Chapter 25
Coastal Climate Adaptation at the Local Level: A Policy Analysis of the Gold Coast

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Introduction

The Gold Coast is a booming coastal city in South East Queensland, Australia renowned for its iconic ocean beaches, lifestyle, and tourism opportunities that take place in the coastal zone. It is home to over half a million people in an area stretching along approximately 57 kilometres of coastline, with the vast majority of development within 6 km of the ocean (ABS 2015; Dedekorkut-Howes and Bosman 2015). The health and stability of coastal ecosystems on the Gold Coast (beaches, dunes, and coastal wetlands) is integral to the protection of the city's developed coastal areas that fuel the lifestyle and tourism that is integral to the city (Zeppel 2012). However, with the impacts of climate change impending, these areas are increasingly vulnerable without adaptive plans, strategies or policies in place. The vulnerability of the Gold Coast's beaches to coastal processes exacerbated by climate change (increased erosion, flooding, frequency and intensity of extreme weather events and ensuing storm surges, tides, and swells) is widely known (Castelle et al. 2008; Sano et al. 2011; Zeppel 2012). As boasted by the City of Gold Coast (2013: 9) in its *Ocean Beaches Strategy 2013–2023*, the city 'has been at the forefront of coastal management since the 1960s. Nevertheless, the ability of the city's coastal management practices to address climate change adaptation is questionable. This paper attempts to evaluate the current status of coastal climate adaptation on the Gold Coast through investigating the following questions: What is the Gold Coast currently doing for coastal climate adaptation? How do the city's plans, policies and strategies compare with 'best practice' for coastal climate adaptation?

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In order to answer these questions first a literature review on coastal climate adaptation best practices was conducted. As coastal climate adaptation is the product of both coastal management and climate change adaptation actions, next both of these are reviewed in turn for the Gold Coast. Then, three key policies and plans are evaluated against an evaluation framework developed for this purpose. The paper concludes with a discussion on what needs to be done to improve local coastal adaptation.

Coastal Climate Adaptation Best Practices

The literature review on coastal climate adaptation best practices is conducted following the systematic quantitative approach developed by Pickering and Byrne (2014). This approach aims to achieve reproducible results through systematic research, quantify the findings, identify the gaps in literature through concise data organizing, and highlight the relationships between geographic locations, subjects, and variables discussed by researchers. The literature review was used to answer two key research questions of 'What is 'best practice' for adapting to climate change impacts in the coastal zone?' and 'What factors affect the development of climate change policy for the coastal zone?' Journal articles were identified through a systematic search on Google Scholar where the first 15 articles from four search strings with relevance to coastal management, climate change adaptation, and planning were selected and entered into an excel database. Of the articles identified, only those published in journals on the 2010 Excellence in Research in Australia journal list developed by the Australian Research Council were included in the quantitative review, resulting in a total of 33 articles.

The literature review identified numerous coastal climate adaptation best practices (see Vickers 2015 for details). Table 25.1 illustrates the number of times each strategy was mentioned in the reviewed literature. 'Total references' indicates the total number of times the practice was discussed, defined, or demonstrated. Because some strategies were identified as a best practice for multiple impacts, each reference contributed to the 'Total references'. Strategies that were mentioned more than 30 times in the 33 articles in the review were used as best practices to evaluate the ability of the plans and policies on the Gold Coast to address best practice coastal climate adaptation and are indicated by shading in the table.

Table 25.1 Coastal climate adaptation best practices

	Best Practices	Total references
Adaptation Practices	Soft infrastructure • Beach nourishment • Dune protection and revegetation • Wetland protection and revegetation	**91**
	Reefs	16
	Hard infrastructure • Seawall • Levees • Groynes	13
Adaptation Policy	**Local government action**	
	Land use modification • Land use manipulation • Down zoning • Re-building restriction	**37** 19 12 6
	Mapping and public information[a]	**7**
	Setbacks[a]	**37**
	State Government Action	
	Collaboration • Horizontal political collaboration • Vertical political collaboration • Interdisciplinary collaboration	**33** 10 14 9
	Land buy-back	7
	Building codes	22
	Institutional Body	7
	Mandate Lower Order Plans	6
	Transfer of Development Rights	2

[a] These practices were included in the analysis separately as 'setbacks' was mentioned much more often than other factors and while 'mapping and public information' is strongly affiliated with land use modification, it is inherently separate from it.

