CHAPTER 4: MINIMISING COASTAL HAZARDS

4.1 INTRODUCTION

A large number of variables are involved when a tragedy occurs due to cliff collapse. Due to the random nature of the physical processes operating, it is impossible to predict when a tragedy will occur, however we can minimise the risk, by reducing the hazard.

Most local governments have implemented strategies in attempt to reduce the hazard associated with coastal landforms. The erection of fencing and signs around dangerous cliff areas has been quite extensive, and the mobility of sand in blowout areas has been reduced through the process of brushing. A large number of these preventative and remedial measures have been employed to comply with the recommendations of geological and engineering consultants. There are however, still many areas that have been neglected. Fenced areas often have alternative entries and some particularly hazardous beaches have no warning signs.

4.2 GEOTECHNICAL REPORTS

Following the Gracetown tragedy, most local governments with costal cliff lines employed geotechnical consultants to inspect and assess coastal landforms that may be of concern to public safety. These reports were quite comprehensive, documenting the stability of the coastline and recommending options for maximising public safety and minimising risk to the LGA. Table 3.1 provides a list of all the LGAs with coastal outcrops of Tamala Limesone.

The City's of Wanneroo, Joondalup, Stirling and Mandurah, along with the Town of Cottesloe and the Shire of Busselton have all had one or more of these geotechnical assessments. We are however, not aware of any reports completed by the Cities of Freemantle, Nedlands or Cockburn, the Shire of Gingin, or the Town of Mosman Park (this does not mean to say that these reports do not exist, it simply means that we have not been able to source any). If there have in fact, been no geotechnical assessments completed within these LGA's, we do recommend that they reassess their need for an inspection of coastal cliff hazards.

Table 3.1 Local Government Areas with coastal outcrops of Tamala Limestone.

LGAs with coastal outcrops of Tamala Limestone	
Shire of Gingin	Town of Mosman Park
City of Wanneroo	City of Freemantle
City of Joondalup	City of Cockburn
City of Stirling	City of Mandurah
City of Nedlands	Shire of Busselton
Town of Cottesloe	

4.3 MINIMISING COASTAL LIMESTONE HAZARDS

4.3.1 Introduction

There are several preventative and remedial measures that can be taken by LGAs to minimise the number of hazardous cliff areas along the coastline. These measures are discussed in detail in many of the geotechnical reports, and provide a variety of options ranging from community education through to the use of explosives. These preventative and remedial measures are summarised and discussed below.

4.3.2 Education

Education is probably the most important factor in maximising public safety. If people are aware of the dangers associated with the coastal limestone, then most people will respond by avoiding precarious locations.

In a report to the City of Wanneroo by Gordon Geological Consultants (1997a), it is suggested that the educational process should begin with the City Rangers and their employees. This would better enable employees to provide reliable information to the public concerning coastal hazards and unsafe areas. It would also be extremely beneficial to educate children about coastal hazards through the process of school visits and presentations.

Equally important in educating the public is the availability of information in the form of pamphlets and poster boards. Examples of these types of pamphlets are the ‘Shore

Safety' pamphlet produced by Geosciensce Australia and the 'Coastal Hazards' pamphlet produced for Rottnest Island. Other LGAs have produced similar literature and this information should be available at all tourist information and accommodation booking centres.

4.3.3 Warning Signs and Fences

Local Government Authorities have been quite active in erecting a variety of signs warning the public about limestone hazards. These warnings range from prohibitive signs such as 'Keep Out' and 'No Entry' (Figure 4.1), to more informative signs specifically warning people not to walk over the cliffs and not to shelter under overhangs (Figure 4.2).

Wire fences have been constructed around some of the more hazardous areas and are often used in conjunction with prohibitive signs such as 'Keep Out' (Figure 4.1). Railed walkways can also be an effective way of ensuring that the public walk on designated paths and stay out of hazardous areas.

Figure 4.1 A variety of prohibitive signs in conjunction with wire fences have been constructed to keep people out of hazardous areas.

