Ocean & Coastal Management xxx (2012) 1–10

Contents lists available at SciVerse ScienceDirect

Ocean & Coastal Management

journal homepage: www.elsevier.com/locate/ocecoaman

Climate change adaptation in coastal Australia: An audit of planning practice

Nicole Gurran [a,*], Barbara Norman [b], Elisabeth Hamin [c]

[a] Faculty of Architecture, Design and Planning, University of Sydney, Darlington, NSW 2006 Australia
[b] University of Canberra, Australia
[c] University of Massachusetts, Amherst, USA

ARTICLE INFO

Article history:
Available online xxx

ABSTRACT

This study examines the state of local practice in planning for climate change adaptation in coastal Australia, in the context of rapidly evolving policy frameworks, using grounded theory to examine the process communities follow as they undertake adaptation planning. Australia's coastal cities and towns, with over 85 per cent of the nation's population, are at the frontline of physical risks associated with sea level rise and changed weather patterns; exacerbated by ongoing concentration of public and private assets in potentially vulnerable locations. This is particularly so for coastal councils beyond the major capital cities, where settlement patterns and lifestyle oriented economies based on tourism and leisure focus on the coastal strip, and local government resources are highly constrained. To assess progress in climate change adaptation planning, this study involved local government professionals, experts and elected officials through a survey and focus groups ($n = 49$) held between February and July 2011. The audit indicates some areas are well underway towards holistic adaptation strategies but, others have neither engaged, nor anticipate, adaptation planning activities; of the strategies that have commenced, few are yet completed; and, despite ongoing development pressure, few councils have yet changed their planning controls for climate risk. Of those areas that have commenced adaptation planning, most strategies and commitments will require additional resourcing and external expertise to implement; while others face community skepticism and "pushback" which may undermine future progress. The results reveal a ladder of adaptation action, whereby communities tend to have to accomplish early steps before they move on to more complex, expensive, or political policies. We connect this ladder to community perceptions of what is supported in state and national frameworks and legislation. Communities in the future may be able to use this ladder to suggest where to start their processes, and directions to undertake as they accomplish their first tasks.

1. Introduction

There is widespread awareness and policy concern regarding the impacts of climate change in coastal Australia (Coasts and Climate Change Council, 2010; House of Representatives, 2009; Department of Climate Change, 2009). As well as the impacts of changed weather patterns, Australia's coastal areas face increased risks from physical exposure to sea level rise, erosion, and storm surge, with implications for coastal infrastructure, homes and biodiversity (Steffen et al., 2009; Department of Climate Change, 2009). Significant assets are already exposed: of the estimated 711,000 existing homes in coastal zones, up to 35 per cent are at risk of inundation within ninety years under a plausible sea level rise scenario of 1.1 m (Department of Climate Change, 2009). Despite these risks, urban development pressures continue to focus on coastal areas surrounding the capital cities and in Australia's key lifestyle regions, in Victoria's South and Bass Coasts, South East and Far North Queensland, and South Western Australia, which experience some of the nation's fastest rates of growth. Driven by "amenity migration", whereby migration to regions rich in natural amenity is underpinned by lifestyle rather than employment factors (McIntyre, 2009), pressures in Australia's non metropolitan coastal areas are exacerbated by ongoing demand for second homes and tourism development to accommodate seasonal populations (Kelly and Hosking, 2008).

This article explores local responses to potential climate risks in the context of such demands. We identify the current state of local climate adaptation in these coastal areas, via an internet survey and focus groups with coastal policy makers, scientists, lawyers, local councilors, and planners. We use these results to develop theory

* Corresponding author. Tel.: +61 2 9351 7729.
E-mail address: nicole.gurran@sydney.edu.au (N. Gurran).

0964-5691/$ – see front matter © 2012 Elsevier Ltd. All rights reserved.
http://dx.doi.org/10.1016/j.ocecoaman.2012.10.014

regarding the paths that adaptation follows in peri- and non-metropolitan areas. The study was funded by the National Sea Change Taskforce (NSCT), a coalition of coastal councils in peri- and non metropolitan regions of Australia.

There is a growing body of international literature on climate change adaptation. Much of this work emphasises that adaptation considerations should be situated within an overarching sustainability paradigm (Swart and Raes, 2007; Davoudi et al., 2009), and addressed across the different sectors of government responsibility (from strategic spatial planning and development assessment, to emergency services, community health, coastal management and economic development) (Department of Climate Change and Energy Efficiency, 2010). Local government engagement is crucial. While national frameworks establish important mandates for action on climate change, the heterogeneous nature of climate risk means that national policy cannot simply be generalised for local implementation (Yoo et al., 2011). Adaptation needs to occur along a variety of scales (Adger et al., 2005). At the same time, the need for scientific information and funding means that national governments cannot devolve all responsibilities to the local level (Government Accountability Office (GAO) 2009; Measham et al., 2011; Juhola et al., 2012).

While locally devised adaptation responses are needed, to date local authorities have been more engaged in work to reduce greenhouse gas emissions than prepare for climate change impacts already underway (Wheeler, 2008), although this is beginning to shift (Tang et al., 2010). Reviews suggests that local authorities who have begun preparatory work are generally at the stage of assessing overall vulnerability to climate change, and developing strategies intended to build resilience, but that fully implemented strategies are rare (Berrang-Ford et al., 2011).

Of the cluster of studies examining local climate change adaptation in the United Kingdom (Few et al., 2007) and the United States (Preston et al., 2011; Mozumder et al., 2011), information, resource constraints, and political will have been the main impediments to local action. In Australia, a benchmark study found varying levels of adaptation planning activity across government and the private sector, with differences linked to levels of climate change awareness and understanding; access to external advice or funding support; and the extent to which the organisation undertakes long term strategic planning (Gardner et al., 2010). However, Measham et al. (2011) caution against over-simplicity in understanding municipal action – or inaction – in relation to climate change adaptation. They point to the range of complex, competing responsibilities facing local government – from facilitating development opportunities through to the provision of infrastructure and services, alongside political pressures, which might interrupt the transmission of climate change concern to local action through planning and risk management frameworks (Measham et al., 2011).

As the literature has progressed, a general perspective on the process of adaptation has emerged. Moser and Ekstrom (2010) suggest that adaptation occurs in these phases: Understanding the problem (detect the problem, gather and use information, re/define problem); planning phase (develop options, assess options); managing stage (implement options, monitor outcomes and environment, evaluate effectiveness of option). See also (Arnell and Delaney, 2006; Moser and Ekstrom, 2010; National Research Council, 2010). The literature to understand barriers at each of these stages has been developing (see. e.g. Moser and Ekstrom, 2010), but, as reported by (Eisenack and Stecker, 2012), there are very few papers that explicitly deal with adaptation actions and assessments of actual actions undertaken. As a national inventory of actual actions, this paper makes a substantial contribution towards understanding what communities are actually doing, rather than just their planning processes.

