

Coastal planning in North Shore City, New Zealand: Developing responsible coastal erosion policy.

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Abstract: North Shore City's coastline has been subject to intensive development pressure over the last 15 years. In this time, new developments have established along previously undeveloped areas of coastline and existing sites have redeveloped with much larger houses. This paper provides a description of the planning controls that currently affect coastal development and an assessment of the effectiveness of these controls. This is followed by an analysis of the role of local government in controlling future development. Contention arises when attempts are made to control the property rights of landowners to protect their properties from coastal erosion. The impacts of private coastal protection works on the coastline have wider impacts than their immediate location and can influence public perception of the coastal environment. Coastal erosion is a prominent issue for North Shore City and this increase in development has increased the risk to both property owners and potentially the Council. Authorities are concerned that current coastal planning controls do not address coastal erosion to a great enough degree.

A methodology for assessing change along the coastline is described and used to identify where planning controls are not being effective by using indicators such as the presence of coastal protection structures and signs of erosion. Alternative policy approaches are identified and evaluated using a cost-benefit analysis framework. It is envisaged that this preliminary cost-benefit analysis will identify policy aspects requiring future in-depth investigation. The practical implications for different policy approaches regarding coastal erosion and private property rights are also explored.

Key words: coast, erosion, planning, cost, benefit, development, protection, structures.

1 Introduction

Coastal real estate is in high demand in New Zealand (Freeman and Cheyne 2008). North Shore City, New Zealand is surrounded by 160km of coastline and is linked to Auckland's CBD by the Auckland Harbour Bridge. This makes it a popular residential city in the Auckland region in terms of both lifestyle and location. Residential development within the coastal areas of North Shore City has intensified over the past 15 years. Many sites have been subdivided and completely redeveloped resulting in larger houses, closer together along the coastline. This is a phenomenon evident in coastal cities through out the world (Freeman and Cheyne 2008). In conjunction with this development, coastal erosion processes are operating. The issue is therefore how to regulate this development in the dynamic coastal environment where the coastline is always changing and existing-use rights are prominent.

Factors contributing to the coast's vulnerability generally make it an attractive place to develop houses. Proximity to the beach and where cliffs rise to flat land at the top are some of these attractive qualities (Caldwell and Segall 2007). As the value of the coast increases, it is only natural for privatization of the coast to begin. State regulations play an important part in helping to define people's property rights because they supply the regulatory mechanisms for controlling coastal development (Cheong 2008). Private property rights are afforded legal protection therefore in combination with the high value of coastal land, pressure to build as close to cliff edges is strong (Bernd-Cohen and Gordon 1999). With this comes the pressure to protect the coastal property at all costs. These efforts are often incompatible with preserving the coast as a functioning ecosystem (Cooper and McKenna 2008).

Coastal protection structures are being built along many coastlines around the world, including North Shore City's. This has various effects on coastal amenity, coastal processes and the public use value of the coastal environment. A debate arises as to when the property rights of land owners to protect their asset become outweighed by the negative externalities such as loss of amenity for the public and increased erosion of adjacent properties. Not only this, but who will pay if a property is lost due to erosion.

This paper explores the problems that other cities are experiencing in dealing with coastal erosion and residential development. North Shore City is the subject of an in-depth look at the effectiveness of the operating coastal controls. This is then considered together with possible options for addressing coastal erosion in the future in North Shore City.

1.1 The coast as a public good

Public choice theory is based on the assumption that an individual will aim to maximize their own interests at the expense of wider public benefit (Reddy 2000). People are selfish by nature and will do what is best for them, even if it may have a significant effect on others. In the case of hazard protection, this seems to hold true. Some aspects of the coastal area can be considered a public good which makes it difficult to determine how valuable a property is to individual property owners (Pompe and Rinehart 1999). Coastal

areas are therefore 'excludable', however non-rivalry characteristics are also prevalent as one person's use of the coast generally doesn't prevent others from using it.

North Shore City's coastline can be attributed a variety of economic values including both use and non-use values (Rudd *et al.* 2003). The coastline of North Shore City represents a diverse ecosystem, as well as a recreational resource for the community. Regardless of this, coastal property owners strive to protect their asset and their properties economic value. This protection often occurs to the detriment of the wider public with negative externalities such as a loss of amenity or greater erosion further down the coast (Reddy 2000; Granja and de Carvalho 1995). This externality impacts upon ecosystems, especially if natural processes are upset.

Local initiatives developed by affected communities may be an effective solution if public goods are being destroyed by the abuse of private property rights (Reddy 2000). This refers to the negative externalities becoming so large that the public values of the coast are compromised. This can be related to inadequacies of district plans to exactly define the property rights people have with coastal properties. This may be through a lack of recognition of the community's right to enjoy unarmoured beaches, or the neglect of the impact of coastal structures on properties further down the coast. Land-use regulations (in a district plan) and the building code are different forms of a public good due to the service they provide (Reddy 2000). If people do not follow these codes and for example, build illegal protection structures, they are essentially 'free-riding' because they benefit from the amenity provided by regulated coastal protection, but still serve their own interests.

The Public Trust doctrine refers to goods in light of common property, land, air or sea which can not be privately owned (California State Lands Commission 2009). This means that intervention in sea and natural beach processes is disallowed. Local Californian governments were surveyed and not one was willing to pay for house removal in known hazardous areas (Fischer *et al.* 1998). This further supports the idea of a public trust doctrine by showing that people who choose to live in these hazardous locations are those that should suffer any consequential expense. The Californian Coastal Act does not specifically refer to coastal hazards so local governments can respond to coastal hazards in various ways (Fischer *et al.* 1998). This system is less reliant on the idea of improved coastal planning, and more focused on a 'buyers beware' mantra. If people are going to build on the coast, they have to be prepared to face the consequences.

However the pressures that are induced by individuals protecting their property rights need to be subject to a statutory framework to promote the sustainability of the coastline (Thom 2004). In the USA city of Malibu, subject to State of California guidelines, if a landowner wants to build within the 10ft setback in an identified hazard area then a waiver must be signed relieving the greater public from liability (Bernd-Cohen and Gordon 1999). This makes the landowner acknowledge that the property has been purchased at their own risk and expense.

1.2 Consequences of ineffective coastal land-use regulation

The Irish Constitution gives extensive legal protection to private property rights and therefore has areas of the coast dominated by armoured structures (Cooper and McKenna 2008). The environmental externalities arising from this policy position are significant. Erosion has increased in unarmoured dune areas and coastal amenity has severely diminished (Cooper and McKenna 2008). The public good aspects have become degraded in an effort to protect private property. According to Cooper and McKenna (2008), Irish case law has not yet assessed an authority's ability to limit coastal protection works along the Irish Coast. They therefore assume that this is likely to continue to be the case along the Irish Coast for some time.

In Australia, coastal land is rapidly being urbanised with more than 60% of the population living along the coastline, especially in areas close to a capital city (Gurran and Blakely 2007). This increasing intensity of coastal development in Australia is also increasing the exposure of people and property to coastal hazards (Gurran and Blakely 2007). This is a similar situation in New Zealand where North Shore City is in close proximity to Auckland's CBD and therefore offers attractive coastal real-estate.

