# EASTERN BAYS SHARED PATH DESIGN FEATURES REPORT

**PREPARED FOR HUTT CITY COUNCIL**

January 2019

Stantec

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# Hutt City Council

## Design Features Report

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# 1. Introduction

## 1.1 Purpose of this report

The Design Features Report (DFR) is a report that outlines design details and construction methodology for the purposes of the resource consent application for the Eastern Bays Shared Path Project (the 'Project'). It has been compiled by the lead consultant, Stantec with input from the other technical experts in the project team. Details of the design features may change slightly as the design progresses from the Preliminary Design phase to Detailed Design as information is received or opportunities emerge. Likewise, the construction methodology may vary depending on the final design and the methodology developed by the contractor.

This report sets out a series of typical designs developed as part of the preliminary design that contributes to the mitigation of any adverse effects that may result from the Project. Further inputs will be required from the design team as the detailed design phase progresses.

## 1.2 Description of the existing roading environment

The Hutt City Council (HCC) proposes to construct a 4.4 km Shared Path (cycleway/walkway) along Marine Drive in two sections: between Point Howard and the northern end of Days Bay, and the southern end of Days Bay (Windy Point) to Eastbourne (Muritai Road / Marine Parade intersection). Approximately five thousand people live along the Eastern Bays, with Marine Drive providing the only road and infrastructure service connections.

Residents have identified that the completion of the Eastern Bays Shared Path, and concern about climate change, are the two most important issues facing the Eastbourne Community. The Project presents an opportunity to integrate an efficient response to both of these issues.

Eastern Bays include Sorrento Bay, Lowry Bay, York Bay, Mahina Bay, Sunshine Bay, Days Bay, Rona Bay, Eastbourne village and Robinson Bay. The Project area is shown on the map in Figure 1-1.

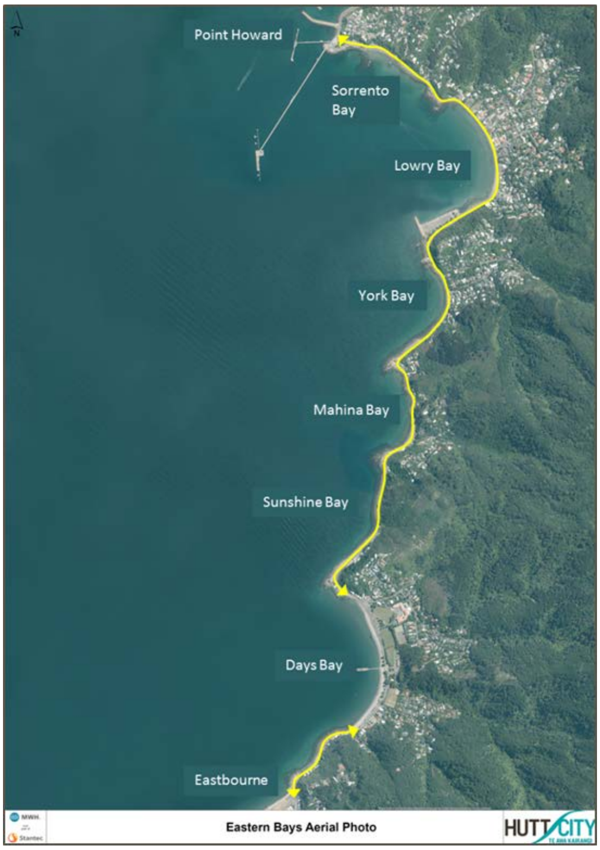

Figure 1-1: Map of Project Area

Marine Drive is a Primary Collector[1] with one lane in each direction that carries up to 8,000 vehicles per day. The coastal road winds its way around several headlands and bays between Point Howard and Eastbourne, and provides the only road access to the residential eastern bay suburbs. The road has generally ~3.5m lane widths but can fluctuate to ~4.5m wide and also narrows down to ~3.0m in width in places. The speed limit on the route varies between 50 km/h to 70 km/h, with Point Howard, Sorrento Bay, Lowry/Whiorau Bay, Days Bay and Windy Point all 50 km/h, while York Bay, Mahina Bay and Sunshine Bay are 70 km/h.

Marine Drive is serviced by bus routes 81, 83, 84 and 85 buses, linking Eastbourne to Wellington CDB via Petone (route 85 also services Lower Hutt). Each weekday there are 95 bus movements on the corridor, with buses operating between 6.00 am and 11.00 pm.

The road originated as a track along the harbour and has a long history of use initially by Māori and later by early European settlers. The 1855 earthquake raised the eastern shoreline by 1.2-1.5 metres thereby improving access along the coast. Over the years the road has been raised and widened into the foreshore to accommodate increasing traffic as the population in the village of Eastbourne grew.

The function, character and demand placed by various road users on this corridor poses challenges and constrains the feasibility of various options. This is exacerbated by further issues such environmental and amenity concerns, resource management requirements, and storm water and geotechnical constraints. Therefore, a solution that seeks an optimum outcome considering the numerous and often competing constraints has required some compromises.

As mentioned above, the road and shoulder width varies significantly over the corridor and where additional width is provided, the space is often used as informal parking, which is highly valued. Given the physical constraints on the landward side of Marine Drive, the widening of the road on the seaward side is considered the most practicable option (alternatives have been assessed with details in Appendix G of the resource consent application).

[1] Classified in the One Network Road Classification (ONRC) contained in Appendix Transport 3 of Hutt City Council District Plan. The Transport Network Hierarchy includes this classification of roads which consists of distributor routes for through-traffic and for local access purposes.

Details of the existing shoulder width are shown in the Base Information Plans (Appendix M) using a colour coding system to represent the different widths along the entire length of the project.

The road is vulnerable to overtopping during storm surges and must be closed periodically. Maintenance crews have to clean obstructed infrastructure of debris at the earliest possible time to minimise impacts to residents. Damage to the seawall also occurs during these storm events. Overall, larger more frequent storm events, coupled with the current state of the seawalls is likely to result in a significant increase in the number of times the route is affected or closed.

# 2. Design Principles

## 2.1 Design Team

To assist with the design of the Project and to provide an understanding of the local environment likely to be affected by the Project, a team of technical experts has worked together to come up with a design that balances the various competing environmental challenges.

The following team members and their field of speciality provided input into the preliminary design.

- Intertidal Ecology - Shelley McMurtrie, EOS Ecology
- Freshwater Fish Passage - Alex James, EOS Ecology
- Avifauna and Vegetation - Fred Overmars, Sustainability Solutions
- Landscape and Visual - Julia Williams, Williams Drakeford Landscape Architects
- Urban Design - Andrew Burns, McIndoe Urban
- Coastal Processes - Dr Michael Allis, NIWA
- Planning - Caroline van Halderen, Stantec
- Structural Engineering - Jeremy Walters, Stantec
- Construction Methodology - Jamie Povall and Jeremy Walters, Stantec
- Engineering Design - Jamie Povall, Stantec
- Recreation - Rob Greenaway, Rob Greenaway and Associates
- Transportation Planning - Dhimantha Ranatunga, Stantec

The design team was assisted by two community board members, Virginia Horrocks and Derek Wilshire.

## 2.2 Principles

The Eastern Bays Marine Drive Design Guide[2] forms part of the Hutt City Design Framework and establishes an agreed and explicit direction for future work by the Hutt City Council (HCC) in the defined area. It focuses on the design of the sea edge, specifically the seawall, walkway and associated elements between Port Road and Browns Point (Windy Point). Its scope includes the design of elements and landscape located on both sides of Marine Drive.

The general design principles outlined in the Eastern Bays Marine Drive Design Guide were taken into account in the early design stages and, where relevant, have been incorporated into the DFR.

These design principles are:

- Achieve compatibility along the bays by consistency in the location and design of elements, and use of materials.
- Consideration of the whole environment into an integrated solution.
- All work must be an improvement on what is existing.
- Change seawall type if necessary at a promontory, rock outcrop or other major feature within the bay, or in locations where a ramp or set of steps provides a logical/neat transition point between wall types.
- Recognise the individual character of each bay by reinforcing and strengthening those valued patterns that establish the unique identity of the bay.

