

5 OPTIONS AND RECOMMENDED STRATEGIES FOR EACH COASTAL UNIT

The existence and nature of erosion issues at each coastal segment as well as the prevailing coastal processes have been described in Section 3. The dominant coastal processes and the level of risk at the various locations will mean that some management options will be more suitable than others for each coastal segment. In the following sections, potential management options are discussed and the recommended strategy is presented for each coastal segment.

5.1 Princess Terrace to Clontarf Point

5.1.1 Introduction

The southern most 250m section of this coastal segment (i.e. in front of Bayview Terrace) is generally in good condition and lined with offshore mangroves. There are no reports of erosion issues along this shoreline section.

The offshore mangroves gradually become sparser towards the north and eventually diminish completely in front of the properties on Haysmouth Parade. Along Haysmouth Parade and further to the north, along Princess Terrace, the shoreline is backed by a low-lying, grassed public foreshore precinct. The shoreline along this section is armoured by seawalls of varying type and quality, which have been built by adjacent property owners in ad hoc efforts to arrest shoreline erosion. The seawalls in front of the beachfront properties on Haysmouth Parade and the two southern most properties on Princess Terrace seem to have been reasonably effective in preventing further shoreline erosion. However, the structural integrity of these seawalls is unlikely to be sufficient to provide appropriate protection against severe wave and flood events. Furthermore, the implemented armouring is aesthetically unattractive and considered to be of limited value in preventing further shoreline erosion.

The erosion issues along this beach are primarily the result of a reduction of sand supply to this segment. The historically sandy beaches along this shoreline have diminished and the present shoreline is characterised by a composition of silt, mud and some finer sand.

5.1.2 Shoreline Management Options Considered

Shoreline erosion management strategies for the shoreline between Princess Terrace and Clontarf Point will need to consider the risks associated with shoreline erosion and the possible impacts of any remedial works on Hays Inlet, which is an area of high biodiversity and ecological value (Fish Habitat Area, Conservation Park Zone of Moreton Bay Marine Park, RAMSAR site etc).

The management options considered for these beaches are:

- Do Nothing
- Beach nourishment alone
- Terminal protection alone

Do Nothing

Although some of the existing seawalls along Haysmouth Parade and Princess Terrace seem to have been reasonably effective in preventing further shoreline erosion, most of the existing armouring is unlikely to provide adequate protection during severe erosion events and, due to their proximity to the shoreline, the residential buildings on 3 and 5 Princess Terrace and 18 Haysmouth Parade may be at risk of erosion during such events. Therefore, the Do Nothing option is unlikely to provide adequate protection to the properties on 3 and 5 Princess Terrace and 18 Haysmouth Parade.

The remaining properties on Princess Terrace are fronted by a state-owned reserve. The existing buffer in front of these properties is typically about 30m, which is, given the slow rate of erosion and the limited vulnerability to short term erosion, considered to be an adequate buffer width in the foreseeable future. Consequently, the Do Nothing option may be considered for this section.

It is noted that the Do Nothing option may require some works to protect the existing stormwater pipe, which drains into Hays Inlet behind Princess Terrace.

To improve the amenity of the shoreline around Princess Terrace, it is recommended to remove the dumped rubble from the foreshore.

Beach nourishment alone

Beach nourishment alone could be considered as an option to reduce or remove the immediate threat of erosion to private property as well as a means of enhancing the visual value of the subjected beach. The beach nourishment option at this beach would require widening of the buffer width in front of 3 and 5 Princess Terrace and 18 Haysmouth Parade (90m of shoreline).

An initial beach nourishment quantity in the order of 4,000 cubic metres would be required to provide these properties appropriate protection against erosion. In addition, some ongoing maintenance nourishment will remain necessary to maintain the beach at its improved level. The maintenance sand nourishment requirement for this beach is expected to be relatively low due to the relative low wave energy available to drive sand transport processes.

Beach nourishment may have adverse impacts on significant areas within Hays Inlet, including disturbance of fisheries resources and changes to sediment composition of the subjected and adjacent beaches, which may lead impacts on existing mangroves on the adjacent beaches.

It is noted that this option may require the relocation of the existing boat ramp at the end of Haysmouth Parade and alterations to the existing stormwater outlet at Princess Parade.

Terminal protection alone

Upgrading of the existing armouring to a uniform and appropriate standard could be considered as an option to reduce or remove the immediate threat of erosion to private property. It is recommended that such revetments are implemented only at locations where significant assets are currently under immediate threat of erosion or likely to become at risk in the foreseeable future. Therefore, if the terminal protection option is adopted, upgrade of the existing seawalls is only required to protect the residential properties on 3 and 5 Princess Terrace and 18 Haysmouth Parade. Implementation of a rock wall along the state-owned reserve at Princess Parade is presently not considered necessary.

To protect the residential properties on 3 and 5 Princess Terrace and 18 Haysmouth Parade, it would be required to upgrade the existing seawalls over a length of about 90m.

Due to the presence of the existing armouring on the foreshore and the lack of beach, implementation of the seawall upgrade along the 90m long section is unlikely to have significant impacts on existing coastal processes or surrounding habitats.

However, to minimise scouring and deepening of soft-sediment habitats in front of the seawall due to increased wave action (reflection), and avoid excessive wave overtopping, the use of reflective vertical walls (such as timber or concrete walls) should be avoided. It is recommended to upgrade the existing seawall by application of a rock wall or a gabion-type of revetment structure.

5.1.3 Recommended Strategy

After assessment of the shoreline management options, the recommended strategy for this coastal segment is to allow an appropriate upgrade of the existing armouring in front of the residential properties on 3 and 5 Princess Terrace and 18 Haysmouth Parade and implement the Do Nothing option along the remaining section of the segment.

The primary purpose of the recommended revetment upgrade is to stabilise the shoreline at this location and provide an appropriate level of erosion protection to the waterfront properties behind the structure. The works that would be required for the option are likely to involve the upgrade of the existing seawall over a length of about 90m. It is recommended to upgrade the existing seawall by implementation of a rock wall or a gabion-type of revetment structure.

As the available buffer width in front of the other residential properties on Princess Terrace is presently considered to be sufficient, it is recommended that no protective action is undertaken and the existing dumped rubble on the foreshore of the state-owned parcel is removed to enhance the amenity of this area. This option is supported by its low cost and lack of environmental disturbance.

Under this option, the threat of damage from short term erosion during storms will need to be handled under emergency provisions. The main threat is damage or loss of public foreshore land and the damage to the existing stormwater outlet at Princess Terrace. The damage potential can be reduced by establishment of offshore mangrove populations, which would reduce the wave attack on the shoreline.

The costs involved in the implementation of the recommended management option will be dependent on the adopted final design for the seawall, but the capital cost for this option are likely to be around \$110,000. There would also be ongoing costs associated with routine foreshore parkland maintenance, maintenance and repair of the seawall and emergency provisions.

It should be recognised that protection of private property is primarily the responsibility of the property owners.

For the southern most 250m section of this coastal segment (i.e. in front of Bayview Terrace) , there are no reports of erosion issues along the shoreline and the most appropriate management option for this section is to leave the shoreline undisturbed (implement the Do Nothing option).

5.2 Clontarf Point to Woody Point

5.2.1 Introduction

This coastal segment is adjacent to Bramble Bay and extends from Woody Point to the Houghton Highway Bridge at Clontarf Point. Most of the shoreline along this coastal segment is armoured, either in the form of rock walls or concrete seawall.

The long term alignment of the three short sandy beaches in this coastal segment seems to be relatively stable.

5.2.2 Recommended Strategy

Because there are no reports of erosion issues in this coastal segment, it is considered that the Do Nothing option is most appropriate. Furthermore, it is recommended that planning constraints should be used to prevent development within the Erosion Prone Area, apart from acceptable temporary or relocatable structures for safety and recreational purposes (e.g. park facilities).