Pompe and Rinehart (1999) used Seabrook in South Carolina, USA, as a case study. All residents of the town contribute money annually into a fund which pays for their beach protection. No state or federal assistance is available for these properties. The amount each individual pays is based on proximity to the beach and whether the site is developed or not (Pompe and Rinehart, 1999). This study fails to outline any development controls that coastal properties are subject to. It seems that different properties are going to gain different levels of benefit from this coastal protection provision. If further development occurs on certain sites i.e. closest to the coast because they have the sense of security provided by protection, then the gap between what they are paying for protection compared to their benefit, and those that live further back from the coast will get larger.

1.3 Who pays?

In the past experience of New Zealand and natural disasters, property owners are rarely left to face the consequences of natural hazard events on their own. This has been observed in the Matata flooding events. The New Zealand Cabinet at the time resolved that the Whakatane Council (the local council) would receive money to help rebuild the town and prevent such an event from happening again (Barker 2005). The media also reinforces this with public appeals commonly appearing on news programs after natural hazard events. New Zealand also has the New Zealand Earthquake Commission which has a Natural Disaster Fund. This money goes to property owners who experience a natural disaster but does not pay for any consequential protection works (Spence 2004). With this psyche so heavily ingrained in New Zealand culture, it would appear to be difficult to introduce a rule or law that resulted in coastal property owners facing the consequences of coastal erosion on their own.

1.4 Erosion as a hazard in the coastal zone.

Coastal erosion is a natural process influenced by humans, consisting of erosion, transport and deposition components that collectively modify coastal landforms (Cooper and McKenna, 2008). These processes all differ both temporally and spatially and cliffs tend to retreat (ARC 2006). Coastal erosion is also a process that is likely to be altered by climate change (Ramsey and Bell 2009). Past hazard studies tend to have been focused on large episodic events and neglect erosion as a significant hazard (Dilley and Rasid 1990). Although this may be true to some extent, it cannot be ignored as erosion in a coastal setting leads to loss of amenity, inconvenience and expense to both the public and landowners (Dilley and Rasid 1990).

Coastal erosion is associated with a large degree of uncertainty (Bernkopf *et al.* 2001). It tends to be that a person will purchase a property in an erosion-prone area, and then simply cross their fingers that nothing will happen to the property and its structures while they own it (Dilley and Rasid 1990). Not only this, but there is often large gaps between what the latest scientific knowledge is, and what policies are being implemented (Fischer *et al.* 1998). In conjunction with this, the upfront costs of developing and implementing coastal erosion mitigation policy often does not appear to be less than the immediate costs of mitigation (Bernkopf *et al.* 2001). This could therefore make it even more difficult to convince politicians of the merit of a preventative coastal policy.

To even use the term ‘coastal protection’ is somewhat misleading as the aim is not to actually protect the ‘coast’ but to protect the structures which people have put there (Dilley and Rasid 1990). Coastal “protection” is often used in both contexts with coastal planting and restoration efforts also being considered as “coastal protection”.

1.5 Local authorities and regulation of property rights

Like elsewhere around the world, national and regional authorities in New Zealand shape and some what dictate a local authority’s ability to administer land-use regulations. Compounding this, local political will of a community can be a barrier to the effective implementation of these regulations (Reddy 2000). This leaves issues such as coastal erosion hazards and land use controls to a reactive response, as opposed to a consistent policy approach at the outset. This is not limited to coastal hazards; flooding hazard is often also addressed reactively in New Zealand.

In New Zealand, development of the coastline is subject to two legislative mandates; the Resource Management Act 1991 (RMA) and the New Zealand Coastal Policy Statement 1994 (NZCPS) (currently under review). Under the RMA it is a statutory requirement for regional councils to develop a Regional Coastal Policy Statement and for a district plan, developed by a local authority, to not be inconsistent with this. Working in conjunction with these is the Hauraki Gulf Marine Park Act 2000 which outlines management objectives which the regional and local legislation must also give effect to (Peart 2005).

Therefore the approach taken to policy and rule development with regard to the coast in New Zealand is a top-down approach. Many local authorities through their district plans

prevent new development in areas where development is considered detrimental to the functioning of the coast (Cooper and McKenna 2008). Such control is limited by what is stipulated in higher level legislation and linkages between these and local land-use planning (Gurran and Blakely 2007). A local council in New Zealand can only regulate the use of the coastal environment to the extent provided for by the NZCPS. The content of this high level framework is therefore essential.

An underlying theme in the NZCPS is the emphasis on preserving the natural character of the coastline and limiting development to those areas which have already had their character compromised. Difficulties arise in trying to reduce the further intensification of coastal urban areas. This is the situation in North Shore City.

The statutory framework for regulating private property rights stems from this legislation and then feeds down into the regional and district plans. The taking of reserves when coastal sites are redeveloped and limitations on possible development within the foreshore yard (setback) are all examples of limiting a landowners property rights within the coastal areas of North Shore City.

In 2009, New Zealand's Ministry for the Environment released a guideline informing local government of principles to be incorporated in dealing with coastal hazards. This addresses development of coastal margins in the face of climate change. It covers precautionary measures, reducing risk over time, the importance of natural coastal margins as a form of coastal defense and integration of decision making. Also outlined is that local governments should be avoiding those developments which will make it more difficult to deal with future coastal hazard events (Ramsey and Bell 2009). This particular aspect is covered further in the North Shore City case study.

In New Zealand there is a need for communities to speak up and fight the further issuing of consents which undermine the public good aspects of the coastal areas of North Shore City. This raises the profile of important coastal issues that affect the community. There are communities around the world which prohibit the construction of coastal protection works or any efforts to harden the shoreline (Reddy 2000).

When a local authority chooses to prohibit coastal protection works this reinforces the idea that erosion is a negative process which has to be stopped. They are effectively stating that the natural beach system is more important than upland/cliff-top structures (Bernd-Cohen and Gordon 1999). This may sound like a strong statement but it essentially covers the intentions of the local authority quite succinctly. As well as this, private property rights are further encouraged by the coastal engineering profession who promote the coast as 'demanding' to be protected (Cooper and McKenna 2008).

The literature seems to be in general agreement that the overall effectiveness of a coastal management program comes back to how successfully an authority can balance hazard protection with public access, and the rights of property owners (Bernd-Cohen and Gordon 1999; Fischer *et al.* 1998). The need to respect property rights is paramount in a coastal setting. There is a high proportion of private ownership; therefore any efforts to

regulate development without consideration of this will be poorly received (Bernd-Cohen and Gordon 1999). A citizen's home is also often the dominant proportion of their wealth therefore any limitations on the use of their property need to be strongly justified (Meyer 2009).

The strong desire of the property owners and property developers to defend their assets is assisted by low societal appreciation of the consequences of intervention at the coast, and the ambiguity associated with 'coastal protection' (Cooper and McKenna 2008). It may be that if local authorities made a greater effort to inform the public of what these consequences would be that they may gain greater support for policy initiatives that prevent inappropriate coastal development.

The attitude of private landowners towards local authorities imposing rules upon their land has to change. Restricting properties on cliff-edges reduces public risk as a liability particularly where development is closer to cliff edges when cliffs eventually fail. Someone has to be responsible for the environmental externalities. In the USA, regulatory tools are most often employed to determine coastal development as most beach front real estate is in private ownership and constantly undergoing change. This 'change' refers to both natural change due to coastal areas being dynamic ecosystems but also change in terms of on-going development (Bernd-Cohen and Gordon 1998). It is important that rules created by local authorities reflect local variations (Reddy 2000). This has been attempted by North Shore City Council with the establishment of the now operative foreshore yard rules in the District Plan which provide for control of development within a certain distance of the coast.

