Point Lonsdale Dog Beach - Adaptation Plan

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The Amendment Record below records the history and issue status of this document.

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01	05 October 2022	Department of Environment, Land, Water and Planning	Final report

Executive Summary

Background

Dog Beach is a relatively short stretch of beach of approximately 300m in length, on ‘The Narrows’ halfway between Point Lonsdale and Queenscliff.

The shoreline from Point Lonsdale has a history of erosion with previous revetment works extending from Point Lonsdale and finishing at the southern end of Dog Beach where a large terminal scour bight has subsequently evolved, cutting into the dune and forming a 10m high erosion escarpment.

DELWP has commissioned BMT to undertake a coastal adaptation plan for Dog Beach to understand the impacts of coastal hazards, commence planning for management of the erosion and terminal scour and respond to sea level rise within an ‘Adaptation Pathways’ framework in accordance with the Victorian Marine and Coastal Policy (VMACP) (DELWP 2020).

Dog Beach is the only off-leash dog beach in the Queenscliff to Point Lonsdale area and is highly valued as a dog walking location and for it’s wide, open and natural character. It is very popular not only for dog walking, but also other recreation such as exercise and swimming. On the crest of the adjoining dune is 'Lovers walk', an along-shore walking path through the native bushland and protected Moonah Woodlands.

The beach and dunes of the study are an area of cultural sensitivity and a high value landscape for the Wadawurrung traditional owners, although there are no registered cultural heritage sites in the study area.

The dune face is steep and unstable and may present a hazard to people who try to climb it. There is ongoing recession (erosion escarpment moving landward) which may threaten the walking path and one section has previously been relocated.

Figure 1. Dog Beach study site

Figure 2. Study area

Coastal Processes and Causes of Erosion

Sediment transport within Lonsdale Bight is driven primarily by tidal currents and swell waves entering the Bay through The Rip. These conditions drive a large flow of approximately 100k m^3/yr of sediment across the seafloor into the Bay and another 80,000 to 100,000 m^3/yr moves along the beach towards Queenscliff, in a process known as along-shore transport (or longshore transport). Where wave energy reaching the coast removes more sand via along-shore transport than is arriving the deficit is made up from erosion of the dune, leading to long term recession (landward movement of the shoreline), and this is particularly the case at the end of long seawalls where a phenomenon termed ‘terminal scour’ occurs. Dog Beach is a clear example of terminal scour with scour bight cut approximately 40m into the dune over a length of 200m of beach, resulting in the wide, flat beach that is popular with users.

This terminal scour bight has developed since the completion of the seawall in 1977 and a key question for this study is whether the terminal scour is ongoing or whether it has reached a stable equilibrium. Analysis of air photos shows that erosion and recession of the dune at the end of the seawall was very rapid for the first few years, then steady from the 1980s to 2000s. The rate of recession appears to have slowed from around 2015 to the present, and it may be reaching an equilibrium state. However, we are not confident in this conclusion as the apparent equilibrium may be due to a temporary variation in the wave climate, or the erosion process could be restarted by climate change and sea level rise.

For the purpose of erosion hazard mapping and adaptation planning we have made the conservative assumption that erosion and recession in the terminal scour bight continues to occur at the average long-term rate observed in the past. This is a ‘worst case’ for future recession (landward movement of the coast), and it is possible that the recession will proceed much slower than predicted.

Coastal hazard lines, representing the predicted future position of the dune erosion escarpment have been calculated with allowances for storm cut, long term recession due to sediment loss (terminal scour) and sea level rise as shown in the figure below. For the next 50 years, up to approximately 2070, the only asset or value at risk from coastal recession is the lovers walk walking path. Beyond 2070 the progression of recession is very difficult to predict but it is possible the road and some private properties may eventually be at risk.

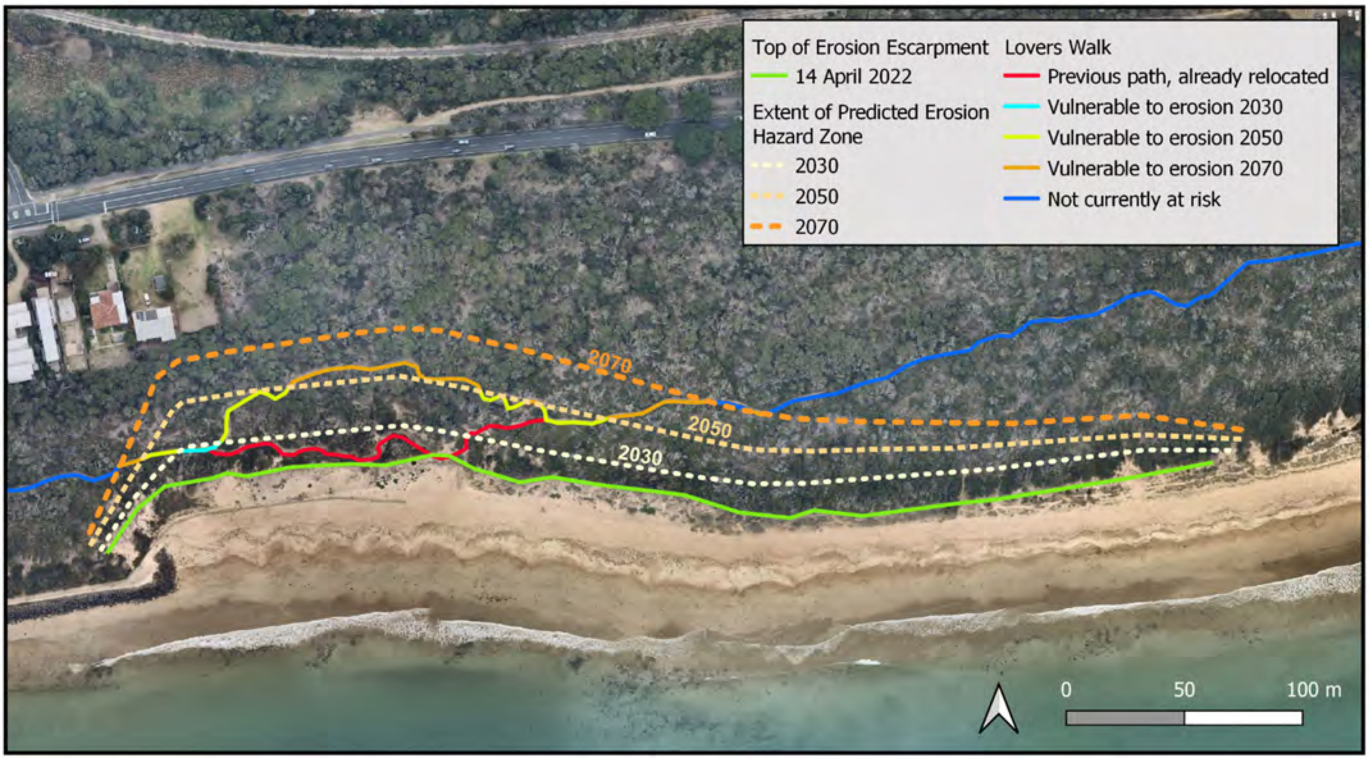

Figure 3. Estimated erosion hazard zones for 2030, 2050 and 2070

Options and Adaptation Pathways

This study has considered a range of adaptation options in accordance with the hierarchy of responses set out in the Victorian Marine and coastal Policy 2020 (VMACP).

VMACP order of consideration	Adaptation Measure
Non-Intervention	• Minimum Intervention with Increased Public Safety
Avoid	(No appropriate options identified for Dog Beach)
Nature-Based Methods	• Dune Management
Accommodate	(No appropriate options identified for Dog Beach)
Retreat	(No appropriate options identified for Dog Beach)
Protect	• Beach Nourishment • Groynes • Rock Revetment Seawall • Offshore Breakwater

The recommended option for the short and medium-term management of erosion at Dog Beach is 'Minimal Intervention' which aims to manage public safety and access around the erosion scarp with no other erosion prevention actions. Specifically, this includes:

- Extending the sand fencing to reduce access to the dune face
- Install signage advising the dangers of climbing on the dune
- Extending the access ramp to prevent the end being exposed during low sand levels
- Relocating sections of the footpath (Lovers Walk) when necessary.

This approach will maintain the wide beach and natural character valued by beach users, and this was the most favoured option during community consultation, supported by the majority of respondents.

Fencing and signage will need to be maintained after storms and relocated occasionally as the dune recedes.

The other adaptation options are not recommended at this time due to either the cost and/or the impact these options will have on the surrounding area. Dune management is assessed as not effective at this site. Beach nourishment would need to be repeated annually and may involve significant social impact from the transport of sand on public roads as no suitable sources of sand have been identified nearby. Groynes, revetments and offshore breakwaters would be very expensive ($5 million plus) and would cause terminal scour further along the beach to the east (towards Queenscliff).

If erosion progresses at the worst-case rate (it may be slower), then the 'minimal intervention' option will no longer be effective sometime after 2070 when assets are at risk from shoreline recession. At this point a decision will need to be made to implement one of the 'protect' options i.e. groynes, revetments or some other measure not yet considered, as per the adaptation pathway shown below.

The position of the erosion escarpment in the dune should be monitoring at least once per year to identify trigger points for the relocation of Lovers Walk and, in the longer term, trigger points for reassessing the pathway and potentially implementing one of the protect adaptation options.

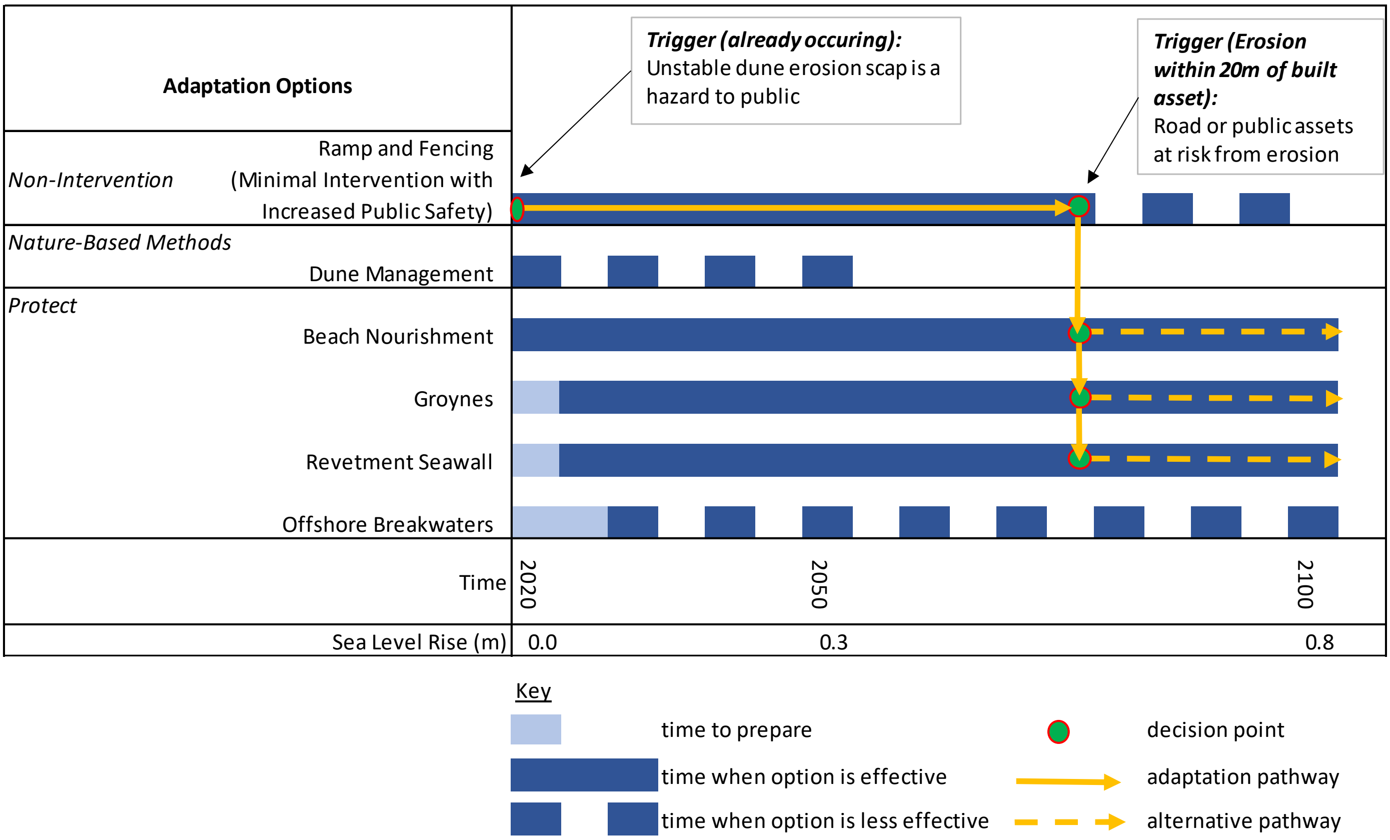

Figure 4. Recommended Adaptation Pathway for Dog Beach

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1 Introduction

1.1 Project Introduction

Dog Beach is a short stretch of wide, accessible beach located in Lonsdale bight, between Point Lonsdale and Queenscliff.

The study site, shown in Figure 1.2, is currently managed by the local council, the Borough of Queenscliffe and overseen by the Department of Environment, Land, Water and Planning (DELWP).

The shoreline from Point Lonsdale has a history of erosion with previous revetment works extending from Point Lonsdale and finishing at the southern end of Dog Beach where a large terminal scour has subsequently evolved.

DELWP has commissioned BMT to undertake this coastal adaptation plan for Dog Beach to understand the impacts of coastal hazards, commence planning for management of the erosion and terminal scour and respond to sea level rise within an ‘Adaptation Pathways’ framework in accordance with the Victorian Marine and Coastal Policy (VMACP) (DELWP 2020).

The study considers both short- and long-term measures and maps their interdependencies.

The objectives of this study are to:

1. Assess a range of management options based on the current understanding of the coastal hazards and how these will change over time
2. Recommend short term measures for the management of erosion that are consistent with the VMACP and do not constrain possible long-term options for the site
3. Develop a long-term adaptation pathway up to 2100 or beyond, that identifies trigger points when decisions need to be made
4. Help build community awareness and understanding of coastal conditions and processes at the site and improve community awareness and understanding of the marine and coastal legislation, including the Marine and Coastal Act 2018, Marine and Coastal Policy 2020 and Marine and Coastal Strategy guiding future coastal management practice
5. Respect natural processes
6. Build resilience and plan for climate change impacts

Figure 1.1 Dog Beach study site

1.2 Study Area

Dog Beach is a relatively short stretch of beach of approximately 300m in length, on ‘The Narrows’ halfway between Point Lonsdale and Queenscliff, situated within the terminal scour bight at the end of the existing seawall from Point Lonsdale. The beach is on Lonsdale Bight, and faces towards ‘The Rip’, the entrance to Port Phillip Bay.

It is the only off-leash dog beach in the Queenscliff to Point Lonsdale area and because it is a particularly wide, flat, and open beach, with a natural character, it is very popular not only for dog walking, but also other recreation such as exercise and swimming. The adjoining dune, has a 10-12m escarpment and a walking path, 'Lovers walk', roughly along the crest. The walking path takes walkers through the native bushland and protected Moonah Woodlands. Due to the scour bight the dune face has become quite steep, with risk of collapse and one section of the path has previously been relocated.