This article is structured in four sections. Firstly, we outline the study context, design and methods. We then discuss key results for individual questions, focussing particularly on recognition of key climate change adaptation issues affecting local government areas in non metropolitan coastal Australia; adaptation planning initiatives already underway; estimated costs associated with climate change; and views regarding state and local planning frameworks. In section three we compare results across the individual questions, using pattern-matching and grounded theory to explore the reasons connecting the findings (Yin, 2009), and develop our theory of an adaptation ladder. Finally, we analyse the implications of these findings as a basis for establishing the state of practice in planning for climate change in coastal Australia, the factors influencing this practice, needs for future research, and the potential reasons explaining differential engagement at the local level.

2. Climate change adaptation in non metropolitan coastal Australia: study context and methodological approach

Australia has a three tiered Federal system of governance. At the national level, the Commonwealth government has limited environmental responsibilities, although it has played a policy development role and yields influence through its numerous funding programs, available to State and local governments, as well as for community groups. Increasingly, the Commonwealth is adopting a strategic role in planning and development matters regarded to be of 'national environmental significance', meaning that major developments in coastal areas often require Commonwealth as well as state and local assessment and approval (Gurran, 2011). As defined under legislation, matters of national environmental significance include Commonwealth listed threatened species and communities, migratory species, Ramsar wetlands, world and national heritage, the Great Barrier Reef Marine Park, and nuclear actions. However, most responsibility, including responsibility for the land–sea interface of the coastal zone, is devolved to the six states and two territories. Local governments, comprised of elected representative 'councilors' and an 'arm's length' professional bureaucracy, have day to day responsibility for the provision of utilities, basic services, as well as local land use planning and development assessment (within a legislative and policy framework dictated by the states and territories). Local government roles include responsibility for managing the beach foreshores and tidal lands along with their other planning and development roles (Norman, 2009). Responsibility for coastal planning and management is a significant undertaking in Australia, where coastal areas absorb 85 per cent of the nation's population, which is mostly concentrated in and around six primate State capitals (Gurran et al., 2006). About twenty per cent of Australians live in coastal areas surrounding and beyond these centres, and this population has been growing since the 1980s (Gurran et al., 2006, 2011).

2.1. Growing national policy concern

Concern for the impacts of coastal urbanisation has been a recurrent theme in Australian environmental policy since the early 1980s (House of Representatives, 2009), but has assumed new resonance as awareness of potential climate change impacts grows (Norman, 2010). In 2008, a Commonwealth parliamentary inquiry into climate change impacts in coastal Australia catalysed policy action (House of Representatives, 2009). Subsequently, a significant research effort to assess potential climate change impacts to coastal environments, settlements and infrastructure, known as the *First Pass National Assessment on Climate Change and Coasts* (Department of Climate Change, 2009) and following series of more detailed thematic assessments has provided a deep evidentiary basis for

Please cite this article in press as: Gurran, N., et al., Climate change adaptation in coastal Australia: An audit of planning practice, Ocean & Coastal Management (2012), http://dx.doi.org/10.1016/j.ocecoaman.2012.10.014

intervention across all levels of government. A Coasts and Climate Change Council was established in late 2009 to assist with stakeholder community engagement and advised the Commonwealth government on national regulatory reform (Coasts and Climate Change Council, 2010), although its limited term was concluded in December 2011. Parallel to these developments, the Commonwealth's Local Adaptation Pathways Program funded 16 local government areas in non metropolitan coastal Australia in 2009, and regional groupings of coastal councils in 2010 to undertake risk assessment or adaptation planning initiatives. More broadly, in 2011, the Australian Productivity Commission conducted an investigation into 'adaptation'. In its draft report to the Australian Government, the Productivity Commission has concluded that the national government should have a limited role in adaptation confined to supporting efforts by sub national and local governments (Productivity Commission, 2012).

2.2. State government responses to climate risk in coastal areas

Across the states and territories, sea level rise has been a key focus, addressed through development control within the South Australian planning system since 1992 (Walsh et al., 2004), and incorporated in other jurisdictions through indicative or mandated thresholds to be considered during plan making or when assessing development proposals. The South Australian Planning Strategy (which sets a statewide policy framework for plan making and development assessment), refers more widely to climate change adaptation.

The *Victorian Coastal Strategy* 2008 established a sea level rise planning benchmark of 0.8 by 2100, reinforced through State Planning Policy which requires new developments to address potential climate change impacts including coastal erosion, storm tides, and inundation (Vasey-Ellis, 2009). In practice this is often achieved via site based vulnerability assessments prepared to support proposed developments. While the framework policy remains in place, a change of government in 2012 has seen the sea level rise planning thresholds revised downwards to 0.4 by 2100.

In the state of New South Wales (NSW), planning policy and coastal management law has evolved to explicitly recognise climate risk, through a coastal planning policy statement (Department of Environment, Climate Change and Water, 2009), and guideline (Department of Planning, 2010). Sea level rise benchmarks of 40 cm above 1990 levels by 2050, rising to 90 cm in 2100 are specified, subject to periodic review. Eight criteria for reviewing coastal development sites are articulated, including potential exposure to immediate coastal risks; public safety; infrastructure capacity; maintaining coastal processes, and public beach, foreshore and waterfront access and amenity; although the policy and guideline are advisory rather than legally binding (Environmental Defender's Office NSW, 2010).

A novel direction in NSW local government law has been to limit liability for local council advice or actions undertaken in good faith, providing some protection against future litigation relating to climate change (Baker and McKenzie, 2011). Similarly, although information about potential climate risk on private property was once regarded highly confidential, local councils in NSW are now encouraged to indicate exposure to projected sea level rise on planning certificates for individual sites.

The state of Queensland has mandated climate change considerations during plan making and development assessment under its primary planning legislation (*Sustainable Planning Act* 2009 (s5(1)(c))). The *Queensland Coastal Plan* which commenced in February 2012 includes a coastal management and state planning policy framework, supported by a detailed development assessment code, with differential sea level rise thresholds and planning time horizons for different types of development, adjusted to reflect expected asset life span.

Policy development on climate change adaptation for coastal areas has been more sporadic in the other Australian jurisdictions. Western Australia has a State Coastal Planning Policy, which specifies sea level rise thresholds as a basis for determining setback and elevation requirements, although is silent on the wider risks associated with climate change. Tasmania's coastal policy has been under review since 2006, with a draft policy exhibited then rejected as inadequate in late 2011 by the independent Tasmanian Planning Commission, in part because it failed to address climate risks. There is no specific coastal policy in the Northern Territory, and policy on climate change mitigation and adaptation is still emerging. In 2009 the Territorial government announced a commitment to developing a series of climate change adaptation strategies, including the articulation of sea level rise thresholds, but to date action has been limited to specific locations.

Despite this variability in policy and planning approaches across the states and territories, taken together, this regulatory and policy framework suggests that municipalities do have the ability to move forward on adaptation plans and policies, particularly in the states of South Australia, NSW, Queensland and Victoria, but whether they have or not remains an open question.

