australiannetwork of environmentaldefender's offices

Submission on the Inquiry into climate change and environmental impacts on coastal communities

7th June 2008

The Australian Network of Environmental Defender's Offices (ANEDO) consists of nine independently constituted and managed community environmental law centres located in each State and Territory of Australia.

Each EDO is dedicated to protecting the environment in the public interest. EDOs provide legal representation and advice, take an active role in environmental law reform and policy formulation, and offer a significant education program designed to facilitate public participation in environmental decision making.

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Executive Summary

The Australian Network of Environmental Defender's Offices Inc (ANEDO) is a network of 9 community legal centres in each state and territory, specialising in public interest environmental law and policy. ANEDO welcomes the opportunity to provide comment on the Inquiry into climate change and environmental impacts on coastal communities.

The impacts of population growth and climate change on the catchment-coast-ocean continuum of Australia are significant. This submission details a range of impacts and a range of measures to address those impacts. Our key recommendation is that a coordinated federal framework is required to urgently coordinate integrated coastal zone management nationally.

In **Part One** we conclude that integrated coastal management must take into account interrelated impacts in the whole catchment-coast-ocean continuum. Our review of the range of legislation, policy, and bodies that have been developed in each jurisdiction to address coastal issues, indicates that a number of challenges exist including that: not all states have a key coastal protection Act, and in many states planning and resource legislation regulate the most significant impacts on the coast; detail is mostly delegated to policies, manuals and guidelines (subordinate to legislation); multiple layers of policies exist, and the status of some initiatives is unclear; while policies may be sound, implementation may be poor, or policy considerations can be easily discounted by other considerations (for example a decision maker may need only "have regard to" a policy rather than actually implement it); local implementation may be hindered by limited resources, and lack of appropriate data; and many different coastal management/advisory bodies exist with varied effectiveness.

In **Part Two** we identify key environmental impacts of population growth as including impacts on: water resources, biodiversity, estuaries, reefs and sediment dynamics. We identify mechanisms to minimise environmental impacts and promote sustainable use of coastal resources including:

- Improved planning and development controls, including no-go areas for development in the most sensitive coastal zones;
- Comprehensive EIA mechanisms for strategic regional planning and development approval, including consideration of cumulative impacts;
- Public participation processes for strategic planning and development assessment processes;
- Mandatory sustainable housing requirements (such as rain water tanks, grey water systems, energy efficiency measures, insulation, solar heating, etc);
- Wildlife corridors;
- Mechanisms to protect water quality (such as improved sewage treatment infrastructure and improved regulation of pollutants in sensitive environments);

- Mechanisms to ensure sustainable recreational use of the coast (such as public awareness, increased regulation, and consideration of cumulative impacts); and
- A comprehensive adequate and representative network of marine protected areas.

We conclude in Part Two that it is essential in order to adequately address environmental impacts and promote sustainable use of coastal resources that an integrated approach to natural resource management, planning and development is adopted in the coastal zone. This requires cooperation between different agencies regulating different resources, land uses and impacts; as well as cooperation between all levels of government.

In **Part Three** we note that the potential impacts of climate change are broad, and have significant management implications, particularly in light of increased population pressures. Specific impacts of sea level rise include: increased coastal flooding and storm surges, increased coastline erosion, inundation of coastal wetlands and lowlands, and potential health impacts. ANEDO submits that an "accommodation" strategy (ie, no action and risk acceptance) would create significant problems in the future, for example, in terms of liability for property damage and relocation of displaced coastal residents.

We submit that a hierarchy of adaptation options should be comprehensively considered, subject to thorough environmental impact assessment and public consultation.

1. Planned retreat – In view of the likelihood of significant sea level rise over the next century and beyond and the inevitable impacts of sea level rise on shoreline development in some areas, the precautionary principle suggests that planned retreat should be the key long-term adaptation response for human communities and to reduce biodiversity impacts. Planned retreat principles (including set-backs, buffers and development restrictions; as well as clear limits on public liability and rules regarding any relocation assistance) should be implemented into local planning and development controls now, to avoid impacts being dealt with and disputed on a case by case basis over the coming years as impacts increase.
2. Where planned retreat is not possible, other adaptation options should be considered including:
    a. Development controls and planning measures including set-backs and no-go zones in vulnerable areas; building codes and design requirements (these may include principles of retreat tailored for a local area where a full-scale retreat plan is not implemented);
    b. Resilience building measures - protection measures to build resilience of natural systems (including dune revegetation, wetland buffer zones, and in limited circumstances, beach nourishment where done according to strict environmental conditions).

c. Early warning systems and emergency response plans
d. Hard engineering solutions (such as seawalls) are not recommended as they interfere with natural systems.

Part Four notes that mechanisms for sustainable communities includes implementing the mechanisms discussed in Parts Two and Three and requires increased coordination between all levels of government to achieve integrated coastal zone management.

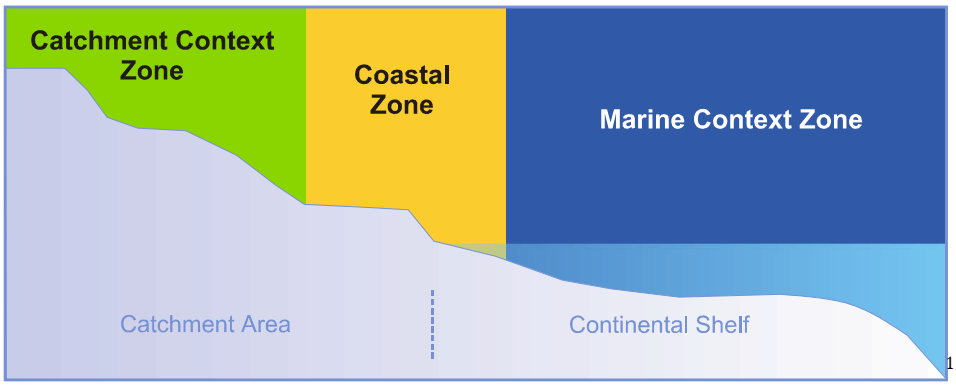
In **Part Five**, we conclude that current governance and institutional arrangements differ in each state and territory causing a 'patchwork' management effect and a lack of integrated coastal management taking into account the catchment-coast-ocean continuum. We recommend the development of a federal coastal framework, established by a COAG agreement and legislation. Elements to be addressed in the framework include:

- improved cohesion and consistency of approach across jurisdictions, driven by an enhanced federal role;
- an integrated management approach taking into account all activities and impacts (and management) within the coastal zone;
- clarification of roles, responsibilities and resourcing of different agencies involved at different levels in coastal management;
- additional guidance and resources for local councils at the front line of implementing measures to address population increase and climate change;
- application of EIA and the principles of ESD;
- comprehensive vulnerability and risk assessment;
- Audit and proper valuation of environment and community assets in the coastal zone; and
- Collation of baseline data and modelling.

Contents

Introduction

An essential starting point for developing coastal management policy is to recognise and understand the practical policy context: the catchment-coast-ocean continuum. The catchment-coast-ocean continuum covers the significant interconnected, influential and overlapping relationships that exist between catchment, coastal and oceanic zones/systems. Scientific findings have demonstrated that when one of these systems is subjected to an input, that system will not display a reaction in isolation, but instead will impact on the other systems in the continuum. An example of this occurs when nutrient loading in catchment areas subsequently impact upon coastal systems (such as estuaries) which in turn affect fish stocks, i.e. ocean systems.



[1]

Not only do an ever increasing number of Australians live within the catchment-coastal zone, but all 3 zones support a diverse range of competing land uses, resource uses and activities. It is therefore fundamental to both understand and incorporate the concept that terrestrial, coastal and ocean systems do not operate in isolation but instead fluctuate in response to each other, when attempting to create effective mechanisms to address coastal population growth and the effects of climate change.

The susceptibility of the catchment-coastal-ocean zones to the influences associated with climate change and increased population densities is becoming increasingly apparent:

> "*With debate largely settled over the extent of the human contribution to climate change and its likely effects, the remaining scientific uncertainty principally concerns the precise nature and extent of the impacts*."[2]

This scientific uncertainty regarding the "precise nature and extent of the impacts" of climate change has historically provided a justification for limited constructive

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[1] Coates B., Hanslow D., & Lord D. 2007, 'NSW Coastal Zone Management Manual', Department of Climate Change, Newcastle, NSW. Available at: www.**coastal**conference.com/2007/papers2007/Bruce%20Coates.doc.

[2] McDonald, J. & England, P. 2007, 'A Risky Climate for Decision-Making: The Legal Liability of Development Authorities for Climate Change Impacts', *QELA Conference*, Kingscliff.

activity being undertaken by local, state and federal bodies to address the impacts associated with climate change and the increasing population densities in the coastal zone. Additionally, there appears to be a lack of understanding regarding which tier of government has the primary responsibility of developing strategies to address these important issues.

This submission will demonstrate that the changes needed to endure these impacts will require significant amendments to instruments regarding governance, infrastructure, land use and planning in the coastal zone. Such changes may disrupt coastal communities in the short term, but the implementation of strategies pre-empting the impacts of climate change and increased population densities will undoubtedly provide benefits in the long term.

> "*The Principle of Least Disruption is a little noted, but pervasive force in human life. It designates our propensity to avoid discomfort by denying the need for policies and actions which produce unsettling and difficult demands for the active alteration of circumstances otherwise felt to be quite acceptable*."[3]

Scientific research has highlighted the requirement for new "policies and actions" to be implemented, as current practices throughout the catchment-coast-ocean continuum are currently inadequate to deal with the wide ranging impacts of climate change and sea-level rise, as highlighted in the extract below.

> "*The major likely direct impacts of global warming and sea-level rise are: increased humidity and decreased human comfort; coastal inundation; coastal flooding by storm surges; salt water intrusion of groundwater; water table elevation; and changes to coastal landforms, especially if coral growth cannot maintain protection from wave action. Socio-economic consequences would include: decreased agricultural productivity due to flooding and groundwater quality decline; salt contamination of drinking water; economic costs of maintaining and repairing buildings and infrastructure such as roads; out-migration from islands and other areas that become uninhabitable.*"[4]

In Australia, impacts also have implications for local coastal communities who are dependent on tourism.

The terms of reference for this submission require analysis of the mechanisms implemented to manage the effects of climate change and increased coastal population. ANEDO is of the view that whilst it is important that measures are taken to identify strategies to manage the effects of climate change, what is even more fundamental is to implement mechanisms that address the source (i.e.

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[3] Lynch, T., Jenkins, B. 2007, 'Global warming, contemporary politics & the principle of least disruption', Australian Quarterly, vol 74, no 2, p30.

[4] Sullivan, M., 'The impacts of projected climate change on coastal land use in Papua New Guinea', in Sustainable Development For Traditional Inhabitants Of The Torres Strait Region. pp. 33-58. Papua New Guinea Univ. Dep. of Geography, Port Moresby Workshop series.

anthropogenic activity) of the problem. It is essential that adaptation strategies are part of an overall mitigation policy for addressing climate change in Australia.

Part One: Existing policies and programs related to coastal zone management, taking in the catchment-coast-ocean continuum

In accordance with the terms of reference, this part examines the existing policies and programs related to coastal zone management in Australia, taking into account the catchment-coast-ocean continuum.

Policy makers have been presented with a difficult problem; how to implement appropriate mechanisms to deal with a crucially important issue which is surrounded by some uncertainty. "The complexity of processes in the climate system means we cannot simply extrapolate past trends to forecast future conditions"[5] and as such the various levels of government are "unsure about the likelihood and severity of climate change risks, which sea-level rise scenario to accommodate and whether there are any particular adaptation actions they can take to protect their communities"[6]. ANEDO submits that this is a prime example of a situation where the precautionary principle must be applied.[7]

Despite the uncertainties, there have been a number of strategies implemented throughout Australia that attempt to address some of the issues associated with climate change and increased population densities within the coastal zone. Examples of these are outlined in the following table.

Tasmania
Tasmania does not have specific coastal protection legislation, or a single coastal management authority. Responsibility for coastal management falls to a range of state and local government agencies under the general framework provided by the *State Coastal Policy 1996*. A State Coastal Advisory Committee was established in 1998 but has not met since 2001. The ***State Coastal Policy 1996***[8] was enacted to provide a consistent, state-wide approach to coastal management and applies to all State waters and land within one kilometre inland of high-water mark. The Policy compromises three overarching principles: ▪ The need to protect both natural and cultural values of the coast

[5] *Climate Change in Australia – Technical Report 2007.* Available at http://www.climatechangeinaustralia.gov.au/documents/resources/TR_Web_Ch4.pdf.

[6] New South Wales Environmental Defenders Office, 2008, 'Coastal Councils and Planning for Climate Change: An assessment of Australian and NSW legislation and government policy provisions relating to climate change relevant to regional and metropolitan coastal councils'. Email info@sydneycoastalcouncils.com.au to obtain a full copy.

[7] The Precautionary Principle in the context of environmental protection essentially pertains to the management of scientific risk. It is defined in Principle 15 of the *Rio Declaration (1992)*[7] and states: "*Where there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation*." United Nations Conference on Environment and Development (UNCED), Rio de Janerio, 1992.

[8] The State Coastal Policy 1996 is currently subject to review. A draft policy was released in 2006, but later withdrawn. A new draft policy is expected to be released by the end of 2008.

- The need for sustainable use and development of the coast
- The need for shared responsibility in the management and protection of the coastal zone.

The Policy also sets out a range of outcomes for each of these principles. These outcomes state that the coastal zone will be managed to "*protect ecological, geomorphological and geological coastal features and aquatic environments of conservation value*" (clause 1.1.2).

The Policy provides guidance for local governments regarding the coastal management issues that should be taken into account in decision-making. Before endorsing any new or amended planning scheme, the Resource Planning and Development Commission must be satisfied that the scheme is in accordance with the State Coastal Policy. For older planning schemes, if there is an inconsistency between a provision of the State Coastal Policy and the planning scheme, the State Coastal Policy will prevail. The Policy provides for a precautionary approach to be taken when assessing applications for use and development in the coastal zone and for coastal developments to be directed to locations which will minimise their environmental impact. The Policy requires suitable urban and residential areas, areas of special value, important wetlands and coastal transport routes to be identified in planning schemes. The design and siting of development must also be subject to planning controls "*to ensure compatibility with natural landscapes*".
The Policy also provides for areas subject to coastal hazards such as storm surge, erosion and sea-level rise to be identified and managed (clause 1.4.1) and for policies to be developed to respond to the potential effects of climate change on use and development in the coastal zone (clause 1.4.3).

It is an offence against the ***State Policies and Projects Act 1993*** to fail to comply with a provision of a State Policy, however the policy is a broad document primarily intended to provide a framework for coastal planning rather than to be an enforceable document. Implementation of the policy is generally achieved through individual planning schemes, enforced by local governments under the ***Land Use Planning and Approvals Act 1993***. However, given the broad nature of the statements in the Policy, it has proven difficult to enforce in practice and has been subject to litigation on numerous occasions. In a recent decision, the Supreme Court held that local governments are bound to give effect to the policy and achieve its outcomes, but recognised that many of the statements in the policy are not prescriptive enough to be directly enforced.[9]

A review of the State Coastal Policy in 2004 also found that lack of technical resources and operational guidance results in many Councils not adequately implementing the Policy. To address this concern, the State government has produced a number of technical reports to assist with the identification of natural values and areas at risk from coastal hazards. In particular,

- The Coastal and Marine Branch of the Department of Environment, Parks, Heritage and the Arts has released GIS mapping tools for coastal vegetation, geomorphic values and fauna habitat. They have also released indicative mapping of coastal areas vulnerable to climate change and sea-level rise.[10]
- The three regional NRM bodies collaborated to produce a set of Estuarine, Coastal and Marine Indicators to assess natural resource conditions in the coastal zone.[11]
- The Local Government Association of Tasmania has released a Climate Change Toolkit comprising case studies to help local governments to address climate change issues.

In addition to this assistance, one of the key initiatives identified in Tasmania's **draft *Climate Change Strategy*** is to:

> Incorporate climate change issues including coastal vulnerability, the impacts of sea level rise and storm surge risk, in planning schemes, and develop practical planning tools to assist local government in taking predicted climate change impacts into consideration.

It is clear that local governments will remain primarily responsible for assessing and managing coastal uses and development in the future.

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[9] *St Helens Landcare and Coastcare v Break O'Day Council* [2007] TASSC 15
[10] Sharples, C., 2004. *Indicative mapping of Tasmanian coastal vulnerability to climate change and sea level rise: Explanatory Report*, Department of Primary Industries, Water and Environment.
[11] *Trialing NRM Resource Condition Indicators in the Coastal Zone – Final Report, May 2006*

Victoria

The current agency that addresses coastal management in Victoria is the **Victorian Coastal Council**, which is appointed by the State Government in accordance with the ***Coastal Management Act 1995***. Under this Act, the VCC has an array of functions; one of which is the responsibility to undertake statewide strategic coastal planning and another being the responsibility to prepare and publish guidelines for the planning and management of the coast. In order to address these responsibilities, the VCC developed the *Victorian Coastal Strategy 1997*, which was subsequently superseded by the ***Victorian Coastal Strategy 2002*** (the Strategy). This Strategy aimed at implementing Integrated Coastal Zone Management, and providing guidance on catchment to coast integration.

With amendments currently being made to the **draft *2007 Victorian Coastal Strategy*** Victorian coastal management is currently in a state of flux. In April 2007, an invitation for comments on the newly developed 2007 Draft Victorian Coastal Strategy was advertised, with the VCC receiving 174 submissions. These submissions are in the process of being analysed and incorporated into the development of the final Victorian Coastal Strategy. In a recent media release the Chair of the VCC, Ms Libby Mears, stated that the redrafted strategy hopes to present "a long-term vision to ensure appropriate planning decisions which protect the aesthetic, cultural and environmental values of the coast", and seeks to achieve this by "addressing the major challenges posed by climate change and development pressures of the 'seachange' phenomenon."[12] The EDO Victoria formulated a submission that outlined a number of key recommendations the 2007 Draft Strategy. Among these was a recommendation for an increased emphasis on integrated management of the coast on a state-wide scale. Additionally, EDO Victoria believed there was a need for a stronger and clearer focus on climate change impacts. Only once the amended strategy is released will it be apparent whether such recommendations will be put into practice.

The ***Planning and Environment Act 1987*** provides that each local government is to have a **municipal planning scheme**, which affects all landowners including the Crown. The development of such planning schemes "provide a mechanism for integrating coastal development, management and outcomes by linking across public and private land"[13]. Local governments may make additional coastal management policies under the powers conferred be the ***Local Government Act 1989***, such as;

- Foreshore management plans
- Open Space and recreation plans
- Local Agenda 21 and local sustainability plans
- Greenhouse strategies
- Stormwater and domestic waste water management plans
- Asset and infrastructure management plans
- Waste and litter management plans.