The seawall from Point Lonsdale has a paved walkway which becomes a ramp down to Dog Beach, where the seawall terminates. The study area also has some existing wet sand fencing in place at the toe of the dune.

Figure 1.2 Study area

1.3 History of the Seawall and Scour Bight

Erosion of the Point Lonsdale Front Beach led to the construction of the first length of seawall in 1900. The first set of groynes being constructed in 1934 to catch the sand and recreate a beach after severe erosion of the beach in front of the wall.

From 1935, the seawall has been extended, in stages, north along the shore. After each extension, the coastline past the (new) end of the wall has continued to erode and a new terminal scour bight has developed in the dune at the down-stream (north-eastern) end of the wall.

In 1977, the seawall reached its current length, and the terminal scour at Dog Beach began to develop. Since then, the scour has cut the approximately 200m long by 30m wide bight into the dune, that is currently evident, leaving a 10m high unstable dune face at the back of the beach.

Figure 1.3 shows the progressive stages of the development of the seawall and the scour bites that developed after each construction.

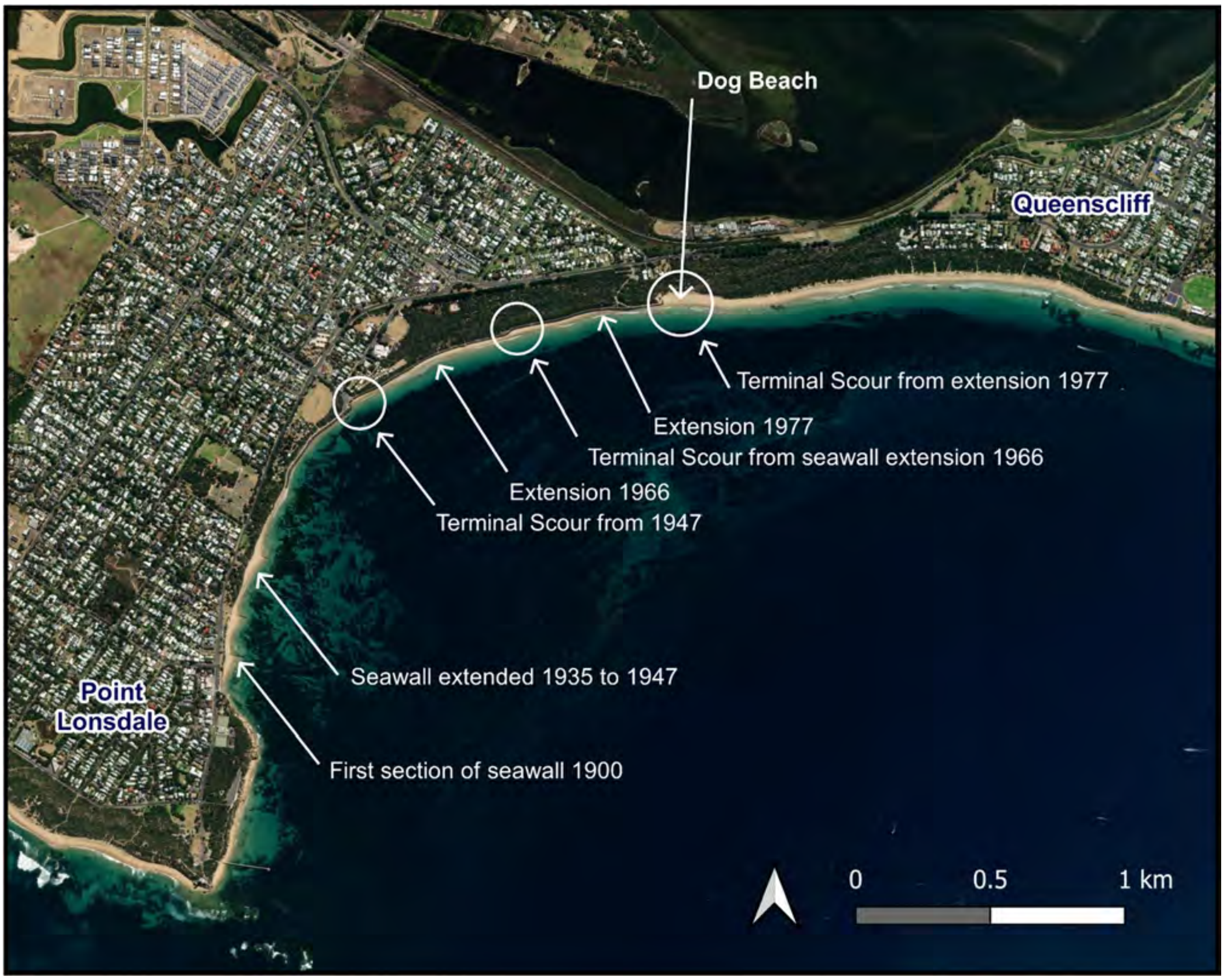

Figure 1.3 History of the existing coastal protection structures.

1.4 Previous Studies

Numerous studies have been undertaken previously, of erosion at Dog Beach and the local vicinity, including coastal processes and reviews of groyne proposals for Point Lonsdale. A summary of a selection of reports since 2006 is below.

1.4.1 Point Lonsdale Seawall Terminal Scour – SKM, 2006

The study by SKM was to investigate the dune loss at Dog Beach, to identify the causes of the loss and to propose recommendations to address the terminal scour. The study consisted of a literature review of two prior reports (Vantree, 1998 and Lawson and Treloar Pty Ltd, 1998) and an assessment of photographs.

From the literature review, SKM reported that Vantree had concluded that the erosion was a localised terminal scour due to the construction of the seawall and that it had reached a dynamic equilibrium and should be left as is. Additionally, the numerical modelling by Lawson and Treloar concluded:

- Longshore sediment transport is between 50,000 and 80,000 m^3 per annum in the area of the terminal scour
- Approximately 100,000 m^3 of sediment moves eastwards across Lonsdale Bight

- During a severe storm (100-year water level) the dune crest could recede around 9 m

The report provides some details on the dune reshaping carried out by the Borough of Queenscliffe to stabilise the dune to reduce the risk of public injury, along with the subsequent re-vegetation works which were deemed to have failed.

The photo analysis suggested that the dune toe suffered severe scouring from a storm that occurred in 2004, but that the crest was not impacted, and the beach system recovered from the event. The analysis also indicated that the dune recession had probably stabilised but there was loss of vegetation which was suspected to be due to wind erosion following the reprofiling works.

The study considered the following options for addressing the terminal scour:

1. Do nothing and monitor
2. Brush protection and re-vegetation
3. Beach Renourishment
4. Extension of the seawall
5. Offshore breakwater

And a wind fencing option to address the wind erosion

The report recommended a combination of the options be implemented:

- Brush protection and revegetation along with monitoring the success of this option
- Temporary fencing along with beach nourishment and replacing protective scrub to address any significant toe scarps caused by storms.
- Installation of wind fencing
- Revegetation of the dune slope

The report also gave the recommendation that beach access for vehicles should be maintained and in particular an engineered permanent facility that will not be damaged by storms should be implemented in the existing position.

1.4.2 Coastal Processes and Adaptation Options at Point Lonsdale Dog Beach – DEPI, 2013

The report by the Department of Environment and Primary Industries (DEPI) summarised the aerial photo analysis they had undertaken to determine the stability of the beach.

The photo analysis used 15 photos from 1939 to 2012 to track the dune toe, measure the distance and calculate the rates of change.

From the analysis they concluded that a terminal scour had occurred at the end of the wall each time the seawall was extended. From 1939 to 1978 it was deemed that the dune toe had receded up to 32 m with the most significant recession being at the end of the wall. Although this was calculated to be 1.2 m per year it was suspected that the recession was not gradual. From 1978 to 2003, it was thought that the recession occurred gradually at first with the dune to remaining at approximately in the same position until 1990. Then from 1990 to 2003 the toe receded up to 20 m. It is suggested that the upgrade and enlargement to the end of the wall may have increased the terminal scour but due to a lack of photos across the period, it is uncertain. From 2003 to 2012, the photo analysis showed that the toe had moved both backwards and forwards suggesting that the site may have reached an equilibrium.

The report also briefly mentions that geotextiles that were laid in 2007 were damaged by storms and recent revegetation was washed away in early 2013.

DEPI concluded that large scale rapid erosion was not likely to occur again at Dog beach but being a dynamic beach, it would continue to erode and accrete in response to short term changes and that small scale collapses of the dune were still a risk.

In alignment with the Victorian Coastal Strategy 2008, several options grouped into the categories, Protect, Accommodate and Retreat were assessed (including three options proposed by Atkins Maritime Engineering Pty Ltd (AME), August 2013):

- Protect
  - Extend seawall
  - Offshore breakwater (AME proposal)
  - Tea tree-brush filled gabions (AME proposal)
  - Sand bag sea wall toe protection and renourishment (AME proposal)
- Accommodate
  - Install fencing at base of dune
  - Undertake revegetation works
  - Monitor site condition
  - Review fencing at top of dune and improve if needed
- Retreat
  - Relocate pathway at top of dunes if erosion continues and current path is assessed as unsafe

DEPI recommended that hard engineered solutions were inappropriate and instead suggested the following:

- Short term:
  - Fencing along dune toe
  - Review of fencing along pathway at top of dune
  - Revegetation in more stable areas where the chance of success is high
  - Implement a community monitoring program to identify when triggers/thresholds are reached.
- Medium term:
  - Retreat of pathway at top of dune
  - Repair to access ramp if undermined by further erosion

1.4.3 Lonsdale Bight Investigations Review and Options Overview – BMT WMB, 2017

The report by BMT WMB was an independent review of investigations in Lonsdale Bight comprising of reviewing 29 previous reports. The report provides a detailed history of erosion and management from Point Lonsdale to Shortland Bluff. The review found that the previous reports generally agreed on the broad coastal processes in the area, but some knowledge gaps existed.

With regard to Dog Beach, it was stated that the terminal scour at the end of the seawall was evident, that fluctuations in the beach occur in response to the prevailing processes and that the shoreline is generally regarded as being relatively stable.

The key issues for the Dog Beach section of the review were identified as:

- Ongoing stability and management of the high dune scarp
- Potential erosion and short-term threats during storm events
- Threats of long-term recession particularly related to climate change
- The potential impacts of works carried out at Point Lonsdale Front Beach.

It was deemed that Dog Beach has a substantial buffer to accommodate erosion and that it is unlikely that the buffer will be breached, or the road threatened by future erosion. As such the proposed strategy for Dog Beach was:

- Let natural processes of erosion and accretion continue to occur
- Continue with dune management of the high erosion scarp to minimise slumping and control pedestrian access at the top and bottom.
- Continue to monitor shoreline fluctuations and particularly recession of the top of the erosion scarp and assess rates of recession.
- Establish a trigger point for consideration of specific actions related to future erosion threatening the development behind.
- Consider options for dealing with the threat of erosion to the property when the trigger point is reached. These would typically include:
- Allow erosion to continue naturally further to the east of the development.

1.4.4 Point Lonsdale Groyne Investigation – Cardno, 2018

The Point Lonsdale Groyne Investigation was a technical investigation to assess using groynes as an option to maintain a sandy beach at Point Lonsdale Front Beach.

The report notes that the beach fluctuates with seasonal conditions, with the most sand movement occurring during storm events with the beach subsequently rebuilding. It is also reported that the sand volume transported along the shore is estimated to be 80,000 to 100,000 m^3 per year

1.4.5 Point Lonsdale Groyne Feasibility Study – Water Technology, 2020

Water Technology completed a review of the "Community Design Option" (CDO), for Point Lonsdale Front Beach that proposes a denser groyne field. The report concluded that the proposed beach groynes would likely increase the width of the beach but may increase erosion to the north.

1.4.6 Extreme Weather Case Study Report – Coastal Erosion (Borough of Queenscliffe) – Spatial Vision and A.S. Miner Geotechnical, 2020

This report details a case study, of a likely extreme weather event. The case study focus' on the area of Dog Beach and the Narrows and looks at the impacts of increased coastal erosion. The case study identified the area and assets likely to be impacted by storm surge events by looking at previously modelled sea level rise and storm surge. Additionally, the case study analysed historical photography to look at the changes that had already occurred and compared them to the hazard lines from Cardno (2014) and deeming them reliable.

The study determined that since 1978, the rate of recession has been approximately 0.8 to 1.0m per year and that parts of Lovers Walk and beach access trails are likely to be affected by future erosion.

1.5 Community Consultation

Several engagement activities have been conducted as part of the Dog Beach, Queenscliff coastal adaptation plan.

The 'What we Heard' documents summarising the listening post and the options consultation can be seen in Annex A and found on the Engage Victoria website at https://engage.vic.gov.au/dog-beach-coastal-adaptation-plan-point-lonsdale

1.5.1 Meeting with Traditional Owners

An initial meeting was held on 15 March 2022.The online meeting was attended by Sarah Eccles representing the Wadawurrung Traditional Owners Aboriginal Corporation (WTOAC), Hannah Fallon (DELWP) and Christian Taylor (BMT).

1.5.2 Local community groups

A meeting was held on site, on 18 March 2022, with representatives from the Save Point Lonsdale Front Beach group and the Queenscliff Climate Action group. The objective of this meeting was to introduce the Dog Beach project, gain input from the groups regarding site values and listen to the Save Point Lonsdale Front Beach groyne proposal for Dog Beach.

1.5.3 Listening Post – Uses and Values

The first engagement activity was a listening post held by DELWP, Borough of Queenscliffe and BMT on 27 March 2022. The listening post was held at the study site with the objective to introduce the project to the community, gain input on site history of erosion, and understand what the community values about the site. Participants were invited to complete a survey which was available at the listening post and online, which received 83 responses.

The most common use of the beach was dog walking (more than two thirds of participants), followed by exercise, swimming, and family recreation such as sunbathing and building sandcastles.

The 'wide and open nature' of the beach, the 'natural vegetation and character' and the 'access along the beach from Queenscliff to Point Lonsdale' were nominated as the key values of the area.

1.5.4 Options Consultation

A second community consultation was conducted by DELWP, Borough of Queenscliffe and BMT, to gauge community response to the six proposed future adaptation options (see Section 3) for Dog Beach. The consultation consisted of an in-person engagement session held on 29 May 2022 at Queenscliff Football and Netball Club and also on-line on the Engage Victoria website from 29 May to 10 July 2022.

Posters of the coastal process at Dog Beach, hazard lines and options were displayed at the engagement session and were available online. Participants, both in person and online, were invited to complete a survey to capture their feedback.

A total of 32 submissions received form this round of community consultation, mostly through the website. Findings are discussed in Section 3.

2 Coastal Hazards

2.1 First Pass Hazard and Risk Screening

Informed by our review of the relevant coastal process background documents, we have undertaken a first-pass assessment of the coastal hazards (as per the Victoria's Resilient Coast – Adapting for 2100+ Pilot Guidelines) which will drive adaptation planning at Dog Beach.