2.3. Methodological approach

Using the anatomy of adaptation developed by Smith et al. (2000) to organise research on the topic, our work is designed to address adaptation to climate change (asking what risks communities are preparing to adapt to); at the municipal level for non metropolitan coastal Australia (focussing on local municipalities as key actors); and, through purposeful processes (asking how does adaptation occur?). Specifically, we examine 55 local government areas involved in the National Sea Change Taskforce membership (just under 10 per cent of Australia's total local municipalities). While this targeted approach limited the sample size, it allowed focus on coastal areas with identified common issues arising from population growth and change, inadequate or declining infrastructure, and economic instability (Gurran et al., 2006). To increase validity we utilised triangulation of data sources: an internet survey of local councils, round table meetings with local representatives and coastal experts, and documentary analyses. Results across these were compared to enable a rich and grounded analysis (Yin, 2010).

The internet survey was designed to obtain information on emerging local council responses to climate change and to explore some of the factors explaining action or inaction. The survey was administered between February and July 2011 (a period of 152 days). Twenty nine responses were received via this approach from representatives of 27 local government areas across NSW, Queensland, Western Australia, South Australia, and Victoria (a response rate of 49%). The majority of respondents to the survey were professional staff, including directors of planning, natural resource management or environmental services. Two respondents held designated climate change positions within their local government areas. Although a relatively small overall sample, it is likely that the self-selecting respondents were particularly aware of climate change matters, and overall, more likely to represent local government areas which have commenced some adaptation planning initiative than other local governments who did not respond to the survey invitation at all. Two local government authorities generated dual respondents to the survey, in both cases from local councilors and professional staff.

To expand the range of views represented, the survey was also administered to selected participants at a national coastal council

Please cite this article in press as: Gurran, N., et al., Climate change adaptation in coastal Australia: An audit of planning practice, Ocean & Coastal Management (2012), http://dx.doi.org/10.1016/j.ocecoaman.2012.10.014

conference held in Torquay between 28 and 30 March 2011. This resulted in a total of 49 responses to key survey questions (although many conference participants focused on the key issues and initiatives, rather than completing the whole questionnaire). The survey was developed with reference to previous studies and consultation processes relevant to climate change adaptation in Australian local government (Pillora, 2010; Department of Climate Change, 2009; Department of Climate Change and Energy Efficiency, 2010; Coasts and Climate Change Council, 2010; Gardner et al., 2010) and the wider international literature on local government issues and responses to climate change (Tang et al., 2010; Howard, 2009). The questionnaire canvassed key issues associated with climate change risks; current adaption efforts and perspectives on the legal, policy, and land use planning framework, and used a combination of closed questions as well as opportunities for additional comment and explanation.

To explore the survey themes in greater detail, two expert focus groups were held during the coastal conference in Torquay. These followed a semi-structured format focussing on four key questions: the legislative and policy framework for climate change, emerging adaptation practice in coastal areas; approaches to climate vulnerability assessment, and priorities for government intervention and support. The 22 participants included local government councilors; planners, and environmental officers; state policy makers; and consultants working on climate risk analyses in coastal areas. Discussions took 1½ hours and were tape recorded and transcribed. Like the survey, participation in the round tables was anonymous and care was taken to remove identifying information in the presentation of results.

To evaluate the implementation of policies mentioned in the roundtables and survey, we undertook a practice audit, reviewing documentary outputs (plans, policies) of non metropolitan coastal projects funded under the Commonwealth's Local Adaptation Pathways Program between 2009 and 2010, as described above. In the analysis that follows, data from the survey is presented first with supplementary information from the roundtables and documentary analysis to assist in interpretation of the survey findings. A full report on the study design and findings was provided to the NSCT and is available on request (Gurran et al., 2011).

3. Results

3.1. Local government perspectives on climate change risks in coastal Australia

Awareness and concern for climate change impacts are considered important preconditions for action (Tang et al., 2010; Berrang-Ford et al., 2011). For this study, a range of potential concerns regarding climate change impacts was derived based on previous studies (Coasts and Climate Change Council, 2010; House of Representatives, 2009; Department of Climate Change, 2009), and survey respondents invited to rank these on a threefold scale (high priority, priority, and not a priority) or nominate new concerns. As expected, respondents indicated a high level of awareness about potential climate risks to their communities. Existing physical exposure associated with sea level rise, shoreline loss, storm surge, and coastal erosion dominated concern, along with the perception that development is continuing to occur in vulnerable locations, exacerbating future risk (Fig. 1).

Other high priorities included the costs of maintaining, renewing, and installing new coastal infrastructure arising from more frequent weather events. Smaller councils were concerned that they would be left without assistance while more heavily populated areas would attract state government funding for protective adaptation work. Consequently, a number of areas anticipate potential depopulation and disinvestment in exposed communities. However, others fear additional population pressures from inland residents seeking respite in cooler coastal climates over the medium to long term.

Potential economic impacts associated with climate change for local tourism operators, fishery, and agricultural industries were regarded priority concerns by many respondents. In the context of the wider socio-economic and demographic challenges affecting coastal communities beyond the major cities, particularly those with ageing populations, many respondents identified community health as a priority issue.

Open ended survey responses and focus groups reflected ongoing community anxiety about impacts of actual or perceived climate risk on property values. Such anxiety was associated with

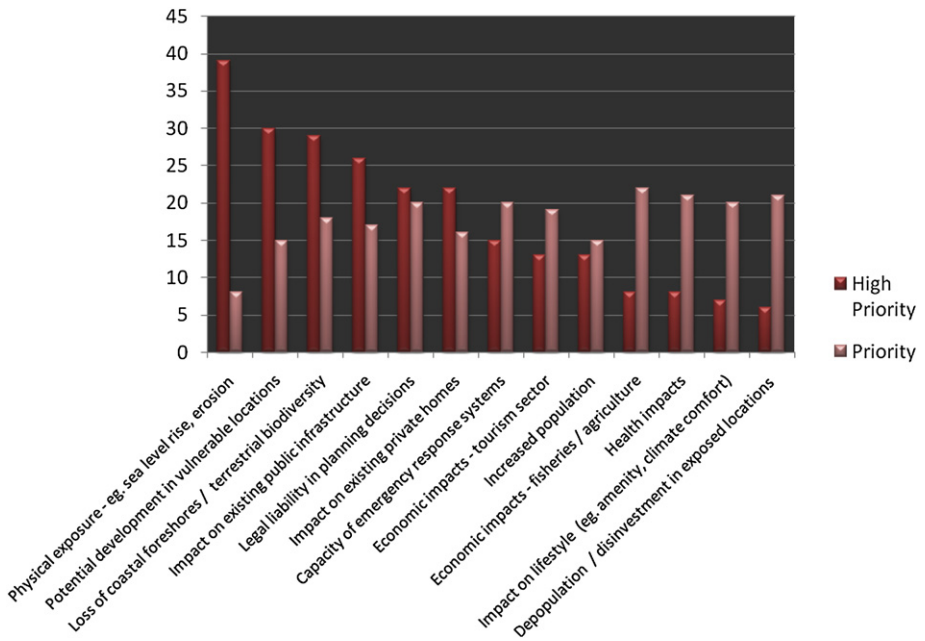

Fig. 1. Local government perspectives on climate change risks in coastal Australia. Source: Climate change adaptation planning in Coastal Australia survey 2011, $N = 49$

Please cite this article in press as: Gurran, N., et al., Climate change adaptation in coastal Australia: An audit of planning practice, Ocean & Coastal Management (2012), http://dx.doi.org/10.1016/j.ocecoaman.2012.10.014

the impact of development restrictions that might limit economic uses of particular sites, as well as damage to home values in properties that are known to be in vulnerable areas. Finally, several respondents called attention to new risks associated with change climatic conditions such as bushfires, with many coastal councils lacking experience in bushfire planning and management.

