The way forward in adapting to coastal hazards in Queensland

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Abstract

The draft State Planning Policy establishes a single state policy for planning and development decision-makers for natural hazard areas including coastal hazard areas. The policy seeks to ensure that the risk of, and the adverse impacts from natural hazards are avoided, minimised or mitigated to protect people and property and enhance the community's resilience to natural hazards.

The proposed planning approach outlined here is the preparation of a coastal hazard adaptation strategy (CHAS) for at risk communities. A CHAS is a strategic mechanism to guide risk mitigation for coastal communities through informed, coordinated and timely actions over the long term. This is necessary to avoid a piecemeal approach which may result in uncoordinated or locally incoherent mitigation actions.

The Queensland Department of Environment and Heritage Protection's 'Guideline for Preparing a Coastal Hazard Adaptation Strategy' establishes a stepped approach to mitigating coastal hazard impacts in urban and peri-urban localities. The guideline has now been tested and refined by a CHAS pilot project using Townsville as a case study (GHD 2012). The pilot project analysed and recommended adaptation options and also delivered a compendium of adaptation options as a supporting resource for coastal councils.

A key output of the pilot project was the Learning's Report which identifies issues associated with preparing a CHAS. Local government is encouraged to consider the recommendations in the Learning's Report when considering undertaking their own CHAS projects. This information should help inform scheduling, budget considerations, data needs, technical quality and community consultation to assist in ensuring the success of future projects.

Introduction

Many coastal communities in Queensland face coastal hazard threats of sea erosion and storm-tide inundation. These include major urban centres such as Cairns, Townsville and Mackay which have large urban communities on erodible coasts and on low lying delta plains. Projected sea-level rise and an increase in cyclone intensity are expected to increase these risks and extend the threats to areas currently at low or no risk. Urban development faces not only the threat of damage or loss but expensive protection, relocation, recovery or mitigation costs. Costs are also not confined to the property owners. The community can also face significant environmental, social and economic costs. For example, loss of recreational beaches caught in the squeeze between retreating shorelines and property protection works.

This increasing coastal hazard risk will occur over a long timeframe and significant changes in sea level or cyclone intensity are not projected to be experienced until beyond 2030. However, land-use planning decisions have long-term implications and therefore need to consider these future threats.

A CHAS is a tool for local government to avoid or mitigate the risk of coastal hazard impacts by guiding and informing future planning and development decisions. Adaptation strategies are intended to identify a way forward for at risk communities. They provide informed, coordinated and timely actions mapped out over a long-term pathway; rather than addressing the risk on an incremental or development-by-development basis.

To assist local government prepare a CHAS, the Local Government Association of Queensland, Townsville City Council and the Queensland Government finalised a pilot coastal hazard adaptation strategy for Townsville (GHD 2012). While the pilot project provides Townsville-specific detail of the risk and potential mitigation to coastal hazards, the overall adaptation strategy process can be used to inform other Queensland coastal councils in undertaking their own strategies.

Overview and Methodology

Coastal hazard areas have been defined throughout Queensland by erosion prone area plans declared by the state government and storm-tide inundation studies undertaken by most local governments. In both cases, projected sea-level rise and an increase in cyclone intensity to 2100 have been built into the hazard assessments. Sea-level rise in particular can significantly extend the areas at risk from coastal hazards. Like other major coastal towns, the problem is large in Townsville where 4400 properties are at risk from a future sea-level rise of 0.8m with 2830 of those located in South Townsville.

Photo 1: Areas of Townsville at risk from sea-level rise to 2100 and storm-tide inundation.

These threats will emerge over a long period of time so they can be problematic to effectively deal with. The planning framework in Queensland is undergoing a significant review by the government. In particular, a draft State Planning Policy establishes a single state policy for planning and development decision-makers in Queensland. For coastal hazard areas, the policy seeks to ensure that the risk of, and the adverse impacts from coastal hazards are avoided, minimised or mitigated to protect people and property and enhance the community's resilience to natural hazards.

The policy promotes the development of an adaptation strategy to plan how people and property in coastal hazard areas where significant infrastructure or population growth is anticipated or already exists will be protected from adverse coastal hazard impacts over time.

As outlined in the 'Guideline for Preparing a Coastal Hazard Adaptation Strategy' (CHAS guideline) a CHAS should follow the steps outlined below to ensure a comprehensive and long-term approach is adopted to mitigate coastal hazard impacts:

1. Identify areas at risk, preferably through local scale hazard mapping
2. Identify current and known future exposed 'assets' (residential, commercial, community) and assess their vulnerability to coastal hazards by 2100, including an assessment of risks
3. Identify potential adaptation options (e.g. avoid, accommodate, defend or retreat)
4. Consult the community about the potential adaptation options
5. Undertake a socio-economic appraisal of adaptation options
6. Select preferred adaptation option(s)
7. Develop an implementation program and financial plan
8. Engage in community consultation on the draft adaptation strategy
9. Develop a process for reviewing and updating the adaptation strategy.

