

# PERMISSIBLE EMERGENCY COASTAL PROTECTION WORKS IN NSW - A COASTAL ENGINEERING PERSPECTIVE

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## Abstract.

Recent amendments to the NSW Coastal Protection Act 1979 mandate the types of coastal emergency protection works, the locations at which they can be used and the processes to be followed in their implementation. The works permitted do not represent sound engineering practice as they are unlikely to provide adequate protection to assets during a significant storm and, in most circumstances, could not be constructed to comply with the legislative restrictions.

## Background

Changes to the NSW Coastal Protection Act 1979 (NSW Govt. 2011c), which came into effect in January 2011, fundamentally altered opportunities for emergency protection of private property in NSW. Specifically, changes to the Act prescribe the emergency management protection options available to individual property owners and the way in which Local Government must manage such works. Structural protection measures that require development approval (not obtained prior to the emergency) are not permitted and substantial penalties have been prescribed in the Act to deter such actions by individuals or Local Government to protect threatened assets during an emergency. Even approved works most likely cannot be implemented during an emergency. They are in reality “holding works” to be installed after an emergency and therefore misrepresented.

Where private property is at risk, only those emergency protection measures specified through the Act and the associated Regulation, codes and guidelines are permitted at locations designated in the schedule of locations, commonly referred to as “erosion hotspots” and included in the Table 1 of Section 4, “Guide to the statutory requirements for emergency coastal protection works” (NSW Govt. 2011b). These works are limited to geotextile container (sandbag) walls of given dimensions or to minor beach nourishment, again within specified guidelines.

In framing the legislation the NSW Government was cautioned repeatedly by Local Government and engineering practitioners that the works proposed could not be implemented and would not protect development during significant coastal storms; such caution largely went unheeded. In relation to these protection works, the Government advises that *“these works are likely to provide protection from wave action during relatively small storms or swells which may also coincide with king tides. They may also provide a nominal or limited degree of protection from erosion during medium to large storms; however, they are also likely to be damaged during such storms. As a*

*result, these works are not a long-term management option for coastal hazard threats*" (NSW Govt. 2011b).

The process of determining the permissible emergency works and the locations at which they may be constructed is complex and convoluted, being contained in the latest amendments to the Coastal Protection Act 1979 (NSW Govt. 2011c), which were passed by the NSW Parliament in late 2010 and came into effect in 2011, and the Regulation to the Act (NSW Govt. 2011d), which came into effect on the 23<sup>rd</sup> March 2011. Part 3 of the Regulation provides "*Requirements Relating to Emergency Coastal Protection Works*". Additional information is presented in the "*Code of Practice Under the Coastal Protection Act 1979*" (NSW Govt. 2011a) and the "*Guide to the Statutory Requirements for Emergency Coastal Protection Works*" (NSW Govt. 2011b) and most recently "*Coastal zone management guide note - Emergency action subplans*" (NSW Govt. 2011e).

In addition to the approved locations, limitations are placed on where, when and how those works may be constructed in an emergency. The Statutory Requirements (NSW Govt. 2011b) mandate a range of conditions, including:

- Works can be installed only at specific locations along the coast and only where there is no public road between the development and the beach.
- Works can be installed only on one occasion and for a period of up to 12 months (if a development application is lodged during that period for permanent works, the emergency works approval is extended until the DA is determined).
- Works must not result in off-site environmental or erosion impacts and must be readily removable.
- Prior to the placement of works, a resident must apply for a certificate authorising the placing of the works, such certificate when issued is valid for 2 years during which the works may be placed without further approval.
- The landowner is responsible for constructing the work, their maintenance and their removal at the end of the approval period.
- The landowner is responsible for ongoing safety risks associated with the works (including construction) and it is recommended that they seek appropriate insurance prior to proceeding.
- If instructed by an authorised officer (e.g. a Council or Government officer appropriately accredited) that the works are likely to cause erosion to adjacent land, restrict access to a beach or headland, pose a threat to public safety or have ceased to be emergency protection works, the landowner must remove the works.
- Emergency works can be placed only to protect a building that is lawfully used for residential, commercial or community purposes from the adverse impacts of erosion.
- The works cannot be installed unless the crest of the erosion escarpment is within 20 metres of the seaward wall of the building at the time of placement.
- The works cannot be placed where any form of coastal protection (illegal or otherwise) has been placed, unless a certificate is provided by a professional engineer that the emergency works proposed, in conjunction with the existing works, provide erosion protection equivalent to the allowable emergency protection works alone.

