Final Report

Sandringham Sand Management Scoping Study

59915509

Prepared for
Department of Environment, Land, Water & Planning

March 2016

Cardno
Shaping the Future

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1 Executive Summary

Cardno was commissioned by the Department of Environment and Primary Industries (DEPI), now the Department of Environment, Land, Water & Planning (DELWP), to undertake a study of sand management options for Sandringham Beach. The purpose of this study was to investigate three preferred erosion management options which were agreed upon following a consultation workshop in 2013. Each option and potential combinations were assessed against technical, social, environmental and economic criteria.

2 Introduction

Cardno was commissioned by the Department of Environment and Primary Industries (DEPI), now the Department of Environment, Land, Water & Planning (DELWP), to undertake a study of sand management options for Sandringham Beach, Port Phillip Bay, from Picnic Point to Potter Street (Figure 2-1).

2.1 Background

Erosion has increased along Sandringham Beach in recent years due to limited sand supply and longshore losses (BECA, 2006). This increased the exposure of the weakly consolidated bluffs and led to some significant slumping. Two groynes were constructed to stabilise the beach and cliffs. Beach nourishment campaigns have also been carried out, with limited success. After the works, erosion issues still remain and strategies to manage this erosion have been considered within this report, as well as the ongoing sedimentation issues within the Sandringham Marina. Ideally, any strategies to manage the erosion along the Sandringham coast would also incorporate measures to reduce the sedimentation, if possible.

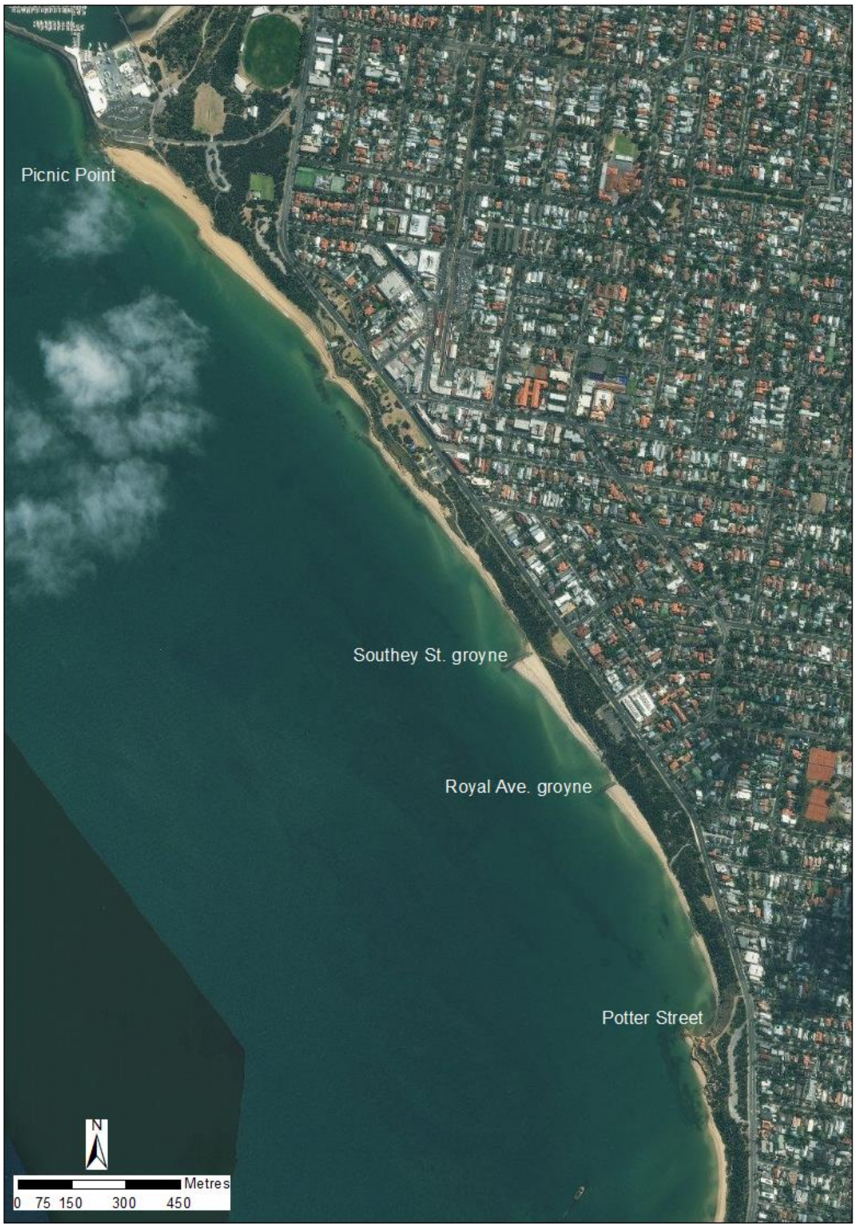


Figure 2-1 Sandringham Beach Study Area (Image: Google)

2.2 Scope

A high-level assessment of the potential options to manage the coastal erosion issues was prepared by Water Technology in February 2014. This reviewed previous studies and developed a suite of seven possible management options, in consultation with DELWP, Bayside City Council and community representatives at a workshop in 2013. Following the workshop three options were identified to be taken forward for further evaluation (this project). These were to be assessed independently, and in combination, to best satisfy the project objectives and local amenity requirements. The three preferred erosion management options identified during the workshop (and evaluated in this study) are:

1. Modifying the rock groyne at Southey Street (Melway ref: 76 G11).
   The intention of this option is to encourage more sedimentation north and south of the groyne, by lowering and shortening the groyne to allow overtopping and more sand to bypass naturally.
2. Sand renourishment at Edward Street (Melway ref: 76 H12);

   This is to widen and increase the elevation of the beach south of the Royal Avenue groyne to increase the amenity and to reduce risk to the hinterland.
3. Installing a groyne at Picnic Point (Melway ref: 76 E8)

   The intention of this option is to limit the amount of sand travelling north and infilling the Sandringham Marina.

3 Brief Review of Available Information

3.1 History of Coastal Issues

Noticeable geomorphological changes have occurred at Sandringham Beach in recent times due to natural coastal processes and the construction of two beach groynes. Historic images of the Sandringham Coast show a narrow but relatively stable and seasonally consistent beach prior to the 1990's. A stormwater outfall, in the location of the current Royal Ave groyne, appears to have had a 'groyne effect' on the beach as shown in Figure 3-1 (1989), that is, the building up of sediment on one side and erosion on the other.

Soon after construction in 1990 the beach south of the outfall started to accrete, and the beach north of the outfall started to erode. This was due to the dominant northerly sediment transport in summer. This increased the risk to the cliffs especially during and after the summer months, and lessened the 'buffer' capacity of the beach in these areas during storms. This enabled larger storm waves to penetrate further landward and erode the toe of the cliff. This eventually led to some significant cliff slumping.

From an amenity perspective, this was not ideal as, although the beach built up on the southern side, the summer erosion was more prominent and effects more damaging meaning the beach in the lee of the groyne was significantly denuded during and after summer.

3.2 Previous Studies

A number of studies have been carried out in and around the study area in the past. These include coastal process assessments, numerical modelling, cliff stability assessments and remediation design reports. The following sections give a brief overview of the understanding gained from some of the key documents.

3.2.1 Vantree (2001)

This report follows on from the construction of the first and southernmost groyne at Royal Avenue. The report considers the coastal processes and methods for minimising the erosion risk to the cliffs north of the Royal Avenue groyne, namely, construction of another containment groyne and a beach nourishment program.