The only costs associated with this recommendation are in relation to the ongoing maintenance of the existing coastal structures, works required to clear the Crockett Park boat ramp and monitoring of the beaches.

5.3 Woody Point to Scott's Point

5.3.1 Introduction

The foreshore between Woody Point and Scott's Point consists predominantly of erosion escarpments and cliffs and along most of this shoreline armouring has been used to resist erosion.

The shoreline section between Picnic Point and Scott's Point is protected by a 700m long rock wall along the Redcliffe Central Coastal Arboretum. This rock wall appears to be in good condition and no action is required for this shoreline section apart from normal maintenance. The 80m long concrete seawall around Picnic Point is in its current condition unlikely to provide adequate protection to the park.

There is evidence of persistent slow erosion superimposed on short term fluctuations at the shoreline between Woody Point and Scott's Point. Along this section of the shoreline, private property is located directly adjacent to the shoreline and residential buildings are relatively close to the shoreline (at some locations less than 5m). A wide range of shoreline protection structures, with varying protection capacity, have been implemented by adjacent property owners to protect private properties, including concrete seawalls, rock armoured revetments and dumped rubble.

In the vicinity of the Gayundah wreck, rubble and broken concrete slabs have been placed on the foreshore by adjacent property owners. The resulting foreshore is not only aesthetically unattractive, but also likely to be of limited value in protecting the shoreline during significant storm events (refer to *Figure 3-2*).

The Council would like to implement a pathway/bikeway between Woody Point and Picnic Point, providing continuous foreshore public access between Clontarf Point and Scott's Point. The section between Woody Point and Picnic Point is the missing link because some freehold allotments along this section of the shoreline have riparian rights and their boundaries extend to the established high water mark.

It appears that in places the implemented shoreline protection structures extend significantly beyond the official riparian boundaries, however this would need to be confirmed by survey and inspection of the original Real Property Plans and other relevant historical records. Due to the existence of riparian boundaries, Council's access to the foreshore area is likely to be significantly constrained at these locations.

The shoreline between Woody Point and Picnic Point is fronted by a Conservation Zone and Marine National Park Zone of the Moreton Bay Marine Park (Refer to Appendix D). Consequently, any engineering works implemented seaward of the high water mark would need obtain a permit from EPA (Queensland Parks and Wildlife).

5.3.2 Shoreline Management Options Considered

Shoreline erosion management strategies for the shoreline between Woody Point and Scott's Point will need to consider the risks to private property associated with erosion, the proximity of the Marine National Park Zone and Council's aspirations in terms of public recreational use of the foreshore.

The management options considered for these beaches are:

- Do nothing
- Planning controls
- Beach nourishment alone
- Terminal protection alone

5.3.2.1 Do Nothing

This option would require no major works apart from removal of the dumped rubble which is currently located on the foreshore around Gayundah wreck. Removal of the dumped rubble from the foreshore will improve the amenity of the Gayundah wreck area but would decrease the level of protection to the shoreline.

Based on the present understanding of the coastal processes and behaviour of the shoreline between Woody Point and Scott's Point, it is considered most improbable that any improvement in the condition of the shoreline will occur naturally. To the contrary, further degradation of the unprotected or poorly protected sections is likely with future sea level rise.

Due to the proximity of private property to the shoreline, the Do Nothing option would not provide adequate protection against the threats associated with erosion

5.3.2.2 *Planning Controls*

An option to manage the risks associated with shoreline erosion is to adopt planning controls. Development conditions are of use in limiting the damage to the shoreline and to the development itself associated with new development in zoned areas and redevelopments. Development controls that might be appropriate for mitigating erosion hazards include:

- Setback lines to avoid inappropriate development within hazard prone zones;
- Requirements to provide coastal engineering works for the purpose of hazard mitigation;
- Structural requirements to withstand coastal hazards.

Due to the high risk status of the Woody Point to Picnic Point shoreline, any future development in this area would be required to sufficiently address these hazards both currently and for the foreseeable future.

Through planning controls, development consent could be subject to demonstration that coastal protection works would be put in place as part of the development, and would sufficiently mitigate the erosion risk and would be adequately maintained for the lifetime of the proposed development. The impact of these protective works on the marine environment (eg. Marine National Park Zone) would need to be assessed. Controls should be put in place to encourage aesthetical consistency along the shoreline and prevent isolated protective structures or discontinuities, which could threaten the overall integrity of the shoreline protection strategy.

In the absence of future protective works to alleviate the erosion hazards, the adoption of setback lines is recommended to prevent new development within the erosion prone area (defined as a zone within 40m of the high water spring tide mark).

The planning control option has limited value in addressing the management of erosion risk of existing development.

5.3.2.3 *Beach nourishment alone*

Due to the exposed nature of the shoreline and the absence of a reliable sand supply, beach nourishment without significant control structures (eg. groynes) is not considered to be a viable option for this shoreline. It would be unlikely that the new beach could be successfully integrated with the nearshore Gayundah wreck, which is culturally significant, or without significantly impacting on the adjacent Marine National Park Zone. Therefore, beach nourishment is not considered to be an appropriate option for this shoreline section.

5.3.2.4 *Terminal Protection alone*

Upgrading of the existing armouring to a uniform and appropriate standard could be considered as an option to reduce or remove the immediate threat of erosion to private property. Should this option be adopted, it is recommended that a rock revetment be implemented along the entire shoreline between Woody Point and Picnic Point, in a consistent alignment 400m long. The rock armouring would need to extend to about +3.1m AHD. Above this level, the foreshore could be left unprotected.

Before the optimised alignment of such rock revetment can be determined, actual freehold tenure would need to be assessed by Council. Nevertheless, it seems possible to implement the revetment by choosing an alignment that does not encroach onto private land.

The revetment could be widened to include a public walkway/bikeway, however this would result in significant additional cost. Furthermore, provision of public access in front of private property that have riparian rights is likely to be subject to significant objection and possible legal action. In addition, it is noted that there is limited space for a revetment with integrated walkway/bikeway facility between private land and Gayundah wreck.

An option to provide public access between Woody Point and Picnic Point, subject to approval by EPA (Queensland Parks and Wildlife), would be to construct an offshore piled boardwalk structure. The piled boardwalk would be located on the seaward side of Gayundah wreck with no access to private property with riparian rights. The superstructure of boardwalk would need to be built above the influence of storm waves.

5.3.3 Recommended Strategy

Although some of the existing seawalls along private property seem to have been reasonably effective in providing protection, it is uncertain if all the private structures can provide adequate protection during severe erosion events. Due to the close proximity of the residential buildings on Woodcliffe Crescent, these buildings may be at risk of erosion during such events.

The recommended strategy for the shoreline section between Woody Point and Picnic Point is to formalise the existing shoreline protection works and, where needed, upgrade the existing structures to an appropriate engineering standard. The primary purpose of the formalisation of the existing protection works is to provide protection to the adjacent private properties. Where possible, required protection works should be located within the property boundaries.

Assessment of the structural capacity of the existing structures would be needed to define the works required to formalise the existing protection works.

To improve the amenity of the foreshore area, it is recommended to remove the inappropriately dumped rubble that is currently located on the foreshore.

The existing rock wall between Picnic Point and Scott's Point provides adequate protection against erosion to the Redcliffe Central Coastal Arboretum. The Do Nothing option is considered to be the most appropriate for this shoreline section.

For the 80m long section around Picnic Point, it is recommended to replace the existing concrete seawall with a rock wall, in accordance with the "Option 2" design in "Gayundah Wreck (Picnic Point) Seawall Rectification Concept Design Report" (KBR, 2007B). The costs that would be involved in the implementation of this recommendation are estimated to be about \$290,000.

In addition to the establishment cost for the recommended shoreline protection upgrades, there should be a minimum provision of about \$45,000 per year for ongoing maintenance and repair of the shoreline protection structures.