3.2. A continuum of climate change adaptation planning responses

Survey respondents were asked to nominate the extent to which their councils have begun to respond to climate change. As shown in Figure two, a continuum of stages in developing climate adaptation responses was evident, beginning with risk analysis (undertaken by the majority of survey respondents), moving through the preparation of an adaptation strategy to changing planning controls. This finding is consistent with previous research identifying a climate risk analysis as a precondition for further adaptation action in Australian public and private sector organisations (Gardner et al., 2010). A round table participant described an iterative process whereby a risk assessment provided a basis for further work, including the evidence base needed to attract funding for a comprehensive planning response.

Changing legal planning controls is a time consuming and often expensive process, sometimes taking several years to complete. As shown in Fig. 2, only six of the 34 councils represented in the survey question have successfully updated their planning controls to address climate risk, although 14 had commenced this work, and another twelve intended to do so in the near future.[1] Of the changes actioned, most related to managing sea level rise, inundation, and coastal erosion.

Infrastructure planning and investment is another area in which local government action has commenced, with 26 of the 34 responses indicating that a new strategy for infrastructure maintenance and investment is underway or planned. Such initiatives depend on additional budgetary resources, to undertake research, often of a highly specialised or technical nature (in the case of vulnerability assessments); obtain legal advice (to support planning scheme changes); to redress and prevent risks to public infrastructure and assets; and, to enable wider community engagement and consultation associated with these activities.

Further round table discussion revealed significant variability in the types of adaptation practices emerging around Australia and the language used to describe this work. For instance, in Victoria, references to a vulnerability or risk assessment usually relate to a commissioned study for a particular site and development proposal, while in the other jurisdictions vulnerability assessments are typically more comprehensive and combine strategic actions for subsequent implementation.

Reservations were expressed about the quality of some of the vulnerability assessment work being undertaken by the private sector. This was of particular concern in Victoria where proposals in designated risk areas must be supported by a vulnerability assessment in the form of a specialist consultant report. Participants expressed the view that site based risk assessments were often expensive and of questionable rigour. Local planning staff indicated concern about their own capacity to assess technical reports, given the lack of formal training or established criteria for review.

[1] The 34 responses indicated to these questions included the 27 local government areas covered by the primary survey and an additional seven responses from different non metropolitan coastal areas (primarily Victoria), who participated in the round tables.

3.3. Explaining local government adaptation action

Previous research and policy development work has emphasised the importance of access to additional resources in helping local governments build capacity for climate change adaptation, particularly in local government areas already struggling with resource constraints (Australian Local Government Association, 2010; Dawkins, 1996; Gardner et al., 2010). In this study, twelve councils had already received funding for climate adaption activities from their state government, and nine from a non-government organisation, primarily from the international group Local Governments for Sustainability (ICLEII). Five councils had won funding under the Commonwealth's *Local Adaptation Pathways Program* (LAPP). State based local government associations such as the NSW Local Government and Shires Association have also been an important source of funding for climate adaptation in coastal areas.

As shown in Fig. 3, considerable energy is spent seeking government funding from Commonwealth and State sources, and access to funds was regarded to be extremely important. The importance of funding for climate change adaptation initiatives was underscored by those who have received funding as well as those who had missed out. One participant described a perpetuating chain whereby better resourced authorities were able to identify funding sources, prepare competitive applications, provide matching funds, and carry out the project if successful. Smaller authorities were unlikely to attract resources under these conditions. Several participants also emphasised the time and resources needed to compete for funds.

> "A lot of funding is competitive funding. When it's competitive funding there's a lot of energy that goes into going for grants and funding and time…. It would be great to have more strategic funding which gets everyone to the same benchmark" (Local government participant, March 2011).

Analysis of survey responses and the focus groups revealed a high relationship between funding success and progress in climate change adaptation work, so future programs may need to extend beyond the competitive funding model to ensure wider diffusion of adaptation practice.

Other stimuli for action described by respondents included catalysing events, such as floods, cyclones or droughts, consistent with the wider literature on triggers for local adaptation work (Berrang-Ford et al., 2011). However, in explaining failure to address climate change at the level, respondents emphasised local political factors as the major constraint. Many described the difficulties they faced in localities where local councilors denied climate risk or were influenced by local property owners or developers, concerned that their land would be devalued and development potential sterilised if climate change risks were fully identified and made public; as discussed further below.

3.4. State and local planning systems

A series of questions were asked about the adequacy of the state and local planning systems, particularly in terms of managing sea level rise, inundation, building and infrastructure standards for climate resilience. Overall, there was strong criticism of planning frameworks at both state and local levels. As shown in Fig. 4, most respondents expressed the view that all matters are poorly addressed, not addressed, or treated inconsistently under state planning law.

However, progress towards addressing sea level rise was acknowledged by respondents in some jurisdictions, who expressed the view that despite overall weaknesses, the articulation of sea level rise benchmarks represented significant progress in coastal policy and climate change.

Please cite this article in press as: Gurran, N., et al., Climate change adaptation in coastal Australia: An audit of planning practice, Ocean & Coastal Management (2012), http://dx.doi.org/10.1016/j.ocecoaman.2012.10.014

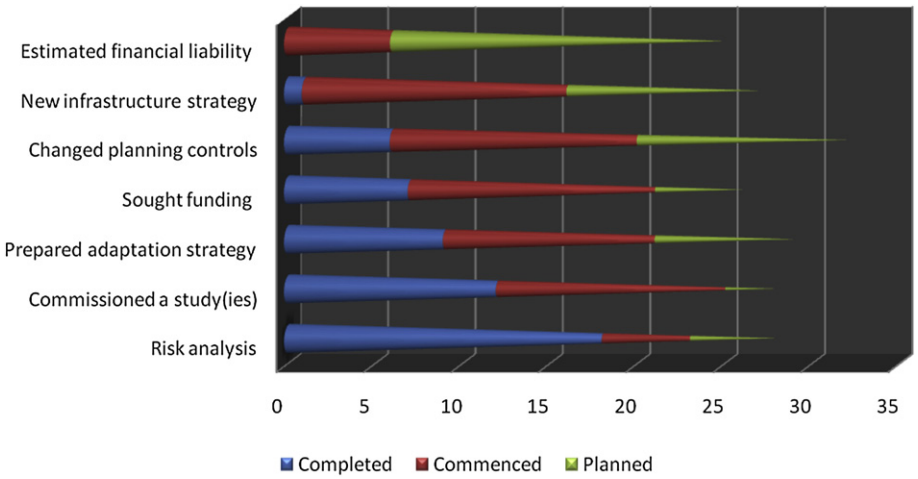

Fig. 2. Local government responses to climate change in coastal Australia. Source: Climate change adaptation planning in Coastal Australia survey 2011, $N = 34$

Views about local planning frameworks were mixed. In some areas, sea level rise is being addressed in local plans, with 13 respondents indicating that sea level rise was partially addressed in their planning framework. However, the majority of survey respondents indicate that sea level rise is not addressed or is poorly addressed in their controls (Fig. 5).