In Dilley and Rasid's (1990) study of Lake Superior Ontario, Canada, property owners subject to coastal erosion held meetings with their local council. A Provincial Government Program existed through a Shoreline Property Assistance Act but this was rarely taken up by respondents in their study. The favoured response to erosion was for private property owners to take their own course of action to prevent further erosion. This is compared to a study carried out in North Carolina where avoidance by implementing land-use restrictions and controls is more favoured (Dilley and Rasid 1990). The shoreline residents of their study believed that the costs of protection should be funded by provincial and federal government. Not surprisingly, residents further away from the shoreline believed that those people affected should have to pay some of the costs of protection (Dilley and Rasid 1990).

"Distributional pressures play an important role in the political economy of rights-based arrangements and also mould the kinds of property rights granted...." (pp.133) (Libecap 2009). This is especially true for North Shore City where coastal landowners are very wealthy, influential and therefore able to appeal rule implementation. This makes it daunting for politicians to make any hard decisions to effectively change management practices (Cooper and McKenna 2008). This occurred when a blanket 30m foreshore yard for the city was suggested in 1994, the Council received so much negative feedback that the proposal was hastily withdrawn (Kath Coombs, pers. comm., 2009)

1.6 Establishing a value system for coastal areas and cost-benefit analysis

The issue of who should pay for coastal protection is highly contentious. It is often the view of private landowners that the local authority should pay. The subsidizing of their land is then at the expense of the ratepayer who is also left to deal with the negative environmental externalities that can arise from protection works. Efforts to establish the public value of the coast are evolving all the time (Swallow and McGonagle 2006; Pompe and Rinehart 1999). Rather than the usual 'willingness to pay' measure, a measure based on willingness to allocate already paid taxes to a cause can be used (Swallow and McGonagle 2006) as well as a 'valuation of enjoyment' (Whitmarsh *et al.* 1999). In North Shore City, it would mean asking the rate payer if they are willing to pay, from their existing rates base, for coastal protection. The opportunity cost arises when their tax money is spent on coastal protection as opposed to other services provided by local government (Swallow and McGonagle 2006).

A world-wide practice now, cost-benefit analysis (CBA) encompasses the effort to allow adequate economic development while retaining efforts to protect the environment (Cheong 2008). When CBA is undertaken for coastal protection policy decisions, it seems that benefits to individual private property owners are considered while the expenses are left to lie with the public (Cooper and McKenna 2008). In the UK, the government requires cost-benefit analysis be undertaken for all capital projects (Whitmarsh *et al.* 1999). This has to equal at least one for the project to be deemed viable and deserving of government financial assistance (Whitmarsh *et al.* 1999). The analysis includes both recreational and environmental costs and benefits. For North Shore City, recreational benefits may be less significant as an indicator because many of the cliffed areas, which are eroding, don't attract people for recreational activities like a beach. The costs and benefits of different measures of coastal erosion protection will change as the price of coastal properties fluctuate (Pompe and Rinehart 1999; Dilley and Rasid 1990). This means that for a city such as North Shore City, reasonable measures to protect properties in one suburb may be completely inappropriate in another area of the city.

2 Case Study: North Shore City, New Zealand

North Shore City is the fourth largest city in New Zealand, by population, with approximately 220000 residents (NSCC, 2008). The North Shore City Council is responsible for 12500ha which is predominantly urban land with 160km of coastline (Ritchie 1999). There are approximately 1850 private properties along this coastline. Based on the 2009 valuations for the 370 sampled properties, their combined capital value is approximately NZ\$946 million (based on NSCC council government valuations). North Shore City originally developed as a holiday destination with various holiday homes scattering the coastline (Ritchie 1999). However, once the Auckland Harbour Bridge was constructed in 1959 and car ownership increased, development intensified with in-land areas developing (Ritchie 1999).

North Shore City has coastal cliff areas along the eastern side of the city which borders the Hauraki Gulf (Riley Consultants 1997). As well as these cliffed areas, the city has sandy beaches along the eastern coast and inner harbour. The 'beach' areas of the City

are accompanied by private development but often have reserves and public car parks associated with them (Coastal Consultants 2002). In the coastal areas of North Shore City, the geology comprises of the Waitemata group, alluvial materials (although not extensive) and volcanic materials. These all interact differently with natural processes giving rise to different geotechnical hazards. The Waitemata group in particular will display different rates of erosion along the coastline of North Shore City depending on wave attack, saturation, stormwater discharges and weathering (Riley Consultants 2004).

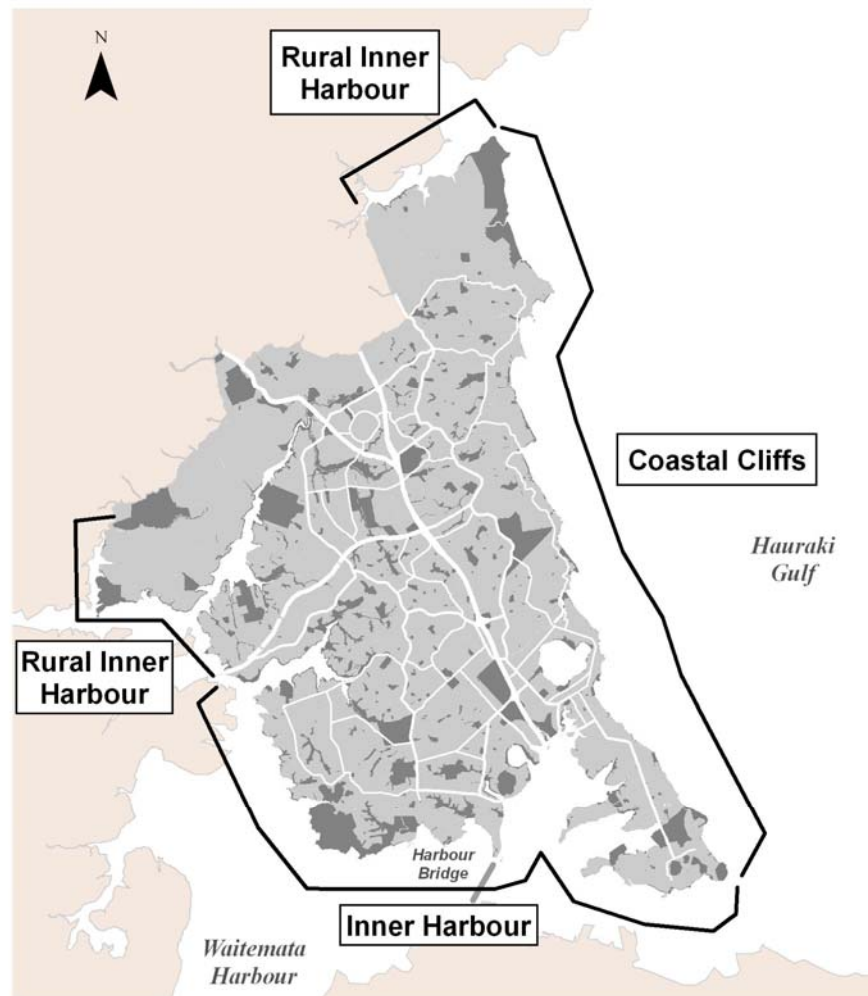


Figure 1. Map of North Shore City and the areas of coastline.

For the purpose of this case study North Shore City's coastline has been divided into 3 defined areas of the city based on the coastal characteristics of the areas shown in Figure 1.