[2] Eastern Bays Marine Drive Design Guide: RAS-GDL-003
http://iportal.huttcity.govt.nz/Record/ReadOnly?Tab=3&Uri=3685680

- Locate all elements carefully to avoid visual clutter and maintain a focus on the seashore and natural environment.
- Design the seawall to be multi-functional.

Further details will be incorporated into the detailed design stages and will be covered in the Landscape and Urban Design Plan (a condition of consents). These details include signage, street furniture, lighting and road markings.

In addition to the design principles previously established in the Marine Drive Design Guide, it is also considered beneficial to include additional principles:

- Design the seawall to be easily adaptable to accommodate sea level rise.
- Maximise the width of the shared path in general accordance with New Zealand standards[3].

The design principles are explained in further detail below:

### 2.2.1 Consistency

To achieve compatibility along the bays by consistency in the location and design of elements, use of materials, the following guidelines are applicable:

- To achieve visual consistency within each bay.
- To ensure consistency of style of design elements.
- To ensure that the top of the seawall is consistently and accurately profiled.
- To avoid the use of construction rubble.
- Stormwater pipes are to follow a common design theme and new plastic pipes are to be flush with the seawall (not to protrude from the concrete surface).
- The transition between types of seawalls is to be integrated to avoid abrupt divisions.
- To maintain general consistency of edge detailing and surfacing along the length of the bays (path surfacing should be asphalt, with concrete edging).

### 2.2.2 Integrated solution

The consideration of the whole environment into an integrated solution is necessary for the design. The key drivers of the Shared Path project take an integrated approach and aims:

- To develop a safe and integrated walking and cycling facility to connect communities along Eastern Bays, and to provide links to other parts of the network for recreation and tourism purposes.
- To provide a basis for future opportunities for protecting the resilience of the road and underground services by upgrading the supporting seawalls.

### 2.2.3 Improvement

Overall, the work is to be an improvement on what is existing. This will be achieved through consistency of design and an integrated solution as outlined in 2.2.2 above. An example of where practical improvements can be made is to remove visible construction rubble (currently used in places as seawall material) with the replacement of seawalls and revetment.

### 2.2.4 Character of bays

Design guidelines recognise the individual character of each bay by reinforcing and strengthening those valued patterns that establish the unique identity of the bay. This is achieved (amongst others) by locating all elements carefully to minimise or avoid visual clutter and maintain a focus on the seashore and natural environment.

### 2.2.5 Seawall transition

A change in seawall type, if necessary, is to be undertaken at a promontory, rock outcrop or other major feature within the bay, or in locations where a ramp or set of steps provides a logical/neat transition point between wall types.

[3] Refer to Path Width Review (Alternatives Assessment, Appendix G).

### 2.2.6 Multi-functional

The design of the seawall and shared path is to be multi-functional, providing a safe and continuous cycleway and walkway, and providing protection from coastal processes. This will be done by:

- Designing to reduce 'slop and splash' onto the road, ensuring that splash reduction performance (i.e. wave redirection) of new walls is better than those that they replace.
- Providing for/maintain safe pedestrian access to beaches through steps and ramps at frequent intervals.
- Providing appropriate means of access for penguins and maintaining, and where practical enhancing, fish passage.
- Placing stormwater outfalls as low as practicable on the wall and locate where they do not cause erosion at the beach, and where they can provide access for fish.

### 2.2.7 Adaptability of Design

The design includes elements that incorporate iterative long term management principles to address sea level rise. The design of a curved seawall can be easily adapted to accommodate sea level rise through increasing the height of the structure. The present designs have adequate structural competence to support the additional loads from raising the defences in the future. Therefore, the proposed seawalls do not preclude future adaptation options or lock-in a future approach beyond that of the present situation and Marine Drive alignment.

### 2.2.8 Width of shared path

The design of the Shared Path aims to maximise the width of the shared path in general accordance with New Zealand standards. A review of path widths is outlined in the Alternatives Assessment (Appendix G).

Both path width options, 2.5m and 3.5m widths, are considered thereby allowing a combination of path widths to be applied. The two options provide the opportunity to alter the width of the path at beaches and sensitive locations. This flexibility in design also enables the shared path to respond to the constraints unique to the various bay environments and mitigate environmental effects on the environment.

# 3. Design Features

The following design features are described in this report:

- Seawalls
- Beach Nourishment
- Beach Access
  - Steps
  - Ramps
- Transition Zones
- Shared Path
- Kerb Separators and Coastal edge
- Stormwater
- Penguin Passage
- Fish Passage
- Bus Stops and Shelters
- Planting
- Street Lighting
- Signage and Markers
- Path comfort facilities

- Traffic Services

## 3.1 Seawalls

The seawalls comprise of the following structures:

- Revetment (rock rip rap) with vertical concrete faced walls adjacent
- Curved concrete seawalls – single, double and triple curved

### 3.1.1 Revetment structure

The revetment structure is likely to consist of a top double layer of large rocks, average diameter 500mm overlaid onto smaller rocks. The structure typically slopes down towards the water at a gradient of 1V:2H or 27°. The interface between the revetment and the shared path varies according to the structural requirements of the wall and the beach location and may include:

- A concrete cantilever wall which supports the shared path. The top of the wall is flush with the shared path. The revetment is at grade with the top of the wall and is level for 1.5m before it slopes down to the water
- Top of revetment is approximately 300mm above the shared path and is level for 1.5m before it slopes down to the water.

Revetment structures are limited to rocky shore areas where it was desirable to maintain a 'non-concrete' or 'non-seawall' shoreline, or replace existing rock revetment and where additional protection was required to reduce wave overtopping.

Due to the dynamic nature of the coastal environment, the revetment seawalls require a double layer of competent weathered rock that is hard wearing and in sufficient quantity for the new revetments (e.g. granite or andesite). The local in situ (i.e. rock excavated from the foundations of the new works) rock is of low quality, small size and insufficient quantity to be of use in the revetments. However, whilst local greywacke quarries (e.g. Horokiwi Quarry) can provide material that would be suitable, it is unlikely to be a sufficient volume for the project. Consequently, revetment rock will probably need to be brought in from other regions. The final selection of rock material for the revetment will be addressed by the contractor[4].

Where a revetment structure is proposed the carriageway and path facility will be supported by a reinforced concrete cantilever wall, refer Figure 3-1.

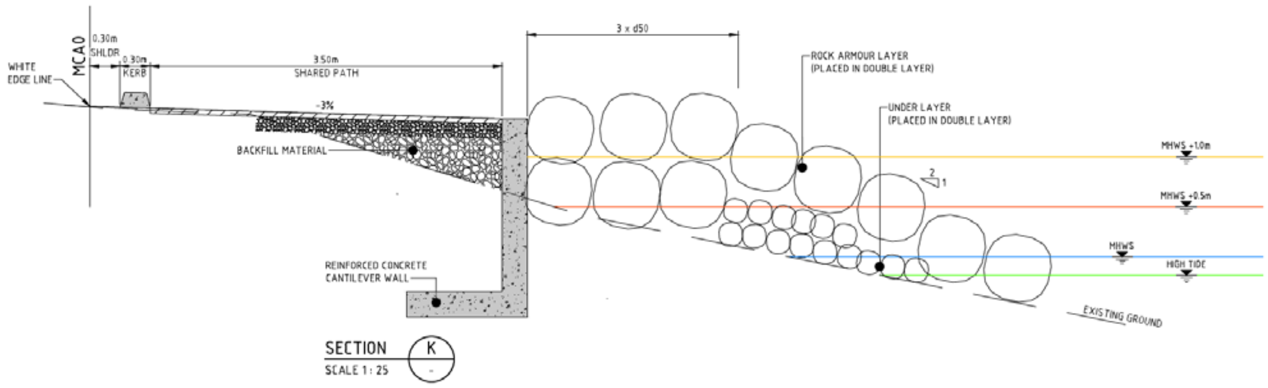


Figure 3-1: Typical revetment with reinforced concrete cantilever wall

The cantilever wall will be designed as a standalone element i.e. the wall will not be reliant on the seaward side rock armouring to retain the road pavement and shared path. The design of the revetment treatment will be refined during detailed design according to the conditions at each site, including the crest height, rock sizing and placement requirements, slope grade and toe detail. Thus, the final footprint may vary

[4] Michael Allis, NIWA, pers. comm.

slightly depending on the site-specific conditions of the existing foreshore, but is not expected to be enlarged from that shown in the preliminary design plans.