These planning schemes were to be implemented to help manage the "change that will inevitably take place across the coast"[14] in relation to population growth and subsequent urbanisation of coastal areas. However, as illustrated by the ***Coastal Spaces and Landscape Assessment Study: State Overview Report*** there has been limited implementation of the schemes. On 27 September 2006, this study was released by the Minister for Planning and provided a comprehensive baseline assessment of visually significant landscapes along the Victorian coast. The study attempted to

[12] Media Release From the Victorian Coastal Council, *Sea level rise key in new draft coastal strategy*, Friday 9 November 2007. Available at: http://www.vcc.vic.gov.au/pdf/mediareleasedraftvcs.pdf
[13] Australian Local Government Association website. Available at: http://www.alga.asn.au/policy/environment/coasts/roles/
[14] Australian Local Government Association website. Available at: http://www.alga.asn.au/policy/environment/coasts/roles/
[15] Department of Sustainability and Environment Victoria. Available at: http://www.dse.vic.gov.au/DSE/nrencm.nsf/LinkView/F3C0CB8C21FD0964CA257157001B4D40C18B7E0199670F29CA256F5E0021B6C8

provide a guideline "on how management and protection of these important landscapes can be better achieved through planning schemes"[15]. The study discovered that of the 87 settlements within two-kilometres of Victoria's coastline, only 18% have included strategic settlement plans into local planning schemes. The EDO Victoria, in it's submission regarding the draft 2007 Draft Strategy, highlighted a need for time limits to be included regarding the compulsory implementation of coastal settlement frameworks into local government planning schemes to better assist in establishing some consistency throughout the coastal zone.

Queensland

The ***Coastal Protection and Management Act 1995*** is the legislation which protects and manages the coastal zone in Queensland, primarily through Coastal Management Plans. The **State and Regional Coastal Management Plans** which sit under the Act and contain most of the detail have chapters on conserving nature, which include broad "coastal management outcomes" and principles and policies for protecting coastal resources, values and managing pressures on those resources. In practice these documents have been applied to regulating coastal development rather than coastal management or rehabilitation.

The **South East Queensland Regional Coastal Management Plan**, maps areas of coastal biodiversity significance and requires local town planning schemes to identify these areas as valuable features and include measures for their conservation and management. Criteria for development assessment are listed, and include directions such as that development does not occur where it will result in the loss, degradation or fragmentation of areas of coastal biodiversity.

The State and Regional Coastal Plans are treated as State Planning Policies for the purposes of the ***Integrated Planning Act 1997*** (IPA), meaning they must be taken into account by an assessment manager (usually the local Council) when assessing development applications. However, this means that Council must only "have regard to" the documents, and in practice they are frequently undermined. To be more effective, State and Regional Coastal Management Plans must be given an elevated status under IPA so that its provisions must be implemented. The State and Regional Plan are also considered a "State Interest" when developing local town planning schemes, meaning that the Planning Minister can require the State Coastal Plan to be reflected in local planning schemes and must also consider the State Plan prior to designating land for community infrastructure. However in practice, the details of the State or Regional Plans are not clearly and thoroughly implemented in local planning schemes as part of the process of doing the state interest check on draft local planning schemes.

Provisions of the **State Coastal Management Plan** address climate change issues. Section 2.2.4 of the State Plan deals with storm tides, cyclone effects and related inundation and recognises these as 'coastal hazards'. The State Plan requires that the associated risks of coastal hazards are minimised, including by carefully considering development in coastal risk areas and wherever possible retaining those areas undeveloped. However, until Councils are obliged to comply with the State and Regional Plans (rather than simply "have regard to" them), these provisions will continue to be ineffective.

Western Australia

WA does not have special purpose coastal protection legislation assigning responsibility to a particular agency or Minister. Instead, advice and strategic policy on the planning and management of the WA coast is provided by the Coastal Planning and Coordination Council, a Committee of the **Western Australian Planning Commission**.

The draft ***Coastal Zone Management Policy for Western Australia (2001)*** provides a 'whole-of-government' policy framework for coastal planning, management and protection. It sets out, in broad terms, coastal zone management objectives, including environmental, community, economic, infrastructure and regional development objectives. It also contains government policies for planning and management of the coastal zone.

The ***Statement of Planning Policy No 2: Environment and Natural Resources Policy*** sets out the broad environment and resource management policies for sustainability. It includes measures to

"[s]afeguard and enhance areas of environmental significance on the coast ... [e]nsure use and development on or adjacent to the coast is compatible with its future sustainable use for conservation, recreation and tourism in appropriate areas [and to] [t]ake into account the potential for impacts from changes in climate and weather on human activities and cultural heritage including coastal and urban communities, natural systems and water resources." (cl 5.1)

The ***Statement of Planning Policy No. 2.6: State Coastal Planning Policy*** applies to the coast state-wide and is intended to complement SPP 2 and draft Coastal Zone Management Policy by addressing the more operational aspects of coastal planning. The policy provides high order guidance for decision-making on coastal planning matters and seeks to inform and guide the WAPC in undertaking its planning responsibilities. It also aims to guide local governments, and other agencies, about those aspects of State planning policy concerning the protection of the coast that should be taken into account in planning decision-making. SPP 2.6 is to be implemented through the preparation of regional and local strategies, plans and statutory planning schemes. It sets out requirements for local governments developing a coastal planning strategy by outlining what should be taken into account in the preparation of the strategy and the types of requirements and guidelines that must be included in the strategy itself. The policy encourages partnership with the broader community in this process. More specifically, SPP 2.6 provides guidance for determining a set-back, which is generally to be 100m from the horizontal setback datum (cl 2.3).

The ***Coastal Planning and Management Manual (2003)*** provides more detailed guidance on coastal planning and management for community groups and local government. It provides further detail on the types of coastal strategies and plans that can be developed and sets out coastal planning and management principles (e.g. sustainable management, identifying limits of acceptable change, maintenance of ecosystem integrity, consultation, minimal intervention etc).

In addition, WA has **Development Control Policies.** Outside the Perth Metropolitan Region, coastal planning in Western Australia has been largely guided by the WAPC's **Development Control Policy 6.1 Country Coastal Planning Policy**. DCP 6.1 operates in a subordinate capacity to the SPPs. It provides general development principles, including requirements to the separation from the coast by a foreshore reserve, public access to the foreshore, and that development should not reduce the visual amenity of the foreshore (cl 3.1). It sets out principles adopted by the WAPC for the allocation of coastal land, for example, "*to give priority to coastal dependent developments over non-coastal dependent developments*" (cl 3.2.1). It also provides guidelines for set-backs (generally 100m) and the preservation of the ecology, visual amenity, and soil and water quality of the coastline. Other WAPC Development Control Policies relevant to the coast are:

- 1.8 Canal Estates and other Artificial Waterway Developments,
- 2.3 Public Open Space in Residential Areas and
- 4.2 Planning for Hazards and Safety.

In addition, many coastal management plans and strategies for specific areas and regions have been prepared by the WAPC, or by local governments, and a Regional strategy for the Perth metropolitan coastline is currently under preparation.

Northern Territory

The overarching policy direction for coastal zone management in the NT is provided by the **Northern Territory Coastal Management Policy**. The policy is designed to guide management, planning and conservation in the NT coastal zone. Initially developed in 1985, this policy is currently under review.

The **Darwin Harbour Regional Plan of Management** (DHRPM) area covers Port Darwin, Shoal Bay and their catchments. The following five goals were identified by the DHRPM in order to achieve sound management of the Darwin Harbour region:
- To maintain a healthy environment;
- To support the sustainable recreational use and enjoyment of the environment;
- To encourage ecologically sustainable development;
- To protect cultural and heritage values; and

- To foster community ownership and participation in management.

A report about the status of the DHRPM was released in September 2007 by the Darling Harbour Advisory Committee. This report noted that "while the expectations remain high that the Plan will be implemented, the committee has been discouraged by a lack of funding and lack of commitment by the government to support the Plan as endorsed by Cabinet in early 2004"[16]. This indicates that the implementation of some of the objectives of the DHRPM in 2005-06 has been hampered by a number of factors. There were additional difficulties implementing the Plan as the "role and responsibility of DHAC as well as the status of the Plan continue to be unrecognized in legislation"[17]. A report by the committee is due to be released regarding the progress of the implementation of those objectives contained in the DHRPM.

The ***Integrated Natural Resource Management Plan for the Northern Territory*** was released in March 2005, and was based on the following three governing principles:

- "It should promote and support ecologically sustainable development;
- It should apply the precautionary principle in the absence of sound data on which to base planning decisions; and
- It should promote and support adaptive management."[18]

The establishment of the three core governing principles demonstrates understanding of the importance of those factors integral to natural resource management. The Natural Resource Management Board (NT) Inc. is the regional body appointed the responsibility of developing and implementing the Plan. The Plan has been criticised as it "lacks detailed information about the role of stakeholders in the implementation and monitoring process."[19]

The Northern Territory Marine Protected Areas Advisory Committee was established to provide stakeholder feedback to the Department of Natural Resources Environment & the Arts on the development of a **draft Northern Territory Marine Protected Areas Strategy**. This Strategy aims to "set out the legislative, scientific, planning and consultation framework" for how new Marine Protected areas will be identified. This strategy is an indication that management of the Northern Territory is beginning to incorporate an integrated approach into coastal zone management. This Strategy is currently being developed.

Other broad conservation plans such as the ***Draft Northern Territory Parks and Conservation Masterplan***[20] may be relevant for the coast, but due to recent comments from government, there is some suggestion that this plan will not be implemented due to insufficient resources.

The ***NT Environmental Impact Assessment Guide – Greenhouse Gas Emissions February 2007*** aims to "assist proponents in providing the information needed by the Environmental Protection Agency Program to assess the impact of greenhouse gas emissions from proposed projects during assessment under the ***Northern Territory Environmental Assessment Act 1994***. It identifies that proponents of projects should give particular consideration to the following five risks associated with the impacts of climate change;

- "increasing average temperature and evaporation rates;
- variation in rainfall and the incidence of floods;

[16] 2005-2006 Status Report on the implementation of The Darwin Harbour Regional Plan of Management. Available at: www.nt.gov.au/nreta/water/dhac/pdf/dhac_status_report.pdf
[17] 2005-2006 Status Report on the implementation of The Darwin Harbour Regional Plan of Management. Available at: www.nt.gov.au/nreta/water/dhac/pdf/dhac_status_report.pdf
[18] Integrated Natural Resource Management Plan for the Northern Territory. Available at: http://nrmbnt.org.au/files/inrmp/INRMPlanMarch2005.pdf
[19] Hilton L. 2007, 'Structuring South West's Natural Management Plan'. Available at http://www.southwestnrm.org.au/publications/downloads/ConsultancyReport_StructuringSWNRMPlan_11-03-07.pdf
[20] Northern Territory Parks and Conservation Masterplan, Summary Paper September 2005. Available at www.nt.gov.au/nreta/parks/masterplan/pdf/summary_paper.pdf

- sea level rise;
- increased frequency and intensity of cyclones and storm surge levels; and
- altered distribution of pests and disease."[21]

South Australia

The ***Coast Protection Act 1972*** was created for the specific purpose of establishing a regulatory statutory body – the **Coast Protection Board** (CPB) – and outlining its powers, requirements and responsibilities. Under section 6 of the Act, the CPB is the statutory authority responsible for the management of the states coastline and administration of the Act. The CPB is particularly interested in establishing whether land and any development on it is likely to affect, or be affected by coastal processes including storm surge flooding and short or long-term changes in the position of the coastline. The CPB assesses the impact of development and rezoning on costal qualities such as conservation of vegetation/reserves/beaches. The CPB will assess the extent of impacts, particularly effects on natural costal processes.

In 1992, the CPB established South Australia as the first State in Australia to adopt planning policies and standards to minimise the risk to coastal development by climate change–induced sea level rise. The ***Coastline: Coastal erosion, flooding and sea level rise standards and protection policy (1992)***, which has been included in the council-wide provisions of development plans, states that:

- Development should not be approved where building sites are lower than a height determined by adding 0.3 m (for 50 years of sea level rise) to the 1-in-100 year storm surge level and making an adjustment (where appropriate) for land level changes to 2050.
- For commercial or habitable buildings, floor levels should be no less than 0.25 m above this minimum site level.
- Development should not be approved unless it is capable, by reasonably practical means, of being protected or raised to withstand a further 0.7 m of sea level rise. (This condition allows for a further sea level rise of 0.7 m from 2050 to 2100 for a total sea level rise of 1 m to 2100).

This policy has been since incorporated into development plans and planning strategies by state and local government.

More recently, the ***Living Coast Strategy for South Australia*** (2004) was devised to formally set out the State Government's environmental policy directions for the sustainable management of these environments. This was in recognition of the significant pressure Australia's coastal, estuarine and marine environments are under following the '*Review of the Management of Adelaide Metropolitan Beaches'* (Government of South Australia 1997), and the *Framework for a National Cooperative Approach to Integrated Coastal Zone Management* (2003) developed by the National Resource Management Ministerial Council. The SA Strategy follows from and builds on the State Government's previous policy document, *Our Seas and Coasts: A Marine and Estuarine Strategy for South Australia 1997*. The strategy encompasses a wide range of environmental initiatives and programs and sets out the policy directions that the State Government will be taking over the following five years to help protect and manage South Australia's coastal areas, estuaries and marine ecosystems. In addition, there is the proposal that there be, in conjunction with local government and the Commonwealth, the development of a clear policy for Government to manage sea-level change.

Due to concerns about sand erosion, tidal drift, seawalls and the need for beach nourishment, the Department for Environment and Heritage, on behalf of the Coast Protection Board initiated a review of the management of Adelaide's metropolitan beaches in 2000, and based on the recommendations of this report developed an innovative strategy for managing Adelaide's beaches called ***Adelaide's Living Beaches: A Strategy for 2005–2025***. The Government of South Australia endorsed the strategy in November 2005. Policy makers recognise that climate change is likely to gradually alter the forces that act on the coastline, and so they must allow for additional supplies of sand to maintain beach width and provide for strengthened dune buffers. It is anticipated that the

[21] Available at: http://www.nt.gov.au/nreta/environment/greenhouse/pdf/ghgemissions.pdf

main effects of climate change along the coast of South Australia will be sea level rise and changes to weather and hence wave conditions. The vast majority of the explanation and policy on the effects of climate change on the coast of SA in this document is simply a re-iteration of the Coastal Protection Board's policy developed in 1992 (*Coastline: Coastal erosion, flooding and sea level rise standards and protection policy* 1992).

The ***Marine Planning Framework for South Australia (2006)*** incorporates elements of '*South Australia's Strategic Plan'* (Government of SA 2004) regarding sustainable development, and *Living Coast Strategy for South Australia*. The framework will require a statutory basis from which to operate, which will be provided through a proposed revision of the ***Coast Protection Act 1972***, and will interact with the ***Development Act 1993*** and the ***Natural Resources Management Act 2004***. The Planning Framework does not contain any specific climate change provisions.

While many of the other policies in this area are purely directional and often aspirational, the Marine Planning Framework (2006) represents a practical embodiment of these and other policy directions that have been incorporated into development legislation. The overarching goals, objectives and strategies from the marine planning zones will, as appropriate, be incorporated into the *Planning Strategy for South Australia* under the *Development Act 1993*. In particular, the Better Development Plans project currently being undertaken by Planning SA will strengthen the linkages between the *Planning Strategy for South Australia*, Marine Plans and Development Plans. This will assist in ensuring that the strategies and objectives of Marine Plans are incorporated into the relevant Development Plans. The Government anticipate that existing responsibilities and jurisdictions of management agencies will remain, but the resource management policies, strategies, and plans will be progressively amended to manage development and use consistent with the objectives applied to relevant zones.

The ***Estuaries Policy and Action Plan*** **(2005)** provides a bridge between DEH coastal policy, and the realm of the Department of Water, Land and Biodiversity Conservation, which deal with the riparian part of the catchment–coast–ocean continuum. The broad vision of this policy document is that of the provision of *'healthy estuaries for the benefit of present and future generations'*. There are 5 key outcomes identified as requisite to achieving this vision:

1) Better management of estuaries for economic, social and environmental sustainability
2) Better development planning tools are established to aid decision making for social and environmental sustainability
3) The conservation values of estuaries are protected
4) Greater community understanding and involvement
5) Comprehensive research and monitoring of estuaries.

With respect to estuarine environments, DEH has (or is in the process of) developing 'Estuaries Information Packages' (EIP) for each of the 5 NRM regions of the state to support NRM bodies, State and local government and other agencies undertaking planning and management in estuarine areas. These EIP's provide an overview of the environmental, social and economic values of the estuaries in each region.

More broadly, the ***South Australia's Strategic Plan*** **(2004)** as reviewed and updated in January 2007, the 'Strategic Plan' represents a dynamic framework for the forward development of the State of South Australia, and acts as an umbrella policy, informing and instructing the creation and development of policy in all areas of governance. The key targets broadly instructing the evolution of South Australian policy on coastal development, climate change and the environment are: Lose no Species, Marine Biodiversity, Ecological Footprint, River Murray – flows, and River Murray – salinity.

New South Wales

A recent review conducted by the NSW Environmental Defender's Office (EDO) discovered that only 7 pieces of Commonwealth and NSW legislation mention climate change.[22] Key legislation of relevance to coastal management in NSW includes: the *Coastal Protection Act 1979*, as amended in 2002; the *Environmental Planning and Assessment Act 1979* (*EP&A Act 1979*); and the *Local Government Act 1993* (*LG Act 1993*).

The ***Coastal Protection Act 1979*** is the principal piece of legislation that applies to the NSW coastal zone. It aims to provide for the protection of the coastal environment of the State "for the benefit of both present and future generations".[23] This Act contains provisions relating to the use and supervision of the coastal zone, the carrying out of development within the coastal zone and the preparation of the Coastal Zone Management Plans.[24] The coastal zone was extended in 2005 and now also applies to the greater metropolitan regions of Sydney, Newcastle, the Illawarra and the Central Coast.

The Act prohibits a public authority from authorising or carrying out development in the coastal zone, without the consent of the Minister, if the Minister is of the opinion that the development:

- is inconsistent with principles of ecologically sustainable development
- adversely affects the behaviour of the sea or an arm of the sea or any bay, inlet, lagoon, lake, body of water, river, stream or watercourse; or
- adversely affects any beach or dune the bed, bank, shoreline, foreshore or flood plain of the sea or an arm of the sea or any bay, inlet, lagoon margin, lake, body of water, river, stream or watercourse. [25]

The preparation of a Coastal Zone Management Plan is currently discretionary, unless the Minister directs a council to prepare a plan. However, it is prudent for a council to prepare such a plan even in the absence of a ministerial direction as it enables a strategic approach to be taken in responding to climate change impacts within the coastal zone.

The ***Environmental Planning and Assessment Act 1979*** (*EP&A Act 1979*) has the potential to greatly influence the interaction between infrastructure and the environment when considering development in the coastal zone[26]. Section 117 of the *EP&A Act 1979*, provides that a Local Environmental Plan (LEP) be developed. An LEP is one environmental planning instrument (EPI) used to control the use of land adjoining the beach[27]. The development of such LEP's should include provisions that give effect to and are consistent with the NSW Coastal Policy 1997. This policy will be discussed in more detail below, however in reference to the development of EPI's, it provides the principles which should be addressed in new and existing LEP's (and Development Control Plans (DCP's)) to ensure:

- Only developments which do not compromise the natural and cultural values of

[22] For further detail please see the report prepared by the NSW EDO for the Sydney Coastal Councils Group: *Coastal Councils and Planning for Climate Change: An assessment of Australian and NSW legislation and government policy provisions relating to climate change relevant to regional and metropolitan coastal councils*. February 2008 and is available at: http://www.edo.org.au/edonsw/site/policy.php.