The report found that the optimal configuration for the beach would be a single renourished beach compartment, bound between the Royal Avenue groyne and a new groyne constructed at Tennyson Street. This would require the importation of 90,000 m^3 of sediment. The report also recommended that the new groyne at Tennyson Street be 125 m long, and the Royal Avenue groyne be extended by 30 m to a length of 70 m.

3.2.2 GHD 2003 (a,b)

Two GHD reports were prepared for the Royal Avenue foreshore in August of 2003:

a) Royal Avenue Cliff Stabilisation - Geotechnical Investigation and Schematic Review

   This report presents the findings of the geotechnical investigations undertaken to inform the cliff stability remediation options.

b) Royal Avenue Foreshore Protection - Cliff Stability Schematic Design Options Report

   This report presents three revetment options and costs for stabilising the Royal Avenue foreshore, which was informed by the findings of the previous geotechnical investigation report, before recommending a preferred option. The preferred option was a combination of two revetment designs to protect the toe of the cliffs and minimise further beach erosion, with an estimated construction cost of $1 million.

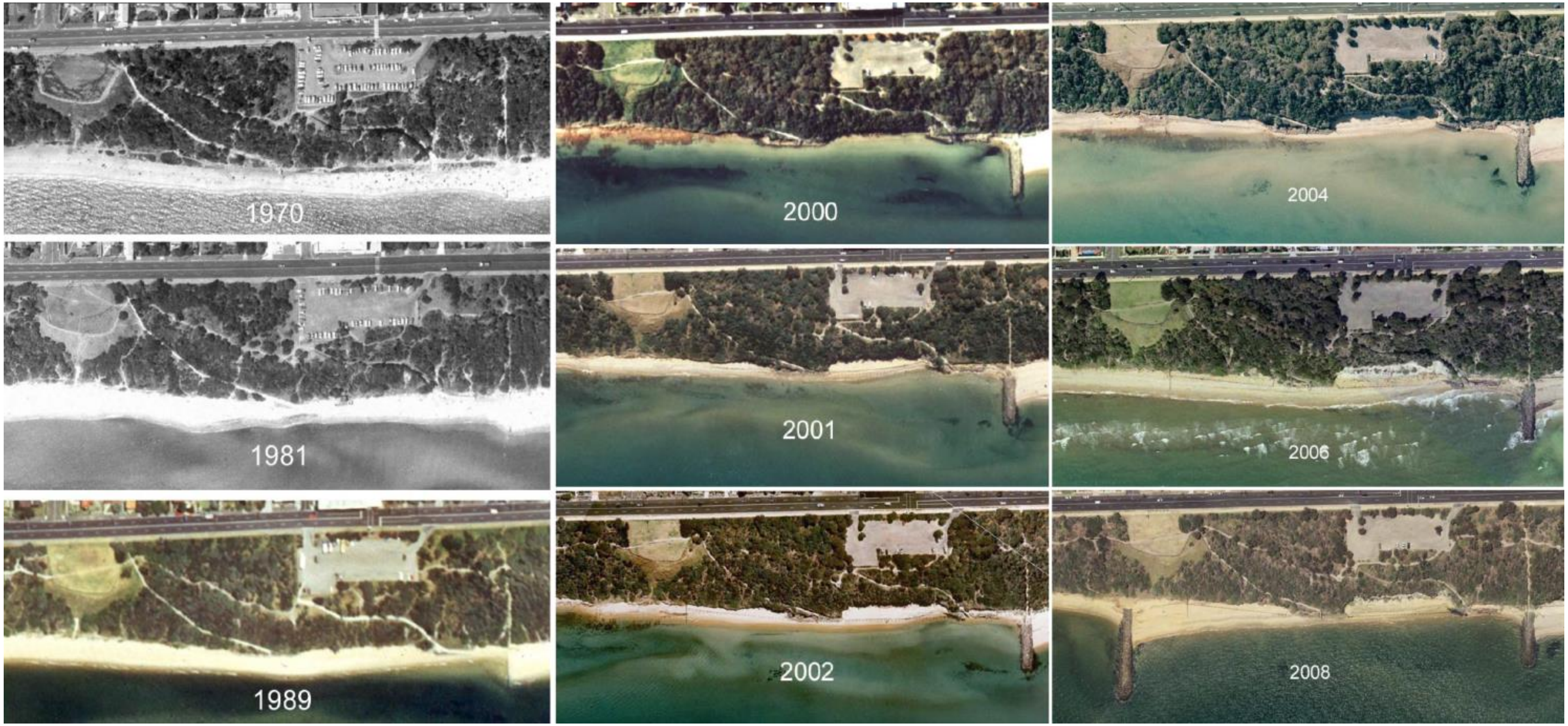


Figure 3-1 Royal Ave car park area of Sandringham Beach 1970-2008 (Bayside City Council, 2011).

3.2.3 Beca (2006)

This report presents the preliminary design of the remedial works to minimise the erosion risk north of the Royal Avenue groyne. This work was done after the previous findings of the GHD report were not carried forward, and a revised approach including beach nourishment and further groyne construction was preferred over the construction of a revetment.

In December 2006, the Southey St groyne was constructed. Anecdotal information and photographs from community members showed that within days of the construction of the groyne, the beach immediately north of the groyne began to scour and eroded back a number of metres.

3.2.4 Worley Parsons (2012)

WorleyParsons were engaged by the then Department of Sustainability and Environment (DSE) to undertake a post beach nourishment monitoring project. Beach nourishment was completed in June 2009 when 20,000 m^3 of nourished sand was placed between the Royal Avenue and Southey Street groynes, and on the area just to the north of Southey Street. A total of 8 surveys along 21 beach profiles were subsequently surveyed over a period of two years. The surveys were analysed to determine the changes occurring to the subaerial and subtidal zones of the beach due to the coastal processes, and to estimate the quantities of sediment movement to and from different sections of the beach. The study found that net sediment transport out of the study area is approximately 2,000 m^3 per year.

3.3 Previous Stakeholder & Community Sessions

A workshop was held in late 2013 to discuss the coastal process and structure issues at Sandringham Beach. The attendees included DEWLP, Bayside City Council representatives and members of local stakeholder groups and the community. Dr Andrew McCowan of Water Technology attended the session as a local coastal process expert. He gave a presentation about the processes that have shaped the bay and the resultant changes on the geomorphology. The options discussed were raised by the workshop attendees.

3.3.1 Water Technology (2013)

Dr McCowan provided a report presenting the most appropriate options to be taken forward for further assessment. The report provides an overview of the work and studies that have been undertaken in relation to the Sandringham erosion issues and the causes and processes behind the ongoing issues identified. The report notes the modelling studies undertaken in the area, and the previous sediment transport findings.

The report presents the ‘long-list’ of the seven potential options to manage the issues and erosion risk, independently. From this, and following discussions during the workshop session, a ‘short-list’ of the three most viable options was determined. These preferred options form the basis of the current project, as presented in Section 5.

