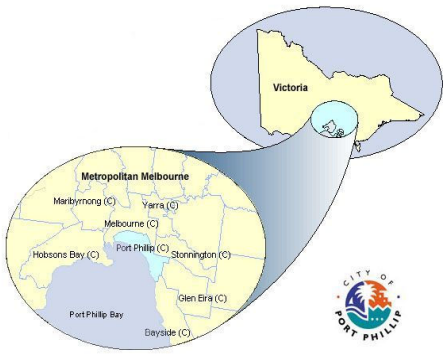
Responding to Assessed Climate Impacts: Implications for Bayside Planning and Community Resilience

Lalitha Ramachandran, Senior Project Manager Sustainability
Kate Nagato, Foreshore Place Manager
Department of Environment & Renewal,
City of Port Phillip

Background

The City of Port Phillip is a highly developed and densely populated inner urban municipality just south of the City of Melbourne, and contains part of the southern Melbourne CBD. One of 10 municipalities around Port Phillip Bay, it has 11 kms of foreshore from Port Melbourne to Elwood. As well as being a popular and vital tourist and urban beach destination, it contains some of Melbourne's iconic foreshore buildings (Luna Park, SeaBaths, Palais Theatre) and premier entertainment and café destinations (Acland Street, Fitzroy Street).

The City is built on mostly low lying coastal swamp, with a flat, sandy terrain that is now largely covered (over 80%) by impervious surfaces. The City also is an end-of-pipe, upstream urban stormwater receiver before its entry into the Bay; much of this received stormwater has high pollutant loads.



Climate Change in the City of Port Phillip – An Initial Perspective

In January 2007, the City of Port Phillip released *Climate Change in the City of Port Phillip – An Initial Perspective*. The report aimed to provide an assessment of the local and regional impacts and likely flow-on effects from known and estimated climate change (2020, 2050, 2100) and the resulting consequences and challenges facing the City. It also aimed to provide some clear emerging directions, considerations and implications for Council and the community in both greenhouse gas abatement and climate change adaptation. The report combined 3 primary aspects:

1. A commissioned assessment of the anticipated local impacts (by Earth Systems and Planning Research Centre, University of Sydney) and an analysis of the likely implications on the municipality
2. A compilation of international and national data on global climate and likely regional economic, social and environmental impacts (draft 4th IPCC Assessment Report, Stern Review)
3. A footprint of the municipality's greenhouse gas emissions (1996-2006) and water use (2001-2006).

The focus of this paper however, is primarily on the first aspect – the risk identification and assessment of local climate impacts. The results suggest a range of risks to Council assets and services as well as for the broader community that require an urgent response. This paper

provides an overview of the City's identified climate risks and flow-on effects, the City's approach to climate adaptation action, and the findings and learnings to date.

What's Different About This Local Climate Risk Assessment?

The City of Port Phillip's local climate risk identification and assessment report was the first local climate change risk and impacts assessment by an Australian Local Government. Most critically, it increased council and community consciousness about both greenhouse gas abatement and climate adaptation, and the differing responses to each.

It also placed the climate adaptation agenda on the map for other Victorian councils. Like many other Australian Local Governments, in 2006 the City initiated an agenda to move toward carbon neutrality, later setting ambitious greenhouse and potable water use reductions targets and timelines for both council and the municipality as a whole (see *Toward Zero Sustainable Environment Strategy*). However, the City also initiated abatement action, at the time, a policy and strategy sleeper for most other Councils, state and federal agencies.

The City of Port Phillip's approach to climate adaptation is as follows.

Strategic Framework for Climate Adaptation, City of Port Phillip	When
STAGE 1 – IDENTIFY and ASSESS LOCAL CLIMATE RISKS ▪ Identify local climate risks (such as sea level rises, storm surges, temperature increases) and determine level of risk ▪ Assess local flow-on effects (determine on-ground effects on assets, infrastructure, services, significant sites, properties)	Completed and Published - Jan 2007
STAGE 2 – ANALYSE LIKELY PRIORITY ACTIONS TO REDUCE RISK A comprehensive analysis of how the City might meet 5 identified primary adaptation needs as follows – 1. Flooding and stormwater management (including permeability and water quality) 2. Building, planning and development 3. Beach and coastal management (including erosion) 4. Infrastructure management (including roads, drainage, maintenance) 5. Emergency management. The analysis includes likely actions required, by when, at what likely cost, and in partnership with whom. It also combines a comprehensive in-council assessment, consultation on issues and emerging solutions with state and regional agencies, and whole-of-catchment modelling and mapping in key needs areas.	Anticipated completion – Dec 2008
STAGE 3 - DEVELOP and IMPLEMENT ACTION PLAN ▪ Resulting Action Plan and regional consultation. ▪ Adopt and Implement Action Plan (reviewed biennially) Effective implementation will definitely require strengthened Local Government advocacy to, and partnerships with, state, federal and regional agencies.	Anticipated completion June 2009