[23] Section 3, *Coastal Protection Act 1979*.

[24] Coastal Zone Management Plans must address the following three things: the protection and preservation of the beach environment and beach amenity; emergency action to be taken during periods of beach erosion; and continuing and undiminished public access to beaches and waterways.

[9] Section 38, *Coastal Protection Act 1979*.

[26] The coastal zone is defined in the *NSW Coastal Policy 1997* as 3 nautical miles seaward of the mainland and offshore islands; 1 km landward of the open coast high water mark; a distance of 1 km around all bays, estuaries, coastal lakes, lagoons and coastal rivers to the limit of mangroves or the tidal limit whichever is closer to the sea.

[27] Thom, B. 2003, 'Beach Protection in NSW, New Measures to secure the environment and amenity of NSW beaches', *Environmental and Planning Law Journal*, vol. 20, no.5, pp 325-358.

the area will be permitted on beaches and frontal dunes; and
- In allowing works to protect, restore and rehabilitate beaches and frontal dunes, to preferably favour "soft" engineering[28] approaches as developed through a Coastline Management Plan.[29]

This Act appears to demonstrate that some efforts have been made to better manage the coastal zone, however in practice, many inappropriate developments are still approved in sensitive coastal zones. A consequence of the listing of developments in the coastal zone as Part 3A projects (under the *EP&A Act 1979)* is that developments that are likely to have the greatest impact on the coastal environment in NSW will be decided by the Planning Minister who determines the scope of any environmental assessment. This would be appropriate, provided that there is a clear process in place to ensure that environmental impacts are adequately considered, that the public is involved in the process and that concurrence is obtained from Minister for Climate Change, Environment and Water. This is not currently the case. Under section 75U of the *Environmental Planning and Assessment Act 1979,* the concurrence of the Minister for Climate Change, Environment and Water is not required for a Part 3A project (ie, the Minister charged with administering the *Coastal Protection Act 1979).*

On 1 November 2002 the Minister for Planning, pursuant to the *Environmental Planning and Assessment Act 1979* (*EP&A 1979*), implemented ***State Environmental Planning Policy Number 71 – Coastal Protection*** **(SEPP 71).** This policy was introduced to regulate all development in NSW (other than the coastal land in the greater Sydney area) within the "coastal zone". The coastal zone is defined by reference to coastal zone maps, however it generally extends to:

- three nautical miles seaward of the mainland and offshore islands,
- one kilometre inland of the 'open coast' high water mark,
- one kilometre around all bays, estuaries, coastal lakes, lagoons and islands, and
- in relation to tidal rivers, one kilometre around the tidal waters of the river to the limit of mangroves, or the tidal limit (whichever is closer to the sea).

Under the policy, development applications that will diminish access to coastal foreshores, result in effluent that negatively affects water quality, or involve discharge of stormwater into the sea, a beach, coastal lake, creek or rock platform, must be rejected by the appropriate consent authority. SEPP 71 requires councils to address some of the environmental impacts associated with climate change, when deciding whether to grant consent to a development application. Councils are required to take into account "the likely impact of coastal processes and coastal hazards on development and any likely impacts of development on coastal processes and hazards"[30]. This policy appears to demonstrate that there has been progress made in implementing considerations regarding climate change when considering the viability of development applications in coastal zones. However, the introduction of the *State Environmental Planning Policy (Major Projects) 2005* (Major Projects SEPP), which incorporated several provisions from SEPP 71, has greatly undermined the environmental assessment process in coastal area. The *NSW Coastal Policy 1997* should be a mandatory consideration for the Planning Minister, and concurrence of the Environment Minister

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[28] Soft engineering approaches are discussed further below.
[29] Thom, B. 2003, 'Beach Protection in NSW, New Measures to secure the environment and amenity of NSW beaches', *Environmental and Planning Law Journal,* vol. 20, no.5, pp 325-358.
[30] *State Environmental Planning Policy No 71 – Coastal Protection*, Part 2 Sec 8(j).
[31] Full submission by the NSW EDO on this topic available at: http://www.edo.org.au/edonsw/site/policy/sepp_major_projects070525.php.
[32] Thom, B. 2003, 'Beach Protection in NSW, New Measures to secure the environment and amenity of NSW beaches', *Environmental and Planning Law Journal,* vol. 20, no.5, pp 325-358.
[33] Thom, B. 2003, 'Beach Protection in NSW, New Measures to secure the environment and amenity of NSW beaches', *Environmental and Planning Law Journal,* vol. 20, no.5, pp 325-358.
[34] *NSW Coastal Policy 1997*, Available at: http://www.planning.nsw.gov.au/plansforaction/pdf/CPPARTA.PDF.
[35] *NSW Coastal Policy 1997*, Available at: http://www.planning.nsw.gov.au/plansforaction/pdf/CPPARTA.PDF.

under the EP&A Act should also be required. Otherwise the overarching policy, which is meant to represent government policy relating to the management of NSW's coast, is meaningless, as it does not apply to activities that are likely to have the most significant impact on the coastal zone[31].

In addition, the ***Local Government Act 1993*** provides that responsibility for the management of lands and waters in a given local government area, falls usually to local councils. Section 377 of the *LG Act 1993* provides for very broad powers to delegate such responsibility to committees, formed under the Act, in regard to "any matter related to development or use of all or part of their LGA"[32]. It is thought that such delegation has "established a process for evaluating hazards, amenities, resource use or conservation of areas periodically subjected to storm events" and has "established the lead role for councils in managing beaches which may or may not be formally in their care and control."[33]

In addition to legislation, a number of policies have been developed for the NSW coast. The principal policy guiding local councils in the coastal zone is the ***NSW Coastal Policy 1997***. One of the aims of the policy is to promote 'the ecologically sustainable development of the New South Wales coastline'. The Policy aims to facilitate the development of the coastal zone in a way which protects and conserves its values. This includes recognising and accommodating natural processes and protecting beach amenity and public access.

> "*The 1997 Coastal Policy is essentially focused on recognising the need to reconcile the rapid population growth currently being experienced in coastal areas with the need to conserve what remains of valuable ecosystems*."[34]

The *NSW Coastal Policy 1997* contains provisions to implement appropriate planning mechanisms that incorporate sea level change scenarios set by the Inter-governmental Panel on Climate Change (IPCC), in order "to protect and conserve the coast for future generations"[35]. The Policy sets out various goals, actions and objectives. The key strategic action outlined in the policy is the development and implementation of Coastal and Estuary Management Plans in accordance with the existing Coastline and draft Estuary Management Manuals.

In June 1988 the NSW Government adopted the ***Coastline Hazard Policy***. The primary objective of the *Coastline Hazard Policy* was to reduce the impact of coastal hazards on individual owners and occupiers, and to reduce private and public losses resulting from natural coastal forces. The Policy sets out that certain actions should be taken to address coastal hazards. First, the impact of coastal forces on existing developed areas shall be reduced by works and measures and by the purchase of property on a voluntary basis, where appropriate. Second, the potential for coastal damage in respect of any proposed coastline development shall be addressed through the application of effective planning and development controls by local councils. Lastly, a merits approach to all development and building decisions should be adopted which takes account of social, economic and ecological as well as oceanic process considerations.

The ***NSW Coastline Management Manual 1990*** was prepared as part of the implementation of the *Coastline Hazard Policy*. The Manual was created to facilitate a sound understanding of coastal processes/hazards in NSW and their underlying causes. It assesses and identifies all available management options against environmental, social and economic criteria. It also provides detailed guidelines for councils to follow to address coastal erosion issues. The Manual also outlines a series of steps to prepare and then implement Coastline Management Plans, as well as other adaptive actions councils can take to address coastal hazards. As part of the **Coastal Protection Package** announced in 2001, Cabinet requested that a new Coastal Zone Management Manual be prepared to combine and revise the existing Coastline and Estuary Management Manuals. This new manual is not expected until 2008-2009. The 2005 **NSW Floodplain Development Manual** also addresses climate change management issues.

The NSW Government supports the coastal management planning process through the **Coastal Management Program.** It aims to enhance the amenity of the NSW coastline and to protect infrastructure from coastal hazards in an ecologically sustainable manner. Under the Program, which is administered by the Department of Environment and Climate Change, the Government

provides funding to local councils on a 50:50 basis for the preparation of Coastal Zone Management Plans. The Program also provides funds toward the implementation of management plans including mitigation works to address coastal hazard problems or coastal amenity enhancement. Furthermore, specialist technical advice is provided to local government addressing coastal processes/hazards and coastal management. This includes representation on Coastal Management Committees, and the provision of technical/specialist advice as required.

Commonwealth

On 3 October 2003, the ***Framework for a National Cooperative Approach to Integrated Coastal Zone Management*** was endorsed by the Natural Resource Management Ministerial Council (NRMMC). The endorsement of this Framework led to the publication of a document titled the *National Cooperative Approach to Integrated Coastal Zone Management, Framework and Implementation Plan* in 2006. This publication set in motion two agendas particularly relevant to this paper; to improve the understanding of climate change on the coastal zone, and to better integrate population trends into coastal planning and management, as detailed in the following table.

Objective: Improve understanding of the impacts of climate change on the coastal zone.			
Actions to implement the objective		**Intended timeframe**	**Responsibility**
3.1.1	Identify international best practice and national research and response priorities for understanding potential climate change impacts in the coastal zone.	2 years	NRPPC. DEH to lead. Input from BoM and OPSAG.
3.1.2	Build a national 'picture' of coastal zone areas that are particularly vulnerable to climate change impacts to better understand the risks and interactions with other stresses in the coastal zone.	Interim report in 5 years. More detailed report in 10 years	NRPPC. DEH to lead. BoM and Geoscience Australia to provide input.
3.1.3	Undertake modelling, in line with state and territory priorities, at the regional scale to inform coastal zone management, in response to climate change scenarios, on issues such as: ◎ sea level rise and foreshore change, ◎ estuary and wetland response (including salt marsh), ◎ wave, storm, cyclone, fire and flood intensity and frequency, ◎ structural response (coastal infrastructure), and ◎ changes to distribution and lifecycles of affected species and ecological communities.	5 years	NRPPC. DEH to lead. Input from BoM and CSIRO States also have responsibility.

Objective: Better integrate population trends into coastal zone planning and management.			
Actions to implement the objective		Intended timeframe	Responsibility
5.1.1	Coordinate and share national research and information available about population change and long-term demographic trends in coastal areas in a format which can be used by state, regional and local planners.	2 years	DEH to lead. Input from Australian Bureau of Statistics (ABS), CSIRO and DoTARS, States and ALGA
5.1.2	Investigate means of improving sustainable growth planning for the recreation and tourism industries, that promotes integrated coastal zone management principles/outcomes.	2 years	DEH
5.1.3	Investigate mechanisms to improve capacity of state, territory and local government bodies to plan for population change in coastal areas.	2 years	DEH

Information regarding the progress or success of these initiatives has been difficult to obtain. Despite this fact, an analysis of such an attempt at a nationally cooperative approach, would be of enormous benefit should new attempts be made to develop instruments to address climate change and increased population densities on a national basis. The development of future federal instruments will be analysed in more detail at a later stage.

There are a range of other national policies that also have relevance to coastal management including:
National Strategy for Ecologically Sustainable Development
Inter-Governmental Agreement on the Environment
Commonwealth Coastal Policy
National Strategy for the Conservation of Australia's Biological Diversity
Australia's Oceans Policy
Regional Marine Planning
Natural Heritage Trust and **Extension of the Natural Heritage Trust**
Marine Protected Areas
National Wetlands Program
Framework for Marine and Estuarine Water Quality Protection
Coastal Catchments Initiative
Integrated Oceans Management.

Part One Summary

- **Integrated coastal management must take into account interrelated impacts in the whole catchment-coast-ocean continuum.**
- **A range of legislation, policy, and bodies have been developed in each jurisdiction to address coastal issues.**
- **Common themes can be observed from the overview of state and territory approaches:**
  - **not all states have a key coastal protection Act, and in many**

states planning and resource legislation regulate the most significant impacts on the coast

- **Detail is mostly delegated to policies, manuals and guidelines (subordinate to legislation);**
- **multiple layers of policies exist, and the status of some initiatives is unclear;**
- **while policies may be sound, implementation may be poor, or policy considerations can be easily discounted by other considerations (for example a decision maker may need only "have regard to" a policy rather than actually implement it). Aspirational principles in guidelines may be difficult to enforce;**
- **local implementation may be hindered by limited resources, and lack of appropriate data; and**
- **many different coastal management/advisory bodies exist with varied effectiveness.**

Part Two - The environmental impacts of coastal population growth and mechanisms to promote sustainable use of coastal resources

2.1 The environmental impacts of coastal population growth.

> "*Around 85 per cent of Australia's population live within 50km of the coastline, and a quarter of all Australians live within three kilometres of the coast. This places significant pressure on these fragile environments. A booming property market, a healthy tourism industry and Australians desire to live by the sea have resulted in a large influx of residents, both permanent and part-time to coastal shires.*"[36]

This section will specifically address how anthropogenic factors are having a dramatic effect on the environmental coastal zone as a result of increased population densities.

The term 'sea change' has been used to describe the "phenomenon of increasing settlement of the Australian coast, particularly those areas outside the primary urban metropolitan centres."[37] The statistics associated with coastal population growth throughout Australia are phenomenal. The Gold Coast is purported to be the area in Australia experiencing the greatest amount of population growth, with an average of 441 people relocating to the area each week from 2001 to 2006[38].

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[36] Department of Environment and Heritage, 2005. *Natural Trust. The Journal of the Natural Heritage Trust*, no. 22, p 3. Available at: http://www.nht.gov.au/publications/newsletters/pubs/nht22.pdf.

[37] Smith, T. & Doherty, M. 2006, 'The suburbanisation of coastal Australia', paper prepared for the 2006 Australia State of the Environment Committee, Department of Environment and Heritage, Canberra. Available at: http://www.deh.gov.au/soe/2006/integrative/coastal/index.html.

[38] Gold Coast City Council, *Community Profile ID*. Available at: http://www.id.com.au/profile/Default.aspx?id=292&pg=230&gid=10&type=enum.

> *"The expansion of coastal urban development has placed increasing pressure on the natural environment through problems such as habitat loss, waste disposal and pollution. In addition, the increasing coastal population brings with it both social and economic changes... the influx of a large number of people over time will radically change a community."*[39]

The above mentioned radical "social and economic changes" experienced by coastal communities are being accompanied by increasing environmental pressures.

> *"Coastal areas include some of the most biologically rich and productive environments in the world. They are dynamic and variable environments, but are often impacted by human activities. Approximately 60% of the world's population is concentrated in settlements within the coastal zone, i.e. areas that extend 50 km inland from the coastline and the figure for Australia is even higher (85%). However, coastal areas have consistently been neglected, poorly understood and exploited, and are under increasing pressure from rapid human population growth and over-exploitation of resources."*[40]

The "over-exploitation of resources" throughout Australia's coastal zone is undoubtedly one of the paramount issues facing Australia. Key impacts include those on: water resources, biodiversity, estuaries, reefs and sediment dynamics. These are discussed briefly below, and mechanisms to address these impacts are discussed in 2.2.

Water Scarcity in Coastal Zones

> "*Quenching urban thirst of growing cities and balancing this thirst against all other freshwater needs is a major challenge*"[41]

Increasing population migration to coastal regions and for example, low dam levels in some areas to cater for increased population, have necessitated adaptations to natural water supplies to cope with the increasing demand for water resources in the coastal zone. Adaptations to waterways, including the construction of dams, channels and other freshwater diversions, have been introduced in an attempt to accommodate the increasing demands of residential, industrial and agricultural activities in the coastal zone. The demand for water is also driving coastal areas such as Perth and Sydney, to begin utilising unsustainable groundwater extraction in their coastal urban areas and hinterlands. Historically these constructions been

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[39] Australian Bureau of Statistics, *Australian Social Trends 2004*, available at http://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/4102.02004?OpenDocument .

[40] Saunders K.M., McMinn A., Roberts, D. et al 2007, 'Recent human-induced salinity changes in Ramsar-listed Orielton Lagoon, south-east Tasmania, Australia: a new approach for coastal lagoon conservation and management', *Aquatic Conservation-Marine and Freshwater Ecosystems*, vol. 17, no. 1, pp 51-70.

[41] FitzHugh, T.W. & Richter, B.D. 2004, 'Quenching urban thirst: growing cities and their impacts on freshwater ecosystems', *BioScience.* vol. 54, no. 8, pp. 741–754.

made with little consideration being given to the environmental impacts that will consequentially arise from such activities.

Reduction in Biodiversity Levels

> "*Climate change and habitat destruction are two of the greatest threats to global biodiversity*."[42]

One of the major concerns with the increasing number of people relocating to coastal areas is the escalating demand for land zoned for residential purposes in order to accommodate the rise in population. Such re-zoning of land is inevitably accompanied by "habitat destruction and alteration, invasive species and altered fire regimes" which have been identified as some of the "major factors in driving Australia's shocking extinction record"[43]. Australia already has the worst rate of mammal extinctions in the world with "40 per cent of mammal extinctions globally in the past 200 years"[44]. Unless urgent action is taken to stem the proliferation of coastal habitat clearance, the ongoing exploitation of the coastal zone will continue to decimate many of Australia's aquatic and terrestrial native species.

Impact on Estuaries

> "*Among the most important environments of the coastal zone are estuaries, which constitute transition zones or ecotones, where fresh water from land drainage mixes with seawater, creating some of the most biologically productive areas on Earth.*"[45]

There is extensive research highlighting the important role that estuarine systems (including wetlands, seagrass beds, lagoons, mangroves, coastal lakes, and saltmarshes) play in maintaining both healthy marine and terrestrial ecosystems. They assist in providing climate buffering, trapping and removal of pollutants, storm protection, cycling of nutrients and organic matter and stabilisation to shorelines.[46] Additionally estuaries form an integral part of the catchment-coast-ocean continuum as "[E]stuary waters, shores and fringing wetlands form the foundation of the coastal food chain"[47].

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[42] Travis, J.M. 2003 ,'Climate change and habitat destruction: a deadly anthropogenic cocktail' Centre for Conservation Science, University of St Andrews, St Andrews. Available at: http://www.pubmedcentral.nih.gov/picrender.fcgi?artid=1691268&blobtype=pdf.

[43] World Wildlife Fund, 2008 'Australia's threatened species face extinction due to climate change'. Available at: http://wwf.org.au/news/species-face-extinction-due-to-climate-change/.

[44] World Wildlife Fund, 2008 'Australia's threatened species face extinction due to climate change'. Available at: http://wwf.org.au/news/species-face-extinction-due-to-climate-change/.

[45] Kennish, M.J. 2002, 'Environmental threats and environmental future of estuaries', *Environmental Conservation*, vol. 29, no. 1, pp 78-107.