3.3.2 Stephenson (2014)

Stephenson (2014), a coastal geomorphologist and lecturer in Environmental Management and Physical Geography provided the Sandringham Foreshore Association with a letter reviewing a draft version of Watertech (2013). His review was generally supportive of the Watertech report but also provided additional commentary on sediment budget, the effects of sea level rise and the role of groynes. Dr Stephenson pointed out that “that static engineered structures often have greater vulnerability to sea level rise than beaches with positive sediment budgets. Beaches are able to maintain effective geomorphic function when well supplied with sediment while sea level rises, even at the rates identified.” His review is supportive of the use of a small anchor groyne at Picnic Point, noting that “we had put this forward as an option in 2006”. Stephenson suggested that this groyne “would trap the northward drifting sand, allow natural return of some sand south in winter and trapped sand could be used for renourishment.”

Stephenson (2014) was of the view that:

- “the Royal Avenue and Southey Street groynes should be removed”;
- “the best defence against cliff erosion (and sea level rise) is a wide voluminous beach that is allowed to respond dynamically to the wave environment”;

- "the combination of beach nourishment and restoration of geomorphic function offers the best option for future management of this shoreline"

He concluded "that management in the Sandringham shoreline will be an ongoing concern and that short term fixes (such as groynes) are unlikely to succeed."

4 Coastal Processes

4.1 Physical Processes, Geomorphology and Sediments

4.1.1 Wind

Meteorological processes mean that within the study area in the winter months, from June to August, the most prevalent winds are northerlies. In summer, December to February, southerly winds from the south east to south west sectors are prevalent. Spring and autumn represent a transition between the two dominant seasons and the wind patterns are a mixture of the summer and winter patterns.

4.1.2 Waves

Waves within Port Phillip are “fetch-limited”. This means wave heights are dictated by local wind speeds and the distance over water (or “fetch”) that these winds blow. Typical wave heights are generally low, less than 1 m (BECA, 2006). During storm conditions waves can reach a significant wave height of 2.7 m. This was the design wave height used in the GHD (2003b) revetment design.

Due to the orientation of the Sandringham coast, large storm waves have a significant impact on the shoreline. The most significant storm systems that affect Port Phillip Bay move in from the south east along the Bass Coast. This means that storm waves reaching the Sandringham coast are likely to hit almost perpendicularly, which is the ‘worst case’ direction for causing erosion.

There are some natural rocky reefs along the Sandringham coast that would aid in minimising wave impact in some locations, however, generally the coast is quite exposed and with limited beach widths and elevations there is little protection during high wave events.

4.1.3 Geomorphology & Sediment Transport

Changes along Sandringham Beach with adverse effects on infrastructure and humans have been documented in a series of reports, dating as far back as the report of the Foreshore Erosion Board (1936). This board was established by the Victorian Government in response to ongoing coastal erosion issues along several sections of the Bayside coastline. Sandringham Beach consists of high bluffs which are (more or less) protected by sandy beaches.

Sediment transport varies between seasons and respective predominant wind and wave direction. WorleyParsons (2012) estimated a net annual northerly drift of sediment of approximately 2,000 m^3.

More technical information about physical processes, geomorphology and sediment transport is documented in Appendices A and B.

4.2 Site Visit Observations

In December 2014 a site visit was attended by Cardno, DEWLP, Council and community representatives. This was to get a better understanding of the local coastal processes as well as collate anecdotal evidence of the changes to the shoreline over the years. Several photographs of the changing beach environment over the years were also received, showing storm damage as well as longer term changes. These photographs provide information in addition to existing (vertical) aerial imagery taken since the 1930s. Additional photographs are collated in Appendix C.

On the day of the site visit, it was evident that the summer season sediment transport regime was in effect, with the accretion of sand on the southern side of both groynes forming two wide sections of beach, with some scour to the north of the groynes. Some recent storm damage was evident, with the toe of some cliff sections scarped by wave action (Figure 4-1).