Stage 2 allows the City of Port Phillip to proactively understand and prepare for the changes required to how we currently plan, manage and service the municipality and community. It also allows the City to understand and evidence the institutional and statutory barriers to such change at the local level, and initiate action in the correct channels to overcome such identified challenges.

Risk Assessment of Local Climate Impacts - Area of Study, Methodology and Data

The study area (10km2) covered the southern half of the municipality's foreshore area – from Albert Park to Elwood and across to St. Kilda Road. It encompasses around 20,750 residential properties, 1,000 commercial properties, one of the City's major activity centres and several significant neighbourhood activity centres, and some of the most popular and visited foreshore areas. It includes Elwood Canal and some of the City's primary flood risk areas.

The methodology is consistent with AS/NZS 4360:1999 and outlined in *Climate Change Impacts and Risk Management – A Guide for Government and Business* (AGO, 2006). The assessment used CSIRO's CLIM tool and all data and aerial imagery available at the time (local, Bureau of Meteorology, state and national). In summary, 2 sets of data were combined - the likelihood of an event and the impact (consequence) of that event. Each was given a score out of 5 (negligible, low, moderate, high, extreme), and then combined to provide a risk score.

In the last 18 months, there have been vast advances in data imaging. Equally, current climate science indicates an accelerated rate of pace of climate change. The City of Port Phillip will be completing a data update in consultation with state and regional agencies (August 2008) to ensure its remaining assessments use the latest climate science.

Assessed Local Impacts and Flow-on Effects from Climate Change

The following table outlines the local climate trends, the climate risk impacts and their primary flow-on effects for the City of Port Phillip.

Indicator	Local Climate Impacts	Primary Associated Risks
Sea Level Rise, Storm Surge and Storm Tide	Over the last 10 years, an averge sea level rise of 3cm has been estimated for Port Phillip Bay. The observed rises in sea level for the City are largely consistent with the global trend. Average sea level rises for the City are estimated to be **4.5cm (3-10cm range) by 2020, 13.5cm (5-30cm range) by 2050 and 28.5cm (10-88cm range) by 2100**. As linear extrapolation of current trends may not be an accurate indication of future changes of variables that increase risk, the ranges above (IPCC and CSIRO) provide indicators of upward variability. Potential future storm surge levels in Port Phillip Bay include a **1.65m storm surge with a 35cm sea level rise, a 2.06m storm surge with an 80cm sea level rise, or a 2.31m storm surge with an 80cm sea level rise and a 10% wind speed increase.**	**Infrastructure Instability** – Beachside buildings and infrastructure, particularly in St. Kilda (St. Kilda Pier, Harbour Marina, SeaBaths and Luna Park) and residential areas adjacent to Elwood Canal, are especially at risk. The City's coastal bike trails and paths and beachside amenities are also at significant risk. **Loss of beaches** - Coastal infrastructure combined with severe storm events has already contributed to significant coastal erosion around Port Phillip Bay in the last 50 years. Modelling of Middle Park Beach indicates that with a mean sea level rise of 30-50cm, the actual recession of the beach berm may be between 3.5m and 5m respectively. Middle Park and St. Kilda Beach are susceptible to erosion and potential loss as a result. West Beach is particularly susceptible to subsequent sediment deposition. This could result in siltation and subsequent obstruction of the Royal Melbourne Yacht Squadron slipway entrance. **Impacts on planning zones –** Increased storm surges and tides leading to potential flooding mean planning designations are likely to be affected in the future. Flooding was the third highest primary risk, and has a lower likelihood of occurrence in the short term, but is likely to be the primary driver behind planning zone impacts. The areas most at risk from coastal inundation and resultant salinity are low-lying areas around the St. Kilda foreshore and Elwood Canal. Flooding of these areas is likely to affect key infrastructure and areas such as Acland Street, Catani Gardens, The Esplanade and Beaconsfield Parade, and residential properties around Elwood Canal. **Flooding of coastal properties** – Erosion increases the vulnerability of coastal infrastructure and buildings to wave attacks during storm events. The City's study area has over 9000 addresses within 3 km of the coastline and below 4m in elevation. These are the most at risk from beach erosion and subsequent flooding. Key tourist attractions (Acland Street, SeaBaths, Luna Park) are also at risk of flooding. **Additional Impacts** – Damage to coastal ecosystems and vegetation, deposition of debris on beaches.
Intense Rainfall	Climate change will increase the magnitude (duration, intensity and frequency) of storm events. The following storm intensity estimations are likely for the City – **5% increase in intensity of a 20 yr event by 2020, 35% increase in intensity of a 20 yr event by 2050, 70% increase in intensity of a 20 yr event by 2100.** CSIRO also predicts **a 5% increase in storm event rainfall per degree of climate warming.** It is estimated that a 5% increase in intensity of the standard design 1 in 100 year ARI would result in an additional 1.8mm of rainfall per 2 hour storm event, and a 10mm increase in flood levels. In short, it results in a 1 in 70 year event.	**Stormwater Runoff** – Impacts focus around the quality, quantity and flow rate of stormwater; which in turn depend on the area of impervious surface and storm intensity/duration. High resolution aerial photography (2004) of the study area suggests that about 80% is impervious. In dry periods, the permeability of pervious surfaces decreases, and is not as capable of dealing with intense rainfall, resulting in increased runoff when it does rain. Primary impact areas as a result of the primary risk areas include stormwater and drainage management, stormwater quality and planning zone implications for onsite stormwater management (WSUD) and increased permeability. **Flooding** – Flooding can occur from accumulated stormwater runoff that drainage infrastructure is unable to cope with. There are approximately 4000 residential properties within the existing ARI flood extents that are at very high risk from future flood events. The City's roads are also susceptible to flooding; this increases the risk of lack of access for people moving in/out of the City as well as emergency services, and can impede transportation services.