5.4 Scott's Point Beach, Margate Beach and Suttons Beach

5.4.1 Introduction

The beaches of Scott's Point Beach, Margate Beach and Suttons Beach form a long, continuous stretch of sandy beach that provides an important recreational function to the community of the southern Redcliffe Peninsula and visitors.

The long term average net longshore sand transport on the Scott's Beach, Margate Beach and Suttons Beach is northwards and there is currently no significant sand transport past Redcliffe Point. Assessment of historical shoreline behaviour of this coastal segment has shown that there has been a tendency for persistent loss of sand along the southern end of the beach (i.e. Scott's Point Beach and Margate Beach) as a result of a sand supply deficit to this beach and the effects of mean sea level rise.

Currently much of Margate Beach lacks sufficient sand to provide an adequate dune buffer against major storm attack, which means that infrastructure and public assets that are not protected by the existing seawalls are currently exposed to erosion threats associated with major storm events. To avoid damage during significant storm events, protection works are required.

5.4.2 Shoreline Management Options Considered

Shoreline erosion management strategies for Scott's Point Beach, Margate Beach and Suttons Beach will need to consider the historical stability of the beaches and the Council's commitment to ongoing beach nourishment at a rate about equivalent to the long term losses at the southern beaches.

The management options considered for these beaches are:

- Do Nothing
- Ongoing maintenance beach nourishment alone
- Beach nourishment alone
- Beach nourishment with groynes

General considerations of these management options were presented in Section 4.4. A more detailed discussion with reference to Scott's Point Beach, Margate Beach and Suttons Beach are discussed below.

Do nothing

If Council's commitment to ongoing beach nourishment would be ceased, the beaches of Scott's Point Beach and Margate Beach are likely to deteriorate further as the erosion process continues. This would almost certainly result in further shoreline recession at Margate Beach, which would progressively put more assets under threat of short term erosion, if shoreline erosion was allowed to occur. Furthermore, without removal of sand from behind the Redcliffe Point groyne, it is likely that substantial dune formation will occur at Sutton Beach, which would increase the inconvenience

caused by sand blown into Suttons Park by onshore winds. Therefore, the Do Nothing option is strongly dissuaded.

Ongoing maintenance beach nourishment alone

Council's commitment to ongoing beach nourishment at a rate about equivalent to the long term losses at the southern beaches will reduce the risk of long term recession at this beach. This should leave only the short term erosion component of 16m as the threat to assets. Assets that are located within the zone of short term erosion potential include the road on Margate Parade, the boardwalk and some Council buildings (including the Margate Bathing Pavilion, a place of cultural significance).

The maintenance requirement associated with the ongoing sand loss from the southern beach is likely to be in the order of 6,000 to 9,000 m³ per year (ie 5,000 m³ per year longshore transport plus losses due to mean sea level rise). A greater amount may be needed if monitoring indicates that ongoing progressive losses are greater.

A cost-effective way to achieve this will be recycling of sand, in which sand that is transported northwards is relocated from the northern end of the beach (Suttons Beach) to Margate Beach. The sand may be relocated by truck transport (over the beach) or pumped via a temporarily installed pipeline system. It is envisaged that the sand relocation works would occur every 2 to 3 years during the winter months, when the beach is less populated.

Sand recycling works would need to be supplemented with the importation of sand from a suitable external sand source.

Beach Nourishment Alone

Beach nourishment could be considered as an option to reduce or remove the immediate threat of erosion to infrastructure and public assets as well as a means of enhancing the recreational value of the beach. This option would require the importation of sand from a suitable grain size and quality.

The quantity of nourishment would be subject to detailed design and consideration of the level of protection required, but as a first assessment, the likely minimum quantity of sand required to restore a suitable buffer zone to protect the road and the boardwalk against storm erosion would be in the order of 60,000 cubic metres.

This may be considered in the context that

- This quantity, if placed initially along about 750 m of the Margate Beach shoreline (between the Scott's Point rock wall and the concrete seawall at Duffield Street), represents an initial dune widening of about 15 metres;
- There will be some initial redistribution of the beach profile and longshore dispersion of the nourished volume over time such that its benefit to the nourished area reduces (allowance of 33% used)

It must be recognised that the sand placed on the beach will be integrated into the natural processes of erosion from the dry beach during storms and subsequent gradual return during calmer conditions and longshore sand transport processes that will disperse the nourished sand alongshore, which will

reduce the effective longer term benefit. Ongoing maintenance nourishment including recycling and importation of sand will remain necessary to maintain the beach at its improved level.

One issue relating to beach nourishment would be the source of sand. Current beach nourishment for the Redcliffe beaches is primarily sourced from a sand pit at Ningi. Ningi sand is similar to that which currently exists on Margate Beach. A range of possible sand sources was investigated by KBR (KBR, 2002).

Although, it is likely that the quantity of sand required for nourishment can be sourced from the Ningi sand pit, this source is distant and delivery by truck may require a specific management plan to avoid environmental and traffic concerns. If major beach nourishment exercises are to be undertaken then studies would need to be commissioned to identify suitable sand sources and means to deliver the material to the site.

Beach nourishment with groynes

Groynes have the primary function to provide increased stability to the nourishment by influencing the longshore drift. The design of such a scheme would seek to provide a suitable volume of sand that would 'fill' the sand trapping capacity of the structure such that adverse downdrift impacts are minimised.

However, these impacts cannot be prevented entirely because:

- The alignment of the updrift beach will be altered such that the longshore transport rate there is reduced;
- The structure will have local effects on waves and currents that impact on the beach shape immediate downdrift of the groyne.

Therefore, without nourishment, either an erosion area would develop to the north of the structure or a rock wall would be needed to retain the present foreshore alignment.

A design for the implementation of a groyne field at Margate Beach was assessed by KBR in the Redcliffe Coastal Process Study (KBR, 2002). The considered groyne field had three groynes with a length of 50m each, supplemented with a significant quantity of beach nourishment (similar volume to beach nourishment alone option). The study concluded that to prevent erosion at the northern end of the groynes, armouring of the shoreline over a distance of 200m. The total costs of the "groyne field with beach nourishment" scheme were estimated to be in the order 50% higher than the beach nourishment alone option.

One significant issue relating to groynes is their intrusion to the vista of the beach and interruption to direct access along the beach. The beach at Margate Beach is a long sweeping beach, and the implementation of a groyne field would result in a significant reduction in visual amenity.

5.4.3 Recommended Strategy

After assessment of the shoreline management options, it is recommended that the beach nourishment option be implemented at this beach. The beach nourishment will provide added protection to the infrastructure assets and minimise the need for other structural protection measures

in the future which may have adverse consequences on adjacent beaches. It will retain natural processes, provide an improvement to the beach amenity and hence the appeal to the locality.

The likely minimum quantity of sand required to provide appropriate protection would be in the order of 60,000 cubic metres.

Ongoing maintenance nourishment will remain necessary at Margate Beach to maintain the beach at its improved level. A cost effective way to achieve part of this will be recycling of sand, which has been transported northwards under longshore transport processes. It is recommended that this occurs from the northern end of Suttons Beach (behind Redcliffe Cliff groyne). The sand could be relocated to Margate Beach by truck (over the beach) or a temporary pump system (temporarily installed pipeline along the foreshore). It is envisaged that the sand relocation works would occur every 2 to 3 years during the winter months, when the beach is less popular. Sand recycling works (5,000 m³ per year) would need to be supplemented with the importation of sand from a suitable external sand source (about 1,000 – 4,000 m³ per year) to cater for long term losses such as sea level rise.

The cost of implementing the recommended nourishment program will be dependent on the adopted final design, negotiations with suppliers and timing of the works. However, the capital cost that would be involved in the implementation of recommended initial beach nourishment works are estimated to be about \$2.4 million, based on a beach nourishment requirement of about 60,000m³ and sand sourced from Ningi.