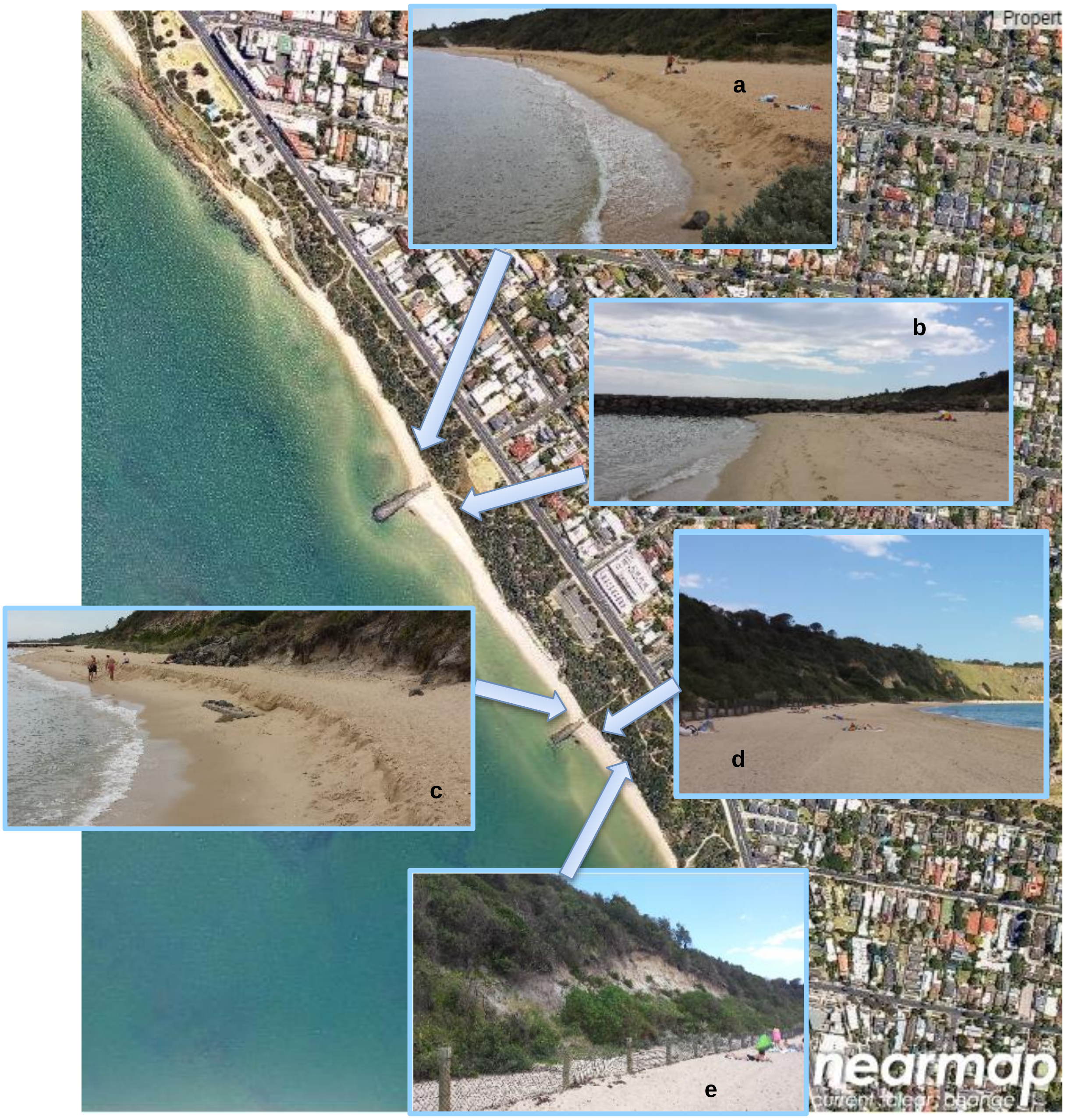


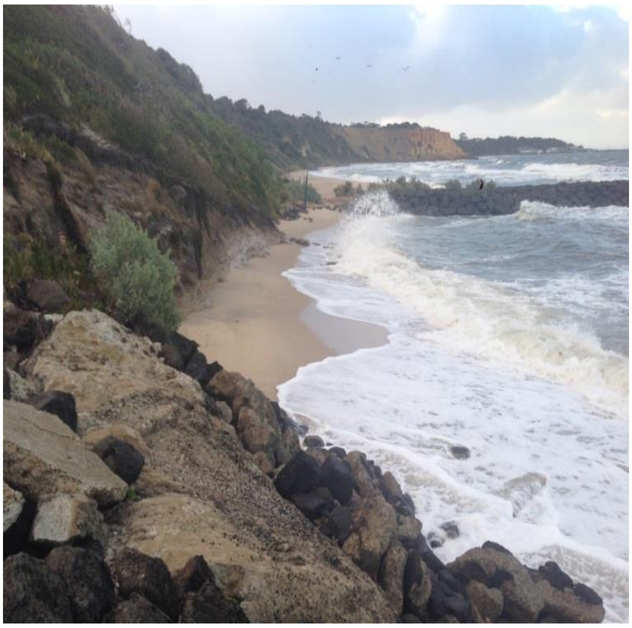
Figure 4-1 Site visit observations - Dec 2014 (a) scarped narrow beach north of the Southey St groyne (b) wide beach to the south of the Southey St groyne (c) scarped narrow beach north of the Royal Ave groyne (d) wide beach south of the Royal Ave groyne (e) slumped cliff south of the Royal Ave groyne (image: nearmap, 2015).

Figure 4-2 below shows the state of Sandringham Beach during late summer and early autumn.

a) Looking south towards Southey Street Groyne (March 2013)

b) Looking south towards Southey Street Groyne (Source: John Amiet, February 2013)

c) Looking north from Royal Avenue Groyne (February 2016)



d) Looking south towards Royal Avenue Groyne (March 2015)

e) Looking south from Royal Avenue Groyne (March 2013)

f) Looking north along Sandringham Beach, showing lee erosion on the northward side of the groynes (March 2015)

Figure 4-2 Photographs taken in during late summer and early autumn, 2013-16. Source: Dr Vicki Karalis. John Amiet)

5 Options Evaluation

5.1 Evaluation Criteria

The sand management options were evaluated against the following criteria:

1. Technical effectiveness (how much sand will move in accordance with the wind and wave movements, beach profile)
2. Key risks (impact of failure, public safety risks, consistency of protection, community adverse impacts, cliff stability, scouring effect)
3. Value for money (consider a balance between capital cost, ongoing costs, and maintenance costs)
4. Estimated costs and timing (to design, construct and maintain)
5. Environmental Impacts (impact on environmental quality, social amenity and ecology).
6. Constructability and methodology (details of how the structure or renourishments will be built in the existing conditions in consideration for contractor safety and well being).
7. Estimated design life of each option.

The short list of preferred options identified in the project brief for evaluation, following on from the options identified at the community workshop and in Water Technology (2013), are described in the following sections. The options are then evaluated against various assessment criteria with regard to technical, social, environmental and economic considerations, amongst others.

5.1.1 Option 1 - Installing a groyne at Picnic Point

The intention of this option is to limit the amount of sand travelling north and infilling the Sandringham Marina, as well as providing a potential sink location to limit the amount of sand leaving the coastal cell. There is also the potential for this location to be used for sand harvesting for future beach maintenance works. Installation of a groyne would ultimately lead to a widening of the beach and more protection of the bluffs and increase the sand volume available for harvesting and reuse (renourishment) at the southern end of the beach, for example by pumping or trucking. Sand harvesting is common practice in many parts of Australia and elsewhere around the world. An example includes Collaroy/Narrabeen Beach on Sydney's Northern Beaches, where sediment is transported in a northerly direction into Narrabeen Lagoon, only to be extracted from the lagoon and trucked to the southern end of the 3.6 km long beach.

For the purposes of this study assumptions have been made as to the dimensions of a groyne that would be appropriate for the conditions, and to facilitate the desired outcomes of this option. A groyne made of similar rock material with similar dimensions to the Royal Avenue groyne has been assumed to allow for a cost estimate in the assessment process. Recent cost estimates of other similar structures around Port Phillip Bay have been obtained to aid in determining a capital and maintenance cost for the options appraisal process.

Detailed modelling and design of this option is beyond the scope of this project. Sub-surface surveys or inspections would be required to consider the sand/rock substrate and viability of construction on this substrate, this uncertainty would require further investigation.

Figure 5-1 Conceptual Drawing of a groyne at Picnic Point. Note that this drawing is NOT sufficiently accuracy to be used for construction.

The assessment of this option against the criteria is presented in Table 5-1.

Table 5-1 Assessment against criteria - Option 1

Installing a groyne at Picnic Point	
Technical:	The construction of a groyne at Picnic Point would encourage the accretion of sediment, widening the amenity beach and providing a potential location for harvesting sediment to recycle for beach maintenance. A groyne here would also likely reduce the amount of sediment lost to the north due to the dominant sediment transport pathway. **Design Information:** The estimated length of the groyne is 50 m, the material rock and design life of a groyne for this purpose would be 50 years. It would take approximately 1 month of additional assessment to facilitate detailed design. **Access & Constructability:** There is an access road to the area; therefore beach access for plant is not likely to be an issue. However, depending on the location of the groyne, construction may be difficult due to plant access beyond the rocks and due to water depths. If marine based plant is required, good weather would be required for construction as the water depths may mean waves and turbulence would be an issue during relatively normal weather conditions. The Picnic Point area is an area of wave focus, and has been impacted in the past. **Key Risks:** Lack of detailed modelling prior to design - increase the potential for scour/erosion or failure. This is not a direct protection structure, thus the impact of failure would be low. Impacts would be technical in that the structure would no longer be fit for purpose to trap sand, or financial impact as in the cost to repair. Erosion impacts would be expected (i.e. standard 'groyne effect'

Installing a groyne at Picnic Point	
	as described in previous sections) these could be minimised with thorough modelling and good design. However, due to the northerly sand movement and absence of sand directly to the north, this structure is unlikely to have any adverse effects. • Inherent risks during construction - however these would be the responsibility of the contractor and client. Any impacts could be reduced by consulting a contractor during the design process.
Social	The accretion of sediment would likely widen the beach in this location, having a positive effect on amenity. **Key Risks:** • Non-acceptance of the structure by the public and removal required. • There would be some disturbance to the amenity of the immediate area during construction. There may also be some disruption to local traffic. This could be minimised by avoiding the busiest summer periods.
Environmental	The accretion of sediment in the area would likely widen the beach in this location providing additional storm protection and lessening the erosion risk in the short term. Additional accreted sand in this area could be harvested for beach recycling to actively maintain the beaches to the south when required, which would aid in minimising the erosion risk, however not eliminate it. Minimising erosion would promote environmental values by ensuring a stable substrate for growth of current flora and habitat, or establishment of new flora and fauna. **Key Risks:** • There would be some disturbance to the local flora and fauna during construction; however care could be taken to minimise negative impact, making the significance of this low. • The rocky reefs are acting as a natural groyne, thus disturbance of this process may be more detrimental to the system than beneficial.
Economics and Value for money	The estimated cost of construction of a groyne would range from $300k-400k depending on the location, scale and necessary plant. This is based on different sources of information, including information about the cost for an 80 m long groyne is in the order of $600k (May 2015). Therefore, a more detailed quote for this groyne would be required at the time of design to capture a more accurate estimate. Depending on the placement and alignment this groyne would retain more of the lost material currently lost to the north around Picnic Point. A maintenance allowance needs to be set aside. Details depend on the design life and quality, and outcome of inspections, for example following large storm events as well as the end of winter. Cardno have developed templates for groyne inspection. **Key Risks:** • Underestimation of costs. • Unforseen additional maintenance or repair costs (e.g. failure following a storm of magnitude larger than the design). **Value for Money:** This is a relatively high cost considering the potential benefits and who the benefits are actually most beneficial to (the Yacht Club and Parks Vic). If this option were to be considered in future, it would be reasonable for those that benefit to contribute to the costs making this option more financially viable.