- Emergency works may only be placed once for any property, irrespective of whether that property changes hands in the future.
- When installation of the works is commenced the owner must notify the relevant authority in writing and, if they are to be placed on public land, they must also notify the public authority with responsibility for care and control of the public land.
- Works can be inspected at any time by an authorised officer and, if they do not comply with the original certificate, the owner can be ordered to remove them.
- Before any works are placed, maintained or removed, a temporary fence must be placed around the works.
- If the erosion escarpment is more than 1 metre in height, an additional safety fence must be placed on the landward side of the escarpment at a distance of not less than 2.5 times the highest point of the escarpment. The area between the escarpment crest and this fence cannot be used for the placement or for maintenance works.
- Should any section of the escarpment collapse, an authorised officer may require the landowner to obtain, before continuing with placing the works, a written opinion from a professional engineer that the placement of the works does not present a significant safety risk.
- Routine or emergency maintenance works must not be undertaken during a storm event unless the landowner has obtained a written opinion from a professional engineer that the repairs do not represent a significant safety risk.
- Access to the beach to undertake the works or maintenance may be across public land where there is no other reasonable alternative. However, the landowner will be responsible for the safety of the public during such works and for the rehabilitation of the public land following those works.

The conditions listed above are a brief summary of the conditions imposed through the legislation and are not comprehensive. Many of these conditions are impractical and cannot realistically be fulfilled during an emergency. Demonstrably, the process outlined requires action to be taken prior to erosion occurring, with the methodology determined and a certificate obtained well in advance of this unforeseen emergency event. Similarly it would be necessary for the property owner to source and store the necessary materials for their work either on their own property or nearby public land until such time as they are required (this could be up to the 2 years validity of the certificate).

Emergency works can only be constructed if the escarpment slope is “safe”; a geotechnical impossibility for the near vertical sand escarpment which normally results during any emergency. Further, the Act prevents mechanical re-shaping of the erosion escarpment to allow for “safe” construction. Any emergency wall is not allowed to have a toe structure buried in the beach and must be constructed of stacked sand bags with a total height of no more than 1.5m and with the toe at the existing beach level (whatever that may be at the time of construction), making it vulnerable to both toe failure and overtopping failure. Minimal excavation is allowed to “level” the toe.

The recommendation that owners obtain insurance cover places an onus on the owner to do so. It is, however, unrealistic given that the works are to be undertaken at a time that is yet to be determined, by persons that may not yet be identifiable and can involve an as yet undefined risk of damage or injury to individuals on the owners property,

adjacent crown land or nearby private property for the duration of the construction and the subsequent approval period. No guidance is provided as to the appropriate level of the potentially unobtainable cover.

In several circumstances, a certificate from a professional engineer is required which will add to the expense and uncertainty of the process. For most of the locations where works are permissible, erosion has been a long identified issue and protection structures, albeit of variable quality, have been constructed previously. It will be challenging to find an experienced, professional engineer prepared to certify that a sand bag wall of a maximum 1.5 m in height with no toe would provide more adequate protection against erosion than the existing works. At many locations, the existing structures are not visible and it would therefore not be responsible to provide such certification until they are exposed (i.e. during the emergency). The partial collapse of an escarpment (vertical, saturated sand) during construction triggers the requirement that an engineering certificate stating that work can continue safely is required. Standard engineering practice dictates that a vertical sand escarpment is inherently unstable.