The concept of a CHAS was piloted in Townsville City Council in 2012. Based on the steps outlined in the CHAS guideline, the project followed a four-stage process as outlined below, which was intended to then inform the planning process and update the guideline where applicable.

Define hazards
Coastal hazard areas were defined as:

- erosion prone areas within a coastal management district
- land affected by sea-level rise of 0.8m above the level of highest astronomical tide
- land that is affected by inundation of more than 1m of depth during a defined storm tide event (the 1% AEP storm tide in 2100).

Determine risk
A qualitative risk assessment was undertaken using vulnerability classifications to assess risk to infrastructure and property from the defined coastal hazards. Specific impact thresholds were developed to inform the vulnerability assessment and included a property floor level database.

Evaluation of adaptation options
The study area was split up into 37 localities for consideration of adaptation options. Over 100 adaptation options were developed for these localities bases on site characteristics and the opinion of coastal experts. Options included retreat (relocate or remove development), defend (seawalls, beach nourishment and levees), accommodate (raising buildings) and maintain status quo (do nothing and accept consequences). All options are detailed in a compendium attached to the CHAS report.

Option evaluation by socio-economic assessment tools was a complex two-stage process. Stage one consisted of a multi-criteria analysis where each criteria was assigned a weighting depending on the importance of the criteria. Each option was assigned a score and corrected for the weighting. By this approach each option received a total score which was used to select the most desirable options for further analysis.

The second stage of the assessment was a Benefit Cost Analysis (BCA). The BCA was used to estimate the economic viability and optimal timing of the adaptation options. The BCA modelling for urban localities included estimating costing of sea-level rise asset losses, storm-tide damage and adaptation options. The BCA also included sensitivity testing of key model assumption such as the discount rate. Also, by systematically modifying the year of implementation of an adaptation option and re-running the simulations of erosion and storm-tide inundation the net present value (NPV) and benefit cost ratio can be plotted as a function of year.

Select adaptation options

Adaptation options for each locality are comparatively assessed with respect to both the benefit cost ratio and the NPV. An example of the output from the BCA is shown in Figure 1. For each locality and for each adaptation option the benefit cost ratio in each year to 2100 shows both the relative benefit of undertaking the adaptation option and the optimal timing. Sensitivity to the discount rate change also assists decision making.

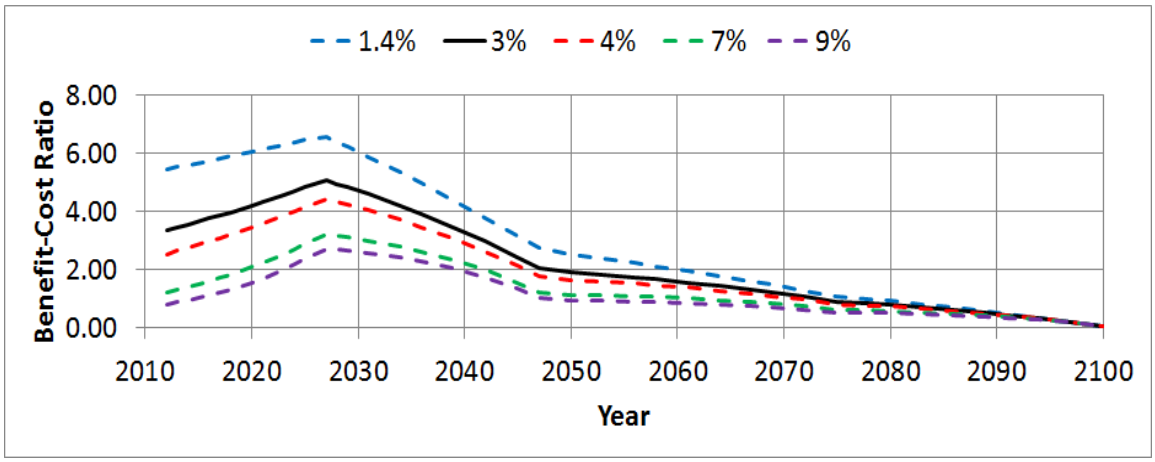

Figure 1: Benefit-cost ratios for Townsville inner suburbs for a defend option with various discount rates to support decision making.

The NPV represents the summation of all benefits and losses associated with a given option over the 88 year project period. Positive results indicate an economically viable option (i.e. where the benefits exceed the overall costs).

Discussion

Preparing a CHAS is an inherently complex undertaking. However, it will provide critically important information needed for strategy development, planning and implementation by coastal councils for decades to come. The complexity of the pilot project required a significant level of effort and data in order to assemble the most basic - yet essential - set of information capable of addressing the study requirements.