[46] Natural Resource Management Ministerial Council, 2006, 'National Cooperative Approach to Integrated Coastal Zone Management. Framework and Implementation Plan'. Available at: www.deh.gov.au/coasts/iczm/index.html.

[47] New South Wales Government, 1992, 'Estuary Management Manual'.

Due to the social and economic benefits available for exploitation in the coastal zone, and the previously poor understanding of "the complexity and interrelationships of the ecological, physical and chemical processes of an estuary and its catchment"[48], Australian estuaries have regularly suffered environmental degradation at the hands of anthropogenic influences.

> *"Population increase has been especially rapid in the coastal zone and has resulted in a multitude of ecological stresses on aquatic systems"[49].*

Despite the increasing awareness of the importance of estuaries, "many serious environmental problems have arisen, primarily in response to pollution inputs and habitat degradation"[50]. The following anthropogenic influences have been identified to be amongst the greatest threats to the future health and viability of estuarine systems: [51]

- habitat loss and alteration,
- nutrient enrichment,
- fisheries overexploitation,
- chemical contaminants,
- introduced species,
- sea-level rise, and
- freshwater diversions.

Impact on Coral Reefs

The influences from anthropogenic activity identified as threats to estuarine ecosystems also apply to the viability of coral reef systems. Coral reefs have been described as the "rain-forests of the sea" due to their extensive biodiversity, and fundamental role they play in maintaining an array of aquatic ecosystems. The Great Barrier Reef Marine Park is particularly vulnerable to the impacts of anthropogenic activity as a result of three major factors. The first factor is the increase in population density, and subsequent increase in development and infrastructure throughout coastal Queensland.

> "*Continuing coastal development will result in a number of pressures on the Great Barrier Reef... development can impact on water quality through*

[48] New South Wales Government, 1992, 'Estuary Management Manual'.
[49] Flemer, D.A & Champ, M.A. 2006, 'What is the future fate of estuaries given nutrient over-enrichment, freshwater diversion and low flows?', *Marine Pollution Bulletin*, vol. 52, no. 3, pp. 247-258.
[50] Kennish, M.J. 2002, 'Environmental threats and environmental future of estuaries', *Environmental Conservation*, vol. 29, no. 1, pp 78-107.
[51] Kennish, M.J. 2002, 'Environmental threats and environmental future of estuaries', *Environmental Conservation*, vol. 29, no. 1, pp 78-107.

pollution, increasing water turbidity from run-off and through the release of acid from acid sulphate coastal soils."[52]

The second concern arises from the impacts of tourism which include "inappropriate anchoring, diving and snorkelling activities, development and operation of moorings, and pollutant discharge from ships and resorts during normal operations and from shipping incidents"[53]. The third concern arises from the increase in water temperature due to a combination of anthropogenic activities which have resulted in global warming:

> *"A 2°C rise in sea temperatures (plus the acidification associated with atmospheric CO2 of 450ppm) will all but eliminate reef-building corals such as those found within the GBR, which are home to an estimated one million species that live in and around coral reefs."*[54]

Impact on Coastal Sediment Dynamics

The influx of human populations to some coastal areas has been accompanied by extensive modifications to shoreline configurations. Such modifications include the construction of retaining walls, break waters and sea walls (discussed below), all of which disrupt the natural flow of sediment deposition and accretion. Such constructions cause depositions to occur at particular coastal points (often driven by aesthetic or economic factors), obviously at the expense of sediment starvation across other sections of coastline. In addition, the diversion of natural freshwater flows and damming of rivers has reduced the amount of coastal sediment deposition caused by alluvial flow. With an increasing reduction in sediment deposition, combined with increased incidence of erosion due to storm surges and sea-level rise (discussed below), a need for the implementation of mechanisms to deal with such issues is becoming increasingly necessary. The legacy from previous land clearing practices around coastal zones has additionally contributed to large areas of sediment instability:

> *"widespread clearing of native vegetation and replacement with intensive cropping and grazing systems have increased erosion and river sediment exports to many times the natural amount*"[55].

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[52] Department of Environment and Heritage, 2006, 'Review of the *Great Barrier Reef Marine Park Act 1975* Review Panel Report'. Available at: http://www.environment.gov.au/coasts/publications/pubs/gbr-marine-park-act.pdf.

[53] Department of Environment and Heritage, 2006, 'Review of the *Great Barrier Reef Marine Park Act 1975* Review Panel Report'. Available at: http://www.environment.gov.au/coasts/publications/pubs/gbr-marine-park-act.pdf.

[54] The Australian Climate Group, 2008, 'Climate Change Solutions for Australia 2008'. Published by World Wildlife Fund. Available at: http://www.wwf.org.au/publications/wwf-climate-change-solutions/.

[55] McKergow, L.A., Prosser, I.P., Hughes, A.O., & Brodiem, J. 2005, 'Sources of sediment to the Great Barrier Reef World Heritage Area', *Marine Pollution Bulletin*, vol 51, pp. 200-211.

Anthropogenic practices associated with development, agriculture and recreational activities are often accompanied with sediment loading of alluvial and coastal aquatic systems (particularly when such activities are in close proximity to catchment areas).

> "*Catchments with high levels of land clearing, cattle grazing and cropping show the largest increases in sediment export compared with natural conditions*"[56].

Threats can arise from both alterations to sediment accretion and depletion. The importance of near shore coastal systems and the effects of anthropogenic land use on sediment dynamics are concepts that need to be acknowledged and incorporated into future coastal zone management practices.

Impacts of recreational activities

An increased population in coastal areas means an increased number of recreational fishers, water craft, four-wheel drives on beaches etc. While individuals may have minimal impacts, the cumulative impacts of concentrated activities may exacerbate environmental impacts discussed above.

Recreational fishing has the potential to greatly impact upon aquatic ecosystems, not only through the depleted fish stocks that arise with increased fishing activity, but also through the side effects that accompany the process of recreational fishing (for example, discarded fishing line and weights entangling or being swallowed by sea birds, turtles etc).

The potential environmental impacts than can arise from irresponsible operation of recreational watercraft are wide ranging and potentially serious, and include impacts to biodiversity, estuaries, and coastal sediment. Improper use of water craft, particularly in shallow coastal areas have the potential to cause environmental impacts in the following ways[57]:

- Increased turbidity – boats have the potential to increase sediment suspension in the water column, reducing light penetration which can in turn deplete vegetation growth and oxygen production in the water.
- Increased noise – can disturb migratory and nesting birds, causing them to temporarily abandon eggs and hatchlings exposing them both to the sun's heat or predators.
- Increased erosion – constant boat wakes may increase the rate of shoreline erosion.
- Disturbance of cetaceans.

The impact of such activities as four-wheel driving, motorbike riding, bush walking, camping and horse riding all have the potential to cause significant

[56] McKergow, L.A., Prosser, I.P., Hughes, A.O., & Brodiem, J. 2005, 'Sources of sediment to the Great Barrier Reef World Heritage Area', *Marine Pollution Bulletin*, vol 51, pp. 200-211.
[57] New South Wales Sea School Marine Training Centre. Available at: http://www.seaschool.com.au.

impacts on the physical dynamics of sand dunes. The thinning out and removal of vegetation from dunes additionally impacts upon sediment dynamics throughout the coastal zone.

2.2 Mechanisms to address environmental impacts and promote sustainable use of coastal resources

This section discusses some of the key mechanisms to address environmental impacts and promote sustainable use of coastal resources.

Development and planning controls

ANEDO submits that one of the principles that should primarily be considered in all future coastal planning is "First, do no more harm". It is important to not compound the significant problems already faced by coastal communities by making further ill-considered planning and infrastructure which ignore looming biophysical realities. If decisions are made ignoring this principle, they will inevitably create even larger costs for future generations to bear, and undermine the concept of intergenerational equity which should inform true ecological sustainable development.

> "*Subdivisions to or near the high water mark have led to the construction of houses and other facilities on coastal sand dunes and other unstable or vulnerable parts of the coast. In some places such developments have been further endangered by natural shoreline erosion or by the disturbance of shoreline processes caused by port and harbour works.*"[58]

The influx of sea changers to coastal zones "outside the primary urban metropolitan areas" has the potential to be dealt with in an ad hoc pro-development fashion, with decisions made now failing to consider cumulative impacts and long term sustainable planning.

> "*The rapid expansion and lack of readily available and useable scientific information has meant many councils have reacted in an ad hoc manner, particularly in regards to planning, infrastructure provision and protecting the natural resource base.*"[59]

It is important to take stock of current construction practices which appear to focus on providing sufficient housing to accommodate the suburbanisation of coastal areas. An increase in population densities will additionally bring pressure upon existing infrastructure such as water supply, sewage and solid waste disposal.

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[58] Gourley, M.R., Harper, B.A., Cox, R.J., Stone P.B. & Webb T. 2004, *Coastal Engineering Guidelines for working with the Australian coast in an ecologically sustainable way*, Engineers Australia, National Committee on Coastal and Ocean Engineering, EA Books, Barton ACT, Australia, p. 101.

[59] Shepard, A., 2005, 'Coastal Survey Report', Australian Local Government Association. Available at: www.alga.asn.au/policy/environment/coasts/survey/report.php

There has been some activity from councils, such as Noosa Council, that "have attempted to limit future population growth because infrastructure such as water supply cannot keep pace"[60]. However, strong drivers exist for Councils to support expansion and development, such as increases in rates revenue, spending, jobs, and the potential for a stronger local economy.

> *"The economics of coastal development are a clear business driver and will provide challenges into the future for environmental protections"*[61]

There are an array of adaptation measures available to councils, and it is at the discretion of each council after taking into account the options and degree of risk, to determine the appropriate mix of adaptation measures that should be implemented. As identified by the Local Government Association of Queensland, adaptation measures vary widely in cost, time and effort in implementation. The Association has suggested a hierarchy of measures appropriate in the coastal zone reflecting the degree of risk, time, cost and effort. At the bottom of the hierarchy is information to the community. In the middle are measures to change regulations and update design guidelines. At the top, the pyramid suggests the relocation of activities. Thus, as the risks of climate change become more pronounced with each new IPCC report, councils should begin moving towards the top of the hierarchy in addressing the impacts of climate change.[62] Adaptation mechanisms will be further discussed below in regard to potential mechanisms implemented to address sea-level rise.

ANEDO has become aware of a community concern that some councils and developer interests are using the sea change phenomenon to justify many unsustainable developments. One useful tool that has been suggested to address these concerns is the development of nationally consistent, thorough and regularly updated housing and land monitor that is made publicly available, so government, investors and communities could know the level of demand and supply of urban land in their particular area. Such a tool has been proposed in some of the NSW Planning coastal strategies (e.g. South Coast Regional Strategy), but it is by no means certain that it will be effectively implemented. Creation of a national monitor of this type would provide a consistent basis upon which to conduct informed debate and planning decisions within the coastal zone.

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[60] Smith, T. & Doherty, M. 2006, 'The suburbanisation of coastal Australia', paper prepared for the 2006 Australia State of the Environment Committee, Department of Environment and Heritage, Canberra. Available at: http://www.deh.gov.au/soe/2006/integrative/coastal/index.html.

[61] Department of Environment and Heritage, 2006, 'Review of the *Great Barrier Reef Marine Park Act 1975* Review Panel Report'. Available at: http://www.environment.gov.au/coasts/publications/pubs/gbr-marine-park-act.pdf.

[62] New South Wales Environmental Defenders Office, 2008, 'Coastal Councils and Planning for Climate Change: An assessment of Australian and NSW legislation and government policy provisions relating to climate change relevant to regional and metropolitan coastal councils'. Email info@sydneycoastalcouncils.com.au to obtain a full copy.

Many facets of current development and planning controls need to be reviewed in the coastal zone to promote sustainable use of resources and ensure that environmental impacts are minimised. These are discussed briefly below.

a) The Importance of EIA

> *"The greater the density of people per hectare in settled areas, the greater the challenge of absorbing the impacts created by those people in situ. On the other hand, diffuse settlements have a more widespread impact, particularly considering that Australians have one of the highest per capita ecological footprints in the world. Should people be concentrated into existing settlements? ... These classic urban planning dilemmas are of equal importance to the management of Australia's coastal settlements as the demand to live on the coast steadily grows."*[63]

In determining where the growing population will be housed in the coastal zone, comprehensive environmental impact assessment (EIA) is a critical first step. Where developments are being proposed in areas of high ecological significance, increased population densities can have disastrous effects on the biodiversity levels of an area. ANEDO submits that rigorous EIA must be undertaken to ascertain the possible flow on effects to the catchment-coast-ocean continuum as a result of any developments located in, or close proximity to, the coastal zone. A diverse range of impacts on estuaries were noted above, and it can be concluded that development of coastal zone mechanisms requires a more thorough analysis of the potential environmental impacts that an activity or development may have on these highly vulnerable areas. Comprehensive EIA must underpin strategic regional planning, as well as be applied to individual developments. The implementation of such assessments would greatly assist in implementing the principles of Ecologically Sustainable Development, which is crucial in addressing climate change.

b) Importance of comprehensive Public Participation mechanisms[64]

With the increasing awareness of the impacts associated with climate change and increased population densities in the coastal zone, it is apparent that current policies and legislation will need to be amended. ANEDO strongly advocates for the incorporation of more mandatory public participation into the amendment stages of policy and legislation relating to development and planning, despite the fact that there appears to be a perception that community participation is an administrative and bureaucratic burden rather than a process that can add much value to decision-making.[65]

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[63] Smith, T. & Doherty, M. 2006, 'The suburbanisation of coastal Australia', paper prepared for the 2006 Australia State of the Environment Committee, Department of Environment and Heritage, Canberra. Available at: http://www.deh.gov.au/soe/2006/integrative/coastal/index.html.

[64] This section contains extracts from the EDO's submission *Recommendations for reforming planning in NSW.* Available in full at: http://www.edo.org.au/edonsw/site/pdf/subs08/reforming_planning_nsw080107.pdf.

[65] For example, see recent comments by the NSW Minister for planning, Frank Sartor on the NSW Planning reforms process.

Genuine public participation adds significant value to government decision-making. This is for three main reasons. *First,* community participation helps to ensure that better decisions are made, as the views of all stakeholders are taken into account. Put simply, community involvement allows decision makers to acquire information about the public's preferences so they can play a part in the decisions about projects, policies or plans. This leads to improved decision-making because the knowledge of the public is incorporated into the calculus of the decision. *Second*, public participation ensures the "buy-in" of the community as people are more likely to accept decisions if they have been given a proper opportunity to be heard. *Thirdly*, and related to the above, public participation helps to ensure fairness, justice and accountability. In terms of fairness, there are well known reasons why certain groups' needs and preferences can go unrecognised through normal government processes. Such needs may only come onto the radar once an open public participation process occurs. This is particularly the case for environmental interests. Public participation is also consistent with accountability in governance. The Institute of Urban and Regional Development at the University of California gives a good example of this in practice;

> *"If a planner can say, 'we held a dozen public hearings and reviewed hundreds of comments and everyone who wanted to have a chance to say his piece,' then whatever they decide to do is, at least in theory, democratic and therefore legitimate."*[66]

Therefore, public involvement is essential to the workings of a democratic system of government, and will assist in developing more appropriate coastal zone management strategies and more rigorous and transparent consideration of all aspects of coastal developments (not just economic considerations).

c) Sustainable Housing Practices

Increased population migration will be accompanied by an increase in the demand for housing in the coastal zone. The potential impact that additional housing can have upon local environmental processes in addition to climate change processes varies greatly depending upon the extent to which those structures incorporate features consistent with sustainable housing. The following table identifies some of the simple structural amendments that can be incorporated into new housing to greatly decrease their environmental impact.

ANEDO submits that housing in the coastal zone should incorporate the following examples of sustainable housing features[67] to minimise environmental impacts and ensure sustainable use of resources such as water.

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[66] Innes, J. & Booher, D. 2007, 'Public Participation in Planning: New Strategies for the 21st Century', *Institute of Urban & Regional Development. IURD Working Paper Series*., University of California, p. 6.

[67] New South Wales Department of Planning, Building Sustainability Index. Available at: www.basix.nsw.gov.au.

rainwater tanks, plumbed to toilet, garden and/or laundry;	cross ventilation
efficient (3A-5A) showerheads, toilets, tap fittings,	insulation
use of indigenous garden species,	external shading
grey water system where appropriate,	performance glazing for large glazed areas and/or poorly oriented areas
solar, heat pump or high efficiency gas hot water systems	ceiling fans, evaporative coolers or high efficiency air conditioning
efficient pool heating and pumps	energy efficient lighting
good solar orientation	alternative energy systems such as photovoltaics

ANEDO submits the use of such sustainable housing requirements should form part of regulatory requirements. The above features are often discussed in terms of government introducing 'measures to encourage' sustainable housing requirements (e.g. rainwater tank rebates etc), however ANEDO submits that mechanisms should be implemented to make such measures not only mandatory, but also effective. It has been noted that a recent major housing development in the A.C.T contained blocks that were well oriented for solar access; despite this fact the block and house sizes were developed in such a way that severely restricted the potential effective use of winter solar energy in the area. [68]

d) Addressing specific needs of the Ageing Coastal Population

It is important to not only implement effective development and planning for the large number of people relocating to the coast, but also put in place mechanisms that appropriately address the demographics of those populations relocating to the coastal zone. Australia's ageing population is now well recognised, as are the lifestyle and economic incentives driving this ageing population to coastal areas.

> "*Pensioners are clearly making decisions to move based on lifestyle factors and personal circumstances, often in pursuit of the 'sea-change' or 'tree-change' dream. Despite recent price inflation on the coast, most parts of non-metropolitan Australia, even on the coast, are significantly cheaper than the cities (especially Sydney). For home owning pensioners - the majority of movers - trading down to cheaper housing provides a financial nest egg to compensate for the low-incomes conferred by a pension.*"[69]

It is important to ensure that there are sufficient services to adequately address the needs of such a population when developing infrastructure in the coastal zone:

[68] Wrigley, D. 2007, 'Climate Change Needs Housing Change', *Nature and Society Forum*

[69] Marshall, N., Murphy, P.A., Burnley, I.H., Hugo, G.J. 2005, 'Australian intrastate migration – the story of Age Pensioners'. Available at: http://www.facs.gov.au/research/austsocpolicy_2005/article3.htm.

> "*There are also emerging issues involving localized and regional patterns of ageing, especially in coastal areas experiencing substantial in-migration of older people, where infrastructure is insufficient and the demand for services by the aged population will exceed the supply potential of the local labour force*."[70]

Issues to be addressed include increased public transport facilities and reviewing the balance between public and private provisions of major services such as health, medicines and aged care in the coastal zone.

> "*One of the biggest issues faced by the elderly or those with a disability living in a rural, coastal or other non-metropolitan area is access to social, health and other personal support services.*"[71]

e) Implementation of Wildlife Corridors

With an increase in infrastructure requirements to service large populations in the coastal zone, it is essential that landscape connections between larger areas of habitat are conserved to minimise impacts on biodiversity. These landscape connections are referred to as wildlife corridors and are implemented to assist migration, colonisation and interbreeding of plants and animals. It is important that the inclusion of such corridors is incorporated into development of the coastal zone. The inclusion of wildlife corridors to an area that has been subjected to high levels of anthropogenic activity is by no means going to sufficiently offset the damage done to biodiversity levels through extensive clearing. However they may, to some extent, alleviate the impact upon local biodiversity levels.