In relation to other climate adaptation measures, most participants indicated that climate change adaptation related considerations for infrastructure and building design and inundation were poorly addressed or not addressed in statutory planning controls.

Several respondents asserted difficulties in addressing climate change through statutory controls, due to the absence of sufficient spatial data to inform plan making and development assessment.

There are also particular issues of managing risks in high amenity contexts. For instance, a number of respondents referred to the issue of building heights, which, they argued, should be lifted to provide protection against inundation. However, to do so would undermine existing standards relating to views and amenity. Such issues may be best addressed through the preparation of specific coastal climate change resilience design guidelines and criteria for balancing existing amenity considerations with potential future climate impacts.

3.5. Planning, risk management, and community "pushback"

The issue of risk was a major focus for local government participants. Respondents indicated different, and changing, approaches to advising property owners of climate risk and of associated planning controls or requirements.

> "There was a period in council when we had the map, [but didn't] make that publicly available cause of the risk that there could be for property values. But, there's been a real … shift in focus because now we're individually identifying properties at risk of storm surge and we're actually putting stickers in the meter boxes of those properties." (local government participant, March 2011)

Several participants described pressure from more affluent newcomers who had purchased sites in vulnerable locations, and now sought to secure approval for new development, despite climate risk.

> "I've got residents who could have bought there in the past and they didn't because they accepted the risk. They watched the waves come in, they watched it all go, you know, the road go out

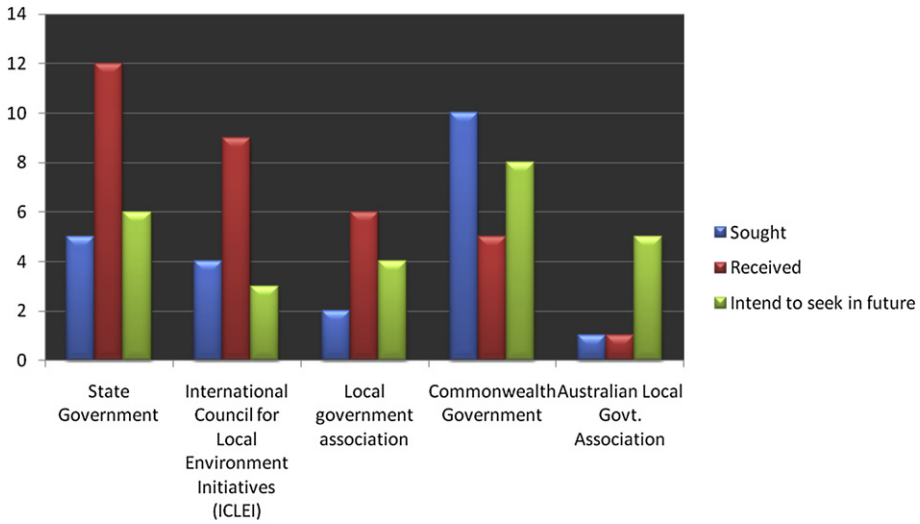

Fig. 3. Financial support for climate change adaptation. Source: Climate change adaptation planning in Coastal Australia survey 2011, $N = 34$

Please cite this article in press as: Gurran, N., et al., Climate change adaptation in coastal Australia: An audit of planning practice, Ocean & Coastal Management (2012), http://dx.doi.org/10.1016/j.ocecoaman.2012.10.014

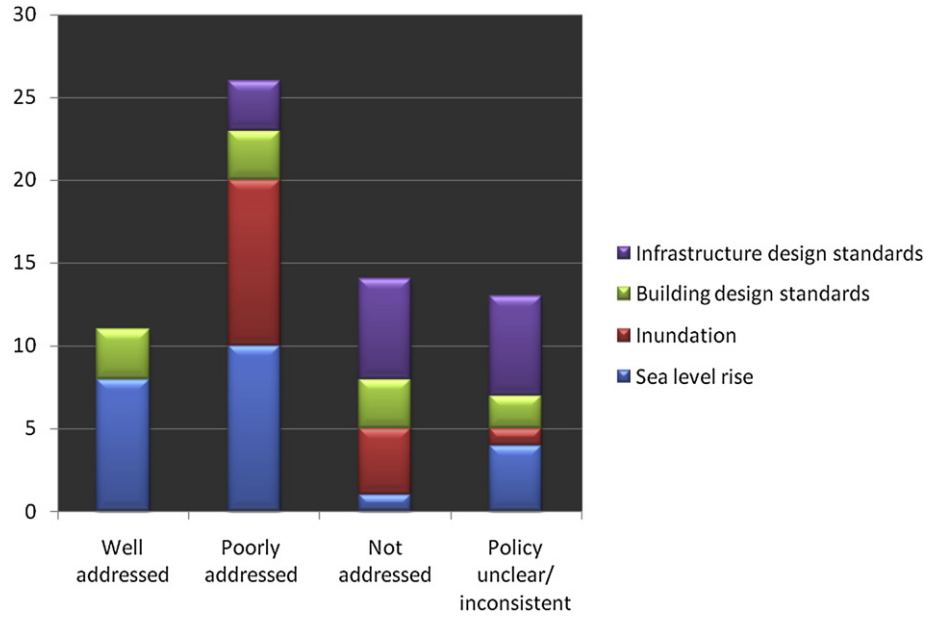

Fig. 4. Adequacy of state planning framework. Source: Climate change adaptation planning in Coastal Australia survey 2011, $N = 27$

and the jetty go out and the houses go, but now we've got some of the richest people in this country who came and bought it and quite frankly just said we don't give a stuff what the council says, we've got mates in high places. We'll build it if we want." (Local government participant, March 2011)

These conflicting pressures arising from various stakeholder groups are a major concern for local councilors and professional staff. Respondents described a growing community 'pushback' against climate change, with potential to erode local political support for adaptation measures. It was felt that this pushback was driven by concern that identifying areas of climate risk and imposing development controls to reduce future exposure, would lower private property values:

"The political sense … is that there has been a pushback in the community. We have significant wealth invested in properties of a million and a half price range. [The introduction of hazard] lines drawn on these maps, [means the] potential development [of these properties might be] sterilised to a very substantial degree and that's where the massive push back is coming from. And the sense politically is well why should we do that when the science is uncertain?" (local government participant, March 2011)

Some local council professionals addressed such concerns by using a language of climate "variability" rather than climate "change", which they felt helped counteract a growing trend towards local skepticism.

