BACK TO THE FUTURE: THE NEXT 50 YEARS

The 51st International Conference of Architectural Science Association (ANZAScA)

29 November - 2 December 2017

Victoria University of Wellington, New Zealand

MARC AUREL SCHNABEL (Ed.)

ASA (ANZAScA)

Back to the Future: The Next 50 Years

51st International Conference of the Architectural Science Association (ANZAScA)

Edited by Marc Aurel Schnabel

Hosted by:

School of Architecture
Victoria University of Wellington
29 November – 2 December 2017

Example of how to cite a paper from these proceedings:
Lastname, A. and Lastname, B. (2017) Example Title of ASA2017 Paper, in M. A. Schnabel (ed), *Back to the Future: The Next 50 Years,* (51st International Conference of the Architectural Science Association (ANZAScA)), Architectural Science Association (ANZAScA), pp. 1–10.

www.anzasca.net

ISBN 978-0-9923835-4-1

Printed in New Zealand
Cover Design: Serdar Aydin

M. A. Schnabel (ed.), Back to the Future: The Next 50 Years, (51st International Conference of the Architectural Science Association (ANZAScA)), ©2017, Architectural Science Association (ANZAScA), pp. 115–124.

Coastal Retreat

Future Implications for Architecture in New Zealand's Coastal Hazard Zones

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Abstract: Climate adaptation strategies evident in New Zealand local authority planning schemes suggest an awareness of coastal hazard issues caused by global warming and subsequent sea level rise. Coastal land identified as hazardous has limits on new residential development. Alterations to existing buildings are required to be within specific floor level heights and constructed of materials that lend themselves for removal. The emphasis is, however, on managing the impending hazard, rather than reducing or removing the risk. Limits on local authority powers and the fee simple entitlement of ownership mean the ability to order removal of buildings is limited to dangerous health and safety issues of immediate concern. Planned building retreat or removal in the face of future uncertainty is not possible without the cooperation of the landowner, a challenging scenario given the high cost and desirability of coastal land. This paper will overview key literature surrounding climate change adaptation policy as it relates to coastal hazards and sea-level rise. It will evaluate and compare the coastal hazard adaptation policies of two district schemes within New Zealand and suggest future strategies around the concept of "managed retreat" that may serve to minimise the potential damage to buildings (and their owners) living within hazardous coastal zones.

Keywords: Environmental policy; adaptation; local government.

1. Introduction

Comparative policy analysis is the systematic study and comparison of public policies and policy-making in different jurisdictions "…to better understand the factors and processes that underpin similarities and differences in policy choices." (Gupta, 2012) Effective comparisons between, as in this paper, the natural hazard adaptation policies of two distinctly different Local Authorities, can elicit clarity about the determining factors that make for the variations in policy and hence "serve as a foundation for theory-building." (Smit et al, 2003) They enable policy makers to draw inferences from the experience of other jurisdictions, and thus help improve the overall quality of adaptation policies across the local government spectrum. Adaptation policies, by their very nature, are dealing with the unknown in an incremental way such that a region's vulnerability, or susceptibility to "negative climate-related impacts" is reduced (McEvoy, 2013). All local governments have some scope for formulating localised policy choices, in spite

of common restraints such as a lack of capacity, scarce resources and central government placed limitations to their authority. The choices they make provide fertile grounds for comparison (Vogel, 2015). This paper then, compares the degree to which the coastal hazard policies within two district schemes, the AUP and the Western Bays of Plenty district scheme, align with the adaptation policies outlined in the New Zealand Coastal Policy Statement (NZCPS). Both district plans border areas of low-lying coastal land. A comparison of their coastal hazards policies is a useful opportunity to test the level of compliance against the NZCPS, the overriding document, and to assess the architectural implications of these policies.