Table 2.1 First pass coastal hazard assessment summary

Coastal Hazard	Importance at Dog Beach Study Area
a. Short-term erosion	High
b. Long-term erosion	High
c. Accretion	Low
d. Storm tide inundation	Low
e. Permanent inundation	Low
f. Estuary dynamics	Low
g. Offshore sediment dynamics	Low
h. Saline intrusion	Low

According to this assessment, we propose to focus our assessment of coastal processes at Dog Beach on the following hazards which will drive management decision making:

- Short term (storm) erosion of beach and dune
- Longer term erosion and recession of the dune

2.2 Coastal Processes

Policy 6.9 of the VMACP states that marine and coastal process should be considered in the context of their coastal compartment type when planning for and managing coastal hazard risks. The secondary compartment, encompassing Dog Beach, as shown in Coastkit, covers the shoreline from Point Lonsdale up to approximately Williamstown. The more local tertiary compartment for Dog Beach extends from Point Lonsdale to Shortland Bluff (Queenscliff) and coastal processes have been considered at this scale.

2.2.1 Geomorphology

Dog beach is situated on 'The Narrows', which according to Bird (1993) is formation of recent Holocene dunes and swamp deposits connecting the older islands of Pleistocene calcarenite at Point Lonsdale and Queenscliff (Figure 2.1).

Rock, presumably calcarenite, is exposed on the seafloor of Lonsdale Bight immediately offshore of Dog Beach at around -3m AHD and there is a possibility that higher calcarenite formations exist within the dune. This is an important question for Dog Beach, because if there were rock buried in the dune it could limit the extent of future erosion.

Spatial Vision and A.S. Miner Geotechnical (2020) reviewed the available data for the area and concluded that it was unlikely that any such rock was present but recommended a geotechnical investigation to confirm the makeup of the dune behind Dog Beach.

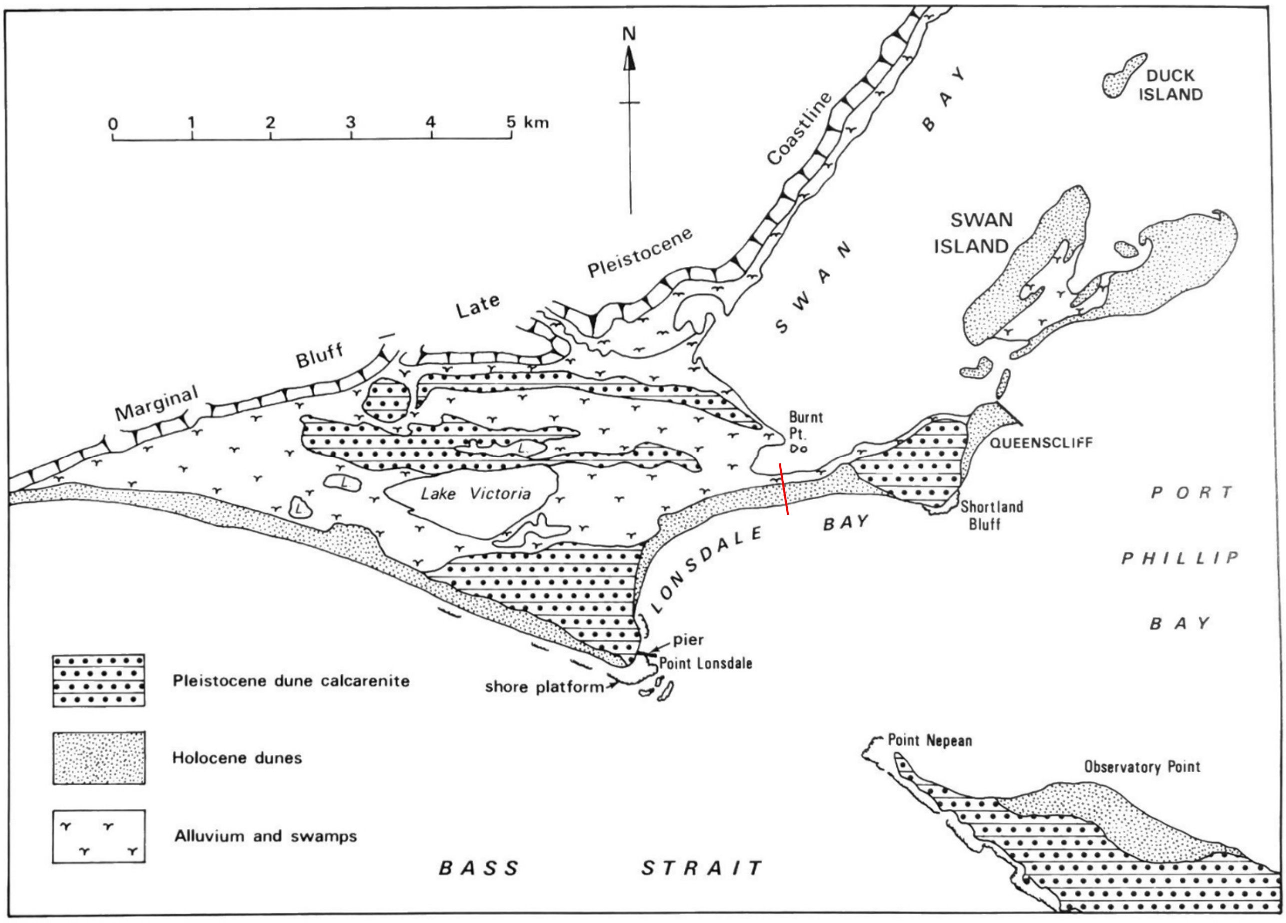

Figure 2.1 Landforms of the Point Lonsdale – Queenscliff area (Bird 1993)

Figure 2.2 shows the existing dune profile through the scour bight (as indicated by the red line in Figure 2.1) from the Future Coasts 2010 digital elevation model, along with the estimated dune profile without the terminal scour.

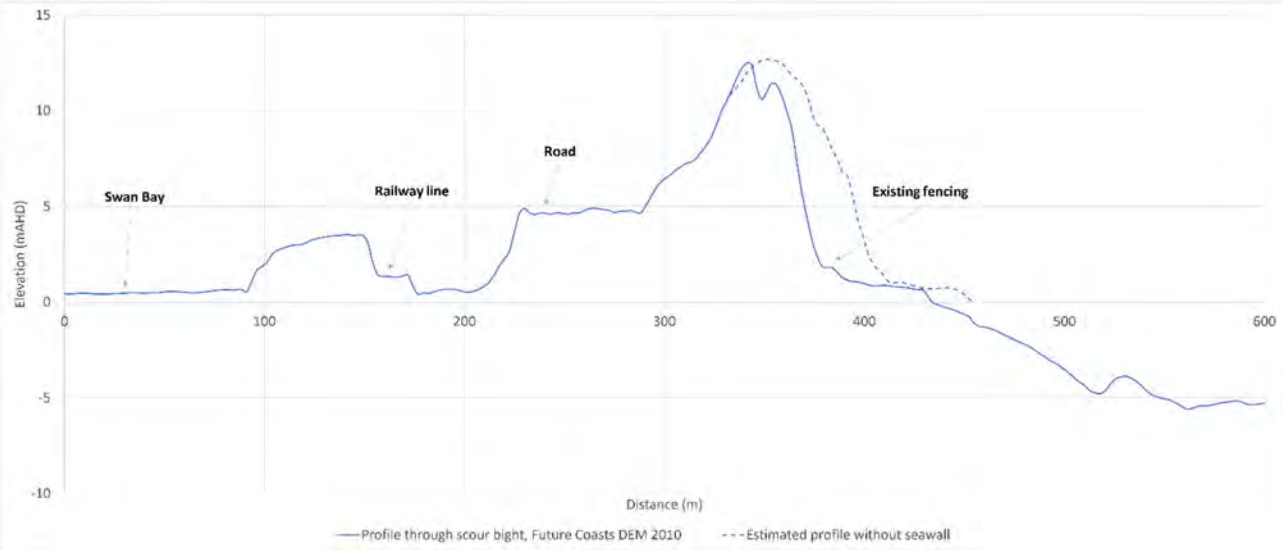

Figure 2.2 Dune Profile from Swan Bay through the scour bight and across Dog Beach.

2.2.2 Water levels and Sea Level Rise

Astronomical tides in the region are micro-tidal (<2 m spring range) and semi-diurnal (two tides per day). Tidal range within Port Phillip Bay decreases with distance from the entrance. Dog Beach, being close to the entrance, has a relatively large spring tidal range of ~1.2 m similar to the open coast outside the bay (Table 2.2).

Table 2.2 Astronomical tide at Point Lonsdale (Port Phillip Heads, source: Australian National Tide Tables 2022)

Tidal Plane	Level (m AHD)	Level m (CD)
HAT (Highest Astronomical Tide)	0.9	1.9
MHWS (Mean High Water Springs)	0.6	1.6
MHWN (Mean High Water Neaps)	0.3	1.3
MSL (Mean Sea Level)	0	1.0
MLWN (Mean Low Water Neaps)	-0.3	0.7
MLWS (Mean Low Water Springs)	-0.6	0.4
LAT (Lowest Astronomical Tide)	-1.0	0

Water levels are further elevated above the astronomical tide levels by meteorological effects, termed ‘storm surge’, and sea level rise. The combined peak water level, termed ‘storm tide’ has been predicted by CSIRO (2009) based on the IPCC’s A1F1 scenario with 0.82m sea level rise by 2100 and an 19% increase in wind speed within Bass Strait (Table 2.3). This is consistent with the Victorian Marine and Coastal Policy (VMACP) requirement for planning for 0.8m sea level rise by 2100.

Table 2.3 Predicted Storm Tide at Point Lonsdale (mAHD) (source: CSIRO 2009)

Average Recurrence Interval (years)	2030	2070	2100
10	1.33	1.77	2.22
20	1.45	1.9	2.37
50	1.56	1.99	2.44
100	1.62	2.07	2.53

The estimated SLR adopted for this study is shown in Table xx and is based on the predictions shown on the Coast Adapt website (https://www.coastadapt.com.au/).

Table 2.4 Estimated SLR

Year	Estimated SLR (m)
2030	0.05
2050	0.25
2070	0.45
2100	0.8

2.2.3 Currents

Very strong tidal currents occur in 'The Rip' as the wide expanse of Port Phillip Bay meets the waters of Bass Strait in an entrance that is just over 3 km wide. Spring tide currents in the inner part off The Rip offshore of Dog Beach reach 2m/s on the flood tide and 1.5m/s on the ebb tide (Advisian, 2016)

2.2.4 Waves

Dog Beach is exposed to relatively small wind waves formed in the southern part of Port Phillip Bay and much larger swell waves from Bass Strait the enter the Bay through the narrow entrance of The Rip. Wave energy reaching the beach is thus concentrated in a very narrow directional band. The tidal currents also modify swell waves as they pass through The Rip and can completely block the wave propagation at peak ebb flow.

Figure 2.3 shows the wave data extracted from a 27-year hindcast across PPB from a SCHISM wave-flow model (Jak McCarroll, 2021). The data is for the node closest to Dog Beach which experiences a swell dominated, medium energy wave climate. The mean significant wave height (Hs) is 1.0m and the average peak period (Tp) is 12.5s. The mean wave direction is southerly (178°). There is an annual oscillation, with longer period waves in winter

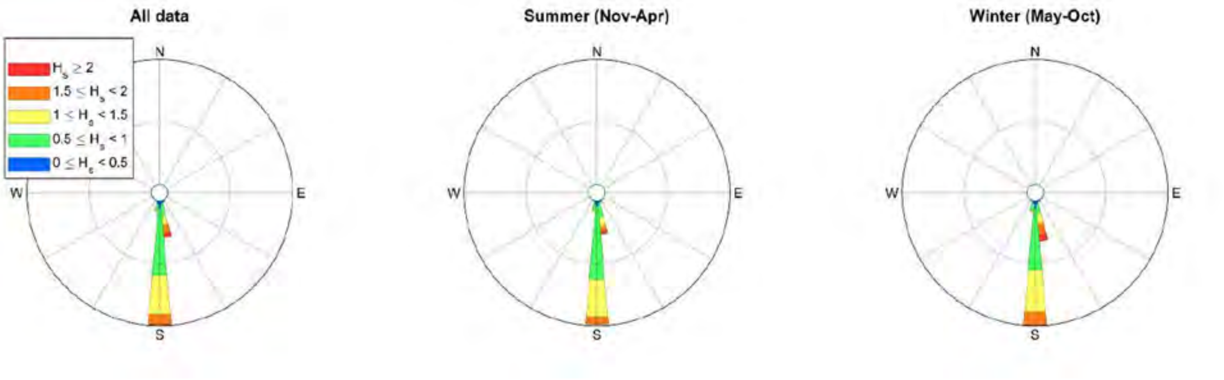

Figure 2.3 Wave climate at Dog Beach, from a SCHISM wave-flow model (Huy Tran, Melbourne University)

2.2.5 Sediment Transport

The sediment transport processes of the entrance to Port Phillip have been the subject of many previous studies, which are described and synthesised in detail in BMT WBM (2007) and summarised here.

There is a net sediment transport from Bass Strait into Port Phillip Bay. Sediment moves eastward along the coast and seafloor under the influence of south westerly swell waves, at an estimated annual rate of 400,000 m^3/yr. When it reached Point Lonsdale approximately half is taken offshore by the ebb tide towards Rip Bank, and the other half is carried into Lonsdale Bight by the flood tide.

Sediment transport within Lonsdale Bight is driven primarily by tidal currents and swell waves entering the Bay through The Rip. These conditions drive a large flow of approximately 100k m^3/yr. of sediment across the seafloor into the Bay and another 80,000 to 100,000 m^3/yr. moves along the beach towards Queenscliff.

Ultimately this sediment is deposited in the Great Sands, an area of sand banks stretching across the southern part of the Bay from St Leonards to Rosebud.

Figure 2.4 illustrates this sediment transport, through the Rip and in Lonsdale Bight

The flow of sand is not constant, varying with time and seasons, and linked to variations in the wave climate of Bass Strait. The movement of sand, known as ‘along-shore’ or ‘longshore’ transport, is the dominant coastal process affecting Lonsdale Bight and Dog Beach. At Dog Beach the along-shore transport is thought to be unidirectional – always towards the east – because it is driven by swell waves which approach the beach from a constant direction.

The along-shore transport drives natural variation on the beaches of Lonsdale Bight, including Dog Beach. When a lot of sand is arriving the beaches ‘accrete’ (gain sand to become wider and higher), and when there is less sand arriving the beaches and dunes erode.

