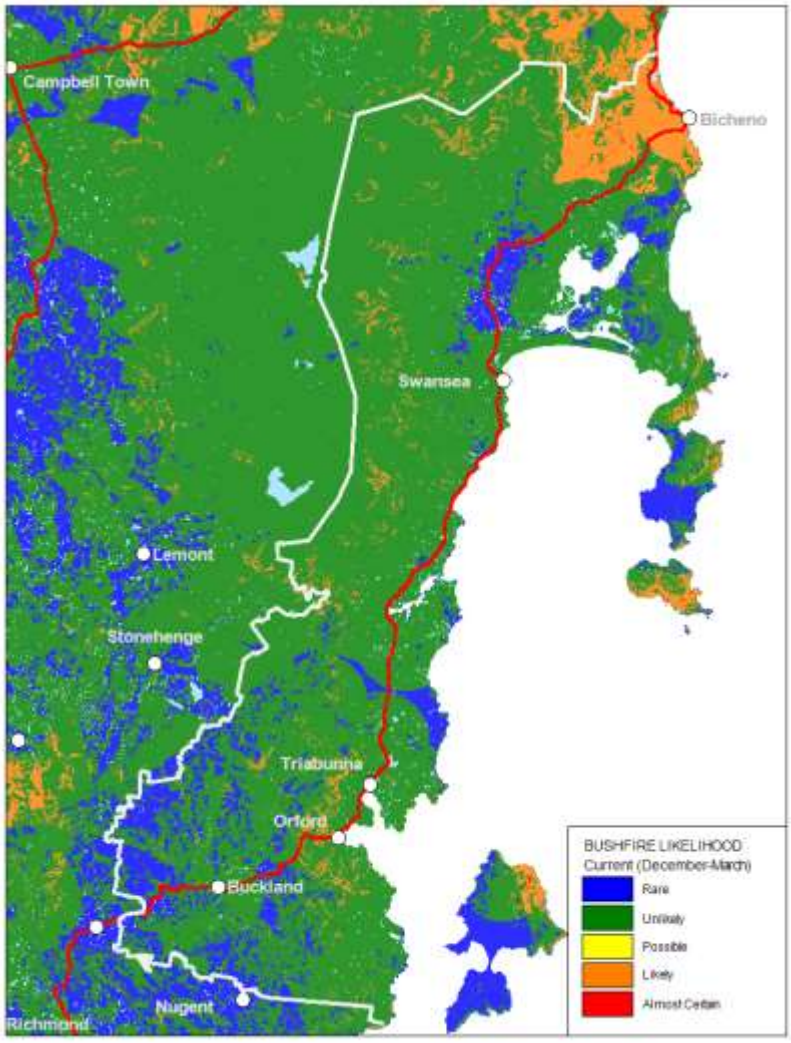


Figure 4: Modelled near future (2010-2039) 'bushfire likelihood' output for Glamorgan Spring Bay Priority climate change impacts and risks

There was no discernable difference between the modeled outputs of 'bushfire likelihood' for each of the time periods for Glamorgan Spring Bay. There was however some difference between baseline and end-of-century for 'fire behaviour' as depicted in Figure 5.

It should be noted that while the modelled change to bushfire likelihood presented here is not great as a result of climate change, there is a very real and significant existing danger. Small increases in likelihood may therefore be sufficient enough to trigger a major event. Moreover, the model's projections do not consider the increase in extreme temperatures, rather the projected change to average summertime temperatures. Projected increases to peak temperatures is a factor that is

particularly difficult to input into the model however may have significant impact on the actual likelihood of a bushfire igniting and the ability to contain it. Furthermore, there exists other factors that have not been considered in the model, which would contribute to an increase in likelihood and severity of bushfire, for example:

- changes to land-use which could lead to changes in fuel density and distribution as well as a change to the vulnerability of communities; and
- a possible change in vegetation type and distribution as a result of increases in atmospheric CO_2 would be an additional factor that may increase the bushfire likelihood.

There may also be other in-direct feedback loops that may occur as a result of climate change.

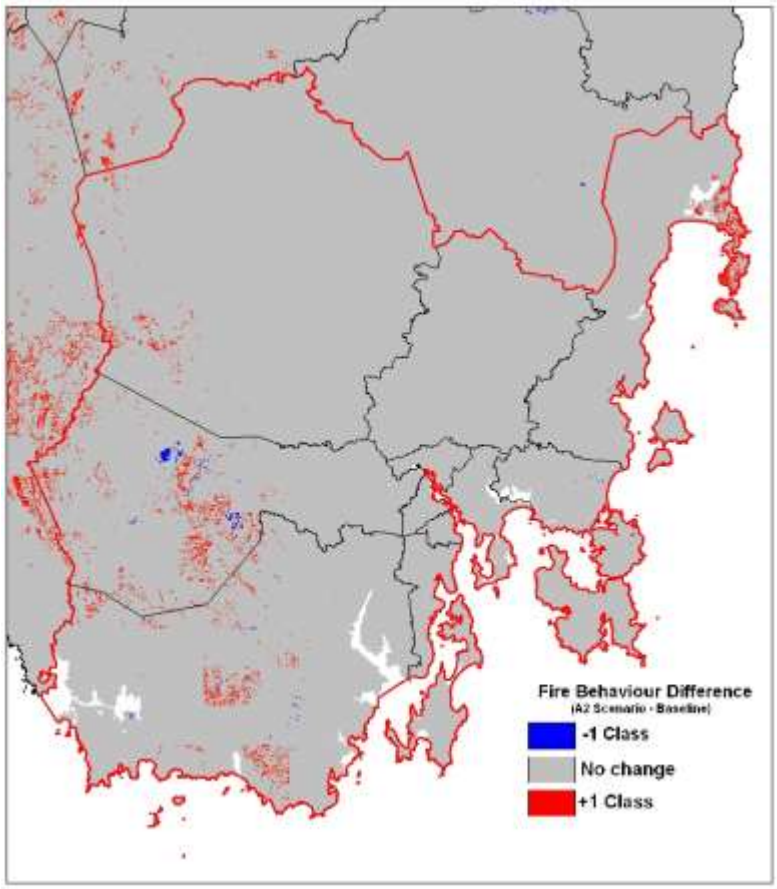


Figure 5: Modelled difference in 'bushfire behaviour' between the baseline and end of century for the Southern Region

Only one priority risk was identified relating to the potential increase in fire risk associated with climate change. This risk related to impacts of wild fire on council assets in bushfire prone areas.

Table 6: Priority risk associated with an increase in fire risk for Glamorgan Spring Bay Council

Risk Code	Risk Statement	Success criteria	Risk Level	Council services primarily affected	Other stakeholders
FR1	Increased frequency and severity of bushfire resulting in damage of council assets leading to increased maintenance and replacement costs	Financial	High	Corporate Services	-

Case Study – Wildfires in Glamorgan Spring Bay

Wildfire is considered as the major threat.

There are significant forestry assets throughout the hinterland adjoining the east coast grasslands where there are substantial agricultural assets and farms. Major forest fires pose a threat to all of the coastal townships.

In 1992 the municipality sustained a number of major fires. Fires surrounded Orford from the west, south and south-east resulting in property damage. Bicheno was threatened twice, from the west and north-west. There was one house lost in these fires. In the same year significant fires also threatened Coles Bay and the Freycinet National Park.

At Dolphin Sands, small acreage development in an area of high fuel loadings presents a threat to the community, particularly as there is only one access and egress road.

A similar situation exists at The Fisheries at Coles Bay where the low impact development is surrounded by heavy vegetation in the Freycinet National Park.

2.5 Summarised Climate Change Risks

In summary of the identified risks, the present section takes a broader view of Glamorgan Spring Bay's risk profile. Helping to focus in on key areas of concern to council staff, here workshop outputs are presented statistically in order to better inform adaptation strategy.

Figure 6 outlines the likelihood and consequence distributions of the initial suite of risk statements, prior to evaluation. A complete list of all risk statements and their ratings are available in Appendix C.

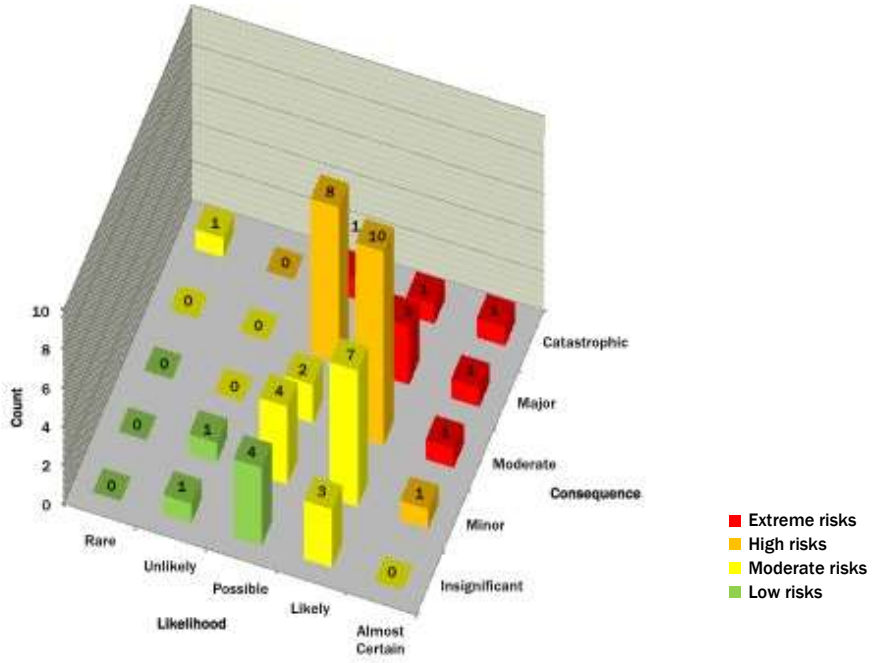


Figure 6: Distribution of climate change risk ratings for Glamorgan Spring Bay Council

The risk assessment resulted in the development of 50 risk statements broken down as follows:

- 8 Extreme risks
- 19 High risks
- 17 Moderate risks
- 6 Low risks

Prior to and during the risk evaluation workshop, a review of the moderate and high risks was undertaken to ensure council officers were satisfied with the break down of risks. This process led to the 27 initial priority risks being reduced to 16.

These risks then became the priority risks and adaptation actions were developed around these in the next stage of the project.

The 16 priority risks were associated with the following business areas:

- Infrastructure and Property
- Natural Resource Management
- Environmental Health
- Corporate Services
- Planning

The distribution of risks across business area and climate impact is shown in Figure 7.

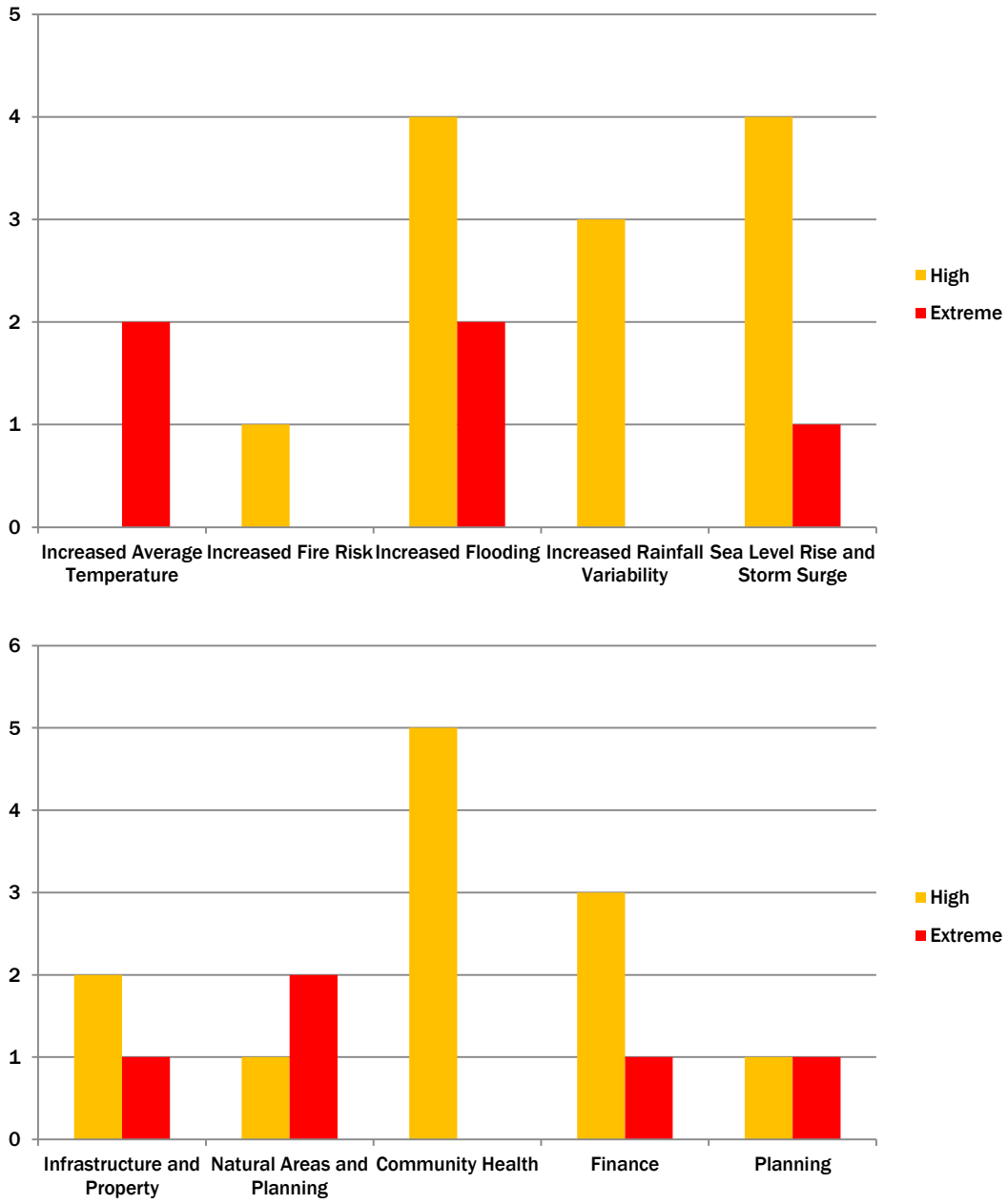


Figure 7: Distribution of Glamorgan Spring Bay Council priority risks across climate impact (top) and business area (bottom)

3. Corporate Adaptation Actions

3.1 Strategic Actions

Strategic actions are broad level climate change adaptation actions that do not specifically address a particular area or risk and fall across numerous Council service areas. Success of such actions is dependant on senior management support. Implementation of strategic actions will provide Council with a solid framework in climate change adaptation and will build an internal culture that supports the implementation of the more specific adaptation actions identified by the Council, described in subsequent sections.