5.1.2 Option 2 - Sand renourishment at Edward Street

Sand renourishment is the process whereby sand is sourced and either placed directly on the beach, or in the nearshore zone to be transported onshore with the natural coastal processes.

This option is to widen and increase the width and elevation of the beach between Red Bluff Street and Edward Street, between the Royal Avenue and Southey St groynes, as well as immediately north of the Southey St groyne. This is primarily to protect the bluffs and structure, but also to increase the amenity. The intention is also to introduce some additional sediment back into the beach cell to be transported within the littoral system. Profile survey information for two profiles (Profiles 2 & 3) in the southern area is available (Figure 5-2); it has been assumed that the renourishment would be carried out between these two profiles (see Figure 5-3). A dotted line shows the potential alignment of the new beach. There would be little difference to the planform shape of the beach at the Profile 3 end of the renourishment; however the beach width would increase at the Profile 2 end. This will widen the sub-aerial beach by approximately 40-50 m after implementation; however this would reduce after the profile equilibrates with the natural coastal processes.

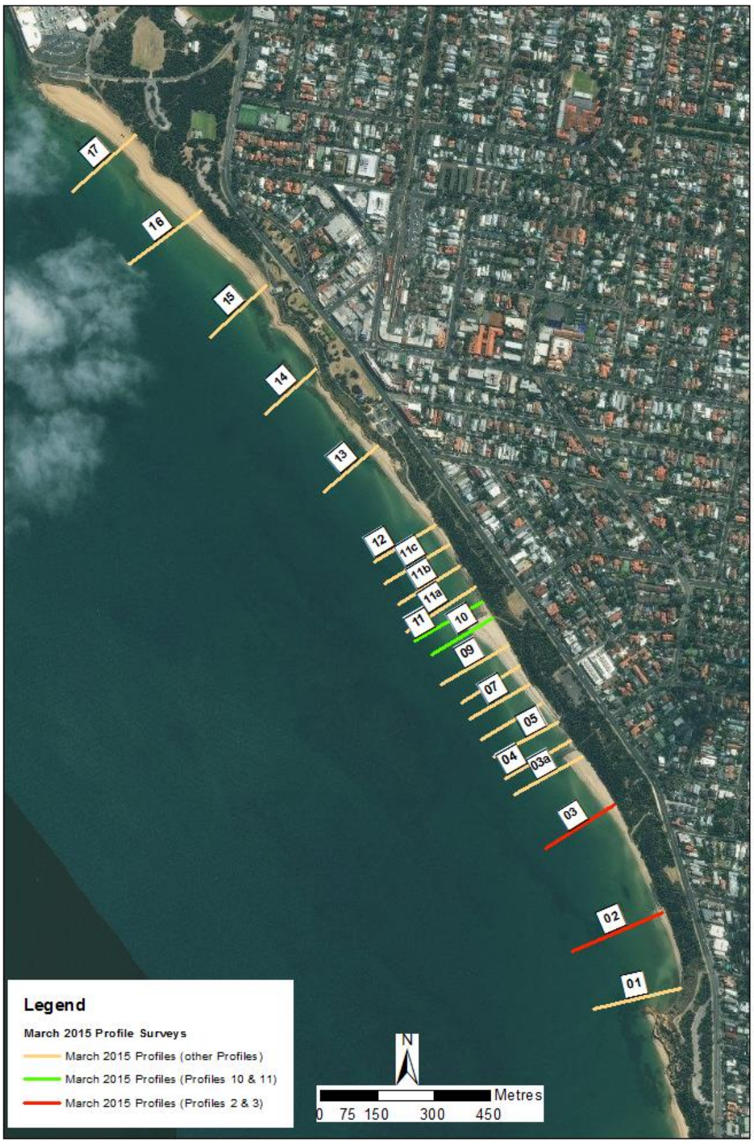


Figure 5-2 Profile locations (Redmapping survey data, March 2015)

Figure 5-3 Beach renourishment locations including potential alignment of new beach between Profile 2 and 3 (dotted line).

Figure 5-4 shows the Profile 2 shape with the renourishment design profile. Figure 5-5 shows the same for Profile 3. The beach is wider here presently than Profile 2, thus the same design would increase the sub-aerial beach width by approximately 10 m. The distance between these two profiles is approximately 250 m. The amount of renourishment required to fill this design would be approximately 12,500 m^3. This is consistent with Water Technology (2013) who estimated the renourishment volume to be between 10,000 m^3 and 20,000 m^3. An overfill factor of 1500 m^3 would be incorporated to account for profile losses for a design life of 10 years, resulting in a total estimated volume of 14,000 m^3 for this area. In the detailed design phase, these numbers would be refined. However, the values presented here are considered sufficient to facilitate the technical and economic aspects of the options assessment. An all-in cost of $30 per cubic metre of dredged/pumped sand, or $50 per cubic metre of quarry sand has been assumed. These costs will be refined following discussions with DELWP and updated costs from the Brighton renourishment project. The design would also be refined, after consultation with the community as to the amenity requirements at this beach location. There is a variance in grain size, larger grain size will stay in position longer and cost for different grain size/type of sand will need to be considered

The assessment of this option against the criteria is presented in Table 5-2.