Coastal Management and Climate Adaptation Frameworks on the Gold Coast

In Queensland, the state government has the statutory authority over coastal management, however, local governments are empowered by state legislation to exercise particular planning and management controls (Mosadeghi et al. 2009). Therefore, state coastal management documents generally provide overarching policy guidance, with local government being the governing body with most power to influence coastal management procedures. The Queensland Government's *Coastal Management Plan* (CMP) (DEHP 2013) is the current state coastal management document advising coastal management for local government areas in Queensland. The CMP provides broad scale policy guidance with six strategic focus areas: Coastal landforms and physical coastal processes, Nature conservation, Indigenous cultural heritage, Public access and enjoyment of the coast, Management planning, and Knowledge sharing and community engagement.

The *Gold Coast Planning Scheme 2003* was the tool used by the City of Gold Coast for guiding and assessing development until recently.[1] All assessable development within the Gold Coast local area must comply with any applicable code as set out in the Planning Scheme, or provide reasonable justification for non-compliance. Among others, the Planning Scheme regulates aspects of land use and development such as: setback requirements from property boundaries, beaches and canals, building height, building density, and car parking requirements. Although not created for the purpose of addressing coastal climate adaptation, the ability of the Planning Scheme to guide development gives this document considerable means for contributing to coastal climate adaptation.

Coastal management on the Gold Coast is guided by the City's *Ocean Beaches Strategy 2013–2023* and was assisted through Policies 7 and 15 of the *Gold Coast Planning Scheme 2003*. The *Ocean Beaches Strategy* is the City of Gold Coast's overarching coastal management tool and seeks to maintain the health, cleanliness, longevity, and economic benefit that the ocean beaches provide. It provides a strategic vision for the management of the city's beaches and a framework for further operational plans such *as Surf Management Plan*, *Commercial Activity Plan*, and *Gold Coast Shoreline Management Plan*. As a strategic document, the *Ocean Beaches Strategy* does not enforce or bind the City of Gold Coast to implement any actions included, but serves as a guidance tool to indicate how Council proposes to manage the ocean beaches (CGC 2013).

In terms of climate adaptation, with partial funding from the former Australian Government Department of Climate Change, the City of Gold Coast did have a *Climate Change Strategy 2009–2014* until 2014. With the retreat of all levels of governments from climate adaptation since 2012 elections (Howes and Dedekorkut-Howes 2016) this lapsed document has not been replaced, nor has anything similar been created. The *Climate Change Strategy* comprehensively addressed the impacts of climate change on the Gold Coast, provided detailed actions for mitigating and adapting to these impacts, and outlined a risk response matrix that clearly identified the likelihood, consequence, level of risk, priority, context, and response action for each impact (Gold Coast City Council 2009). Among other impacts, those relevant to coastal climate adaptation were sea level rise and coastal flooding and the increase in frequency and intensity of extreme weather events, with medium and high level priority for addressing these impacts respectively. While there is no direct climate change plan or strategy for the Gold Coast currently, the *Ocean Beaches Strategy* does make reference to 'climate variability', however this is drastically insufficient to be considered action on climate change (Howes and Dedekorkut-Howes 2016). Similarly, although climate change is mentioned in the *Gold Coast Planning Scheme 2003* in at least one Constraint Code (Flood Affected Areas), there is no specific focus on it in this planning scheme.

[1]This analysis was conducted before the new city plan came into effect on 2 February 2016.