For ongoing maintenance beach nourishment, there should be a provision of \$90,000 per annum, which may need to increase to about \$210,000 per annum in the future if mean sea level rise accelerates due to climate change. In addition, there should be some provision for costs associated with dune stabilisation and management at this beach.

5.5 Redcliffe Point to North Reef Spit

5.5.1 Introduction

The shoreline between Redcliffe Point and North Reef Spit consists of a number of curved embayments that are formed between headlands and groynes which have intercepted the longshore sand transport to the north.

Most of the beaches are continually nourished with small amounts of sand to retain the current long term average shoreline position. Without beach replenishments, there would be a tendency for persistent loss of sand from this coastal segment. The primary causes for this loss of sand are the long term deficit in sand supply, offshore losses and the effects of mean sea level rise.

Assessment of the immediate erosion risk has shown that in places private property and recreational assets are located within the calculated short term erosion buffer width requirement of ~16m, including:

- Private property at Queens Beach;
- Bikeways, shelters and other recreational facilities at various locations; and
- Stands of significant Norfolk Pines at Captain Cook Park and Scarborough Park foreshores.

Along Queens Beach, residential buildings along Prince Edward Parade are under immediate threat of erosion. The residential property on 82 Prince Edward Parade and a residential building of the Bullivant Residential Resort have a buffer width of about 10m in front the buildings.

Along the entire coastline within this coastal segment, the foreshore bikeway and various recreational facilities are located within close proximity of the beach. At some locations, the bikeway is less than 5m from the front dune. The stands of Norfolk Pines at Captain Cook Park and Scarborough Park foreshores are highly significant and close to the beach. The Norfolk Pines at Captain Cook Park, which are dedicated to soldiers who fell in World War 1, are of great value to the Redcliffe community and MBRC.

Shoreline erosion management strategies for the shoreline between Redcliffe Point and North Reef Spit will need to consider the historical stability of the beaches, Council's commitment to ongoing beach nourishment at a rate about equivalent to the long term losses at the southern beaches and management of risks associated with erosion during storm events.

Due to the differences in the nature of erosion problem varies along the Redcliffe Point and North Reef Spit shoreline, possible management options are discussed for individual sections of the coastal segment below. The extent of the individual sections is presented in Figure 5-1.

5.5.2 Queens Beach South

In addition to the persistent loss of sand from this beach, the implementation of the Redcliffe Jetty offshore breakwater has initiated morphological changes at Queens Beach South, which has resulted in shoreline erosion at the northern end of the Queens Beach South embayment and accumulation of sand near the jetty (in the lee of the offshore breakwater).

The management options considered for this beach are:

- Do nothing
- Ongoing maintenance nourishment and sand recycling alone
- Beach nourishment alone
- Terminal protection alone
- Terminal protection with beach nourishment

Do Nothing

Without Council's commitment to ongoing beach nourishment and sand relocation works, this shoreline will continue to have a tendency to re-align itself and experience a relocation of sand from the northern end of the Queens Beach South to the area behind the offshore breakwater. In addition, there will be an ongoing loss of sand from the beach due to deficits in sand supply and the effects of mean sea level rise.

As a consequence, the Do Nothing option would result in further recession of the shoreline at Captain Cook Park and is likely to result in loss of the Norfolk Pines, the toilet block in Captain Cook Park and sections of the foreshore bikeway. Furthermore, the ongoing deposition of sand behind the offshore breakwater will result in significant siltation at the Anzac Park creek outlet, which without frequent

clearing could cause stormwater drainage issues. Therefore, the Do Nothing option is not considered to be a viable option.

Ongoing maintenance nourishment and sand recycling alone

Ongoing beach nourishment and sand recycling can be used to mitigate the ongoing recession of the shoreline at the northern sections of Queens Beach South. However, without the addition of a substantial volume of sand to increase the buffer of available sand to accommodate short term erosion, the Norfolk Pines, the toilet block in Captain Cook Park and sections of the foreshore bikeway will remain under immediate threat of short term erosion. This option is unlikely to provide adequate certainty to the Redcliffe community and MBRC.

Beach nourishment alone

This option would involve the initial placement of additional sand onto the active beach system to provide sufficient buffer to accommodate short term erosion and reduce the immediate threat of erosion to the Norfolk Pines and foreshore park facilities.

The seaward movement of the active beach is likely to result in substantial deposition of sand at the creek entrance, requiring relocation/extension of the stormwater outlet. In addition, the seaward movement of the active beach is also likely to increase maintenance dredging requirements of the Redcliffe Jetty. These outcomes are serious impediments to this option.

Terminal protection alone

Seawalls or rock walls are commonly built with the intent of providing terminal protection against shoreline retreat. At Queens Beach South, there may be a need for the implementation of a seawall in front of the Norfolk Pines at Captain Cook Park. Implementation of a seawall would provide protection against storm erosion.

On a receding shoreline such as in front of Captain Cook Park, the implementation of a seawall will not prevent the loss of sand from the beach and, without mitigation measures, it will lead to lowering and eventual loss of beach in front of the structure. Furthermore, the implementation of a seawall is likely to transfer the erosion to the beach at the downdrift end of the structure, if no mitigation measures are taken. In order to avoid that shoreline recession at the northern end, the wall is to extend along the entire northern section of Queens Beach South, from the existing rock wall in front of Anzac Place to the existing rock wall at the creek entrance in the north. This would require a seawall with a length of approximately 460m.

Extending the seawall to protect the entire beach does not prevent the loss of sand, and over time is likely to result in the complete loss of beach in front of the structure. This will have adverse impacts on the recreational value of the beach, the wider foreshore area and beaches to the north. These outcomes are considered unacceptable in a popular beach location.

Terminal protection with beach nourishment

An option to minimise adverse impacts of a seawall is to mitigate the loss of sand by beach nourishment. In this option, protection of the Norfolk Pines against significant storm events is provided by a 130m long seawall fronting the trees, while the placement of sand (beach nourishment)

will ensure that a sandy recreational beach is maintained during most circumstances. The beach nourishment quantity that would need to be placed is such that the seawall would remain buried for the majority of time.

The beach in front of the seawall would remain subject to gradual loss of sand due to dispersion of sand to adjacent beaches and the long term recession trends. Ongoing maintenance nourishment would remain necessary to maintain a beach in front of the seawall. The required ongoing beach nourishment rate should be equivalent to the long term losses plus the rate of dispersion at which sand is moving towards the lee of the offshore breakwater and would be the subject of a detailed design exercise.

The dispersion of sand to the area behind the Redcliffe Jetty breakwater can be minimised with the implementation of a groyne. The function of the groyne is to prevent sand from moving southwards into the shadow of offshore breakwater under longshore transport processes. Once in the shadow of the breakwater the sand cannot be reactivated by longshore transport processes and it is lost to the active system. The groyne will act to hold sand on its northern side during periods of southerly longshore transport. The sand held by the groyne would subsequently be available for longshore transport to the north. Should the implementation of a groyne be considered, the structure would need to extend beyond the zone of active longshore sand transport and be placed northwards of the northern end of the offshore breakwater. The resulting beach between the groyne and the Shields Street groyne to the north is expected to be relatively stable and not require ongoing beach nourishment.

Recommended Strategy

After assessment of the shoreline management options, it is recommended that the terminal protection (seawall) with beach nourishment option be implemented at this beach. A 130m long seawall will provide appropriate protection to the Norfolk Pines and foreshore park facilities; while the ongoing beach nourishment will ensure that a sandy recreational beach is maintained during most of the time and will guarantee a source of sand for the beaches to the north (i.e. Queens Beach) under longshore transport processes.