The purpose of a seawall/revetment (whether constructed of geotextile containers, rock or any other materials) is to stop erosion of the dune and the supply of sand from the area landward of the structure, to the beach. By definition this will result in an increase in the scour depth seaward of the wall and/or an increase in erosion rates on adjacent lands as the sand the wall has deprived from the littoral system is picked up to match the sediment transport potential. Hence the requirement that if walls are likely to cause erosion to adjacent land the owner can be ordered to remove them, effectively means that walls are not a viable option.

The approval, supervision of construction and ongoing monitoring and maintenance requirements, prosecution of breaches and ensuring removal of non-complying works will inevitably be the responsibility of Local Government. Similarly the recording of what works have been constructed, where and when will also be the responsibility of Local Government. The cumulative impact of the conditions that must be met, would suggest that in almost all the approved locations for emergency works, along the open NSW coast, it will not be possible to legally construct “permissible” walls.

## **Engineering analysis of the “permissible” geotextile protection structures**

### ***What is supposedly allowed?***

The “Code of Practice Under the Coastal Protection Act 1979” (NSW Govt. 2011a) describes the type of structure that may be constructed. At section 2.2.2 it states:

#### *“2.2.2 Placement and maintenance of sandbag works*

*Works comprising the placement of sandbags must meet the following requirements:*

- (a) the height of the works must not exceed 1.5 metres from the base (or toe) of the escarpment*
- (b) the works must be placed against the seaward side of the escarpment and be within 4 metres of the escarpment*
- (c) the slope of the face of the works must not exceed 34 degrees from the horizontal plane*

*(d) no voids on any exposed faces of the works, or between the works and the escarpment, of a size that may present a public safety risk.”*

Figure 1 below is taken from the consultation draft of the NSW Government Guide to Statutory Requirements for Emergency Coastal Protection Works (NSW Govt. 2010) and shows a typical emergency revetment constructed in accordance with the guidelines using 0.75m<sup>3</sup> geotextile containers (The maximum permissible size for emergency protection works).

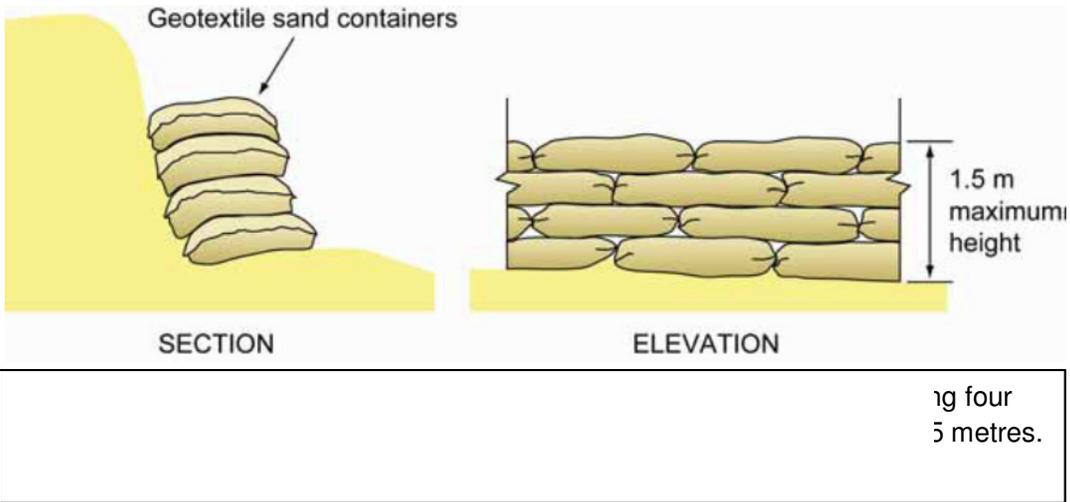


Figure 2 shows a photograph from the same draft document (NSW Govt. 2010) of a similar type of structure constructed at Byron Bay. This photo is also included on the cover of the finalised Code of Practice (NSW Govt. 2011a). While this drawing and photograph were not included in the final guide as published (NSW Govt. 2011b), they do illustrate the type and scale of protection permitted under the emergency provisions of the amendments to the Coastal Protection Act.



geotextile  
containers  
for coastal  
protection  
works at  
Byron Bay  
for use in  
emergency  
situations  
(10,000  
containers).