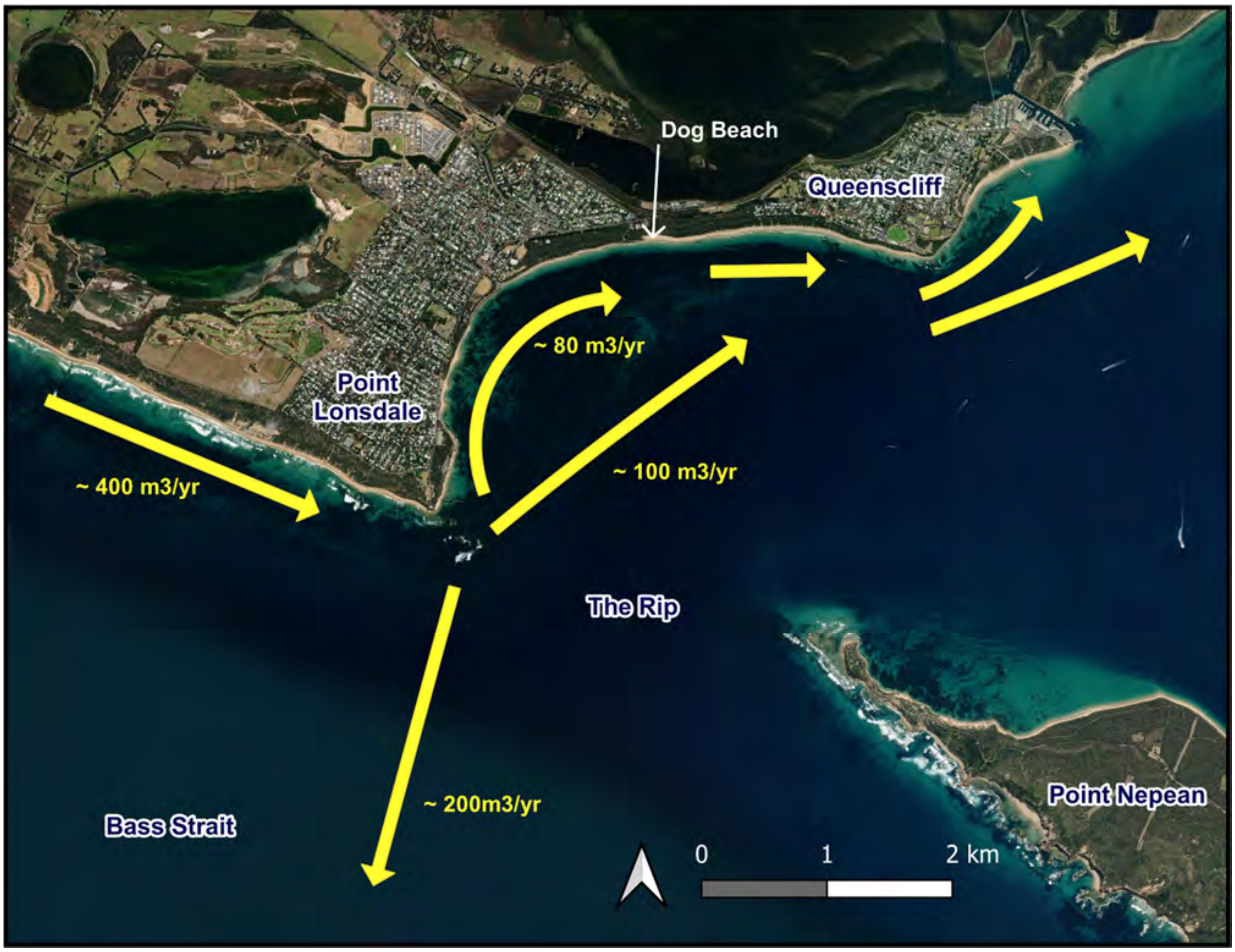

Figure 2.4 Sediment transport around Lonsdale Bight

Erosion of the dunes also contributes sediment to the beach. When storms, or along-shore transport, remove sand from the beach, the dune erodes, adding sand to the beach to make up the deficit. At other times, waves move sand onto the beach and wind blows the sand up onto the dune, reversing the process. In the long term, dune erosion allows the beach to migrate landwards in response to sediment loss, while preserving the width of the beach.

The beach in front of the seawall to the west is much narrower than Dog Beach and is usually completely submerged from mid to high tide. As the seawall protects the dune in this area, it cannot contribute sand to the beach and the beach cannot move landward in response to the sediment loss.

The erosion of the dune is a natural mechanism that helps maintain the beach, but it can also create a high and unstable dune face. When this happens the dune face needs to be managed as it can be hazardous to anyone who tries to climb it.

2.2.6 Storm Demand

Storm demand is the volume of erosion (m^3/m) that occurs in major storm event, measured as an area change in the shore profile above mean sea level (0m AHD). Typically, this sand is eroded from the beach and dune and settles in a near-shore sand bar. After the storm this sand will be slowly moved back onto the beach by lower waves.

The Antarctic Climate and Ecosystems Cooperative Research Centre (ACE-CRC) commissioned the Water Research Laboratory (WRL), to provide "Generic Design Coastal Erosion Volumes and Setbacks for Australia" which included values for storm demand. Although Dog Beach is not a specific study site in the analysis, they do determine suggested design values for coastal Port Phillip Bay Coast and for the Lonsdale to Lorne coast (Table 2.5).

Although Dog Beach is on the Port Phillip Coast it is close to the heads and can be exposed to swell waves coming through the heads. It is therefore unlikely that the suggested Port Phillip Bay Coast volumes are realistic for the Dog Beach study site. Similarly, the Lonsdale to Lorne coast is more exposed than Dog Beach and as such we assume a value of 100m^3/m for this study.

Table 2.5 Suggested design erosion volumes based on 2x 100 year ARI storm (WRL, 2012)

Regional Coast	Suggested design volume (m^3/m above AHD)
Port Phillip Bay Coast	20
Lonsdale to Lorne Coast	150

2.2.7 Terminal Scour

'Terminal scour' or 'end scour' is a phenomenon associated with seawalls, or any hard structure built along the beach, where increased erosion occurs at the ends of the structure and in particular the 'down drift' end, which is the downstream end for alongshore sediment transport. Terminal scour is caused by wave reflections and increased turbulence at the ends of the structure as well as reduced sediment supply because the wall prevents the dune eroding and providing sediment to the beach down-drift.

The Water Research Laboratory (WRL 2013) examined the potential for seawalls and coastal protection structures to impact on the surrounding beaches. Although it is expected that different construction types, such as slope angle are likely to cause differing impacts, for the study they assume all seawalls act in a similar manner and using methods that originated from McDougal et al (1987), developed and empirical formulae for predicting the extent of terminal scour.

Figure 2.5 shows the expected shape of a terminal scour, where

Ls = alongshore length of structure (m)

S = alongshore impact distance = 100 + 0.6Ls (with a maximum cap of 400m)

e = storm cut (m) from a storm demand 'SD' (m^3/m)

r = additional erosion (m) in the impact area from storm demand AE = (1-NDV) * SD (m^3/m)

where NDV = non dimensional volume (seaward of the wall above AHD)

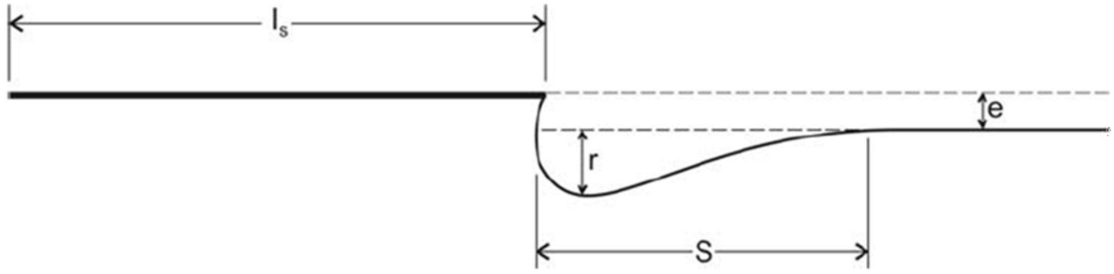

Figure 2.5 Technique for assessing the impact of a seawall, Water Research Laboratory (2013)

Using the Water Research Laboratory method, applied to Dog Beach, the theoretical maximum scour will have an alongshore length (S) of 400m.The storm demand, SD is 100m^3/m (see section 2.2.6). Assuming NDV = 0 as there is little to no beach in front of the seawall, AE = SD = 100m^3/m.

To calculate the total depth of the scour bight (r + e), we adopted the methods of Nielson et al. (1992) to derive the distance and dune profile.

Figure 2.6 shows the predicted scour profile using the WRL method compared the existing dune profile and estimated dune profile without the terminal scour. The shape of the calculated scour bight is further shown in Figure 2.7

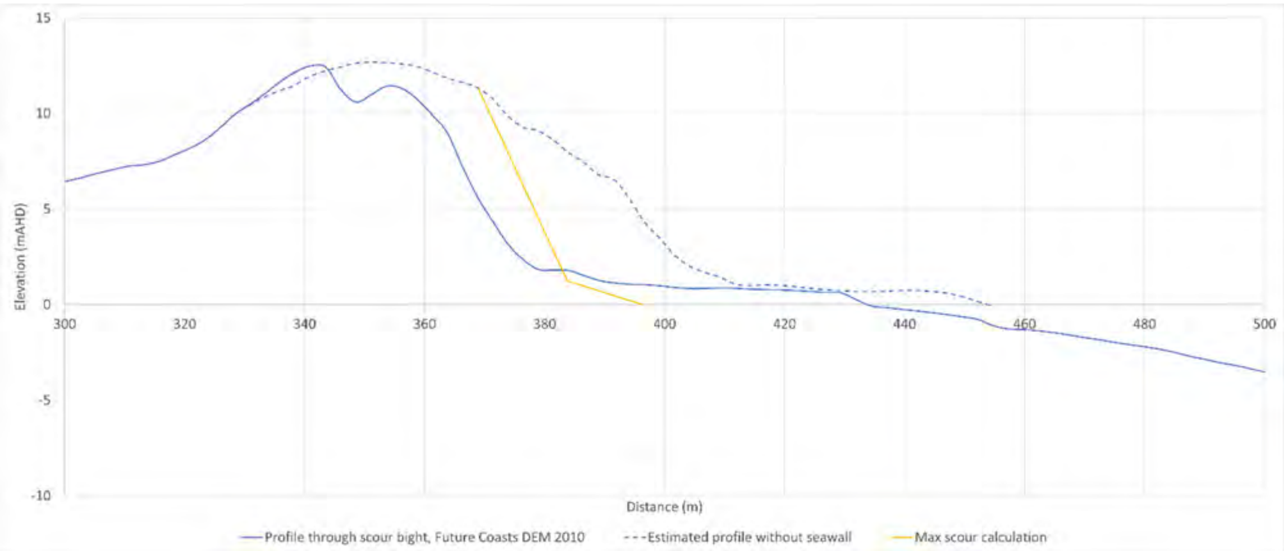

Figure 2.6 Dune Profile from Swan Bay through the scour bight and across Dog Beach.

Figure 2.7 Predicted Terminal Scour by WRL method

The shape of the predicted terminal scour bight shown in Figure 2.5 is similar to the scour evident at Dog Beach, although the predicted along-shore extent is somewhat longer, and the cross-shore prediction is somewhat less than the actual scour.

2.3 Erosion Hazard

The erosion hazard zone is the area that may be impacted by storm erosion, either by direct wave impact by waves during the storm, or the subsequent slumping of the dune face after the storm has passed. This zone expands with time due to sea level rise and ongoing recession.

This study has mapped hazard lines which represent the predicted landward limit of the erosion hazard zone. The current and future position of the hazard lines has been calculated considering three components:

1. Recession due to the net sediment loss
2. Storm erosion (also known as storm bight)
3. Recession due to sea level rise

2.3.1 Recession due to Net Sediment Loss.

A major cause long-term coastal recession is sediment deficit, or net sediment loss. A sediment deficit occurs on a beach when there is more sand being removed from the area, by the coastal process, than is being returned (e.g., through along-shore transport). Although the shoreline position often fluctuates on shorter time scales (e.g., seasonally), a sediment deficit causes long term recession.

At Dog Beach, the net sediment transport is from the southwest towards the northeast. The existing sea wall restricts the volume of sand being delivered from the southwest to the beach, as there is little to no beach in front of the wall and this causes the deficit, which in turn causes the beach and subsequently the dune system to erode. The result is shoreline recession at the end of the wall causing the terminal scour bight and the overall shape shown above in Figure 2.5.

The shoreline recession can be identified through a variety of methods including the comparison of aerial imagery, analysis of survey data and analysis of the geomorphological context of a site.

An estimate of recession due to sediment loss at Dog Beach has been calculated using aerial photos from 1960 to 2022. Four transect lines, shown in Figure 2.8, were used to compare the changes in the dune toe and crest to calculate the average rate of retreat of the dune.

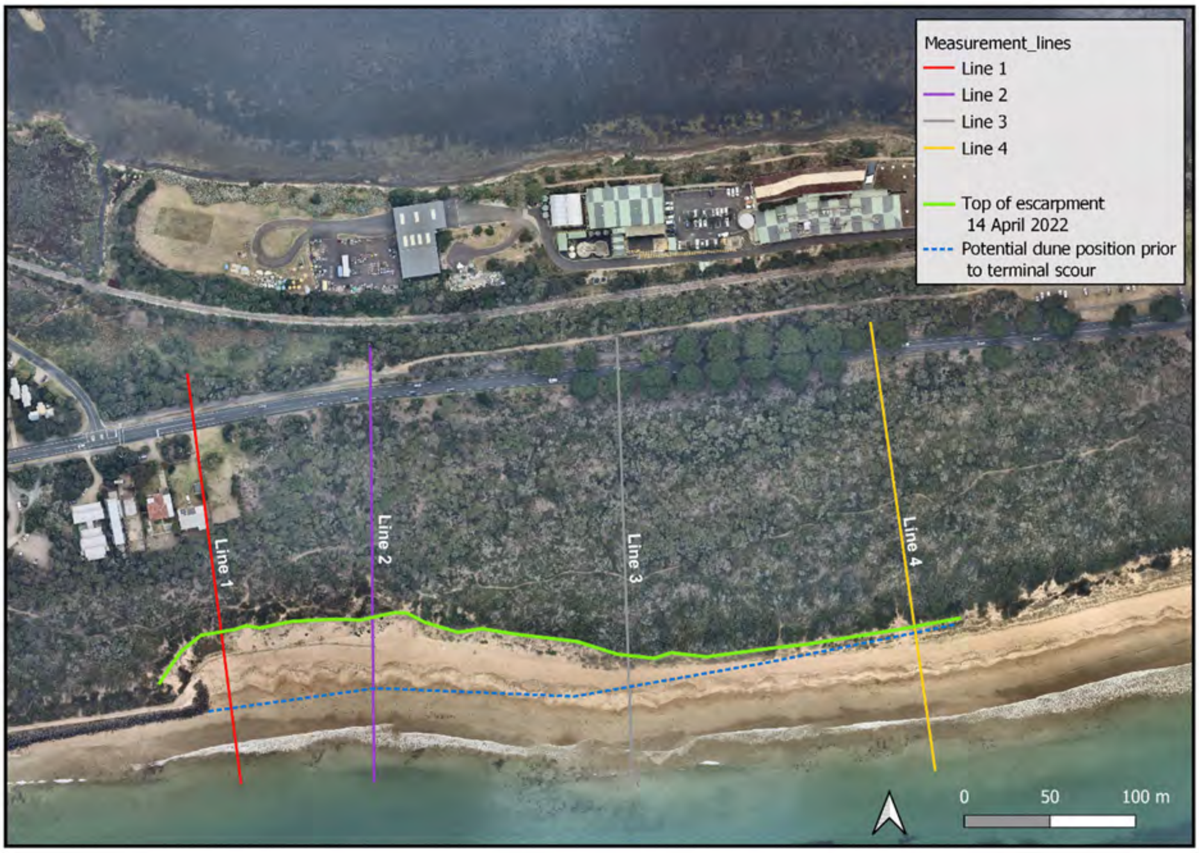

Figure 2.8 Location of measurement lines used to calculate recession

After completion of the seawall in 1977, there was initially a very rapid rate of erosion for a couple of years then from around 1980 to 2000, the rate reduced (Figure 2.9). There is some evidence that the rate of erosion may have reduced even further after 2000 and the terminal scour may be reaching an equilibrium condition with little ongoing recession. Figure 2.9 shows that since 2010, there has been relatively small changes in most areas (all measured transects except line 2), and since 2016 all measured areas are showing small changes indicating that the equilibrium point may have been achieved.