Indicator	Local Climate Impacts	Primary Associated Risks
Extreme Weather Events	There will be an **increased frequency of strong winds**, hailstorms and lightning. It is estimated that changes to hailstorm and lightning events will be negligible. The primary impact is strong winds. Like storm surges and intense rainfall, increased strong winds indicate changes to atmospheric and surface temperatures, which affect pressure systems resulting in increased wind speeds. Strong winds can therefore exacerbate the effects of storm surges and intense rainfall.	**Roof and Structure Damage from heavy winds** – corrugated iron roofs and fences are particularly susceptible **Damage to Buildings, Powerlines and Roads from falling trees and branches –** general infrastructure damage, energy infrastructure damage, indirect roof and building damage, increased maintenance and clean-up. A 25% increase in peak gust can cause a 650% increase in building damages (AGO 2006). Wind gusts during the February 2005 storms reached 104 km/h and resulted in $300,000 worth of damage to trees alone and over 12,000 reports of building damage (Port Phillip City Council, 2005). Wind gusts in April 2008 reached 132 km/h and cut power to 300,000 homes and properties in Victoria.
Temperature Rises (Study assumed that there has already been a 1.0°C rise in temperature)	The best available predictions for Port Phillip indicate that mean temperature may increase further by **0.5°C by 2020, 1.5°C by 2050, and 2.5°C by 2100** as a result of climate change. Each 1.0°C rise is equivalent to towns in southern Australia shifting northward by about 100km (BOM, 2006). The **number of days over 35°C** in Melbourne will increase from 9 days to 11 days per year by 2020, 16 days by 2050 and as many as 40 days by 2100. In 2005, the average Australian temperature was 0.9°C above the standard 1961-1990 average. There has also been an increase in the frequency of heat waves in the last 5 years.	**Heat-related illness** – Primary risks are heat stress, heat stroke, heat exhaustion and dehydration, as well as exacerbation of respiratory and cardiac conditions. The primary group at risk is the 25% of the City's population over 60 years. The secondary group are the anticipated increased numbers of beach-goers. **Water and Energy Demand** – Extremely hot days generally result in sharp increases in peak energy and water demand. **Infrastructure Risks** – Extreme heat can affect road materials and undermine their stability, leading to drying out and cracking of building materials. However, these impacts are more as a result of persistent increased mean temperatures. **Fire Risk** – Increased fire risk and propensity to bushfires across Victoria, as well as increased smog mean that Melbourne's air quality is likely to deteriorate during hot and dry periods. Timber structures and other flammable materials in residential properties are also at increased risk of fire.
Decreasing Precipitation and Increasing Evaporation	Regional predictions for Victoria indicate a decrease in precipitation per degree of climate warming. Future precipitation decreases across the City include **a decrease of 2% by 2020, 4% by 2050 and 15% by 2100.** Coupled with decreasing precipitation is the potential increase in evaporation. **The average potential evaporation for Melbourne is estimated to increase by 3% by 2020**. In effect, our climate and terrestrial surfaces are becoming progressively dryer, with even less humidity. **Rainfall** - The last 10 years have recorded annual rainfall of over 100 mm below the Melbourne average (539 vs 655mm pa). This is likely to lead to step decreases in rainfall to **510 mm pa by 2020 and to 465mm pa or 25% less than standard by 2050**.	**Water Availability** - Coupled with falling rainfall and inflows to Melbourne's catchments, Melbourne is likely to continue experiencing dry spells and droughts, as well as significant water shortages. **Water Quality** - Decreased precipitation can affect water quality. Negative water quality impacts on Port Phillip Bay are possible due to increased concentrations of pollutants entering the Bay coupled with higher ambient bay water temperatures. Decreased stream flow can also reduce the quality of water entering Melbourne's catchments. **Biodiversity, Parks and Gardens** – Changes in precipitation coupled with less rainfall and encroaching saline waters will significantly impact on both vegetation and wildlife. **Infrastructure Damage and Thermal Comfort** – Moisture loss from building materials and soil (ground subsidence) can lead to warping in timber and cracking in mortar, as well as consequent instability of building foundations.