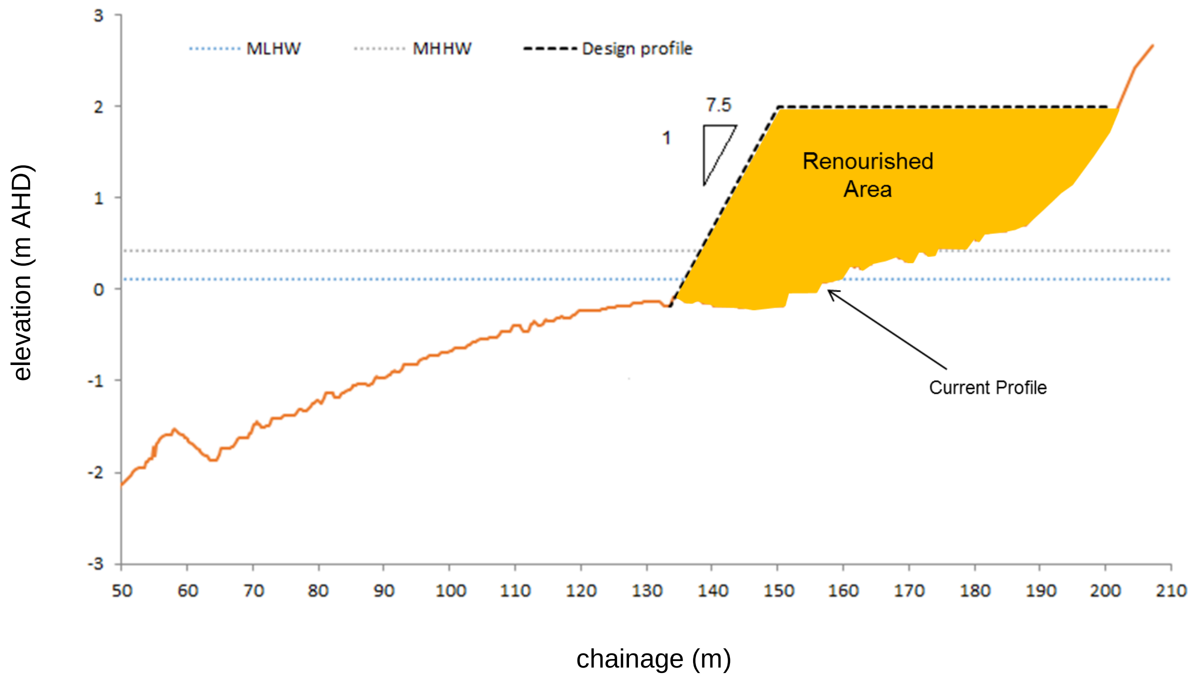


Figure 5-4 Outline design profile - profile 2 (Red Bluff St)

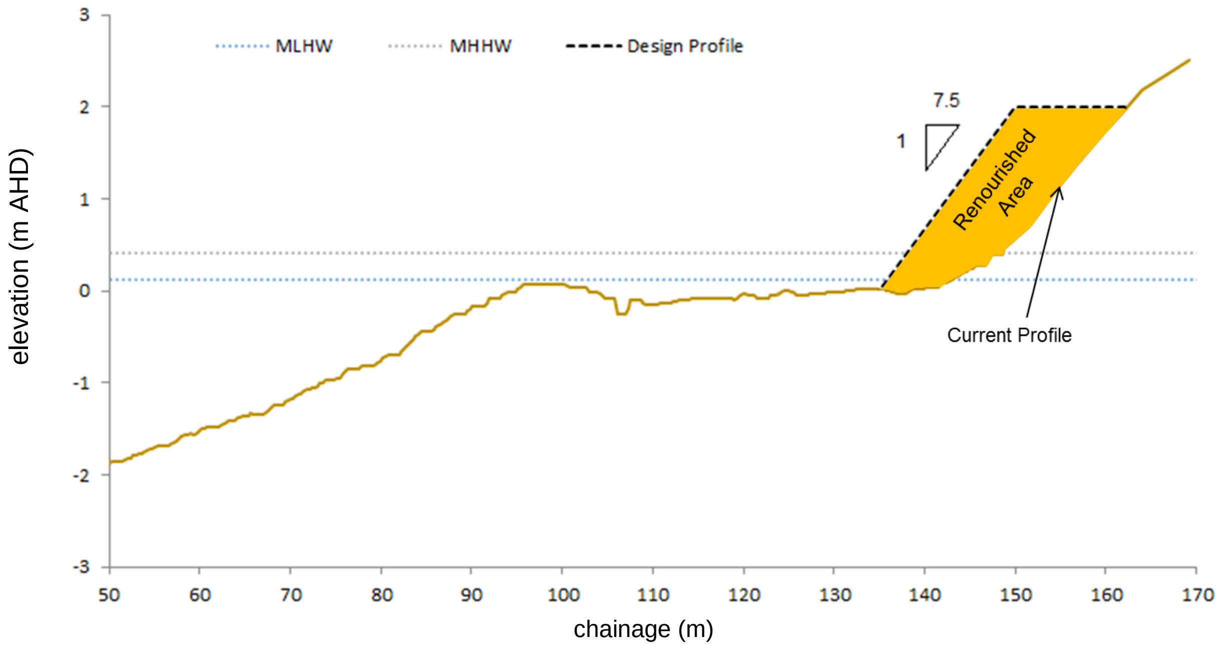


Figure 5-5 Outline design profile - profile 3 (Edward St)

Table 5-2 Assessment table against criteria for Option 2

Sand renourishment at Edward Street	
Technical:	**Design Information:** The estimated design life of a renourishment in this location is 5 to 10 years. A sediment volume of approximately 14,000m³ would be required for this area. It would take approximately 1 month of additional assessment to facilitate detailed design. Construction may take 1-3 months depending on source and placement methods. **Access & Constructability:** There is an access road to the area; therefore beach access for plant is not likely to be an issue. Constructability would depend on the source of sediment material - quarry material would be easier to transport and place than from sediment sourced /dredged from offshore, and pumped ashore. There is a variance in grain size, larger grain size will stay in position longer and cost for different grain size/type of sand will need to be considered **Key Risks:** • Lack of detailed assessment in the design - resulting in a lesser design life. This will increase the erosion risks and have a financial impact if another renourishment is required. • Although care can be taken with a renourishment to include an overfill factor to account for profile losses, there is no way to totally account for longshore and cross shore storm losses without increasing the source sediment/construction costs to where they become unaffordable. • Inherent risks during construction - however these would be the responsibility of the contractor and client. • Risk of major storm event washing sand away
Social	This option would have immediate benefit to beach amenity by providing a wide beach for community use. **Key Risks:** • Non-acceptance of the project by the public and sediment removal required. • Public disapproval if a large storm event was to deplete the beach. • A period of profile equilibration would happen immediately after the renourishment - this would need to be communicated to inform the public that the post renourishment profile of the beach would change and that this is expected, and the lessening of width does not constitute a lack of project success. • There would be some disturbance to the amenity of the immediate area during construction. There may also be some disruption to local traffic. This could be minimised by avoiding the busiest summer periods.
Environmental	This option would have immediate benefit to the beach environment by minimising the erosion risk significantly in the short term. This would also provide some additional source material for upstream and downstream beaches during normal seasonal sediment movement. Previous studies have shown that the coastal cell is experiencing a yearly net loss; therefore any additional material would be beneficial to the wider system also. Stabilising the beach system has the ‘knock-on’ effect of providing a stable substrate for growth of current flora and habitat, or establishment of new flora and fauna, thus promoting environmental values. **Key Risks:** • There would be some disturbance to the local flora and fauna (smothering) during construction; however care could be taken to minimise negative impact, making the significance of this low.
Economics and Value for money	A volume of approximately 14,000m³ would be required to effectively renourish the beach in this location. Therefore an estimate of between $400k - 700k is likely to be required for the capital works depending on the source material and placement method.

Sand renourishment at Edward Street	
	Maintenance of the area would be required to ensure the longevity of the project. Details depend on the design life and quality, and outcome of inspections, for example following large storm events as well as the end of winter. **Key Risks:** • Underestimation/overestimation of costs. • Unforseen additional maintenance costs (e.g. large loss of material following a storm of magnitude larger than the design). **Value for Money:** This is a relatively high cost, however, the benefits are mostly to the advantage of the beach system in that erosion risk is likely to be reduced cell wide (potentially, and the rate of reduction would be different for every location). Has direct benefit of providing additional protection to the seawall structure at the base of the bluff at Red Bluff Street, providing additional value by reducing potential maintenance costs. Good research into sourcing and negotiation with a quarry could see the costs reduce - DELWP undertakes many renourishments, thus using a common source for all sediment could see prices per cubic metre negotiated down to a large scale long-term bulk rate.