An example of revetment is shown in the photo below of the Coastal Walkway in New Plymouth.

Figure 3-2: Coastal Walkway in New Plymouth

### 3.1.2 Curved concrete seawall

Typical examples of curved concrete seawalls are shown in the figures below. The curved concrete wall has a flat top that forms the base of the shared path, and either a single or a double curved face that acts as a giant step, with a 900mm tread (600mm nose to nose) and an 800mm riser. It replicates the existing curved sea wall at the south end of York Bay.

Vertical curved seawalls have been chosen across most of the Project length because they deflect wave overtopping most effectively and create a reduced footprint on the foreshore compared to other non-vertical seawalls. This design also offers the flexibility to adapt the design to accommodate sea level rise in the future. The following cross sections show the seawall types and also include indicative tidal levels for a selected example locations along the length including future levels at 0.5m and 1m sea level rise.

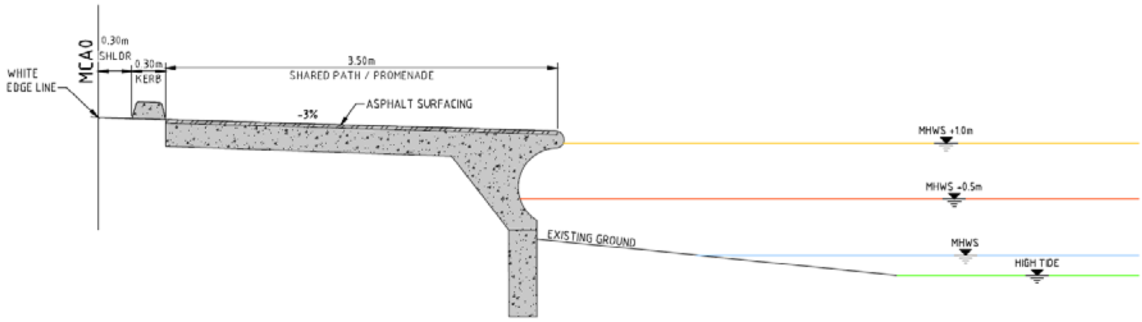


Figure 3-3: Single curved concrete seawall

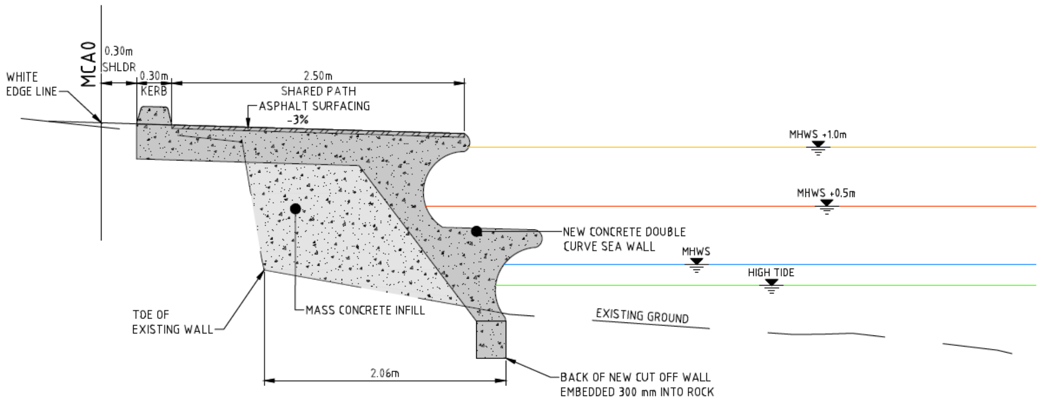


Figure 3-4: Double curved concrete wall

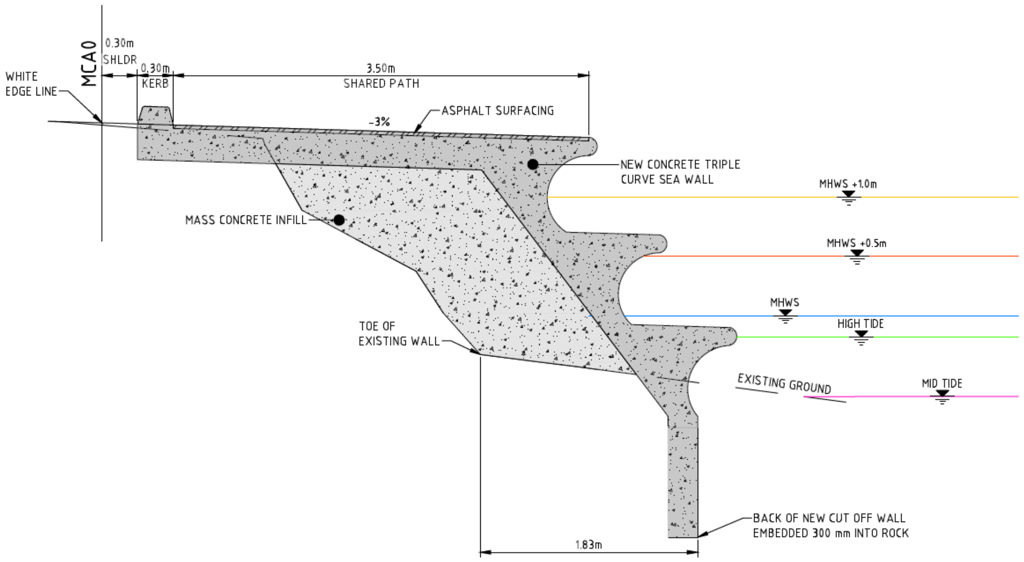


Figure 3-5: Triple curved concrete wall

A double curved wall is the most widespread type of curved concrete seawall proposed for the Project, although variants include single and triple curved.

At beach locations, the wall height between the road and beach surface is dynamic (i.e. the beach surface levels change frequently), changing with tidal conditions. Beach materials can be deposited or removed quickly – the wall design needs to account for this and take a conservative approach for when the beach material is at lower levels to avoid a large vertical drop off at these times. Beach nourishment (described in section 3.2) will also influence the wall height between the road and beach surface.

There may be some beach locations where material transportation is less active and therefore a single curve wall may suffice. It is noted that using a single rather than double curve can avoid an additional 600mm horizontal beach encroachment which has amenity benefits. A rounded profile used in the curved walls will be used consistently throughout where curved concrete seawalls are constructed.

The curved wall will be cast in situ to aid constructability given the irregularity in the coastal area to construct into. While there are environmental risks with this approach, they will be managed as outlined in the construction methodology (see Section 4).

Textures will be incorporated into the concrete surface of the seawalls to provide opportunities to establish biota habitat.

## 3.2 Beach Nourishment

Beach nourishment is proposed at Point Howard, Lowry Bay and York Bay as a strategy to mitigate loss of beach area available for beach amenity. Nourishing the beaches with imported beach-compatible fill, has a secondary benefit of improved coastal protection.

Indicative volumes required for nourishment, construction methodology, and monitoring and consent conditions for the Eastern Bays Shared Path project are described in detail in the Coastal Processes Report (Appendix E) and the Beach Nourishment Design (Appendix F) of the resource consent application.

## 3.3 Beach Access

It will be important to maintain beach access for beach users on foot and also boat or kayak access. The connectivity between the shared path and the beach will be achieved through the careful placement and design of ramps and steps. Generally, the design provides a minimum of two accesses per beach.

No new boat or kayak access is proposed, instead where existing boat ramps are provided, the design intent will be to maintain these. Maximum boat ramp grades have been set at 1V:4H (instead of 1V:8H), boat ramps are to be provided only in locations where the wall height is very low to create a safe and convenient access and also to minimise beach encroachment (as a 1m high boat ramp would project 4m into the beach, or further if the fall of the beach is taken into account). Boat ramps will be provided parallel to the seawall, rather than perpendicular, again to create a safe and convenient access and also to reduce beach encroachment.