A CHAS can also point to a transformative response to coastal hazards such as retreating assets or changing the land use, or provide a desired end point so that an adaptation pathway can be mapped out, for example incremental protection works.

A key output of the pilot project was the Learning's Report which identifies the realities and issues associated with preparing a CHAS. In total, some 36 learning's were identified with the key ones being:

- Prior to undertaking a CHAS, data availability (such as floor level data bases and adequate coastal hazard mapping) needs to be assessed and procured prior to commencing a CHAS. Otherwise, the output can be significantly impeded.

- The CHAS report deliverable in this case, while termed a 'strategy' document, should perhaps be more appropriately termed a 'study report' that informs a higher order strategy. It may be beneficial to separate the CHAS into two parts:
  1. a study report which identifies adaptation options and analyses comparative community and economic benefit; and
  2. a strategy which would include broad community involvement in its development, and would serve to inform the local government planning scheme and land-use planning.

- The CHAS analysis covered areas that were subsequently identified by council as regions where major developments or intensification of development was unlikely therefore will not benefit from a land-use planning response. Early identification of areas that can be treated more simplistically in an adaptation strategy is beneficial in reducing the workload.

- The study focused more on single long-term solutions for a given coastal area than a potential staging of short to medium-term solutions. Identification of interim measures to progress the ultimate coastal hazard adaptation solution may provide opportunities to better align with planning horizons. Such interim measures may be both more effective and less controversial for the community, whist maintaining the overall long-term goals of adaptation. Councils should allow for a multi-staged approach to developing a long-term strategy. This should involve an initial high level, long-term assessment of options followed by more detailed studies that further investigate opportunities and targets for interim staging.

In summary a CHAS can naturally be broken up into three components: data collection; economic analysis of adaptation options; and development of an adaptation strategy with broad community involvement. A key issue in any strategy will be identifying staged or sequential measures to achieve the long-term outcome. In this respect the currently used 'Shoreline Erosion Management Plans' will have a complementary role.

Where does a CHAS sit in the coastal management framework?
Coastal policy has evolved in Queensland. Previously, coastal hazard threats were addressed at the development application stage, where issues were dealt with on a lot–by-lot basis. Now, there is a strong focus on addressing threats at the land-use allocation and planning stage. A CHAS progresses this approach by informing land-use decisions for land potentially at risk from future coastal hazard impacts over a long planning horizon.

The current framework of coastal hazard management support tools can be summarised in the following table.

Table 1: Coastal hazard management support tools

Tool	Purpose	Timeframe	Use
Coastal hazard area studies and mapping products	Define areas at risk from coastal hazards	10–20 year currency	Inform risk/vulnerability analysis, statutory land-use controls and development decisions

Coastal hazard risk/vulnerability assessments	Identify present day risks and vulnerabilities of the community	0–10 years	Inform emergency response and planning schemes
Shoreline erosion management Plans	Identify optimal sea erosion management solutions	Imminent threat usually 0–5 years	Direct immediate erosion management solutions and fast track development assessment process
Coastal hazard adaptation strategy	Identify broad response or adaptation pathways	Emerging major threats usually 5–100 years	Inform planning instruments especially planning schemes/instruments.

A CHAS has parallels with coastal hazard risk assessments but is primarily intended to consider the change in risk and vulnerability from emerging climate change factors such as sea-level rise. In this regard it is a forward looking strategy and is the ideal instrument to inform planning scheme development. In a practical sense, the implementation of a CHAS can be broken down into a series of steps. A Shoreline Erosion Management Plan can then become the tool to guide a coastal erosion threat response as the threat emerges.

In addition, decisions on where and how intensification may occur in the medium to long term should be considered in order to minimise the complexity of undertaking a risk assessment and socio-economic analysis. Local government could therefore prioritise timeframes for locations where intensification is proposed – for example, in the next decade, and then the next. This should allow a more manageable approach to deciding where and when an adaptation study is required to inform a CHAS.

Take home messages

A CHAS is an essential tool for informing on long-term transformative strategies to address the emerging threats from coastal hazards, including projected sea-level rise, on the coast. It is also valuable for informed decision making on intensifying land use on the coast.

But a CHAS is a complex undertaking requiring detailed coastal hazard and asset data sets. It is important to identify and gain this information prior to commencement.

A CHAS should be considered a high level strategy framework that takes account of a coastal hazard adaptation study and other relevant plans or programs such as emergency, financial, infrastructure and corporate plans. A key element of strategy development will be public engagement which may be complex and demanding especially when dealing with private assets.

A CHAS should be considered a ‘living’ document to deal with changing risks, uncertainties and innovative responses. In this regard, the identification of short to medium-term solutions is beneficial.

Acknowledgments

- Local Government Association of Queensland
- Townsville City Council
- GHD Australia Pty Ltd
- Department of the Environment (Australian Government)
- Griffith University Centre for Coastal Management.

References

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