The Flow-On Effects from Local Climate Impacts

In summary, the following were demonstrated to be highly likely.

By 2020 -

- Increased flooding and storm damage of properties and infrastructure – at least 9000 properties at high risk of inundation, traffic and debris congestion very likely to cause further damage to nearby properties in floods
- Increased pressure on drainage infrastructure capacities and requirements for stormwater and flood management (action needs to be initiated from at least 2010 to meet the challenge)
- Increased loss of beaches as well as additional beach debris (already very costly)
- Increased structural damage to built form from prolonged and extreme hot and dry weather
- Increased heat stress and drought on parks, trees, reserves

- Increased need for adequate and current emergency response management.

By 2050 -
- Accelerated beach and coastal erosion
- Regular flooding and inundation
- Regular storm damage to properties and infrastructure
- Increased infrastructure and built form instability and subsidence
- Increased heat-related and respiratory illnesses.

City of Port Phillip - Storm Surge Inundation Estimates -

Resulting Climate Adaptation Recommendations from the Report

The report provided a series of adaptation and abatement recommendations for action. The adaptation recommendations, many of which have been initiated, are as follows:

1. **Expansion of local climate risk identification and assessment** regionally across both Port Phillip Bay (Association of Bayside Municipalities) as well as neighbouring upstream catchment (inner Melbourne and Yarra region) to provide the following primary outputs –
    - Comprehensive local climate data, modelling and research across Port Phillip Bay and inner Melbourne/Yarra region over the next 4 years
    - A Local Government climate risk assessment tool to strategically identify priorities and develop solutions
    - Regional and national collaboration to achieve the other recommended outputs.

2. An **assessment of Council infrastructure** with regard to capacity to be climate-adept. This includes Council's stormwater and drainage systems, road infrastructure in identified

risk areas such as coastal roads and low-lying areas, and coastal public amenities and facilities

3. An **assessment of Council and community assets** with regard to capacity to be climate adept. This includes most of Council's public buildings, coastal parks and reserves, and recreational facilities along the foreshore, as well as properties (residential and commercial).

4. Enhanced efforts to secure **changes to the state planning policy framework for sustainable and climate-adept built form** through the planning and zoning process. Consideration of the **development of an adaptation planning tool** that works side-by-side with sustainable design tools such as STEPS/SDS to assist all developments, redevelopments and renovations in the municipality to become more sustainable and climate-adept.

5. **Water sensitive urban design** to develop a City with increased permeability, increased stormwater quality, reduced water needs, and stormwater calming infrastructure

6. An **assessment of Council's foreshore and coastal management** with regard to managing erosion, calming coastal inundation and flooding/stormwater management.

