Insurance for Coastal Assets – A Titanic Question

Angus D Gordon[1]
[1]Coastal Zone Management and Planning, Sydney, sandgus@optusnet.com.au

Background

All too often land that was known to be in areas under threat from flooding and/or coastal erosion and long-term shoreline recession has been allowed, and in some cases encouraged, to be developed, generally for reasons of short-term financial gain. This has led to unwise development that has exposed communities to both emotional and financial hardship, and often left the wider populace with a financial burden for the emergency response capability and the long-term repair of damaged infrastructure.

Insurance is a mechanism for providing a financial safety net should losses occur as the result of adverse events. Insurance is most effective, efficient and economic for both the insurer and the insured if the likelihood of an adverse event occurring, during a defined period, is remote but possible. It is least effective when the likelihood of an event is high. Insurers are reluctant to offer products unless they can reasonably estimate the probability of loss, there is a degree of randomness or chance, the risks can be diversified, and policyholders are prepared to pay the premiums (PCIR, 2012).

The following illustrates the insurance dilemma for flood prone properties. A property affected by what is commonly called a 1 in 100 year annual recurrence interval flood in fact has a 1% probability of being flooded each year which means that in a 30 year period, it has a 26% probability of being impacted by that magnitude of flood. Therefore, clearly any insurance company that wishes to provide flood insurance, and at the same time remain solvent, has to set its premiums based on a near certain loss within a period of substantially less than 100 years. This is likely to generate premiums that may be unaffordable to many, unless the premiums are directly subsidized by Government, or indirectly subsidized by increased premiums for owners of properties unaffected by flooding.

A recent article by Harling (2013), a MIT Emeritus Professor, points to the US FEMA now introducing a 5 year ramp up of flood insurance levees, which will result in premiums of up to $50,000 pa for a maximum $250,000 cover, on the basis of the premium reflecting realistic “actuarial rates”.

The 2013 Australian Federal Government’s enquiry into the impacts of, and the readiness for, extreme events has estimated that the cost to the Federal budget, and hence the Australian taxpayers in general, of both the relief and re-construction of infrastructure following the 2011 Brisbane floods, smaller flood than the 1974 event, was $2,950 million. This is over and above the cost to the Brisbane City Council ($400 million), the insurance payouts of $3,700 million, the significant losses experienced by those uninsured, and the estimated economic losses of between $5,000 and $6,000 million (ECRC, 2013).

For coastal development in areas affected by beach fluctuations, oceanic inundation and long-term coastal recession both the developed asset and the land it stands on are certain to be lost over time. The only unknown is exactly when the loss will occur. Hence the concept of “insurance” is a poor fit yet, in recent times. it has become politically expedient to divert attention away from the past poor coastal planning and management of development by suggesting “solutions” options such as insurance.

Natural Phenomenon and Natural Disasters

There is an important difference between natural phenomenon and natural disasters. “Natural phenomena” are natural events, often weather related, that occur to varying degrees and at varying frequencies; they are part of the natural processes that shape, and continue to modify, landforms. Natural phenomena can take the form of being one-off events, a series of events or a continuous process.

“Natural disasters” occur when people and assets are allowed/encouraged to be placed in harms way and/or the assets are not adequately designed to cope with the natural events and/or trends that can occur in a particular region/location.

Climate Uncertainty - Change and Natural Variability

It has been a convenient construct to believe there is sufficient data to describe climate variability and hence the probability of occurrence of events. Clearly this is statistically invalid as there is less than 200 years of record and arguably only about 100 years of reliable (or semi-reliable) data. Cordery (1992) contended that, if there is a need to estimate an event which is likely to be exceeded only once in “Y” years then data needs to be available for 3”Y” years, hence estimating a 1% event requires 300 years of reliable data; provided that the data relates to a statistically stationary series.