Mechanisms to protect water quality

The increase in population in coastal areas has impacts on water quality and can, for example, create an influx of nutrients, and subsequent eutrophication[72] of aquatic systems such as the already discussed, estuarine habitats. Nutrient sources include fertiliser runoff from both agricultural and domestic land use, inadequate

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[70] Committee for Economic Development of Australia, 2005, 'Australia's Ageing Population: Meeting the Challenge'. Available at: http://ceda.com.au/public/publications/policy/docs/ageing_policy_statement.pdf.

[71] Marshall, N., Murphy, P.A., Burnley, I.H., Hugo, G.J. 2005, 'Australian intrastate migration – the story of Age Pensioners'. Available at: http://www.facs.gov.au/research/austsocpolicy_2005/article3.htm.

[72] Accelerated primary production - Eutrophication is the response in water due to over enrichment by nutrients, primarily phosphorus and nitrogen, and can occur under natural or manmade (anthropogenic) conditions. "Eutrophication can result in visible cyanobacterial or algal blooms, surface scums, floating plant mats and benthic macrophyte aggregations. The decay of this organic matter may lead to the depletion of dissolved oxygen in the water, which in turn can cause secondary problems such as fish mortality from lack of oxygen and liberation of toxic substances or phosphates that were previously bound to oxidised sediments." Chorus, I. & Bartram, J. 1999, 'Toxic Cyanobacteria in Water: A guide to their public health consequences, monitoring and management', World Health Organisation. Available at: http://www.who.int/water_sanitation_health/resourcesquality/toxcyanchap1.pdf.

sewage collection (i.e. septic tank leakage) and insufficient sewage treatment devices. Such runoff is rich in nitrogen and phosphorus and is one of the key contributions to the "fluctuations in algal blooms (including harmful taxa), accumulation of organic matter, and excessive oxygen consumption (hypoxia and anoxia)"[73].

It is important therefore to incorporate into development proposals measures such as sufficient sewage treatment infrastructure to reduce the chance of such contaminants being introduced into aquatic, especially estuarine, systems.

> *"The environmental impact of different sanitation systems can be measured in terms of the conservation and use of natural resources, discharges to water bodies, air emissions and the impacts on soils. In this type of assessment, source separation and household-centred use systems frequently score more favourably than conventional systems."*[74]

Minimisation of eutrophication and other water pollution is undoubtedly a case whereby prevention is better than a cure, and as such if mechanisms are put in place at the source to reduce nutrient or pollutant leakage, as opposed to implementing treatment solutions to deal with the consequences, then both the environmental and economic costs will be reduced.

Minimisation of impact from Recreational Activities

As noted above, the impacts of recreational activities upon coastal systems may at first seem minimal, however on closer examination they reveal the potential for significant disturbances to coastal systems. Public awareness of the potential impact that both terrestrial and aquatic based recreational activities can have on the ecosystems, should be a key focus of council activities. Mechanisms to ensure sustainable resource use include: increased public awareness, and enhanced regulation, compliance and monitoring.

An example regarding public awareness applies to recreational fishing. Educating coastal communities to incorporate the following simple strategies when fishing can greatly minimise environmental degradation:

- "*Fish away from bird feeding and nesting areas.*
- *Avoid using unattended lines.*
- *Avoid using stainless steel hooks which take years to break down in the environment.*
- *Collect and dispose of any discarded fishing line, other gear or rubbish.*

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[73] Paerl, H.W. 2006, 'Assessing and managing nutrient-enhanced eutrophication in estuarine and coastal waters: Interactive effects of human and climatic perturbations', *Ecological Engineering*, vol. 26, no.1, pp. 40-54.

[74] World Health Organisation, 2006 'Guidelines for the safe use of wastewater, excreta and greywater'. Available at: http://whqlibdoc.who.int/publications/2006/9241546824_eng.pdf.

- *Cut discarded fishing line into small pieces to avoid entanglement in case birds and other animals scavenge rubbish bins.*
- *Don't leave ANYTHING behind. Even plastic bags can prove fatal when sea turtles mistake them for natural jellyfish prey."*[75]

The benefits from making the public aware of such strategies are two fold; not only will there be the direct environmental benefits from the implementation of such strategies, but the escalation of community awareness of environmental issues has the potential to have flow on effects into other areas of coastal management.

Enhanced regulation has a role in addition to awareness-raising. For example, ANEDO supports enhanced regulation and policing of watercraft speed around sensitive coastal areas to ensure that the environmental impacts from anthropogenic activities can be significantly reduced. Regulation should more clearly stipulate no-go areas at certain times of the year – for example, during breeding/nesting seasons.

Increased compliance monitoring is also required. Imposing penalties – both financial and orders for remediation - plays an important deterrence role. For example, protecting dune rejuvenation by increasing compliance relating to regulation of activities impacting such sensitive areas should be at the forefront of those consent bodies that have typically taken a relaxed approach to management of near shore systems.

Network of Marine Protected Areas

ANEDO submits that due to the wide array of potential threats, and demonstrated importance of estuarine zones, strong and logical incentives exist for the instigation in Australia of a much more extensive "comprehensive, adequate and representative" network of marine parks. This is a vital mechanism in ensuring the future health of fish stocks and marine biodiversity.

Summary and recommendations for Part Two

- **Key environmental impacts of population growth include impacts on: water resources, biodiversity, estuaries, reefs and sediment dynamics.**
- **Important not to compound the significant problems already faced by coastal communities by making further ill-considered planning and infrastructure decisions.**
- **In addition to impacts of new housing developments and infrastructure, recreational activities may also have negative cumulative impacts.**
- **Mechanisms to minimise environmental impacts and promote sustainable use of coastal resources include:**

[75] New South Wales Department of Primary Industries, 2005, 'Responsible fishing to reduce wildlife injuries.' Available at: http://www.dpi.nsw.gov.au/fisheries/recreational/publications/general/wildlife-injuries.

- **Improved planning and development controls, including no-go areas for development in the most sensitive coastal zones;**
- **Comprehensive EIA mechanisms for strategic regional planning and development approval, including consideration of cumulative impacts;**
- **Public participation processes for strategic planning and development assessment processes;**
- **Mandatory sustainable housing requirements (such as rain water tanks, grey water systems, energy efficiency measures, insulation, solar heating, etc);**
- **Wildlife corridors;**
- **Mechanisms to protect water quality (such as improved sewage treatment infrastructure and improved regulation of pollutants in sensitive environments);**
- **Mechanisms to ensure sustainable recreational use of the coast (such as public awareness, increased regulation, and consideration of cumulative impacts); and**
- **A comprehensive adequate and representative network of marine protected areas.**

- **In summary, it is essential in order to adequately address environmental impacts and promote sustainable use of coastal resources that an integrated approach to natural resource management, planning and development is adopted in the coastal zone. This requires cooperation between different agencies regulating different resources, land uses and impacts; as well as cooperation between all levels of government.**

Part Three - The impact of climate change on coastal areas and strategies to deal with climate change adaptation, particularly in response to projected sea-level rise

3.1 The impacts from Climate Change on Coastal Areas

Having addressed some of the impacts of population increase in and around the coastal zone in Part 2; this part examines the impacts of climate change, specifically sea level rise, on the coastal zone.

Climate change is an issue that needs to be at the forefront of governance bodies' priorities when developing law and policy relating to the coastal zone. It is an issue that has started, and will continue, to influence natural environmental processes as well as social and economic developments.

> "*Some coastal ecosystems are particularly at risk from climate change, including saltwater marshes, mangrove ecosystems, coastal wetlands, sandy beaches, coral*

reefs, coral cays and river deltas. Changes in these ecosystems would have major negative effects on tourism, freshwater supplies, fisheries and biodiversity."[76]

The above statement highlights that the effects of climate change on coastal regions are diverse but also interrelated. The following table identifies some of the main issues that have been identified as potential impacts:

Table 1. Principal climate change drivers and possible direct and indirect impacts on the coast of Australia, synthesised from IPCC and SURVAS summaries, with tentative indication of confidence level in their likelihood of occurrence (very high [VHC], high [HC], medium [MC], low [LC] or very low [VLC] confidence).

Climate change (Driver)	Principal direct physical and ecosystem effects	Potential secondary and indirect impacts
Sea-level change [VHC] (principally rise)	• increased coastal erosion [VHC] • increased inundation of coastal wetlands and lowlands [MC] • increased risk of flooding and storm damage [HC] • increased salinisation of surface and ground waters. [MC]	• infrastructure and economic activity impacted [MC] • displacement of vulnerable populations [LC]
Sea-surface temperature [HC] (principally rise)	• increased coral bleaching [HC] • pole ward species migration [LC] • increased algal blooms [LC]	• impact on tourism [LC] • possible health impacts [LC]
Altered precipitation and runoff [MC] (local increases/decreases)	• altered river sediment supply [MC] • altered lowland flood risk [MC] • water quality/nutrient impacts [LC]	• implications for erosion and flooding [LC]
Altered wave climate [LC] (uncertain)	• altered wave run-up [VLC] • altered erosion and accretion [LC]	• further erosion [LC]
Storm frequency and intensity changes [LC] (uncertain)	• increased waves and surges [LC] • altered cyclone zones [LC]	• further storm damage [LC]
Increases in CO_2 concentration in the atmosphere [VHC] and ocean [HC]	• increased ocean acidification [HC] • increased disruption to food chains (eg. Southern Ocean) [MC]	• less resilient reefs [LC] • impaired movement and function of high oxygen demand fauna (eg. squid, fish) [MC]

[77]

As can be seen from the above table, a multitude of potential impacts are predicted to arise as a result of the effects of climate change. It is important to note that the impacts of climate change and the resilience of natural coastal systems will be

[76] Gourley M.R., Harper B.A., Cox R.J., Stone P.B. and Webb T., 2004, 'Coastal Engineering Guidelines for working with the Australian coast in an ecologically sustainable way', *Engineers Australia*, National Committee on Coastal and Ocean Engineering, EA Books, Barton ACT, Australia, p. 101.

[77] Abuodha, P.A. & Woodroffe, C.D. 2006, 'International assessments of the vulnerability of the coastal zone to climate change, including an Australian perspective', School of Earth and Environmental Sciences, University of Wollongong, for the Australian Greenhouse Office, Department of Environment and Heritage. Available at: http://www.greenhouse.gov.au/impacts/publications/pubs/coastal-international.pdf.

affected by the impacts of population growth as discussed in Part 2. In accordance with the terms of reference, this part specifically focuses upon the impacts of climate change associated with sea-level rise.

Sea-level Rise

> "*Global average sea-level rose at an average rate of 1.8 [1.3 to 2.3] mm per year over 1961 to 2003. The rate was faster over 1993 to 2003, about 3.1 [2.4 to 3.8] mm per year...There is high confidence that the rate of observed sea-level rise increased from the 19th to the 20th century. The total 20th century rise is estimated to be 0.17 [0.12 to 0.22] m.*[78]"

Scientific studies, clearly demonstrate that a rise in sea-level is occurring. The main geophysical factors that have contributed to a rise in sea-level are as follows:

- "thermal expansion of the oceans caused by warming;
- the melting of glaciers and small ice caps, also caused by warming;
- the contribution of the large ice caps (Greenland and Antarctica) to sea-level changes through the melting and/or accumulation of snow; and
- changes in terrestrial storage."[79]

When addressing the issue of what impacts sea-level rise has on coastal zones in Australia, it is important to understand that "sea-level rise itself does not cause coastline recession; it is the resulting changes in the wave climate and the alongshore transport that causes increased erosion.[80]" Furthermore, it is important to understand that these impacts will continue long term, well beyond modelling horizons of 2100.

> *"Sea-level rise may accelerate the erosion of coastal margins, threatening land and property. It also diminishes the effectiveness of the buffer provided by the beach, bringing higher energy waves closer to the dune system. Rising seas may increase the incidence of coastal flooding, either by increasing the height of storm surges, or by acting as a higher seaward barrier restricting the escape of flood waters caused by excessive runoff.*[81]"

Sea-level rise therefore has the potential for devastating effects on many aspects relating to the coastal zone. These are discussed briefly below.

a) Increased coastal flooding and storm surges

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[78] IPPC, 'Climate Change 2007: The Physical Science Basis: Summary for Policy Makers, Contribution of Working group I to the Fourth Assessment report of the Intergovernmental Panel on Climate Change'. Available at: http://www.aaas.org/news/press_room/climate_change/media/4th_spm2feb07.pdf.

[79] Walsh, K.J.E, Betts, H., Church, J., Pittock, A.B., McInnest, K.L., Jackett, D.R. & McDougall, T.J. 2004, 'Using Sea-level Rise Projections for Urban Planning in Australia', *Journal of Coastal Research*, vol. 20, no. 2, pp. 586–598.

[80] Ibid.

[81] Ibid.

A storm surge or tidal surge is an offshore rise of water associated with a low pressure system, usually a tropical cyclone. This offshore rise of water takes the shape of a raised dome of sea water typically 60-80km across and 2 to 5 metres above normal sea level. As these surges reach the coast, they move quickly inland with the potential to cause extensive coastal flooding.

> "*An increase of sea-level would restrict the outflow of flood waters from local river systems into the ocean, thereby increasing peak flood levels*"[82].

The consequences from these processes are likely to impact upon social, infrastructure and economic activity in addition to causing, in extreme cases, the displacement of low-lying vulnerable populations. The CSIRO has conducted research that indicates modest to moderate increases in maximum cyclone intensities are expected in coastal Australia in the near future:

> "*impacts of sea-level rise and storm surges could be expected along the full length of the tropical coast. On the NSW coast, where a narrow continental shelf limits the size of storm surges, large wind-driven waves can have significant impacts.*"[83]

Furthermore, CSIRO modelling has demonstrated that the 100-year storm surge event in current climate conditions for a cyclone of extreme intensity would be reduced to a 60-year event with the predicted alterations to climate conditions. Additionally, if the mid-range estimate of a 20cm increase in sea-level rise by 2050 is incorporated into the modelling, then the likelihood of extreme cyclonic activity is reduced to a 40-year period. Such modelling highlights the need for the implementation of the precautionary principle for any management strategies for the catchment-coast ocean continuum.

b) Increased coastline erosion

It is well understood that sandy beaches are dynamic sedimentary systems that experience fluctuations in phases of erosion and deposition. However the impacts of the increased coastal flooding and storm surges, in addition to more frequent tropical cyclones, has subsequently lead to a corresponding increase of coastline erosion being experienced by large areas of Australia. As such, the need for preserving natural mechanisms that provide for coastal sediment stabilisation, such as preventing the clearing of coastal vegetation, and maintaining estuarine systems, is of vital importance to decrease the potentially devastating impacts of sea-level rise.

c) Inundation of coastal wetlands and lowlands

The importance of coastal wetlands, particularly estuaries, was noted in Part 2. It is important to realise that in addition to human impacts such as nutrient enrichment,

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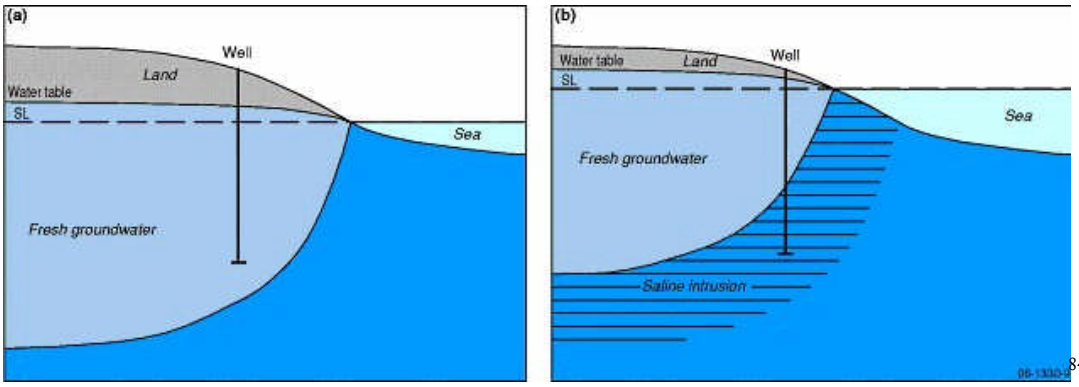
[82] Ibid.

[83] CSIRO Marine Research, 'Global Sea-Level Rise', *The facts -Understanding Our Oceans*. Available at http://www.marine.csiro.au/LeafletsFolder/45slevel/45.html.

and chemical contaminants, these ecosystems are also in jeopardy due to sea-level rise. There are some suggestions that with sea-level rise, what will be witnessed is inland encroachment by the coastal wetlands. With current trends in planning policy having the potential to permit the construction of infrastructure within 100 metres below mean high water mark, inland encroachment in many areas by such wetlands would be impossible, resulting in the rapid decline of such systems, and resultant loss of associated ecosystem services.

d) Increased salt water intrusion into aquifers

The following Figure depicts a) an unconfined coastal aquifer, and b) the same aquifer under a sea-level rise scenario. What can be noted is the influx of sea water into an area that under normal conditions would not usually be exposed to high levels of salinity.



[84]

This increased salt water intrusion into aquifers has the potential to impact not only on freshwater reserves (used to support the environment and the increasing population), but additionally cause major shifts in coastal ecosystem dynamics. Tomago Sands Beds provides much of the water supply for the Newcastle area, and has been identified as being vulnerable to saltwater intrusion from rising sea levels.

e) Potential Health Impacts

An increase in the likelihood of flooding around coastal areas is likely to be accompanied by the proliferation of waterborne diseases.

> *"Many infectious diseases are sensitive to climate conditions. Bacterial food poisoning rates increase with warmer temperatures. Diseases spread by mosquitoes and other vectors tend to spread more widely with increases in temperatures, rainfall and humidity – and some, such as mosquito-borne dengue fever, are anticipated to spread further south into sub-tropical Australia"*[85].

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[84] Hepplewhite, C., OzCoast and OzEstuaries – Australia's online coastal information portal, 'What is saline intrusion?'. Available at: http://www.ozcoasts.org.au/indicators/saline_intrusion.jsp.
[85] The Australian Climate Group, 2008, 'Climate Change Solutions for Australia 2008'. Published by World Wildlife Fund. Available at: http://www.wwf.org.au/publications/wwf-climate-change-solutions/.

Although the health effects associated with climate change are rarely a focus concern in Australia, they are very real consequences that need to be taken into account by governance bodies:

> "*A 2003 joint study by the World Health Organisation and the London School of Hygiene and Tropical Medicine states that global warming may already be responsible for more than 160,000 deaths a year from malaria and malnutrition; a number that could double by 2020.*"[86]

A human rights approach to climate change in Australia highlights the importance of addressing the health aspects of climate change. Particular attention needs to be directed at developing plans to ensure the health and well-being of indigenous populations that have traditionally been the recipients of substandard health care and subsequently display a disparity in life expectancy in comparison to non-indigenous Australians.

