Climate Change and the Coast – Think Global, Act Local!
Speaker Abstracts

Dr John Church: Antarctic Climate and Ecosystems Cooperative Research Centre and CSIRO Marine and Atmospheric Research
Understanding Sea-Level Rise

Sea level has risen by over 120 m since the last glacial maximum, about 20 thousand years ago. The majority of this rise occurred before 6 thousand years ago. From ancient Roman times until the 18th century there has been little rise in global average sea level. The longest tide gauge records, extending over several centuries, indicate an increase in the rate of rise commenced in the 19th century. A combination of tide gauge data and satellite-altimeter data have been used to estimate sea levels from 1870 to the present. These data show sea levels have risen by about 20 cm over this period, a 20th century rate of rise of 1.7 ± 0.3 mm yr-1 and a significant acceleration in the rate of rise. Satellite-altimeter data from 1993 indicate a rate of rise closer to 3 mm yr-1.

The largest contributions to late 20th century sea-level rise are ocean thermal expansion and the melting of glaciers and ice caps. The ice sheets of Greenland and Antarctica have made smaller contributions. The contributions from changes in terrestrial storage have significant uncertainties. Volcanic activity is one of the causes of decadal variability in sea level. Immediately after an eruption, the decrease in short wave radiation reaching the ocean surface results in an ocean cooling that can persist in the oceans for decades to centuries.

Sea level is likely to continue to rise through the 21st century and beyond. Even after stabilization of greenhouse gas concentrations in the atmosphere, sea levels are likely to continue to rise for decades and centuries because of the long time scales associated with ocean circulation and the ice sheets. There is increasing concern that the large ice sheets of Greenland and Antarctica might contribute significantly to sea-level rise through surface melting (for Greenland) and dynamic responses unless there is a significant reduction in the emission of greenhouse gases.

A rise in sea level leads to more frequent flooding events of a given level. There is already evidence that this has occurred during the 20th century. Changes in the intensity of atmospheric weather patterns (for example, an increase in the intensity of tropical cyclones) will also alter the frequency and intensity of extreme events. By 2100, tens of millions of people may be vulnerable each year to coastal flooding events associated with sea-level rise and extreme events. Appropriate planning and adaptation actions can significantly reduce the number of people affected.

Darren Cooper: Development Director, Mirvac Western Australia
A Developer's Perspective

Climate change is now a globally-acknowledged fact, which has vast potential to impact patterns of human settlement and enterprise. Rising sea levels due to climate change stand to have significant consequences on coastal areas, threatening both private property and the public realm. In the face of all this, common sense tells us that a precautionary approach is required.

For some years now, Western Australia has adopted a system of coastal setbacks, via a Statement of Planning Policy, which take into account several factors, including long term sea level rise. However does this go far enough?

Western Australia has an outstanding opportunity via its centralised planning system to adopt a leading practice position in relation to coastal planning for an uncertain future. However, blanket restrictions are not the answer. Rather than adopting a solution, good coastal planning outcomes

could be achieved under a mechanism by which all the involved stakeholders negotiate and agree good sustainability outcomes.

But will developers be happy with a system which only guarantees certainty of process, rather than certainty of outcome? Provided that the key principles of certainty, equity, transparency and stage implementation are met, most leading Developers would accept such a process. What is required, however, is more balanced policies and decision-making regarding key tradeoff elements, such as density and height. In this way, coastal planning should be seen as a suite of controls, tradeoffs and opportunities, rather than simply blanket setback and height restrictions.

Mayor Paddi Creevey: City of Mandurah
What Issues Do We Face Now and How Can We Face Them In the Future – Local Government Policy

The implications of climate change on coastal communities are many for those local government councils responsible for these communities. Planning for the future takes on a whole new meaning when considering the impacts of rising sea levels and increased frequency and severity of storms. Some forethought has gone into coastal planning over the past decade with increased setbacks for buildings close to the coast, and those near estuaries and rivers.

The City of Mandurah is a long narrow council area between 51km of coastline and about 40km along the Peel-Harvey Estuary and the Serpentine River. Much of Mandurah's development is low-lying near to these water bodies, which make it particularly vulnerable to rising sea levels and severe weather events.

How do we plan for the future, where do we build and how do we build future facilities and infrastructure? What contingencies do we put into place that will help protect our community against impacts of climate change? Will there be an increased health threat from mosquitoes? Do we wait for direction from State and Federal Governments or do we start developing our own strategies and contingencies?

As a member of the Cities for Climate Protection Program since 1998, the City of Mandurah has set targets to reduce corporate greenhouse gas emissions by 30 per cent and community emissions by 20 per cent by 2011. It is also a strong supporter of ICLEI initiatives and is one of 240 CPP councils showing leadership on climate protection through representation on the Australasian Mayors Council on Climate Protection.

In January 2007, the City of Mandurah resolved that it should start gathering local knowledge that could help address issues on climate change for Mandurah and the Peel Region. This "Climate Change and the Coast" conference is one of the ways in which the City of Mandurah is developing a comprehensive local tool kit of climate change actions by working with its local people and business community, other local government councils, State and Government agencies, non-government organisations, developers and business.