While the debate on whether the world is experiencing anthropogenic climate change versus natural long term variations, or a combination of both, the fact is that there is little scientific basis to believe that the data presently available is adequate to define a statistically stationary series; if indeed this is a reasonable assumption at all. In addition, when considering the management of coastal assets, and particularly the use of insurance as a management option/tool, it must be remembered that the current anthropogenic climate change argument is based on modelling projections formulated from scenarios, not on predictions. Gordon (2009, 2012) points out the uncertainty of the potential future climate outcomes due to both anthropogenic and natural variability and the uncertainty this engenders for management decisions for coastal development, not to mention attempts to use insurance as a management tool.

Of significance is that most modelling and projections carried out to date predict the climate changes in a continuous manner, albeit potentially exponentially increasing. However the historical evidence of past major changes suggests that many have occurred almost as step functions. There has been much speculation as to why such sudden major shifts have occurred (Diamond, 2005, Fagan, 2008, Plimer, 2009 and Carter, 2010**)** however the evidence suggests that catastrophic changes have occurred in the past, so it is not unreasonable to consider they could again occur in the future.

The situation is further complicated by the understanding that is progressively being developed regarding the El Nino Southern Oscillation (ENSO) phenomenon that typically has a periodicity of years, the Inter-decadal Pacific Oscillation (IPO) that has a periodicity of several decades and, the interaction between the two. Kiem and Verdon-Kidd (2012), for example, argue that during times dominated by La Nina there is up to 5 times the likelihood of a 1% flood event, and when the negative phase of the IPO coincides with a La Nina phase, there can be up to 12 times the potential for1% floods.

To date a similar analysis for ocean storms causing coastal erosion has not been undertaken as there is generally less than 40 years of data. It is however not unreasonable to assume that there is the potential for a similar outcome for erosion events threatening coastal assets. Given that the IPO has a periodicity of between 50 and 60 years, even the longest reliable coastal records, at best, capture only 1 cycle.

The traditional reliance on concepts of probability of occurrence of natural events is therefore clearly a flawed approach for projecting future climate behavior. Hence traditional methods of actuarial assessment are inappropriate. This introduces a significant challenge for the use of insurance as a coastal management tool.

Coastal Insurance

When examining the appropriateness of insurance as a tool for managing losses associated with the occurrence of coastal hazards it is convenient to examine the hazards in terms of five different categories: Short term beach fluctuations (including "storm cut"); long term coastal recession of both beaches and cliffs; climate change induced coastal recession; oceanic inundation and; wave impact on structures.

Short Term Beach Fluctuations

"Short term beach fluctuations" is the terminology used to describe the cutting of beaches during storm events followed by beach rebuilding during calmer periods. Short term fluctuations, can result in up to 250m^3/m run of beach being eroded from the sub-aerial beach in a matter of hours during a very severe storm, especially if the storm is accompanied by a high tide. However more typically it is of the order 50 to 100m^3/m run, Gordon (1987 a). In the case of very severe storm cut it may take several years for a beach to fully recover, however more typically recovery occurs in less than 1 year. While in an idealistic situation the short-term fluctuation behaviour could be considered to display stationarity, in reality the interdependence of wave behaviour, recent erosion events and tidal amplitude/water level during events, and their combined implications for a specific erosion event, make it difficult to develop meaningful statistics that would be useful for actuarial analysis.

Conventional wisdom is to not place assets in the region affected by short-term fluctuations. Insurance for residential, recreational, commercial and industrial buildings that are, or are to be, located in the short-term fluctuation zone only encourages unwise development. Experience has also demonstrated that subsidizing insurance for buildings at risk has resulted in the repeated re-building of development that is subsequently again lost. In the United States of America insurance of buildings in the short-term fluctuation zone has not only fostered unwise development but has also proved so expensive that even Federal Government subsidization of insurance schemes has had to be progressively abandoned. Harling (3013) estimates that the FEMA flood insurance pay outs in recent years has resulted in up to $30 Billion in US Government debt.

Long term Coastal Recession

The long-term behaviour of coastal systems can be analysed by means of a "sediment budget" approach. This identifies and quantifies all the "sources" and "sinks" of sand associated with a region. If there is a net long-term gain in sand then the shoreline accretes and If there is a net long-term loss of sand the shoreline erodes.