It is noted that sand will continue to be transported from the beach at Captain Cook Park towards the area behind the Redcliffe Jetty and this will continue to cause siltation at the Anzac Park creek outlet. Therefore regular sand relocation works, where sand is relocated from the creek outlet area to the northern sections of Queens Beach South and ongoing beach nourishment will remain necessary after implementation of this option.

The cost of implementing the recommended option will be dependent on the adopted final design of the seawall (eg. concrete steps or rock wall) and timing of the works. It is expected that the capital cost is likely to be around \$500,000, subject to more detailed design. In addition, there will be ongoing costs associated with regular sand recycling works and ongoing beach nourishment.

5.5.3 Queens Beach

Shoreline erosion management strategies for Queens Beach will need to consider the risks associated with private property under immediate threat of erosion and Council's commitment to ongoing beach nourishment at a rate about equivalent to the long term losses. Assessment of the

immediate erosion threat has identified that the likely buffer requirement is 16m and the residential property on 82 Prince Edward Parade and a main residential building of Bullivant Residential Resort only have about 10m. In addition, the foreshore bikeway and associated recreational facilities are within the zone subject to immediate threat of short term erosion.

The management options considered for this beach are:

- Do nothing
- Ongoing maintenance nourishment alone
- Beach nourishment alone
- Beach nourishment with groyne extension

Do nothing

If Council's commitment to ongoing beach nourishment ceases, the beaches of Queens Beach are likely to deteriorate further as erosion processes continue resulting in further shoreline recession at Queens Beach. Therefore, more assets would progressively become threatened by short term erosion or loss due to ongoing shoreline recession.

Due to the significant value (economic and social) of the existing development that is located within the erosion prone area, the Do Nothing option is not considered to be viable for Queens Beach.

Ongoing maintenance beach nourishment alone

The ongoing maintenance beach nourishment alone option essentially aims to maintain the shoreline at its current position by means of a sand replenishment program (so called "hold-the-line" option). Council's commitment to ongoing beach nourishment at a rate about equivalent to the long term losses to Queens Beach (so called "hold-the-line" option) will reduce the risk of long term recession at this beach, but will not reduce the existing short term erosion threat. This means that development with an available buffer zone width of 16m or less remains at risk of erosion during storm conditions. At Queens Beach, significant development is located within this short term erosion zone. Therefore, the "hold-the-line" option has a high risk of erosion and loss of property and is not appropriate for the long term.

Beach nourishment alone

Beach nourishment alone could be considered as an option to reduce or remove the immediate threat of erosion to private property and public assets as well as a means of enhancing the recreational value of the beach. However, without the enhancement of the existing Osbourne Point groyne (i.e. seaward extension of the groyne), any nourishment would have the potential to quickly bypass the groyne and move to the north at the prevailing longshore transport rate. Therefore this is not an effective option.

Beach nourishment with groyne enhancement

Beach nourishment could be considered as an option to reduce or remove the immediate threat of erosion to private property and public assets as well as a means of enhancing the recreational value of the beach. Beach nourishment at Queens Beach would require the enhancement of the existing

Osbourne Point groyne (i.e. seaward extension of the groyne) to be effective. If no seaward extension of this groyne occurred, any nourishment would have the potential to be quickly bypass the groyne and move to the north at the prevailing longshore transport rate.

This option would require the ongoing importation of sand. The quantity of nourishment would be subject to detailed design and consideration of the level of protection required (including morphological assessments), but it is likely that an initial dune widening of about 15m along about 770m of beach is appropriate (between Osbourne Point groyne and the northern end of the seawall at Shield Street Groyne). This would represent an initial beach nourishment requirement of about 60,000 cubic metres.

It must be recognised that the sand placed on the beach will be integrated into the natural processes of erosion from the beach during storms and subsequent gradual return during calmer conditions and longshore sand transport processes that will disperse the nourished sand alongshore. These will reduce the effective longer term benefit, at the southern end in particular, of Queens Beach and require ongoing maintenance nourishment to maintain the beach at its improved level.

It is noted that this option may require relocation of the existing boat ramp as well as alterations to the various stormwater drains discharging onto the beach.

Recommended Strategy

After assessment of the shoreline management options, it is recommended that beach nourishment with groyne enhancement be implemented at Queens Beach. The purpose of the beach nourishment is to provide added protection to beachfront property and foreshore infrastructure, while the extension of the groyne is to hold sand at its southern end.

The quantity of initial beach nourishment required is subject to more detailed design, but it is likely that a quantity in the order of 60,000 cubic metres would provide an appropriate level of protection at Queens Beach. In addition, ongoing maintenance nourishment will remain necessary at Queens Beach to cater for long term losses such as sea level rise.

The cost of implementing the recommended management option will be dependent on the adopted final design for the beach nourishment, negotiations with suppliers and timing of the works. The capital cost that would be involved in the implementation of recommended initial works are likely to be around \$2.5 million, subject to more detailed design. In addition, there should be a provision for ongoing beach nourishment, dune stabilisation and management and maintenance and repair of damage of existing coastal structures.

5.5.4 Queen Beach North

Shoreline erosion management strategies for Queens Beach North will need to consider Council's commitment to ongoing beach nourishment at a rate about equivalent to the long term losses, the risks associated with Council assets under immediate threat of erosion and the status of dune vegetation.

Assessment of the immediate erosion threat has identified that a number of Council assets are located within the zone that is under immediate erosion threat including the public car park on

Flinders Parade, the foreshore bikeway, a toilet block on Flinders Parade and various recreational facilities.

The management options considered for this beach are:

- Do Nothing
- Ongoing maintenance nourishment alone
- Beach nourishment alone
- Beach Nourishment with groyne extension

Do nothing

If Council's commitment to ongoing beach nourishment would be ceased, the beaches of Queens Beach are likely to deteriorate further as the erosion process continues. This would almost certainly result in further shoreline recession at Queens Beach North, which could over time put the road at Flinders Parade and significant parts of Flinders Parade park (including associated facilities) under threat of short term erosion or loss due to continued shoreline recession.

Due to the significant value (economic and social) of the road and park facilities, the Do Nothing option is not considered to be a viable option for Queens Beach North.

Ongoing maintenance beach nourishment alone

The ongoing maintenance beach nourishment alone option essentially aims to maintain the shoreline at its current position by means of a sand replenishment program (so called "hold-the-line" option). Council's commitment to ongoing beach nourishment at a rate about equivalent to the long term losses to Queens Beach North will reduce the risk of long term recession at this beach. This should leave only the short term erosion component of 16m as the threat to assets. At Queens Beach North, the public car park, Council's toilet block and Flinders Parade park facilities are located within the short term erosion zone and in this option would remain at risk of erosion during significant storm erosion events.

This option requires no major works apart from routine beach nourishment maintenance and a dune management program.

Beach nourishment alone

Beach nourishment alone could be considered as an option to reduce or remove the immediate threat of erosion to private property and public assets as well as a means of enhancing the recreational value of the beach. However, without the enhancement of the existing Donkin Street groyne (i.e. seaward extension of the groyne), any nourishment would have the potential to quickly bypass the groyne and move to the north at the prevailing longshore transport rate. Therefore this is not an effective option.

Beach Nourishment with groyne enhancement

Beach nourishment could be considered as an option to reduce or remove the immediate threat of erosion to private property and public assets as well as a means of enhancing the recreational value of the beach. Beach nourishment at Queens Beach North would require the enhancement of the

existing Donkin Street groyne (i.e. seaward extension of the groyne) to be effective. If no seaward extension of this groyne would occur, any nourishment would have the potential to be quickly redistributed to the north at the prevailing longshore transport rate.

This option would require the importation of sand from a suitable grain size and quality. The quantity of nourishment would be subject to detailed design and consideration of the level of protection required (including morphological assessments), but it is likely that an initial dune widening of about 15m along about 500m of beach is appropriate. This would represent an initial beach nourishment requirement of about 37,000 cubic metres.