Evaluation of Gold Coast Coastal Climate Adaptation Policies

Gold Coast's rich history of coastal management has been examined various times before (Macdonald and Patterson 1984; Castelle et al. 2008; Strauss et al. 2009). However, although inherently related, coastal management does not always parallel coastal climate adaptation (Vickers 2015). With no specific climate change plan in place by the local council, it is questionable whether the current coastal management measures adequately address coastal climate adaptation. To this end, this section of the paper evaluates the three key policies in place relevant to coastal management and climate adaptation on the Gold Coast to determine how well they achieve best practice coastal climate adaptation as identified through the literature review.

The evaluation framework used in this paper is an adaptation of that established by Baker et al. (2012) where numeric values are allocated to indicate the extent to which the policy action achieves a best practice on a five-point scale. The plan or policy actions were recorded to either: have no evidence of the practice (0), acknowledge the practice but lack further definition and not provide detail (1), mention the practice and include a moderate level of detail, however remain entirely descriptive and lack application and analysis (2), mention the practice and include a limited level of specific application methods (3), or provide detailed methods for the implementation of the practice (4). The ability for each plan or policy to achieve best practice is then determined by dividing the actual score (cumulative total) of the policy (sum of average scores for each of the 9 best practices) by the highest possible score a policy can get (i.e. 36, 9 best practices each with highest possible score of 4). This allows a comprehensive and quantifiable means for determining how appropriately each plan or strategy is achieving best practice coastal climate adaptation. This percentage figure then represents the adaptive capacity of the plan. One key limitation of this method is that the numerical value allocated to each action is purely reliant on a personal interpretation of how well it achieves a practice.

Queensland Coastal Management Plan

The CMP is prepared under the *Coastal Protection and Management Act 1995* and has two overarching goals: (1) provide for the protection, conservation, rehabilitation, and management of the coastal zone, including its resources and biological diversity, and (2) encourage the enhancement of knowledge of coastal resources and the effect of human activities on the coastal zone (DEHP 2013). The plan includes six strategic objectives regarding how coastal land is to be managed. Four of these objectives whose actions were relevant to coastal management or coastal climate planning were included in the analysis (see Table 25.2). Suggested

Table 25.2 Evaluation of Queensland Coastal Management Plan

	Coastal Climate Adaptation Best Practices									
	Soft infrastructure measures			Land use measures			Collaboration			
Strategic Objectives Suggested Management Actions	Beach Nourishment	Dune protection/ revegetation	Wetland protection/ revegetation	Setback requirements	Mapping and public information	Other land use measures	Horizontal political	Vertical political	Inter-disciplinary	Cumulative Total
Coastal Landforms and Physical Coastal Processes										
Exclusion fencing to protect dunes	1	4	-	-	-	2	-	-	-	
Fenced and hardened access points for pedestrians	1	1	-	1	-	1	-	-	-	
Periodic fertilising to increase stock or plant vigour	-	4	4	-	-	-	-	-	-	
Vegetating banks of rivers, creeks, estuaries and wetlands	1	1	2	-	-	-	-	-	-	
Nature Conservation										
Regulating beach driving	1	3	1	2	-	2	-	-	-	
Rehabilitating damaged vegetation	-	4	4	-	-	-	-	-	-	
Management Planning										
Establish a local management plan	1	1	1	1	1	1	1	1	1	
Consult with the broader community for local plan	-	-	-	-	2	-	-	-	2	
Knowledge and Community Engagement										
Develop key stakeholder lists for consultation	-	-	-	-	4	-	-	-	4	
Use a variety of methods to engage with the community	-	-	-	-	4	-	-	-	4	
Average Score	1	2.57	2.40	1.33	2.75	1.50	1	1	2.75	**16.48**
Highest Possible Score	4	4	4	4	4	4	4	4	4	**36**
Adaptive Capacity (%)										**46**

management actions for these strategic objectives indicate how to achieve the outcomes in a direct policy action. These actions are analysed here to determine the degree to which they achieve best practice coastal climate adaptation as identified in the literature review.