### **How will they perform?**

The use of sand filled geotextile containers for terminal protection structures is a relatively new concept and no design standard is available. While structures have been constructed around the NSW coast and overseas over the past 20 years, the design criteria relating to the use of these units is still developing. There are many examples of successful and appropriate applications and many examples where they have been poorly used and failed. The applicable design criteria and experience with their application is continuing to develop.

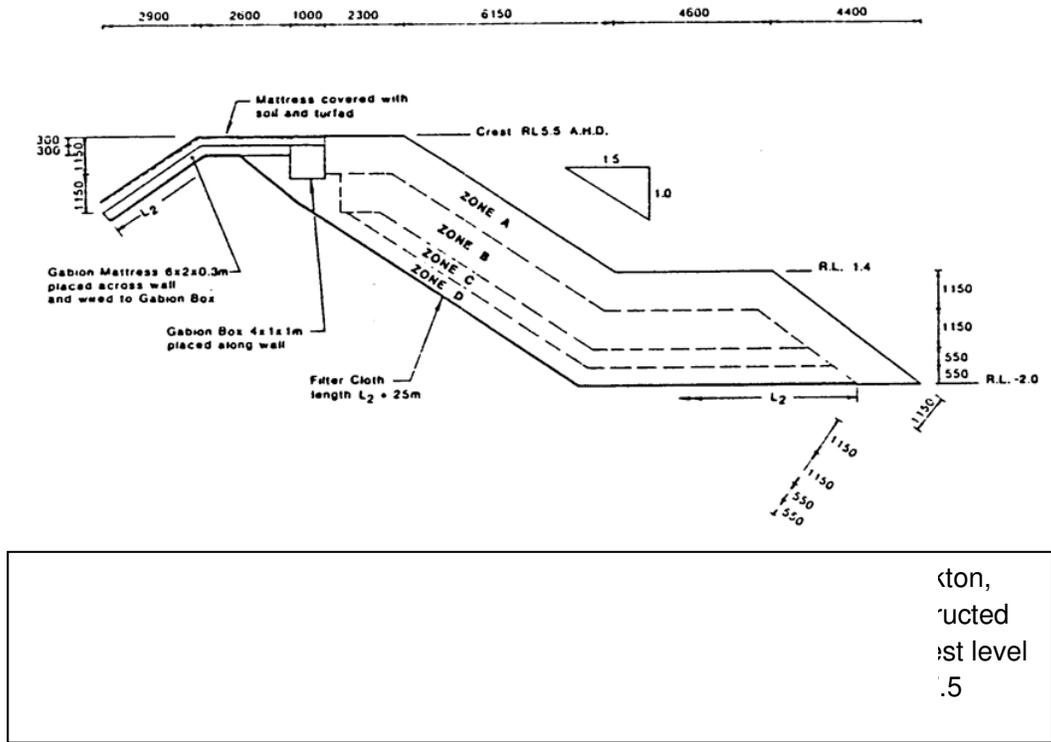


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Laboratory testing of the performance of these geotextile container structures is being undertaken in Australia and overseas (e.g. Hornsey et. al., 2011). Testing carried out by the UNSW Water Research Laboratory and presented in preliminary design curves included in the Hornsey et. al. (2011) paper show that for the 0.75m<sup>3</sup> geotextile sand filled container structure modelled (2 layers and incorporating a geotextile underlayer) at a slope of 1.0V:1.5H, failure was initiated for a spectral wave period of 10 seconds and a wave height of 1.3 metres. It is noted that the test revetment structure crest was sufficiently high and the toe level sufficiently low that wave overtopping and scour at the toe were not an issue. The authors note the test was for the more stable 2 layer configuration (not a single layer as shown in Figure 1 above). The design curves published by Hornsey et. al. (2011) show the acceptable wave height reduces for longer (storm) wave periods and for flatter design slopes. The limiting wave height for damage approximates “*the median (50% exceedance) significant wave height along the NSW coast (which) ranges from 1.30 m at Batemans Bay to 1.52 m at Eden*” (Shand et. al. 2010).

Recent work published by Nielsen & Mostyn (2011) shows that from geotechnical considerations the maximum safe slope (Factor of Safety 1.5) for a sand bag revetment constructed on typical dune sands would be 1.0V:3.0H. Based on their analysis, recommending a slope of 1.0V:1.5H is not appropriate for the emergency works allowable under the current legislation, as it produces a structure with an unacceptable FOS that may be inherently unstable and hence unsafe.

The two research papers cited above raises serious concerns as to the effectiveness of the measures specified by the Code of Practice and their ability to resist even a moderate period of elevated water level and average wave conditions.