Sand can be gained by longshore movement of sand into a region or, from onshore transport if there is excessive sand on the continental shelf or, if there is terrestrial sand delivered to the coast by rivers and creeks, and also by nearby cliff and bluff erosion. Sand can be lost by longshore drift out of a region, offshore loss due to a range of processes including sea level rise, wind blown sand drift into dunes that move inland and sand transported into creeks, estuaries and lakes by wave and tidal movements.

When long-term shoreline recession is occurring on a coastline it has been traditional to characterize it as an average rate per year, calculated over an extended time period. However, because of the variability of weather conditions including factors such as El Nino and La Nina dominated periods, in reality long term recession occurs in steps, during periods of "stormy" years, then partially recovers during quieter times. In any one year, the recession rate is seldom that of the long-term calculated value and this can lead to confusion, if not lack of confidence, regarding the stated long-term net value.

Too often the focus is only on receding beaches without recognizing that cliff and bluff areas of shoreline are potentially exposed to the same fate (the difference between "cliffs" and bluffs" is generally taken as "cliffs" consisting of less erodible rocky material whereas "bluffs" are more erodible features, generally of clay or mudstone).

There are already a number of NSW locations, particularly in the Greater Sydney Area where development is located on cliff and bluff tops. Because the long-term average recession rate is generally far less than that of the neighbouring beaches, there can be complacency about the vulnerability of assets located near cliff/bluff edges. This complacency is reinforced by the fact that cliffs and bluffs will often apparently remain stable, although being undermined at their base, for many years, even decades, and then suddenly fail in a catastrophic manner.

Failure of cliffs and bluffs can also be brought on by inappropriate development/re-development such as replacement of lightweight "weekenders" with more "permanent" heavy masonry buildings. The increased load on the cliff/bluff crest and/or the re-direction of groundwater as a result of building activity can lead to an acceleration of instability.

In general beach erosion/recession is a very obvious process giving sufficient warning that, while fixed assets may be lost, movable assets and people living near the shoreline can be saved. Unfortunately however the same cannot be said about the situation for cliffs and bluffs. Failure is sudden and often without warning.

Insurance is clearly an inappropriate management option for shoreline areas suffering long-term recession; whether beaches, bluffs or cliffs. It is not a matter of if assets will be lost but rather when, and in the case of bluffs and cliffs whether lives as well as assets will be lost. While appropriate planning options and controls are the key to managing new development, a sinking fund to encourage relocation, rather than an insurance approach, is a more appropriate way forward.

Climate Change

To date the politically convenient approach to climate change impacts on the coast has tended to be limited to sea level rise considerations including the direct inundation of coastal areas, and the secondary effect of the associated coastal recession. As previously alluded to, there are however more issues surrounding climate change impacts than just sea level rise. In 1991 the Australian National Committee on Coastal and Ocean Engineering produced a document that provided guidelines for managing the more complex issues and their interactions, this document has been regularly revised (NCCOE, 2012). The availability of this document places a professional responsibility and discipline on any persons undertaking planning or construction in the coastal zone.

It must be recognised that changes in weather patterns means changes in location of the events that produce erosion and possibly the increase in the number of severe events. These changes in turn mean changes to the wave energy flux reaching the coast; that is, changes in wave energy and direction. Such changes can alter the shoreline alignment of embayments resulting in increased erosion at one end and possibly even accretion at the other. To date little data has been collected, or analysis undertaken, to document the potential coastal re-alignment due to a changing climate however the fact this has been recognised as an issue for over 20 years (Gordon, 1987 b) means that at the very least a sensitivity analysis should be undertaken.

Interestingly others are now also questioning the fixation on sea level rise and its associated erosion potential. The Insurance Australia Group, in their submission to the Senate inquiry into extreme weather, pointed to their growing concerns that more needed to be understood in regard to the potential changes in weather system locations, intensities and implications (ECRC, 2013).