Research studies into the effects of global warming and its anticipated effect on sea level rise (SLR) have undergone a significant increase in the last 15 years (McSweeney, 2015). These studies have a particular relevance to the New Zealand context. Hall et al, for example, suggests present day sea levels in the United Kingdom could rise by up to 0.69 metres by the year 2080 (Hall et al, 2006) with damage depending on size and frequency of surge event (Hulme, 1998, 2002). Studies emanating from Latin America suggest population rise and building development in coastal areas is set to continue alongside rising sea levels and changes to extreme sea levels associated with storms, thereby adding to the risk level (Reguero et al, 2015) and, of course, the cost (Jongman et al, 2012). Peer-reviewed publications such as Rahmstorf (2007), using techniques that relate sea level to historical average temperatures, suggest a rise of 0.55 metres to 1.25 metres, depending upon emission scenarios. Other researchers (Vermeer & Rahmstorf, 2009; Horton et al, 2008; Grinsted et al, 2015, Pfeffer et al, 2008) range in their estimates of a sea rise level from a low 0.18 metres to a high of 1.6 metres by the year 2100, depending upon the methods used and the various emission scenarios. Research studies in New Zealand by the Commissioner for the Environment suggest similar increasing frequencies of 100-year exceedences over time, with Auckland's rise lagging that of other New Zealand cities due to tidal differences (Parliamentary Commissioner for the Environment, 2015). Golledge et al (2015), Naish et al. (2015) suggest, the upper limit of SLR projections could be too conservative, with ice sheet melt from Antarctica alone estimated in their modelling to contribute a base sea rise of as much as 0.40 metres by the year 2100 if a maximum global temperature rise of 2 degrees is not maintained. This would result in a significant increase in the Intergovernmental Panel on Climate Change (IPCC) report estimates, which in 2013 estimated a SLR range from a low 0.26 metres to as high as 0.98 metres, depending on the Representative Concentration Pathway chosen (Church et al, 2016). Golledge et al's (2015) scenario, (a projection that has a present IPCC *low confidence* rating due to levels of uncertainly in the modelling of these process-based projections), would, if borne out, result in Antarctic sea-ice melt, ice shelf erosion (and subsequent melt) and a resultant SLR of several metres. Such research reinforces the need for greater understanding of the coastal hazard processes and a long-term commitment to mitigating the effects that cause it.

2. Methodology

The policies relating to coastal hazards are outlined in Section 3. Section 4 discusses and compares the various policy attributes under the appropriate criteria derived from the NZCPS. Table 1, within this section, summarizes the results and tabulates the architectural implications for residential construction.

3. Policy Context

3.1. Auckland's Unitary Plan Section E36: Natural Hazards and Flooding[1]

Five objectives and policies (excluding flooding) are specifically devoted to natural hazards and define the type of land subject to risk, specify conditions under which subdivision and development is allowed and outline, in detail, the risk assessment considerations for such development proposals that would be considered in any specialist (resource consent) application. These include the type of activity, its effect on public safety, consequences for other activities including effect on landscape values, public access, retention of land forms, nature of the site layout, planting to mitigate the severity of the hazard and the design and construction profile of the building and its ability to be relocated in the future should this be required. Other pertinent policies that relate specifically to coastal inundation and SLR include formulas that establish the finished floor levels of buildings located within the natural hazard zones. (Auckland Unitary Plan, 2017)

3.2. The Western Bay of Plenty District Council (WBOPDC) District Scheme (Waihi Beach Coastal Protection Area*)*

Research into coastal processes was first commissioned by the Bay of Plenty Regional Council in 1993. The special "Coastal Protection Areas" for Waihi Beach grew out of this research. They were incorporated into the first District Plan for the district in 1994, becoming operative in 2002 (WBOPDC: Coastal Protection Zone, 2015). The initial research was revisited as recently as 2015 with the modified protection zones for Waihi Beach incorporated into the present Operative District Plan soon after (WBOPDC: District Scheme, 2015). This northern semi-rural district forms an arc around (but does not include) the fast-growing Bay of Plenty city of Tauranga, now the fifth largest city in New Zealand. It contains the iconic ocean beaches of Waihi and Pukehina, the former being the particular focus of this study. Waihi Beach is a long-established holiday retreat for many New Zealanders, with many small holiday houses (baches) dotting the coastline. As with many others coastal areas, development pressure and desire for coastal land over the last 30 years has seen the small holiday bach give way to the large house and the urban apartment. Much of the early development was ad hoc and gave scant regard to the long-term effects of coastal processes. As the town of Waihi Beach has grown, however, issues such as flooding, flood plains and coastal hazards including erosion and inundation have come to the fore.