While most actions in the CMP incorporate more than one best management practice most practices are only acknowledged (56%), with no further definition or detail of implementation provided. This is not unusual in a higher order policy document whose purpose is to provide strategic guidance for lower level policy. 25% of the actions provide detailed methods for the implementation of the practice, the remaining actions either only mention the practice and include a moderate level of detail, but remain entirely descriptive and lack application and analysis (13%), or mention the practice and include a limited level of specific application methods (6%). The CMP could undoubtedly improve by including more detail on how to implement these best practices.

The CMP only refers to 'climate variability' as a pressure compounding the vulnerability of Queensland's low-lying coastal areas, noting that degraded environments accelerate the rate of change and instability. The plan distinguishes factors such as changed rainfall patterns and increases in sea levels and storm intensity as resultant of 'climate variability'. Not only does climate change carry greater impacts on coastal areas than those identified by this plan (storm surge, coastal flooding, coastal erosion, wet and dry land degradation), but each carries additional compounding impacts that require individual attention. It is essential in state level coastal frameworks that the impacts of climate change are identified and addressed accordingly with best practice coastal adaptation strategies to ensure local coastal

frameworks reflect appropriate adaptive practices concurrently and consistently. Overall, the CMP is underperforming in terms of best practice coastal climate adaptation, attaining only 46% adaptive capacity.

Ocean Beaches Strategy

The *Ocean Beaches Strategy 2013–2023* is comprised of four key Strategic Outcomes: everyone can enjoy a beach experience, our beaches are healthy and clean, our infrastructure is protected from coastal hazards, and there is joint stewardship of the ocean beaches (CGC 2013). These Strategic Outcomes provide an overarching framework that make up the intent for the Strategy. The Strategy outlines 13 key actions to achieve these objectives, as well as 'outcome measures' to evaluate the effectiveness of the actions, and 'deliverables' to summarise and present the results of implementation. These key actions have been analysed according to the evaluation framework to determine their ability to achieve best practice coastal climate adaptation.

Only 35% of the 17 best practices included in the 13 actions provide detailed methods of implementation, most notably for beach nourishment and dune protection/revegetation. Another 35% are only descriptive and lack any further mention of application and analysis. The remaining 30% include a limited level of specific application methods. None of the actions address the protection/revegetation of wetlands, setback requirements, or any modification of land use. Of all practices, mapping and public information and interdisciplinary collaboration are the most mentioned.

Overall, the *Ocean Beaches Strategy* achieved an adaptive capacity of 47% (see Table 25.3). Evidently, by achieving only half of its potential adaptive capacity, the strategy is underperforming in terms of coastal climate adaptation with regard to the best practices identified in this research. While the *Ocean Beaches Strategy* clearly targets a diverse range of practices that could be considered good coastal management (beach nourishment, dune protection), and potentially appropriate measures for coastal climate adaptation, the document only refers to 'climate variability' as a driver for increasing erosion. Similarly, where other impacts of climate change such as sea level rise and frequent and intense storms are mentioned in the document, they too are only noted as influencing erosion. While these impacts of climate change contribute to erosion, they pose additional considerable threats to coastal zones and should be considered independently.

Gold Coast Planning Scheme

In the Planning Scheme, hazards relative to coastal climate impacts are addressed by constraint codes affiliated with overlay maps that are implemented through