Beach access generic options are described below. They include:

- Standard steps
- Mini steps
- Boat ramps

### 3.3.1 Standard Steps

Parallel access steps are proposed, as opposed to perpendicular steps, to offer a safe accessway and also to reduce the encroachment on the beach, and thereby to avoid creating a chute which potentially leads to wave overtopping. A number of variations are proposed depending on the type of seawall. An example of steps on a double curved wall are outlined below.

- Extended single curve around the steps results in a fall height <1m
- Width of steps to be between 1500mm (upper level) and 1200mm (lower level)
- Provides a seat for beach users
- Lower 'seating' level could be at risk of being slippery due to it being wet (if it falls within the intertidal zone); concrete surface to be roughened to reduce slipperiness
- Tapered platform to minimise localised beach transport effects around the structure
- Handrail likely to be in very limited locations where height requires it.

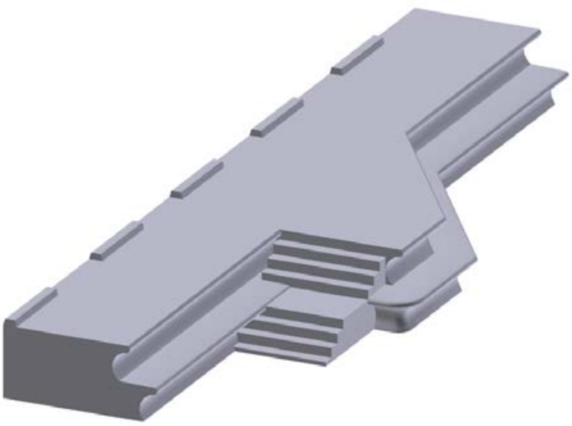

Figure 3-6: Parallel Access Steps on Double Curve Wall

Where steps transition into revetment (proposed in Sunshine Bay), the following design is proposed:

- Localised riprap around the steps results in a fall height <1m.
- Results in high level of beach encroachment and only to be used above rocky areas not in a beach area.
- Integrates access and wall type transition.

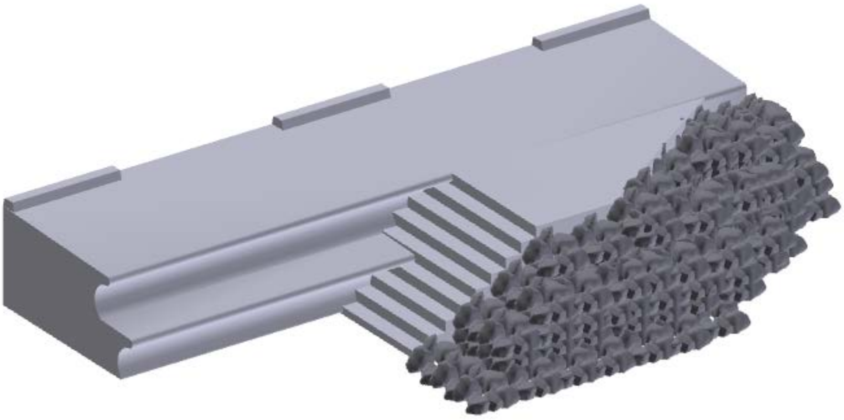

Figure 3-7: Parallel Access Steps on Double Curve Wall with Rock Rip Rap

### 3.3.2 Mini Steps

Mini steps are proposed at intervals between the standard steps to achieve additional access to the beach without encroaching unnecessarily onto the coastal marine area. These steps will also be suitable for penguin access given that the rise of the step is approximately 350mm in most places.

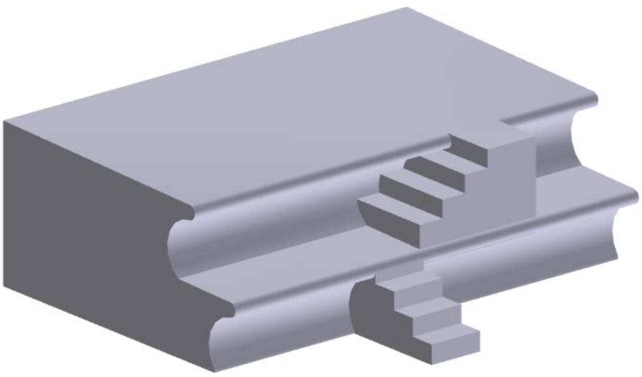

Figure 3-8: Mini Steps

### 3.3.3 Boat Ramps

Parallel boat ramps are proposed so as to minimise encroachment onto the beach. The boat ramp on the bottom left has a gradient of 1V:4H which is similar to the existing ramps. The boat ramp on the top right is 1V:8H and meets maximum boat ramp gradient requirements typically used for motorised access. It results in a slight increased beach encroachment due to the extended ramp length. The 1V:8H has been discounted due to the additional beach encroachment and will therefore not be used in the proposal.

No vehicle launch boat ramps will be provided – only 'like for like' boat ramp access will be provided.

A corrugated texture will be added to the concrete surface to shed sea water and reduce slipperiness.

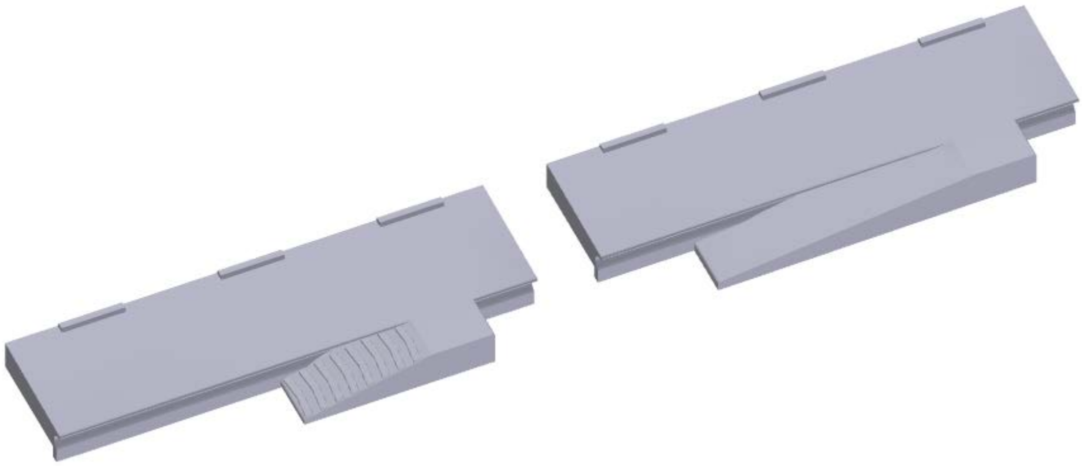

Figure 3-9: Boat Ramps

## 3.4 Transition Zones

A generic wall transition between a double curve wall and a revetment structure is illustrated in Figure 3-10 below. This will be the most common wall transition.

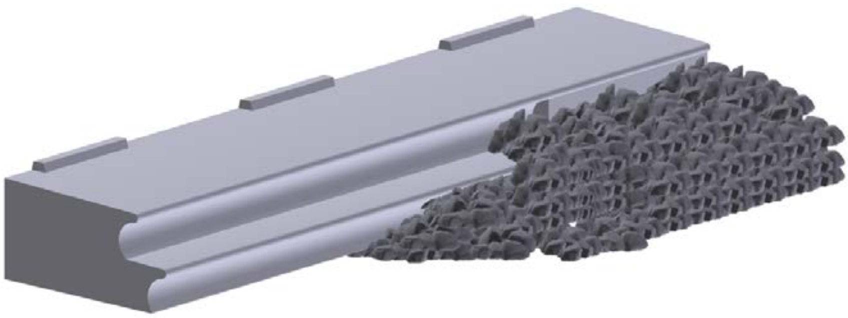

Figure 3-10: Transition Zone

Variations will incorporate steps into the revetment, especially where this will result in minimising the construction of a beach access in the immediate vicinity of the transition zone to reduce the number of accessways encroaching onto the beach. Within the transition zones, informal steps can be added during construction using judiciously placed selected rocks with a relatively flat face suitable for stepping on. This enables public access via an informal 'unofficial' step and will require some contractor expertise and direction. This would be addressed in the CEMP.

Other variations could include ramps (or a combination of an integrated ramp and steps) being incorporated into the revetment.