3.2 Mechanisms to cope with Sea-Level Rise

Prior to discussing some of the mechanisms that have been, or are recommended to be, implemented in response to sea-level rise, it is important to acknowledge the fact that a great deal of scientific uncertainty exists regarding the "precise nature and extent of the impacts"[87] that will take place as a result sea-level rise. While it is important to acknowledge this fact, however what is even more fundamental is to not allow this uncertainty to act as a justification for a plan of action that adopts a "sit and wait" mentality. The 2001 IPCC Report estimated a sea-level rise of between 9 and 88cm between 1990 and 2100. In 2007 IPCC report estimated a sea-level rise of between 18 and 59 cm. There have been additional studies that suggest sea-level rises of 50cm to 1.4m over this century are not out of the question[88]. At a recent conference on sea level rise hosted by Pittwater Council in Sydney, a number of speakers noted that in addition to the IPCC projections, it is necessary to add an ice-flow melt uncertainty factor, and additional CSIRO projections for the NSW coastline, meaning the predicted range of sea-level rise is more like 0.18-0.91m by 2090-2100.[89] As such, "there is a need for a concerted effort to assess and promote appropriate adaptation to climate change and SLR (sea-level rise) in coastal zones"[90].

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[86] Human Rights and Equal Opportunity Commission, 2008, '*Background Paper; Human Rights and Climate Change*'. Available at: http://www.humanrights.gov.au/about/media/papers/hrandclimate_change.html.

[87] McDonald, J. & England, P. 2007, "A Risky Climate for Decision-Making: The Legal Liability of Development Authorities for Climate Change Impacts", *QELA Conference*, Kingscliff.

[88] Wilkinson, M. & Frew, W., 2007 'Seas could rise much more than we thought', *Sydney Morning Herald,* August 6. Available at: http://www.smh.com.au/news/environment/seas-could-rise-much-more-than-we-thought/2007/08/05/1186252546977.html.

[89] See Duncan McLuckie "Adapting for climate change impacts on Flooding" paper presented at the Pittwater Conference, 29th May 2008.

[90] Tol, R.S.J., Klein, R.J.T., & Nicholls, R.J., 2008, 'Towards successful adaptation to sea-level rise along Europe's coasts', *Journal of Coastal Research,* vol. 24, no. 2, pp. 432-442.

The reports from bodies such the IPCC have delivered estimates for projected sea level rise in regard to a limited time scale, for example the year 2100. As noted above, it is essential to understand regardless of what society can achieve in terms of effectively reducing greenhouse emissions, science indicates we are faced with the prospect of ongoing sea level rise for centuries to come. Any responses implemented, such as strategic planning, policy and adaptation mechanisms all need to incorporate elements of flexibility that can adapt and accommodate the inevitable changes in the scientific data. For example, a legislative framework should set out a clear process for projected sea level development lines to be increased where new data becomes available. There is not an artificial 'end date' for designing measures to deal with sea level rise, and the framework should set in place the right planning principles and flexibility mechanisms for communities and government to address the issues in perpetuity.

ANEDO concedes that the range of estimates, as highlighted above, vary from the conservative to the extreme. Due to this fact, it is essential that the precautionary principle and adaptive management mechanisms be incorporated into any implementation mechanisms that aim to address sea-level rise, and it would be prudent to plan for the higher end of projected rises.

The main policy options are: accommodation versus adaptation.

a) Accommodation

Should Australia chose to do nothing in response to current and predicted sea-level rise, then the mechanism we will be choosing to pursue is accommodation. This simply means that coastal communities pursue a course of risk acceptance and in short, do nothing. Due to a combination of factors such as the high cost of infrastructure and social demand for coastal living, accommodation is not an option and would, for example, cause significant legal and liability disputes over inevitable property damage, and fail to deal with future climate refugees and displaced communities.

b) Adaptation

> *"Adaptation of our built environment will be needed to help communities withstand the impact of more severe weather events, hotter temperatures and higher sea-levels. The location of our coastal buildings, the construction standards and materials we use, and our emergency management capacity are just some examples of the areas where we are likely to require adaptation to climate change."*[91]

[91] The Australian Climate Group, 2008, 'Climate Change Solutions for Australia 2008'. Published by World Wildlife Fund. Available at: http://www.wwf.org.au/publications/wwf-climate-change-solutions/ .

Should the increases that Australia is witnessing in both sea-level rise and coastal population density continue to occur, adaptive mechanisms will need to be implemented to manage the interaction between environmental processes and anthropogenic demands. Before looking at the adaptive mechanisms that have, and may potentially be implemented, it is important to define what constitutes adaptation. The International Panel on Climate Change provides the following definition for adaptation:

> "*Adjustment in natural or human systems in response to actual or expected stimuli or their effects, which moderates harm or exploits beneficial opportunities. Various types of adaptation can be distinguished, including anticipatory and reactive adaptation, and autonomous and planned adaptation.*"[92]

Examples of anticipatory adaptation "which is implemented before impacts of climate change are observed", and reactive adaptation which "takes place in response to impacts[93]"can be seen in the table below.

Anticipatory Adaptation	**Reactive Adaptation**
• Planning reforms • New building codes and design standards • Incentives for relocation • Shoreline management planning • Early-warning systems	• Compensatory payments and subsides • Disaster relief • Shoreline defence

[94]

A crucial first step for adaptation planning is comprehensive **risk assessment** that takes into account not just the most conservative modelling, but provides for increased extreme events. A tool to assist this is being trialled on the central and Hunter coasts of NSW, involving terrain surveys (aerial lasers canning) assessing coastal vulnerability and identifying assets that may be at risk.[95] This kind of assessment should be undertaken nationally.

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[92] IPCC, 2007: Summary for Policymakers. In: *Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change* [M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

[93] Tol, R.S.J., Klein, R.J.T., & Nicholls, R.J., 2008, 'Towards successful adaptation to sea-level rise along Europe's coasts', *Journal of Coastal Research,* vol. 24, no. 2, pp. 432-442.

[94] Adapted from Smit, B., Pilifosova, O., Burtin, I., Challenger, B., Huq, S., Klein, R.J.T., & YOHE, G., 2001, 'Adaptation to climate change in the context of sustainable development and equity'. In McCarthy, J.J., Canziani, O.F., Leary, N.A., Dokken, D.J., & White, K.S. (eds.), *Climate Change 2001: Impacts, Adaptation and Vulnerability*. Cambridge, United Kingdom: Cambridge University Press, pp. 877–912.

[95] NSW LiDAR project. See High resolution terrain mapping of the NSW Central and Hunter coasts for assessments of potential climate change impacts: final project report (May 2008) at http://www.planning.nsw.gov.au/plansforaction/climatechange_mapping.asp.

Planning Reforms

Having already discussed the planning reforms associated with increased population impacts in the coastal zone, the terms of reference require an analysis of measures to address sea-level rise.

> *"Coastal urban planning needs to take sea-level rise into account because its effects will be apparent during the typical replacement time of urban infrastructure such as buildings (before about 70 years)."*[96]

The development of appropriate coastal planning policy is the key to adapting to impacts associated with sea-level rise. Policies will need to be flexible, as sea-level rise may well exceed current projections;

> "*climate models suggest that this warming will accelerate in the future; moreover, the thermal lag of the oceans caused by their very large heat capacity means that global mean sea-level would continue to rise for the next several decades or longer even if there were no further production of gases*[97]"

This acceleration of sea-level rise will continue for some time, however "the inevitability of these changes is not a reason to accept defeat and further delay mitigation and reduction targets, but it does demand a parallel strategy of climate adaptation to reduce the impact of inevitable changes"[98]. Such strategies have been developed, for example, focusing on locating new development in areas not vulnerable to impacts of climate change.[99] Western Australia has managed to integrate into its coastal zone management, principles that incorporate setbacks from influence by coastal processes, whilst still taking into account natural attributes such as wetlands and conservation of biodiversity, and recreational needs.[100] As recommended in Part 3, the integration of such natural processes and planning development is important:

> *"Coastal management over the last 100 years has had a strong tendency to restrict the natural dynamics of coastal systems... coastal processes should be allowed enough space to change dynamically over time – which implies larger dynamic buffers between the sea and any human activity at the coast...the two*

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[96] Walsh, K.J.E, Betts, H., Church, J., Pittock, A.B., McInnest, K.L., Jackett, D.R. & McDougall, T.J. 2004, 'Using Sea-level Rise Projections for Urban Planning in Australia', *Journal of Coastal Research*, vol. 20, no. 2, pp. 586–598.

[97] Ibid.

[98] McDonald, J. & England, P. 2007, "A Risky Climate for Decision-Making: The Legal Liability of Development Authorities for Climate Change Impacts", *QELA Conference*, Kingscliff.

[99] Queensland State Coastal Plan. Available at: www.env.qld.gov.au/cgi-bin/w3-msql/environment/coast/management/msqlwelcome.html?page=sp.html.

[100] Walsh, K.J.E, Betts, H., Church, J., Pittock, A.B., McInnest, K.L., Jackett, D.R. & McDougall, T.J. 2004, 'Using Sea-level Rise Projections for Urban Planning in Australia', *Journal of Coastal Research*, vol. 20, no. 2, pp. 586–598.

critical management characteristics of resilient natural systems are that they need space to adapt and are dynamic. "[101]

The above statement highlights the importance of ensuring sufficient buffers exists to accommodate not only short term predicted sea-level rise, but also the changes in both sea-level rise, and rate, in the future. As when developing legislation and policies for increased population densities, public participation and community consultation is fundamental to the development of any such instruments when addressing sea-level rise.

"*To achieve 'sustainable floodplain management', policy makers and local government officers need to have an effective knowledge of the risks considered to be 'acceptable' by the community as well as the levels of flood awareness and local experience*" [102].

Community consultation is imperative in managing the threats associated with increased storm surges and subsequent coastal flooding;

"*research identified a number of issues concerning floodplain land-use planning, risk management and acceptable risk and concluded that more attention could be directed towards planning* with *as to opposed to* for *the community when considering the acceptability of risks and hazard impacts*"

The threat of increased storm surges and subsequent coastal flooding is going to vary from community to community. The development of planning reforms that may sufficiently address these issues in one area may prove to be completely ineffective in another; local knowledge through community involvement is crucial.

Hierarchy of adaptation planning options

1. Planned Retreat

Due to the projections of significant sea level rise that will exacerbate coastal erosion combined with historical development too near the shoreline, it is inevitable that retreat will be the only option for ocean-front properties in some areas. ANEDO submits that it is better to put in place sound plans for such retreat in these areas now, rather than dealing with the environmental and property damage consequences in an ad hoc, case by case manner as the impacts increase over the years to come.

"*The location of existing and new settlements should be carefully considered, and in some areas, people should be encouraged with appropriate incentives to move away from the most vulnerable coastal and river valley locations...The option of*

[101] Tol, R.S.J., Klein, R.J.T., & Nicholls, R.J., 2008, 'Towards successful adaptation to sea-level rise along Europe's coasts', *Journal of Coastal Research,* vol. 24, no. 2, pp. 432-442.
[102] Godber, A.M. 2006, 'Local government views on addressing flood risk management on the Gold Coast', *The Australian Journal of Emergency Management*, vol. 21, no.3.

qualified retreat from high-risk coastal zones should routinely be considered in all long-term planning schemes."[103]

The process of managed retreat includes the refusal of granting planning permission to rebuild properties damaged during storms, landward realignment of flood defences and building setbacks on eroding coasts; and may constitute an enabling policy whereby land that is likely to be eroded or periodically inundated can be used for temporary purposes such as relocatable homes and caravan parks. Planned retreat more generally means "all natural system effects are allowed to occur and human impacts are minimised by pulling back from the coast"[104].

The severe biodiversity impacts likely to occur as a result of sea level rise and related climate change impacts on coastal areas can be mitigated to some extent by adopting a policy of planned retreat, since it allows strategic planning to occur with due recognition of the need for flora and fauna buffers, corridors and refuges. Alternative approaches, especially seawalls, protect property at the expense of habitat in intertidal zones, saline and freshwater wetlands and the coastal floodplain.

It should be noted that planned retreat is not a "one size fits all" policy mandating no new coastal development and the gradual removal of all existing structures. It is, above all, a recognition that in some areas there is no sustainable long-term alternative, given the prospect of substantial sea level rise over the next century and beyond, to moving back from the coast.

The outcomes of a recent expert seminar analysing the implications for other coastal communities of the planned retreat policy implemented since 1988 by Byron Shire Council are included at **Appendix 1**, where the policy is defined and explained. Byron Shire Council has implemented a policy based on three precincts with different planning controls for each. Other councils and state governments may adopt different standards and planning controls.

ANEDO submits that planned retreat is the preferred long-term option for dealing with the impacts of sea level rise. However, where broadscale planned retreat may not be possible, the following measures in the hierarchy should be considered.

2. Development controls and planning measures

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[103] Bierbaum, R.M., Holdren, J.P., MacCracken, M.C., Moss, R.H., & Raven, P.H. (eds) 2007, *Confronting Climate Change: Avoiding the Unmanageable and Managing the Unavoidable*, *Report prepared for the United Nations Commission on Sustainable Development*, Sigma Xi, Research Triangle Park, NC, and the United Nations Foundation, Washington, DC. Available at: http://www.unfoundation.org/files/pdf/2007/SEG_Report.pdf.

[104] Abuodha, P.A. & Woodroffe, C.D. 2006, 'International assessments of the vulnerability of the coastal zone to climate change, including an Australian perspective', School of Earth and Environmental Sciences, University of Wollongong, for the Australian Greenhouse Office, Department of Environment and Heritage. Available at: http://www.greenhouse.gov.au/impacts/publications/pubs/coastal-international.pdf.

Where a full-scale planned retreat policy is not implemented, there are retreat planning measures that may still be tailored to local situations. Buffer zones, wildlife corridors and no-go development areas can be confirmed over greenfield sites; and, as recommended in Part 3, building codes and design standards can be applied to developed coastal areas.

3. Resilience building measures

Effective shoreline management planning has the potential to greatly assist in protecting coastal communities from the impacts of sea-level rise and climate change.

Protection options include employing both soft (beach nourishment) and hard (sea wall) mechanisms to control sediment dynamics. Protective mechanisms implemented to deal with sea-level rise are often subject to a great deal of controversy largely due to the impact they have upon natural coastal processes. The techniques of artificial beach nourishment, groyne construction, sea wall construction, and island raising are often implemented to control sediment erosion and accretion.

ANEDO submits that soft protections options that build the resilience of natural systems are preferred to options that interfere with natural processes such as hard engineering structures. Resilience building measures include: dune revegetation, dune and coastal wetland buffer zones, revegetated corridors, and in some circumstances, beach nourishment.

Beach nourishment involves the process of mechanically collecting sand from an area dubbed a borrow site, and depositing it at alternate location, or nourishment site. A recent example of this process is the implementation of submarine sandshifter installed at Noosa Beach.

> "*The system recycles littoral drift sand to provide regular beach nourishment. The equipment traps sand at the down drift end of the beach and pumps it back to the eroded areas of the beach for continuous beach nourishment.*"[105]

It is not suitable for all locations as it requires a readily available supply of sand to feed the borrow site. Further more, the initial extraction, deposit and ongoing requirement for renourishment (as nourished beaches tend to erode faster than natural beaches) all contribute to this option being an extremely expensive process. Therefore beach nourishment may only be appropriate for a small number of beaches, such as in Sydney or Noosa, where given the economic/tourist values of the beaches, financial resources may be available for such an option.

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[105] Nankervis, L. 2005, 'Beach Nourishment with the Submarine Sandshifter'. In: *Coasts and Ports: Coastal Living - Living Coast; Australasian Conference 2005*', pages: 341-344, Townsend, M.R., Walker, D., (Eds). Barton, A.C.T. Institution of Engineers, Australia, 2005.

The process of beach nourishment is accompanied by an array of environmental side effects that impact upon both the borrow and nourishment sites which "may lead to modifications of sedimentary environments and inhabiting fauna"[106]. If the correct measures are not taken to ensure that factors such as grain size and sorting are analogous between sites, beach nourishment can lead to the development of adverse consequences such as "loss of sediments due to aeolian (wind) transport, generation of a shell pavement, loss of sand quality, obstruction of natural drainage to the beach, erosion by rainfall creeks and changes on the use of the beach profile sub-environments"[107].

Additional impacts include short-term direct mortality to sessile organisms, impairment of light penetration due to increased sediment in the water column, and changes in topography of critical habitat. Finally, "borrow sites designated solely for nourishment can experience the greatest impact if the borrow activity affects hard bottom communities or there is a change in the sediment composition."[108] It is therefore important, in the limited case where it is economically feasible, that precautions are undertaken to ensure that if sand extraction does occur, steps are taken to minimise the impacts of such activities on the environment; for example, undertaking comprehensive EIA, and imposing conditions to factor in that "impacts of beach nourishment can be reduced by limiting activities to the colder months when recruitment of beach fauna is often the lowest."[109]

4. Development of effective early warning systems and emergency response plans

While resilience measures such as buffers, set-backs and no-go areas may be useful planning tools in areas proposed for new development and potentially ameliorate sea level rise impacts, they cannot easily be applied to already built up areas. Due to a combination of geographical factors, a historical lack of understanding of risk awareness and lack of appropriate planning instruments, and previously unchecked development, some coastal communities are more at risk from the impacts of climate change than others. It is important that such communities put in place early warning mechanisms and response plans to prepare for potential increased impacts and risks. The following emergency response mechanisms were recommended by Hanslow and Howard to be incorporated into new coastal management policies and guidelines.

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[106] Colosio, F., Abbiati, M. & Airolodi, L. 2007, 'Effects of beach nourishment on sediments and benthic assemblages', *Marine Pollution Bulletin*, vol 54, no. 8, pp.1197-1206.
[107] Marcomini, S.C. & Lopez, R.A. 2006, 'Evolution of a beach nourishment project at Mar del Plata',
Journal of Coastal Research, vol. 2, no. 39, pp. 834-837.
[108] Frank, G. 2001, 'Yelverton Corps of Engineers' views of environmental impacts of beach nourishment', *Abstracts with Programs - Geological Society of America*, vol. 33, no. 2, p. 11.
[109] Frank, G. 2001, 'Yelverton Corps of Engineers' views of environmental impacts of beach nourishment', *Abstracts with Programs - Geological Society of America*, vol. 33, no. 2, p. 11.