3.1.1 Legal liability

A key consideration for councils in the face of climate change is the potential liability that they are exposed to through their various statutory roles, powers and functions. The main 'legal' concern for councils is the potential liability that they are exposed to through their adopted action or inaction in particular circumstances. The advice established (refer to Section 1.3) that overall councils will not be liable for existing use or development, nor will they incur liability for 'no action' in response to climate impacts, however should they take action they could be liable should that action cause harm or damage. It also considered that councils might be found liable for operational advice such as the assessment of planning applications and new developments. Legal advice to this Project contained three options that councils could pursue, with the State Government and in their own capacity to reduce their exposure and potential liability (Table 7), bearing in mind that these actions may be more appropriately pursued through a regional approach (refer to the Regional Climate Change Adaptation Plan compiled under the Regional Climate Change Adaptation Project).

Table 7: Potential corporate actions for Council to pursue in relation to legal liability

Amendment to *Local Government Act* (Tas) 1996, by the State Government, to insert an equivalent section to s733 *Local Government Act* (NSW) that exempts local governments for civil liability for the impacts of climate change where statutory powers, planning scheme provisions and assessment of development applications are done in good faith and in accordance with manual/s prepared by the State Government.
Review State Coastal Policy 1996 or develop and appropriate Framework that is specific about: how planning schemes must deal with the impacts of climate change; provides specific recommendations and guidelines for managing climate change impacts; and sets prescribed levels for sea level rise in developed coastal regions.
Formulation of state-wide codes to deal with climate change impacts to achieve a uniform set of provisions across the State that: contain specific development controls; removes decision making from planning authorities; does not require risk

analysis; and sets prescribed levels for sea level rise in developed coastal regions throughout the State.

3.1.2 Overarching corporate actions

There are key overarching corporate functions that are worth considering for minimising Council's risk in the face of extreme events posed by climate change including: incorporation of climate change risks into council's risk register in relation to minimising the risk of litigation in relation to extreme events; incorporation of climate change planning into strategic, annual and financial planning; and developing a process for communication. Potential overarching corporate actions for Council to pursue are provided in Table 8.

Table 8: Potential overarching corporate actions

Risk Register Integrate climate change risk management into Council's existing risk assessment framework.
Emergency Management Planning Ensure that the projected impacts of climate change are properly considered in Council's emergency management planning. Emergency response plans should be investigated, developed and implemented considering the best available climate change projections. Up to date emergency response procedures can minimise consequences when extreme events occur.
Communication Develop and implement a climate change communication and education plan for Council staff. Increased staff capacity and awareness will assist in incorporating climate change scenarios and impacts into policy and decision making processes.
Other Council Plans & Strategies Consideration of climate change risks and impacts in other Council strategies, policies and plans (Strategic & Annual Plan). The climate change impacts and risk process outlined throughout this Adaptation Plan should be considered in the development of future plans, policies and strategies. This will also ensure there are a range of potential internal mechanisms for important actions to be implemented.
Reporting Consider developing climate change related performance Indicators that could be reported on through Council's Annual Report.

This following sections present corporate adaptation actions for treatment of priority climate change risks (those rated as 'extreme' or 'high') identified by Glamorgan Spring Bay Council staff. Glamorgan Spring Bay's 27 priority adaptation actions are presented to align with council business areas – Asset Management, Corporate Services, Planning, Community Health and Natural Resource Management.

3.2 Environmental Health

Council's role in regard to environmental health may include: aged care, child health, special needs care, supported accommodation and counselling and support services.

Climate change has many implications for community health. Gradual shifts over time in temperature, humidity and rainfall patterns can create ideal conditions for disease vectors, such as mosquitos, in areas where there was no previous exposure. Direct impact of extreme events such as bushfire and heatwaves can result in emergency services and community support services being stretched beyond their capacity, at times leading to a spike in mortality. Severe seasonal conditions such as drought lead to tough environmental and economic outcomes for farmers often resulting in more widespread, mental illness, depression and suicide. Councils have an important community role in promoting and maintaining links to relevant support services in times of hardship.

Glamorgan Spring Bay's priority adaptation actions, and identified treatments, in relation to community health are presented in table 9.

Table 9: Environmental Health adaptation options for treatment of priority climate change risks

Action Code	Adaptation Action	Responsible business unit	Relevant Council documents/strategies	Relative cost of implementation	Ease of implementation	Timeline for delivery	Risks treated	Original risk level	Treated risk level
Advocacy									
6	**Advocate to Southern Water for sharing of information around wastewater infrastructure risks and upgrades. (This will assist in the delivery of actions 1-5)**	Environmental Health Officer and Works Manager	Ongoing open communication with Southern Water	$	High	As required	SL2	High	Moderate

Action Code	Adaptation Action	Responsible business unit	Relevant Council documents/strategies	Relative cost of implementation	Ease of implementation	Timeline for delivery	Risks treated	Original risk level	Treated risk level
Education/Awareness									
1	**Develop a communication protocol to deal with existing properties that are affected by the projected impacts of sea level rise and storm surge. This protocol should be developed to deal with reputational issues that may result for Council**	Corporate Services	Communications Policy	$	High	Jan-13	SL1	High	Moderate
2	**Through identification of high-risk areas, develop targeted educational programs to inform community about the risk of coastal inundation to their property. (This could be combined with action 1)**	Sustainability Officer - NRM section	Better implemented as a region through a partnership agreement	$	High	Mar-12	SL1	High	Moderate
3	**Develop general information sheets on climate change risks to help community understand the science and manage the impacts individually**	Sustainability Officer - NRM section	Better implemented as a region through a partnership agreement	$	High	Mar-12	SL1	High	Moderate
4	**Educate community on disease vectors to minimise the effects and spread of wastewater related disease and other human health related issues**	Environmental Health Officer	Communications Strategy with other stakeholders e.g. DHHS	$	High	As required	SL2	High	Moderate

Action Code	Adaptation Action	Responsible business unit	Relevant Council documents/strategies	Relative cost of implementation	Ease of implementation	Timeline for delivery	Risks treated	Original risk level	Treated risk level
5	**Collaborate with state agencies (DHHS) and other councils to educate community and better manage wastewater related diseases in a proactive manner**	Environmental Health Officer	Communications Strategy with other stakeholders e.g. DHHS	$	High	As required	SL2	High	Moderate
11	**Educate community on disease vectors to minimise the effects and spread of disease due to long periods of standing flood water (This could be done in combination with education/awareness raising actions for managing sea level rise and storm surge)**	Environmental Health Officer	Communications Strategy with other stakeholders e.g. DHHS	$	High	As required	FL1	High	Moderate
12	**Collaborate with state agencies (DHHS) and other councils to educate community and better manage flood water related diseases in a proactive manner (May be linked to 5)**	Environmental Health Officer	Communications Strategy with other stakeholders e.g. DHHS	$	High	As required	FL1	High	Moderate
20	**Consider a community education program aimed at raising awareness around disease risks and causes associated with an increased stormwater loading on recreational waters**	Environmental Health Officer / NRM	Ongoing commitment to Catchment To Coast ICM program which provides regular means of engagement around catchment management issues	$	High	Ongoing	RV1	High	Moderate

Action Code	Adaptation Action	Responsible business unit	Relevant Council documents/strategies	Relative cost of implementation	Ease of implementation	Timeline for delivery	Risks treated	Original risk level	Treated risk level
Initiative									
13	**Identify high risk areas vulnerable to flooding in order to inform other flood management actions**	Environmental Health Officer	Communications Strategy with other stakeholders e.g. DHHS	$	High	As required	FL1	High	Moderate
Policy/Strategy									
19	**Undertake a strategic review of the recreational water monitoring program considering the projected increases to stormwater loading on local beaches**	Environmental Health Officer / NRM	Links to existing Recycled Water program and integrated catchment management through the NRM sections Catchments to Coast program	$$	Medium	Commence discussions in 2012	RV1	High	High
21	**Develop better standard planning conditions that require the installation of gross pollutant traps (GPTs) and other engineering solutions (swales, bioretention, WSUD) for the management of an increased contaminated stormwater loading on local recreational waters**	Regulatory Services / NRM / Works Department	Aim to develop Council policy and procedures in 2012	$	High	2012	RV1	High	Moderate

3.3 Infrastructure and Property

Council's asset management team is responsible for overseeing the construction, maintenance and replacement of property and infrastructure assets, including roads, drains and culverts, bridges, stormwater infrastructure, council owned buildings and recreational infrastructure such as walking tracks. For councils, effective asset management is about understanding the required level of service and delivering it in the most cost effective manner. Managing this objective is core business for local government and is key to ensuring council sustainability. The projected impacts of climate change threaten conventional asset management both in terms of financial modelling, as well as the level of service that is acceptable or even achievable.

Projected increases in the intensity and frequency of extreme events directly impact on council asset base with significant and unpredictable financial and service delivery implications. Council's stormwater system for example is designed for historical climate and with projected climate change, will likely become significantly under capacity. Council will therefore need to consider the additional cost of managing stormwater at the current acceptable level of service and either fund that cost or accept that a greater frequency of inundation events is likely. Acknowledging this, public inconvenience and safety issues have been identified as a recurring risk theme in relation to the impact of extreme events on council infrastructure.

Further to the projected increases in extreme events, incremental changes to the climate such as increasing average temperatures or reduced average rainfall will also have implications to council's capacity to deliver its infrastructure based services. Such changes may result in accelerated structural fatigue in council's infrastructure. Design standards based upon past climate data and patterns may need to be reconsidered for new or replacement infrastructure to account for incremental climate change projections.

Glamorgan Spring Bay's priority adaptation actions, and identified treatments, in relation to asset management are presented in table 10.

Table 10: Asset Management adaptation options for treatment of priority climate change risks

Action Code	Adaptation Action	Responsible business unit	Relevant Council documents/strategies	Relative cost of implementation	Ease of implementation	Timeline for delivery	Risks treated	Original risk level	Treated risk level
Advocacy									
15	**Advocate for clearer state regulation on planning considerations for climate change projections**	Sustainability officer - NRM section / Regulatory Services	Planning processes	$	Medium	When opportunities arise through participation in external organisations e.g. STCA	FL2	Extreme	High
Initiative									
7	**Investigate and consider feasibility on the range of available engineering options for management of inundated stormwater outfalls during storm surge events**	Works Manager	Incorporation into budgetary processes annually	$$	Medium	As required	SL4	Extreme	Moderate
Policy/Strategy									

Action Code	Adaptation Action	Responsible business unit	Relevant Council documents/strategies	Relative cost of implementation	Ease of implementation	Timeline for delivery	Risks treated	Original risk level	Treated risk level
8	**Prepare a GIS layer and an associated planning overlay identifying areas vulnerable to stormwater flooding as a result of inundated outfalls during storm surge events. Develop planning strategies/standard conditions to mitigate the risk on future developments**	Planning/Regulatory Services	Need to liaise with STCA and other relevant stakeholders to commence this process immediately	$$	Medium	As soon as possible	SL4	Extreme	Moderate
14	**Implement Council policy requiring proper consideration for climate change projections on design and construction of new Council assets**	Works Manager	Climate Change Policy to be updated	$	High	As required	FL2	Extreme	Moderate

3.4 Natural Resource Management

The natural resource management (NRM) role of local government varies greatly between councils. For urban councils, NRM is often focused on management of local parks and reserves, particularly in relation to maintaining amenity, protecting local biodiversity, managing threats such as weeds, and running community programs in relation to enjoyment of, engagement with and interpretation of nature. For rural councils NRM functions are often conducted in collaboration with NRM South and can include: revegetation programs, protection of biodiversity, weed management, reserve management, community landcare and working with farmers on regenerative farming techniques.

Biodiverse natural environments are resilient and have been able to adjust and adapt in accordance with shifts in climate over many thousands of years by retracting and expanding accordingly. The climate change we are now experiencing is occurring relatively rapidly. In natural vegetation communities this change is likely to favour some species and disadvantage others. A likely outcome is local extinction of vulnerable species and changes in structure, function and composition of vegetation communities. Additionally, exacerbated threat to vegetation communities may occur through proliferation of weeds, which may be favoured by changing temperature and rainfall conditions. Direct physical impacts on natural systems may also be exacerbated under climate change; for example, rivers and streams are likely to experience a higher frequency of flood flows creating vulnerability to erosion in riparian areas.

The Glamorgan Spring Bay Council has had a long and active involvement in NRM. The current NRM program has built on many programs and community initiatives, such as landcare, bushcare and coastcare, over the last 20 years. The NRM Unit of Council has a full time manager and a number of part time and casual staff including technical specialists (including a Sustainability Officer) and an on ground works crew. The NRM program is overseen and guided by the NRM Committee (NRMC), which is a Section 21 Special Committee of Council made up of professionals and volunteers involved in NRM from throughout the municipality. A key program of the NRMC is the Catchments To Coasts (CTC) program which is co funded by Council and NRM South. External grants are regularly applied for to fund many of the on ground activities. The CTC program is guided by a number of strategic documents, specifically the the GSB Weed Management Plan, the three catchment management plans (Prosser, Little Swanport and Swan Apsley) which encompass the entire municipality, and the southern regional NRM Strategy. The work of the NRM Unit is regularly reviewed in light of new information and knowledge and climate change is clearly recognised as a key factor for consideration in current and future activity. The GSB NRM programs involve a broad range of organisations, technical specialists and stakeholders with an interest and involvement in NRM from both within and also outside of the municipality.