To calculate the future position of the coast we have taken a conservative approach and assumed that even though the data shows signs of reaching equilibrium, the long-term recession rate will continue. Even if the terminal scour is currently stable, there is a good chance that sea level rise will reactivate it, with increased water depths and wave heights increasing sediment transport and storm erosion.

The long-term recession rate from 1980 to 2022 are shown in Figure 2.9. The rate is highest in the terminal scour area (lines 1 and 2) with the dune crest moving landward at an average rate of approximately 0.7 meters per year. Further along the beach (line 3) the rate reduces to around 0.4 m/y and at line 4, past the influence of the seawall, the rate of retreat is only 0.07m/y. Taking the conservative approach, we use these long-term recession rates to calculate the worst-case future position of the coast, however if an equilibrium has been reached these rates will be much closer to zero.

This equates to an average net sediment loss of approximately 1,200m^3 per year.

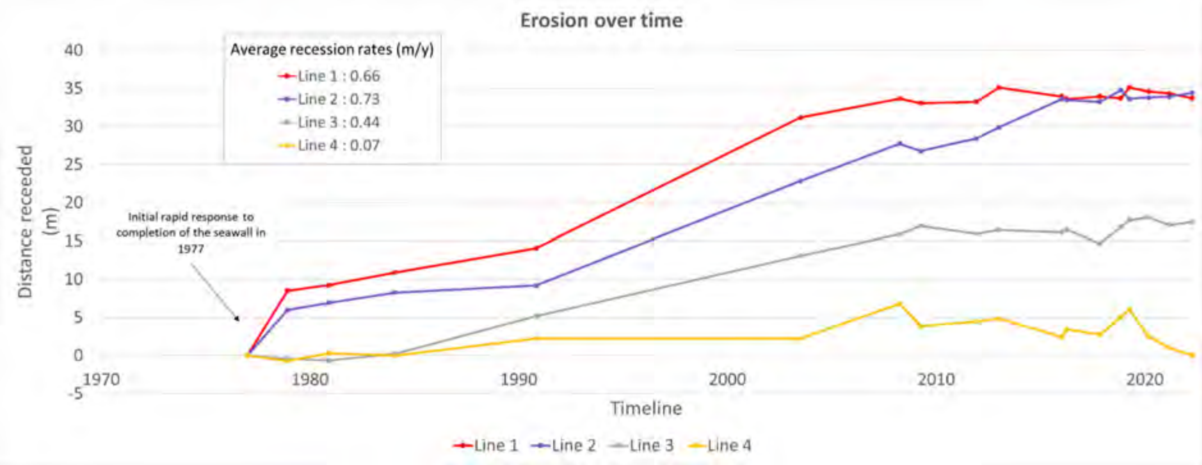

Figure 2.9 Graph showing the recession of the dune toe from 1977 to 2022

2.3.2 Storm Erosion (Storm Bight)

There are no available surveys taken directly before and after a storm which allow us to quantify the storm bite for a single extreme storm at Dog Beach. A review of the four years of VCMP drone surveys show that one recent minor storm event (13-17 May 2021) was captured but it had no impact on the dune face, only lowering the beach (Figure 2.8).

For calculating the erosion hazard we have used a storm demand of 100m^3/m, resulting from 2 x 100yr ARI storms (see section 2.2.6). Assuming an average dune height of 12m, gives an estimated storm cut of 8m.

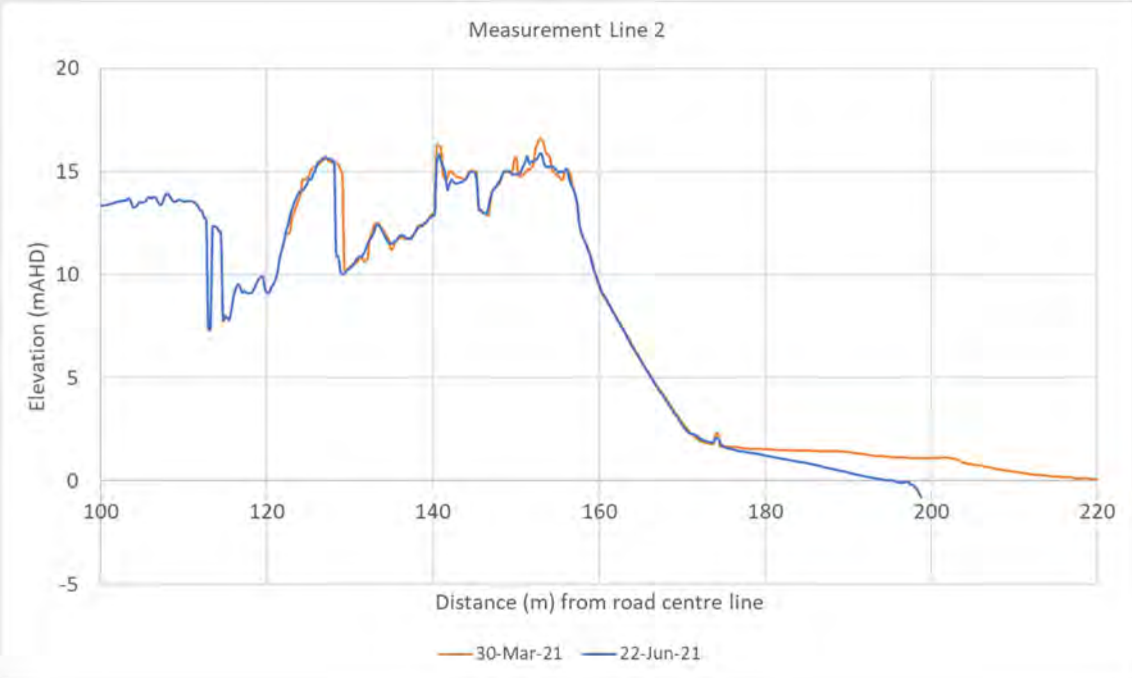

Figure 2.10 Dune and beach profile before and after a storm event, VCMP drone survey data

2.3.3 Recession due to Sea Level Rise

Coastal recession can also occur due to sea level rise (SLR) as rising sea levels increase the depth of water close to the beach which allows larger waves to reach the shore.

Recession caused by SLR is inherently difficult to predict due to fine scale variability of the beach structure, e.g., sediment types, the presence (or absence) of underlying rock and/or coastal protection structures. As such, any prediction of shoreline retreat due to SLR has a high degree of uncertainty.

To assess the likely extent of shoreline retreat due to SLR, at Dog Beach, we use the Brunn rule to calculate a recession rate (distance (m) of recession per metre of SLR). The Brunn rule assumes the beach profile is in equilibrium with the water level and will rise as the sea level rises. For this to occur, the beach profile must also shift landward due to the finite volume of sediment available. This landward movement may be halted or slowed by erosion resistant material, however we have conservatively assumed that the dune at Dog Beach is entirely formed of sand and therefore exclude the potential for this landward movement to halt.

The Brunn rule calculates recession as the product of SLR and the shoreline slope. In this study, the slope was calculated from the height of wave runup to the nearshore rock outcrops, yielding a shoreline slope of 1 in 30, which means 30 m recession per 1m of SLR. Note that the full height of the dune was excluded from the calculation as this is a wind-built feature which is decoupled from water levels and waves processes.

Table 2.6 Estimated recession due to SLR at a rate of 30m/1m SLR

Year	Estimated SLR (m)	Recession due to SLR (m)
2030	0.05	1.5
2050	0.25	7.5

Year	Estimated SLR (m)	Recession due to SLR (m)
2070	0.45	13.5
2100	0.8	24

2.3.4 Predicted Erosion hazard Lines

The erosion hazard zones for Dog Beach were calculated by combining the estimates of coastal recession due to sediment loss, storm erosion, and coastal recession due to sea level rise as summarized in Table 2.2. This enabled estimation and mapping of the possible (or worst case) locations of the erosion hazard zone under various SLR scenarios.

Table 2.7 Estimated future recession (m)

	Recession due to sediment loss (m)				Recession due to storm bight	Recession due to SLR	Total estimated recession (m)			
Year	Line 1	Line 2	Line 3	Line 4			Line 1	Line 2	Line 3	Line 4
2030	5	6	3	1	8	2	15	16	13	11
2050	18	20	12	2	8	8	34	36	28	18
2070	31.	35	21	4	8	14	53	57	43	26
2100	51	57	34	6	8	24	83	89	66	38

The forecast hazard lines mapped in Figure 2.11 are based on the following assumptions:

1. The dune is entirely formed of sand.

   This is a conservative (worst case) assumption. A geotechnical study would be required to confirm if the dune is entirely sand or if any other harder substrate is present that could limit erosion.

2. The terminal scour has not reached a point of equilibrium or max size.

   This assumption is also conservative (worst case) and assumes that terminal scour erosion will continue to occur.

The calculated recession, summarised in Table 2.7, has been applied to the current dune crest to calculate the potential worst case future hazard zones in Figure 2.11. The lines shown in Figure 2.11 are calculated and drawn to see where the worst case recession extends to so that management plans and trigger points can then be determined (see sections 3, 4 and 5).

Note the 2100 hazard zone has not been drawn as there is too much uncertainty about the rate of recession and the shape of the terminal scour bight this far in the future to make a credible prediction. However, the adaptation pathway can be defined to 2100 and beyond, as the actions are only implemented if the erosion risk eventuates (refer section 4).

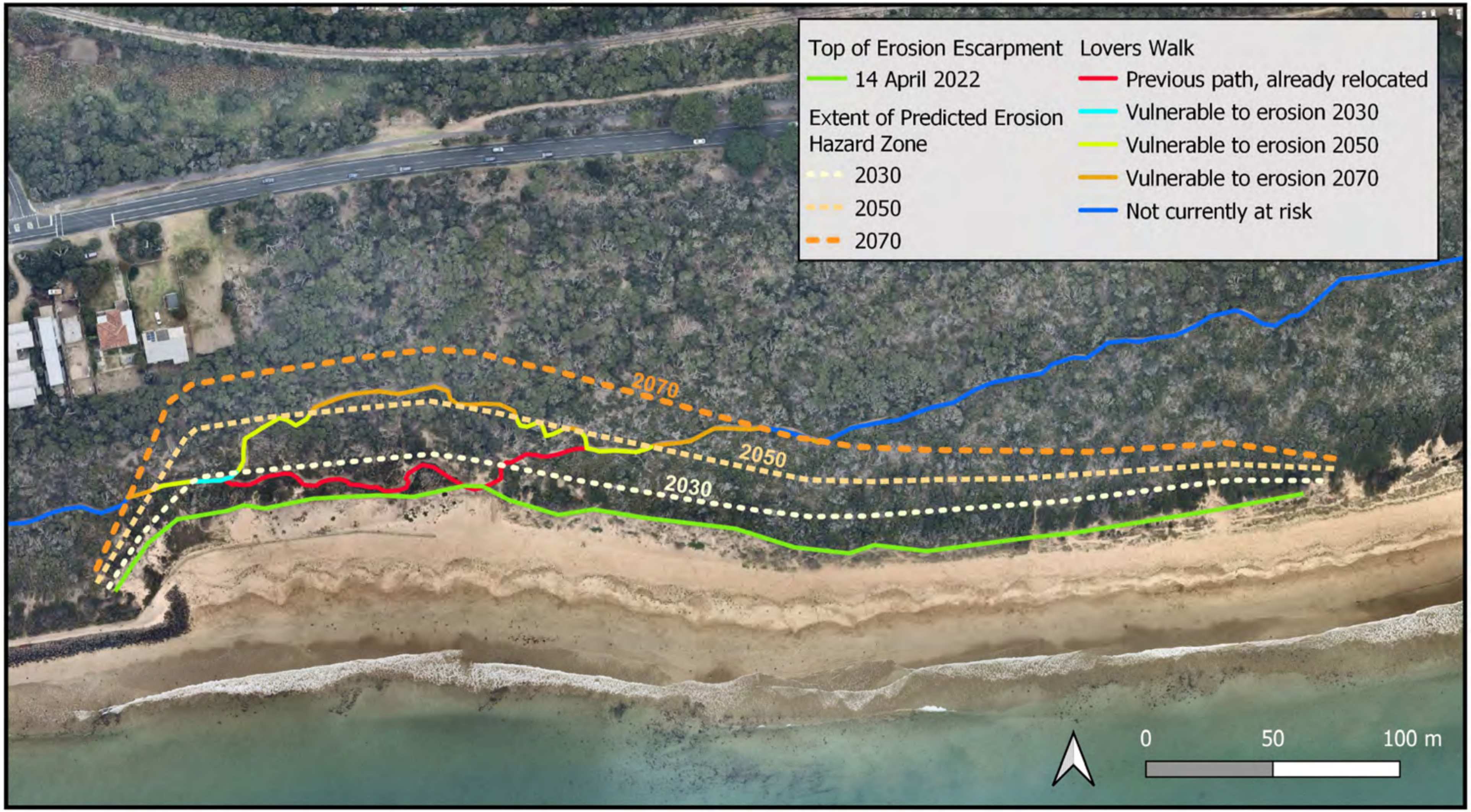

Figure 2.11 Estimated erosion hazard zones for 2030, 2050 and 2070.

2.4 Vulnerability

2.4.1 Beach Access and Walking Path

Lovers Walk

The dune-top walking path has previously been impacted by erosion with a section of approximately 163 m of the path being relocated further landward (see Figure 1.2 and Figure 2.11). As the terminal scour and erosion scarp recedes further into the dune, additional sections of the path will be at risk from erosion if no action is taken. The areas at risk, under the worst case erosion predictions are shown in Figure 2.11, with the lengths of the path vulnerable to erosion, should erosion continue with no mitigating action detailed in Table 2.8.

Table 2.8 Lovers Walk, walking path erosion vulnerability

Timeframe	Predicted length of walking path vulnerable to erosion (m)
Current	0
2030	18
2050	138 (total across 3 sections)
2070	295 (inclusive of sections vulnerable at 2050)
2100	Unknown

Beach access

The main access to the beach is from the ramp at the end of the of the seawall. From the aerial imagery it is believed the ramp was constructed in its existing concrete form between 2006 and 2008. Currently when beach levels are low the end of the ramp is exposed, sometimes causing a large step down to the beach. Beach levels will continue to fluctuate in this dynamic setting, and the average hight of the beach at the ramp may reduce with ongoing recession making access difficult. Figure 2.12 shows the access ramp on the morning of the site visit, 18 March 2022, when beach levels were not considered to be exceptionally low.