- 'Coastal cliffs' – Extends along the East Coast of the City to the south. Although small beaches are present between the hard-cliffed areas, the entire stretch of coastline is subject to the same high energy environment. It has therefore been considered as one area. This area is also highly modified and intensely urbanised.

- 'Inner Harbour' – This area is a low energy coastal environment which is characterised by smaller, well-vegetated cliff areas but is still a developed urban area.
- 'Rural Inner Harbour' – This area is characterised by low-levels of development, predominantly a rural zoning, low energy coastal environment and generally larger lot sizes with extensive vegetation coverage.

In 1995 and 1996, the high rainfall of the winter months exposed poor cliff stability in North Shore City. During 1995, five major failures were recorded and in 1996 14 major failures were recorded in the cliffed coastal area which affected both the rock material in the cliff face and the loose rock and soil overburden material at the top of the cliff (Riley Consultants 1997). Other areas of the city are recognised as at risk coastal hazard zones and reports have been commissioned to look at the corresponding issues with coastal protection works (Coastline Consultants 2002); however these have not been eventuated into policy development. Most reports have been site specific or based on discrete lengths of the coastline.

Cliff erosion is a natural process and the gradual retreat of the cliffs in North Shore City is an inevitable, natural process (Riley Consultants 1997; Coastline Consultants 2002; ARC 2006). A study carried out by the Auckland Regional Council (ARC) suggests that for the Auckland Region, the structure and surface condition of cliffs is contributing more importantly to erosion than exposure. The key marine process operating on the cliffs has been identified as removal of debris from the cliff due to wave action which would otherwise have formed the cliff toe. The sandy beaches of North Shore City are also subject to coastal erosion due to the impact of wave action on the shoreline (Coastal Consultants Ltd 2002; ARC 2006).

A study executed by Riley Consultants Ltd in 1997 concluded that cliff retreat within the 'coastal cliffs' area of the city (see Figure 1) was due to erosion by weathering and cliff failure. This report also acknowledged that for the study area (which was only 4.5km of the Takapuna cliff coast line); site specific recommendations would need to be made because the cliffs were variable in geological and geotechnical characteristics. This portrays the complexity of the city's coastline and what study would be required to justify a policy change.

In North Shore City development is controlled by a set of rules that work with underlying zone controls. This area is deemed to be the 'coastal conservation area' by North Shore City Council and is displayed graphically on the district planning maps. This area includes land which is characterized by flora, landforms, visual amenity, natural surface drainage and activities that define the coastal environment (NSCC District Plan 2009). Associated with this defined area is a set of specific objectives, policies and rules. These cover the protection of natural character of the coast, public access, cultural heritage, ecology and landforms (NSCC District Plan 2009). Four policies are assigned to hazard mitigation in the coastal environment with one policy addressing coastal protection works in particular. All development in the coastal conservation area is a 'controlled activity' and therefore requires resource consent from the Council (NSCC District Plan 2009). This is an attempt to try and control externalities.

A key part of the Coastal Conservation Area is the operation of the foreshore yard rules which are needed to give effect to the policies outlined in the district plan relating to this defined area. These differ in width throughout the city depending on the different environments present (NSCC District Plan 2009). It is a setback distance measured from Mean High Water Springs within which development is subject to regulation. The initial foreshore yard rule of a 30m setback proposed in 1994 when the North Shore City district plan was notified was fiercely contested by the public. Therefore the council resorted back to the foreshore yards operating under the District Schemes (NSCC 2002). Landuse consent is required for buildings within the defined foreshore yard.

It is important to note the foreshore yard rules were designed for all intent and purposes to protect the coastal amenity of North Shore City and coastal hazards and protection structures were not given much consideration (Kath Coombes, pers. comm., 2009).

There is a limited supply of cliff-top properties in North Shore City. Therefore the value of these properties has greatly increased with further houses also being built through site subdivision (Riley Consultants 1997; ARC 2006). North Shore City currently has two sets of operative provisions in the District Plan relating specifically to the coastal area. This case study will focus on how effective these controls and guidelines have been at regulating development right up to the edge of North Shore city's coastline. The Geographic aerial system and coastal oblique photo records for 1993, 1998, 2003 and 2008 were the source of this information that has been analysed using Microsoft Excel. The sample consisted of 370 privately owned coastal properties.

This information was analysed in light of an increased coastal erosion hazard risk as a result of more intense coastal development. Possible policy options to address coastal hazards are then explored and evaluated.

3 Results

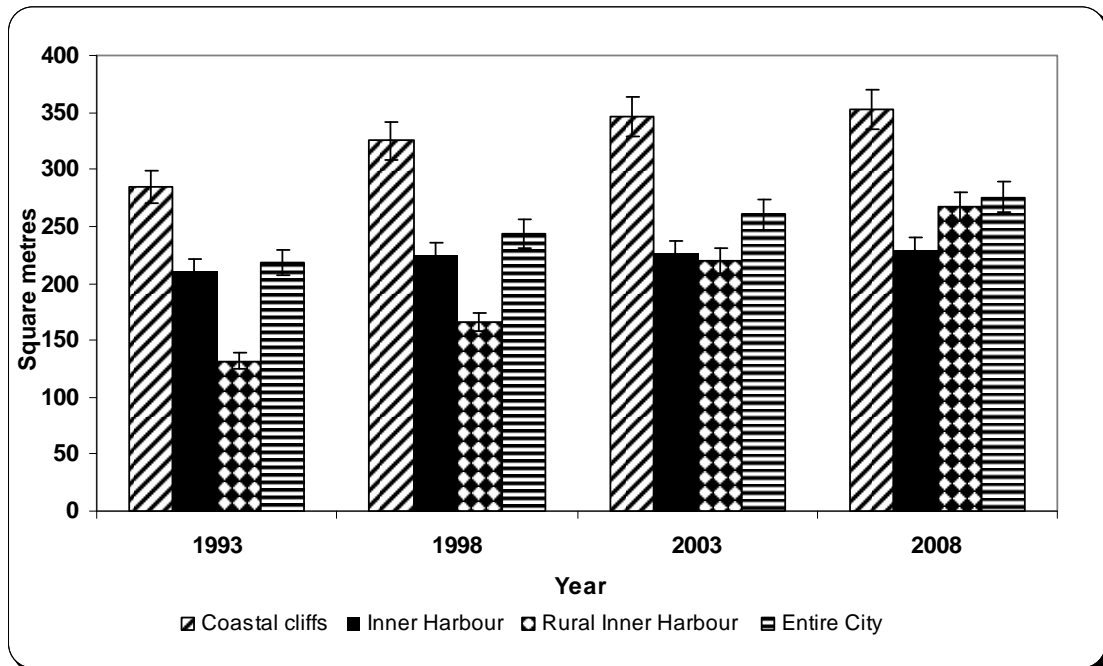


Figure 2. Average building foot print for each of the subject areas in 1993, 1998, 2003 and 2008.