Bruun developed a simple approach to predicting the impacts on shoreline recession, summarized in Brunn and Schwartz, 1985. When the Bruun approach is applied to the NSW coast it usually produces relationships that suggest the recession will be between 50 and 100 times the amount the sea level rises. Gordon (1987 b) examined the historical erosion trends at 32 NSW beaches and compared them to predictions based on the “Bruun Rule”. The comparison suggested that the historical long-term recession rates on many of the beaches was of the same order of magnitude as predicted by the Bruun Rule, for the measured long-term sea level rise for NSW. There is however increasing debate as to whether the “Bruun Rule” is too simplistic.

The uncertainty regarding what is causing climate change, and the implications for changes in weather systems, makes insurance provision a challenge. Insufficient is known to enable any sensible statistical assessment; if indeed such an approach is valid. Further, for example, the projections regarding sea level rise alone, based on the climatic modelling scenarios, don’t appear to be being validated by measured results (Watson, 2011). In fact Watson argues that not only is the historical rate of rise in sea level not accelerating, but rather that the tide gauge information suggests it may be decelerating. Further, the impact of sea level rise is already embedded in the long-term recessional data, hence to make further allowance for it may be “double counting”.

Insurance as an option/method for managing the coastal aspects of possible climate change impacts would require a very novel approach. The uncertainties of knowledge and lack of data most likely means that if insurance for properties deemed to be at risk is to be considered it will need to be either prohibitively expensive or will require subsidization by government, or by other, non affected, policy holders.

Oceanic Inundation

Gordon (2012) describes the historical development of coastal villages and towns. The laiss’ez-faire approach to early coastal developments has created a legacy of private property ownership of flood and erosion prone land. In coastal areas, while some of the flooding is due to rivers and creeks, oceanic inundation during storm can be a major problem. During such events normal tidal ranges are increased due to wind and barometric set-up (storm surge) and by wave set-up. There continues to be debate as to how to meaningfully combine storm surge and wave set-up with the co-incidence of tidal water levels to develop future predictions of the recurrence of high water levels with storm wave conditions, and hence the frequency of oceanic inundation at sites.

Projected sea level rise as a possible outcome of climate change again adds a further uncertainty as to what future coastal water levels might be. Just assuming that the scenario-based sea level rise projections will occur, and then adding the currently known information on storm surge and wave set-up, overlooks the possibility that climate change may alter the storm surge and wave set-up; a concern recently reinforced by the ECRC (2013).

Again, any rationally based insurance model will of necessity be conservative due to the uncertainty of future processes and outcomes, let alone the information required to apply conventional techniques for actuarial purposes. Hence again premiums will undoubtedly reflect a necessarily conservative approach that in turn raises the question as to the need for subsidization of premiums either by Government or by other non-affected policy owners.

Wave impact on Structures

On the NSW coast there are few buildings or structures, excluding harbour breakwaters, river training works and some surf clubs, which are sufficiently close to the shoreline to experience direct wave impact. Should climate change result in sea level rises, and increased storm severity, this may change. Further, there are numerous cliff-top buildings that are currently out of wave-reach but may find themselves in a more vulnerable position in the future.

Storm waves approaching the NSW shoreline are depth limited. That is waves break when they reach a depth of 1.28 of their height. Projected sea level rises will increase depths however sandy shorelines will adjust by erosion so the final shore-break will be the same height. Where there are rock shelves, seawalls, revetments, river training walls and harbour breakwaters, any increase in depth means that a larger wave will break on the structure. If the structure hasn't been designed for this larger wave then it may suffer failure, particularly since the relationship between wave height and energy is an exponential function, so a small increase in wave height produces a disproportionally large increase in energy available to damage the structure. Should the structure survive however, it may be overtopped by the wave run-up resulting in a surcharge of water that will directly impact on any nearby building.

Where sea walls and rock revetments have been constructed to protect buildings, their damage, due to increased wave attack, may produce catastrophic results. At Sheltering Palms NSW, just north of Brunswick Heads, a village of 17 houses was wiped out by a series of cyclones in the early 1970s, mainly due to wave over-wash. Some of the houses had rock revetments "protecting" them however rocks from these revetments became missiles that destroyed the houses. Some houses had rocks weighing more than a ton in their living rooms and on their front verandahs (Gordon et al, 1978).