Figure 2.12 Beach access ramp on 18 March 2022

2.4.2 Recreational use

Recreational use, especially for dog walking was raised as the main community value of the beach. As the erosion continues the beach will move landward but should maintain its wide, flat character. The retreating dune face will likely remain steep and unstable, presenting a hazard to public safety if people try to climb or dig into the dune, as per the current situation.

2.4.3 Natural Environment

The natural look and feel of the beach and surrounds are highly valued by the community. Beach fluctuations and a retreating shoreline are natural coastal process and as erosion continues and the beach moves landward it should maintain its wide, flat, and natural character. Although the retreating dune face will likely remain steep and unstable, it will retain its natural feel.

2.4.4 Cultural Heritage

The Aboriginal Cultural Heritage Register and Information System (ACHRIS) has no specific registered sites within the study area, but Dog Beach is located in an overall area of cultural sensitivity. Continuation of the erosion will move the beach and dune landward in this culturally sensitive area, but no registered sites will be vulnerable to the erosion.

2.4.5 Built assets

Road

The predicted but worst-case erosion hazard lines for 2030, 2050 and 2070 do not recede into the dune far enough to reach the road, so there is no imminent risk to this asset. However, erosion to 2100 beyond is very unclear at which point it is possible that at some stage the road could be impacted.

Private property

Although private property is not the responsibility of DELWP, we include it here for completeness. As with the road, the erosion hazard lines for 2030, 2050 and 2070 do not reach private properties (see Figure 2.11). The erosion hazard zone by 2070 is approximately 20m from private property.

3 Adaptation Measures Assessment

This study has considered a range of options in accordance with the hierarchy of responses set out in the Victorian Marine and coastal Policy 2020 (VMACP). Chapter six of the policy is specific to managing coastal hazard risk and policy 6.7 states:

- Take a pathway approach to planning that:
  a. assesses the full range of available adaptation actions in order of: non-intervention, avoid, nature-based methods, accommodate, retreat, and protect.
  b. assesses costs, effectiveness, benefits, impacts (direct, cumulative and synergistic) and path-dependency adaptation actions.

Although the policy lists the hierarchical order that adaptation actions should be considered, it has not been possible at Dog Beach to identify an adaptation measure within all the possible categories. Table 3.1 lists the identified and considered adaption measures, in order of the hierarchy as detailed in policy 6.7a of the VMACP.

Table 3.1 Adaptation measures with respect to the VMACP hierarchy

VMACP order of consideration	Adaptation Measure
Non-Intervention	Minimum Intervention with Increased Public Safety
Avoid	N/A
Nature-Based Methods	Dune Management
Accommodate	N/A
Retreat	N/A
Protect	Beach Nourishment Groynes Rock Revetment Seawall Offshore Breakwater

Note: N/A is listed where an appropriate adaptation measure has not been identified for the VMACP hierarchical category

To assess each measure (in accordance with VMACP policy 6,7b), each item will be rated on a scale of strongly positive to strongly negative as detailed in Table 3.2. These ratings, although applied to each assessment for each option are applied relatively to the other adaptation measures.

Table 3.2 Assessment scale

Scale	Description	Example
Strongly negative	The overall outcome is highly undesirable	Risk to public safety is drastically increased
Negative	The overall outcome is undesirable	Risk to public safety is increased
Neutral	The overall outcome is neither desirable nor undesirable	Risk to public safety is not significantly changed

Scale	Description	Example
Positive	The overall outcome is desirable	Risk to public safety is reduced
Strongly Positive	The overall outcome is highly undesirable	Risk to public safety has been significantly reduced or removed

3.1 Option1 - Minimum Intervention with Increased Public Safety

The 'minimum intervention required to increase public safety' option consists of:

- Extending the sand fencing to discourage access to the dune face
- Install signage advising the dangers of climbing on the dune
- Extending the access ramp to prevent the end being exposed during low sand levels
- Relocating sections of the footpath when necessary.

The Minimum Intervention option, shown in Table 3.1 and Figure 3.1 is a 'Non-Intervention' approach in terms of the VMACP hierarchy. It does nothing to address long-term erosion, but instead focuses on managing public safety. It is a low-cost option and is imminently feasible. Although this option may not be suitable forever, it is the preferred option whilst no public assets are at risk.

As erosion removes sand from the bottom of the dune, the dune face becomes unstable and mat slip, causing a risk to those who try to climb on it. Reducing access to the dune face with fencing and signage reduces the risk. Fencing and signage are both quick to construct and have low capital costs but do require ongoing maintenance.

The sand levels on the beach naturally fluctuate and when the levels are low the end of the access ramp is exposed and can have a large step down to the beach, causing a hazard to users. Extending the access ramp so that it reaches the beach, and the end is not exposed when sand levels are low would allow for the natural fluctuations to continue whilst removing the safety hazard. Extending the ramp is relatively quick to construct with relatively low capital costs and should require minimal ongoing maintenance.

Based on the worst-case erosion predictions, sections of the Lovers Walk will be within the erosion hazard zone by 2030 (see Figure 2.11 and Table 2.8). To maintain the use of the Lovers Walk, walking path, landward realignment of the path (an example is shown in Figure 3.1) would need to commence when the erosion escarpment is 8 metres (potential storm bight) from the path.

To implement this option including the sections of the Lovers Walk that are potentially vulnerable by 2030 is estimated to cost in the range of $75,000 to $120,000.

This option retains the beach amenity and access whilst keeping the natural look and feel of the beach, as valued by the community, and manages the risk to people's safety. As such this option is recommended for Dog Beach as an initial approach to reduce risks and hazards and should be effective for at least 50 years.

Figure 3.1 Diagram of Option 1 – Minimal Intervention with Increased Public Safety

Table 3.3 Assessment of Option 1 - Minimal Intervention with Increased Public Safety

VMACP policy 6.7b	Assessment Criteria	Comment
Costs	Capital cost and constructability	Strongly Positive – The is low capital cost and can be constructed quickly.
	Ongoing maintenance	Neutral – Fencing and signage would need maintaining, and the path relocated at times, but this is relatively low cost.
Effectiveness	Public safety	Positive – Public safety would be improved but fencing and signage is unlikely to fully prevent people climbing on the dune.
	Manage erosion risks	Negative – Erosion would continue to impact the beach and sand dune, however this will not impact on built assets for at least 50 years.
Benefits	Beach use, access, amenity	Strongly Positive – The beach will remain a wide, accessible beach with natural character.
Impacts (direct, cumulative and synergistic)	Impacts	Strongly Positive – This option has minimal impact on the environment and coastal processes in surrounding area.
Path-dependency adaptation actions	Path dependency	Strongly Positive – This option does not prevent any other options being implemented at a later stage
	Community Feedback	this option was the preferred approach, supported by the majority of respondents.

3.2 Option 2 – Dune Management

The Dune Management option involves reshaping/reprofiling the seaward face of the dune to increase stability and then re-vegetating it. An example of dune management using coir logs and planted coastal grasses at Marengo in 2017 is shown in Figure 3.2.

The Dune Management option is a 'Nature-Based Method' in terms of the VMACP hierarchy. It does not address long-term erosion but focuses on managing public safety with regard to dune stability. It is a relatively low capital cost option but requires ongoing maintenance and a previous attempt at this site in the 1990s was not successful.

By itself dune management would not be effective at preventing dune retreat at Dog Beach because the coastal processes remove more sand from the beach than arrives, eating into the dune toe and causing the face to collapse, regardless of the slope or vegetation. As such this option is not recommended in isolation at Dog Beach and does not have a trigger point to consider this option. However, this option could be used in combination with other options, which prevent further sediment loss, such as beach nourishment, groynes, rock revetment or offshore reefs.

To implement this option is estimated to cost in the range of $75,000 to $150,000 assuming that much of the revegetation planting would be carried out by volunteers under supervision.

This option retains the beach amenity and access whilst keeping the natural look and feel of the beach, as valued by the community, however if applied in isolation this option does not manage the existing the risk to people's safety.

Figure 3.2 An example of dune management techniques using coir logs and planted coastal grasses, Marengo 2017

Table 3.4 Assessment of Option 2 - Dune management

VMACP policy 6.7b	Assessment Criteria	Comment
Costs	Capital cost and constructability	Positive – There is relatively low capital cost and can be implemented relatively quickly
	Ongoing maintenance	Negative – The dune management would require ongoing maintenance as erosion continues to occur.
Effectiveness	Public safety	Negative – The steep and unstable erosion scarp will re-form.
	Manage erosion risks	Negative – By itself dune management would not stop erosion at Dog Beach, and existing risks would remain.
Benefits	Beach use, access, amenity	Positive – The beach will remain a wide, accessible beach with natural character.
Impacts (direct, cumulative and synergistic)	Impacts	Positive – This option will have little impact on coastal processes impacting surrounding areas but will change the shape of the dune face
Path-dependency adaptation actions	Path dependency	Positive – This option does not prevent other options being implemented at a later stage although if unsuccessful may influence when the walking path is vulnerable
	Community Feedback	Dune Management was not well supported

3.3 Option 3 – Beach Nourishment

The Beach Nourishment option involves bringing sand to Dog Beach to replace sand that has been removed by coastal processes. The amount of sediment removed by the coastal processes is likely to be different each year however the long-term recession rates from 1980 to 2022, equate to an average net sediment loss of approximately 1,200m^3 per year. The Beach Nourishment option is a 'Protect' approach in terms of the VMACP hierarchy. It aims to stop the long-term recession by replacing the removed sand whilst allowing the natural processes to continue. There are no suitable areas for the extraction of sand from the beach or seabed between Pt Lonsdale and Shortland Bluff, so sand would need to be brought in by road, from an alternative location with a suitable source of sand, such as Queenscliff Harbour, making this a relatively high cost option, with impact on the local community with trucks moving through the town. The option also requires ongoing maintenance, as sand nourishment would need to be repeated regularly.

To implement this option is estimated to cost in the range of $50,000 to $75,000 per year.

This option retains the beach amenity and access whilst keeping the natural look and feel of the beach, as valued by the community, however, beach access and use will be severely disrupted during the nourishments. Additionally nourishing the beach to stop further recession will reduce further instability of the dune face but does not necessarily manage the existing risk to people's safety.

This approach can be effective for as long as the monitoring and maintenance is continued but the wave action will continue to carry the sand along shore recreating the scour bight, meaning that nourishment will need to be continued repeatedly. This option in one of three options that could be considered long term at Dog Beach and the trigger point for this decision is when the erosion scarp is within 20m of a built asset.

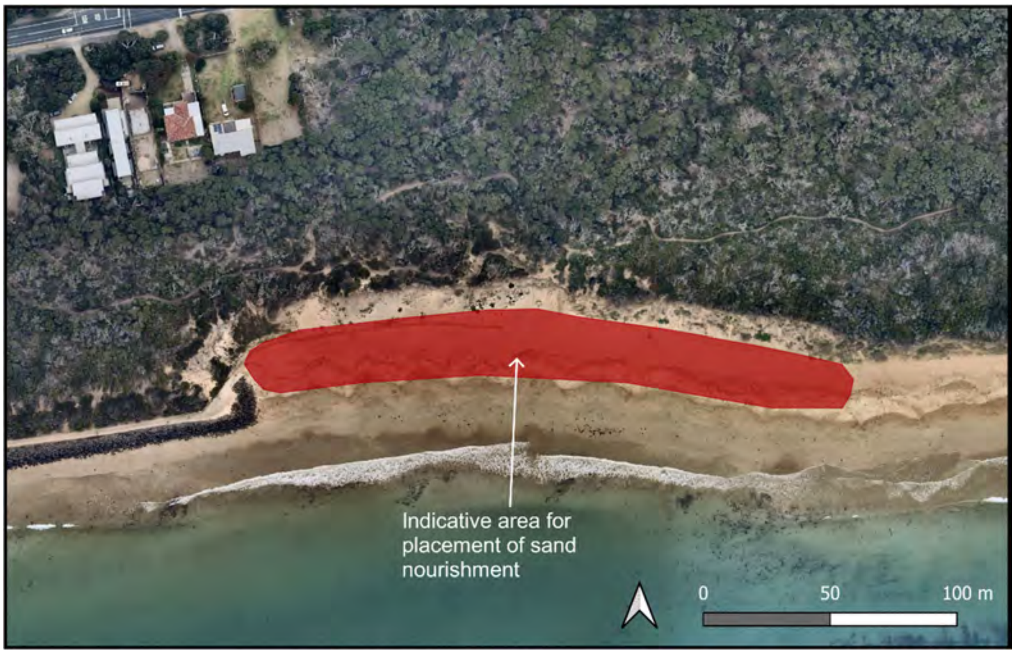

Figure 3.3 Diagram of Option 3 - Beach Nourishment

Table 3.5 Assessment of Option 3 - Beach Nourishment

VMACP policy 6.7b	Assessment Criteria	Comment
Cost	Capital cost and constructability	Negative – Beach nourishment has a relatively high capital cost as sand will need to be sourced and brought to Dog Beach by road.
	Ongoing maintenance	Strongly Negative – Beach nourishment at Dog Beach will need to be repeated regularly. Sea level rise may increase the frequency of required nourishment in the long term.
Effectiveness	Public safety	Positive – Nourishing the beach will stop the dune receding and allow the dune face to stabilise over time.
	Manage erosion risks	Positive – Although erosion will continue, Beach Nourishment will replace the sand eroded so that the dune does not recede further.
Benefits	Beach use, access, amenity	Neutral – This option retains the wide, open beach and natural character,

VMACP policy 6.7b	Assessment Criteria	Comment
		however there is significant disruption associated with the sand carting works.
Impacts (direct, cumulative and synergistic)	Impacts	Strongly Positive – Beach Nourishment stops the dune receding whilst allowing the natural coastal processes to occur.
Path-dependency adaptation actions	Path dependency	Strongly Positive – This option does not prevent any other options being implemented at a later stage
	Community Feedback	Beach Nourishment was not well supported

3.4 Option 4 – Groynes

The Groyne option involves building a series of three groynes at Dog Beach, including access walkways over the groynes, as well as stabilization and replanting of the dune face.

The Groynes option is a 'Protect' approach in terms of the VMACP hierarchy. It aims to stop the long-term recession by capturing sand in the groyne compartments which would create a wide beach and prevent further erosion dune.

Construction of groynes at Dog Beach should be effective at preventing further erosion of the dune in the area between the groynes only but would result in the development of a new scour bight past the groynes (towards Queenscliff). This is an inevitable consequence of any hard protection option (groynes, revetment, offshore breakwaters) due to the imbalance between sediment transport potential and sediment supply, i.e., the waves are removing more sand from the beach than is arriving.

Additionally, groynes would break the beach up into several compartments, similar to the Point Lonsdale Front Beach, altering its character. This option has a relatively high cost and takes time to plan and construct.

Figure 3.4 shows an indicative diagram of groynes and the potential new scour that would result at Dog Beach. The arrangement of the groynes, in Figure 3.4, is from a proposal submitted by members of the local community.

To implement this option is estimated to cost in the range of $5m to $7m on the assumption that three groynes (see Figure 3.4) are constructed. A single sand nourishment campaign to fill the compartments between the groynes and dune reshaping and revegetation are included in the estimated cost.

This option retains the valued beach access, but the beach would be broken into compartments divided by the groyne structures. As such the natural look and feel, that the community value, would be lost. Additionally, the option would stop further recession, reduce further instability of the dune face and reduce the risk to public safety but it creates an additional safety risk if people were to climb on the rock groyne structures.