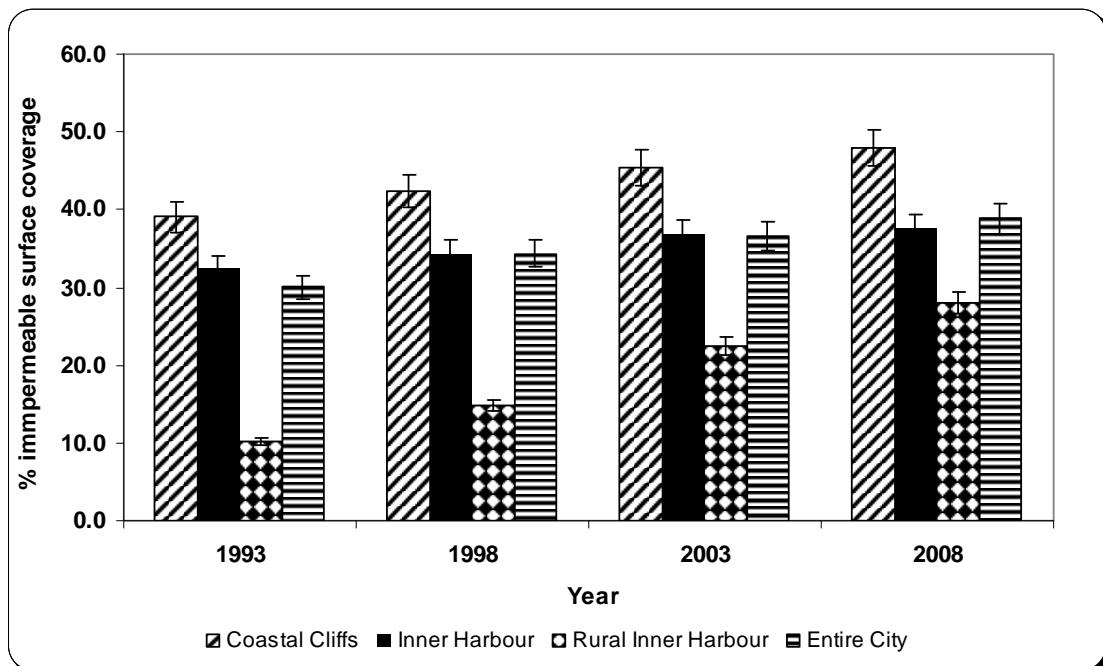


Figure 3. Average overall impermeable surface coverage of the site for each of the subject areas in 1993, 1998, 2003 and 2008.

Figure 2 and Figure 3 show the overall trend observed for the city was an increase in average building footprint and site impermeable surface coverage. The ‘coastal cliffs’

average lot size is 1541m², 'inner harbour' area is 1337m² and 'rural inner harbour' is 1463m².

The 'coastal cliff' area had the greatest average building footprint observed with the average of 353m² in 2008 compared to the average building footprint of the entire city in 2008 of 276m². The data obtained from the 'coastal cliff' area showed an increase in building footprint size between 1993 and 1998 from 285m² to 325m². This exceeded the increase in average building footprint size obtained for the entire city between 1993 and 1998 of 218m² to 244m².

The 'rural inner harbour' showed the greatest increase in average building footprint between all study years. The results for the 'rural inner harbour' are not unusual as this area has only begun developing in the past 15 years. The results for 'coastal cliffs' however are more concerning as this is where residential development is well-established. This was predominantly 'holiday home development' which became replaced by permanent residents with the building of the Auckland Harbour Bridge in 1959. The redevelopment of these sites equates to landowners removing smaller, more modest homes. These are replaced with larger homes, closer to the coastal edge (also supported by the increase in building footprint observed in Figure 2 and the results for the structures in the foreshore yard indicator).

These coastal sites are in high demand and the erection of large, expensive properties further increases the value of this real-estate (Freeman and Cheyne 2008; Collins and Kearns 2008). The zoning of the 'coastal cliff' areas also influences the ability of a property to be redeveloped by controlling building footprint and minimum lot sizes. However average impermeable surface coverage for the 'rural inner harbour' differs most from the average for the 'entire city' in all of the study years being approximately 20% less than the 'entire city' in 1993 and 10% less than the 'entire city' in 2008. This is because the sites in many cases have gone from having no impermeable surface coverage, to large proportions of impermeable surface coverage.

The increase in average building footprint and impermeable surface coverage reflects an increase in hazard risk in the coastal area of the city. The houses have become larger and more expensive which results in a more valuable asset at risk from coastal erosion. Increase in building footprint can also lead to more complex and expensive solutions to protect properties from coastal erosion as the houses tend to be located closer towards the coastal edge (Price pers. comm., 2009).

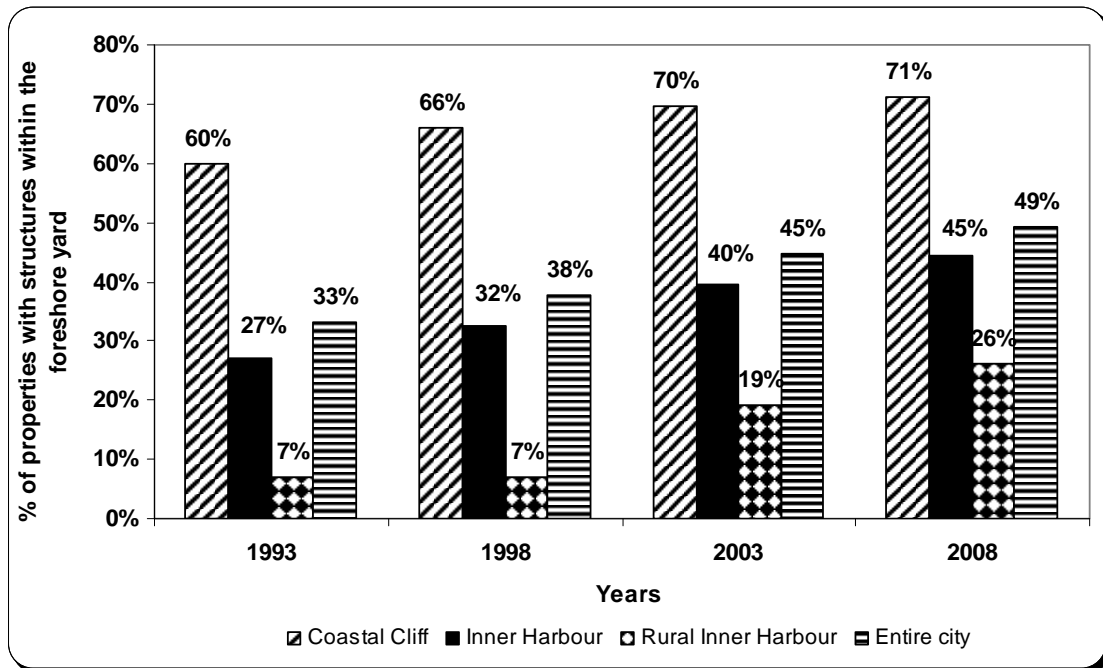


Figure 4. Structures present within the defined foreshore yard area in each of the subject areas in 1993, 1998, 2003 and 2008.

Figure 4 shows a trend of an increasing presence of structures within the foreshore yard in all study areas. The number of properties with structures within the foreshore yard in the ‘coastal cliffs’ area exceeded the overall percentage obtained for the ‘entire city’ in all study years. In 2008, 82 out of 115 (71%) ‘coastal cliff’ properties had structures present within the foreshore yard. In the same year 19 out of 54 properties (26%) in the ‘rural inner harbour’ had structures present.

Structures varied from swimming pools, fences, retaining walls and protection works, to the presence of the house within the foreshore yard. The rules for development within the foreshore yard are not deterring people from applying for consents. This is supported by the large number of resource consents being issued for the CCA. An increasing presence of structures within the defined foreshore yard areas of the city supports the need for stronger policy to control this as this equates to an increase in hazard risk within the coastal environment.

