

Chapter 6 Alternatives

The Baird 2003 report gives a list of alternatives to be considered for better control and management of the coastal areas mainly when dealing with natural hazards or extreme events like cyclones and storm surges. Alongside, The Do Nothing option has been considered. While the alternatives listed have been considered in this present report, they are being discussed as the alternatives to the proposed breakwater structure for the particular site under consideration.

For the purpose of this report, the Do Nothing option was first considered and the alternatives are then discussed in the same order and under the same grouping as presented in the Baird 2003 report, that is

1. Prevention

- a) Setback
- b) Relocation

2. Non Structural Intervention

- a) Shore and beach management
- b) Beach nourishment

3. Structural intervention

- a) Groynes
- b) Detached breakwaters and Artificial Headland
- c) Shoreline armouring

6.1.1. The 'Do Nothing' Option

As a first alternative, the Do Nothing option was considered for the site. Leaving the shoreline as it is and without any protection will only see the more erosion of the sandy areas. The sea will continue to move landward and the escarpment will eventually get bigger especially after an extreme event where there are frontal wave attacks from the north. This can be noticed through the landward advancement of the high water mark from the archived aerial photographs. The Do Nothing option could have been a viable option for cases where erosion is caused naturally and where there are possibilities of the materials to come back. However, in the present case the main cause of the erosion at the site is the near vertical wall that is adjacent and to the east of the site.

The historical nature of the wall is not known but a safe guess would be that it was put in place because of erosion happening at the present wall location due mainly to the natural stone wall to the east of the wall. The wall has left the eroded beach, under consideration through this report, very much more vulnerable and prone to erosion from the wave attacks and longshore current.

Past experiences have shown the difficulties arising from pulling down a wall. These difficulties which are before, during and after the pulling down action relate to the physical, environmental and legal aspects. As such pulling down can take a long time to happen and be retarded while at the same time unrecoverable damages would have been done at the present site under study.

The Do Nothing option has also been considered in the event that the wall is pulled down even though there is no certainty and neither any indication that this would happen in the near future. While it is acknowledge that pulling down the wall would have for effect to diminish the erosive

power through the diminution of the current at the site especially during an extreme event, the shoreline would still be under direct wave attack from the north and would still be prone to erosion.

6.1.2. Prevention

The preventive alternatives like respecting the 30 m setback from the high water mark or else relocation of the project is not applicable to the present case which is mainly driven towards the control of erosion happening at the site which is being caused by the wall found immediately to the east of the site. The concrete structure at the site, viz. the house under corrugated iron sheet roof, is well beyond the 30 m from the high water mark and has been standing well before 1967.

The benefit of having a setback of 30 m is acknowledge and appreciated. It is observed, in this present case, the devastating effects of having a solid structure within the 30 m setback. The consolidated concrete-rock wall, which is literally at the high water mark, is responsible for the massive erosion at the site and as such should be pulled down and necessary restructuring of the dunes and protective measures be put in place at the location of the wall to prevent any erosion.

Relocation of any structures is also not an alternative as these are not under any immediate threat and also the land lease along with the house are under the actual tenant for more than 30 years and as such has much more than a financial value attached to it. Further to those, there is no alternative site available for any relocation.

6.1.3. Non structural interventions

Non-structural interventions on their own would not provide the necessary control for the erosion at the site. However, they would definitely be used in conjunction with the proposed structural intervention so as to ensure the sustainability of the beach when all the structures are in place.

Plants like salt water resistant grass and *Ipomea sp.*(Batatran) will be planted along the topmost part of the beach dune. These plant are not expected to control erosion caused by the wall but would most definitely help in the reducing the effects and maintain the sand to some extent.

Beach reprofiling is a measure that has been adopted to control erosion at the site and it will be done at a later stage when the stability of the shore has been ensured through the construction of the permeable breakwater structure. The beach slope will be reprofiled by the addition of carbonate materials of the appropriate grain size such that a slope of 7 to 8 degrees is obtained. The beach will then be maintained regularly, mainly on an as-and-when required basis through the addition of sand.

6.1.4. Structural intervention

a) Groynes

A groyne is a narrow structure projecting from the shoreline to the nearshore at approximately right angle (i.e. perpendicular to the shore). Groynes can be installed parallel to each other and can come into a variety of shapes and can be constructed with different materials like stone and masonry. The main intent of using groynes to control erosion at a site is to trap some or all of the material being transported along the shore. The materials are usually trapped on the updrift side of the groyne.