Specific to the Glamorgan Spring Bay municipality, the following natural value impacts are expected as a result of climate change:[11]

- This municipal area includes Freycinet and Maria Island national parks, and two internationally important Ramsar wetland sites (Moulting Lagoon and Apsley Marshes), all with important biodiversity vulnerable to the effects of sea level rise and climate change.
- Rare coastal plant and bird species are at risk from sea level rise unless conditions are maintained to allow the landward migration of saltmarsh and sand dunes that are their habitat. For example, the endangered Tasmanian sea lavender is a short-lived perennial herb that is known only from the Triabunna area. It grows in saltmarsh close to the high water mark, typically near small brackish streams. Beach nesting bird such as hooded plover, red-capped plover, pied and sooty oystercatcher, and many tern species have experienced significant decreases in their numbers over recent decades.
- Protection of key refugia and important connectivity is an important adaptation action. The steep environmental gradients from the coast to the inland Eastern Tiers provides for the movement of species to more favourable environments, and safe havens for retreat. Wetlands in particular provide refuge for many species, including migratory birds, and moist shaded steep gullies and gorges also act as refuges from drought, fire and climate.

Glamorgan Spring Bay's priority adaptation actions, and identified treatments, in relation to natural resource management are presented in table 11.

[11] Department of Primary Industries, Parks, Water and Environment, Resource Management and Conservation Division (2010).Vulnerability of Tasmania's Natural Environment to Climate Change: An Overview. Unpublished report. Department of Primary Industries, Parks, Water and Environment, Hobart, Tasmania

Table 11: Natural Resource Management adaptation options for treatment of priority climate change risks

Action Code	Adaptation Action	Responsible business unit	Relevant Council documents/strategies	Relative cost of implementation	Ease of implementation	Timeline for delivery	Risks treated	Original risk level	Treated risk level
Education/Awareness									
23	**Facilitate forums for industry groups, liaise with aquaculture industry to inform about climate change and facilitate adaptation**	NRM Section	Links to Catchments To Coast program	$	High	As required	AT2	Extreme	Moderate
Initiative									
9	**Undertake mapping of saltmarsh in GSB and investigation of retreat planning and relocation options to preserve habitat**	NRM Section	Liaise with NRM South, University of Tasmania, DPIPWE	$	High	Commence discussions in 2012	SL5	Extreme	Moderate
Policy/Strategy									
10	**Collaborate with other organisations (i.e. DPIPWE, National Parks, Federal Government) to identify and implement protection options for the preservation of estuarine communities (e.g. Baudin's Sea Lavender)**	NRM Section	Ongoing liaison with all relevant stakeholders	$	High	Commence discussions in 2012	SL5	Extreme	Moderate

Action Code	Adaptation Action	Responsible business unit	Relevant Council documents/strategies	Relative cost of implementation	Ease of implementation	Timeline for delivery	Risks treated	Original risk level	Treated risk level
22	**Continue to liaise with relevant organisations (local; regional; state; national & international) to better understand the risks associated with increased ocean water temperatures and ocean acidification and work to educate community**	All sections of Council have a responsibility to keep a watching brief.	Council Policy	$	High	Ongoing	AT1	Extreme	High
24	**Ensure that an ongoing dialogue exists (e.g. through NRM committee) so that Council is prepared to help facilitate adaptation of aquaculture industry as ocean acidification impacts more on the industry**	NRM Section	NRMC engaged in CC space	$	High	On going	AT2	Extreme	Moderate

3.5 Planning

Climate change risks have significant implications for council's role in planning and development control. In coastal areas, development in low lying areas vulnerable to sea level rise and storm surge needs to be managed appropriately to minimise risk to property and to eliminate risk to life and potential for litigation. Similarly, in relation to changes in flood and bushfire risk, planning schemes need to be well informed through scientific data and modelling to appropriately guide development in flood prone areas and in areas with high fire likelihood.

To some extent, council's approach to managing climate change risks in relation to its planning responsibilities will be managed through the Regional Planning Project's Regional Land-use Strategy and also through specific state-wide hazards codes being developed by the Tasmanian Planning Commission. In some cases it may be pertinent for development of codes to address specific risks at a regional level to tie in with timelines for the Regional Planning Project (refer to Section 3.4.1).

Glamorgan Spring Bay's priority adaptation actions, and identified treatments, in relation to planning and development roles are presented in table 12.

Table 12: Planning & Development adaptation options for treatment of priority climate change risks

Action Code	Adaptation Action	Responsible business unit	Relevant Council documents/strategies	Relative cost of implementation	Ease of implementation	Timeline for delivery	Risks treated	Original risk level	Treated risk level
Advocacy									
16	**Advocate to state government to provide regulation (e.g. mandatory disclosure through 337 forms) or advice (guidelines) around planning and development in relation to property/land at risk of flooding**	Sustainability officer - NRM section / Regulatory Services	Planning Processes	$	Medium	When opportunities arise through participation in external organisations e.g. STCA	FL3	Extreme	Moderate

Action Code	Adaptation Action	Responsible business unit	Relevant Council documents/strategies	Relative cost of implementation	Ease of implementation	Timeline for delivery	Risks treated	Original risk level	Treated risk level
Education/Awareness									
18	**Educate potential new residents of vulnerable areas about the projected impacts of climate change (e.g. through forums, newsletters, flood mapping)**	Corporate Services / NRM	Partnering with other organisations to access information for distribution through Council's networks and suit the community needs	$$	Medium	As soon as possible	FL3	Extreme	Moderate
Initiative									
17	**Collaborate with other organisations to undertake floodplain modelling which incorporates climate change in order to better inform planning decisions**	Regulatory Services / NRM Section	More detailed information on likely projections for flooding are critical for current and future planning	$	High	As soon as possible	FL3	Extreme	Extreme

3.5.1 Regional 'Coastal Inundation & Hazards Code'

The Tasmanian Planning Commission is in the process of drafting a Coastal Hazards Code as part of its draft Coastal Planning Framework (which is replacing the Coastal Policy). As the timeframe for completion of this Coastal Hazards Code is uncertain – the STCA's Regional Planning Project is developing an interim regional 'Coastal Inundation & Hazards Code' in conjunction with Technical Reference Group representatives to ensure that there is guidance on this issue in the new planning schemes for coastal councils of the region.

The interim regional 'Coastal Inundation & Hazards Code' will:

1. Implement the Southern Tasmanian Land-use Strategy e.g.
    - Ensure use and development in coastal areas is responsive to effects of climate change including sea level rise, coastal inundation and shoreline recession.
    - Include provisions in planning schemes relating to minimising risk from sea level rise, storm surge and shoreline recession. Identify areas at high risk from these impacts through the use of overlays.
    - Ensure growth is located in areas that avoid exacerbating current risk to the community through local area or structure planning for settlements and the Urban Growth Boundary for the Greater Hobart metropolitan area.
    - Identify and protect areas that are likely to provide for the landward retreat of coastal habitats at risk from predicted sea level rise.
2. Align where possible with content planning scheme prescriptions already adopted by Clarence City Council and Hobart City Council.

    Clarence City Council's coastal inundation and hazard prescriptions adopted in their planning scheme in 2011 includes:

    - An **'inundation overlay'** that, amongst other things, identifies areas subject to periodic inundation from the sea as at 2050 and 2100 (according to currently available data), and precludes development that will change coastal dynamics in a way detrimental to other property.

      Development within areas covered by the overlay to require floor level heights (in AHD) for the 'high' 2050 levels (site specific 2.1-3.0 m) and the 'high' 2100 levels (site specific 2.7 – 3.6 m).

    - A **'Coastal Erosion Hazard' overlay** to identify, amongst other things, areas potentially subject to erosion, recession or wave run-up related to coastal processes; and to control impacts on coastal infrastructure and development from coastal hazards.

3.6 Corporate Services

Council's Corporate Services area comprises: finance, information technology, human resources, marketing & public relations, governance, customer service, corporate planning and information management.

Climate change impacts largely affect corporate services indirectly, however there are key overarching corporate functions that are required for the implementation of climate change actions, for example: incorporation of climate change planning into corporate, annual and financial planning. Incorporation of climate change risks into council's risk register is of strategic importance in relation to minimising the risk of litigation in relation to extreme events. Glamorgan Spring Bay's priority adaptation actions, and identified treatments, in relation to corporate services are presented in table 13.

Table 13: Corporate Services adaptation options for treatment of priority climate change risks

Action Code	Adaptation Action	Responsible business unit	Relevant Council documents/strategies	Relative cost of implementation	Ease of implementation	Timeline for delivery	Risks treated	Original risk level	Treated risk level
Initiative									
26	**Develop and maintain a bushfire management plan for Council assets, including an asset register that identifies and prioritises high risk assets**	Risk / Asset Management	Emergency Management Planning	$$	High	Commence in 2012	FR1	High	Moderate
Policy/Strategy									
25	**Review bushfire insurance coverage on all of Council's vulnerable assets**	Risk / Financial Management	Annual insurance renewals	$	High	Ongoing	FR1	High	Moderate
27	**Undertake audits of assets most vulnerable to bushfire (e.g. check appropriateness of asset protection zones) (This should be incorporated into action 26, bushfire management planning)**	Risk / Asset Management	Emergency Management Planning	$$	Medium	Commence in 2012	FR1	High	Moderate

3.7 Multi-Criteria Analysis of Actions

A 'multi-criteria analysis' (MCA) is a useful approach to begin the process of prioritising the implementation of defined actions. A multi-criteria analysis for Glamorgan Spring Bay's climate change adaptation actions was undertaken according to the following criteria:

- Relative cost - the potential cost of implementing the action relative to the other actions (high, medium, low);
- Immediacy - the timeframe required to implement the action (short-term, medium-term, long-term);
- Political feasibility - how feasible the action is politically. This is dependent on Council views (leader, collaborator, influencer);
- Community acceptance - the acceptance of the action by Councils rate payers (popular, indifferent, controversial); and
- Concurrent effects - whether the action has associated benefits or costs associated with its implementation (positive, neutral, negative).

As cost is generally a key criterion in decision-making, this was assigned a weighting of 50%. The remaining 50% of weighting was distributed equally across the other four criteria. The adaptation actions were prioritised by plotting actual cost against the combined score of the combined criteria. The result of the MCA for Glamorgan Spring Bay is presented in figure 8.

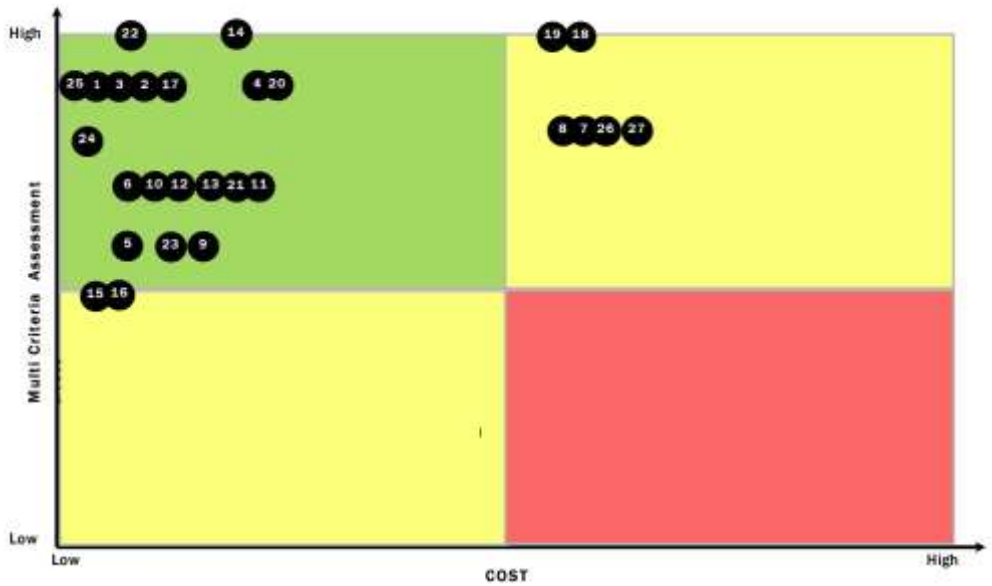


Figure 8: Distribution of Glamorgan Spring Bay Council adaptation actions across the MCA matrix for ease of implementation

The MCA is designed to provide a first look at feasibility and should be used as a guide and for getting a feel for what might be achievable in the short term. A mechanism for identifying the 'low hanging fruit'.

It is evident in figure 8 that there are a number of actions that may not require substantial planning and resourcing and that could be implemented with relative ease. Those actions in the yellow will require a greater investment in resourcing and planning and will likely require their own feasibility analysis. They may however yield significant benefit and thus must not be overlooked.

Figure 8 demonstrates that the majority of actions are likely to be achievable with relative ease and should be explored further.

4. Stakeholder involvement & collaboration

Climate change projections are likely to impact either directly or indirectly on all aspects of council function. Further to this, impacts are liable to be felt throughout the community and within many other organisations that council has direct involvement with. A collaborative adaptation response between all stakeholders is therefore essential for council to maintain its high service levels in a changing climate.

There is also a significant body of work currently being undertaken within other organisations throughout the community that contribute to meeting climate change adaptation objectives for Southern Tasmania, and that act to assist council in meeting its own objectives. It is therefore important that these linkages are identified; that complimentary processes value-add to one another and duplication of efforts is avoided wherever possible.

With these points in mind, through the 'risk management' and 'adaptation options' workshops, held with each of the twelve Councils in Southern Tasmania, a number of key stakeholders were identified as shown in figure 9.