3.6. Priorities for government support

Survey respondents were asked to indicate the key state and Commonwealth initiatives likely to be of most benefit to their own local government area (Fig. 6).

As shown in Fig. 6, stronger Commonwealth and state policy on climate change adaptation was ranked as the highest priority measure. Respondents also called for better communication of information arising from Commonwealth and state initiatives, both

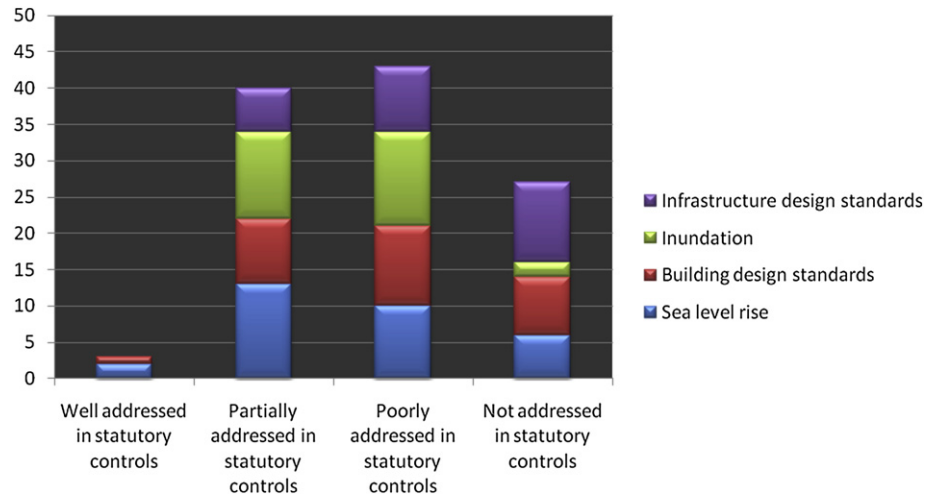

Fig. 5. Adequacy of local planning framework. Climate change adaptation planning in Coastal Australia survey 2011, $N = 27$

Please cite this article in press as: Gurran, N., et al., Climate change adaptation in coastal Australia: An audit of planning practice, Ocean & Coastal Management (2012), http://dx.doi.org/10.1016/j.ocecoaman.2012.10.014

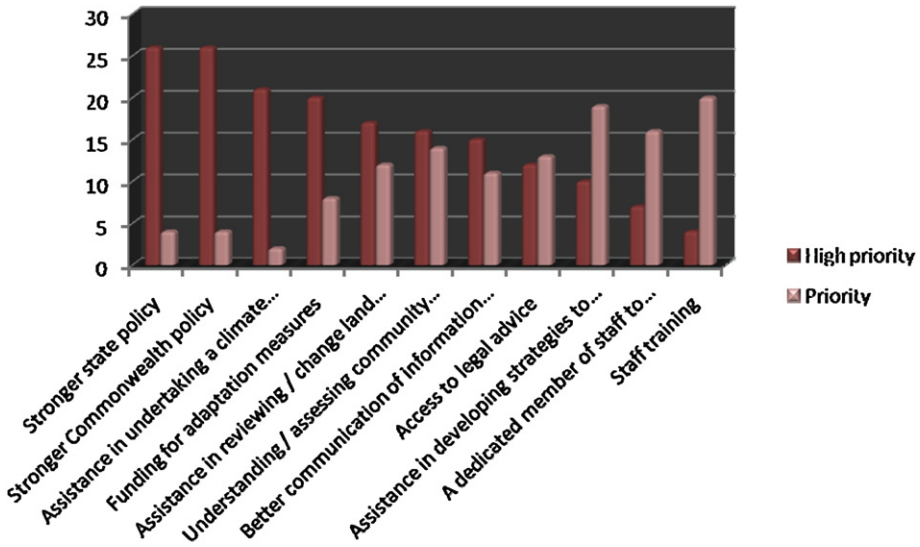

Fig. 6. State or Commonwealth government initiatives viewed as most beneficial. Source: Climate change adaptation planning in Coastal Australia survey 2011, $N = 34$

in terms of understanding the outcomes of these initiatives but also knowing opportunities to secure any available external resources. In focus groups, the wider policy work of the Commonwealth was regarded to be extremely important. Round table participants also emphasised that strong state policy provided a mandate for local government action:

> "I'm of the view that you do need good legislative frameworks which don't give local governments wriggle room to get out of putting in place good land use policies." (Local government participant, March 2011)

Assistance in interpreting technical vulnerability assessments undertaken to support particular development applications was also raised as a priority. As part of this, a major issue was assistance in addressing problems associated with existing development in locations that are now vulnerable:

> "It's the old stuff … that was built below sea level … on land that is now naturally getting washed away. Where the only practical albeit very expensive option [is] to buy these people out." (Local government participant, March 2011)

A similar issue requiring higher level government support, relates to whether damaged homes should be able to be rebuilt in vulnerable locations, such as areas prone to significant flood risk. Participants were generally against permitting damaged properties to be rebuilt, while also emphasising the need for strategies to offset the financial burdens for individual owners affected by decisions to implement strategies for coastal retreat.

4. Analysis

Reviewing the findings together suggests that there are clear (and perhaps unsurprising) connections across the factors that enabled communities in specific adaptation actions — funding, regulations, technical standards — and the actions they took. There has been funding for planning and risk analysis, and thus that is the actions that communities primarily took. Respondents worried most about physical exposure, and view state planning frameworks as better for addressing sea level rise than other climate risks, and have commenced changing their planning controls accordingly. But because the built form responds slowly to changes in regulations, the risk remains. Inundation, building design standards, and infrastructure are less well addressed in the state frameworks, and, likely as a result, are poorly addressed in local planning frameworks. It is not unexpected that respondents' main desire was stronger state and Commonwealth policy, significantly outpacing even funding for actual measures (Fig. 6). Our smaller respondent set and descriptive statistics are not sufficient to make strong conclusions on causality or the necessity of progression from one policy to the other. But logic and these findings are highly suggestive of the important role the state and the Commonwealth have to play in influencing the pattern of policy uptake in communities. This is particularly interesting in that it potentially contrasts with the draft findings of the Productivity Commission that sees a lesser role for the Australian Government and a greater reliance on 'autonomous adaptation' (Productivity Commission, 2012, p. 248).