Table 25.3 Evaluation of Ocean Beaches Strategy

Key Actions	Coastal Climate Adaptation Best Practices									Cumulative Total
	Soft infrastructure measures			Land use measures			Collaboration			
	Beach Nourishment	Dune protection/ revegetation	Wetland protection/ revegetation	Setback requirements	Mapping and public information	Other land use measures	Horizontal political	Vertical political	Inter-disciplinary	
Monitor and improve beach health	4	4	-	-	4	-	-	-	-	
Undertake planning related to coastal protection	-	-	-	-	3	-	-	2	4	
Implement Shoreline Management Plan	4	4	-	-	-	-	-	-	-	
Develop collaborations to support ocean beach man.	-	-	-	-	-	-	2	2	2	
Undertake and promote research about the ocean beaches	-	-	-	-	2	-	-	-	2	
Actively engage local stakeholders in ocean beach man.	3	3	-	-	3	-	-	-	3	
Report on Ocean Beaches Strategy Outcomes	-	-	-	-	2	-	-	-	-	
Average Score	3.67	3.67	0	0	2.80	0	2	2	2.75	**16.89**
Highest Possible Score	4	4	4	4	4	4	4	4	4	**36**
Adaptive Capacity (%)										**47**

development assessment. Performance Criteria include the actions that seek to achieve the intent for each code. A total of 38 Performance Criteria extracted from four relevant Constraint Codes were analysed here. *Canals and Waterways* code seeks to ensure that development adjacent to canals and waterways positively contributes to the maintenance and improvement of water quality while protecting the banks of estuaries, lakes, canals, rivers, streams and other waterbodies from erosion. *Flood Affected Areas* code aims to ensure that development does not cause or have the potential to cause damage to land or premises, and provides standards for development so as to reduce any potential adverse impacts of flood on the environment. *Natural Wetland Areas and Natural Waterways* code seeks to ensure the long term protection, enhancement and management of natural waterways and wetlands for their ecological, fishery, shoreline and bank stabilisation, hydro-geological, open space, recreational, environmental, scientific, and cultural value. *Ocean Front Land* code seeks to protect ocean front properties and beach environment with a foreshore seawall, protect and replenish sand resources, preserve visual amenity of the foreshore, protect and enhance the coastal environment, and ensure adequate access for foreshore seawall maintenance.

Of the best practices included in the planning scheme only 39% provide detailed methods for the implementation. 33% only acknowledge a practice, lacking further definition, detail, or mention of implementation, and 18% mention the practice and include a moderate level of detail, but remain entirely descriptive and lack application and analysis. Evidently, although a significant percentage of Performance Criteria provide methods for implementation, the majority are lacking detail.

Soft practices, setback requirements, and land use modification are the most mentioned best practices in the Constraint Codes (see Table 25.4). A significant number of the Performance Criteria that addressed these best practices provide detailed methods for the implementation. This was expected of the Constraint Codes, as their purpose is to guide development in areas susceptible to coastal