This option in one of three options that could be considered long term at Dog Beach and the trigger point for this decision is when the erosion scarp is within 20m of a built asset.

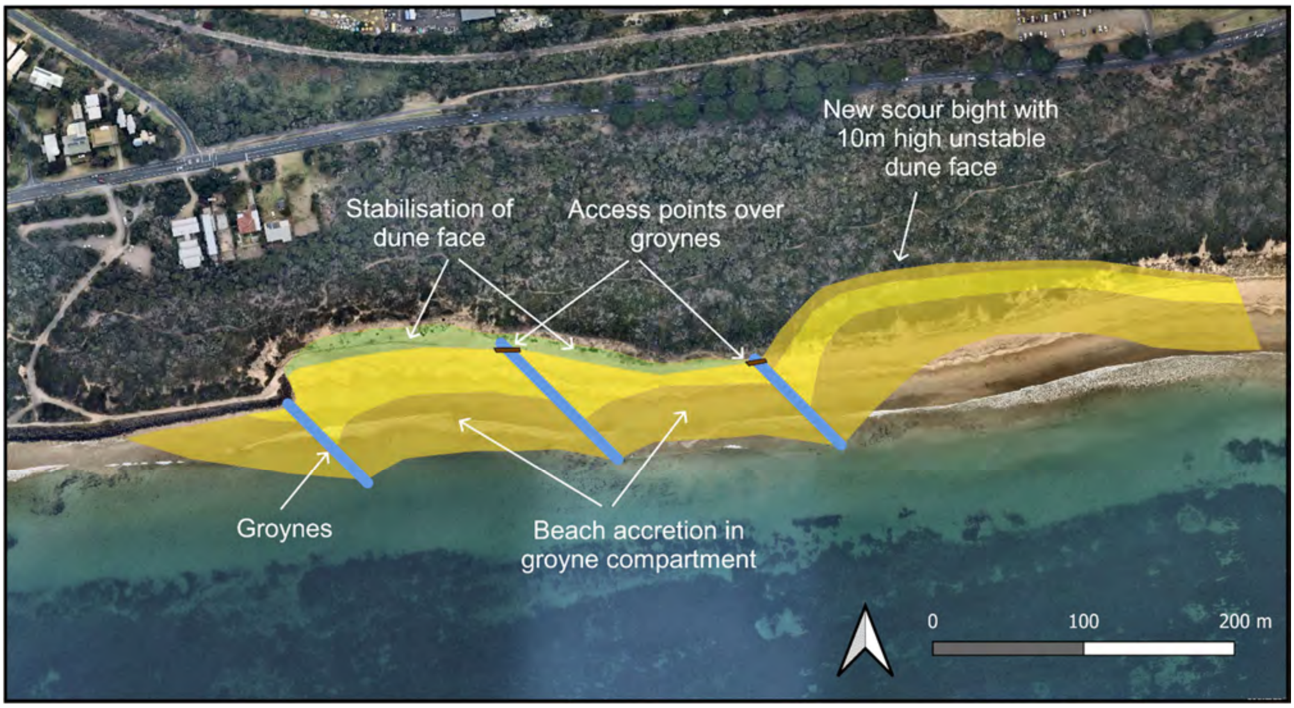

Figure 3.4 Diagram of Option 4 – Groynes

Table 3.6 Assessment of Option 4 - Groynes

VMACP policy 6.7b	Assessment Criteria	Comment
Costs	Capital cost and constructability	Strongly Negative – Groynes have a high capital cost and a relatively long timeframe to design, and construct.
	Ongoing maintenance	Neutral – Rock groynes will require little ongoing maintenance, but sea level rise may make them less effective in the long term
Effectiveness	Public safety	Neutral – The Groyne option simply shifts the erosion problem with hazardous dune face further down the beach
	Manage erosion risks	Positive – This option has been implemented effectively at Point Lonsdale Front Beach. Stabilising the dune reduces the existing erosion risks.
Benefits	Beach use, access, amenity	Neutral - A narrower and compartmentalised beach with reduced area for dog walking but walkways over the groynes allow access between compartments. Groynes alter the natural character of the beach.
Impacts (direct, cumulative and synergistic)	Impacts	Strongly Negative - Groynes will cause further erosion towards Queenscliff.

VMACP policy 6.7b	Assessment Criteria	Comment
Path-dependency adaptation actions	Path dependency	Negative – This option potentially makes beach nourishment harder as the beach will be in separate compartments
	Community Feedback	Groynes received a mix of responses, but majority were against this option.

3.5 Option 5 - Rock Revetment Seawall

The Rock Revetment Seawall option involves extending the existing seawall along the beach to the end of the terminal scour bight.

The Rock Revetment Seawall option is a 'Protect' approach in terms of the VMACP hierarchy. It aims to stop the long-term recession by blocking sand being removed from the beach and dune.

Seawalls are very good at protecting the land behind the wall, but they tend to increase the erosion of the beach in front of the wall, which is demonstrated by the existing seawall between Point Lonsdale and Dog Beach. Extension of the existing seawall (which is a rock revetment type) along the shore would be an effective measure to prevent dune erosion at Dog Beach but the resultant scour in front of the revetment would lower beach levels so that the beach is under water for half the tide (as per the beach in front of the existing revetment). Additionally, the development of a new terminal scour bight in the dune at the end of the new revetment would occur.

To limit the size of the terminal scour, the revetment could be built in stages allowing a pre-determined amount of terminal scour to develop before the next section is constructed, however this would result in a steady reduction in available beach area for recreation.

A rock revetment seawall could be a long-term solution to erosion at Dog Beach, however it would be relatively high cost and take time to plan and construct.

To implement this option is estimated to cost in the range of $5m to $7m on the assumption that the rock revetment is extended approximately 325m along the shore and the area behind is sand filled with sand, and dune reshaping and revegetation occurs (see Figure 3.5).

This option does not retain the valued beach access and amenity as the beach in its current location is likely to be lost. However, a new beach would develop over time in a new terminal scour. Similarly, the natural look and feel, that the community value would be lost. In addition, this option would stop further recession, reduce further instability of the dune face, and reduce the existing risk to public safety but also creates an additional safety risk if people were to climb on or over the rock revetment.

This option in one of three options that could be considered long term at Dog Beach and the trigger point for this decision is when the erosion scarp is within 20m of a built asset.

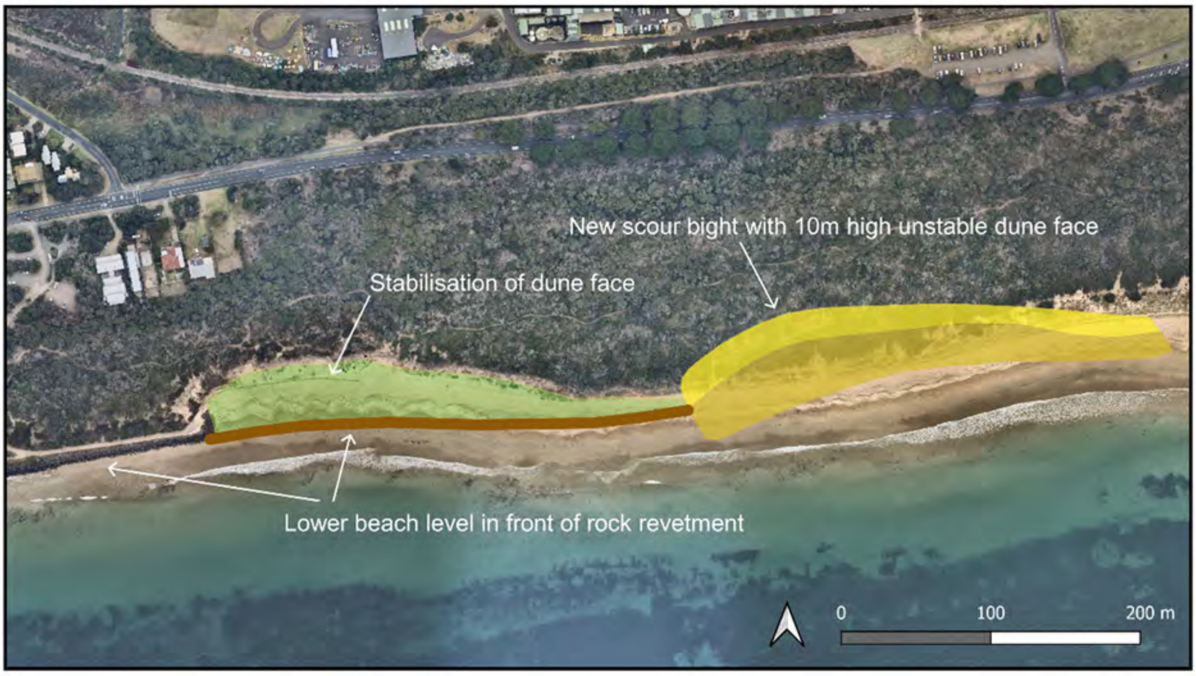

Figure 3.5 Diagram of Option 5 – Rock Revetment Seawall

Table 3.7 Assessment of Option 5 - Rock Revetment Seawall

VMACP policy 6.7b	Assessment Criteria	Comment
Costs	Capital cost and constructability	Strongly Negative – Rock Revetment Seawalls have a high capital cost and a relatively long timeframe to design, and construct.
	Ongoing maintenance	Positive – Rock Revetment Seawalls will require little ongoing maintenance, but sea level rise may make them less effective in the long term
Effectiveness	Public safety	Neutral – The steep dune can be stabilized and vegetated behind a rock revetment, however building a rock structure poses new safety risk if people climb on or over the structure
	Manage erosion risks	Strongly Positive – This option has been implemented effectively from Point Lonsdale Front Beach to its current end at Dog Beach. Stabilising the dune reduces the existing erosion risks.
Benefits	Beach use, access, amenity	Strongly Negative - A seawall will reduce the available beach area for dog walking and removes the natural character of the beach.

VMACP policy 6.7b	Assessment Criteria	Comment
Impacts (direct, cumulative and synergistic)	Impacts on surrounding area	Strongly Negative – Extending the seawall will cause a new end scour to develop at the site of the new end point.
Path-dependency adaptation actions	Path dependency	Strongly Negative – This option prevents beach nourishment continuing to be an option, as there will be little or no beach until a new scour develops
	Community Feedback	Rock Revetment Seawall received a mix of responses, but majority of feedback was negative

3.6 Option 6 – Offshore Breakwater

The offshore breakwater option involves building one or several breakwater structures offshore of the beach to reduce wave energy reaching the beach.

The offshore breakwater option is a 'Protect' approach in terms of the VMACP hierarchy. It aims to stop the long-term recession by dissipating the wave energy and therefore the reducing the sediment transport potential in scour bight area. Figure 3.6 shows examples of offshore breakwaters of different scales and materials.

Effective offshore breakwaters would be difficult to design and construct at Dog Beach. High waves and very high currents would mean the structure would need to be made of very large and heavy elements for stability, most likely large boulders, or concrete units. These conditions would also make construction extremely challenging. Note this area would be unsuitable for shellfish reefs for the same reasons.

The high currents would also hamper sand build up in the lee of the breakwaters, and there is a risk they would not be effective at all. As per the other hard protect options, they would create a new scour zone further along the beach towards Queenscliff. They would also have a major impact on the coastal processes of the surrounding coast and seabed, potentially including the Port Phillip Heads Marine Park.

To implement this option could be very expensive, potentially tens of millions.

Construction of offshore breakwaters is not recommended for Dog Beach at this time due to cost and uncertainty about the effectiveness and impact on surrounding areas.

Figure 3.6 Examples of an offshore breakwaters (Top left: England, UK, Top right: Brighton, Port Phillip Bay, Bottom left: Point Richards, Bellarine Peninsula, Bottom right: JamJerrup, Western Port Bay)

Table 3.8 Table 3.5 Assessment of Option 6 - Offshore Breakwater

VMACP policy 6.7b	Assessment Criteria	Comment
Costs	Capital cost and constructability	Strongly Negative – An offshore breakwater will have an exceptionally high capital cost, a long timeframe to construct and added complexities being built in a high energy zone offshore.
	Ongoing maintenance	Negative – Ongoing maintenance may be required

VMACP policy 6.7b	Assessment Criteria	Comment
Effectiveness	Public safety	Neutral – The success of an offshore breakwater at this site is unknown
	Manage erosion risks	Neutral – Offshore breakwaters have been successfully implemented elsewhere but the success of an offshore breakwater at this site is unknown
Benefits	Beach use, access, amenity	Neutral – The success of an offshore breakwater at this site is unknown
Impacts (direct, cumulative and synergistic)	Impacts	Strongly Negative – A new scour zone would form to the east and there is potential to impact the marine park.
Path-dependency adaptation actions	Path dependency	Positive – This option should not prevent any other options being implemented
	Community Feedback	An Offshore Breakwater was the least favourable option

4 Adaptation Pathways

The VMACP 2020 defines a pathways approach as a decision-making strategy made up of a sequence of manageable steps and decision points over time. According to the policy, a pathway approach also includes:

- Consideration of the impacts of climate change on the marine environment using best available and conservative coastal process understanding,
- A comprehensive list of all available and relevant management options,
- Identification of relevant coastal hazards and prediction of how hazards will change over time,
- A list of thresholds or triggers for when new decisions need to be made,
- Recommendations of future decision points in light of the above information and considering costs, effectiveness, benefits, impacts and path dependency of adaptation actions.

In line with the VMACP 2020, adaptation pathways have been developed for Dog Beach and as shown below in Figure 4.1.

As detailed in section 3, there are six potential options ranging from low cost 'Do Nothing' to very high cost 'Protect' options, such as a rock revetment seawall. The dune management and offshore breakwater options are the least feasible as the effectiveness is somewhat unknown. As such, the recommended pathway is minimal intervention initially as it is favoured by both the VCMP, and the community. Additionally, it is the cheapest option and the easiest to implement in the near future.

This option should be effective until at least until 2050, but probably longer, as long as the recession is monitored, fencing and signage is maintained, and the Lovers Walk is relocated when necessary. To allow the time for planning and implementation the trigger to relocate the path is when it is within 8 m of the crest of the erosion scarp (the estimated storm cut for a 100 yr ARI storm).

If the erosion continues, eventually assets and values may be threatened and it will be necessary to reconsider the adaptation pathway and potentially implement one of the feasible protect options, i.e.: groynes, rock revetment or beach nourishment. As the protect options will require time to plan and implement, the trigger for this reassessment should be when the crest of the erosion scarp is within 20 m of a fixed asset, i.e., the road.