5.1.3 Option 3 - Modifying the rock groyne at Southey Street

The intention of this option is to encourage more sedimentation north and south of the groyne, by lowering and shortening the groyne to allow overtopping and more sand to bypass naturally (Figure 5-6).

This option was tested with Profile 10 (immediately south of Southey St groyne) and Profile 11 (immediately north of Southey St groyne) to assess the impact of a modification on both sides of the groyne. LITDRIFT was run for both the mean sea level (MSL) and mean higher high water (MHHW) water level conditions.

The shortened groyne option, for Profile 10, would lead to an increase of approximately 44 m^3 of material (of a possible total of approximately 1000 m^3) transported northward for the MSL water level condition. Whereas the shortened groyne option, for Profile 11, appears not to release any material. For the MHHW water level condition, about 140 m^3 of material is estimated to be released northwards if the groyne length is shortened, for Profile 10, whereas this amount is 15 m^3 for Profile 11.

These potential volume changes are not likely to be sufficient to improve the seasonal erosion problems south or north of the Southey Street groyne as localised scouring will always be present as a result of sediment transport (Figure 5-7).

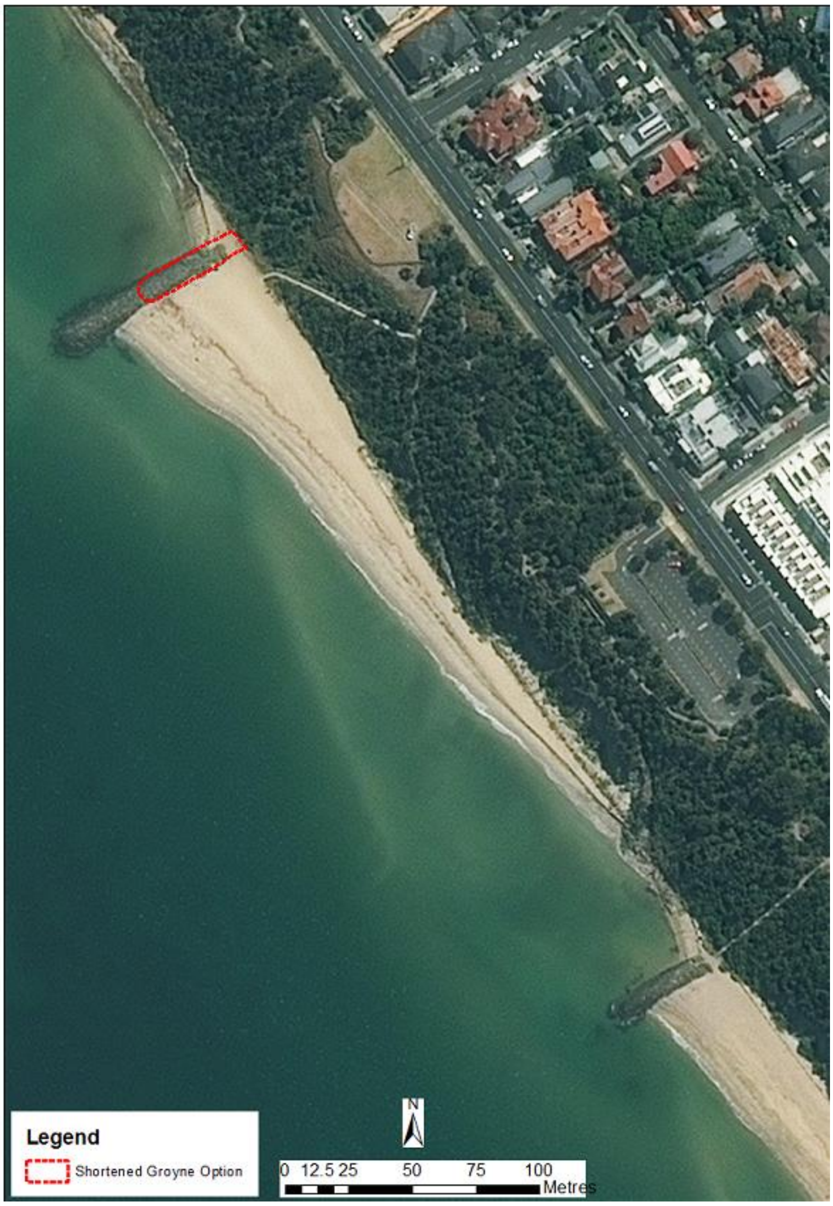


Figure 5-6 Optional shortening of the Southey Street groyne. The length of original groyne is approximately 100 m, length of the shortened groyne option approximately 50 m.

Nevertheless, a shortened groyne may cause less erosion on the leeward side, as shown in the conceptual sketch below (Figure 5-7). However, this requires detailed analysis of the groyne shortening effects, and consideration of local factors, including seasonal reversal of longshore transport.

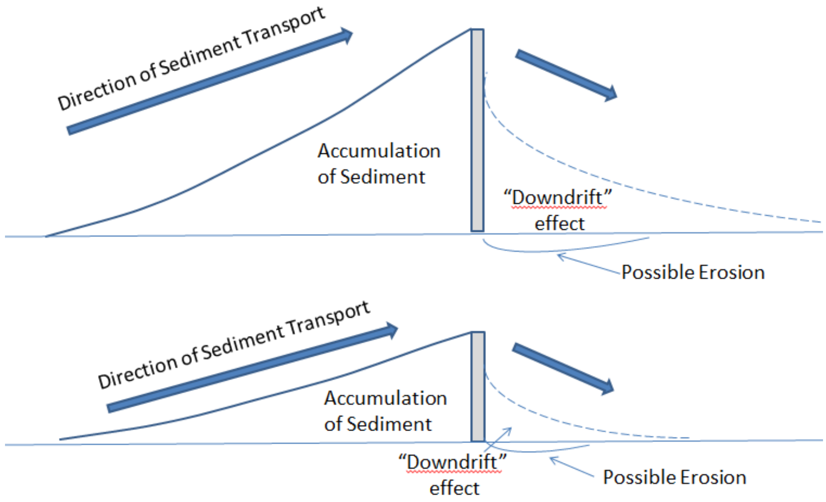


Figure 5-7 Conceptual sketch showing effects of groyne shortening. Note that the potential for erosion on the downdrift site of the groyne still exists if it was shortened. Only the complete removal of the groyne would remove this effect. However, this is likely to the detriment of the coast updrift of the groyne.

Table 5-3 shows the evaluation of Option 3 against the different criteria.