## 3.5 Kerb separators and coastal edge treatment

Concrete kerb separators will be used to separate the shared path from the road. They would require reflectors on traffic side for improved night time visibility. The benefits of concrete are:

- Concrete separators have the adaptability to incorporate textures and colour and can be easily mass produced once the concrete forms have been manufactured
- Concrete is preferable to timber due to structural integrity and cost
- Durability in a marine environment

Kerb separators are shown in the photo below (Figure 3-11) off York Bay.

A concrete coastal edge treatment will be provided to create a consistent edging on the seaward side of the shared path, as shown in the photo.

Figure 3-11: Coastal Edge Treatment

No seaward side barrier is currently proposed[5].

The wall has been designed to provide a tiered solution avoiding a greater than 1m drop in any location. Potential mitigation could include a low level wheel stop at the edge. Care would need to be taken to ensure that this did not become a trip hazard and would likely need to be very obvious such as through the use of a contrasting paint colour (which has visual implications). This mitigation will be addressed in consultation with community during the detailed design stage, as part of the Landscape and Urban Design Plan (a condition of the consent).

## 3.6 Stormwater

The proposed shared path will be contoured so rainfall flows away from the road into the sea. There are infrequent sections with existing kerb and channel in place. The existing kerb and channel will be left as is with the new path constructed behind.

There are a large number of culverts under the existing carriageway which will need to be extended by some degree to accommodate the increased width of the new path. The required extensions will simply comprise lengthening the culvert using standard couplers connecting onto new plastic pipes that will be tied into the wall to be flush with seawall.

Wellington Water Limited has consent to install duckbill valve devices at selected sites to prevent blockages by beach gravels. Details of these culverts are in the Fish Passage Report (Appendix B of the resource consent application).

Certain culverts will also be used for penguin passage. There are approximately 5 culverts where penguins may need access, generally those of 600mm diameter or greater. Details are confirmed in the Avifauna and Vegetation Assessment (Appendix C of the resource consent application).

[5] The decision to not include edge protection was made by HCC when the section of York Bay was completed. While this has been reviewed as part of the current project, an assessment of the Building Code requirements was also completed, there remains no appetite by HCC or the community to provide a seaward side barrier due to the perceived interruption between the land and the coastal edge.

The treatment of culverts and stormwater outfalls in seawalls will be addressed in the detailed design stage to incorporate the required features.

## 3.7 Penguin Passage

Design elements may include localised rock rip rap at the base of culverts to allow penguins easy access to and from culverts.

The penguin survey has however indicated that most of the penguins are found on the seaward side of Marine Drive and therefore there is limited need to cross the road. Details are confirmed in the Avifauna and Vegetation Assessment (Appendix C of the application).

## 3.8 Fish passage

For the three fish passage outlets that are currently elevated above the existing beach level (Howard Stream, Wilmore Way Stream and Sunshine Bay Stream) it will be important to ensure that the extended outlets do not become perched with an overhang. Solutions will be site-specific as it will depend on the relative level of the outlet and seawall design at each location, but may include constructing a short concrete ramp or use of mussel spat rope.

The majority (11 of the 14 assessed) of fish passage outlets are at beach level and a modest extension of the same diameter and gradient should not alter this. Provided conditions (e.g., beach sediment erosion and depositional dynamics) around these beach level outlets remain the same as they are now there should be no alteration in their fish passage status as a result of construction of the shared path. The exception are four outlets that currently have or are proposed to have structures installed, which are detailed in Fish Passage Report (Appendix B of the resource consent application).

## 3.9 Bus Stops and Shelters

The northbound bus stops at Mahina Bay and York Bay will require relocation. The design of the new bus shelters will include ensuring sufficient width is available when designing the new sea walls and providing a foundation for the new structure. The bus stop structure is an integral part of the local identity and will be designed in consultation with the community to ensure that there is some variation to respond to local prevailing wind and rain. The new bus shelter design will be undertaken separately to the new seawall works, but the required platform footprint for a new bus shelter will be incorporated into the new seawall detailed design (with the shelter itself being provided via a separate process). It is noted that a proprietary shelter has very recently been installed in Sunshine Bay by Greater Wellington Regional Council (GWRC). New bus stops will be powered either through a connection to underground network or through solar panel.

Although the existing structures hold some inherent value within the local community, it is considered uneconomic to relocate the existing building structures to the new locations given that many of the structures are in poor condition. Deconstructing and re-establishing the existing structures (if even possible), is likely to be a costly exercise in terms of both design and construction, hence reasonably robust and proprietary shelters (for the coastal conditions) may be advisable but will be subject to further community input.

Other bus shelters along the corridor will be retained but, in all circumstances, the shared path will be directed to the rear of the shelter to minimise conflicts with path users and bus passengers (following best practice design).

The provision of bus shelters will be addressed in the Landscape and Urban Design Plan (a suggested condition of the consent).

## 3.10 Planting

The ‘Atkinson tree’ would need to be removed. The option of transplanting the tree to another location (the triangular piece of land behind the bus shelter in Taungata Road) was investigated. An arborist’s report was commissioned, and it concluded that the tree was in poor health and unlikely to survive relocation to another location.[6]

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[6] David Spencer, Arborlab Consultancy Services, March 2018.

The approach to landscaping is to allow for provision for self-sowing vegetation to occur. That is, there is no provision for planted landscaping within the design scope. Details to be addressed as part of a Landscape and Urban Design Plan at the detailed design stage (as a condition of the consent). There are opportunities to include the community and iwi in preparing these details to incorporate features of local value and interest.

## 3.11 Street Lighting

An assessment of existing street lighting will be undertaken during the detailed design stage to establish if additional lighting will be required along the route. There are a number of existing street lighting columns that will need to be relocated as part of the Project. The section completed at York Bay previously appears to have not required any lighting upgrades.

The provision of street lighting will be addressed in the Landscape and Urban Design Plan (a suggested condition of the consent).

## 3.12 Signage and Markers

- 'Story boards' to include interesting features, such as places of cultural interest, information about the 'ecological textures' of the seawall and in the location where additional vertical 'pot plant' rock pools are added to the curved surface.
- Community and iwi to be consulted on these designs.
- Path signage and markings to be kept minimal and low impact.

This will be addressed in a Landscape and Urban Design Plan (a suggested condition of this consent).

## 3.13 Path comfort facilities

Seating will be required along the shared path at frequent locations. Seating will be prioritised in locations where additional widening of the path can be avoided, in order to minimise costs and environmental effects. There may however be locations where this is not feasible, or where the desire to provide seating in a particularly attractive location overrides cost considerations.

Seating would include community involvement and should be consistent with that proposed for the Great Harbour Way. Some consistency is also required with what has been proposed with memorial seating in the area.

This will be addressed in a Landscape and Urban Design Plan, a suggested condition of this consent.

No further path comfort facilities, such as bathrooms or water fountains are proposed.

## 3.14 Traffic Services

Traffic services such as safety barriers, signage and marking will form part of the detailed design stage. So as to avoid visual clutter, the intent would be to only use coloured surfacing in locations of high conflict (such as where the path crosses in front of bus stops as an example).

Parking will be retained where possible to do so adjacent to the shared path of the seaward side, however some parking that is not currently formally marked out will inevitably be lost due to limited space availability. Some locations where formalised parking will be marked out and retained is shown in Figure 3-12 and Figure 3-13.