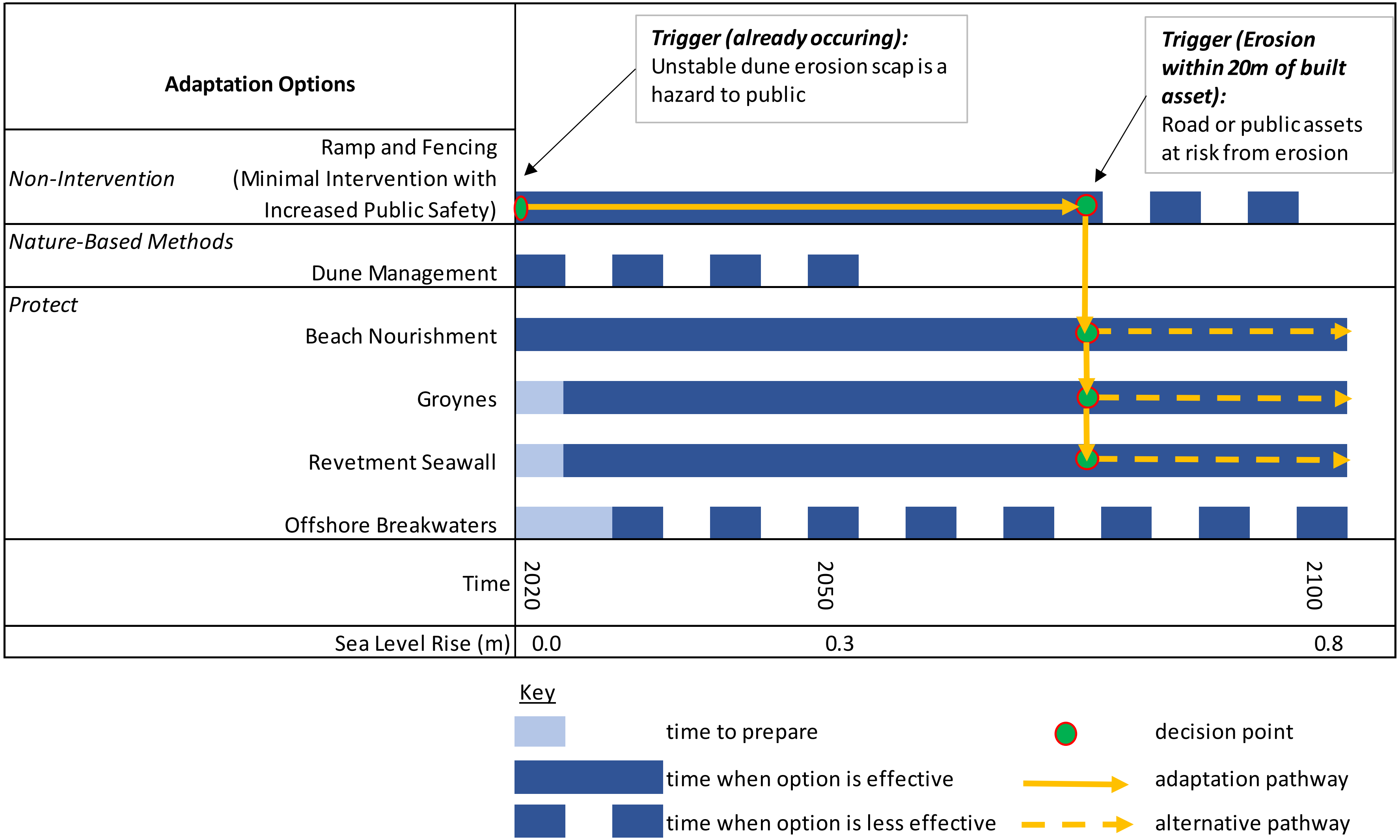

Figure 4.1 Adaptation Pathway for Dog Beach

5 Recommendations

The recommendation from this study is to manage public safety and access around the erosion scarp with no other erosion prevention actions at this time. That is, implement the minimal intervention with increased public safety option and continue to monitor erosion to identify future trigger points. Specifically, this includes:

- Extending the sand fencing to reduce access to the dune face
- Install signage advising the dangers of climbing on the dune
- Extending the access ramp to prevent the end being exposed during low sand levels
- Relocating sections of the footpath (Lovers Walk) when necessary.

Although there are some signs that the erosion is stabilising, it is uncertain at this time so the hazard zones have been calculated using conservative assumptions, namely the dune is entirely sand, and that the storm bight could be up to 8m. Even with these conservative assumptions, the only asset that is threatened in the next 50 years is the Lovers Walk, which can be relocated as necessary.

This approach will maintain and protect the wide beach and natural character valued by beach users.

Fencing and signage will need to be maintained after storms and relocated occasionally as the dune recedes.

The position of the erosion escarpment in the dune should be monitoring at least once per year to identify trigger points for the relocation of Lovers Walk and, in the longer term, trigger points for reassessing the pathway and potentially implementing a protect option.

5.1 Monitoring

The pathways approach is based on trigger points for decisions and as such monitoring is required to identify when the trigger points are approaching.

Monitoring at Dog Beach should consist of annual checks of the distance between the walking path and the road to the erosion scarp. We suggest using the VCMP drone survey data (or other aerial imagery such as Nearmap) to identify and measure the shortest distance from the assets to the top of the erosion scarp. These distances need to be compared to the trigger values (see section 4), and if equal to or less than the trigger values, management decisions need to be made in line with the adaptation pathway.

Additionally, signage and fencing should be regularly monitored as part of a standard maintenance program.

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Annex A 'What We Heard'

'What We Heard' Dog Beach Community Consultation

Community Feedback from a listening post that was held at Dog Beach on 27 March 2022

‘What We Heard’ Dog Beach Community Consultation

This Listening Post was the first of several engagement activities to be conducted as part of the Dog Beach, Queenscliff coastal adaptation plan. The objective was to introduce the project to the community, gain input on site history of erosion, and understand what the community values about the site.

Participants were asked:

- **why they came to the beach**
- **how they used it,**
- **what they valued about the area,**
- **about their knowledge of coastal process, and**
- **what they perceived as issues at the beach.**

This is what we heard:

- Many people understand the history of erosion and are concerned about the steep erosion escarpment in the dune at Dog Beach. The primary concern was safety, especially for children.

"Danger with kids climbing overhangs, no matter how many signs are erected."

- Off-leash dog walking is the main reason people come to the beach. The wide, open, and unobstructed character of the beach is highly valued as it allows dogs to spread out and reduces conflicts.

"Suitability for dogs off leash area needs to be maintained. This includes reducing hazardous erosion."

Who we heard from:

The majority of the people we heard from were locals, or people who lived in the Bellarine Peninsula, and visited the beach regularly to walk their dogs. Only a small number were holiday makers. Most visited the beach at least weekly, and the majority were over 50 years old.

Uses and values:

Dog walking was the most common use (more than two thirds), followed by exercise, swimming, and family recreation (sunbathing, building sandcastles etc).
The people we spoke to nominated the ’wide and open nature’ of the beach, the ‘natural vegetation and character’ and the ‘access along the beach from Queenscliff to Point Lonsdale’ as the key values of the area.

Awareness of coastal hazards:

All the beach users we spoke to had either a good understanding or general awareness of coastal hazards. Of particular concern was the erosion of the sand dune and the resulting high unstable dune escarpment which may be a hazard to people or animals that try to climb it, in particular children.

"Safety issues resulting from eroded dunes"

There was also concern about how far the erosion could extend in future and whether it could impact houses, the road or even sever The Neck connecting Point Lonsdale to Queenscliff.
Additionally, awareness was shown that intervention could damage the character of the beach and/or cause problems elsewhere.

Participants were invited to complete a survey which was available at the listening post and online. The following summarises the 83 responses received.

Q1 - How would you describe your connection to Dog Beach?

The majority of respondents described themselves as local residents or frequent visitors. Only a few people identified as holiday makers.

Q2 - How often do you use Dog Beach?

Most respondents were regular beach users, with two thirds visiting daily or several times a week. About one third visited a few times a month and only three visited annually.

'What We Heard' Dog Beach Community Consultation

Q3 – Please specify your age range?

Around 80% of respondents were over 50, the rest were between 18 and 50.

Q4 - What do you value about the Dog Beach area?

The survey responses, in order of popularity, were:

1. Wide sandy beach at all tides
2. Native vegetation and natural landscape
3. Access along the beach between Queenscliff and Point Lonsdale
4. Car parking and access over the dune to the beach
5. Walking path in dunes between Queenscliff and Point Lonsdale (Lovers Walk)
6. All of the above
7. Dog friendly and off-lead area

Q5 How do you use Dog Beach?

Dog walking was the most common use nominated (more than two thirds), followed by exercise, swimming, and family recreation (sunbathing, building castles etc).

Q6 How would you rate your current understanding of the potential for coastal hazards in the area?

The majority of respondents had either a good understanding or a general awareness of the coastal hazards in the area.

Q7 How severe do you think coastal hazards impacts (e.g., erosion, long term recession) are at Dog Beach currently?

Over half of the respondents rated the severity of coastal hazards as 'severe'.

Next steps:

The next steps in the Coastal Adaptation Plan are to develop and assess a range of options to manage the coastal hazards at Dog Beach. This assessment will include a technical feasibility assessment of a proposal submitted by some members of the community. Once the technical assessment has been undertaken a second round of community engagement will be conducted to seek feedback on the options.

All potential options will be prepared in line with the *Marine and Coastal Policy 2020* that aims to reduce environmental impacts through an adaptive approach over new and existing physical infrastructure where possible.

Only options that are technically feasible and in line with relevant legislation will be considered for further engagement and assessment.

DELWP and Borough of Queenscliffe wish to thank the participants who provided valuable feedback which will be used into future planning decisions

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'What We Heard' Dog Beach Community Consultation

Community Feedback from Community Engagement Session
29 May 2022 and online on Engage Victoria
29 May 2022 to 10 July 2022

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‘What We Heard’ Dog Beach Community Consultation

DELWP and the Borough of Queenscliffe are developing a Coastal Adaptation Plan for Dog Beach, Point Lonsdale. Community consultation was conducted to gain community feedback on six proposed adaptation options for the beach.

The consultation was undertaken at an in-person engagement session held at Queenscliff Football and Netball Club on 29 May 2022, and also on-line on the Engage Victoria website from 29 May to 10 July 2022.

For each option, participants were asked:

- **What are the advantages of the option?**
- **What are the disadvantages of the option?**
- **To share any other thoughts about the option**

Thirty-two submissions were received, and this is what we heard:

Option 1 – Minimal Intervention and Improved Public Safety

There were 29 responses for option 1, 19 were positive, 5 were neutral and 5 were negative.

Option 1 was by far the most favoured option with the majority of respondents providing positive feedback to this option. Very few participants responded negatively to this option. Beach amenity, specifically retaining a wide natural beach for dog walking, was a common concern along with the use of public money with several participants noting this was the least costly option.

"Best option for maintaining as an off leash dog beach, given there are no other leash free areas available."

"The main advantage of this option is that it maintains public amenity. Continued use of a 'natural' beach and access to the bush track, albeit re-routed in some areas. The extended fencing is a low visual impact solution."

Option 2 – Dune Management

There were 24 responses for option 2, 5 were positive, 5 were neutral and 14 were negative.

Option 2 was not well supported with most participants responding negatively to this option. The general perception is that this option would not succeed, in part as it has been attempted at this site previously. Ongoing maintenance and cost were also raised as concerns.

"Unlikely to suceeed due to the topography of this particular dune site, will require ongoing monitoring and maintenance, failure risk too high and unlikely impacts may deveolop requiring further cost."

A few participants were mildly in favour of this option as it does not restrict amenity.

"Beach access remains easy and feel would be retained"

Additionally, some participants thought this option was viable in conjunction with other options.

Option 3 – Beach Nourishment

There were 24 responses for option 3, 5 were positive, 4 were neutral and 15 were negative.

Option 3 was also not well supported with most participants responding negatively to this option. The main concerns were the cost, that each nourishment is a temporary solution, and that beach amenity would be restricted whilst the nourishment occurs.

"It is a costly temporary solution that will be washed away in a short time period."

Option 4 – Groynes

There were 26 responses for option 4, 9 were positive, 1 was neutral and 16 were negative.

Option 4 had the largest mix of favourable and non-favourable responses, but the overall feedback was negative. The positive feedback included that it would trap sand and reduce erosion at this site.

"The dune face is stabilised & further erosion is limited."

The negative feedback and concerns included cost, lack of beach amenity during construction, erosion further along the beach, safety to people crossing between compartments, submerged rocks, and the lack of natural wide beach.

"cost, moves the erosion further along, loss of dog beach at this location"

"Expensive, ugly, dangerous to public, destroys amenity of the beach, should be avoided at all costs."

Option 5 – Rock Revetment

There were 22 responses for option 5, 8 were positive, 2 were neutral and 12 were negative.

Option 5 had very similar responses to Option 4 – Groynes, again with the overall feedback being negative.

The positive feedback was that it addresses the erosion at the Dog Beach site.

"addresses the problem at this point for the longer term"

Like option 4, the main concerns included cost, erosion further along the beach and the loss of the current wide beach.

"No beach for half the time. ugly. destroys much of the attraction of the beach as it stands."

"There is not any mitigation against the impacts of this option on the new scour bight further along the beach. The effect of this strategy may be worse than the current situation."

Option 6 – Offshore Breakwater

There were 21 responses for option 6, 4 were positive, 4 were neutral and 13 were negative.

Option 6 was the least favourable option with strong negative feedback, and no exceptionally favourable responses. This option also had the smallest number of responses. The main concerns were the lack of certainty of success for this option, the cost, and the disturbance to natural systems and marine life.

"This seems like a major work with no guarantee of addressing erosion problem"

"There has already been considerable disruption to the bay via dredging over past years to widen the shipping channel with impacts on marine life, sea grasses and reef systems.

Not what residents want for this unique area, we value the environment we have."

Overall concerns:

The overall concerns raised by participants were losing beach amenity and somewhere for off leash dog walking, along with losing the natural character of the beach.

Other suggestions:

A few participants suggested that the erosion should be left to occur and a bridge to Queenscliff should be built when needed.

Other participants suggested implementing options in combination especially Dune Management in combination with more engineered options such as a Rock Revetment and a few suggested having a staged approach.

"The "Progressive Rock Revetment" many be the best solution. In this option the wall would be extended about 150-200m* every say 20-25* years so that a new scour area and beach forms at the new end. The area behind the new section of rock wall would be reconstructed and vegetated knowing that it would be protected. When the new scour area became too extensive and permanent damage could occur, the rockwall would be extended again creating a new beach at the new end. This progressive approach would continue along the beach."

Next steps:

The final report will be made available on the Engage Victoria website on the 15 September 2022.

DELWP and Borough of Queenscliffe wish to thank the participants who provided valuable feedback which will be used into future planning decisions

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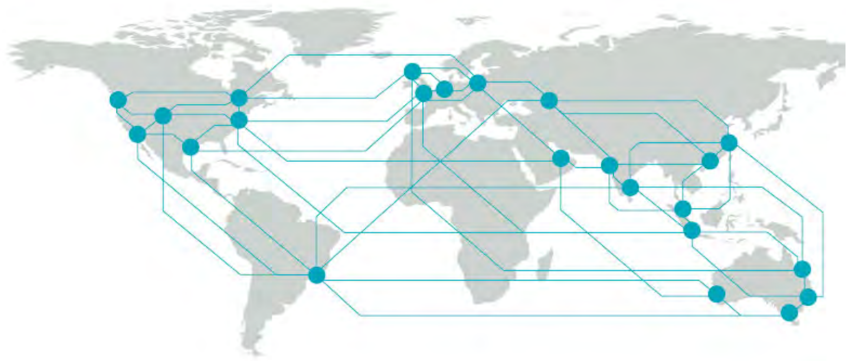

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