3.3. New Zealand Coastal Policy Statement 2010

Both the Auckland Unitary Plan (AUP), Auckland City's new Planning document, and the Western Bay of Plenty District Council's (WBOPDC) scheme are in fact a series of plans that detail how the regional area will deal with managing the "use, development and protection of natural and physical resources in a way, or at a rate, which enables people and communities to provide for their social, economic, and cultural well-being and for their health and safety" (Auckland Regional Policy Statement, 2016). These statutory planning schemes are the vehicle through which local government manage development and growth and make and implement land-use decisions. The development decisions should reflect the regional planning priorities, advance the purpose of the RMA in achieving ecological sustainability and take account of the

[1]In Previous AUP versions: Ch5.12.

short and long-term environmental effects development on climate change. In the specific areas of Coastal management, the RMA requires local and regional government to give effect to the objectives and policies stated in the New Zealand Coastal Policy Statement 2010 (NZCPS). Within this document are the specific objectives and policies that pertain to coastal hazards local government is required to give effect to (Department of Conservation, 2010). They will in this paper become the base criteria against which the respective natural hazard policies of the two jurisdictions are compared.

4. Results and Discussion:

4.1. Significant issues outlined and hazard identification clearly stated in the adaptation policies.

Both scheme plans acknowledge the risks associated with their locality, including coastal erosion, coastal inundation, tsunami, land instability, flooding, earthquake and volcanic eruption.

4.1.1. Definitions. The AUP, unlike the WBOPDC scheme, gives a detailed definition of land that may be subject to natural hazards. More specifically, this is land defined as:

a) within a horizontal distance of 20m from the top of any cliff with a slope angle steeper than 1:3 (18 degrees);
b) on any slope with an angle greater than or equal to 1 in 2 (26 degrees);
c) at an elevation less than 3m above Mean High Water Spring MHWS if the activity is within 20m of MHWS; and
d) any natural hazard area identified with the Council's natural hazard register, database, GISviewer or commissioned natural hazard study (AUP, 2017).

4.1.2. Hazard Mapping. Both schemes augment written information with maps or databases that identify the location and scale of the hazard. In the AUP, the Auckland Council has taken the map technology one step further, with the National Institute of Water and Atmospheric Research (NIWA) assigned to instigate a series of digital overlay maps based on cadastral level information which, when overlaid over any base zone map, provide information about the projected extent of coastal inundation within a zoned area (Figure 1).

4.1.3. Hazards Database. The WBOPDC scheme identifies other natural hazards, such as land instability and notates them on the plans, unlike the AUP which, for reasons associated with the new city's size and complexity, has elected to schedule hazards other than those associated with coastal hazards on separate databases. The onus in this latter case would be on the user to search out and identify these hazards prior to initiating a project for consideration.

4.2. New development and coastal hazards.

Both plans have addressed the issue. The Waihi Beach Coastal Protection Plan differs from the AUP, which has incorporated only one Coastal Hazard Zone, that being the 100year projection. As with the AUP, the WBOPDC allows limited residential development to proceed outside the coastal erosion zones (where it is prohibited), provided hazard protection work is not required. The mapped presence of primary (50 year) zone and the secondary (100 year) coastal erosion zones in the local Waihi Beach area is another positive feature (Figure 2). Sub-divisional development located within these erosion zones is prohibited. Elsewhere in inundation zones, it is restricted to heights related to a common datum and to an assessment regime

that takes into account the degree of portability of the structure, the avoidance in the use of concrete walls and floors, minimum distances to dune toe and the degree to which the sub-division impacts on the coastal environment.