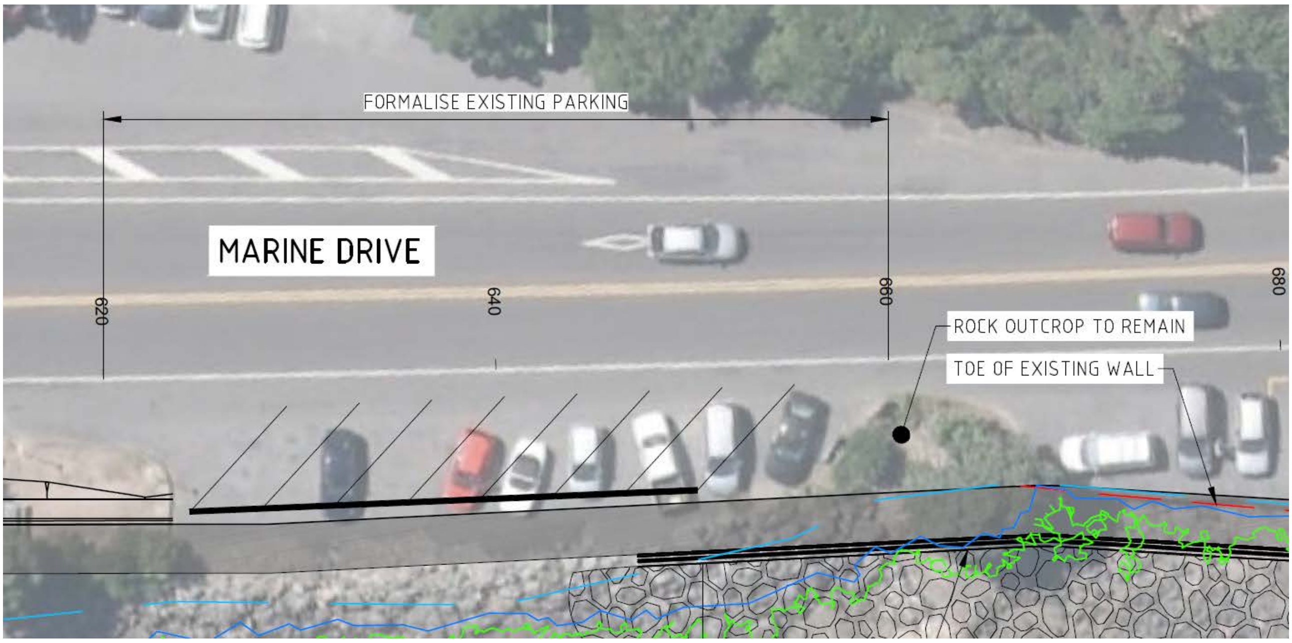


Figure 3-12: Formalised parking at north end of scheme

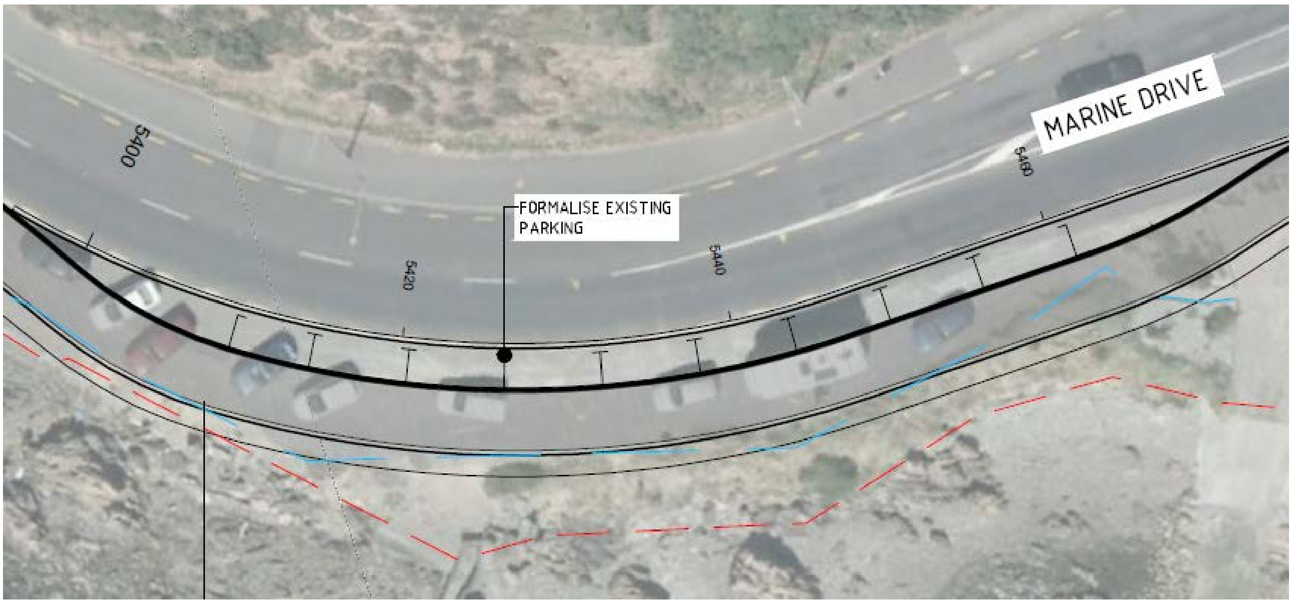


Figure 3-13: Formalised parking at south end of scheme

# 4. Construction Methodology

The Project construction methodology described within this section is proposed and provides measures to avoid, remedy, or mitigate any adverse effects of activities on the environment. Final construction methodology will be developed by the Contractor once consent conditions are confirmed, and further design has been undertaken.

This section provides an overview of the proposed construction methodology across the Project, and provides information in regard to the nature, scale and duration of construction activities throughout the Project, including:

- Construction programme
- Construction activities
- Construction management

## 4.1 Construction Programme

An indicative construction programme for the Project will be developed. This is developed to understand the duration of the Project to enable a better understanding of cost; to recognise the potential complexities in the construction programme, allowing identification of potential opportunities and to recognise the critical path activities; and to mitigate potential effects on the environment and community. This programme will be incorporated into the Construction and Environmental Management Plan (CEMP) to be prepared as a condition of this consent.

### 4.1.1 Staging of Works

Presently Hutt City Council (HCC) intends to deliver the entirety of the Project (at expected present day construction cost rates) in around 6 years (as a maximum), but this will be dependent upon council and government funding decisions. The intention is to stage the works per bay and that for each stage that a bay is completed in its entirety.

Part of York Bay was undertaken previously and, while there may have been clear reasoning for this, it is not an ideal situation for either the bay community, or wider users of the facility. Partial works lack completeness and result in a haphazard facility for users and a sense of 'being in limbo' for the community. Completing each bay in totality also provides consistency between the bays and avoids the risk of small inconsistencies arising, given the methodologies of different contractors which may undertake the work across successive years. From an ecological perspective, a staged approach also gives newly constructed areas a chance to receive species recruitment from the adjacent bays.

Currently it is proposed to complete Windy Point first, followed by Point Howard/Sorrento, and then Lowry Bay, over three separate financial years. This will be followed by the other bays. The construction of the first stage of the Project is intended to commence in 2019. The staged implementation is subject to change following further discussions with HCC and confirmation of funding availability.

### 4.1.2 Duration and Timing

As mentioned above, the construction of the shared path is likely to be undertaken over a six year period. Each section is likely to take about 3-6 months (depending on bay length and complexity) to complete depending on the extent of the particular works per bay.

Specific details such as when road closures might occur will be developed at a later date with the contractor, immediately prior to construction starting. This will form part of the CEMP. Works will generally be undertaken during daylight hours except where operations are being carried out at low tide or on the road that will require work to be undertaken during off-peak hours or at night. The CEMP will also outline periods and locations were specific works cannot be undertaken – for example at little blue penguin breeding grounds during breeding season.

## 4.2 Site preparation, excavation and demolition

In general, the construction of the seawall and shared path will typically involve the following tasks:

- Install site office facilities and traffic control

- Install silt control measures. Details of the control of sediment and cementitious material is set out in section 4.5 of this report.

There are sections of the seawall where excavation within the coastal marine area (CMA) will be necessary where the toe of a seawall is to be embedded into the substrate. This will occur for the construction of the single, double and triple curve walls and the cantilever retaining walls supporting the road to the rear of the revetment sections. Excavation within the CMA will also be necessary to accommodate the foundations for the boat ramps and access steps and to toe-in the base of the revetment treatments.

The construction zone will be clearly demarked to include a minimum working distance beyond the toe of the new seawall to allow for excavation of the bed to construct and bury the seawall edge. Demarcating the allowable area for access on the beach floor/intertidal area will also help to minimise encroachment of the construction on adjacent areas.