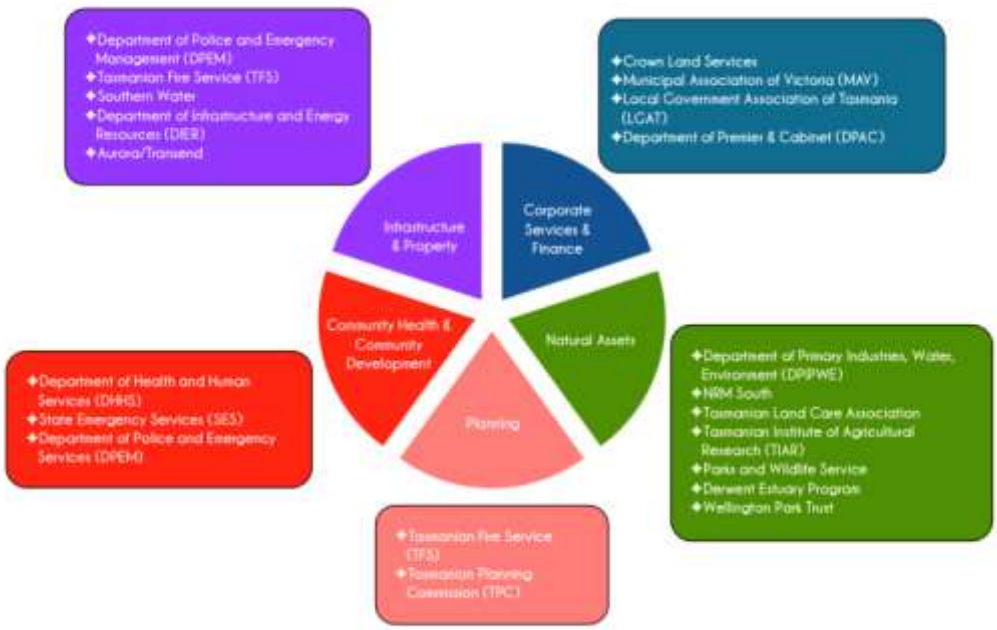


Figure 9: Stakeholder organisations identified during the council corporate risk and adaptation planning workshops

In order for there to be clear understanding of roles and responsibilities in relation to management of the identified climate

change risks, together with recognition of opportunities to develop or strengthen existing collaborations, RCCAP engaged with the identified stakeholders.

Further to information provided here, the complete response from each of the stakeholders may be obtained on request. Subsections below summarise the responses.

4.1 Aurora

Aurora manages the local electricity distribution network around Tasmania and is the electricity provider for the majority of Tasmania's electricity usage. Many of council's services are dependent on the proper operation of Aurora's assets.

The Tasmanian Electricity Code governs Aurora, requiring it to maintain its infrastructure to minimise risks associated with the failure or reduced performance of assets. Thus, if the operating environment changes in a way that increases the risk of asset failure, as a result of climate change, then Aurora has an obligation to manage that change.

Aurora has not identified climate change as a key business risk, however the Distribution Business Division (responsible for managing Aurora's network) has identified climate change broadly as one of 19 divisional risks.

A key area of concern for Aurora is the lack of consultation during assessment of development applications in vulnerable areas. When new developments are approved by councils, Aurora is required under law to provide power to site. Aurora is not included in the planning assessment process and where proposals may be vulnerable to the projected impacts of climate change, delivery of this requirement may in the future become difficult. Collaboration in the planning approval stage could better manage these situations.

4.2 Dept. of Health and Human Services (DHHS)

The Department of Health and Human Services (DHHS) is responsible for delivery of integrated services that maintain and improve the health and wellbeing of individual Tasmanians and the Tasmanian community.

A national process, coordinated by the Department of Health and Aging, which is developing a national human health climate change adaptation plan, drives climate action for DHHS. The internal draft climate change plan is to be developed by the Australian Health Protection Committee's Environmental Health Committee, however there is no clear timeframe for its completion. It is not expected that climate impacts will be as significant as that experienced by other States.

In lieu of the national plan the DHHS does not currently have any documents for the management of climate change risks.

4.3 Dept. of Infrastructure Energy and Resources (DIER)

DIER provides infrastructure and related services for the social and economic development of Tasmania. DIER reports to the Minister for Infrastructure, Hon David O'Byrne MP; the Minister for Energy and Resources and the Minister for Racing, Hon Bryan Green MP; and the Minister for Sustainable Transport, Hon Nick McKim MP. By providing a strategic approach to the provision of both physical infrastructure and regulatory frameworks, DIER aims to (amongst other unrelated factors):

- Enhance infrastructure decision-making across Government;
- Facilitate a safe, sustainable and efficient transport system that enhances economic and social development, in the context of the challenges of climate change, and
- Promote reliable, efficient, safe and sustainable energy systems.

The state road network is approximately 3700km in length and includes approximately 800 bridge structures and 500 culverts. The network is divided in to three regional networks; each network has its own Network Manager (NM) and three Network Supervisors (NS). This structure sees each NS responsible for the management of approximately 400km of road. Not surprisingly, these staff have an in-depth knowledge of their 'turf' and the direct/indirect effects of extreme weather events. Therefore it is fair to state that DIER staff have inadvertently been documenting and managing the effects of a changing climate for some time now and are thus well positioned to manage the road network in to the future. DIER acknowledges that climate change per se has not featured prominently in past decision-making; however, this is not to say that DIER is unaware of the impacts of a changing climate. Climate change is but one element of the 'risk assessment' (RA) process. DIER acknowledges the significance/weighting of climate change within the RA process is increasing in-line with DIER's continually improving awareness and understanding.

DIER acknowledges that the impacts of a changing climate are highly varied, but notes there are impacts more likely to affect the serviceability of the state road network. From a DIER perspective, the key threatening climate change related impacts are:

- Increased intensity of rainfall events (and the effects of);
- Sea level rise, and
- Storm surge.

DIER has chosen not to independently fund climate change research; instead, opting for a collaborative approach that has to date, proven quite successful. Given that DIER has limited financial resources (at present and into future) with particular reference to climate change type investments; DIER will continue to support and sponsor collaborative research and the development of tools and applications that have the capacity to make DIER a 'more informed' client. In terms of projects, DIER has co-funded/sponsored three climate change related projects in the past 18 months; these include:

- Climate Futures Tasmania – Infrastructure (CFT-I);

- Greenhouse Gas Assessment Workbook for Road Projects – Transport Authorities Greenhouse Group (TAGG), and
- 'Carbon Gauge – Calculating the Greenhouse Footprint of Roads'.

DIER is considering a whole-of-asset risk assessment to identify those sections of the road network more at risk from the effects of climate change over the next 20-40 years for road infrastructure, and 100 years for bridges. Outputs from this project would then assist development of DIER's work plan for the next 5-10 years. Anecdotally, DIER considers that in the absence of major construction projects, managing the road asset for the effects of climate change should in fact be affordable under historical road transport funding levels.

4.4 Dept. Primary Industries, Parks, Water & Environment (DPIPWE)

DPIPWE have three key programs in relation to climate change adaptation:

1. Natural Systems Resilient to Climate Change Project;
2. Climate Change and Coastal Vulnerability Program; and
3. Climate Change Impact Monitoring Program for the World Heritage Area (WHA)

Key elements of the Natural Systems Resilient to Climate Change Project are the unpublished report: [DPIPWE (2010) Vulnerability of Tasmania's Natural Environment to Climate Change: An Overview], and a series of relevant spatial resources:

- spatial layer predicting spread/occurrence of WONS (weeds of national significance) in the future;
- spatial layer predicting areas that are not vulnerable to the root-rot fungus (Phytophthora cinnamomi);
- spatial layer as a predictor of biosecurity and disease issues related to the natural environment;
- spatial layer identifying fire 'refugia' i.e. areas in the landscape with low vulnerability to wildfire; and
- spatial layer highlighting past glacial 'refugia', i.e. where vegetation communities have contracted to in the past during changing climate.

In combination, the spatial layers may be used to refine or compliment the 'refugia' analysis conducted by NRM South. Once defined, 'refugia' have the potential to be protected through the planning scheme as special areas. Additionally, each individual spatial layer may be used to inform development decisions and would be useful additions to the GIS data libraries of Councils.

Components of the *Climate Change and Coastal Vulnerability Program* include:

- the Climate Change and Coastal Risk Assessment Project which has tools and resources to assist with risk-based

management and planning for various assets and values in the coastal zone; and

- The 'Sharples' Report – Indicative Mapping of Tasmanian Coastal Vulnerability to Climate Change and Sea Level Rise.

The Climate Change Impact Monitoring Program (WHA) includes:

- Vegetation community monitoring, particularly endemic conifers.
- Efforts to improve understanding of the effect of sea level changes on coastal geodiversity and biodiversity and identification of opportunities for adaptive management. There is alignment here with the NRM South saltmarsh inundation mapping project.
- A recently released report [Climate Change and Geodiversity in the World Heritage Area], which highlights how climate change may impact upon Tasmania's geological, geomorphological and soil features (and processes).

4.5 Derwent Estuary Program (DEP)

The Derwent Estuary Program (DEP) is a regional partnership between local governments, the Tasmanian state government, commercial and industrial enterprises, and community-based groups to restore and promote the Derwent Estuary.

The DEP has a strong interest in retaining environmental assets within the Derwent Estuary & improving estuary water quality, which appear to be at risk from climate change. Key areas of interest including the following:

- Sea level rise causing coastal squeeze and loss of tidal wetlands and saltmarshes. The DEP is advocating for planning consideration to be given to current, vulnerable areas and habitat retreat corridors.
- Potential reduced River Derwent flows (if rainfall decreases in the highlands & water extraction increases) causing reduced dissolved oxygen at depth with the estuary (releasing nutrients and heavy metals from estuary sediments). The DEP encourages research and information to assist discussion of this risk.
- Increased occurrence of intense rainfall events in Hobart's urban areas, causing stormwater management issues such as urban stream scour. The DEP is promoting retention of natural watercourses and local government application of the state stormwater strategy.

The DEP has written a discussion paper that looks at planning mechanisms that may apply the findings of scientific assessment and identification of the areas important for tidal wetland and saltmarsh retreat due to sea-level rise. The DEP wetland & saltmarsh discussion paper has been shared with stakeholders since Jan 2011, including the STCA, TPC, the DEP's six local government partners (DVC, GCC, HCC, KC, CCC, BC) and staff within DPAC working on climate change adaptation projects (John Harkin) and risk assessment (Luke Roberts), and experts looking at the social implications of climate change (e.g. Clive

Attwater). A draft planning overlay was created for discussion. The science behind the creation of the overlay has been now been undertaken at other location in the state (e.g. Pittwater, Boulanger Bay) and will soon encompass many areas in the south of the state (project being undertaken by NRM South – employing Vishnu Prahalad (who also worked on the Derwent estuary study).

The DEP is advocating for a new 'Natural Coastal Processes' overlay, which would capture wetland and saltmarsh coastal types, and others at risk of recession due to climate change.

4.6 MAV Insurance Liability Mutual Insurance (LMI)

MAV Insurance Liability Mutual Insurance (LMI) is the primary insurer for all of the councils in Southern Tasmania. Many of the Councils have identified LMI as their most critical risk management framework that should be considered in climate change risk management and adaptation planning.

LMI does not have a statutory obligation to manage climate risks. They do however have a general commitment to assist member councils in effectively managing their risks with a focus on continuous improvement. LMI has developed a broad range of manuals and guidance documents for its members, although not specific and limited to climate change. These documents and support materials may be made available on request.

LMI conducts a biennial audit on all its members, part of which is an Organisational Risk Management section. As part of this section we examine the comprehensiveness of risk assessments for 4 risk areas of council in some detail, one of which is climate change.

LMI also has an internal risk register that includes risks to the scheme from a key claims driver view as well as unusual, new and emerging risks. Climate Change is one of the risks, and is being monitored by the Risk Committee. LMI is unable to provide this risk register to Councils, as it is an internal document only.

LMI does not dictate to members about how they manage their risks. Recommendations and suggestions for improvements may be made, however they have neither the power nor the inclination to 'demand' changes.

4.7 NRM South

The Southern regional NRM Strategy provides the primary framework through which NRM South prioritises and implements projects involving climate change adaptation.

NRM South is working in several ways to address the impact of climate change on natural systems and agricultural land of the southern region. In terms of natural systems NRM South has:

- Completed a preliminary report on 'refugia' (key places in the landscape that will be most resilient to effects of climate change and hence important reservoirs of genetic diversity) with a view to these areas receiving attention for protection and preservation into the future.
- Progressed saltmarsh inundation mapping and associated identification of opportunities for saltmarsh migration. This work has involved councils to determine a mechanism by which planning schemes may be used to facilitate the migration of this vulnerable vegetation community.

There is a potential role for local government in using planning instruments, such as planning scheme overlays, for protection of the identified 'refugia' and to make allowance for migration of vulnerable vegetation communities such as saltmarsh.

In terms of adaptation in agricultural systems, NRM South is working with the farming community, with involvement of local government, to assist in building resilience in soils and the landscape. Through NRM South's Sustainable Practices on Farms Program there has been a series of seminars and field days on the theme of 'living soils', and promotion and trialling of 'regenerative' techniques such as pasture cropping, holistic grazing, compost teas (making and application) & 'keyline' systems.

Other collaborations involving local government include:

- Healthy Catchments to Coast Program looking at management approaches that will help protect habitat. More specifically – habitat protection for the 40-spotted pardalote and swift parrot under 'Mountains to Marine' (Kingborough & Hobart City).
- Protection of remnants of the endangered Miena cider gum (a victim of changing rainfall patterns) with Central Highlands Council.
- Development of a Biodiversity, Geodiversity & Landscape Regional Planning Code.

4.8 Southern Water

Southern Water is the council owned water and wastewater corporation for the Southern Tasmanian region. Southern Water is responsible for delivering water and wastewater services to the community and managing the associated asset base.

Southern Water is beginning to actively manage climate change in its operations and strategic planning. This is primarily being driven by a recognition that climate change may compromise achieving level of service standards and since a commitment has been made to achieving service level provisions, the organisation must therefore adopt an adaptation response.