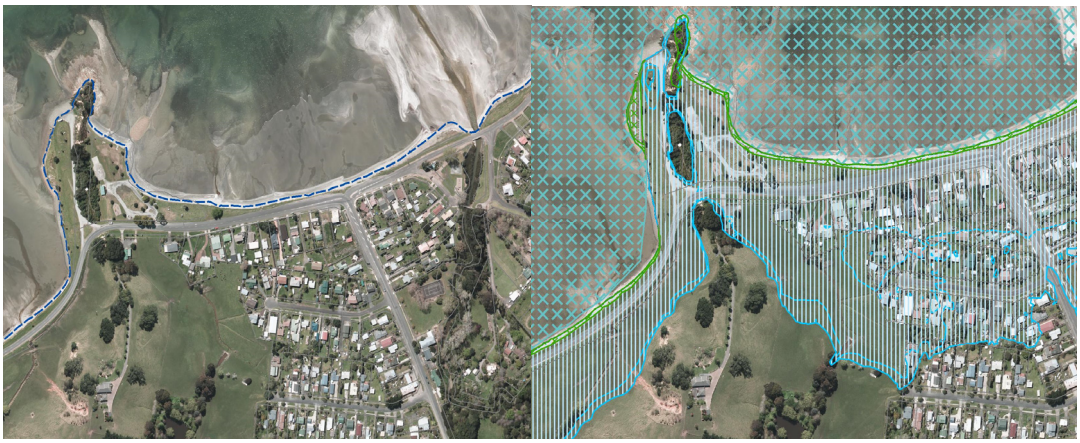

Figure 1. Digital overlay (left) to part Kawakawa Bay map (right) showing extent of coastal inundation predicted for a 1% AEP + 1 metre SLR event. (Source AUP)

The AUP's policy allows subdivision in certain limited circumstances but in all cases, requires a full risk assessment of each sub-divisional proposal. Eleven specific criteria are outlined against which the subdivision proposal is measured. These include type, frequency and scale of the natural hazard, type of activity, design and scale, effects on public safety, exacerbation of an existing natural hazard, ease of movement for the building should it be required by severe shoreline retreat and the use and retention of natural landform buffers over hard engineering solutions. All such land requires an engineering assessment to confirm whether the land is, or will be, subject to erosion, inundation or instability over the next 100 years.

4.3.Existing developments and Coastal Hazards

The WBOPDC District Scheme plan allows for development of land already developed in urban areas now known to be at risk from natural hazards "only when any likely adverse effects can be avoided or appropriately mitigated." (WBOPDC District Scheme, 2015) Clause 8.5.2 of the plan elaborates on risk assessment criteria, with dwellings, alterations or extension located in inundation areas required to be above the 2 percent AEP storm tide event plus a 0.50m freeboard height.

Development of existing land and building in the AUP is subject to the same restrictions as subdivision and new development ie., engineering assessment to assess its hazard free status. Failing that, a resource consent is required (special planning permission) in which the risk criteria summarised in Section 4.2 are examined. Should planning consent be given, finished floor levels for dwellings, alterations or extensions to the dwelling(s) located in coastal inundation areas are required to be above the mapped 1 percent AEP storm tide event plus 1.0m projected SLR.

Figure 2. Waihi beach coastal protection zones (source: WBOPDC)

4.4. Policy attitudes to natural and hard engineering coastal hazard defences

The WBOPDC policy requires "the encouragement and enhancement of natural features such as sand dunes and wetlands which have the capacity to protect existing developed land." (WBOPDC District Scheme: Cl.8.2.2) Hard engineering works are seen as last resort. Where hazard protection works are necessary "form, location and design are such as to avoid or mitigate potential adverse environmental effects," a difficult proposition to achieve, as Figure 3 illustrates.

The AUP requirements have the same intent, but are more specific in what is *not* acceptable as a hard engineering solution. For example, such solutions must not "undermine the foundations at the base of the structure, cause erosion in front of, behind or around the ends of the structure, cause settlement or loss of foundation material, movement or dislodgement of individual structural elements, long term loss of sediment from the immediate vicinity or long term adverse visual effects on coastal landscape and amenity values." (AUP: E36.3.12. (a-i))

Figure 3: Waihi Beach rock buttresses

4.5. Policy attitudes to managed or voluntary retreat within coastal hazard areas

The issue of "planned retreat" for existing communities is not addressed to any degree of resolution in either scheme, even though consideration is a part of the NZCPS objective and a logical outcome of the RMA focus to "avoid, remedy and mitigate adverse effects" from planning decisions. The prospect of later building removal as a result of future coastal erosion and inundation is implicit in Policy 8 of the WBOPDC scheme in that it requires re-locatable buildings and prohibits "the use of concrete and blockwork foundations, floors and walls in the coastal erosion zones."(WBOPDC District Scheme: Cl.8.2.2(8)) The AUP similarly hints that the ability of a building proposal to be relocated in the future would be one of the factors influencing permission to develop or subdivide land (AUP: E36.3.(5)). However, there is no specific requirement in the present planning scheme for *existing* buildings in coastal hazard areas to be re-locatable or relocated over time. Even new additions or alterations within these existing buildings are required only to ensure the risk from their presence to people, environment and infrastructure is not increased, and where practical, reduced. This policy is tested by resource consent application. Absent as a specific policy is the concept of managed retreat, where communities and local government discuss and agree on long-term action strategies to remove building stock from inundation and erosion prone areas. Studies, such as the Climate Change Research Institute (CCRI, 2011) report, have expressed concern that coastal management at a local authority level in New Zealand, particularly in relation to SLR and its effects, is even now not taken seriously enough, in spite of recent internationally published estimates from researchers such as Rahmstorf (2007) and Pfeffer, et al (2008). CCRI's report expresses the view that existing settlements in low lying coastal areas, such as Waihi Beach, may have already accepted the inevitability of a coastal adaptation approach that depends on hard engineering stabilization. This approach, whilst it may be appealing in the short-term, "will decrease community resilience and increase vulnerability in the long-term" (CCRI, 2011).