The following tasks will be typically carried out:

- Breaking out the existing seawall as necessary to allow for construction of the new wall. In some instances, the complete removal of the existing seawall may be required to provide access to construct the new wall.
- Demolition and removal of the existing wall would be undertaken using an excavator and/or excavator mounted breaker.
- The area of disturbance would be kept to the absolute minimum to undertake the construction. Where there is adequate space, machinery would work from the road verge rather than from the beach/foreshore, meaning that there will be less area outside of the direct excavation zone that is subject to construction plant. Working from the road verge will however require a lane closure with the resulting traffic disruption. The detailed methodology will be addressed in the CEMP for specific sites.
- All demolition is to be contained within a silt-fence or behind the new seawall.
- It is highly likely that the existing concrete material is, by current day standards, of substandard quality to be used in the seawall itself. All demolition material would most likely have to be removed from site, but it could possibly be put through a crusher and reused on another construction site.
- Discarding demolition waste (concrete, non-native bulk fill, reinforcing) would be to an appropriate landfill site.
- There would be no exposure of non-native backfill material to sea (to be enclosed by seawall and silt fences).
- The use of the excavator on the beach would be minimised to limit damage to the beach area. The excavator would not be stored overnight nor maintained or refuelled on the beach.
- Machinery working in the foreshore/harbour floor would track across weight-bearing mats to reduce compaction of softer/looser substrate and help to protect the intertidal surface structure within the beach areas. It will also provide a defined road for the machinery to work from, further reducing unnecessary impact to the beach/harbour floor substrate.
- Whilst excavation will generally be shallow (<1m) for most of the Project, in some beach locations site investigations have indicated seawall foundations may need to extend down up to 5m below current beach level in order to reach material of acceptable bearing capacity, whilst ensuring the design is not compromised (undermined) by the long-term effects of coastal erosion. These deeper foundations will utilise traditional deep foundation techniques such as reinforced concrete cut-off walls, sheetpiling, or bored or driven reinforced concrete piles as required, depending on depth and loading on the foundation[7]. Details will be provided in the CEMP for the specific sections of seawall.
- Excavations will need to be dewatered to enable foundations for the seawall and revetment to be constructed. Methods used to dewater are outlined in section 4.6 of this document.
- Excavated beach material is to be stockpiled nearby and replaced on the beach after construction of each section of wall as appropriate. This will only relate to suitable natural weathered material that has been colonised by intertidal biota for subsequent reintroduction and relates mainly to larger rock

[7] These locations include Sonnets Bay (50m), Lowry Bay (585m), York Bay (450m), Mahina Bay (220m), Sunshine Bay (250m)

material that can be placed in front of the new seawalls rather than sandy/gravel beach material. The stockpiling and placement only refers to natural beach materials.

Figure 4-1: Removal of sections of existing seawall

## 4.3 Construction

In situ concrete construction has been adopted for this project as it is considered to provide a far better engineering solution from a constructability perspective than precast construction, in particular when considering the length of the Project and the potentially difficult horizontal and vertical construction challenges associated with this site. This method of construction has also been proven to work well during the construction of the previously constructed York Bay section of wall. Whilst there are obvious benefits associated with a precast solution, they are generally focused on speed of construction and surface finishes. For a project that has the potential to present significant challenges during the construction stage a highly adaptable method of construction is considered to be of paramount importance. This flexibility is only achieved with in situ concrete construction.

The environmental challenges of in situ concrete construction are mainly associated with the risks of releasing of cementitious products into the aquatic environment which is detrimental to intertidal ecology. This methodology includes clear procedures for the pouring of concrete and dewatering activities.

- Wall construction comprises two main types:
  - Curved wall (single, double or triple, depending on wall height)
  - Rock revetment
- The curved walls will be in situ reinforced concrete with the same curve proportions as the double curve seawall installation in York Bay. The number of curves will be dictated by the height from beach level to shared path level. The curves will be constructed using prefabricated formwork. The void to the rear of the curved façade will be backfilled with no-fines mass concrete. Drainage will be provided in the form of weepholes.
- The rock revetment comprises two components: a reinforced concrete cantilever retaining wall supporting the shared path, and the rock rip rap which is typically placed in front of this structure on a geofabric and AP65 granular bedding layer. Geofabric may only be necessary when placed on unconsolidated sediment (beach, cobbles and gravels). Placement of geofabric over rock platforms may not be required as it will depend on the bedding material. If geofabric is placed, the edge and tails of the geotextile is to be hidden beneath the rock.
- An integral part of the construction will be access provision to the beach areas via steps and boat ramps. Any new structures provided will be orientated parallel to the road to minimise building into the

foreshore. Both steps and boat ramps will comprise in situ reinforced concrete (designs are shown in section 3.3 of this document).

- Careful consideration has also been given to the transitions between adjacent structural types, in particular the curved wall to rip rap wall juncture as shown in the designs (section 3.4).
- In general, the in situ founding material is competent weathered rock and the installation for the foundation base would be completed using an excavator and/or breaker either from the road verge or from the beach. As stated in section 4.2 above, where possible the machines will work from the road as it is preferable to minimise disturbance and minimise extending the construction zone out into the foreshore.

Figure 4-2: Preparation for foundations

- Following completion of the foundations, the lower level of the seawall will be poured on site in sections using shaped formers for the curved wall or vertical formers for the cantilever wall. Both wall types, due to their height, will be formed in 'lifts' to aid construction and minimise time in the intertidal zone.
- The first lift of the wall is generally poured in sections using shaped formers as per the photo below:

Figure 4-3: In situ concrete pouring using shape formers (lower section)

- Working within the tidal zone poses constraints on construction zones and concrete pours. Shoring will be required at some locations to enable construction to take place in a timely and environmentally acceptable manner. The location, type and depth of shoring to be used will be determined in the CEMP.
- Dewatering is likely, and any discharges are proposed to be treated and either discharged to the sewer or pumped directly back to the sea. Details of dewatering is outlined in section 4.6.
- The second level of wall is poured using the same formers as shown in the photo below.

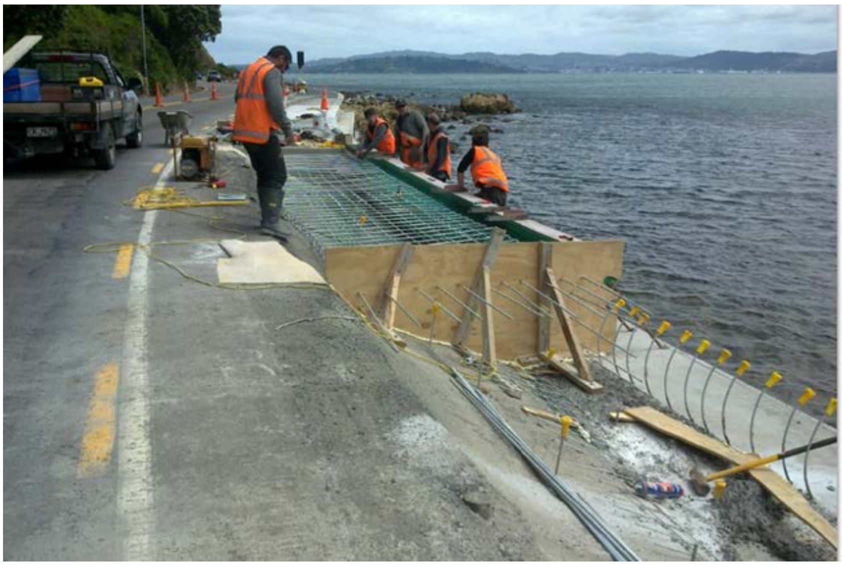

Figure 4-4: In situ concrete pouring using shape formers (upper section)

- Following the pouring of the upper section of wall the surface is prepared and sealed with asphalt, concrete edging and concrete kerb separator blocks installed.
- The machinery used to pour the concrete would be retained on the road verge, with mainly personnel working within the intertidal/beach area.
- Up to 20 metre lengths of seawall would be exposed at any one-time during replacement to contain small increments of potential discharge of sediments and reduce the risk of wave overtopping.

- Careful consideration and multi-day forecasting of tide, wind and wave conditions would be needed to prevent overwhelming of defenses during construction. This will form part of CEMP. This is essential given the known sensitivity and frequency of overtopping, and the risk of cementitious materials being washed away during storm events.
- Machinery working on the beach floor/intertidal area would use biodegradable hydraulic fluids.
- A spill kit would be maintained on site at all times, to contain any accidental spills relating to machinery working in the area.