It can be anticipated there will be increasing incidents of wave damage to buildings in the future. This will certainly provide a challenge for any attempt to construct a suitable insurance cover, especially if rocks from the very seawall or revetment that was constructed to protect the building are the agents causing the damage.

Harbour seawalls such as those at Port Kembla, Coffs Harbour and Ulladulla have long histories of damage during storm events with extensive evidence of 40 ton concrete cubes being thrown over the wall crest during major storms. Ulladulla is an interesting example because there is a wharf on the inside of the breakwater. During the 1974 May storm rocks from the seaward armour ended up on the decks of the fishing boats tied up at the wharf. Should the projected changes in sea level and storm intensity eventuate, then increased damage to these structures could be anticipated.

Most of the NSW river training walls have a history of damage, any long-term increases of sea level will only exacerbate this damage. Further, severe storms often result in rocks and concrete armour units being washed off the heads, with some ending up in the navigation channels; an interesting marine insurance risk as well as a major issue for port authorities' insurance.

Way Forward

In discussing the appropriateness, or otherwise, of the future use of insurance for coastal assets, two quite different situations need to be addressed; that of the how to manage existing developments, and the approach that should be taken to new developments. These two situations should be approached quite differently as existing developments have limited options to deal with future loss as a result of unforeseen long term coastal processes, whereas new development can be managed by appropriate planning options.

Existing Development

There are people in erosion, shoreline recession and oceanic inundation prone areas that were not aware, and could not have been aware, of the threat at the time of purchase, and indeed the information may not have been available to the authorities, at the time. Further, there are locations where the data and information/understanding is not currently available or there may be unforeseen consequences due to climatic uncertainties.

In dealing with the challenge of existing development there is economic and social benefit, for both those directly involved, and for the broader populous, to provide incentive to move out of harm's way, or to protect and progressively adapt existing buildings and infrastructure for their economic lives, and then to re-locate or abandon them. An insurance-based option for managing existing development in areas of potential/known threat is clearly inappropriate as it is likely to encourage continuation of an existing and repeatable problem situation. It may even provide a driver for exacerbation of the problem, and hence the overall societal stress and adverse economic impact.

However a sinking fund approach could build up a pool of funds to enable the progressive relocation of people/industries to places less exposed to known threats. Given that land may be subject to erosion, recession and/or oceanic inundation, but the development on it and the infrastructure servicing it can, in many cases, be adapted (Gordon, 2012) to manage the risk for the life of the building, there is the potential to extend the life of properties currently under threat. In many existing situations this could provide sufficient time for a successful sinking fund to be established and fully funded. Alternatively, and within the sinking fund type philosophy, potentially threatened property could be purchased well before it is likely to be lost and then either leased back to existing owners or rented to new occupiers. This approach can be applied, not only to single residences or commercial premises, but also to blocks of units where individual units can be progressively brought into the scheme as owners choose to sell. The funds generated by the rental income become part of a revolving fund to progress the final outcome of withdrawal. The earlier the properties are purchased, the greater the probabilities they will pay for themselves and even possibly generate excess funds for the "pool".

Unlike the argument against subsidization of insurance, it could be argued that encouragement for a sinking fund, a one off payment for those currently at risk, could be justified as a politically, economically and socially amenable long-term solution.

New Developments/infrastructure

All new development and associated infrastructure should be planned and designed to cope with the known natural events and coastal processes for the particular location, to the best of current knowledge. This includes adequate provisions for development setbacks and planning mechanisms for on-going adaption such as time limited consents and the use of long leasehold rather than freehold land ownership as detailed by Gordon (2012).