The following actions are currently being implemented:

- Desktop risk register (completed)
- Climate change strategy (mitigation and adaptation) with a view to develop precinct plans (currently being developed)
- Policy to include climate change as a key part of corporate plan goals and actions.

In terms of collaboration in climate change adaptation and effective service delivery, Southern Water has raised the following points:

- Loss of critical infrastructure around coast lines due to inundation as a result of sea level rise and storm surge is identified as a key climate change risk to Southern Water. Better consideration needs to be made when approving a development adjacent to the coast or creek where adequate setback for water and sewer infrastructure may not be provided to ensure protection from erosion/inundation.
- Reduced water availability is identified as a key climate change risk to Southern Water and better collaboration needs to be achieved in setting growth boundaries around towns so that population limitations are set within the sustainable yield profile of the drinking water catchment and/or reservations are put in place for additional drinking water catchments.
- Better management of bushfire risk needs to be achieved, allowing for approval of critical asset protection measures (e.g. creating buffers around pump stations) within council planning.
- Bushfire management is a key strategic risk for southern water as it has huge effects upon drinking water catchments, service provision, abnormal demand management spikes, hydrant performance, and power outages to water and wastewater infrastructure. Council and TFS could jointly help manage these risks with Southern Water in a number of ways, and probably requires further discussion.

4.9 State Emergency Services (SES)

The State Emergency Services is the statutory authority that coordinates emergency management responses Tasmania-wide. It is a division of the Department of Police and Emergency Management and is comprised of both paid staff and

volunteers. It has four core functions that are set out in the Emergency Management Act (Tas) 2006 s.26 as follows:

- the provision of advice and services relating to emergency management in accordance with emergency management plans or as otherwise authorised by the State Controller or Minister in writing provided to the Director SES, other than the provision of a service provided by another statutory service;
- the provision of services relating to rescue and retrieval operations as authorised by the Minister or State Controller;
- the provision of administrative services for the State Committee and each Regional Committee, including support in the preparation and review of emergency management plans as required by the State Committee and Regional Committees; and
- the recruitment, training and support of volunteer members of the State Emergency Service;

Local Government is an important stakeholder in the delivery of emergency management responses and planning. It is identified in key SES documents and plans that set out the key roles and responsibilities of stakeholders. Pursuant to section 34 of the EMA each Council must: prepare an Emergency Management Plan: review the EMP every 2 years; appoint an emergency management coordinator and establish and maintain voluntary units

The SES's response to climate change, through the 'Natural Disaster Resilience Program and other funding programs, has been to fund and engage in research initiatives that identify and seek to quantify key climate risks as they apply across Tasmania, including:

- Climate Futures Tasmania - Bushfire
- Climate Futures Tasmania - Extreme Events
- Clarence City Council study into the effect of sea level rise – this was the precursor to the current work that CCC has undertaken
- Tasmanian Extreme Wind Hazards Standalone Tool (TEWHST)
- State Framework for natural hazards and Land Use Planning Project.

The SES is the custodian of a significant body of climate change data as a result of its involvement in the Climate Futures Tasmania project and collaboration with Geoscience Australia (Extreme Wind Hazard Project). Opportunities exist for the utilisation of this data to inform local, regional and state emergency management planning.

4.10 Tasmania Fire Service (TFS)

Tasmania Fire Service (TFS) is involved with multiple forums dealing with the impacts of climate change and the potential risks associated with the onset of climate change. Through the bushfire cooperative research council (BCRC) and the Australasian Fire & Emergency Service Council (AFAC), TFS is participating in research and modelling for bushfire. The research being conducted includes, looking at current bushfire risks and assessing current prediction tools to determine modelling for the future. This research will have a bearing on issues such as:

- resource to risk modelling;
- community protection planning;
- bushfire prediction tools;
- bushfire weather modelling;
- prescribed burning modelling; and
- fire management planning.

TFS has also participated in the Climate Futures for Tasmania Project, especially the 'Extreme Events' component. TFS will use this to map a pathway forward for future strategic planning.

Currently, TFS is reviewing the State Fire Protection Plan in which the above issues are called up. Additionally, as part of another review process, TFS is incorporating these developed strategies into its operational corporate plan.

From TFS's perspective the relationship with local government will be important, if not critical for future directions in climate change. Through the State Fire Management Council (SFMC), where LGAT is represented, TFS will engage with local government to ensure they are consulted regarding climate change and bushfire risk into the future. SFMC is currently lobbying State Government for funding to assist with additional programs to develop strategies for vegetation management for the mitigation of bushfires. This also includes legislative changes. Although currently in its infancy, this program will include climate change contingencies as part of the planning process. LGAT are an identified key stakeholder in this program and will be consulted throughout the development of this strategy.

SFMC provides a forum for local government to work with TFS and other land management agencies in relation to climate change and bushfire mitigation. At a 'coal face' level TFS will need to work closely with local government for the development of fire management planning, prescribed burning programs and development planning, especially in bushfire prone areas.

4.11 Tasmanian Landcare Association (TLCA)

The Tasmanian Landcare Fund and Tasmanian Landcaring Grants administered by the TLCA have provided financial support to care groups and landowners for a range of Landcare projects. Often local government NRM facilitators work with groups and

landowners to develop applications and implement projects that address climate change risk themes.

4.12 Tasmanian Planning Commission (TPC)

The TPC has formed a Coastal Planning Advisory Committee comprising two Commissioners, John Ramsay and Roger Howlett, the head of the Tasmanian Climate Change Office, Wendy Spencer, and the Deputy Secretary of DPIPWE, John Whittington, to:

1. prepare a Coastal Planning Framework for consideration by Cabinet (The TPC has been requested by the Premier to prepare the framework following the Premier's decision to accept the TPC's recommendation to reject the revised draft State Coastal Policy);
2. peer review and conduct community and stakeholder consultation on a draft 'coastal hazards' code prepared by the TPC's Policy Division; and
3. coordinate the statewide 'coastal hazards' code review with the formal assessment and determination of a statewide 'flooding' code.

The Advisory Committee has commenced its review of a draft Coastal Planning Framework prepared by the TPC's Policy Division and is due to report to the Commission in the first half of 2012. It is anticipated that the draft 'coastal hazards' code will be released for informal comment in the first half of 2012 and submitted to the Minister for approval as a draft Planning Directive for formal advertising for representations and formal assessment and determination in the second half of 2012.

In terms of other natural hazards and risks, the TPC formed an Assessment Panel in the second half of 2011 to formally assess draft state-wide planning codes prepared by the TPC's Policy Division covering bushfire prone areas, flooding and landslide. These draft codes have been formally advertised and public hearings have been held involving local government representatives.

5. Implementation Plan

The implementation of this Plan requires a co-ordinated approach, both across council corporate service areas and in partnership with other councils as well as public and private external stakeholders. This represents a critical aspect in enabling actions included in this Plan and promoting resilience to respond to a changing climate. Key components of the implementation plan include:

- a consistent process for plan endorsement by all councils of the region;
- a logical way for incorporation of key local risks and adaptation actions into council documents and processes such as risk registers, strategic plans, annual plans or asset management plans;
- an appropriate mechanism to implement sub-regional and regional adaptation actions either through advocacy or collaboration; and
- a mechanism for plan review and updating.

Section 3 of this Plan contains some 27 actions for addressing priority climate change risks. When implemented, these actions will provide Glamorgan Spring Bay Council with an initial response to the challenges posed by climate change.

As discussed throughout this Plan effective implementation does not mean 're-inventing the wheel'; to the contrary many of Council's current activities/operational practices can be modified to assist in managing future climate variability. To this end it will be important that outcomes from the risk assessment process used to support the development of this Plan are integrated with other Glamorgan Spring Bay Council strategic risk management and planning activities. It is recommended that a climate change champion be appointed to oversee implementation of the actions included in this Plan. Senior management will also provide a key role in Plan implementation by remaining engaged with this process and through assuming responsibility for maintaining the risk assessment and implementing treatments (adaptation actions), including those recommended in this Plan (see Strategic Priortities – Section 5.4).

5.1 Financial and resource requirements

Financial and resource availability are critical factors for enabling implementation of adaptation actions. The adaptation options identified in this Plan will come at varying degrees of cost and resource requirement. It is likely that Glamorgan Spring Bay Council will initially support implementation of those adaptation actions, which are cost effective and align with current resource capacity and availability. Implementation of these actions i.e. 'low hanging fruit' will enable Council to gain some

initial momentum in responding to impacts posed by climate change.

It is important to recognise that not all climate change action within Council will require its own funding, but will become embedded in the operational business of Council through appropriate governance arrangements, planning and policy. Notwithstanding this some of the more complex adaptation options will require substantial financial support and resources. For these actions, pursuing grant funding and establishing partnerships for collaborative or common actions can be effective in reducing the overall cost of action for Council, enabling the full cost of action to be offset.

5.2 Monitoring and Evaluation

Monitoring and evaluating the implementation of actions contained within this Plan will be critical in tracking progress with regard to the appropriateness and effectiveness of actions. Monitoring, evaluation and reporting (MER) is a systematic and objective review of either (or a combination of) the appropriateness, efficiency, effectiveness and impact of a set of actions. An example of the key aspects of the climate monitoring, evaluation, review and improvement cycle are highlighted in Figure .

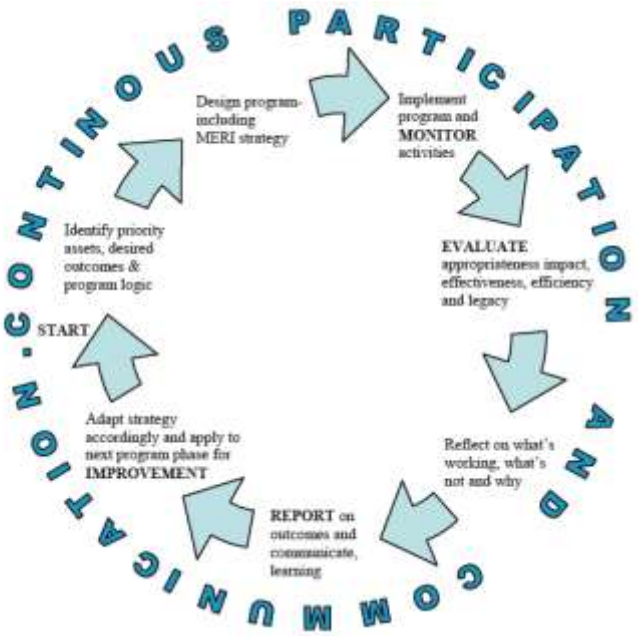


Figure 10: MER Framework to support climate change adaptation plan implementation[12]

Tracking progress against actions in this Plan is important to determine:

- Whether actions need to be reviewed
- Whether actions are being implemented via operational plans

Ongoing monitoring of this Plan should include the following:

- Reporting of implementation of adaptation actions
- Reviewing progress for each council division
- Testing whether actions are still relevant
- Consideration of barriers and barriers to implementing this Plan
- Consulting with external stakeholders to determine progress with regard to implementation of actions
- Identifying barriers to action implementation.

Annual monitoring should be reported in Council's annual report.

As discussed in the previous sections, this Plan focuses on the treatment or priority climate change risks. Although non-priority risks are not addressed in this Plan they should not be ignored. Council should maintain a 'watching brief' on non-priority risks rated as 'moderate' or 'low' as part of the Plan review process. This would include:

- Reviewing the ratings of non-priority risks should new information become available,
- Upgrading risks to priority risks and developing adaptation actions where appropriate.

5.3 Review

This Plan should be reviewed every three years, or earlier if circumstances require. Plan review will be required in context of:

- progress on initial actions;
- updated information on climate science and its relevance at the municipal scale;
- progress in regional and state-wide planning instruments, particularly in relation to codes that guide development in areas likely to be impacted by climate change e.g. the coastal zone;

[12] Department of Environment, Water, Heritage and the Arts (2008). Australian Government Natural Resource Management Monitoring, Evaluation, Reporting and Improvement Framework, May 2008.

- developments in State policy in relation to climate change and the coastal zone;
- changes to the legal framework in relation to council's liability in relation to managing climate change risk and implementing actions;

The 'Toolkit' developed as part of the Regional Climate Change Adaptation Project will guide Council staff in revisiting the risk assessment and adaptation action processes used in the development of this Plan.

5.4 Strategic Priorities

Strategic priorities are broad level climate change adaptation actions that do not specifically address a particular area or risk and fall across numerous Council service areas. Council's senior management team should drive these actions as they require implementation across all Council service areas. This will enable integration of climate change risk management within the business.

Implementation of these actions will provide Council with a solid framework in climate change adaptation and will build an internal culture that supports the implementation of the more specific adaptation actions described earlier. Table 14 over page describes the strategic priorities and the reasoning behind each.