While signs and fences cannot guarantee that everyone will observe the warnings and be responsible, they do inform people of the dangers, and discharge in whole, or in part a duty of care. In general, LGAs have implemented the use of signs and fences quite effectively, however there are some localities where more work could be done. For example, at site 15 (see Appendix A) located in the City of Mandurah, highly weathered limestone outcrop forms 3-4 m cliffs with clear evidence of undercutting and the development of overhangs. There are large sections of rock that have separated from

the cliff, and some of these are encroaching on to the public staircase that provides access to the beach (Figure 4.3). There did not appear to be any warning signs at this site, despite recommendations to do so in a draft safety audit for the City in 1997. It may be possible however, that these signs have been removed or are still in the process of being developed.

Figure 4.2 An example of an informative sign within the City of Wanneroo. This type of sign does not deny public access, but alerts people to the dangers associated with limestone cliffs.

Figure 4.3 Limestone blocks encroaching on to a stair way that provides the public with beach access.

4.3.4 Catch fences and catch ditches

Catch fences and ditches are not used as frequently as other preventative measures, but are put into operation to prevent falling blocks from rolling down slope onto a road or path.

4.3.5 Limestone blocks and spalls

Cut limestone blocks and limestone rubble of various sizes (also known as limestone spalls) can be used to infill spaces such as caves or those under overhangs. The placement of these materials under hazardous areas can provide support to the overhang and help prevent potential rockfalls. These materials cannot be moved without the use of mechanical equipment, and therefore prevent the public from sheltering under these areas. This method is a commonly suggested remedial method.

4.3.6 Mechanical removal

Loose or unstable blocks of limestone are extremely hazardous in frequently used areas. Removing loosened blocks or rolling them down the slope using mechanical equipment such as a backhoe bucket can reduce the risk of rockfall. This remedial method has been suggested for several localities by geotechnical consultants.

4.3.7 Demolition

If no other method is appropriate to remediate a particular hazard, then demolition may be the only available option. This can be achieved in one of two ways, either by using chemical expanders, or as a last resort, explosives.

Chemical expanders can be poured into drill holes within the rock to be demolished. The material then hardens and expands causing cracks to form systematically. The rock may break unaided along the drill lines, or can be easily removed with a hammer or backhoe bucket.

There are extremely few recommendations to use explosive force to remove dangerous overhangs or demolish caves. Explosives are dangerous to use and can cause damage to

and weaken adjacent rock structures causing widespread cracking.

4.4 MINIMISING COASTAL DUNE HAZARDS

4.4.1 Introduction

The main hazard associated with coastal dunes is an increase in the natural angle of repose through the process of erosion. When this angle of repose is increased, the dunes may become unstable and collapse, therefore creating a hazard for people visiting the beach. Another consequence of dune erosion is the mobilisation of sand, which can inundate roads and houses, creating a problem for residents.

All of the LGAs within the study area have coastal dune formations, and therefore need to consider their stability as a serious issue. While the draft safety audit produced by the City of Mandurah mainly focused on limestone headlands, a small section of the report was devoted to foredune stability. Although very general, its inclusion in the report highlights the significance of coastal dunes as a hazard to the community.

4.4.2 Education

As with coastal cliff lines, we can minimise the risk associated with coastal sand dunes by educating the public about the related hazards. Once again, these sorts of community programs should be specifically targeted towards school children in the form of school visits. Information should also be contained within tourist information brochures and appropriate signage displayed at beaches. There are a number of other preventative and remedial measures that can be undertaken to ensure the stability of our dune systems and these are listed below.

4.4.3 Artificial walkways

Providing the community with designated walkways over the dunes will help minimise the damage to surrounding areas. Walkways are most effective if they are clearly visible to the public, and this will depend on the nature of the walkway. If a regularly used track has been worn into the dunes, then this should be roped off to ensure people stay on this path and do not disturb other areas of the dunes. Alternatively, artificial

walkways can be constructed using railway sleepers or pine timbers. It can also be appropriate to use suitable quantities of shell or bark to form a walkway. All options provide a pathway that will give the dunes some protection from erosion.