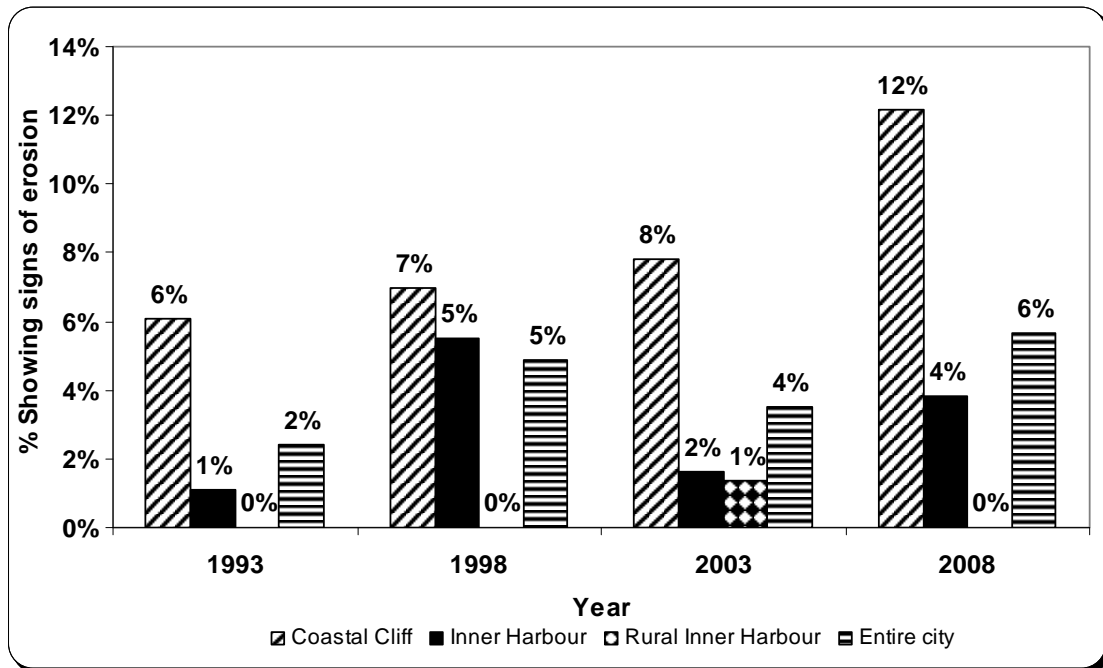


Figure 5. Signs of erosion present within each of the subject areas in North Shore City in 1993, 1998, 2003 and 2008.

The sample sites showing signs of erosion observed in each study year did not exceed 12% for any coastal areas (seen in Figure 5). ‘Coastal cliffs’ showed the greatest frequency of signs of erosion in 2008 with 14 of 115 sites sampled showing signs of erosion.

The erosion results only represent what was obvious from aerial photos and coastal oblique images in each study year. Coastal erosion was an issue during the winters of 1995 and 1996 in North Shore City. Particularly in the ‘coastal cliff’ areas of the city, due to their geology and high energy wave environment. The erosion observed within the ‘inner harbour’ area was seen as soil slippage along the coastline in 1998 and 2003. Within this area, large exotic conifers were observed along certain areas of the inner harbour where the erosion was observed. In Bergquist (1991), a recommendation to remove such trees in erosion situations is discussed and pohutukawa planting is encouraged. Bergquist’s reasoning is that the ‘large and upright’ form of conifers is not as suitable for the coastal environment as pohutukawa which have a form and root system effectively binding the coast.

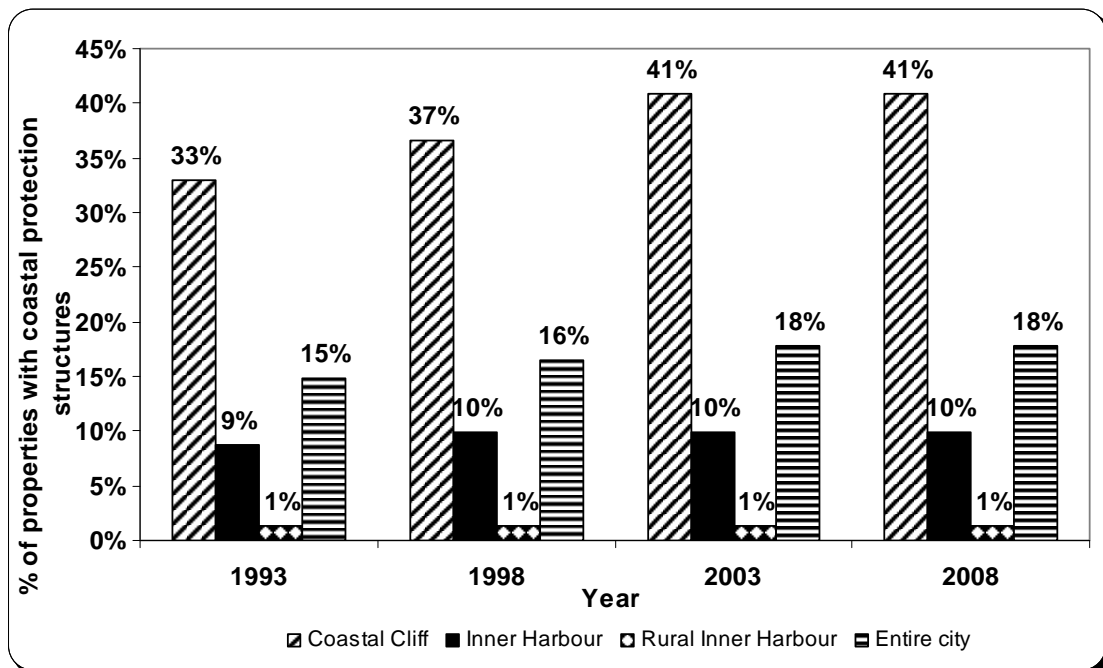


Figure 6. Presence of coastal protection structures within the subject areas in 1993, 1998, 2003 and 2008.

The trend observed for the ‘entire city’ was an increase in coastal protection structures (as seen in Figure 6). Results for the ‘entire city’ showed an occurrence of 15% in 1993 compared to 18% in 2008. However the increase in coastal protection works within the ‘coastal cliffs’ area for the same time period was from 33% to 41%. There was no change in the number of sites with coastal protection works for the ‘entire city’ between 2003 and 2008. This was also the case for the ‘inner harbour’ and ‘coastal cliff’ areas between 2003 and 2008.

The results for coastal protection works in North Shore City support the information provided by Riley Consultants (see Section on cost of coastal protection). The ‘coastal cliff’ area which demonstrates the greatest increase in coastal protection structures has large building footprints, large impermeable surface coverage and less foreshore yard vegetation coverage than the ‘entire city’. Landowners have taken measures to protect their assets and land.

The reality of these results is that the actual presence of coastal protection works along the coastline is higher than what was observed. This is because forms of protection have been constructed which are not yet visible. Palisade walls along NSC coastline will not be visible until the erosion of the cliffs has reached the palisade wall. North Shore City is experiencing more intense development, closer to the coastal edge, as well as coastal protection works. These facts alone support the need for a stronger policy direction that will ensure the ‘soft coastal fringe’ of North Shore City is retained.