3. Conclusions

This research is a first stage attempt to compare coastal hazard adaptation policies for scheme plans of two very differently scaled settlements. One is a large metropolitan city, the other a semi-rural district with pockets of urban coastal settlements. The comparison analysis exercise is tabulated in Table 3. The exercise suggests value in additional research where a wider cross section of coastal hazard adaptation policies can be compared and rated in accordance with the degree of specificity of a policy to a particular hazard or locality. That is, the more generic or global the objective or policy, the less its assessed value. The more focused the policy on geographically specific risk, the higher the rating. This approach is supported by academic research that suggests good adaptation processes include working with coastal communities to achieve change, understanding existing local risks and vulnerabilities to coastal hazards and identifying and mitigating the most adverse in a flexible process that is open to change through on-going monitoring.

Whilst there are wide differences between the two district schemes in terms of scale and urban density, there is a window of commonality in that both jurisdictions contain tracts of low-lying, erosion prone coastal land. The comparison found that in both schemes coastal land identified as hazardous within the two district schemes had limits on new residential development. Alterations to existing buildings are required to be within specific floor level heights and constructed of materials that lent themselves for removal. The emphasis is, however, on managing the impending hazard, rather than

Table 4: Comparison of Development Conditions in Coastal Hazard Zones: Implications for Construction

Item	**WBOPDP –Waihi Protection Plan**	**Auckland Unitary Plan**
New buildings within a new subdivision	Not permitted	Permitted with conditions • Full engineering risk assessment required • Multiple conditions: type, frequency, scale of development, public safety, exacerbation of existing hazards; type of activity, design & scale, ease of movement off site if required (shoreline retreat)
Existing and new buildings within existing subdivisions (including alteration, additions)	Permitted with conditions: • Subject to Engineering assessment to determine hazard status • Floor datum height limitations 2 per cent AEP storm tide + 0.50m freeboard height	Permitted with conditions: • Subject to engineering assessment to determine hazard status • Floor datum height limitations 1 per cent AEP storm tide + 1.0m projected SLR.
Mitigation of coastal defences through hard engineering works	Permitted only as a "last resort". Natural defences encouraged. • form, location and design are required to avoid or mitigate potential adverse environmental effects	Permitted under specific conditions: • H/E works must NOT undermine the foundations, cause erosion to structure, cause settlement, loss of foundation material, movement or dislodgement of structural elements, loss of sediment from the immediate vicinity, long term adverse visual effects on coastal landscape and amenity values."
Consideration given to future managed or voluntary retreat:	• Building structure required to be re-locatable • Concrete walls, foundations & walls prohibited	• The degree of building relocatability is a consideration in permitting construction of a dwelling in the coastal erosion zone.
Existence of managed or voluntary retreat policy:	• No	• No

reducing or removing the risk with a long-term community strategy of managed retreat. Limits on local authority powers and the fee simple entitlement of ownership mean the ability to order removal of buildings is limited at present to dangerous health and safety issues of immediate concern. Specific policies on managed or voluntary retreat in the face of future uncertainty is a significantly more complex policy field, and one that will, without governmental support, unfairly test the limited resources of many coastal local authorities. The development of a national government strategy on the equitable sharing of risk associated with SLR between community, local and national government would help significantly in informing coastal property owners of the issues associated with ongoing coastal ownership in an era of rapid climate change. This strategy would need to include such issues as compensation, if any, for the curtailing of property rights, issues associated with coastal property insurance, criteria defining the limits in the use of hard engineering solutions to mitigate coastal erosion, and consistency in the approach to building construction within hazardous areas.

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