Dr Ian Eliot: Western Australian Coastal Scientist
Coastal Data and the Impacts of Climate Change in Western Australia

The aim of this paper is to overview coastal data and research in Western Australia relevant to assessment of coastal impacts of projected climate change. The Western Australian coast spans a latitudinal extent far greater than any other Australian State and encompasses a wide variety of physical settings. Processes of change and their impacts are likely to vary significantly around the State. The major data sources for the coast are records maintained by Commonwealth and State Government agencies, particularly data derived from environmental monitoring services provided by the Commonwealth Bureau of Meteorology and the Maritime Branch of the

Department of Planning and Infrastructure. The records provide a substantive picture of regional variation in climatologic and oceanographic process around the coast, and have specific application only to the locale in which they were gathered. They enable broad estimation of the type of problems likely to be associated with climate change drivers such sea level rise, changes in storminess, storm surge and inundation of coastal flood plains. The extent to which such information is useful in risk and coastal vulnerability assessment at a local scale remains open to question, as does the adequacy of the information as a basis for modeling coastal change.

It is clear from recent research that global vulnerability and adaptation assessment methods are not applicable at a site-specific scale on the Western Australian coast. For example, current methods used to identify appropriate setback to development on sandy coast are based on two dimensional models such as the Bruun Rule with little relevance to areas underlain by rock platforms or sheltered from offshore swell by reefs and islands. Actual impacts will be strongly affected by the combination of climate induced change with existing patterns of coastal change. Additionally, there is a need to tailor vulnerability assessment to the changing dynamics of the coast in order for any planned response to perceived risk to be incorporated in an adaptive management process. Presently, adaptive responses are mostly defined by the capacity of the organisation undertaking such assessment, and largely high level in nature. This may require a rethink of the way in which coastal science is coordinated as well as more focused extension of data acquisition programs for site-specific assessments. Such a multi-disciplinary approach over long enough time periods can only be done through organisations such as the Western Australian Marine Science Institution (WAMSI) which has the capacity to bring together corporate, governmental and academic interests and expertise to serve the community.

Dr Peter Hick: Peel-Harvey Catchment Council.
Some Oceanic and Estuarine Implications of Sea level Change in the Peel Region

The +200 km of both oceanic coastlines and estuarine shorelines of the Peel Region will be affected by sea level changes. The IPCC prediction is for a sea level rise by 2100 of 0.09 - 0.88m. Fremantle Sea Level has risen 20cm since 1915 at a rate of 1.38mm/year. However, the interpolation of the data over the past 30 years produces an average figure closer to 3.0mm/year (Hick, 2007).

The effects may initially be noticed during dramatic events, but a combination of gradual rising sea-level, increased storm intensity, tidal and meteorological coincidence are likely to create notable incidents. This will raise alarm but it may be difficult to separate the insidious sea level rise from compounding factors and planning will need to be conservative and rely on expensive engineered mid-term solutions.

The loss of coastline is being calculated using such models as those developed by Bruun (1980) and it will be shown that this model is valid in some of the Peel region's coastline (Hayne, 2002). However, the effect on estuarine shorelines is less well understood and a program to adapt the modelling has commenced. Engineered solutions may be possible for high value property, but of great concern to the PHCC, is the loss of fragile coastal environments and biological diversity typified by the Ramsar-listed wetlands. Coastlines and shoreline ecosystems generally re-establish very quickly and often with biological integrity. However, some situations and intertidal habitats will be lost forever and preservation efforts may be unrewarded.

Estuary basin volume will increase with higher sea level, and although complex to calculate exact exchange volumes, sieching effects, greater tide flow and velocities (probably double) will have a significant effect on existing channel state.

These results and other associated data will from the recently completed study of Climate Change in the Peel Region will be presented.

Glen McLeod: Partner, Minter Ellison Lawyers and Adjunct Professor, Murdoch University

Climate Change and the Law Present Trends and Possible Future Developments

Although there has been some policy development to meet the climate change challenge, directed at emissions trading and carbon offsets, the potential broad scope of the response needed to the Climate Change challenge, has not to date been evident. The broader paradigm of 'sustainable development' or sustainability is the key concept on this subject for the contemporary environmental lawyer.

In regard to coastal developments the statutory framework includes town planning and environmental law. This is complimentary to private law, in particular nuisance and negligence. These torts have for some time been increasingly important in the protection of property rights and the environment.
The legal framework is considered in the context of the relevant administrative and policy challenges facing Government, as well as the interdisciplinary nature of environmental law and the effect this has on policy development and law reform.

The increased scope and complexity of the content of environmental law occasioned by climate change may spread to private law, in particular, actions to protect property, proving damage, director liability and the documentation of transactions.

These are in a sense the soft end of the legal implications of climate change. At the other end there is litigation. In Nigeria for example, Shell was successfully sued for flaring off and creating greenhouse gas in the process. In Australia there have been several cases which indicate how complex the resolution of competing issues will be in the future. The cases will be examined with a view to seeming what they possibly show about the future.