Each of the sample sites were looked at over the 15 year period for evidence of complete site redevelopment. This involved the removal of the existing house which was then

replaced by a new house, or the establishment of a house on a site that was previously undeveloped. This trend has also been observed in New Zealand by Collins and Kearns (2008). The occurrence of this in the 'coastal cliffs' region of the city was 29 sites out of 115 (25%), for the 'inner harbour' was 19 out of 182 (10%), and 'rural inner harbour' was 33 out of 73 (45%). Overall for the 'entire city', 22% of the sites were redeveloped within this 15 year period. This supports the need for changes to existing coastal planning controls.

3.1 Results in terms of coastal hazard risk

The trends identified for each of the parameters of the study all indicate the risk to coastal landowners is increasing. Development and investment is increasing in the CCA and therefore larger property investments are at risk. In the future, liability for such property losses may be an issue. A change to current NSCC coastal policy needs to reflect the state of North Shore City's privately owned coastline. The occurrence of the hazard event or likelihood of the hazardous event has not been investigated by this case study.

3.2 Cost of Coastal Protection

A phone interview was undertaken with Steven Price from Riley Consultants Ltd., a commonly used engineering and geology firm in North Shore City. The interview discussed the costs involved with various types of coastal protection works constructed in the City. During the discussion, Price outlined that coastal protection works were not encouraged as a favourable option for landowners due to the difficulty of getting consent.

From this discussion it was concluded that palisade walls were more often the chosen form of protection over seawalls. It is easier to get consent for a palisade wall at the top of a cliff, than for a seawall at the bottom of the cliff. A palisade wall is not immediately visible, while a seawall interacts with public spaces and the sea. This often triggers landuse consent from the Auckland Regional Council in addition to consent from NSCC. Seawalls and palisade walls used in North Shore City are designed to exceed 100 years. When coastal landowners are informed of the standard of seawall required to gain consent, they are deterred from that option.

For a 20m wide property, the approximate costs of a seawall are: \$50-60,000 for construction; \$4-10,000 for consultant's fees; \$5000 for ARC fees; and \$2-3,000 for NSCC fees. The costs of a palisade wall depend on the extent of wall required but can range from \$50-150,000. The closer the palisade wall has to be to the cliff edge, the more expensive the wall becomes. Therefore when large properties are built very close to the cliff-edge, their options available for protection are in fact limited. They will generally require both a seawall and palisade wall to gain the necessary protection for the property.

Future demand for palisade walls may be partially dependent on how palisade walls are perceived in the next 50 years when they become exposed. If they are perceived as detrimental to the amenity of the coastline, then more fierce opposition to them may arise. On the contrary, if they are accepted by the public then support may grow for their

presence. This will depend on how negative externalities have arisen and whether the public perceives these as impacting upon their coastal amenity.

4 Policy Options and Evaluation

The implementation of rules needs to occur incrementally over a long period of time to gain acceptability. Local government is a dynamic political environment dealing with contentious community issues (Reddy 2000). Slow changes can occur with community opinion and thinking, and therefore become in-grained in the policy making (Reddy 2000). The shift has to be from protection of built assets on the coast, to the protection of the coast as an ecosystem. It is essential that man-made infrastructure built along cliff edges is viewed as being unacceptable, not something that is at risk (Cooper and McKenna 2008). Participation with affected communities and the sharing of information is also important.

A preliminary approach has been undertaken identifying costs and benefits which will require further, in-depth analysis and economic evaluation. A thorough CBA should be undertaken regarding the implications of each of the possible policy options (Rudd *et al.* 2003; Whitmarsh *et al.* 1999). If the 'costs' of a policy are outweighed by the economic benefits (producer plus consumer surplus), then this policy has merit and is worth pursuing (Rudd *et al.* 2003). It is expected that contingent valuation studies would need to be undertaken. These would determine exactly how much the public value North Shore City's coastline and whether they believe private property owners should be protected by the Council. It would also determine if the public think coastal property owners should be able to protect their property at all costs.

Policy direction taken by a local authority should be supported by the general public in order to generate private incentives which encourage innovative environmental mitigation options (Cerin 2005). Which ever policy direction is adopted by the local authority, it has to be consistent with the national and regional approaches to coastal hazard mitigation (Bagstad *et al.* 2007). It can not be undermined by any other policies that exist or its integrity will be compromised right from the start. It is important that the adopted policy approach is based on localized, site specific data (Bernkoff *et al.* 2001).

A 'precautionary principle' could be considered here for coastal policy options (Ramsey and Bell 2009; Stojanovic 2009). This is considered in Roger *et al.* (1997) and gives attention to issues which have elements of both risk and uncertainty therefore relating to erosion processes in the coastal environment. Roger *et al.* (1997) perceive aspects of uncertainty and risk as preventing a complete CBA from being achieved for environmental management. Erosion processes in the coastal environment are likely to be affected by climate change and therefore this degree of uncertainty may be increased even further (Ramsey and Bell 2009).

There is also the possibility that North Shore City could adopt a variety of policy options, depending on the geographical locations of the city or different zoned areas. This was the case for various UK initiatives which have coastal policy for different geographical and biogeographical areas (Stojanovic *et al.* 2009). With further investigation in North Shore

City, different areas of the city could be identified as being subject to differing levels of risk and the policy response could be tailored appropriately (Bernkopf *et al.* 2001). Dollar values will need to be established for both market and non-market aspects of the coast which represent the true social values (Roger *et al.* 1997) of North Shore City’s coastline to the greatest extent. The following policy approaches that NSCC could adopt have been subject to a high-level CBA.

Policy Approach 1: Prohibit the construction of coastal protection structures.

Distributional Issues

Most costs will have to be worn by the property owner. In New Zealand, there is the conception that the government will pay the costs of damage by natural causes i.e. flooding and earthquake damage in NZ. Rate payers from around the city would not be expected to pay for damage to coastal properties.

Effect on incentives

This would create a very strong incentive for a property owner to take account of the full risks of buying a coastal property. People would be less tempted to build precariously close to the coastal edge.

Table 1: CBA of Policy Approach 1

Costs	Benefits
<p>Private Costs High cost to landowners if their property falls into the sea. Resulting in a decrease in property value. It could be argued that this new value is the deflated value that recognizes the risks of owning a coastal property.</p> <p>Council Costs Legal litigation against the council for adopting such a contentious policy could cost millions. Tauranga City Council experienced extensive litigation over their controversial provisions. Could lead to increased pressure on enforcement and monitoring teams with increased occurrence of illegal shoreline works. The clean-up costs associated with cliff failure and loss of structures may be left with the Council.</p> <p>Environmental May lose some habitat for species if areas of pohutukawa along the coastline are lost during erosion processes (Bergquist 1991). Loss of amenity due to loss of cliff face.</p> <p>Social May be very difficult to enforce if there is a lack of strong political will (Reddy 2000). An aggressive stance could have obvious political ramifications and public outrage is not unfeasible. Could be publicly viewed as a mass removal of property rights of coastal landowners and a lack of support from local government for people at risk from coastal hazards.</p>	<p>Private Benefits Coastal property owners would not have to be concerned with neighbours building protection works that then increase erosion of their properties.</p> <p>Council Benefits Less time spent processing resource consents for applications within the CCA and foreshore yard. Creates a strong disincentive to build in this area. The aim of this is to have a decrease in the value of buildings within the at-risk area and the risk to people who live in the area (Becca Carter Hollings and Ferner 2005). Can encourage collaboration between Councils and insurance companies to identify ‘sustainable’ options managing risks associated with coastal erosion (Ramsey and Bell 2009).</p> <p>Environmental A higher amenity level along the coastline with a more natural looking coastal environment. The operation of natural processes in the coastal environment is not hindered. Will have a coherent and strong policy in place in the face of climate change and expected increased pressure from landowners to armour the coastline (Caldwell and Segall 2007).</p> <p>Social None.</p>

Policy Approach 2: Coastal construction control areas based on a setback line.