It must be recognised that the sand placed on the beach will be integrated into the natural processes of erosion from the dry beach during storms and subsequent gradual return during calmer conditions and longshore sand transport processes that will disperse the nourished sand alongshore, which will reduce the effective longer term benefit in particular at the southern end of Queens Beach North. Ongoing maintenance nourishment will remain necessary to maintain the beach at its improved level.

It is noted that this option may require relocation of the existing boat ramp as well as alterations to the various stormwater drains that are currently discharging onto the beach.

Recommended Strategy

After assessment of the shoreline management options, it is recommended that beach nourishment with groyne enhancement be implemented at Queens Beach North. The purpose of the beach nourishment is to provide added protection to beachfront property and foreshore infrastructure, while the extension of the Donkin Street groyne is to hold sand at its southern end.

The quantity of initial beach nourishment required is subject to more detailed design, but it is likely that a quantity in the order of 37,000 cubic metres would provide an appropriate level of protection to the public car park, Council's toilet block and the various recreational facilities along Flinders Parade. In addition, ongoing maintenance nourishment will remain necessary at Queens Beach to cater for long term losses such as sea level rise.

The cost of implementing the recommended management option will be dependent on the adopted final design for the beach nourishment, negotiations with suppliers and timing of the works. The capital cost that would be involved in the implementation of recommended initial works are likely to be around \$1.6 million, subject to more detailed design. In addition, there should be a provision for ongoing beach nourishment, dune stabilisation and management and maintenance and repair of damage of existing coastal structures.

5.5.5 Drury Point Cliffs

There is evidence of moderate undercutting of the Drury Point cliffs by wave action. The erosion that has occurred from both the existing beach and the nearshore rocky platform following the implementation of the Donkin Street groyne has resulted in increased wave energy reaching the base of the cliffs, which may have resulted in increased cliff erosion. At the moment, the seaward edge of the cliff top is located within about 8m of the road at some locations. Surveys by Council indicate that the average rate of erosion at the base of the cliffs has been about 30mm/year (based on survey over three years).

Management options for Drury Point Cliffs have been assessed in “*Redcliffe Peninsula Foreshore Cliffs Study*” (Refer to Geo-Eng, 1999).

Recommended Strategy

Based on the current understanding of the erosion rate, the recommended strategy for the Drury Point Cliffs is to further investigate the risks associated with possible cliff degradation. This investigation should include a geotechnical assessment of the risk status of the cliff by a qualified geotechnical engineer and the implementation of a monitoring program to monitor the cliff degradation.

Should the investigations indicate that erosion mitigation is required, Council could consider the implementation of rock armouring on the cliff base conform the options in the *Redcliffe Peninsula Foreshore Cliffs Study*. If the risk is considered acceptable, the ‘Do Nothing’ option is the most appropriate management option.

5.5.6 Scarborough Beach

Shoreline erosion management strategies for Scarborough Beach will need to consider Council’s commitment to ongoing beach nourishment at a rate about equivalent to the long term losses and the significance of risks associated with assets under immediate threat of erosion

Assessment of the erosion threat has identified that the foreshore bikeway and the two stands of Norfolk Pines, consisting of 4 and 13 trees respectively, are located within the zone that is under immediate erosion threat. It is noted that the present buffer width available in front of most park facilities and the most northern stand of Norfolk Pines provides adequate protection against most storm erosion events and no significant development is located within the erosion prone area (the zone 40m landwards of the toe of the dune front).

The management options considered for this beach are:

- Do Nothing
- Ongoing maintenance nourishment alone
- Terminal Protection alone
- Terminal Protection with beach nourishment
- Beach nourishment alone
- Beach Nourishment with groyne extension

Do nothing

If Council’s commitment to ongoing beach nourishment would be ceased, the beaches of Scarborough beach are likely to deteriorate further as the erosion process continues. This would result in progressive recession of the shoreline at Scarborough Beach and almost certainly lead to the loss of significant Norfolk Pines and significant parts of Scarborough Park.

Because of the likely impacts on Scarborough Park and the stands of Norfolk Pines, the Do Nothing option is not considered to be an appropriate option for Scarborough Beach.

Ongoing maintenance beach nourishment alone

The ongoing maintenance beach nourishment alone option essentially aims to maintain the shoreline at its current position by means of a sand replenishment program (so called “hold-the-line” option). Council’s commitment to ongoing beach nourishment at a rate about equivalent to the long term losses to Scarborough Beach will reduce the risk of long term recession at this beach. This should leave only the short term erosion component of 16m as the threat to assets.

At the moment, the only assets located within the zone under immediate threat of short term erosion are the foreshore bikeway and the two stands of significant Norfolk Pines, consisting of 4 and 13 trees respectively at the southern end of the beach. The available buffer width in front of the two southern stands of significant Norfolk Pines is only a few metres. This means that, if this option is adopted, the significant Norfolk Pines remain at risk of being lost during storm erosion events. The available buffer width in front of the bikeway is somewhat larger, but in this option also the bikeway would remain at risk of erosion during severe storm erosion events.

Because the Norfolk Pines are of great value to the Redcliffe community, this may not be considered favourable by the general public.

This option requires no major works apart from routine beach nourishment maintenance and a dune management program.

Terminal protection alone

Seawalls or rock walls are commonly built with the intent to providing terminal protection against shoreline retreat. At Scarborough Beach, the implementation of a seawall in front of the Norfolk Pines at Scarborough Park is not considered appropriate without significant beach nourishment.

To avoid disruption of the root systems of the Norfolk Pines, the seawall would need to be placed a considerable distance seaward of the tree trunks and therefore it would be required to locate the wall well within the active beach zone with the current quantity of sand at Scarborough Beach. A seawall at such location will lead to loss of beach in front of the wall and is likely to interrupt the longshore sediment transport processes.

The loss of beach will have adverse impacts on the recreational value of the beach, the wider foreshore area and beaches to the north. These outcomes are considered unacceptable in a popular beach location.

Terminal protection with beach nourishment

An option to minimise adverse impacts of a seawall is to mitigate the loss of sand by beach nourishment. In this option, protection of the Norfolk Pines against significant storm events is provided by a 340m long seawall fronting the trees, while the placement of sand (beach nourishment) will ensure that a sandy recreational beach is maintained during most circumstances. The beach nourishment quantity that would need to be placed is such that the seawall would remain buried for the majority of time.

The beach in front of the seawall would remain subject to gradual loss of sand due to dispersion of sand to adjacent beaches and the long term recession trends. Ongoing maintenance nourishment

would remain necessary to maintain a beach in front of the seawall. The required ongoing beach nourishment rate should be equivalent to the long term losses plus the rate of dispersion at which sand is moving towards the lee of the offshore breakwater and would be the subject of a detailed design exercise.

The cost of implementing a rock wall along the two stands of Norfolk Pines (length of 340m) will be dependent on the final design of the seawall (eg. concrete steps or rock wall) and timing of the works, but are likely to be around \$1.3 million, subject to more detailed design. In addition, beach nourishment will be required. The quantity of initial beach nourishment is subject to detailed design and consideration of the dune buffer width requirements, but an initial volume of about 28,500m³ is likely to provide a reasonable buffer in front of the rock wall to maintain a sandy beach during most storms (initial dune buffer width of about 10m). The costs associated with the initial beach nourishment are likely to be around \$1.1 million, subject to more detailed design, leading to a minimum total implementation cost for this option of around \$2.4 million.

In addition, there may be a need to extend the existing Scarborough Point groyne to be effective. The need will be dependant on the alignment of the rock wall and the adopted beach nourishment philosophy (i.e. dune alignment) and will need to be determined in more-detailed assessments, should this management option be adopted. Furthermore, there should be a provision for ongoing beach nourishment.