Under these conditions, there appears to be an emerging progression in actual adaptation policies undertaken. Clearly, awareness of climate risks is a necessary precondition for action. As expected in the literature, communities move from this awareness to undertake a more formal risk analysis as the first step towards developing an adaptation strategy. This risk analysis informs the development of a framework for strategic adaptation action across the many responsibilities of local government, and might include actions ranging from community education through to developing applications for external funding and resources. In our study, a next step was to change the planning and regulatory framework governing future development, so that such development enhances resilience to climate risks, rather than furthering exposure. Subsequent actions involve rethinking the ways in which local infrastructure (both public and private) is designed and delivered, before finally establishing a funding strategy to resource ongoing intervention. These last two stages have as yet been undertaken by only a few of the councils involved in our study, but the vast majority of responding councils indicated that they intended to commence such work in the near future. In doing so, a strong evidence base will be needed with detailed local level information, including costings on necessary adaptation expenses over time. Strategic assistance to help councils overcome barriers to the adoption of more resilient forms of infrastructure design and delivery, will also be needed.

Taken together, these series of actions suggest a ladder of adaptation that communities are tending to follow, at least in coastal Australia (Fig. 7). It is perhaps surprising that communities

Please cite this article in press as: Gurran, N., et al., Climate change adaptation in coastal Australia: An audit of planning practice, Ocean & Coastal Management (2012), http://dx.doi.org/10.1016/j.ocecoaman.2012.10.014

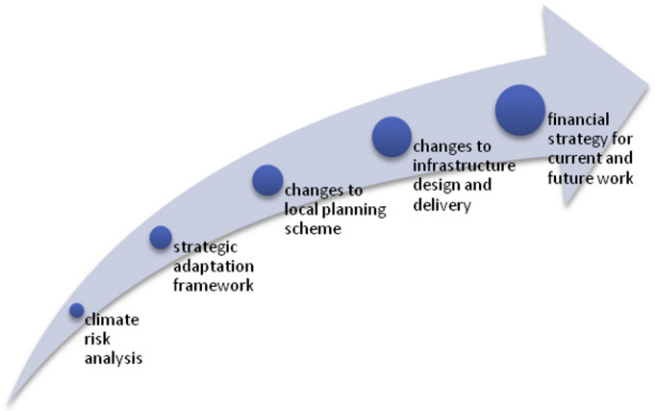

Fig. 7. A ladder of adaptation action in coastal Australia.

are finding adapting their own infrastructural investments more difficult than managing the regulations of others' land, but that appears to be the case. The finding accords with (Tompkins et al., 2010) claim that sectors that deal in large scale infrastructure have tended to be ahead of local governments in implementing adaptations. The highly constrained funding environment affecting Australian local government, particularly beyond the main population centres, may explain this tendency towards regulation rather than positive adaptation action. It is likely that, within the communities involved in this study, changes to planning regulation (while still resource intensive) are viewed as a lower cost way of managing risk exposure over time. By contrast, expensive, retrospective adaptation action in relation to existing infrastructure might be delayed until the infrastructure requires replacement, resources are available, and or, the risk becomes more urgent.

5. Conclusion: climbing the ladder of adaptation action

As adaptation planning moves from initial process considerations and risk analyses towards implementation practices, it is essential that research moves along too to support implementation. Our findings suggest that municipal adaptation actions are tending to happen in a particular order, and that communities move along a 'ladder' of adaptation. The research suggests, but does not prove, that there is a strong connection between actions the state enables (risk analyses, local implementation of sea level rise regulations), actions that still face significant barriers (infrastructure design guidelines), and what communities undertake first. As more cities move from the planning stage to the implementation stage, it will be important to test these findings, to see whether the ladder is relevant outside the Australian context, and to compare what happens when national and or state policy frameworks change. Does policy change at higher levels of government induce local change as well, for better or worse?

Our substantive findings highlight significant awareness and concern about climate change risk within coastal areas beyond the major capital cities. For most, but not all councils participating in this study, such concern has translated to some form of preparatory action, ranging from studies of local vulnerability through to specific changes to local planning schemes. This supports the idea that there appears to be an overall fairly slow but steady uptake of adaptation planning: early reports found little action in adaptation planning among communities (e.g., Wheeler, 2008); later there was some planning (e.g., Tang et al., 2010), recently some preliminary adaptation implementation (Berrang-Ford et al., 2011), and our survey demonstrates more implementation. Some responses to climate change adaptation have been comprehensive, addressing many sectors of local government responsibility and may extend to the regional scale; but others are site based and focus on assessing and ameliorating risk in relation to a specific site or development.

Smaller local government areas in particular face barriers to action associated with their limited financial and human resources. In some cases, pressure from affluent property owners, and a growing mood of climate change skepticism amongst sectors of the local community, is eroding local political support for preparatory action. Such reactions threaten to "pushback" against adaptation progress already made. While overall, Australian coastal government staff and representatives appear to demonstrate relatively high levels of awareness and concern for climate risk, particularly in comparison to international counterparts (Tang et al., 2010), the lack of a clear and consistent national level framework for integrated coastal planning and management, inadequate state and territorial policy and legislation, and significant resource constraints, continue to slow this work. Still, communities are moving along the 'ladder of adaptation' and beginning to significantly implement at least the actions that state and national policies support. In order to move further along the ladder, that support needs to be stronger for early stages, and in particular begin to address the significant barriers to the infrastructural and financial stages required for a comprehensive response to climate change.

References

Adger, W. Neil, Arnell, Nigel W., Tompkins, Emma L., 2005. Adapting to climate change: perspectives across scales. Global Environmental Change 15 (2), 75–76.
Arnell, NIgel W., Delaney, E. Kate, 2006. Adapting to climate change: public water supply in England and Wales. Climatic Change 78, 227–255.
Australian Local Government Association, 2010. Climate Change ALGA Position Paper and Discussion Document. ALGA, Canberra.
Baker, McKenzie, 2011. Local Council Risk of Liability in the Face of Climate Change – Resolving Uncertainties. Australian Local Government Association, Canberra.
Berrang-Ford, Lea, Ford, James D., Paterson, Jaclyn, 2011. Are we adapting to climate change? Global Environmental Change Human and Policy Dimensions 21 (1), 25–33.
Coasts and Climate Change Council, 2010. Coasts and Climate Change Council Report to Minister Combet. Canberra: Coasts and Climate Change Council.
Davoudi, S., Crawford, J., Mehmood, A., 2009. Planning for Climate Change; Strategies for Mitigation and Adaptation for Spatial Planners. Earthscan, London.
Dawkins, Jeremy., 1996. In praise of regulation [Earlier version of this paper presented at the Conference of Planning Schools (1995: University of Technology, Sydney).].
Department of Climate Change, 2009. In: Department of Climate Change (Ed.), Climate Change Risks to Australia's Coast, A First Pass National Assessment. Australian Government, Canberra.
Department of Climate Change and Energy Efficiency, 2010. In: Department of Climate Change and Energy Efficiency (Ed.), Developing a National Coastal Adaptation Agenda: A Report on the National Coastal Climate Change Forum. Australian Government, Canberra.
Department of Environment, Climate Change and Water NSW, 2009. Sea Level Rise Policy Statement. NSW Government, Sydney.
Department of Planning, 2010. NSW Coastal Planning Guideline: Adapting to Sea Level Rise. NSW Department of Planning, Sydney.
Eisenack, K., Stecker, R., 2012. A framework for analyzing climate change adaptations as actions. Mitigation and Adaptation Strategies for Global Change 17 (3), 243–260.
Environmental Defender's Office NSW, 2010. Audit of Sea Level Rise, Coastal Erosion and Inundation Legislation and Policy; Report Prepared by the Environmental Defender's Office of NSW for the Sydney Coastal Council's Group. Sydney: Sydney Coastal Councils Group.
Few, Roger, Brown, Katrina, Tompkins, Emma L., 2007. Climate change and coastal management decisions: insights from Christchurch Bay, UK. Coastal Management 35 (2–3), 255–270.
Gardner, J., Parsons, R., Paxton, G., 2010. Adaptation Benchmarking Survey Initial Report. Canberra: Australian Government.
Government Accountability Office (GAO), 2009. Climate Change Adaptation: Strategic Federal Planning Could Help Government Officials Make More Informed Decisions. GAO, Washington DC.
Gurran, N., 2011. Australian Urban Land Use Planning: Principles, Systems and Practice. Sydney University Press, Sydney.
Gurran, N., Norman, B., Gilbert, C., Hamin, E., 2011. Planning for Climate Change Adaptation in Coastal Australia: State of Practice Sydney: Report No. 4 for the