Table 25.4 Evaluation of Gold Coast Planning Scheme

Constraint Codes Performance Criteria	Coastal Climate Adaptation Best Practices									Cumulative Total
	Soft infrastructure measures			Land use measures			Collaboration			
	Beach Nourishment	Dune protection/ revegetation	Wetland protection/ revegetation	Setback requirements	Mapping and public information	Other land use measures	Horizontal political	Vertical political	Inter-disciplinary	
Canals and Waterways										
Provide for setbacks from the waterway	-	-	-	4	4	-	-	-	-	
Boat ramps etc be designed for waterside location	-	-	-	-	-	4	-	-	-	
Stormwater outlets designed for waterside location	-	-	-	-	-	4	-	-	-	
Ensure the water quality and quantity is maintained	-	-	1	-	-	2	-	-	-	
Areas below high water level kept for public purposes	-	-	-	-	4	-	-	-	-	
Not adversely affect the waterbody or bank	-	1	4	-	-	1	-	-	-	
Flood Affected Areas										
Not detrimentally affect flood storage capacity	-	-	1	1	-	-	-	-	-	
Allowance for hydraulic gradient above main floodway	-	-	-	2	-	-	-	-	-	
Height reflecting acceptable flood risk for their purpose	-	-	-	1	-	-	-	-	-	
Not obstruct the free passage of stormwater	-	-	-	1	-	-	-	-	-	
Not damage, not increase the level of risk to life	-	-	-	1	-	-	-	-	-	
Consider hydrologic and hydraulic impacts	-	-	-	1	-	2	-	-	-	
Avoid causing exposure to undue flood hazard	-	-	-	2	-	4	-	-	-	
Sufficient access or egress available to enable evacuation	-	-	-	2	-	1	-	-	-	
Not cause sedimentation, erosion or impact on drainage	-	2	1	-	-	-	-	-	-	
Not impede a natural watercourse, flood channel etc.	-	-	2	-	-	-	-	-	-	
Not be inundated during a designated flood event	-	-	-	4	-	1	-	-	-	
Natural Wetland Areas and Natural Waterways										
Ecological features, functions be identified and assessed	-	-	2	-	-	-	-	-	-	
Ecologically significant areas protected and maintained	-	-	3	-	-	1	-	-	-	
Ecologically significant areas not be negatively impacted	-	-	1	1	-	1	-	-	-	
Development set back from ecologically significant areas	-	-	2	4	-	1	-	-	-	
Degraded wetland and waterway areas be rehabilitated	-	-	4	-	-	-	-	-	-	
Natural hydrological regimes of wetlands be maintained	-	-	3	-	-	-	-	-	-	
Ecologically significant areas buffered from effluent	-	-	3	-	-	-	-	-	-	
Buffers to ensure no negative impact on significant areas	-	-	4	4	-	-	-	-	-	
Ecological corridors to link ecologically significant areas	-	-	4	3	-	-	-	-	-	
Facilitate protection of ecologically significant areas	-	-	3	1	-	-	-	-	-	
Minimise vehicular and pedestrian crossings	-	-	2	1	-	4	-	-	-	
Ocean Front Land										
Set back from active dunal areas/foreshore seawall line	1	2	-	4	-	-	-	-	-	
Certified foreshore seawall provided in designated areas	-	-	-	4	4	-	-	-	-	
A rear dune fence for dune restoration and protection	-	4	-	1	-	2	-	-	-	
Excavated sand cleaned and placed on an ocean beach	4	4	-	4	4	-	-	-	-	
Beach protection/restoration measures used in excavation	4	4	-	-	2	-	-	-	-	
Maintain or enhance local natural coastal environment	4	4	4	-	-	1	-	-	-	
Public access/beach protection in land subdivisions	-	1	1	-	-	3	-	-	-	
Average Score	3.25	2.75	2.50	2.30	3.60	2.13	0	0	0	**16.53**
Highest Possible Score	4	4	4	4	4	4	4	4	4	**36**
Adaptive Capacity (%)										**46**

impacts that these codes seek to address. Conversely, no collaborative practice was mentioned at all. The Ocean Front Land Constraint Code indicated the greatest adaptive capacity with the majority of Performance Criteria providing detailed methods for the implementation of soft infrastructure practices, while also addressing the requirement for setbacks and land use modifications. The majority of the Performance Criteria in the Natural Wetland Areas and Natural Waterways

Constraint Code addressed the protection/revegetation of wetlands, setbacks and land use modification, identifying some methods for implementation; however no other practices were addressed by the Code.

Overall the Planning Scheme scored an adaptive capacity of 46% and is clearly underachieving in terms of best practice coastal climate adaptation. Although this analysis of the Planning Scheme is limited in that it has only evaluated specific Constraint Codes, these are the specific codes used for guiding and assessing development in vulnerable coastal areas. There are measures of coastal management that could be considered coastal climate adaptation throughout the Planning Scheme such as soft infrastructural protective measures, setback requirements, land use modification and the provision of mapping and public information. Additionally, there is at least some mention of climate change in the document. One Performance Criterion that specifically addressed climate change, PC8 of the Flood Affected Areas Code, states that development must consider hydrologic and hydraulic impacts of development in flood affected areas with regard to future climate change. Nonetheless, as the city's planning and development tool, overall the Planning Scheme's Constraint Codes are underperforming in terms of best practice coastal climate adaptation.