4.4.4 Brushing and revegetation

Brushing is remedial method used to encourage the regeneration of vegetation within the dune systems. This method involves the spreading of tree prunings around the de-vegetated area to protect the sand dunes from the direct impact of wind and to help stabilise the sand. The prunings also facilitate the capture and establishment of wind blown seeds within the sand, accelerating the growth of new vegetation. Brushing can be used by itself to encourage new vegetation growth, or in conjunction with manual sowing or planting of dune grass. In addition to revegetation, brushing also makes access to the areas more difficult and deters people from using them.

4.4.5 Sand fences

In areas where large quantities of sand are being blown out of the dunes, sand fences can be used to rapidly accumulate sand within the area. These fences can be constructed out of perforated plastic and erected at right angles to the direction of the prevailing wind. These fences act to slow down the wind sufficiently enough for sand particles to settle out. When enough sand has accumulated to rebuild the dunes, revegetation must occur to stabilise the dune and to prevent further blow outs.

4.4.6 Regrading dune surfaces

When the face of coastal sand dunes becomes over-steepened due to wave action or aeolian processes, there is an increased potential for these dunes to collapse. Particularly hazardous dunes may need their surface regraded to a natural, less steep angle of repose. This will greatly reduce the potential for collapse.

4.5 HERITAGE VALUES

4.5.1 Introduction

The Tamala Limestone cliffs and the dunes of the Safety Bay Sand can pose a serious hazard to the community. It is not uncommon to see hazardous areas altered or removed in the interest of public safety. It must be noted however, that these geological and landscape features may also be areas that have significant natural or cultural heritage values.

4.5.2 Natural heritage values

Any area that has a particular importance to a group of people can be determined to have heritage values. Natural heritage sites are natural areas that are important for present and future generations in terms of their scientific, social, educational, aesthetic and life-support value.

The south-west coast of Western Australia has some spectacular limestone cliffs and dune systems that demonstrate natural processes at work. These features not only illustrate the effects of present exposure to climate and earth forces, but also document past geological processes. In conjunction with their scientific and educational value, these landforms are also the habitat of many species of plants and animals, and are areas of natural beauty.

When making decisions on appropriate hazard prevention and/or remedial measures, the natural heritage value of our coastline should be taken in to account. Consider if there are there any rare or endangered species of plants or animals living in the area, or if the geological formation may be important for scientific or educational purposes. No one wants to see all of the spectacular cliffs, caves and overhangs altered or removed by explosives or excavators. Equally, no one wants to see a myriad of signs and fences. A balance must be reached between hazard mitigation and preserving the natural environment.

For example: When using limestone blocks and spalls to fill in spaces under overhangs and in caves, the more natural the limestone looks the better. It is preferable to use blocks with rugged faces, rather than cut faces. Uncut blocks with more or less flat faces on bedding planes are a good option. When building a limestone wall it is essential to have the mortar the same colour as the limestone to provide a natural look.

2.5.3 Indigenous heritage values

Cultural heritage, in particular, Indigenous heritage, is something that can be found in almost all, natural areas. For more than 60 000 years, Aboriginal and Torres Strait Islander people have left signs of their occupation in Australia. Indigenous people's heritage is an important element of the whole of Australia's heritage. Their heritage is something that is of continuing significance, creating and maintaining continuous links with the people and the land.

If there are hazardous areas within a site that has particular significance to the Indigenous people, then their consultation should be the first step towards finding an appropriate remedial method.

2.5.4 The Heritage Council of Western Australia

The Heritage of Western Australia Act 1990 requires Local Government Authorities and State Government Agencies to seek the advice of the Heritage Council if they are considering development of a place that is entered in the Register of Heritage Places. Work may not proceed before advice has been received and the work must comply with the advice.

Advice can also be sought from the Heritage Council in regard to proposed development of non-registered places. This advice can be sought at the discretion of the owner or developer, Local Government Authority or State Government Agency. In these instances the advice is for consideration only and is not binding.

2.5.5 Conclusions

Australia's heritage, shaped by nature and history, is an inheritance passed from one generation to the next. Our heritage helps us to understand and tell stories about this land and its people.

In planning for the future, it is important to ensure that all elements of significance are protected. Hazard mitigation and remediation must strike a balance between conserving our natural and cultural heritage values and increasing safety along our coastline. If done correctly, our coastline will remain a beautiful and safe place for everyone to enjoy for many years to come.