Beach nourishment alone

Beach nourishment alone could be considered as an option to reduce or remove the immediate threat of erosion to the significant Norfolk Pines and the bikeway as well as a means of enhancing the recreational value of the beach. However, without the enhancement of the existing Scarborough Point groyne, any nourishment would have the potential to quickly bypass the groyne and move to the north at the prevailing longshore transport rate. Therefore this is not an effective option.

Beach Nourishment with groyne enhancement

Beach nourishment could be considered as an option to reduce or remove the immediate threat of erosion to private property and public assets as well as a means of enhancing the recreational value of the beach. Beach nourishment at Scarborough Beach would require the enhancement of the existing Scarborough Point groyne to be effective. The enhancement of the existing Scarborough Point groyne would require elevation of the existing trunk and a seaward extension of the tip of the groyne. If no enhancement of this groyne would occur, any nourishment would have the potential to be quickly redistributed to the north at the prevailing longshore transport rate.

This option would require the importation of sand from a suitable grain size and quality. The quantity of nourishment would be subject to detailed design and consideration of the level of protection required, but it is likely that an initial dune widening of about 15m along about 570m of beach is appropriate. This would represent an initial beach nourishment requirement of about 42,000 cubic metres.

The cost of implementing this option will be dependent on the adopted final design for the beach nourishment, negotiations with suppliers and timing of the works, but are likely to be around \$1.8 million, subject to more detailed design.

It must be recognised that the sand placed on the beach will be integrated into the natural processes of erosion from the dry beach during storms and subsequent gradual return during calmer conditions and longshore sand transport processes that will disperse the nourished sand alongshore, which will reduce the effective longer term benefit in particular at the southern end of Scarborough Beach. Ongoing maintenance nourishment will remain necessary to maintain the beach at its improved level.

It is noted that this option may require alteration works to the stormwater drains that are currently discharging onto the beach.

Recommended Strategy

After assessment of the shoreline management options and consideration of the risks associated with erosion, it is recommended that “ongoing maintenance beach nourishment alone” option be implemented at Scarborough Beach. The “ongoing maintenance beach nourishment alone” option aims to maintain the shoreline at its present position and undertakes no specific action to reduce the risk that erosion may threaten the Norfolk Pines and the foreshore bikeway.

Therefore, the recommendation is to accept the risk that erosion may threaten the Norfolk Pines and the foreshore bikeway during a significant storm. Within this context, it should be recognised that the stand of Norfolk Pines further to the north (16 trees adjacent to the car park) do have a sufficient buffer against most erosion events and that there may be opportunities to establish new stands of similar species elsewhere on the parkland, further landwards. The limited threat to the bikeway under severe storm conditions could be managed through emergency response measures and/or partial retreat.

Should the risk that erosion could threaten the Norfolk Pines and the foreshore bikeway considered to be unacceptable, then Council could consider implementation of the beach nourishment with groyne enhancement option. The costs that would be involved for this option are likely to be around \$1.8 million.

5.5.7 Scarborough Cliffs

As a consequence of the shoreline orientation, the net longshore transport potential at the Scarborough Cliffs is significantly greater than the transport potential at the beaches to the south. The Redcliffe Coastal Process Study (KBR, 2002) suggests that the net longshore transport potential along the Scarborough Cliffs shoreline is typically about twice as high as elsewhere along the eastern beaches. Also, because the cliffs protrude from the regional alignment the net longshore transport potential at the cliffs is considered to be even greater.

Due to this increased net longshore transport potential, there is a tendency for erosion at the cliff base and there is no significant sand supply available naturally to satisfy this requirement. Consequently, beach nourishment without significant control structures (eg. groynes) is not considered to be a viable option to maintain a beach that would protect the cliffs against wave attack.

Options for Scarborough Cliffs have been assessed in “Scarborough Cliffs Options Analysis Report” (KBR, 2007A).

Recommended Strategy

The recommended management option in the study by KBR is long term managed retreat with the placement of rock armour at the base of the cliff. Works to the staircase at Scarborough Cliffs may be required to alleviate health and safety risks associated with the current status of the public beach access.

5.5.8 Scarborough Cliffs to North Reef Spit

Similar to the situation at Scarborough Cliffs, the net longshore sediment transport potential at this shoreline section is significantly greater than the transport potential at the beaches further to the south. As a consequence, sand stored within this shoreline section is confined to a relative thin veneer over rock.

The foreshore between the Scarborough Cliffs and North Reef Spit consists predominantly of erosion escarpments and cliffs and along most of this shoreline section private property is located in close proximity to the shoreline. Some property owners have implemented shoreline protection works to resist erosion.

Shoreline erosion management strategies for this shoreline section will need to consider the close proximity of private property to the shoreline and the fact that the sandy beach that regularly occurs along this section consists of a relative thin veneer of sand over rock.

Recommended Strategy

The recommended strategy to manage the risks associated with shoreline erosion is for Council to adopt appropriate planning controls. The strategy would allow private property owners to provide protection to their assets against erosion threats within their own property boundary. The development and implementation of these planning controls would need to be carried out by Council's Planning Section.

Planning controls that might be appropriate at this shoreline section could include:

- Setback lines to avoid inappropriate development within hazard prone zones;
- Requirements to provide coastal engineering works for the purpose of hazard mitigation;
- Structural requirements to withstand coastal hazards.

Through planning controls, development consent could be subject to demonstration that coastal protection works would be put in place as part of the development, and would sufficiently mitigate the erosion risk and would be adequately maintained by the property owner for the lifetime of the proposed development.

The implementation of any protection work would require approvals by the relevant State government agencies, including approval by the Department of Environment and Resource Management (DERM).

Although the impact of any protective works proposed would need to be assessed on a case-by-case basis, seawall protection along this section of the shoreline, if appropriately aligned, is not considered to significantly compromise coastal management principles as sand resource at this site is confined to a thin veneer over rock.

Controls should be put in place to encourage aesthetical consistency along the shoreline and prevent isolated protective structures or discontinuities, which could threaten the overall integrity of the shoreline protection strategy.

5.5.9 Recommended Strategy

After a review of the coastal processes, risks and values of each individual beach and assessment of possible shoreline management options, the overall recommendation for the shoreline between Redcliffe Point and Scarborough Beach is to prevent further deterioration of the beaches by offsetting the persistent loss of sediment from this coastal segment. In addition, there are beaches where the current status of the beaches warrants works.

The recommended strategy for each individual beach is summarised in Table 5-1.

To offset the persistent sediment losses due to longshore transport and long term losses such as sea level rise, ongoing maintenance nourishment is required. The maintenance requirement to offset long term sediment losses is likely to be in the order of 12,000 m³ per year - i.e. 10,000 m³ per year for longshore transport (KBR, 2002) plus losses due to mean sea level rise. This may need to be increased to about 17,000m³ per year in the future if mean sea level rise accelerates due to climate change.

There may be an opportunity to recycle sand, which has been transported northwards. This could occur from the northern end of Scarborough Beach and would require extension of the Scarborough Point groyne to trap longshore sand transport. The sand deposited behind the groyne over time would be relocated to nourish the beaches to south. It is noted that extension of the Scarborough Point groyne would reduce the sand supply to the shoreline to the north, which could result in loss of sand along this shoreline section. However, because this shoreline consists predominantly of armoured cliffs, this is unlikely that this will lead to exacerbated shoreline erosion.

Table 5-1 Recommended Erosion Management Strategy for Each Beach

Beach/shoreline location	Recommended Management Option
Queen Beach South	Seawall with beach nourishment
Queen Beach	Beach nourishment with groyne enhancement
Queen Beach North	Beach nourishment with groyne enhancement
Drury Point Cliffs	Undertake geotechnical investigation with ongoing cliff monitoring
Scarborough Beach	Ongoing maintenance beach nourishment alone
Scarborough Cliffs	Managed retreat with the rock armouring of the cliff base; Refer to <i>Scarborough Cliffs Options Analysis Report (KBR, 2007A)</i>
Scarborough Cliffs to North Reef Spit	Allow appropriate protection works via implementation of planning controls

5.6 Scarborough Boat Harbour to Albatross Canal

5.6.1 Introduction

Due to its location, this section of the shoreline is located in a relatively low energy environment. Nevertheless, the erosion scarps and damaged concrete revetment at the southern end of Oyster Point Esplanade provides evidence that the shoreline is subject to storm erosion.