Table 14: Broad level climate change adaptation actions to be implemented across Council (Strategic Priorities)

Strategic Priority Description	Reasoning
Integrate climate change risk management into existing Council wide risk assessment framework.	Climate change risks should be incorporated into Council's existing risk management processes. From a process point of view this will ensure that climate change risks continue to be properly addressed.
Appoint a 'climate change champion' to oversee implementation of this Plan.	A representative from Council is recommended to be appointed to oversee the implementation of actions outlined in the Plan.
Consideration of climate change risks and impacts during the development of other Council strategies, policies and plans.	The climate change impacts and risk process outlined throughout this adaptation action plan should be considered in the development of future plans, policies and strategies to ensure that these issues are incorporated throughout all of Council's service areas. This will also ensure there are mechanisms for actions to be implemented.
Support the STCA in engaging with relevant State Government departments to identify and address gaps in planning instruments, policies, funding and legislation.	State Government has a significant influence over planning and policy at the local Government level. By engaging state government and establishing clear lines of communication, Glamorgan Spring Bay Council, in partnership with the STCA, may be able to inform and influence relevant State Government departments to assist in local climate change impact adaptation.
Develop and implement a climate change communication and education plan for Council staff	Educating staff and communicating initiatives on climate change will strengthen the profile of climate change within local government. Increased staff capacity and awareness will assist in incorporating climate change scenarios and impacts into policy and decision making processes.
Integration of adaptation action plan and greenhouse gas mitigation measures to prioritise projects that have dual benefits.	Ensure that future emissions are considered in the decision making process of prioritising adaptation actions. Often dual benefits can be achieved for climate change mitigation and adaptation.
Implement the monitoring and review process outlined in the implementation plan section of this report.	An adequate monitoring and review process, set up as periodic Council process, will ensure that the most up to date climate change information is always considered and that climate change adaptation becomes ingrained into council's business.
Report on climate change adaptation progress into any future publicly available documents or reports.	Reporting on climate change adaptation progress will assist in engaging the community and informing other Councils on Glamorgan Spring Bay's progress.
Consider developing climate change related KPI's which would be reported on through Council's annual report	Consider developing climate change related KPI's which would be reported on through Council's annual report
Ensure that the projected impacts of climate change are properly considered in Council's emergency management planning.	Emergency response plans should be investigated, developed and implemented considering the best available climate change projections. Up to date emergency response procedures can minimise consequences when extreme events occur.
Where required, support the implementation of the Regional Councils Climate Change Adaptation Strategy	Administered through the STCA, the Regional Councils Climate Change Adaptation Strategy aims to drive adaptation in local government for the region and deliver on a number of common actions that are relevant to its member councils. The success of this strategy is dependent on a high level of buy in from each of the Councils across Southern Tasmania.

Appendices

Appendix A – Climate Futures for Tasmania, Profile for Glamorgan Spring Bay

Local climate profile:

Glamorgan-Spring Bay Municipality

Past and current climate:

- Glamorgan-Spring Bay has a temperate, maritime climate with relatively mild winters. The average daily maximum temperature at Orford is 22 °C in January and 13.1 °C in July
- The municipality receives around 600-700 mm of rainfall a year with no strong seasonal cycle (approx. 50-70 mm each month). Rainfall can come from westerly cold fronts systems or episodic rainfalls from easterly systems such as cutoff lows
- Year-to-year rainfall variability in this municipality is correlated with atmospheric blocking in the Tasman Sea, which is associated with easterly systems including cutoff lows mentioned above. Rainfall is also correlated with the El Niño Southern Oscillation, especially in winter. Temperature and rainfall is influenced by warmer waters offshore brought southwards by the East Australia Current
- Long-term average temperatures have risen in the decades since the 1950s, at a rate similar to the rest of Tasmania (up to 0.1 °C per decade). Daily minimum temperatures have risen slightly more than daily maximum temperatures
- There has been a decline in average rainfall and a lack of very wet years in the municipality since the mid 1970s, and this decline has been strongest in autumn. This decline was exacerbated by the 'big dry' drought of 1995-2009. The recent two years have seen average or slightly above average conditions

Future scenarios - from the Climate Futures for Tasmania *project*

Fine-scale model projections of Tasmanian climate were made for two hypothetical but plausible scenarios of human emissions for the 21st Century (taken from the special report on emissions scenarios (SRES) from the Intergovernmental Panel on Climate Change (IPCC)). The scenarios are of ongoing high emissions, A2, and one where emissions plateau and fall, B1. The climate response under the two scenarios is similar through the first half of the century, but the changes under the higher emissions scenario become much stronger than the lower scenario in the in the later half of the 21st Century.

1. Temperature

- Under the higher emissions scenario (A2), the municipality is projected to experience a rise in average temperatures of 2.6 to 3.3 °C over the entire 21st Century. The rise in daily minimum temperature is expected to be slightly greater than daily maximum temperature, and fairly similar in the different seasons. Under the lower emissions scenario (B1), the projected change over the entire century is 1.3 to 2.0 °C. A time series of projected mean Tasmanian temperature is shown in Figure 1
- The projected change in average temperatures is similar to the rest of Tasmania, but less than the global average and significantly less than northern Australia and many regions around the world, especially the large northern hemisphere continents and the Arctic

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For the Southern Tasmanian Councils Authority (STCA)
Using material from the set of Technical reports of the Climate Futures for Tasmania project

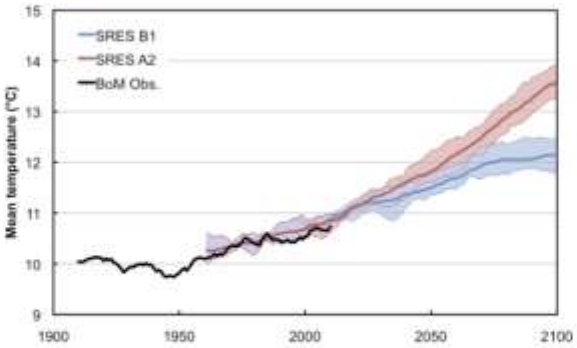

Figure 1. Tasmanian average temperature in observations (black) and model projections for the A2 scenario (red) and the B1 scenario (blue), all series are smoothed (11-year running average), shading shows the range of model projections. Changes under the higher scenario by the very end of the century (box) are discussed in the examples below

- The projected change in average temperature is accompanied by a change in the frequency, intensity and duration of hot and cold extremes of temperature. For Swansea under the A2 (higher) scenario by the end of the century the projections indicate:
  - The number of Summer Days (>25 °C) more than doubles
  - The temperature of very hot days will increase by more than the average temperature (up to 4 °C in some seasons)
  - Frost risk days will be very infrequent, but still occur occasionally
  - Warm spells (days in a row where temperatures are in the top 5% of baseline levels) currently between 4 to 6 days, will last 3 to 5 days longer
- An increase in sea temperature at the coast due to the ongoing strengthening of the East Australia Current is likely to have large impacts to marine and coastal systems

2. Rainfall, runoff and rivers

- The climate response to rainfall and runoff is similar in nature between the two scenarios, but stronger by the end of the century under the A2 scenario. The general long-term influence of climate warming by the end of the century is for increased average annual rainfall in the Glamorgan-Spring Bay municipality

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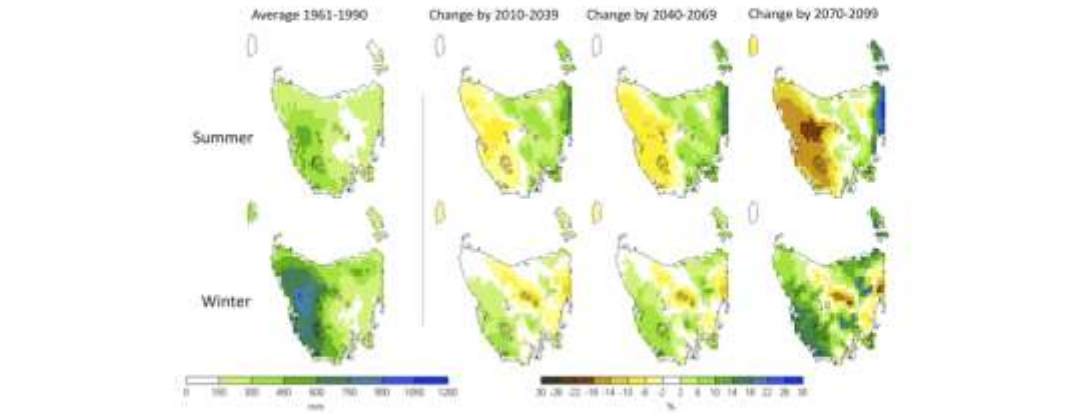

Figure 2. Average rainfall in summer and winter – the left hand side plots show the average rainfall in the baseline period (1961-1990), the plots to the right show the proportional change (%) from that amount in various periods in the 21st century in the average of six climate model projections under the A2 (higher) emissions scenario

- Rainfall is projected to increase in autumn and summer compared to the baseline period for both emissions scenarios – by up to 20% under the higher emissions scenario by the end of the century. The increase is strongest at the coast. Rainfall shows no change or a slight decline in winter and spring
- The long-term effect of greenhouse warming is on top of the usual cycles of rainfall, including droughts, termed 'natural variability'. The model projections indicate that the recent dry conditions of the 'big dry' drought is not a new ongoing climate average state. These projections indicate that in the long term, drought frequency and severity will decrease significantly due to the increased average rainfall
- The projected increase in rainfall is primarily driven by increasing sea temperatures offshore, changes to atmospheric circulation and the synoptic systems that bring rainfall
- A major influence of greenhouse warming on rainfall is the tendency for heavier rainfalls interspersed by longer dry periods, and for greater extremes. For eastern Tasmania under the A2 scenario by the end of the century there is projected to be:
    - An increase in the average rainfall per rain day of up to 15%
    - Three more days each year where rainfall exceeds 10 mm (a 20% increase)
    - An average of 12 mm more rainfall on the wettest day of the year (20% increase)
    - Rainfall brought by rare extreme events will increase: a 200-year average recurrence interval (ARI) event increases by up to 110 mm (90% increase). More common ARI events (ARI-10, ARI-50) increase by a similar proportion.
- Pan evaporation is projected to increase, by up to 19% under the A2 scenario by the end of the century, driven by the increases in temperature but also changes to relative humidity, wind speeds, cloudiness and radiation.
- Changes to rainfall and evaporation lead to changes in water runoff and river flows. This in turn has impacts on the inflows into dams and water storages. Under the A2 scenario by the end of the century:
    - Average runoff increases considerably in summer and autumn, with no major change in winter and spring

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- Proportional (%) increases in runoff are larger than the change to average rainfall, changes to runoff may exceed 30%
- Runoff amounts during high events are likely to increase, including those that may lead to erosion or flooding, runoff amounts during low events are likely to stay much the same
- Flows in the Little Swanport River upstream of the Tasman Highway are likely to increase by around 15% (range -7 to +45 %), and change in seasonality
- Inflows into Tooms Lake and Lake Leake are likely to increase by over 20%, but their reliability for meeting current demand may not change considerably

3. Agricultural impacts

- Chilling affects the growth and flowering of berries, fruits and nuts. Accumulated chill hours decrease given the warming under the two future climate scenarios. Under the A2 scenario, accumulated chill hours drop from around 2300 per year in the baseline climate, to around 1300 per year in the decades at the end of the century.
- Conditions to grow wine grapes are likely to change markedly, which will affect choices such as grape variety and harvest date. Vineyards around Swansea currently experience around 1100 ± 200 annual BEGDD (a measure of heating for crop growth and development) making them suitable for growing Pinot grapes. Under the A2 scenario, this is likely to change to around 1300 BEGDD in the coming decades, and around 1800 BEGDD in the last decades of the century. If the vineyard continues growing Pinot grapes, the harvest date will move forward from June to February and the grape quality will be affected. Otherwise, the wine grower may plant other varieties of grapes, such as Shiraz and Cabernet Sauvignon. As well as temperature, other climate changes are likely to impact upon the wine industry, including heavy rain events leading to soil erosion

4. Extreme sea level events

High water events causing coastal inundation comes from a combination of sea level, tide, storm surge and wind waves. Sea level has been rising at a rate of 3.3 ±0.4 mm/year in the recent period, and are expected to continue rising with further climate warming. The upper range of model projections indicates a rise of up to 0.82 m global average sea level by 2100 under a high emissions scenario. The sea level rise varies in different locations, and for Tasmania the sea level rise for this scenario is close to the global average.

On the east and southeast coasts of Tasmania, the very high tide height and the coastal surge contribute a roughly equal amount to high sea level events – the current 100-year storm tide event in Spring Bay is 1.05 m above average sea level. High storm heights in the southeast are generally brought by westerly cold frontal systems with a low-pressure system to the south of Tasmania. Changes to storm surges by the end of the century are projected to be much less than sea level rise. Accounting for all effects, the current 100-year event in Hobart is projected to be a 1.58 m in Spring Bay by 2090 under the high emissions scenario.

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Appendix – details of climate projections

Greenhouse gas emissions have an influence on the Earth's climate system, along with other human activities such as the emission of ozone-depleting substances, emission of aerosol (particles) and changing the land cover (e.g. deforestation). Sophisticated model simulations can be used to project the likely effect of these influences into the future given our current state of knowledge. It is impossible to predict exactly what future human emissions will be, so models are run under a set of plausible hypothetical *emissions scenarios*. A model simulation shows the likely effect if we follow that scenario, so it is not a single 'prediction' of the future. The simulation can't include the effect of things that are impossible to predict (such as major volcanic eruptions)

The *Climate Futures for Tasmania* project produced a set of climate projections at the regional scale for Tasmania. Two emissions scenarios were considered – one of ongoing high emissions (SRES A2), and one where emissions plateau and fall (SRES B1). The climate response under the two scenarios is similar through the first half of the century, but the changes under the higher emissions scenario become much stronger than the lower scenario in the latter half of the 21st Century.

Climate warming causes many complex changes to the earth's climate system. These changes include alterations to ocean currents, average atmospheric circulation and ocean-atmosphere cycles such as the El Niño Southern Oscillation. Projected effects that are relevant to Tasmania include a continued extension of the East Australia Current bringing warmer waters off the east and northeast coast of Tasmania, a pole-ward shift of the subtropical ridge of high pressure and shifts in the mid-latitude westerlies (the 'Roaring 40s'), and a change in remote climate drivers such as atmospheric blocking, the El Niño Southern Oscillation and the Southern Annular Mode. The position of Tasmania adjacent to the Southern Ocean means that the effect of climate warming is not as severe as other more continental regions.

The results presented in this report were made using established methods, including:

- Extreme value distribution fitting in a generalized Pareto distribution to calculate the average recurrence intervals (ARIs)
- Hydrology runoff models developed and calibrated for the Tasmanian Sustainable Yields project to estimate the runoff, river flows and inflows to storages
- Standard agricultural indices such as the Utah model to calculate chill hours and standard equations and a 10 °C threshold to calculate Growing Degree Days

All information is drawn from the *Climate Futures for Tasmania* Technical reports please see these reports for more details, and to cite in other written work.