- "*Coastal erosion hazard—identification of the extent and nature of the risks posed to existing development.*
- *Appropriate responses—the plan should outline council response actions that are appropriate given the nature of the hazards and local site conditions.*
- *Proposed responses should be based on an assessment of all available options and their relative merits.*
- *Where planning for the protection of life and readily movable property during storms has been included in SES Sub Plans, the Coastal Zone Management Plan should refer directly to the relevant SES sub plan. The Coastal Zone Management Plan should not seek to replicate arrangements in SES sub-plans.*
- *Preparedness—the plan should include measures to facilitate efficient responses to coastal erosion emergencies.*
- *Trigger conditions—the plan should identify the circumstances in which emergency responses should or should not occur.*
- *Responsibilities and contacts—the plan should clearly specify a hierarchy of responsibilities for the emergency responses.*
- *Recovery and rehabilitation—the plan should clearly specify those actions which are to be undertaken to mitigate any impact of emergency works on beaches, dunes or other coastal settings, and should specify when they will be undertaken and by whom*."[110]

5. Hard engineering solutions

In addition to the implementation of soft solutions to the issue of sea-level rise, some coastal communities have attempted to instigate more solid structural changes toaddress coastal impacts. The building of structures such as groynes is often implemented to control sediment flows in and around the coastal zone. A groyne is "a shore protection structure built (usually perpendicular to the shoreline) to trap littoral drift or retard erosion of the shore"[111]. Groynes were successfully implemented to stabilise sediment flows around the Currumbin Creek entrance, which was historically "highly variable in terms of inlet location and sand bar characteristics due to a cyclical behaviour of spit migration."[112]

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[110] Hanslow, D.J. & Howard, M., 2005, 'Emergency Management of Coastal Erosion in NSW'. In R.J. Morrison, S. Quin and E.A. Bryant (eds.), *Planning for Natural Hazards — How Can We Mitigate the Impacts?, Proceedings of a Symposium*, 2-5 February 2005, University of Wollongong, GeoQuEST Research Centre.

[111] Gourley, M.R., Harper, B.A., Cox, R.J., Stone P.B. & Webb T. 2004, *Coastal Engineering Guidelines for working with the Australian coast in an ecologically sustainable way*, Engineers Australia, National Committee on Coastal and Ocean Engineering, EA Books, Barton ACT, Australia, p. 101.

[112] Castelle, B., Bourget, J., Molnar, N., Strauss, D., Deschamps, S., & Tomlinson, R. 2007, 'Dynamics of a wave-dominated tidal inlet and influence on adjacent beaches, Currumbin Creek, Gold Coast, Australia', *Coastal Engineering*, vol 54, pp. 77–90.

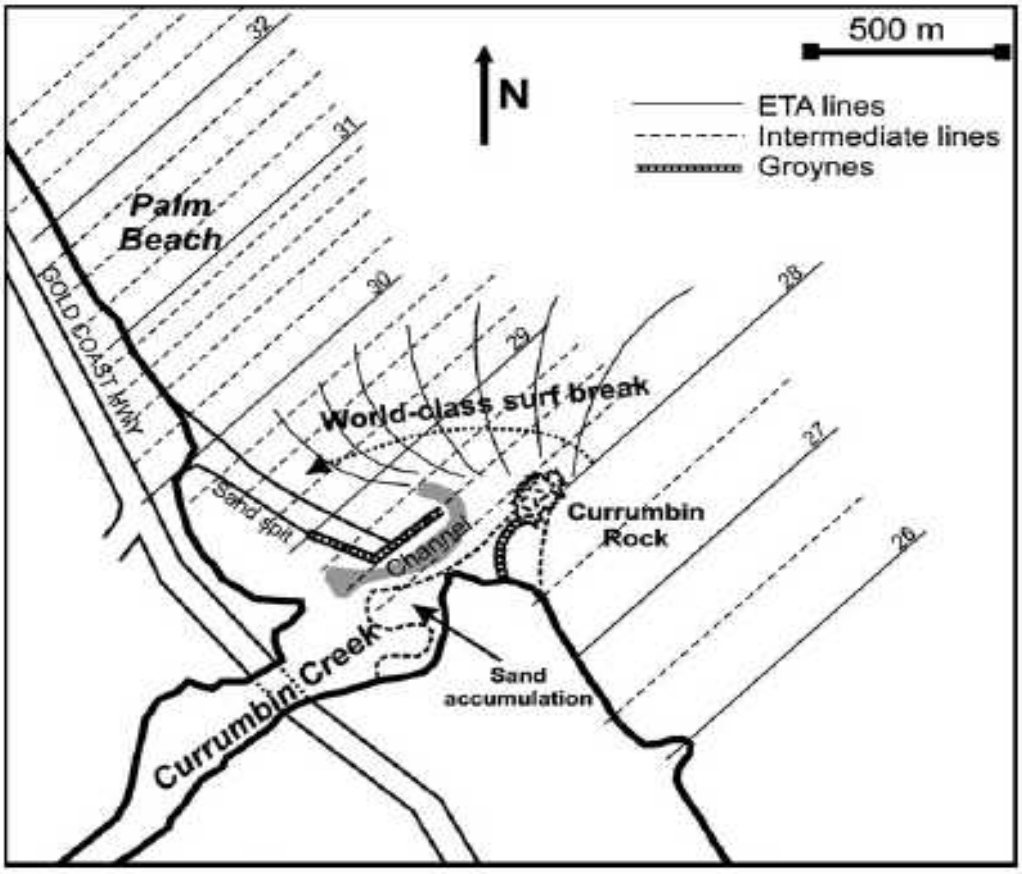

Fig. 2. Currumbin Creek and the southern part of Palm Beach in current configuration. Location of the groynes, the sand spit, the channel, the surfing break and the ETA lines. [113]

However as noted, structures such as groynes and sea walls are ecologically damaging, expensive and not aesthetically pleasing - an important consideration for those coastal communities dedicated to tourism. Many communities, such as that of Narrabeen in Sydney, have strongly opposed sea walls.[114]

ANEDO is concerned that hard engineering solutions such as sea walls interfere with natural coastal systems and can themselves degrade the coastline values. Options that build resilience of natural systems (such as dune revegetation, wetland buffer regeneration) should be explored first, and hard engineering options should only be considered as a last resort as they are not economically or environmentally feasible in the long term.

Summary and recommendations for Part Three

- **The potential impacts of climate change are broad, and have significant management implications, particularly in light of increased population pressures.**
- **Specific impacts of sea level rise include: increased coastal flooding and**

[113] Ibid.
[114] See "Line in the Sand" community protest.

storm surges, increased coastline erosion, inundation of coastal wetlands and lowlands, and potential health impacts.

- An "accommodation" strategy (ie, no action and risk acceptance) would create significant problems in the future, for example, in terms of liability for property damage and relocation of displaced coastal residents.
- A range of adaptation options should be comprehensively considered, subject to thorough environmental impact assessment and public consultation.
- ANEDO recommends a hierarchy of adaptation options be applied:
    1. Planned retreat – In view of the likelihood of significant sea level rise over the next century and beyond and the inevitable impacts of sea level rise on shoreline development in some areas, the precautionary principle suggests that planned retreat should be the key long-term adaptation response for human communities and to reduce biodiversity impacts. Planned retreat principles (including set-backs, buffers and development restrictions; as well as clear limits on public liability and rules regarding any relocation assistance) should be implemented into local planning and development controls now, to avoid impacts being dealt with and disputed on a case by case basis over the coming years as impacts increase.
    2. Where planned retreat is not possible, other adaptation options should be considered including:
        a. Development controls and planning measures including set-backs and no-go zones in vulnerable areas; building codes and design requirements (these may include principles of retreat tailored for a local area where a full-scale retreat plan is not implemented);
        b. Resilience building measures - protection measures to build resilience of natural systems (including dune revegetation, wetland buffer zones, and in limited circumstances, beach nourishment where done according to strict environmental conditions).
        c. Early warning systems and emergency response plans
        d. Hard engineering solutions (such as seawalls) are not recommended as they interfere with natural systems.
- To assist in adaptation planning, comprehensive risk and vulnerability mapping of the coast is needed. ANEDO recommends the extension of the NSW LiDAR program (or similar) nationally, as this would provide essential data to underpin and inform adaptation planning.
- Human rights considerations are also highly relevant to adaptation planning for affected coastal communities, especially in relation to coastal and island indigenous communities in terms of health impacts of climate change and culturally appropriate management of traditional land and coastal resources.

Part Four - Mechanisms to promote sustainable coastal communities

Mechanisms to promote sustainable coastal communities include mechanisms to minimise population impacts and promote sustainable coastal resources; and adaptation planning mechanisms to specifically address sea level rise impacts. These mechanisms fall under the umbrella of "integrated coastal zone management".

As noted in **Part Two**, mechanisms to minimise population impacts and promote sustainable use of coastal resources include:

- Improved planning and development controls, including no-go areas for development in the most sensitive coastal zones;
- Comprehensive EIA mechanisms for strategic regional planning and development approval, including consideration of cumulative impacts;
- Public participation processes for strategic planning and development assessment processes;
- Mandatory sustainable housing requirements (such as rain water tanks, grey water systems, energy efficiency measures, insulation, solar heating, etc);
- Wildlife corridors;
- Mechanisms to protect water quality (such as improved sewage treatment infrastructure and improved regulation of pollutants in sensitive environments);
- Mechanisms to ensure sustainable recreational use of the coast (such as public awareness, increased regulation, and consideration of cumulative impacts); and
- A comprehensive adequate and representative network of marine protected areas.

As noted in Part Two, it is essential in order to adequately address environmental impacts and promote sustainable use of coastal resources that an **integrated approach to natural resource management, planning and development** is adopted in the coastal zone. This requires cooperation between different agencies regulating different resources, land uses and impacts; as well as **cooperation between all levels of government.**

As noted in **Part Three**, a range of adaptation options should be comprehensively considered, subject to thorough environmental impact assessment and public consultation. Mechanisms to minimise climate change impacts such as those associated with sea level rise include a hierarchy of adaptation planning measures:

1. Planned retreat – In view of the likelihood of significant sea level rise over the next century and beyond and the inevitable impacts of sea level rise on shoreline development in some areas, the precautionary principle suggests that planned retreat should be the key long-term adaptation response for human communities and to reduce biodiversity impacts. Planned retreat principles (including set-backs, buffers and development restrictions; as well as clear limits on public liability and rules regarding any relocation assistance) should be

implemented into local planning and development controls now, to avoid impacts being dealt with and disputed on a case by case basis over the coming years as impacts increase.

2. Where planned retreat is not possible, other adaptation options should be considered including:
    a. Development controls and planning measures including set-backs and no-go zones in vulnerable areas; building codes and design requirements (these may include principles of retreat tailored for a local area where a full-scale retreat plan is not implemented);
    b. Resilience building measures - protection measures to build resilience of natural systems (including dune revegetation, wetland buffer zones, and in limited circumstances, beach nourishment where done according to strict environmental conditions).
    c. Early warning systems and emergency response plans
    d. Hard engineering solutions (such as seawalls) are not recommended as they interfere with natural systems.

Many of these mechanisms listed have been or are being implemented to different degrees, in jurisdictions around Australia (as summarised in **Part One**). The crucial challenge is how to **improve coordination and consistency** of implementation of the necessary mechanisms. While each local area will need tailored solution, there is an urgent need for a **federal framework**, under which the implementation of the necessary mechanisms can be provided for and resourced. Enhanced cooperation between all levels of government is essential if integrated natural resource management and adaptation planning is to be realised and comprehensively implemented.

Part Five - Governance and institutional arrangements for the coastal zone.

A study conducted in 2008 concerning the adaptation to sea-level rise along Europe's coasts identified four different ways in which countries were responding, or not, as the case may be, to the issue of climate change, sea-level rise, and increased population densities:

1. "*Those that do not worry about accelerated sea-level rise and should not as their coasts are not susceptible*
2. *Those that do not worry as they have more urgent problems*
3. *Those that do not worry but probably should*
4. *Those that do worry and have started to adapt.*"[115]

[115] Tol, R.S.J., Klein, R.J.T., & Nicholls, R.J., 2008, 'Towards successful adaptation to sea-level rise along Europe's coasts', *Journal of Coastal Research,* vol. 24, no. 2, pp. 432-442.

Australia falls under category four as there have been attempts at responses at a local, state and federal level (as outlined). Unfortunately these responses have been developed in a relatively ad hoc fashion. As a result, the governance arrangements implemented to manage Australia's coast line have traditionally been marred by complexity, confusion and a lack of integration. New South Wales management is an example of a strategy that displays such attributes;

> "*Until recently, any local coastal area in New South Wales might have been subject simultaneously to a coastal management plan, estuary management plan, floodplain management plan, and catchment management plan. In addition, it is possible for a range of statutory and non-statutory instruments relating to landuse and environmental planning to be administered independently by any of the three tiers of government. Adding to this complexity is the nature of many planning instruments that are specific to an issue or sector, thus creating conflicting goals within and between institutions*."[116]

The overview of existing policies in Part One illustrated there are a plethora of plans, policies, legislative instruments, committees and bodies dealing with coastal management across Australia. It was also apparent that there is a lack of consistency and coordination of efforts and a lack of clarity around responsibility and resourcing.

As noted at the start of this submission, the catchment-coast-ocean continuum is not a series of autonomous systems but instead a series of interrelated dynamic systems that fluctuate in response to one another. It is necessary to recognise this interconnectedness when implementing coastal management mechanisms across local and state boundaries. The reality is that coastal management mechanisms implemented by one council, will have environmental consequences on the surrounding area, and as such there is a desperate need for integration and cohesion to be amongst the main priorities when attempting to develop effective coastal management strategies. Steps rapidly need to be taken to remove the ad hoc system by which management of the coastal zone is currently being addressed, and one way of doing so is through the development of an overarching federal coastal management system.

To create a cohesive framework involving all tiers of government, and to ensure that appropriate mechanisms are put in place to address impacts of population growth and climate change, it is necessary to identify key elements that must be addressed when developing the framework. These are discussed below.

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[116] Smith, T. & Doherty, M. 2006, 'The suburbanisation of coastal Australia', paper prepared for the 2006 Australia State of the Environment Committee, Department of Environment and Heritage, Canberra. Available at: http://www.deh.gov.au/soe/2006/integrative/coastal/index.html.

The need for a cohesive federal framework

ANEDO supports development of a more comprehensive federal framework to address the ad hoc fashion in which the impacts of climate change are currently being addressed.

> "*A national cooperative approach will open opportunities to adequately plan for and consider appropriate responses to managing the impacts of climate change. While these changes will not be uniform across the coastal zone, a common understanding of potential impacts can assist in maximising cross-jurisdictional opportunities and minimising adverse environmental, social and economic consequences*."[117]

As the above quotation suggests, the changes experienced by different coastal communities will "not be uniform across the coastal zone", and as such the development of a rigid formula for coastal zone management throughout Australia would undoubtedly prove to be ineffective. However, it is essential that of a number of key federal themes that are likely to impact upon coastal communities as a result of climate change and increased coastal population, are identified. This would assist local governing bodies in recognising where they need to focus resources to develop threat abatement and adaptation planning mechanisms that best manage the vulnerabilities associated with their specific area.

> "*In some cases, authorities should take action to encourage adaptation. In other cases, the authorities themselves should adapt. Coastal zones are frequently managed by a patchwork of regional, national, and international authorities looking after specific aspects (flooding, drinking water, water quality, transport, land use, nature conservation, etc). Each management decision affects other aspects and other authorities' mandates*."[118]

It is therefore important to develop a framework that begins to move away from the traditional structure of "patchwork authorities" operating independently of one another, and towards a structure that encourages integration. Through federal integration, the dysfunction that has often characterised coastal zone management throughout Australia can be replaced by the development of a cohesive framework, which in turn should result in a management strategy that more adequately addresses the issues of increased population and climate change in the coastal zone.

As noted above, the *Framework for a National Cooperative Approach to Integrated Coastal Zone Management* was developed to improve the understanding of climate change on the coastal zone, and to better integrate population trends into coastal planning and management. The on the ground impacts from the implementation of

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[117] Natural Resource Management Ministerial Council, 2006, 'National Cooperative Approach to Integrated Coastal Zone Management. Framework and Implementation Plan'. Available at: www.deh.gov.au/coasts/iczm/index.html.

[118] Tol, R.S.J., Klein, R.J.T., & Nicholls, R.J., 2008, 'Towards successful adaptation to sea-level rise along Europe's coasts', *Journal of Coastal Research,* vol. 24, no. 2, pp. 432-442.

the Framework are yet to be realised, however the methodology intended to achieve these goals provides that the national integration aspect of the Framework was to be achieved through a two level approach:

> "*(1) managing national scale issues by coordination of across-government jurisdictions and (2) managing regional issues by complementing State and Territory initiatives*"[119]

A lack of consistency arise between state and federal initiatives would greatly diminish Australia's ability to effectively address the impacts of climate change and increased coastal population.

ANEDO recommends that the framework be reviewed and expanded with key elements of the framework established in a COAG agreement on coastal protection and legislation, such as a National Coastal Protection Act.[120]

The need for an integrated management approach and clearly defined roles and responsibilities

It is important to ensure that a new federal framework, does not simply create a new layer of coastal policy confusion. A thorough analysis needs to be conducted to ascertain why previous cross jurisdictional, or cross sector mechanisms have traditionally not achieved integrated coastal management. There is little use in putting in place systems analogous to those that have failed in the past.

The new framework must clearly define roles:

1) The key **Commonwealth** role should be one of coordination, funding and review where appropriate. For example, the key functions of the Commonwealth could include: co-funding essential programs, such as obtaining the necessary baseline data (such as risk and vulnerability mapping) needed to underpin adaptation planning; developing nationally consistent guidelines for integrated coastal management; accrediting various mechanisms (according to sustainability criteria) that could be implemented where appropriate around Australia; and coordinating and resourcing a national coastal advisory body made up of representatives from all levels of government. These functions could be outlined ina Federal Coastal Protection Act. While coastal development is traditionally dealt with at a state and local government level and the Commonwealth has not tended to

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[119] Gourley, M.R., Harper, B.A., Cox, R.J., Stone P.B. & Webb T. 2004, *Coastal Engineering Guidelines for working with the Australian coast in an ecologically sustainable way*, Engineers Australia, National Committee on Coastal and Ocean Engineering, EA Books, Barton ACT, Australia, p. 101.

[120] There are a number of international conventions that give the Commonwealth authority to legislate regarding impacts of climate change on coastal communities and for example, impacts of coastal population increases on biodiversity, for example: the United Nations Framework Convention on Climate Change 1992 (UNFCCC) and the Convention on Biological Diversity 1992.

intervene, it is clear that a strong Commonwealth role would benefit consistent policy development. In terms of Commonwealth involvement in individual projects, the new framework could be complemented by amendments to existing legislation to allow the Commonwealth to intervene where coastal development is inconsistent with national protection standards or guidelines (for example, by including significant coastal developments as a matter of national environmental significance under the *Environment Protection and Biodiversity Conservation act 1999*).

2) In terms of establishing **state level** integrated coastal management, there have been attempts at inter-departmental integrated management bodies in the past, such as the NSW Department of Infrastructure, Planning and Natural Resources (DIPNR) and the NSW Coastal Advisory Committee. Both have subsequently been dissolved, accompanied by a disintegration of cohesiveness in management strategies. There have been suggestions that the responsibilities of bodies such as these have been too broad to effectively monitor the areas they have been assigned to supervise. To achieve a more integrated approach at a state level (under the new federal framework), what may prove useful in increasing communication between the various departments is the appointment of a sustainability commissioner or sustainability office which is specifically assigned to manage key aspects of the coastal zone. The sustainability office with a more focussed mandate could not only ensure a state-wide whole-of-government approach to coastal management by facilitating communication between the various departments with responsibilities in the coastal zone, but could also report to the federal advisory body to ensure national consistency.
3) As noted throughout this submission, it is often **local government** that is at the coal face dealing with population increases and environmental impacts. The need to provide support to enhance this role is discussed below.