The existing concrete revetment at the southern end of Oyster Point Esplanade is in a poor condition and considered to provide insufficient protection to the esplanade road against erosion. Due to the limited buffer available in front of the road (6m at some locations), short term erosion may threaten the esplanade road.

Further to the north, the shoreline along Oyster Point Esplanade is fronted by offshore mangroves. There is some evidence of minor erosion around Council's toilet block near Michel Road.

The approximately 1100m long rock wall that is implemented along Endeavour Esplanade provides adequate protection against erosion to the adjacent esplanade. No action is required for this section of the shoreline.

5.6.2 Shoreline Management Options Considered

Shoreline erosion management strategies for the shoreline between the Scarborough Boat Harbour and Albatross Canal will need to consider the threat of short term erosion and the risk of ongoing recession from reduced sand supply and mean sea level rise.

The management options considered for these beaches are:

- Do nothing
- Terminal protection alone

5.6.2.1 Do Nothing

Despite the relative low energy environment and the lack of historical evidence of significant beach movement, short term storm erosion may threaten sections of Oyster Point Esplanade road. In particular the section of the road between Endeavour Esplanade and Michel Road, where the road is located within 6m of the shoreline.

Although the existing concrete revetment at this location may provide some protection, there is a significant risk that the road is subject to erosion during a severe storm event. Therefore, the Do Nothing is not recommended for this section of the shoreline.

As a reasonable buffer in front of the esplanade road remains further to the north, the Do Nothing option could be considered for the northern 300m of this coastal segment. This section of the shoreline is fronted by mangroves and erosion rates are generally low..

The minimum available buffer width at the esplanade road is around 12m, which is considered to be adequate to accommodate most short term erosion, also because of the presence of the offshore mangroves, which provide protection to the foreshore against direct wave attack.

However, the buffer width available at Council's toilet block near Michel Road (about 7m) may be too small to accommodate short term erosion during major events and without remedial works, this building may be threaten by storm erosion.

The Do Nothing option would require no major work in terms of remediation of erosion.

5.6.2.2 *Terminal protection alone*

The implementation of a revetment could be considered as an option to reduce or remove the threat of erosion to the esplanade road and the foreshore recreational facilities.

This option is recommended for the shoreline section along the southern end of Oyster Point Esplanade (between Endeavour Esplanade and Michel Road), where the available buffer width at the esplanade road is only around 6m. The rock wall would provide added protection to the road and mitigate the long term erosion threat for the foreseeable future. If adopted, application of a rubble mound rock wall, similar to the rock wall immediately to the south, along Endeavour Esplanade, is recommended. As part of this option, the existing concrete armouring along the southern end of Oyster Point Esplanade would need to be replaced

Implementation of a rock wall along the northern section of Oyster Point Esplanade may provide added certainty to the road and Council's toilet block, but may require removal of existing mangroves from the immediate foreshore area.

5.6.3 **Recommended Strategy**

Currently only an isolated section of Oyster Point Esplanade is under immediate threat of short term erosion. In order to provide protection to this section of the road, it is recommended to extend the existing rock wall along Endeavour Esplanade over a length of approximately 80m up to the southern edge of the mangroves. This rock wall should be designed to mitigate the existing and future erosion hazards. To minimise the potential impacts on the adjacent mangroves, the proposed rock wall extension is to be highly dissipative of wave energy.

Given this relative stability, the Do Nothing option is considered the most appropriate option for the 300m long shoreline that is fronted by mangroves. The Do Nothing option would require no major work in terms of remediation of erosion in the short term. The Do Nothing option is favoured because of its low cost and lack of disruption to the offshore mangroves.

It should however be recognised that a risk remains of shoreline erosion threatening the esplanade road under extreme conditions. This limited threat to the esplanade road under severe storm conditions could be managed through emergency response measures. A monitoring program is to be implemented to monitor the shoreline.

In relation to Council's toilet block around Michel Road, it is recommended to undertake no action to protect this asset. The recommended strategy for the toilet block is either to accept that this asset is under immediate erosion threat or remove/relocate the facility. To improve the amenity of the foreshore area around Oyster Point Esplanade, it is recommended to remove the dumped rubble that is currently located on the foreshore.

The costs that would be involved in the implementation of the recommended rock wall along the southern 80m of Oyster Point Esplanade are estimated to be in the order of \$100,000. In addition, there should be a minimum provision of about \$36,000 per year for ongoing maintenance and repair to the 1200m long rock wall. There would also be ongoing costs associated with routine foreshore parkland maintenance and the ongoing monitoring of the shoreline.

5.7 Summary

After a review of the coastal processes, risks and values at each of section of the shoreline, potential management options for each beach were assessed. A detailed discussion on the possible management options and the recommended strategies for each individual beach is provided above.

The overall recommendation for the Eastern Beaches (beaches between Margate Beach and Scarborough Beach) is to prevent further deterioration of the beaches by offsetting the persistent loss of sediment from these beaches. In addition, there are beaches where the current status of the beaches warrants works.

Furthermore, it is recommended to implement planning controls to minimize possible future issues associated with erosion management and to prevent development in inappropriate locations. Planning controls may include:

- Setback lines to avoid inappropriate development within hazard prone zones;
- Requirements to provide coastal engineering works for the purpose of hazard mitigation;
- Structural requirements to withstand coastal hazards

The development and implementation of these planning controls would need to be carried out by Council's Planning Section.

A summary of the recommended erosion management strategies for each beach is presented in Table 5-2.

Table 5-2 Recommended Erosion Management Strategy for Each Beach

<i>Beach/shoreline location</i>	<i>Location Map</i>	<i>Recommended Erosion Management Strategy</i>
Princess Terrace to Clontarf Point (Clontarf)	Figure N-8	Upgrade the existing armouring in front of 3 and 5 Princess Terrace and 18 Haysmouth Parade (section of 90m) and implement the Do Nothing option along the remaining section
Clontarf Point to Woody Point	Figure N-6 & Figure N-7	The Do Nothing option
Woody Point to Picnic Point	Figure N-6	Formalise the existing shoreline protection works and, where needed, upgrade the existing structures to an appropriate engineering standard
Picnic Point to Scott's Point	Figure N-6	Upgrade the existing concrete seawall around Picnic Point; and implement the Do Nothing option along the remaining sections
Margate Beach & Suttons Beach	Figure N-5 & Figure N-6	Ongoing maintenance nourishment to offset persistent loss of sediment and prevent further deterioration of the beaches
Queen Beach South	Figure N-4	Seawall with beach nourishment
Queen Beach	Figure N-3 & Figure N-4	Beach nourishment with groyne enhancement
Queen Beach North	Figure N-3	Beach nourishment with groyne enhancement
Drury Point Cliffs	Figure N-3	Undertake geotechnical investigation with ongoing cliff monitoring
Scarborough Beach	Figure N-2	Ongoing maintenance beach nourishment alone
Scarborough Cliffs	Figure N-2	Managed retreat with the rock armouring of the cliff base; Refer to Scarborough Cliffs Options Analysis Report (KBR, 2007A)
Scarborough Cliffs to North Reef Spit	Figure N-2	Allow appropriate protection works via implementation of planning controls
Scarborough Boat Harbour to Albatross Canal	Figure N-1	Extend existing rock wall along oyster Point Esplanade by 80m and implement the Do Nothing option along the remaining sections