7. An **assessment of Council's management plans and contracts** with regard to managing local climate impacts, particularly in drought and heat management, beach cleaning and maintenance, vegetation management, planning and surface conditioning, site development or redevelopment.

8. An **assessment of the municipality's emergency management** with regard to capacity for effective responses to community safety in the event of severe weather events or floods.

9. Increased efforts to **regionally advocate for and collaborate on climate change action**, through Council's current regional Local Government forums such as RMF (Regional Mayors Forum), IMAP (Inner Melbourne Action Plan) and ABM (Association of Bayside Municipalities).

Lessons and Emerging Challenges to Date

<u>The Flooding Paradox -</u>

Victorian Councils have responsibility for land use planning and stormwater drainage but no statutory responsibility for floodplain management. The City of Port Philip's flood management requirements now include -

- Catchment - How to get more water out quickly (inundation, storm water – both local and upstream)
- Sea - How to keep more water out more effectively (sea level rise and storm surges)
- Increased efforts to reduce pollutant loads in stormwater and increase water quality to the Bay

Current primary challenges include –

- The lack of current science and modeling to inform emerging solutions, for instance, updated flood modeling and whole-of-catchment mapping (such as of stormwater, total drainage capacity)
- The lack of a holistic approach to regional modeling and consultation on emerging solutions – for instance, the Department of Sustainablity and Environment's *Future Coasts Study* only examines coastal impacts.
- Emerging solutions already look to combine a variety of defensive (eg. sea walls) and flood calming (eg. stormwater reticulation tanks) measures, but their considerations to date demonstrate that without a widely consulted regional approach using current climate science, we are unlikely to find and implement solutions that may not have an

adverse impact in some other direction (example, neighbouring municipality).

The Planning Paradox -

Victorian Councils have no legislative power to require either sustainable design or climate adaptation requirements in planning and building beyond the minimum standards set by the state and federal governments (currently non-existent). The City of Port Philip's planning and development management requirements should now include –

- State allowance of local planning scheme amendments and overlays addressing flooding and structural integrity for over 40% of all existing properties and development sites in the municipality (at least 20,000 properties/sites)
- The capacity to limit foreshore site developments that do not address identified local climate risks; as well as the capacity to retrospectively require appropriate climate adaptation measures on significant foreshore buildings and developments.
- The capacity to limit Local Government liability from past planning decisions when climate change impacts affect foreshore properties.

Current primary challenges include -

- The lack of proactive state and federal action in setting minimum climate adaptation (and sustainable design) standards in both planning frameworks and building codes.
- The absence of state planning policy addressing climate adaptation based on current science and modeling.
- Who wears the cost of abandoning property and retreating to higher ground? Federal legislation (such as Environment Protection and Biodiversity Conservation Act 2000) effectively makes Local Government responsible for community liability.

The Playground Paradox -

Urban beaches are a vital part of the intricate web that currently sustains community vitality and sense of place in most inner urban Cities with a foreshore around Australia. Port Phillip's beaches are already facing increasing erosion from storm surges and extreme weather. The City of Port Philip's foreshore management requirements should now include –

- Supporting and protecting urban beaches – in effect, beach protects infrastructure protects properties
- Retreat is not an option for urban communities! There is nowhere to go….
- Increased foreshore pollution – debris and rubbish.

Current primary challenges include -

- The lack of regional foreshore management plans and policy using current science and whole-of-catchment modeling (There is a Victorian Coastal Strategy but not a management plan)
- Beach renourishment is increasingly complex, expensive and short-term
- Issues with long-term solutions (eg. groynes) are primarily around balancing aesthetics with effectiveness

Conclusion

Risk management is not a new area for Local Governments, and indeed, a critical component to good local governance. However, climate change does pose new challenges and solutions that require new ways of doing and thinking. This is undoubtedly complicated by the rate of pace of climate change and the resulting shifts in climate science. Equally, many of the practical solutions to both climate adaptation and greenhouse gas abatement are already there.

Cities can proactively manage & reduce the local impacts of climate change through adaptation solutions that make local spaces climate-adept & act to prevent the worst impacts. Most critically, proactively laying the foundation for a climate-adept future City is going to be the cornerstone for building community resilience. The City of Port Phillip is up for the challenge!