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For the Southern Tasmanian Councils Authority (STCA)
Using material from the set of Technical reports of the Climate Futures for Tasmania project

Appendix B – Project Methodology

The development of this Plan has involved two key stages, including a climate change risk assessment and identification of adaptation actions for treatment of priority climate change risks. Five steps supported these two stages of the project as shown in figure 11. This framework is consistent with the International Organisation for Standardisation (ISO) 31000:2009 Standard for Risk Management as well as the Australian Government publication *Climate Change Impacts and Risk Management: A Guide for Business and Government* (AGO 2007).

Figure 11: Process for risk assessment used in the Glamorgan Spring Bay Climate Change Adaptation Plan

This risk assessment process was developed to address priority climate change risks[13], which are primarily associated with Council assets and service areas. This Plan also identifies adaptation actions to manage risks that are within the Council's sphere of influence. Risks have been identified which must be managed in collaboration with other stakeholders (such as State Government Agencies, Community Groups and Private Corporations). Although Council may not directly manage these risks, they remain as important risks to identify as they affect Council service areas and assets. A more detailed outline of the project methodology is documented below for the above-mentioned steps.

[13] Priority climate change risks are those risks rated as 'extreme' or 'high'. Other risks rated as 'moderate' or 'low' are not addressed in this Plan.

B.1 Climate Change Risk Assessment

Establish the context

Establishing the context sets the scene for outlining the potential impacts of climate change to Glamorgan Spring Bay Council from a risk perspective. This was undertaken by the following:

- Defining the business or organisation to be assessed and the scope of the assessment. In this case, identifying Council service areas and its sphere of influence
- Clarifying the objectives of Glamorgan Spring Bay Council
- Identifying stakeholders and their objectives and concerns
- Establishing success criteria against which risks to Council's objectives can be evaluated
- Determining relevant climate change scenarios for the climate change risk assessment (AGO 2007).

The climate change scenario adopted for Glamorgan Spring Bay was the A2 scenario for the year 2100.

Senior management at Glamorgan Spring Bay Council were engaged at this stage to encourage greater attendance and participation in the future stages of the project and to ensure the process was effectively owned by Council.

Identify the risks

The process of risk identification was undertaken to describe and list how climate change could impact on each of the key business areas within Glamorgan Spring Bay Council. This was undertaken using the information gathered in the previous stage of establishing the context.

Risks were identified in a workshop format with key Council staff from the following areas:

- Natural Areas
- Planning
- Infrastructure and property
- Community health

The workshop participants were presented with information that established the context around climate change risk and Glamorgan Spring Bay Council operations. Workshop participants were asked to consider the climate impacts specific to the Glamorgan Spring Bay (outlined in Section 2) and brainstorm potential risks to their business areas based on their Council experience and local knowledge of the area. Risks were framed as cause and effect risk statements that include a hazard and its associated consequence. During the brainstorming session, all risk statements were considered and participants were encouraged to be open and build on each other's ideas. Generally, the following were considered when identifying risks to

Council from climate change:

- ***What can happen*** - events or incidents that could occur whereby the source of risk or threat has an impact on the achievement of objectives?
- ***Where things can happen*** - The physical locations/assets where the event could occur or where the direct or indirect consequences may be experienced
- ***How it can happen*** - The manner or method in which the risk event or incident could occur
- ***When It can happen*** - the specific times or time periods when the event is likely to occur or the consequences realised
- ***Business areas/stakeholders affected*** - Which business units/stakeholders may be involved or impacted. Some risks may impact Council but may also involve external stakeholders and these should be considered
- ***Existing Controls*** - What controls currently exist to minimise the likelihood and consequence of each risk

In many cases, climate change related risks were similar to current weather related risks to Council. These risks are merely exacerbated with the effects of climate change and are assessed as more extreme as current controls become inadequate resulting in changes to the risk profile.

Analyse the risks

Following brainstorming of risks, participants analysed each of the identified risk statements in their business units using the agreed risk assessment framework. The framework provides Council with a comprehensive approach to identifying and managing risk. The framework is based on the processes and criteria outlined in *Climate change impacts and risk management - A guide for Business and Government* (AGO 2007). This guide has been adopted by a significant number of Councils and organisations across Australia and is consistent with the ISO 31000 standard for risk management.

Each risk statement was analysed using the likelihood and consequence scales outlined in Appendix A. Consequence ranged from insignificant to catastrophic and was rated based on the following success criteria (detailed further in Appendix A):

- Financial
- Public safety
- Reputation
- Community and lifestyle
- Environmental
- Strategy
- Service delivery

These success criteria were used to align consequence to Council objectives. Essentially, all risks can eventually lead to a

financial consequence. However, associating success criteria to risk statements guides the development of adaptation actions that manage risks before they become purely financial. A level of risk was determined based on the likelihood and consequence criteria using the risk matrix outlined in Table .

Table 15: Matrix of likelihood and consequence for prioritisation of risks

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

A definition of risk categories is provided below (AGO 2007):

Extreme priority risks demand urgent attention at the most senior level and cannot be simply accepted as part of routine operations without executive sanction.

High priority risks are the most severe that can be accepted as part of routine operations without executive sanction but they will be the responsibility of the most senior operational management.

Moderate risks can be expected to form part of routine operations although they will be explicitly assigned to relevant managers for action and maintained under review.

Low risks will be maintained under review but it is expected that existing controls will be sufficient.

During risk analysis, it was important to consider the current control measures implemented in Council to manage any current risks associated with climate and extreme weather events. For example, Glamorgan Spring Bay Council currently has procedures in place to manage risks associated with the current bushfire regime to its assets. These procedures have been implemented to manage current risks to an acceptable level. Climate change has the potential to exacerbate these risks in the future. Increased temperatures and the incidence and/or the frequency of extreme weather events means that the climate change risks may increase to an unacceptable level where current controls may not be adequate. Adaptation responses for treating these risks will take the form of one or a number of actions in order to reduce the risk profile to a more acceptable level. This is illustrated in figure 12.

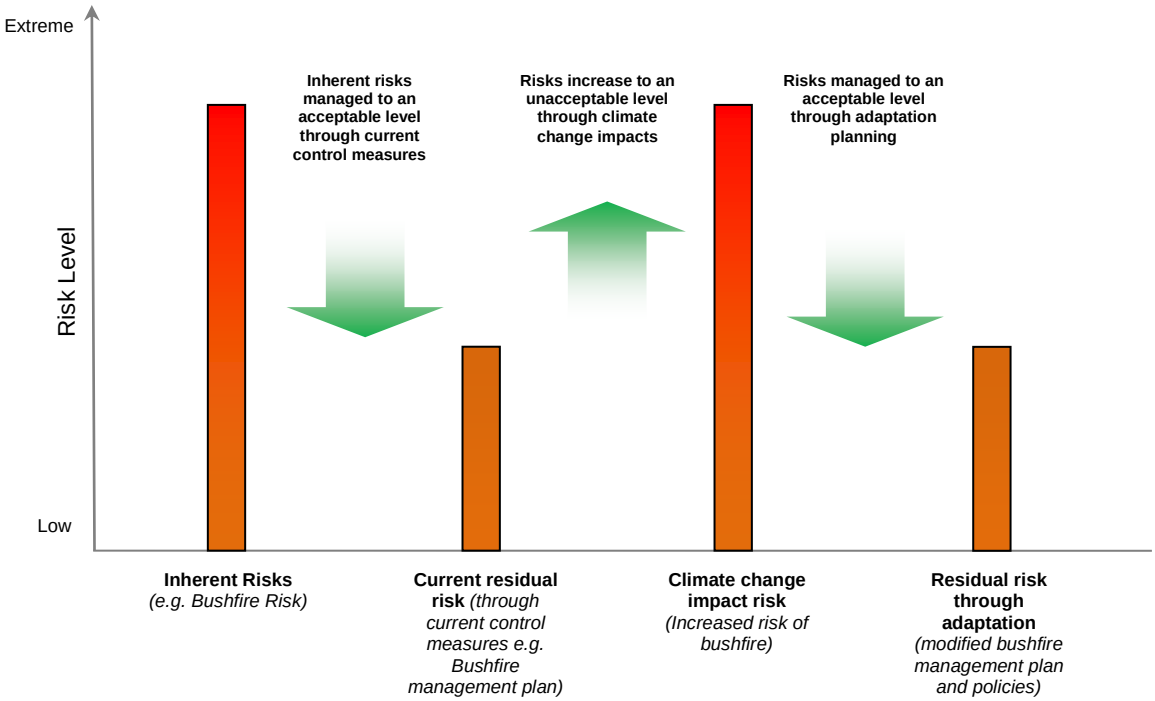

Figure 52: Managing risks through current controls and adaptation planning

Evaluate the risks

Following the identification and analysis of the risks, it is important to evaluate the risks and reassess them in relation to each other. Often, brainstorming and initial assessment of risks can lead to some inconsistency in the way likelihood and consequence scales are applied. Following the risk analysis session, key Council staff were brought together to consider the final risk ratings. These participants were asked to evaluate the relative risk ratings to ensure that they were consistent, and agreed upon across Council. The risk evaluation step assists to gain general consensus on the final risk ratings.

B.2 Climate change adaptation planning

Treat the risks

The treatment of priority risks involves the development of adaptation actions designed to help manage risks to an acceptable level.

Figure 13: Adaptation actions against increasing time, cost and effort

A brainstorming exercise was undertaken in workshop format with key Council staff to develop adaptation actions for the priority risks. As with brainstorming in the previous risk assessment exercise, all actions were considered and participants were encouraged to be open and build on each other's ideas. Once actions had been identified for the priority risks, participants re-rated the likelihood and consequence of each priority risk while considering the impact of the adaptation action. Implementation of adaptation actions vary in terms of cost, time, effort and other criteria. Figure 13 shows that educational type actions such as provision of information to the community are generally easier to implement when compared to engineering or redevelopment type actions. Each action was prioritised based on the following screening criteria:

- ***Cost*** - the potential cost of implementing the action relative to the other actions (high, medium, low)
- **Immediacy** - the timeframe required to implement the action (short term, medium term, long term)
- **Political feasibility** - how feasible the action is politically. This is dependent on Council views (leader, collaborator, influencer)
- **Community acceptance** - the acceptance of the action by Councils rate payers (popular, indifferent, controversial)
- **Concurrent effects** - whether the action has associated benefits or costs associated with its implementation (positive, neutral, negative).

Each adaptation action was scored for each of the above criteria using a multi criteria assessment (MCA) approach. As cost is generally a key criterion in decision-making, this was weighted as 50% of the weighting in prioritising the actions. The remaining 50% of weighting was distributed equally across the other four criteria. The adaptation actions were prioritised by plotting cost against the combined score of the other four criteria in the priority matrix presented in figure 14.

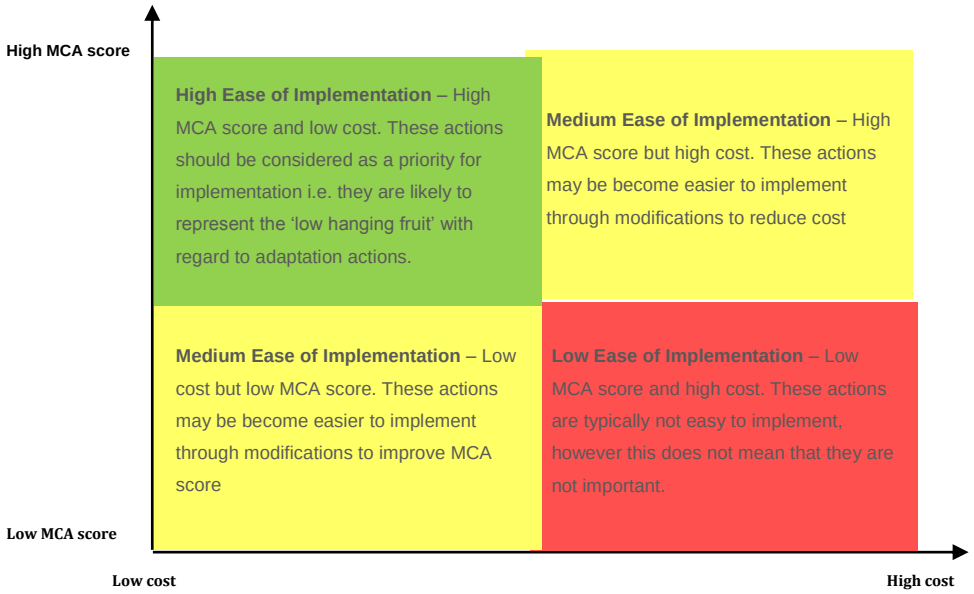

Figure 64: Prioritisation matrix for adaptation actions incorporating cost and four non-monetary criteria.

B.3 Consultation and communication

Stakeholder engagement was paramount in the development of this climate change adaptation action plan. Local knowledge of the area and Council activity is just as important as climate change projections to develop a relevant Plan for Glamorgan Spring Bay Council.

The stakeholder consultation rounds were designed to engage Council staff and incorporate their knowledge and expertise to develop a Plan that has Council input and ownership. Engagement of key Council staff and other relevant stakeholders resulted in increased support and will therefore lead to more success during implementation.

The consultation approach consisted of three distinct rounds outlined in table 16.

Table 16: Description of consultation rounds during plan development

Consultation Round	Stage	Description
Round 1	Briefing RCCI and Minister for Climate Change	Two-hour briefing of the STCA Regional Councils Climate Initiative who form the Technical Working group to the Project and the Minister for Climate Change - with possible attendance from the Minister for Local Government and Planning subject to availability.
	Engagement of senior council management	One-on-one meetings with the senior management team at each council, to encourage greater attendance in the future consultation rounds and to ensure the process is effectively owned by key stakeholders.
Round 2	Risk assessment	Designed to identify and assess risks associated with future climate change at each council. This was undertaken in a focus group or workshop setting with decision makers from each council business unit. During this Round, risks were identified and assessed for both Council corporate activities and for the associated four land use themes (Rural, Natural, Urban, Peri-Urban).
Round 3	Adaptation option prioritisation	Primarily to fine tune and prioritise adaptation options for inclusion into the adaptation plan. In addition, this engagement defined process and system changes within each council that will be required to see actual change eventuate from adoption of the adaptation plan. It included the same participants as those in Round 2 and was in a workshop or focus group setting. Adaptation options were prioritised for both Council corporate activities and for the community and associated four land use themes.
	Engagement with external stakeholders	Targeted consultation with external stakeholders that operate across council boundaries, providing additional input to the adaptation plans. External stakeholders were consulted to engage them in the development of the land use adaptation plans and to determine their role in implementation (i.e. Public Private Partnerships, funding, rebates, education etc.).