Please cite this article in press as: Gurran, N., et al., Climate change adaptation in coastal Australia: An audit of planning practice, Ocean & Coastal Management (2012), http://dx.doi.org/10.1016/j.ocecoaman.2012.10.014

National Sea Change Taskforce, Faculty of Architecture, Design and Planning, University of Sydney, Sydney.

Gurran, N., Squires, C., Blakely, E., 2006. Meeting the Sea Change Challenge: Best Practice Models of Local and Regional Planning for Sea Change Communities: Report for the National Sea Change Task Force, Planning Research Centre, University of Sydney, Sydney.

House of Representatives, 2009. House of Representatives Standing Committee on Climate Change, Water, Environment and the Arts House of Representatives Committee Report: Managing Our Coastal Zone in a Changing Climate: The Time to Act Is Now. Canberra: Australian Government.

Howard, J., 2009. Climate change mitigation and adaptation in developed nations: a critical perspective on the adaptation turn in urban climate planning. In: Davoudi, S., Crawford, J., Mehmood, A. (Eds.), Planning for Climate Change. Earthscan, London.

Juhola, Sirkku, Peltonen, Lasse, Niemi, Petteri, 2012. The ability of Nordic countries to adapt to climate change: assessing adaptive capacity at the regional level. Local Environment: The International Journal of Justice and Sustainability, 1–18 (iFirst Article).

Kelly, G., Hosking, K., 2008. Nonpermanent residents, place attachment and "sea change" communities. Environment and Behavior 40 (4), 575–594.

McIntyre, N., 2009. Rethinking amenity migration: integrating mobility, lifestyle and social-ecological systems. Erde 140 (3), 229–250.

Measham, Thomas G., Preston, Benjamin L., Smith, Timothy F., Brooke, Cassandra, Gorddard, Russell, Withycombe, Geoff, Morrison, Craig, 2011. Adapting to climate change through local municipal planning: barriers and challenges. Mitigation and Adaptation Strategies for Global Change 16 (8), 889–909.

Moser, Susanne C., Ekstrom, Julia A., 2010. A framework to diagnose barriers to climate change adaptation. Proceedings of the National Academy of Sciences of the United States of America 107 (51), 22026–22031.

Mozumder, Pallab, Flugman, Evan, Randhir, Timothy, 2011. Adaptation behavior in the face of global climate change: survey responses from experts and decision makers serving the Florida Keys. Ocean & Coastal Management 54 (1), 37–44.

National Research Council, 2010. Adapting to the Impacts of Climate Change, America's Climate Choices. National Academy of Sciences, Washington, D.C.

Norman, B., 2010. Sustainable Coastal Planning for Urban Growth and Climate Change. Paper Read at NSW Coastal Conference, 10–12 November 2010, at Bateman's Bay.

Norman, Barbara, 2009. Principles for an intergovernmental agreement for coastal planning and climate change in Australia. Habitat International 33 (3), 293–299.

Pillora, S., 2010. Australian Local Government and Climate Change, Working Paper No. 1. Sydney: Australian Centre of Excellence for Local Government, University of Technology.

Productivity Commission, 2012. Barriers to Effective Climate Change Adaptation, Draft Report, Productivity Commission, Canberra.

Preston, B.L., Westaway, R.M., Yuen, E.J., 2011. Climate adaptation planning in practice: an evaluation of adaptation plans from three developed nations. Mitigation and Adaptation Strategies for Global Change 16 (4), 407–438.

Smith, Barry, Burton, Ian, Klein, Richard J.T., Wandel, J., 2000. An anatomy of adaptation to climate change and variability. Climatic Change 45 (1), 223–251.

Steffen, W., Burbage, A., Hughes, L., Kitching, R., Lindenmayer, D., Musgrave, W., Stafford Smith, M., Werner, P., 2009. Australia's Biodiversity and Climate Change; A Strategic Assessment of the Vulnerability of Australia's Biodiversity to Climate Change Canberra: Australian Government.

Swart, R., Raes, F., 2007. Making integration of adaptation and mitigation work: mainstreaming into sustainable development policies? Climate Policy 7 (4), 288–303.

Tang, Z.H., Brody, S.D., Quinn, C., Chang, L., Wei, T., 2010. Moving from agenda to action: evaluating local climate change action plans. Journal of Environmental Planning and Management 53 (1), 41–62.

Tompkins, Emma L., Adger, W. Neil, Boyd, Emily, Nicholson-Cole, Sophie, Weatherhead, Keith, Arnell, Nigel, 2010. Observed adaptation to climate change: UK evidence of transition to a well-adapting society. Global Environmental Change 20 (4), 627–635.

Vasey-Ellis, Natasha, 2009. Planning for climate change in coastal Victoria. Urban Policy and Research 27 (2), 157–169.

Walsh, K.J.E., Betts, H., Church, J., Pittock, A.B., McInnes, K.L., Jackett, D.R., McDougall, T.J., 2004. Using sea level rise projections for urban planning in Australia. Journal of Coastal Research 20 (2), 586–598.

Wheeler, Stephen M., 2008. State and municipal climate change plans: the first generation. Journal of the American Planning Association 74 (4), 481–496.

Yin, Robert K., 2009. Case Study Research: Design and Methods, fourth ed.. In: Applied Social Research Methods Sage Publications, Los Angeles, Calif.

Yoo, Gayoung, Hwan Hwang, Jin, Choi, Choongik, 2011. Development and application of a methodology for vulnerability assessment of climate change in coastal cities. Ocean & Coastal Management 54 (7), 524–534.

Please cite this article in press as: Gurran, N., et al., Climate change adaptation in coastal Australia: An audit of planning practice, Ocean & Coastal Management (2012), http://dx.doi.org/10.1016/j.ocecoaman.2012.10.014