Persons who chose to purchase/live/build/invest in areas with known potential future impacts from natural events should be made aware of the issue at the time of purchase and agree to accept the risk without any recourse to compensation. That is, purchasers should be made fully aware that while they are free to "enjoy" the property/asset for as long as it exists, once it ceases to be viable they have no recourse through any form of compensation including insurance. To implement such an approach legislation would be required to create a statutory process for transferring the undertaking of the recognition of risk, to future owners.

Summary

Beach erosion, shoreline recession and oceanic inundation are natural phenomenon that all contribute to the ambulatory nature of coastlines and hence the lack of permanency of coastal lands. Placing assets on such land is only reasonable so long as it is recognized that such assets have a limited life for their enjoyment and that in time both the asset, and the property it stands on, will be lost.

Many so called "natural disasters", where property and lives are lost, are readily predictable and only occur because assets have been allowed and/or have been encouraged to be placed, in harm's way. The fact that such "disasters" occur therefore reflects poor planning by Government, inept administration or lack of knowledge/understanding/data regarding naturally occurring phenomena. The latter is arguably justified in being considered an insurable risk, the former is simply incompetence, at best, and negligence, at worst, and should be seen as such, and not used as an excuse for Government to suggest inappropriate insurance solutions.

Given the uncertainty that exists regarding future climate and even the present relatively short climate record, it is essential that all development and infrastructure in areas of potential risk should be designed and constructed to be adaptable. The degree of adaptability should depend on the likelihood of adverse impacts, the potential consequences and the design life of the development/infrastructure. Regardless, assets knowingly placed in harm's way should not be considered to constitute an insurable risk.

The Productivity Commission concludes by recommending that there should be no government subsidization for household or business insurance for properties in coastal areas at risk (PCIR, 2012). Hence if insurance is being promoted by parties, as a potential "solution" it is vital that a risk/consequence matrix approach be adopted. Such a matrix would consider who created the risk, who manages the risk, who takes the risk, is sufficient information available regarding the risk, is the available information available to all parties involved, what are the consequences likely to eventuate, who will suffer those consequences and did they adequately understand the risk and consequences when taking the risk. In short, what is the chain of responsibility and accountability?

New buildings, and their contents, in areas where the best available knowledge is that they will be lost over time to the ravages of either coastal erosion or shoreline recession, should not be insurable. Insurance in such circumstances encourages, and promotes unwise development and, given the likely prohibitive levels of premiums for individual properties, can only result in the need for subsidization either directly by Government or indirectly as a result of higher premiums by those in unaffected areas. That is, insurance for knowingly threatened properties is a societal contingent liability.

Where there are existing assets under threat they are arguably best dealt with by sinking fund type scheme, rather than insurance. Such schemes should be aimed at compensating those who have purchased properties, at a time when the threat was not recognized or documented. The objective should be to encourage and enable owners to re-establish elsewhere rather than re-build in an area at risk. Subsidies for a sinking fund approach, unlike insurance, can be justified because they are a one off, make up for past lack of knowledge, and act to reduce the long-term societal contingent liability.

If persons wish to take the risk of being adversely affected by natural phenomena they should be fully accountable for their actions and not expect to be subsidized, or financially "rescued". If government agencies/politicians "invite" people to "unknowingly" take risks that are in fact known to the agency/politician, then those responsible should be held fully accountable and should not be able to cover-up their actions by relying/invoking/promoting insurance as a safety net.

It follows that the potential for loss and/or severe damage of coastal properties should be clearly conveyed to purchasers, lending authorities and potential insurers through instruments maintained in a readily accessible form through local councils and State Government instrumentalities. This will assist the market place to more appropriately value land, and the associated assets, destined to be lost to erosion, oceanic inundation and shoreline recession. It will also allow better decision making by purchasers in regard to their preparedness to pay for the enjoyment of the land, and the developed asset, while it is there, but write it off, and the cost of its removal, over the best available estimate of time of the continuance of the asset.

Finally, insurance should not be a panacea for negligent planning. The problem must be addressed at its source and unless this is recognized, both current and future generations will be committed to a growing legacy of contingent liability with a resulting adverse impact on the Australian economy, as is the case in the US.

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