The more significant issue relates to the crest and toe levels permitted by the emergency management conditions. While the crest and toe level are not stated, they are limited by the requirement for a maximum structure height of 1.5 metres. If the wall is constructed before or after the storm when the beach is in a period of recovery, then the beach level against the dune is likely to be 1.5m AHD to as much as 3.0m AHD, giving a maximum crest level around 4.5m AHD. If the beach is eroded and sand is lapping the escarpment toe at mid to high tide, then construction of the emergency works at low tide may result in a sand level at the escarpment toe of 0.5m AHD giving a crest level of 2.0m AHD. The guidelines do not allow the toe of the seawall to be excavated into the beach; it must be constructed at the existing beach sand level.

Typically, revetment construction along an open coast in NSW specifies a toe level of approximately -1m AHD (or lower) and a crest level above 5m AHD, an overall structure height exceeding 6 metres (e.g. Figure 4 and Figure 5). At Byron Bay geotextile bag walls with designed toes and higher crest levels than specified by the legislation failed due to toe failure and overtopping (Figure 3), even under modest wave attack. This clear and available evidence was ignored in framing the Legislation and the "Code".



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Comparison of the “permissible” design for emergency works in Figure 1 (typically a seawall with a toe level of 1.5m AHD and crest level 3.0m AHD) with a constructed and proven seawall design (also by the NSW Government) as shown in Figure 4, simply highlights the issues.

Hence, the Act specifies and codifies design criteria that will have failure as the outcome, an interesting concept for engineering and social responsibility and indeed, a novel approach to legislation and risk management!

To frame such impractical measures in legislation can only be seen as an attempt to fool coast front landowners into believing they may implement works in an emergency without telling them that, in all probability, the “permissible” measures cannot or will not be constructed and if they are, will most likely fail when needed.

## **Engineering analysis of the “permissible” emergency sand nourishment**

### ***What Nourishment is Allowed?***

The “Code of Practice Under the Coastal Protection Act 1979” (NSW Govt. 2011a) describes the type of beach nourishment that may be undertaken. At section 2.2.3 it states:

#### ***“2.2.3 Placement and maintenance of sand works***

***Emergency coastal protection works comprising the placement of sand must meet the following requirements:***

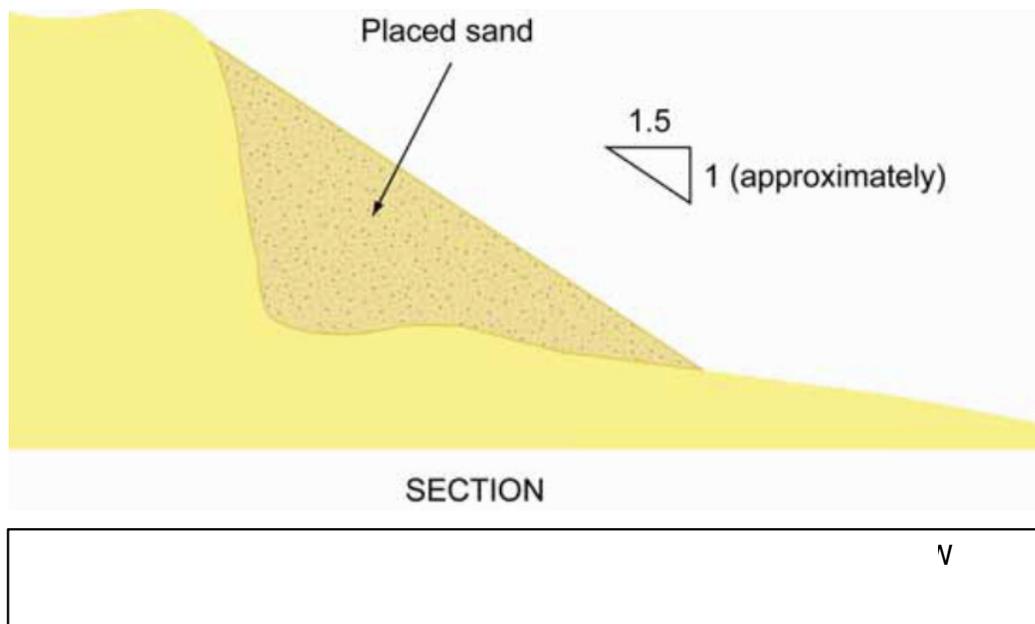
- (a) the sand must be placed against the escarpment on the seaward side
- (b) the slope of the face of the works must not exceed 34 degrees from the horizontal plane”

Figure 6 again taken from the draft Statutory Requirements (NSW Govt., 2010) was not included in the final version, but does illustrate the concept proposed for beach nourishment under the current legislation.

**How will it perform?**

Emergency minor sand nourishment is an alternative option to construction of a revetment for “emergency” protection. Again the conditions placed on the sourcing and placement of sand makes it unlikely to be an acceptable or effective emergency option and, given the additional approvals and environmental studies potentially required to obtain the sand, makes this a non-viable option.

Beach nourishment is generally not practical as a sensible approach to providing protection to an individual property. The sand placed would be quickly eroded and moved offshore and alongshore during storm conditions, it is not possible to retain the sand in front of an individual property without some containment structure; which is not allowed. The objective in nourishing the beach is not to fill the fillet of sand eroded in forming an erosion escarpment (Figure 6) but is intended to broaden the beach and nearshore profile to provide a buffer against erosion during storms. Gordon (1987) suggested values for storm erosion demand on NSW beaches, based on assessment of surveyed data that showed a volume of between 100m<sup>3</sup>/metre of beach and 250m<sup>3</sup>/metre of beach may be removed during a single storm, depending on the beach exposure, beach condition and dune height. Subsequent isolated measurements by the NSW Government based on photogrammetric beach profiles have indicated volumes in excess of this upper figure may occur.



While the slope of the placed sand at 1V:1.5H is quoted as a maximum (flatter slopes can presumably be employed), it should be noted that at this slope loose beach sand has a FOS of 1.0 against slumping. This is not appropriate for placement of material in an accessible public space, from an engineering perspective it poses an unacceptable risk.

Experience dictates that sand placed at this maximum slope will have little impact on reducing erosion and protecting properties as the volumes are too small. For example a 6m high escarpment with a beach at the base eroded to mean sea level, would permit the placement of 27m<sup>3</sup>/metre of beach – approximately 10% of the likely storm erosion demand. A 2m high escarpment would allow only 3m<sup>3</sup>/metre to be placed.