Discussion

All the plans evaluated here scored similar adaptive capacities staying just shy of half of their potential in terms of coastal climate adaptation but their strengths and weaknesses were in different areas. The state *Coastal Management Plan* provided detail on implementing practices for mapping and public information, interdisciplinary collaboration, and dune and wetland protection and revegetation. Regardless, five out of the nine best practices received no further than acknowledgement from the actions in the CMP. As the CMP is a state government plan, local governments are entrusted with implementing coastal management procedures. However, the CMP includes no mention of any form of intergovernmental collaboration, vertical or horizontal. As the literature review highlighted, the higher order plans such as state government plans greatly influence the production of lower order plans such as local government plans. Additionally, both higher order plans that mandate lower order plans and horizontal and vertical collaboration can contribute to enabling policy development (Kaswan 2013; Flood and Schechtman 2014; Gurran et al. 2013; Beirbaum et al. 2013; Tobey et al. 2010; Martinez et al. 2011). In the case of Queensland previous research has shown that only local governments which were located in a region with a statutory regional plan that has specific emphasis on climate change adaptation have prepared climate adaptation strategies (Dedekorkut-Howes and Sloan 2012). Furthermore, whereas previously the state of Queensland had a specific policy to address climate change and the

preceding Queensland state coastal management policies have mandated coastal local councils to produce a coastal hazard adaptation strategy and required sea level rise to be taken into account in coastal development (Howes and Dedekorkut-Howes 2012), the state no longer has a climate policy and the CMP, the former conservative Liberal National state government's framework advising the development of coastal management plans for local government areas, does not mandate coastal hazard strategies (Dedekorkut-Howes and Howes 2014). In fact, Moreton Bay Council, which included a 0.8-metre sea level rise in its draft planning scheme effectively barring any development below that water mark, was directed by the former Liberal National Government's deputy premier Jeff Seeney 'to remove any assumption about a theoretical projected sea level rise' to protect the rights of existing property owners (Solomons and Willacy 2014). Aligning with the intent of the Liberal National Party in power at the time to remove 'red tape' for development, the current CMP merely provides guidance over the strategic focus areas for Councils that seek to create coastal plans. Therefore, as a state government plan that does not mandate lower order plans; have no mention of vertical collaboration or overseeing/instigating any horizontal collaboration; nor provide any information further than acknowledging multiple best practices, the CMP is fundamentally underperforming in terms of best practice coastal climate adaptation.

The *Ocean Beaches Strategy* does contain particular best practices for coastal climate adaptation, however is lacking specifics relative to the best practices identified in the literature review. The strategy provides detailed methods for implementing four out of nine best practices: beach nourishment, dune protection and revegetation, inter-disciplinary collaboration, and mapping and public information. Soft infrastructure practices such as beach nourishment and dune protection are considered essential to coastal climate adaptation as a means of protection for coastal settlements (Harman et al. 2015; Coleman 2012; Martinez et al. 2011; Klein et al. 2000). However, the strategy fails to address wetland protection and revegetation, setback requirements, and land use modification and only mentions vertical and horizontal political collaboration with limited detail. Revegetating and protecting wetlands is integral to coastal climate adaptation as a protective measure to impacts like storm surge and coastal flooding (Hanak and Moreno 2012; Spalding et al. 2014; Harman et al. 2015) and setback and land use modification are essential as a means of accommodating the impacts of coastal flooding, sea level rise, and erosion in vulnerable areas while providing the mutual benefit of reducing environmental degradation (Hwang 1991; Grannis et al. 2012). While the *Ocean Beaches Strategy* does not have the authority to influence land use or setbacks, the strategy does discuss the implementation of the *Draft City Plan 2015* suggesting that the document will reflect the desired outcomes of the *Ocean Beaches Strategy*. The best practices missing from the *Ocean Beaches Strategy* are integral to coastal climate adaptation and their absence is detrimental to the adaptive capacity of the strategy. As it is intrinsically a coastal management strategy, it should pay greater attention to climate change.