Table 5-3 Assessment against criteria for Option 3

Modifying the rock groyne at Southey Street	
Technical:	The groyne could be lowered and shortened. Lowering would allow more sediment to pass over and through the structure, whilst still maintaining a relatively wide beach during the summer months. However, the beach would not be as wide as is currently seen seasonally as more sediment would be able to bypass and overtop the structure and either deposit on the beach north of the structure or, depending on weather conditions, remain in the littoral system moving north towards Picnic Point. This would aid in reducing the erosion risk, however not eliminate the scour immediately north in the lee of the groyne (assuming the dominant northwards sediment transport direction). During times of southwards transport (winter) the accretion north of the groyne would likely be less than currently seen seasonally, with the beach on either side of the groyne being potentially narrower. Additional detailed modelling would be required to better determine the outcomes of lowering the groyne to become an overtopping structure; however this is considered is a viable option based on the preliminary findings. **Design Information:** The estimated design life of the reconstructed groyne would be 50 years. Additional modelling and design of the structure would take 4 - 6 weeks. **Access & Constructability:** There is an access to the area north or south of the groyne location; therefore beach access for plant would not be an issue. Reconstruction of the groyne would be relatively straight forward for an experienced contractor. **Key Risks:** • Lack of detailed modelling to optimise the design - increase the potential for erosion or structure failure. This is not a direct protection structure, thus the impact of failure would be low. Impacts

Modifying the rock groyne at Southey Street	
	would be technical in that the structure would no longer be fit for purpose to trap sand, or financial impact as in the cost to repair. • Inherent risks during construction - however these would be the responsibility of the contractor and client.
Social	The landscape has been visually affected by the size and prominence of the groyne. Feedback from the local community is that they are unhappy with the look and performance of the groyne and the erosion in the vicinity of the groynes. Modification would be welcomed by the community, who favour removal. However a smaller less prominent structure may also be acceptable, hence the options tested. **Key Risks:** • Non-acceptance of the structure by the public and removal required. • There would be some disturbance to the amenity of the immediate area during construction. There may also be some disruption to local traffic. This could be minimised by avoiding the busiest summer periods. The visual and amenity benefits of modification would outweigh the limited construction interruptions.
Environmental	There would be some disturbance to the local flora and fauna during construction; however care could be taken to minimise negative impact, making the significance of this low. This would have a positive environmental effect by potentially increasing accretion to the north of the groyne, thus reducing the erosion risk. However, the volumes of additional accretion at present appears low, and would require further detailed assessment. The level of detail of the current assessment is sufficient to inform a high level options appraisal process. **Key Risks:** • There would be some disturbance to the local flora and fauna during construction; however care could be taken to minimise negative impact, making the significance of this low.
Economics and Value for money	The estimated cost of re-construction of a groyne would range from $200k-300k depending on the final design of the structure. More accurate costing would be required via contractor quotes after a detailed design process. A maintenance allowance may be required to supplement the performance of the structure (active maintenance and beach recycling). Details depend on the design life and quality of the modified groyne and outcome of inspections, for example following large storm events as well as the end of winter. There would be the potential to re-use some of the removed rock armouring, thus, incurring a negative cost, and increasing the overall benefits. **Key Risks:** • Underestimation of costs • The modifications do not encourage the desired results to a level that would consider the project and the expenditure a success. **Value for Money:** Reconstruction costs are relatively high when weighing up the benefits. Active maintenance may be preferred over structure modification, and although this may cost more in the long term, the lower yearly costs to be factored into budget may be preferred by DELWP over the large capital upfront cost. A more detailed formal assessment of the costs and benefits may be required to facilitate the decision making process for this option, and satisfy funding requirements.

5.1.4 Additional Option Investigation - Tennyson St Groyne

This option was tested with Profile 13 (near Tennyson St) to encourage more sedimentation south of Tennyson St and north of Southey St groyne. LITDRIFT was run for MSL condition using Profile 13.

The option was tested with two groyne lengths. It was found that unless the groyne is positioned on the profile below the 0m AHD level, it has no impact on the changes in sedimentation.

5.1.5 Combined options

To address the issues at hand, combining two or all three options was also investigated, considering the assessment criteria of the three options presented in Table 5-1 for Option 1, Table 5-2 for Option 2 and Table 5-3 for Option 3. The combinations considered are:

A) Combining Options 1 & 2 – Picnic Point Groyne & Sand renourishment

B) Combining Options 2 & 3 – Sand renourishment and shortening of Southey St groyne

C) Combining Options 1, 2 & 3 – Groyne shortening, Picnic Point groyne, sand renourishment

A) Combining Options 1 & 2.

This combined option is to renourish the area at Edward Street and the area between Royal Avenue and Southey Street and reduce the loss of sand at Picnic Point, and thereby replenish the area with sand that is lost as part of the dominating northward annual sediment transport. The aim is to increase the amenity at the other end of the beach and to reduce the risk of erosion along this section of beach and the bluffs. It is uncertain at present how much sand will be lost in the future with the placement of a groyne. The construction of a groyne in the correct location and correct angle would retain more sand than at present. Ultimately, more sediment will be trapped at Picnic Point as a result of a newly constructed groyne, and suitable portions of the trapped sand may be harvested and used to nourish the southern sections. This approach fulfils two purposes: a) renourishment of the beach at Edward Street and b) capturing more sand at Picnic Point. However, once the accommodation space is filled, sediment will be transported around the groyne.

The key issues are:

a. need for more detailed modelling of sediment transport and effects of the groyne and appropriate groyne design

b. potentially adverse effects on local flora and fauna during groyne construction

c. cost of groyne construction

d. sand renourishment will not solve the erosion problem on the northern side of the Southey Street Groyne entirely.

B) Combining Options 2 & 3

This combined option considers placing sand towards the southern end of the beach which would lead to the widening of the beach. Shortening the groyne would allow for an additional small amount of sediment to be transported around the shortened groyne. A shortened groyne would reduce the ‘downdrift’ effect of the groyne to some extent. However, scouring on the leeward side of the groyne would still occur. This may require the placement of sand at regular intervals to maintain the beach. Modelling undertaken for this project has shown that shortening the groyne has only limited effects on additional sediment transport and erosion on its leeward site. The effects of groyne shortening, or even possibly removal, on the stability of the bluffs would need to be considered. Compensating this effect may require regular trucking or pumping of sand onto this section of beach potentially leading to a significant reduction in beach amenity.

C) Combining Options 1, 2 & 3

This option combines all three options addressed in this report. Combing all options would imply that more sediment is trapped at the northern end of the beach and an opportunity exists to reuse part of that sediment for beach renourishment at the southern end. Shortening the Southey St groyne allows for an additional amount of sediment to be transported around the groyne, however, the deposition immediately north of the groyne is not likely. The issue of beach/bluff erosion immediately north of the groynes would require placement of sand. Implementing all three options over time would imply an additional structure at Picnic Point and also lead to a greater encapsulation of this cell. Sediment transport around Picnic Point will be reduced (at least temporarily) and sand placement at the southern end addresses the current erosion problems. Pumping or trucking of sand down the beach is still required to manage the beach long-term. While beach amenity at the southern end is improved by shortening the groyne and placing sand, building a groyne at Picnic Point will reduce amenity there.

In summary, every option and combination of options has advantages and limitations which require careful consideration for any decision making process. Human interference with natural systems ultimately leads to changes in coastal behaviour, which is often addressed by more interference over time. Port Phillip Bay is such an example. However, ”letting go” of this section of coast is not considered to be an option given the high value of natural and infrastructure assets in the area. The development of a short to medium management plan is considered of substantial value. This is to better understand available resources, assignment of responsibilities, methodologies etc., to manage this section of coast.

For Additional consideration:

One possible approach for consideration is a staged approach whereby the initial activity consists of beach renourishment and monitoring over a given period of time. Detailed documentation of weather patterns and storm events, as well as beach monitoring will ultimately provide information that will inform steps required in the future. These may be ‘just’ the continuation of beach renourishment efforts at given times throughout or a year, or resulting in the need to construct a new groyne at the northern end of the beach to trap more sand and widen that section of the beach, and/or the shortening of the Southey Street Groyne. Amenity, safety, protection of the natural and human/infrastructure environment, as well construction versus renourishment cost need to be taken into consideration. Commencing this process with a soft engineering option, ie beach renourishment, is considered to be the least intrusive and most cost effective option.

6 References

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