If the sand is to be placed at flatter slopes, then the volumes required would increase, taking over more of the beach width for the works and increasing the likelihood that in the short term a significant proportion of the sand placed is eroded and redistributed alongshore. Safety issues also exist as to the method of placement (on a public beach) and the requirements for the works to be fenced during placement and subsequent maintenance; another insurance challenge.



sand beach location.
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There are also other restrictions that effectively make the use of nourishment impractical for individual properties. For example, sand to be placed must not be sourced from a beach or dune. It cannot be obtained from offshore sand reserves under current NSW Policy. This leaves the option for a property owner of sourcing sand from their own property (but not the beach or dune) or purchasing it from a licensed quarry. This would be an extremely expensive option and would still leave the question of stockpiling the sand in preparation for the emergency. Under the legislation the

materials should be stored on the property, or if that is not practical may be stored on public land.

The restrictions on placement again make sand nourishment difficult during an emergency. Restrictions on the use of the area immediately adjacent to the escarpment crest, make it unlikely that the material can be placed onto the beach from the property itself. For a six metre escarpment the Code of Practice requires a 15 metre exclusion zone from the dune crest where materials cannot be stored, and machinery or trucks cannot be used. Likewise the safety requirements dictate that placement from on the beach during an emergency would not be possible without considerable and unacceptable risk. This leaves the only option to be the placement of the nourishment prior to the emergency occurring. In that case it is likely that the small sand volume placed adjacent to an individual property would be eroded and moved (alongshore or offshore) prior to an emergency occurring, under natural wave action.

There are good coastal engineering reasons why beach nourishment is not used for protection of individual properties; the approach is usually applied to an overall embayment and requires large volumes of sand to allow for redistribution under the ambient wave conditions, while still leaving an appropriate sand buffer to accommodate future beach erosion. Typically, volumes placed are designed to increase the beach width by around 10m to 20m along the whole beach. Figure 7 shows a beach nourishment campaign in progress along Shoal Bay, a sheltered beach within Port Stephens. This nourishment is repeated at regular intervals and constantly maintained by the Council. Such works are well beyond the scope of the individual property owner.

### **What Does it Mean for Community and Local Government?**

The changes to the NSW Coastal Protection Act negates decades of coastal engineering experience focused on integrated and negotiated coastal management outcomes and do not accord with long established international practice. A significant portion of the Act now deals with “emergency management” provisions. A casual reader may believe that the intention of these provisions is to assist property owners by allowing them to place emergency protection works to protect their property while working toward a long-term solution to the problem; sadly they would be wrong.

While the opportunity to address protection of individual properties existed in the previous version of the Act, its inclusion as a major section of the revised Act can be seen as an admission of lack of confidence in adequate State and Local Government planning capability. It is not simply the incorporation of the concept of emergency measures, but the manner in which those measures are enunciated. The Act (including the Regulation and associated code and guides) provides detailed specifications of, and limitations to, emergency structures; where, when and how they may be built. The engineering specifications mandated by the Act provide measures which any competent coastal engineer knows could not be constructed during an emergency. Further, if the measures were installed after an emergency to potentially extend the time for consideration of more permanent works, again any competent coastal engineer would recognise that, if constructed as specified, the emergency measures are unlikely to survive the next, even modest storm, and may even contribute to accelerating the problem.

Not surprisingly, the associated Code of Practice and Guide (NSW Govt 2011a, b) carry a disclaimer stating, amongst other things, that “*No representation is made about the accuracy, completeness or suitability of the source material included in this document for any particular purpose.*” That is, “no care and no responsibility”; an interesting comment for a “Code of Practice”.

However, the accompanying Legislation (NSW Govt., 2011c) requires Local Government and their residents to comply with the Code.