Appendix C – Complete Risk Table

As discussed in Appendix B.1, following the initial identification and analysis of the risks they were re-evaluated in relation to each other in order to ensure that they were consistent, and agreed upon across Council. This process occurred for only the priority (high and extreme) risks. Table 15 below presents the complete risk register that was developed at Glamorgan Spring Bay Council's round 2 engagement, the risk assessment workshop. This table was therefore developed prior to the re-evaluation process. Reassessed priority risks have been provided throughout section 2 of this plan.

Table 15: Council's complete risk register, developed at the risk assessment workshop

	Climate Impact	Risk Statement	Success Criteria	Business Area	Likelihood	Consequence	Risk	Comments
1	Increased average temperature	Increased water temperatures and ocean acidification leading to changes in fish species / diversity etc. with possible consequence for aquaculture resulting in biodiversity issues	Environmental	Natural Assets	Almost Certain	Catastrophic	Extreme	
2	Increased fire risk	Bushfire events may result in increased injuries or death for community members living in bushfire prone areas.	Community and lifestyle	Community Health	Likely	Catastrophic	Extreme	
3	Increased flooding	Flooding of infrastructure assets (e.g. road asset network, stormwater, walking tracks, parks) resulting in impacts on council budgets, particularly where assets are not insured	Financial	Infrastructure and Property	Likely	Major	Extreme	
4	Increased flooding	Increased risk of flooding may present increased danger for low lying homes with regards to planning decisions (e.g. change zones, add conditions) resulting in increased public complaints	Reputation	Planning	Almost Certain	Moderate	Extreme	
5	Sea level rise and storm surge	Severance of infrastructure in low lying areas resulting in isolation of communities from essential services	Service Delivery	Community Health	Almost Certain	Major	Extreme	

	Climate Impact	Risk Statement	Success Criteria	Business Area	Likelihood	Consequence	Risk	Comments
6	Sea level rise and storm surge	Inundation of infrastructure (e.g. road asset network, stormwater, walking tracks, parks) resulting in financial loss to council, particularly where assets are not insured	Financial	Infrastructure and Property	Likely	Major	Extreme	
7	Sea level rise and storm surge	Network disruptions with stormwater inundation affecting wastewater networks and resulting in infrastructure shut down and increased costs associated with maintenance, retrofitting or replacement	Service Delivery	Infrastructure and Property	Likely	Major	Extreme	
8	Sea level rise and storm surge	Inundation of saltmarsh and associated estuarine communities (e.g. Baudin's Sea Lavender in Triabunna) resulting in decreased habitat extent and biodiversity impacts	Environmental	Natural Assets	Possible	Catastrophic	Extreme	
9	Increased average temperature	Increased water temperatures and ocean acidification leading to changes in fish species / diversity etc. with possible consequence for aquaculture resulting in community financial issues	Reputation	Natural Assets	Likely	Moderate	High	
10	Increased fire risk	Bushfires impact council assets resulting in increased maintenance and replacement costs	Financial	Finance	Possible	Major	High	
11	Increased fire risk	Increased frequency of extreme bushfire events resulting in impacts on natural areas and therefore reducing the 'beauty' of the area impacting on tourism and population growth.	Community and lifestyle	Natural Assets	Possible	Major	High	Corporate
12	Increased flooding	Inundation of low lying areas for extended periods triggering disease vectors (e.g. wastewater treatment related diseases) and impacts on community health	Public Safety	Community Health	Possible	Major	High	
13	Increased flooding	Increased extent of residential properties in low lying areas subject to flooding resulting in increased frequency of litigation action	Financial	Finance	Almost Certain	Minor	High	

	Climate Impact	Risk Statement	Success Criteria	Business Area	Likelihood	Consequence	Risk	Comments
14	Increased flooding	Increased flooding causing degradation of road networks/bridges due to flooding resulting in increased maintenance costs.	Service Delivery	Infrastructure and Property	Likely	Moderate	High	
15	Increased flooding	Increased intense rainfall and flood events may result in wastewater overflows and water quality decline (sedimentation) in creeks, rivers, estuarine and coastal areas resulting in degradation of biodiversity values.	Environmental	Natural Assets	Possible	Major	High	
16	Increased flooding	Increased intense rainfall and flood events may result in wastewater overflows and water quality decline (sedimentation) in creeks, rivers, estuarine and coastal areas resulting loss of tourism to GSB region.	Financial	Natural Assets	Possible	Major	High	
17	Increased flooding	Increased flooding may result in requirements to change land use planning zones which may trigger community dissatisfaction and litigation due to potential impacts on property values	Financial	Planning	Likely	Moderate	High	
18	Increased rainfall variability	Increased rainfall and temperature variability requiring changes in variety of crops and management practices resulting in financial and psychological impacts on landholders and rural communities.	Community and lifestyle	Community Health	Likely	Moderate	High	
19	Increased rainfall variability	Increased rain and temperature events triggering spread of disease i.e.. Ross River Fever (notifiable Disease) and impacts on public health	Public Safety	Community Health	Possible	Major	High	
20	Increased rainfall variability	Increased rainfall leading to increased stormwater input resulting in lower water quality and increase disease at local beaches	Reputation	Community Health	Likely	Moderate	High	

	Climate Impact	Risk Statement	Success Criteria	Business Area	Likelihood	Consequence	Risk	Comments
21	Increased rainfall variability	Increased rainfall and temperature variability requiring changes in variety of crops and management practices resulting in detrimental impact on the environment.	Environmental	Natural Assets	Likely	Moderate	High	
22	Sea level rise and storm surge	Potential saltwater intrusion into Dolphin Sands aquifer resulting in reduced access to freshwater and loss of potable water and public health issues	Community and lifestyle	Community Health	Possible	Major	High	
23	Sea level rise and storm surge	Loss of coastal property may trigger psychological impact due to high levels of uncertainty and anxiety	Reputation	Community Health	Likely	Moderate	High	
24	Sea level rise and storm surge	Risk to community health due to inundation of low lying areas for extended periods triggering disease vectors (e.g. wastewater treatment related diseases)	Reputation	Community Health	Likely	Moderate	High	
25	Sea level rise and storm surge	Severance of low lying roads/bridges due to flooding resulting in decreased safety due to isolation form essential services	Service Delivery	Community Health	Likely	Moderate	High	
26	Sea level rise and storm surge	Sea level rise causing rising groundwater levels in low lying areas impacting on structural stability of infrastructure , resulting in reduced asset lifecycles and increased maintenance costs.	Financial	Infrastructure and Property	Possible	Major	High	
27	Sea level rise and storm surge	Planning decision which do not consider potential for increased frequency of storm surge events that may ultimately lead to litigation due to impacts of storm surge erosion on community assets	Financial	Planning	Likely	Moderate	High	

	Climate Impact	Risk Statement	Success Criteria	Business Area	Likelihood	Consequence	Risk	Comments
28	Increase in hot days	Increased frequency of hot days resulting in additional cooling requirements for council operated facilities and increased operational costs for council managed facilities	Financial	Finance	Rare	Catastrophic	Moderate	
29	Increased atmospheric CO2	Introduction of carbon tax resulting in increased cost of living expenses for community placing additional pressures on vulnerable community members	Financial	Community Health	Likely	Insignificant	Moderate	
30	Increased atmospheric CO2	Increased operational costs for council operated facilities due to introduction of carbon tax.	Financial	Finance	Likely	Insignificant	Moderate	
31	Increased atmospheric CO2	Introduction of carbon cost will drive up costs associated with construction and operation of critical infrastructure assets	Financial	Infrastructure and Property	Likely	Minor	Moderate	
32	Increased fire risk	Increased frequency of bushfire events may result in increased maintenance and replacement costs for council assets located in bushfire prone areas	Financial	Infrastructure and Property	Possible	Moderate	Moderate	
33	Increased flooding	Flooding causing contamination of recreational and potable water supplies resulting in public health issues	Public Safety	Community Health	Likely	Minor	Moderate	
34	Increased flooding	Increased litigation by community members whose properties are subject to impacts posed by flooding	Financial	Finance	Likely	Minor	Moderate	
35	Increased flooding	Severance of infrastructure in low lying areas subject to flooding resulting in decreased access for the community (isolation as a worst case scenario) resulting in reputational impacts	Reputation	Infrastructure and Property	Likely	Minor	Moderate	
36	Increased flooding	Increased flooding may result in under capacity culverts resulting in potential for failure and increased public health issues	Service Delivery	Infrastructure and Property	Likely	Minor	Moderate	

	Climate Impact	Risk Statement	Success Criteria	Business Area	Likelihood	Consequence	Risk	Comments
37	Increased rainfall variability	Rising Water Table under existing dwellings resulting in public health issues (e.g. mould)	Public Safety	Community Health	Likely	Insignificant	Moderate	
38	Increased rainfall variability	Increased rainfall leading to increased stormwater input resulting in lower water quality and increase disease at local beaches	Public Safety	Community Health	Possible	Minor	Moderate	
39	Increased rainfall variability	Declining water security may result in increased water rates charges and impacts on maintenance and lifecycle of council assets (e.g. parks and reserves).	Financial	Finance	Possible	Moderate	Moderate	
40	Increased rainfall variability	Increased rainfall and temperature variability causing changes in variety of crops, productivity decline resulting in financial impacts to council (e.g. landholders unable to pay rates or leave region)	Financial	Finance	Possible	Minor	Moderate	
41	Increased rainfall variability	Rising Water Table under existing dwellings resulting in building footing instability	Financial	Infrastructure and Property	Possible	Minor	Moderate	
42	Sea level rise and storm surge	Inundation of infrastructure (e.g. road asset network, stormwater, walking tracks, parks) resulting in increased insurance premiums and impacts on council budgets	Financial	Finance	Likely	Minor	Moderate	
43	Sea level rise and storm surge	Increased damage from foreshore erosion on residential properties leading to increased risk of litigation from community	Financial	Finance	Likely	Minor	Moderate	
44	Sea level rise and storm surge	Rising groundwater levels in low lying areas impacting on structural stability of infrastructure resulting in increased litigation from community members	Financial	Finance	Possible	Minor	Moderate	
45	Increased average temperature	Migration of people from the mainland to take advantage of a more favourable climate leading to stresses on health infrastructure	Public Safety	Community Health	Possible	Insignificant	Low	

	Climate Impact	Risk Statement	Success Criteria	Business Area	Likelihood	Consequence	Risk	Comments
46	Increased fire risk	Bushfire events resulting in loss of uninsured assets resulting in community health issues (e.g. anxiety, depression, etc.)	Community and lifestyle	Infrastructure and Property	Possible	Insignificant	Low	
47	Increased fire risk	Increased frequency of extreme bushfire events resulting in impacts on natural areas and biodiversity decline	Environmental	Natural Assets	Unlikely	Minor	Low	
48	Increased fire risk	Requirements to change land use planning zones may trigger community dissatisfaction and litigation due to potential impacts on property values	Financial	Planning	Possible	Insignificant	Low	
49	Increased flooding	Declining property values in low lying areas subject to flooding combined with rising insurance costs may result in increased community mental health issues	Community and lifestyle	Community Health	Possible	Insignificant	Low	
50	Sea level rise and storm surge	Inundation low lying property combined with rising insurance costs may result in increased community mental health issues	Community and lifestyle	Community Health	Unlikely	Insignificant	Low	
51	Increase in hot days	Reduced community productivity due to OH&S related impacts associated with stop work events	Community and lifestyle	Community Health			NOT EVALUATED	
52	Increase in hot days	Increased health issues such as heat stroke, cardiovascular problems amongst vulnerable community members resulting in public safety health issues	Public Safety	Community Health			NOT EVALUATED	
53	Increase in hot days	Increased costs for council to ensure appropriate shade facilities in public areas to reduce exposure to hot weather related impacts	Financial	Infrastructure and Property			NOT EVALUATED	
54	Increase in hot days	Increased demand by community for shelter in public facilities (e.g. swimming pools, libraries) resulting in increased costs to council	Financial	Infrastructure and Property			NOT EVALUATED	

	Climate Impact	Risk Statement	Success Criteria	Business Area	Likelihood	Consequence	Risk	Comments
55	Increased atmospheric CO2	Increase atmospheric CO2 may promote greater spread of woody plant growth and biodiversity decline.	Environmental	Natural Assets			NOT EVALUATED	
56	Increased fire risk	Impacts on assets resulting in public safety issues such as isolation from essential services	Service Delivery	Community Health			NOT EVALUATED	
57	Increased fire risk	Approval of development in fire prone areas causing public safety risk and liability to council	Public Safety	Planning			NOT EVALUATED	
58	Increased flooding	Increased intense rainfall and flood events resulting in water quality decline and loss of aquatic biodiversity	Environmental	Natural Assets			NOT EVALUATED	
59	Increased rainfall variability	Reduced water security due to variations in rainfall for areas relying on tank water only.	Service Delivery	Infrastructure and Property			NOT EVALUATED	
60	Sea level rise and storm surge	Sea level rise increases saltwater intrusion (particularly low lying coastal areas) leading to increased cost of upgrading infrastructure and community dissatisfaction due to increasing water and sewage rates	Reputation	Infrastructure and Property			NOT EVALUATED	Corporate
61	Sea level rise and storm surge	Loss of shorebird habitat due to sea level rise resulting in decreased habitat extent and biodiversity impacts	Environmental	Natural Assets			NOT EVALUATED	
62	Sea level rise and storm surge	Approving a zoning that allows for development that proves inappropriate, causing reputational impacts to council	Reputation	Planning			NOT EVALUATED	