Research should be conducted into utilising the intergovernmental forums that currently exist such as the Council of Australian Governments (COAG) and the Intergovernmental Coastal Advisory Group (ICAG). As stated earlier, a great deal of confusion already exists around the subject of appropriate coastal zone management, and simply developing more legislation and management authorities without a strategic federal framework in place has the potential to further complicate the already complex situation.

The need for guidelines and resources for local government

A great deal of disparity exists in coastal councils when it comes to adapting to the effects of climate change and increased coastal population. Factors hindering action include: lack of baseline data, lack of guidance from state and federal government, lack of resources to implement initiatives, and a high level of uncertainty concerning the extent to which councils are liable for their activity/inactivity. The current situation, especially in NSW, is that councils are responding to the threat of sea level rise on a voluntary, not mandatory basis.

The NSW EDO recently prepared a report identifying the current legal liability of some NSW metropolitan councils in relation to implementing strategies to address climate change and the associated potential hazards. This report identified a clear need for state or federal government guidelines to assist councils in setting benchmarks for strategic planning in relation to coastal hazards, and in providing guidance on when and how to conduct adaptive activities that address climate change risks in the coastal zone. In addition to removing much of the uncertainty for councils, such guidelines would ensure that a consistent approach to sea level rise is taken throughout NSW[121].

Councils are at the front line when attempting to address the concerns of their immediate communities. A clear demarcation of the considerations that do and don't fall within the responsibility of local government bodies would greatly assist coastal councils when developing effective coastal management systems. The development of such guidelines, whether it be on a state or federal level, are fundamental to give local bodies the confidence to use the best available scientific data, without fear of prosecution in the future.

Application of environmental impact assessment (EIA) and the principles of ecologically sustainable development (ESD)

As noted throughout this submission, comprehensive environmental impact assessment is of fundamental importance for strategic planning and development assessment on the coast. Many jurisdictions currently have conflicting state and local planning controls, and a lack of baseline data on environmental assets in the coastal zone. A significant problem is the lack of assessment of cumulative impacts, and this will become increasingly important with rapid population increases and more intense pressures on the coastal zone.

Key components of ESD include: the precautionary principle (as relevant to implementing mechanisms to address impacts associated with sea level rise), intergenerational equity (relevant to the duty to preserve and not damage the coast and coastal resources for future generations), and conservation of biodiversity (which is under increasing pressure in areas of high development). The following case study, *Walker v Minister for Planning (2007)*, highlights that to some extent, there a need for consent authorities to begin to consider the impacts of climate change on coastal developments through their consideration of the principles of ESD, however clear benchmarks would provide much more guidance.

Case study: ***Walker v Minister for Planning (2007)*** **NSWLEC 741.**

This case involved a successful appeal against a decision by the Minister for Planning to approve a concept plan for a project to subdivide land at Sandon Point in order to construct a retirement development. The ruling is likely to have significant implications for future development in coastal areas that are potentially subject to increased flooding and sea-level rise as a consequence of climate

[121] New South Wales Environmental Defenders Office, 2008, 'Coastal Councils and Planning for Climate Change: An assessment of Australian and NSW legislation and government policy provisions relating to climate change relevant to regional and metropolitan coastal councils'. Email info@sydneycoastalcouncils.com.au to obtain a full copy.

change.

Justice Biscoe found that the Minister for Planning had failed to consider ESD by failing to consider whether the impacts of the proposed development would be compounded by climate change. In particular, the Minister failed to consider whether potential flooding associated with climate change may impact the land at Sandon Point, which is located on flood prone land.

After finding that climate change was a deadly serious issue involving risk to the survival of the human race and other species, he concluded:

"*In my opinion, having regard to the subject matter, scope and purpose of the EPA Act and the gravity of the well-known potential consequences of climate change, in circumstances where the Director-General's report (nor any other document before the Minister) appeared to have considered whether climate change flood risk was relevant to this flood constrained coastal plain project, the Minister was under an implied obligation to consider whether it was relevant and, if so, to take it into consideration when deciding whether to approve the concept plan. The Minister did not discharge that function.*"

Although this case was considered under Part 3A and not under Part 4, it is nonetheless indicative of a recent trend in the Land and Environment Court towards climate change and coastal hazards. The Court has made it clear that consent authorities will be required to demonstrate that real regard was had to principles of ESD and to climate change impacts. As a result of this decision, councils should assume that there is the potential for greater flooding and inundation as a result of climate change in the coastal zone when considering coastal developments and take this into consideration. Councils must be able to demonstrate that they have taken into account the potential impacts that sea-level rise and climate change on the proposed development and whether any mitigation measures could be put in place to lessen any future flooding impacts."[122]

While such judgements are useful, they are made on a case by case basis, and clear consistent legislative mandatory requirements for improved application of ESD and EIA are needed across Australia.

The need for vulnerability and risk assessment surveys

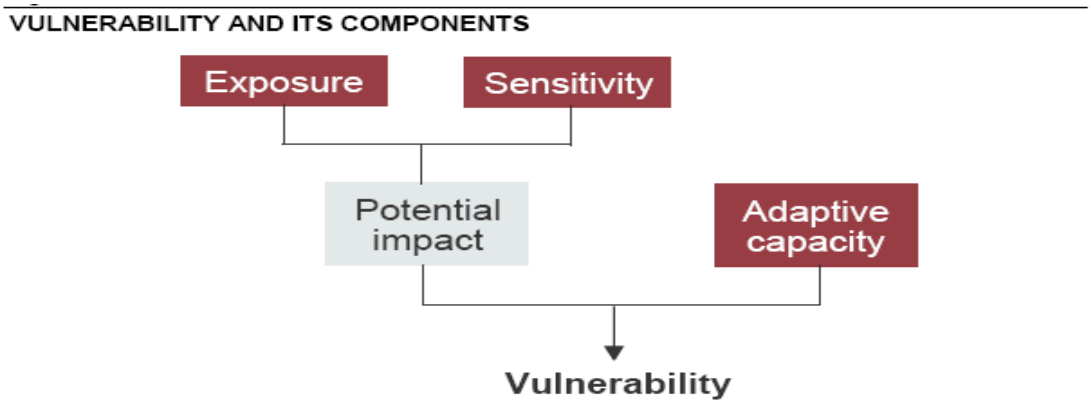
Local bodies often lack the expertise or resources to accurately assess the extent to which their area is likely to be affected by increased population and the impacts of climate change. As such, the development of a robust federal framework should include establishing processes that accurately assesses the vulnerability of an area and provide local bodies the information necessary to employ effective governance strategies (as recommended in Part 3).

The diagram below suggests that the vulnerability of a system can be determined as a function of three elements:

1. Exposure (the influences or stimuli that impact on a system)
2. Sensitivity (the responsiveness of a system to climatic/anthropogenic influences)

[122] New South Wales Environmental Defenders Office, 2008, 'Coastal Councils and Planning for Climate Change: An assessment of Australian and NSW legislation and government policy provisions relating to climate change relevant to regional and metropolitan coastal councils'. Email info@sydneycoastalcouncils.com.au to obtain a full copy.

3. Adaptive Capacity (the ability of a system to change to deal with external influences)[123]



Source: Adapted from D. Schroter and the ATEAM consortium 2004, *Global change vulnerability — assessing the European human–environment system*, Potsdam Institute for Climate Impact Research.

The development of reports that address exposure, sensitivity and adaptive capacity may assist local bodies in identifying where, and how, to allocate coastal management resources to most effectively address the concerns associated with climate change and increased population densities.

Audit of community and environmental assets

It is important to comprehensively gather and analyse information that highlights the significant economic and social benefits that arise from implementing governance strategies that preserve the natural environment of the coastal zone. With the current social and economic trends driving increased population densities to Australia's coasts, it is easy for councils to assess land value from a perspective that focuses on the development potential of an area.

Studies such as the one currently being carried out in NSW ("*Quantifying the Value of Sydney (NSW) Beaches in order to assess cost/benefit of necessary coastal protection/abatement measures as a result of enhanced climate change impact*"[124]) will assist in assessing the influence that arises from correctly/incorrectly managing the coastal zone upon sectors such as tourism.

The coastal zone includes "large areas of public land under a variety of tenures, including Crown land, community land, national parks, marine parks and aquatic reserves"[125]. Increased population migration to coastal zones is accompanied by increased pressure on local councils to open up these massive public reserves to

[123] Allen Consulting Group, March 2005, *Climate Change risk and Vulnerability, Promoting and efficient adaptation response in Australia*, Report to the Australian Greenhouse Office, Department of the Environment and Heritage. Available at: http://www.greenhouse.gov.au/impacts/publications/pubs/risk-vulnerability.pdf.

[124] Prepared for the Sydney Coastal Councils Group, 2008.

[125] Coates B., Hanslow D., & Lord D. 2007, 'NSW Coastal Zone Management Manual', Department of Climate Change, Newcastle, NSW. Available at: www.**coastal**conference.com/2007/papers2007/Bruce%20Coates.doc.

developers to accommodate this rapid influx. The widely publicised "New South Wales Open for Business" campaign is an example of how an emphasis on coastal economic growth has the potential to encroach on environmental conservation. There have been suggestions that due to the focus on economic growth in large areas of the coastal zone, there may be a need for "voluntary acquisition of areas of land to ensure public access to waterfront land is ensured."[126]

The undertaking of cost/benefit analysis's of implementing effective environmental management mechanisms to the coastal zone, will equip councils with the economic rationale to include a strong emphasis on ensuring environmental values are maintained. Additionally, realising the economic, social and environmental value of private and publicly owned sites that are vulnerable to the impacts of climate change, may give councils the incentive needed to begin implementing the necessary threat abatement mechanisms. A federal framework needs to establish better ways of more accurately and comprehensively valuing and assessing coastal amenity and public open space.

Collation and sharing of updated baseline data

As highlighted throughout this submission, the development of instruments to address the issues associated with climate change and population growth, have historically been impeded by the absence of accurate projections, particularly in regard to sea-level rise. It is therefore important to recognise the benefits that can be obtained from monitoring, evaluating and exchanging information regarding those mechanisms that have been implemented to address these issues. The exchange of such information allows the science behind the concepts to be evaluated and also assists in developing the scale of alterations that need to be implemented into the coastal zone to cope with both anthropogenic and climatic influences. ANEDO strongly believes most effective management strategies will employ the best available scientific information, and establishment of a federal framework will improve this.

Summary and recommendations for Part Five

- **Current governance and institutional arrangements differ in each state and territory causing a 'patchwork' management effect and a lack of integrated coastal management taking into account the catchment-coast-ocean continuum.**
- **ANEDO recommends the development of a federal coastal framework, established by a COAG agreement and legislation.**
- **Elements to be addressed in the framework include:**

[126] Lipman Z., & Stokes R. 2003, 'Shifting sands, The implications of climate change and a changing coastline for private interests and public authorities in relation to waterfront land' *Environmental and Planning Law Journal*, Vol 20, pp.206.

- **improved cohesion and consistency of approach across jurisdictions, driven by an enhanced federal role;**
- **an integrated management approach taking into account all activities and impacts (and management) within the coastal zone;**
- **clarification of roles, responsibilities and resourcing of different agencies involved at different levels in coastal management;**
- **additional guidance and resources for local councils at the front line of implementing measures to address population increase and climate change;**
- **application of EIA and the principles of ESD;**
- **comprehensive vulnerability and risk assessment;**
- **Audit and proper valuation of environment and community assets in the coastal zone; and**
- **Collation of baseline data and modelling.**

APPENDIX

PLANNED RETREAT

1. **Background**

The following principles and recommendations are submitted in response to the Inquiry's 3rd term of reference: ***"the impact of climate change on coastal areas and strategies to deal with climate change adaptation, particularly in response to projected sea level rise."***

These principles and recommendations were discussed at an expert seminar held on 31 May 2008. The subject of this seminar was Byron Shire Council's policy of planned retreat, which has been in place since 1988 and has withstood several legal challenges. The seminar was attended by twelve lawyers, planners, ecologists and community campaigners with a range of experience of planned retreat in Byron Shire and Queensland.

The seminar was held specifically to inform the Inquiry about the possible implications for other coastal communities around Australia of implementing a policy of planned retreat in response to sea level rise as well as natural coastal erosion processes.

2. **Challenges**

Arriving at a definitive policy and regulatory response to the impact of sea level rise on coastal communities is complicated by a number of factors, including:

- The wide range and ephemerality of IPCC and CSIRO projections for sea level rise, and the likelihood that it will continue for a millennium rather than a century, making the adoption of planning lines based on a single scenario a short-term solution.
- The interaction of natural coastal erosion processes and climate change-related sea level rise.
- The interaction of sea level rise with other impacts of climate change, including more intense severe weather events and climatic unpredictability, rising sea as well as atmospheric temperatures, greater bushfire risk and reduced biodiversity, with the result that planning must take account of cumulative rather than discrete impacts.
- The range of alternative responses available, including sand nourishment, hard structure (seawall and groyne) construction, and the adoption of locally appropriate building standards, as well as planned retreat.
- The need to develop different adaptation responses for public infrastructure and private development, and existing and new development.
- Wide variations in the vulnerability and resilience of different Australian communities and ecosystems.
- The social as well as economic capital in existing communities and the impacts of relocation on different socio-economic groups.
- The likelihood of largely severe and irreversible impacts on coastal biodiversity, largely independent of adaptation measures.
- The different impacts on beaches, which are likely to suffer episodic and irreversible impacts, and estuaries, which will suffer mostly incremental impacts.
- The apprehension of local and state governments regarding the legal implications of not protecting foreshore properties on the one hand, and appearing to restrict development on the other.
- The constitutional problems associated with Federal Government leadership on issues relating to land use management.
- The challenging implications of a policy of planned retreat for public perceptions of the inviolability of private property.
- The need to consider emergency as well as longer term planning responses to the catastrophic impacts of severe storms.

3. **Policy responses**

In spite of these challenges, the precautionary principle and other principles of ecologically

sustainable development require that Australian governments respond quickly and vigorously to the likely impacts on coastal communities of substantial sea level rises over the coming century.

Of the possible responses to sea level rise, planned retreat (as defined below) was considered by the experts at the seminar to be the only viable long term and widespread option to adapt to substantial sea level rises, from the planning, legal, economic and biodiversity perspectives.

This does not preclude the appropriateness of other solutions in localised settings or as short term solutions. However, other solutions are unsustainable for the Australian economy and environment, over the coming century and beyond. Failure to provide leadership on this critical issue is likely to lead to greater uncertainty, litigation and biodiversity loss.

4. **Definition**

For the purposes of the seminar, planned retreat was taken to be the policy of managing coastal development and biodiversity close to shorelines (beaches and estuaries) likely to be inundated by storm surges and wave action exacerbated by sea level rise. The following elements of planned retreat were discussed:

Planning

While it is explained in more detail below, planned retreat essentially involves not allowing new permanent structures, and planning for the staged removal of existing buildings and other structures, in areas likely to be inundated during peak events, with stricter controls the closer land is to the existing erosion impact line; and anticipating the need for relocation of properties and whole communities in strategic planning.

Legal

Clarifying the existing common law risk carried by oceanfront landowners, and instituting a mechanism such as rolling easements to ensure that property boundaries reflect or anticipate shifting shorelines.

Biodiversity

Creating buffer zones and corridors to increase the chances of intertidal, wetland and floodplain communities and their constituent species to adapt to the impacts of rising sea levels.

Social and economic

Ensuring that the costs of relocating homes (other than holiday houses) are borne by those most able to afford them, while supporting those requiring assistance; but not allowing these costs to prevent the implementation of the policy, in view of the greater costs of alternative responses.

Sea level rise scenario

The most appropriate standard, having regard to the present state of knowledge, for the implementation of planning lines would appear to be 90-100 cms (the IPCC's Scenario 4 being for a 91 cm rise by 2100) in addition to current planning lines for 1 in 100 year coastal erosion events. However, it should be explicitly acknowledged that this line may change depending on the scientific data and projections available.

5. **Implementation options**

Implementation was discussed in terms of the following measures:

Federal role

The Federal Government could use COAG to formulate and implement a national policy of planned retreat. The Federal Department of Environment, Heritage and the Arts could prepare a Green Paper on planned retreat as a prelude to introducing the appropriate legislation. The Green Paper could consider the use of the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) ('EPBC Act') to implement this policy – for instance, by introducing a "sea level rise" trigger for referring major coastal developments to the Minister for determination. The Commonwealth could also initiate a policy of planned retreat for its own (Defence and other) properties.

State and local governments
State governments could introduce a new planning instrument requiring councils to reject subdivision, rezoning and development applications for land within the Planned Retreat Precinct - perhaps along the lines of Queensland's Shoreline Erosion Management Plans or NSW State Environmental Planning Policy 14, Coastal Wetlands) - or requiring such controls to be introduced into local planning instruments.

Within a *Planned Retreat Precinct* restrictions could include that:

- Only temporary or relocatable structures and developments (eg, playgrounds and caravan parks) should be approved for construction in the precinct between the impact zone and the 1 in 100 year plus 90-100 cms line (the Planned Retreat Precinct),
- New and existing development should be subject to time or physical triggers for removal or abandonment,
- No new "hard" defensive coastal protection structures should be permitted, except as short-term investments pending the relocation of critical public infrastructure, and
- Investments in new public infrastructure should be made on a risk-averse basis.

Strategic planning
Strategic planning should allow for the need to rehouse people and settlements well away from the Planned Retreat Precinct, as long as this does not negatively impact on biodiversity values and adaptation.

6. **Other issues**
The experts at the seminar also discussed liability and for example, the need for a public education campaign to reiterate fundamental principles of the common law relevant to sea level rise, especially:

- "where the profit falls, so shall the risk" (so oceanfront landowners have no right to force councils to protect their homes or properties);
- *caveat emptor* - that is, buyers should make themselves aware of the risks of erosion and inundation before purchase; and
- that governments have the right to resume land for public purposes including public safety (noting the right to compensation on just terms that accompanies forced resumption).

It was also concluded that issues of liability and any compensation measures (for example, for longtime coastal zone landowners on low incomes forced to move by the impacts of climate change) be clarified in a nationally consistent manner.

Ideas such as rolling easements and planned retreat precinct boundaries were also discussed.

In relation to biodiversity, it was suggested that as an integral component of a policy of planned retreat, intertidal zones, saline and freshwater wetlands and all plant communities on the coastal floodplain (particularly listed Endangered and Vulnerable Ecological Communities, eg under the *Threatened Species Conservation Act 1995* (NSW) or the EPBC Act 1999 (Cth)) should be provided with the maximum capacity to move through the landscape by the creation of buffer zones and corridors. This is likely to require the active restoration of some land currently occupied by development and infrastructure. Furthermore it was suggested that there should be a prohibition on all new ribbon development in coastal areas which may reduce the amount of buffer zone or corridor land potentially available for biodiversity adaptation.

It was also noted that in view of the episodic and potentially dangerous nature of likely climate change impacts, the implementation of a policy of planned retreat should not preclude the formulation of complementary plans for emergency evacuation. This should be done on the basis of the likelihood of peak events (eg, cyclones plus high tides) rather than statistical averages. It should also proceed on the proviso that the priority must be the protection of human and other lives, rather than property.