The *Gold Coast Planning Scheme 2003* is effective in detailing the implementation of six out of nine best practices concerning soft infrastructure (beach

nourishment and dune and wetland protection and revegetation), setback requirements, land use modification, and mapping and public information. The literature review highlighted that implementing soft infrastructure defences, down-zoning (including setback requirements and land use modification), and providing mapping and public information are beneficial local government initiatives for coastal climate adaptation. However, the Planning Scheme does not address any form of collaboration. Vertical, horizontal, and interdisciplinary collaboration are essential for coastal climate adaptation, as they create congruent implementation throughout neighbouring coastal areas (Martinez et al. 2011), provide opportunities to learn and exchange expertise gathered in other coastal areas (Flood and Schechtman 2014), and break down the communication and interpretation barriers between researchers and policy makers (Langridge et al. 2014). The Planning Scheme is not a document seeking to achieve coastal climate adaptation, but to guide and assess development, thus more applicable to land use. Therefore, although underachieving in terms of best practice coastal climate adaptation, as a local government tool for guiding and assessing development and land use, the Planning Scheme is fairly effective in addressing some coastal climate adaptation practices relative to its purpose on paper.

Conclusions

While Gold Coast local coastal management and planning documents do address particular coastal climate adaptation best practices, neither document is specifically developed for achieving coastal climate adaptation. Thus both are lacking the fundamental purposive attention to best practice adaptation strategies. Additionally, despite the state government's CMP addressing select best practices, this policy does not acknowledge climate change, provides no guidance on land use modification, setback requirements, or beach nourishment, and most detrimentally as a higher order plan carries no mandate for lower order plans and makes no mention of any form of collaboration, vertical or horizontal. Consequently, the City of Gold Coast is in dire need of direction for coastal climate adaptation.

As supra local level guidance is beneficial for achieving effective coordination of coastal adaptation policy (Verschuuren and McDonald 2012; Boyer 2012), and higher order plans that mandate lower order plans assist policy development (Kaswan 2013; Flood and Schechtman 2014; Gurran et al. 2013), this coordination would best originate in higher levels of government. While some plans addressed interdisciplinary collaboration, no plan even acknowledged vertical or horizontal political collaboration. This is particularly detrimental to the CMP as a state government document. Without horizontal collaboration, the City of Gold Coast is potentially missing out on vital expertise through information sharing and learning from other coastal areas (Flood and Schechtman 2014). Without vertical collaboration, adaptation measures are generally less likely to be employed (Hurlimann et al. 2014), and local action without guidance could be implemented in redundant

and inefficient ways (Boyer 2012). Additionally, the presence of an institutional body to coordinate collaboration greatly contributes to the congruent adoption of effective climate adaptation practices (Martinez et al. 2011; Verschuuren and McDonald 2012; Hurlimann et al. 2014).

Whereas the *Gold Coast Planning Scheme 2003* stated that climate change should be considered in development of flood affected areas, the more recent *Ocean Beaches Strategy* and the *Coastal Management Plan* only noted that climate variability exists and contributes to generic coastal processes. While public pressure can create a barrier to climate policy development (Abel et al. 2011; Gurran et al. 2013; Verschuuren and McDonald 2012), action for climate change in local planning is essential (Boyer 2012; Baker et al. 2012; Serrao-Neumann et al. 2014; Dedekorkut et al. 2010), particularly for coastal resort cities such as the Gold Coast (Cooper and Lemckert 2012).

Although the Gold Coast boasts of decades of coastal management expertise, in the age of coastal climate adaptation it is quickly falling behind. This research has reviewed the current state of coastal management and climate adaptation on the Gold Coast and discussed the ability of the city's plans and policies to address best practice coastal climate adaptation. This evaluation points to an urgent need of a local plan, policy or strategy with the specific purpose of informing coastal climate adaptation; horizontal and vertical political collaboration regarding coastal climate adaptation, potentially through an institutional body or department (with guidance that may originate in higher government); and a higher order climate adaptation policy document to provide guidance for general climate adaptation with specific reference to coastal climate adaptation.

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