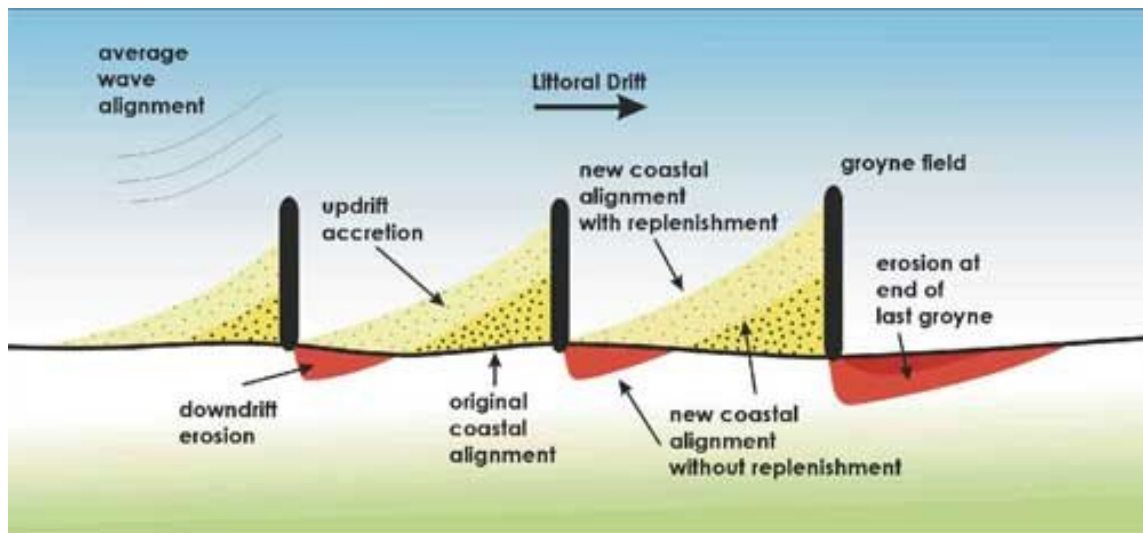


Figure 6.1.: Schematic of Groynes. Source: www.environment.sa.gov.au

The erosion at the present site is being caused primarily by the hydrodynamics created by the wall and a groyne as per the definition and use given above would not be suitable for the site even though there are good resemblances to the proposed structure. The primary objective of the proposed structure is to limit to a maximum the hydrodynamics caused by the wall and entrapment of materials would be a secondary effect expected. The length of shoreline available for intervention is also too short to allow for a series of groynes to be placed to ensure entrapment of the materials within the region of concern. In addition, the fact that the wave attack, during extreme events, at the site would be mainly from the north and north west, any materials accumulated between the groynes would be emptied.

Structurally a series of groynes would require more materials like rocks and boulders to be placed along the shoreline and would thus be more costly. The fact that groynes will have to be placed in front of neighbouring sites as well is also an issue and thus has been considered negatively.

b) Detached breakwaters and artificial headlands

Detached breakwaters are structures that are constructed at a considerable distance and parallel to the shore and are not connected to the shore by any sand-retaining structure. Detached breakwaters can be constructed as a single continuous structure or a series of structures interspaced with gaps.

Unlike groynes which trap materials from the longshore current, detached breakwater have for main effect to create an area of reduced wave energy on the leeward side of the structure by dissipating, diffracting and reflecting the incoming waves. A reduction in the wave energy would usually result in a reduction in the currents and the sediments are thus more prone to be deposited and accumulated. Usually detached breakwaters are more effective where sediments are transported cross-shore.



Picture 6.1. (a) & (b): Aerial and satellite image of detached breakwaters in front of The Sands Resort
Source Aerial from Baird 2003, Satellite from Flash Earth

Detached breakwaters have been considered in the present case and have been turned down for the following reasons

- The detached breakwaters would have been located some 200 m from the shoreline and would thus require heavy machinery over an extended area of the lagoon. This would have had detrimental effects on the habitat.
- The detached breakwaters would reduce the waves reaching the wall and thus diminish the current created but there would still be a current flow along the wall.
- The detached breakwaters would be placed directly opposite to the wall and thus in front of neighbouring sites and this could probably be viewed as aesthetically incorrect and unnatural.
- The detached breakwaters may hinder navigation within the lagoon
- The amount of materials, such as rocks and boulders, needed is relatively much higher than the proposed structure and is thus more expensive to put in place.
- Reaching such distances with heavy machinery may cause lost of damage to the marine environment.

Artificial headlands which are designed to combine aspects of groynes, like the trapping of sediment from the longshore current, and aspects of the detached breakwater, like altering incoming waves through diffraction, have also been considered. The use of headlands was consequently turned down for the same reasons the groynes and the detached breakwaters have been turned down.

c) Shoreline armoring through revetments and seawalls

The definition of the revetments and seawalls are taken as described in Baird 2003 report. The revetment is defined as a sloped facing of stone, concrete or other durable materials build to protect a scarp or embankment against erosion by wave action. The seawall is a vertical or near vertical shoreline protection work protection works separating the lands and the water areas.



Picture 6.2.: Rock armour on the shoreline



Picture 6.3.: Gabion rock revetment. Source: Baird 2003

The present cause of erosion is due to the wall adjacent to the site. The construction of a seawall, as a continuation to the existing one has been considered but eventually turned down for the reasons highlighted in Baird 2003 report but also for the following:

- The seawall would eventually cause erosion at the neighbouring site to the west and immediately in front of the wall.
- The seawall would interfere with the hydrodynamics in such way that it would be unsustainable in the long term.
- The scour and the undermining effects would eventually affect the wall itself through its collapse.
- The construction of the wall would be more expensive than the proposed structure.

Revetment of the beach using either static stone revetment, dynamic stone revetment or sloping gabion structure has also been considered and turned down due to the disadvantages highlighted in the Baird 2003 report but also because:

- The revetment would cover a good portion of the existing sand beach and as such would considerably degrade the immediate marine environment.
- The revetment would be aesthetically and visually unsuitable for the proposed site.
- The lifetime of the revetment is limited especially for the sloping gabion and requires regular maintenance
- The costs involve in the construction and in terms of materials needed are very high as compared to the proposed structure.
- The revetment could cause erosion to the neighbouring site to the west.