Stefanie Pidcock: Director of the Climate Change Adaptation Section, Australian Greenhouse Office, Department of the Environment and Water Resources

First Pass Assessment of Australia's Coastal Vulnerability

Many of Australia's coastal areas are vulnerable to impacts from climate change. The collective economic, environmental and social value of Australia's coastal areas, combined with the extent of likely biophysical changes under climate change models makes the coastal zone a priority for national focus.

In April 2006, the Natural Resource Management Ministerial Council agreed to substantially progress an assessment of vulnerability of our coasts to climate change. The Australian Greenhouse Office is leading the national coastal vulnerability assessment to:
Identify key vulnerabilities in Australia's coastal zone to climate change, and provide strategic direction on priority research and data gaps; and
Bring together and integrate biophysical and socio-economic analyses to enable decision-makers to better understand the risks of climate change in the coastal zone.
In developing these outcomes, a number of areas of capacity will also be progressed. These are: a national coastal Digital Elevation Model (DEM); a foundation for a Georeferenced Spatial System; and digitisation of various historical data sets.

The presentation will provide an update on progress of the First Pass Assessment of Australia's Coastal Vulnerability to Climate Change, and the rationale and approach to the Assessment.

Dr Luke Twomey: Principal Scientist, Swan River Trust
Potential Impacts of Climate Change on the Swan and Canning Rivers

Based on the Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report - Summary for Policy Makers, the Swan River Trust has drafted a paper on the implications of climate change for management of the Swan and Canning estuary. The paper describes two future scenarios which consider various degrees of success by the global community in stabilisation and reduction of greenhouse gasses. The first, typified as business as usual, describes only marginal success. The second represents an aspirational outcome with early and aggressive commitment to greenhouse gas abatement. The basis for Swan Canning estuary climate scenarios were determined from local research data and judgments interpolating, extrapolating or factoring in available data. The scenarios represent plausible alternative circumstances which might be encountered in future river management.

Climate change is already evident in the Swan Canning estuary. The rate of change is increasing relative to the past century and changes to the familiar regime will become increasingly evident and significant as the century progresses. For the next 30 years the rate of change has largely been determined by past decisions made globally. However, in the longer term, differences in outcome between business as usual and aspirational scenarios will become significant.

The system will be altered by diminished stream-flow associated with warming of the water bodies and surrounding environment. There will be changes in the seasonal timing of flows with smaller and later Autumn/Winter flows and potentially similar or possibly higher Summer event flows. Tidal reaches will also be affected by sea-level rise and superimposed storm surges. The lower winter flows, especially during the transitions from salty to fresh in Spring and Autumn, could prolong and exacerbate low oxygen conditions over significant lengths of the tidal riverine reaches.

The potential impacts of these described events on the catchment, ecology, infrastructure, human health and economy are considered, with particular emphasis on adaptation management strategies for the Swan Canning estuary.

Steve Waller: Office of Climate Change, Department of Environment and Conservation
Adapting to Climate Change – The Western Australian Governments Policy Framework

Coastal zones are highly vulnerable to climate change. Forecasts of higher sea levels, more intense storms, greater storm surges and warmer, more acidic seas could severely impact coastal marine ecosystems and the entire coastal environment.

Increasing levels of greenhouse gas emissions from human actions have reached a concentration that is unprecedented for at least 600,000 to 800,000 years. This increase in greenhouse gases has been linked to a global warming trend that has the potential to cause dramatic shifts in environmental systems. Some significant changes are already underway.

Observed changes show a world in flux, with previously stable systems showing indications of instability. Because there is a lag between current levels of greenhouse gases and the subsequent associated warming, past anthropogenic emissions have 'locked in' a warming trajectory that has a high potential to raise the average global temperature 2°C above the 1960-1990 average.

Climate change, sea level rise and changing ocean acidity require a plan of action to adapt to the changing circumstances that will unfold over the coming years and decades. A cost of 1% of global annual GDP has been estimated for mitigating climate change, compared with a cost of

approximately 20% of current annual global GDP, if mitigation was deferred significantly. This cost is related to the extra adaptation response required as atmospheric greenhouse gas concentrations rise further.

The Western Australian Government has recently committed to further its adaptation response, building on the innovative Indian Ocean Climate Initiative (IOCI) and funding a range of adaptation initiatives and policy research. This increased response sits within a strengthened governance framework within the State Government that gives greater prominence to adaptation measures. Addressing the breadth of tasks involved in delivering a meaningful adaptation response requires significant efforts from government, industry and the community.

The first stage of a coordinated adaptation program demands reliable, high quality science. In 1998 IOCI was created to provide Western Australian based climate data and predictions, the first in Australia to undertake such localised and specialised research. Having this facility gives Western Australia a strong foundation to determine the areas of highest risk from climate change. From this data robust vulnerability assessments can be developed, showing the most exposed areas of the State.

Local level governance, including regional councils and Local Government, play a central role in the overall structure of climate change adaptation and mitigation policy development and implementation. Responsible for areas such as planning, building and waste and having a close connection with community, these organisations will continue to be fundamental in assisting communities to reduce their greenhouse footprint and adapt to the inevitable impacts of climate change.