To date, NSW Councils generally have not realised their duty of care to warn residents directly that, under this Act, those with existing protective measures (approved or illegal) are not permitted to take any additional emergency measures, (including strengthening their existing protection) during an event in order to save their properties. Further, that if they do so the Council has the responsibility to issue “stop work” orders and to seek to impose significant penalties, up to \$247,500 for an individual and \$495,000 for a corporation (NSW Govt. 2011b). Nor have Councils exercised their duty of care to advise people directly with no current protection that, in terms of the Act, property owners generally will not be permitted to take measures to save their property during an erosion event and, indeed, these significant penalties will apply if they attempt to do so. Further, if they wish to take “emergency measures” after a significant event to reduce future damage, they may be permitted to do so but only using the specified protection measures designed to fail when needed.

Local Government in NSW has been delegated the role of implementing this legislation with limited training and expertise. Local Government through their nominated regulatory officers will be required to approve or refuse structures (both emergency and long term). They will have to issue individual certificates prior to the installation of emergency measures and, then, supervise and monitor those works, ensuring they continue to comply with the original certificate and that they are removed immediately upon expiry of the approval (usually 12 months from their implementation).

The demonstrable engineering incompetence of the “permissible” emergency measures is fertile grounds for legal action. The argument that in NSW Councils have been provided extended legal protection for their decisions under Section 733 of the Local Government Act is of questionable value as the required “good faith” defence will need Councils to show that their officers acted “reasonably”. To do so they will, undoubtedly, have to demonstrate an appropriate level of expertise and experience. Further, as they will be responsible for issuing “stop work” orders which may result in property loss and penalties during an actual emergency if property owners attempt to protect their properties using methods other than stipulated in the Legislation, Councils can reasonably expect property owners to seek legal recourse in common law; Councils will be damned if they do and damned if they don’t.

One Council has already demonstrated concerns with the issuing of certificates under part 4C of the updated Coastal Protection Act. Warringah Council, based on legal advice, has adopted a report (WSC, 2011) recommending amongst other things that Council issues a cautionary clause in any certification for Emergency Coastal Protection Works (ECPW). The wording was amended from that suggested in the original report to Council and subsequently accepted by Council (pers. com. Daylan Cameron 17<sup>th</sup> October 2010). The clause now reads:

*“In granting this certificate under Part 4C of the Coastal Protection Act 1979, Council does not warrant that the ECPW will protect the owner's land from erosion, prevent damage to any building located on the owner's land or achieve the result (if any) specified in the Part 4C application. If the ECPW cause impacts on adjacent areas they can be ordered to be removed at the owner's expense.”*

That a Council feels compelled to advise an applicant that the works they are proposing and for which Council is obliged to issue a certificate allowing them to be constructed, may not work and in fact could result in damage to adjacent properties, is at best disturbing.

Interestingly, at the time of finalisation of this report, the authors are not aware of a single application for a certificate for emergency works being requested or issued by any of the approved authorities since the revised legislation came into effect. Possibly, property owners recognise the futility of relying on this process for protection of their property.

## **Conclusion**

Both the provisions for construction of a geotextile container wall or minor beach nourishment as emergency protection in accordance with the legislated requirements will not work. The works permitted do not represent sound engineering practice and are unlikely to provide adequate protection to assets during a significant or even moderate storm. Further, with few exceptions, they could not be constructed during an emergency to comply with the conditions mandated through the legislation.

It remains likely that individual residents will resort to protecting their properties through whatever means are available to them (if they are threatened by storms) and then sort out the legal implications afterwards. The resolve of the Government will be tested at that time when they are required to remove the works, rehabilitate the beach and to attempt to prosecute the property owners for protecting their homes. Invariably in an emergency when property is threatened, the outcome will be ad-hoc protection measures and significant time and expense through the courts, both for property owners and Local Government.

It is difficult to argue that the significant Government expenditure over the past three years in reviewing and amending the legislation to permit ineffective emergency works at restricted locations, preparing guidelines as to how these works may be constructed thereby ensuring that in all likelihood they cannot be effective and funding Local Government to prepare emergency action plans that advise that no emergency action can be undertaken by landowners to protect private property, is a sound commitment of the limited coastal management resources and expertise in NSW.

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