Texture is to be incorporated into the concrete surfaces of the seawalls, to provide opportunities to establish biota habitat. Providing a fully textured finish (i.e. exposed aggregate concrete) on an in situ structure is not considered feasible due to expense and the potential environmental effects of water blasting 'green' concrete in the marine environment. However, a form liner/void former can be used to create a suitably textured surface on the vertical curved faces (ca 5mm in depth) and on the flat step of the curved seawall (ca 50 – 70mm in depth). Details of these features are to be provided in the Landscape and Urban Design Plan, where there will be input from the design ecologist, engineer, landscape architect and urban designer.

## 4.4 Beach Nourishment

It is anticipated that the existing beach sediment that is present both within the proposed footprint and immediately seaward of the construction area will be moved down the beach face prior to the construction of the shared path structure rather than removing and stockpiling. This is to retain the material on the foreshore to provide a buffer against coastal processes.

This is likely to be done by a hydraulic excavator operating along the crest of the existing wall and with machinery working along the upper part of the beach adjacent to the existing seawall. The sediment will be pushed immediately seaward of the proposed wall, but it is expected to be largely above the existing beach footprint, creating an over-steepened upper intertidal beach face (typically with a seaward slope of 1(V):3-5(H) depending on the reach of the excavator. Over the construction process this sediment will be transported down and along the beach face depending on the incident wave conditions, with the net result being a slight increase in levels along the beach area.

For the placement of imported beach sediments, it is assumed that the sediment will be transported to site by truck. The sediment could either be:

- end tipped to the foreshore over the edge of the wall
- placed on the road/cycleway and then redistributed by hydraulic excavator
- unloaded from the truck by hydraulic excavator with direct placement onto the foreshore (i.e. no temporary stockpiling on the road/cycleway.

To minimise the extent of disturbance it is proposed to place imported sediment over a smaller area. This is less than the effective beach length to provide a shorter area where the beach sediment can be placed, with the expectation that coastal processes will assist in redistributing the sediments within the embayment. Control structures are not proposed for the beaches given that they are largely headland controlled or within embayed areas so limited sand transfer is expected.

It is assumed that all imported sediment would be of a marine source or processed to remove fines, so only comprise minor portions of silt (typical beach sediments can have 2-3% of silt. This means that there is no additional sediment erosion control required seaward of the beach nourishment process.

Details on beach nourishment are contained in section 6 of the Beach Nourishment Report, Appendix F of the resource consent application.

## 4.5 Sediment Control

The main risk to the intertidal and subtidal environment during the construction phase is potential sediment-related effects as well as the accidental release of water contaminated with cementitious products. Sediment generation would be kept to a minimum through the use of crushed material that is clean of fines in the construction of the shared path. Sediments introduced as part of the construction would not incorporate fines smaller than sand particles, to promote quick settling of suspended particles.

Any excavation in areas where it is predominantly gravel/sand beach zone (as opposed to the rocky shore areas) would also be undertaken using methods that cause the least amount of sediment to be released from the construction area. This would include bunding / shuttering that will effectively contain and isolate the construction area from the incoming tide until construction is completed. This bund could be built from clean beach gravel sourced from the excavated area, or could be achieved via the use of sheet piling. Such a structure would need to be large enough to allow construction to continue 'in the dry' while the tide is in and strong enough to withstand waves and the incoming tide.

In areas where the material in the construction footprint is of larger material (i.e., rocky shore habitats) or where seawall works occur close to the mid tide mark, alternative sediment control devices will be provided. These may include sand filled geotextile containers or tubes (sand to be locally sourced) that can be easily removed following completion of the works.

Earthworks and construction activities (including beach nourishment) will be sensitive to tide timing and tidal height to avoid movement of sediment potentially containing fine sediment in a wet environment. Storm events will very likely overtop any sediment control mechanism used. During overtopping, sediment will likely be shifted into the excavated seawall footing area. A site plan for sediment removal would be developed. Site management will monitor weather conditions to anticipate any weather and high tide events that may lead to high seas and plan mitigation measures accordingly. These details will be addressed in the CEMP for the specific sections of seawall.

If dewatering is required during construction, then this will be undertaken as set out in Section 4.6 below to adequately deal with any discharge so as to reduce the impacts of discharging dirty water.

A methodology for ensuring that wet cementitious products are not discharged to the environment will include:

- Pouring of concrete in situ to be done in the dry.
- If it is not possible to undertake the works in dry conditions, then the following steps will be followed:
    - Contain the potentially contaminated water, and pump to the wastewater network
    - Contain the potentially contaminated water and pump to a treatment structure where the water can be treated to get pH to a level suitable for the local receiving environment; determining the suitable level may require sampling pH in the bay during times when it would be expected that discharges would occur.

If discharging suitably treated water to the environment (either directly or indirectly via the stormwater network) then this is to be done at high tide when there is the greatest level of dilution. The pH of any water on site is to be monitored to ensure compliance with this requirement.

## 4.6 Dewatering of Excavations

Dewatering of excavations is needed to remove ground water from the work area so as to construct the foundations for the seawalls and revetments. Given the close proximity to the coastal environment, the excavations will be heavily influenced by tidal flows. Where possible the amount of water entering the excavation will be minimised by diverting surface water away from the trench. This may be done by constructing a bund between the sea and the excavation to divert water. Trench support is often provided by either traditional trench shoring or sheet piling, depending on the location, depth of excavation, and the ground conditions. Trench shields and plates are also used and while they act like sheet piling, they do not provide a complete seal for groundwater inflow from the sides of the excavations.

- Dewatering is typically carried out by installing a pump system in the trench/excavation.
- Dewatered water would be pumped to a settlement tank or a large container (such as a shipping container) where it is retained for the length of time required for sediment to settle. This varies depending on factors such as dewatering rates and what type and how much sediment is present in the dewatered water. Ideally, the concentration of sediment in the water will be less than the permitted activity standards of 0.5g/m$^3$ in the operative and proposed regional plans for a discharge to the stormwater system.
- Water is removed from the top of the settling area, where water is cleaner. A float is used to keep the intake off the bottom.
- A filter is used on the pump inlet to help minimise sediment in the discharge.
- Sludge and sediment from the bottom of the tank may be removed by a vacuum excavation systems truck (sucker truck) or excavator and disposed of off-site.

- All water from the excavations is to be treated for sediment and cementitious products before being discharged.

## 4.7 Construction and Environmental Management

During construction, specific mitigation measures and environmental monitoring will be required to ensure that potential adverse effects on the environment are avoided, remedied or mitigated, as appropriate.

A Construction Environmental Management Plan (CEMP) will be prepared for the various stages of the Project. It will include the environmental management and monitoring procedures to be implemented during the Project's construction phases. The CEMP outlines details of the 'who, what, where and when' in respect of the environmental management and mitigation measures to be implemented. The CEMP will be a condition of the consent and will be updated and modified as appropriate once a contractor is appointed.

The principles and general approach to managing the environmental effects will be set out in the main body of the CEMP. The management of specific construction effects (such as noise and vibration) will be set out in more particular detail within the suite of environmental management plans (subplans).

The CEMP, its subplans, and other site-specific environmental management plans (such as landscape and urban plan) for locations along the route, are to be consistent with and complement the AEE report, and will be developed in accordance with the proposed consent conditions. Once the conditions have been confirmed through the consenting process, the CEMP will be prepared in conjunction with the contractor prior to works commencing. A separate CEMP will be prepared for each section of work (individual work package).

Construction of the Project involves truck movements, lane closures and periods of lowered speed limits on the road, all of which have the potential to cause inconvenience to road users and residents. A Construction Traffic Management Plan (CTMP) will need to be prepared and included in the CEMP. It will detail traffic management methodologies and mitigation measures to be adopted for the Project during construction. The CTMP details the traffic control activities and the effects on pedestrians, cyclists, residents, businesses, public transport, and general traffic.

Noise and vibration will result from construction activities. The intention is that all construction, demolition, and maintenance work shall comply with NZS 6803P 'Measurement and Assessment of Noise from Construction, Maintenance and Demolition Work' and therefore comply with the activity status in the HCC District Plan.

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