Distributional Issues

This will reduce the development potential of landowners within the set back line. The costs of the setback line would therefore be reflected by the drop in property value. Ratepayers would be likely to pay for the implementation of the setback as it may be fiercely contested in court.

Effect on incentives

This will create a disincentive to build on the coastal edge as the setback line has been identified. It may also have implications for the insurance of properties.

Table 2: CBA of Policy Approach 2

Costs	Benefits
<p>Private Costs Potential increase in the cost of house design in order to comply with restrictions on site of developable land. Implications for house and contents insurance. Costs involved with hiring consultants to do extensive consent applications.</p> <p>Council Costs Use of a setback line to restrict coastal development needs to have a strong implementation basis (Granja and de Carvalho 1995). May be fiercely contested by residents of these properties because of effects on property values and development potential (Becca Carter Hollings and Ferner Ltd 2005). Ideally the policy should be based on an aggregation of site-specific erosion data. This will be a very expensive exercise to commission and will also need up-dating on a regular basis to allow for increase/decrease in hazard zone (Bernkoff <i>et al.</i> 2001; Becca Carter Hollings and Ferner Ltd 2005). Increased monitoring costs for the Council. Costs to Council in developing a model which the hazard zones are based on. All ongoing costs associated with providing advice to landowners within the hazard zone, options they can have, consultation with the public etc. (Becca Carter Hollings and Ferner Ltd 2005).</p> <p>Environmental None.</p> <p>Social None.</p>	<p>Private Benefits Reduce the loss of life and property from hazardous natural events (Bernd-Cohen and Gordon 1999; Becca Carter Hollings and Ferner Ltd 2005).) Avoids future losses.</p> <p>Council benefits Increase in the ability to further avoid, remedy, or mitigate adverse effects on land and structures within the coastal environment due to natural coastal processes i.e. erosion. Allows a proactive approach to be taken as opposed to reactive which is cheaper in the long run and sets a consistent policy approach promoting better environmental outcomes (Fischer <i>et al.</i> 1998). Avoids future losses. This would still allow certain developments to go ahead, but will make it more difficult requiring more mitigating options to be adopted. This would be in addition to the existing foreshore yard provisions. It is in line with the national direction outlined in the New Zealand Coastal Policy Statement.</p> <p>Environmental Create an area along the coastline that acts as a buffer (Bernd-Cohen and Gordon 1999) retaining the ‘soft green fringe’ which is in line with the intention of North Shore City’s coastal amenity policies (NSCC 2009).</p> <p>Social None.</p>

Policy Approach 3: Provide more information to landowners on what they can do to keep erosion at bay i.e. planting of good ‘erosion proof’ species etc and offer an advice service to landowners.

Distributional Issues

It poses no distributional issues. Information would be available for all members of the public.

Effect on incentives

No real incentives for landowners to change their behaviour and building habits. It is a passive response to coastal erosion and inappropriate coastal development.

Table 3: CBA of Policy Approach 3.

Costs	Benefits
<p>Private costs It is unlikely that owners will take on-board the information and adopt a proactive approach to coastal hazards (Ramsey and Bell, 2009).</p> <p>Council costs Regardless of providing more information, the uncertainty that is associated with coastal hazards can deter landowners from taking suggested loss-reduction measures (i.e. not building structures on the cliff edge) if the risk is to be perceived as being low (Bernkoff <i>et al.</i> 2001; Environment Waikato, 2002). May be expensive to continue an advice service to coastal property owners as experts will be required. It should be recognized that people living in the coastal zone are generally wealthier than inland residents and could be able to pay for some of this research (Fisher <i>et al.</i> 1995). Providing information does not mean people have to use it (Ramsey and Bell, 2009).</p> <p>Environmental Further development within the coastal area may still continue regardless of more information creating a greater property asset at risk from coastal hazards.</p> <p>Social. None.</p>	<p>Private benefits Advice offered to property owners and technical assistance and recommendations to those land-owners affected by erosion (Bernkopf et al, 2001). Results in sites still maintaining their development potential and owners still having their private property rights.</p> <p>Council benefits May achieve intended environmental outcomes without an enforced regulatory approach. May lead to a more incentive based approach to coastal management as opposed to a regulatory approach which requires enforcement which will save the Council money. Will allow innovative ideas and approaches to coastal hazards to be readily available to the public and increase general awareness of the issues so that if future policy direction takes a more stringent regulatory approach, people are more aware of what issues we are actually dealing with. Free information from Universities could be utilized.</p> <p>Environmental Potentially could be an increase in coastal amenity if information is utilised.</p> <p>Social. Local environmental knowledge, a very important source (Stojanovic <i>et al.</i> 2009); Can give greater attention to coastal problems which other wise may have gone unnoticed (Fischer <i>et al.</i> 1998).</p>

Policy Approach 4: Do nothing. Make no changes to existing coastal controls.

Distributional Issues

The distributional issues that are present now, that coastal property owners are building close to the edge and degrading coastal amenity which is experienced by the greater public.

Effect on incentives

No effect on incentives.

Table 4: CBA of Policy Approach 4.

Costs	Benefits
<p>Private costs People will continue to spend large amounts of money building protection sea walls and revetments, and palisade walls (Price pers. comm., 2009). Further buildings within the coastal area which will be at risk in the future, complicating problems in the</p>	<p>Private benefits People will be able to continue to gain consent to protect their properties.</p> <p>Council benefits Council will not have to incur plan change costs (Tauranga City Council's coastal hazard and</p>

Costs	Benefits
<p>long-term (Coastline Consultants 2002).</p> <p>Council costs If people continue to build hard defenses, then development is being encouraged in areas which are facing a high erosion risk. As well as this, it reinforces the long-term commitment to hard coastal protection works (Cooper and McKenna 2008a).</p> <p>Environmental Adhoc development will continue with decisions to allow coastal protection and building within the foreshore yard being made on an individual basis. Beaches may begin to be undermined by the increase in hard structures (Caldwell and Segall 2007). May get gradual hard coastline, especially as sea level rises. Further interruption of coastal ecosystem functions and processes (Cooper and McKenna 2008). Loss of amenity as houses and structures continue to be built in the foreshore yard (as shown by study results discussed).</p> <p>Social Barriers to public access with coastal fortification (Caldwell and Segall 2007).</p>	<p>setback line project was approx \$1 million from start to finish)</p> <p>Environmental None.</p> <p>Social None.</p>

Conclusion

North Shore City Council needs to be proactive and adopt a consistent coastal erosion policy approach. Intensification of the coastline is increasing and presents great risks to landowners and the Council. Policy Approach 2, although expensive, may be the best option for North Shore City. This would allow existing-use rights to remain, however any new development of sites would require new stronger policies and rules to be followed. Over time, this will result in coastal development that impacts less upon coastal amenity, and reduces the risks imposed by erosion hazards. Further CBA and contingent valuation studies regarding this policy would be required to refine the detail and extent of the policy.

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