Jacobs

Memorandum

Motunau: upgrade of river mouth training wall

Subject	**Motunau: upgrade of river mouth training wall**	**Project Name**	Hurunui Coastal Hazards
Attention	Monique Eade	**Project No.**	IZ128301
From	Derek Todd		
Date	18 January 2023		
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1. Background

At a community workshop in October 2022, members of the community put forward the option of extending the existing true right mouth training wall to provide a greater level of protection of the cliff fronting the settlement from coastal erosion due providing shelter from incoming wave events. There is a perception within the community that the frequency of erosive cliff episodes has increased as the training wall has been degraded over time, and that repairing/extending the wall will reduce this erosion. The purpose of this memo is to provide a high-level assessment on whether repairing/extending this training wall will reduce cliff erosion at the settlement.

Google Earth Images, the training wall has been measured to extend from the shoreline in the order of 180 m across the shore platforming in a SSW direction along the true right side of the mouth channel (see Figure 1).

Figure 1: Current extent of the True right Motunau River Training Wall. Base photograph Nov-2010

The exact age of the training wall is unknown, but from the description of the environment section of a 2005 consent application (CRC052254) by the Motunau Fisherman's Association (MFA) notes that "*During the late 1980s and early 1990s the local fishermen placed concrete blocks and large rocks along each side of the Motunau River mouth to 'train' the river and enhance the natural river flow ability to flush out from the channel the sediment built up by southerly storms which regularly created a dangerous bar*". Based on these dates, it is likely that the at least the start of this placement preceded the RMA, and therefore no consents were granted for the activity. However, the conditions on a consent granted to the MFA in August 1993 (CRC930734) to dredge the river mouth and deposit the material in the Coastal Marine Area includes the following references to the existence of the training walls:

1 *The grantee shall not use concrete, rubble or metal in performing any maintenance repairs to the western mouth training wall.*
2 *The grantee shall not increase the length of any mouth training walls in exercising this permit.*

There is no reference to a consented length or elevation of the training wall in consent documents for this consent filed in the ECan consents database.

This consent expired in October 2005, and was replaced by consent CRC052254 in June 2005. The conditions on this consent included the following reference the training walls:

4 *Works to maintain and repair the existing seawalls shall only use like materials, and shall not increase the height or length of the seawalls.*

Again, there is no reference to the length or elevation of the works covered by this consent. This consent expired in July 2017, but has been subsequently transferred to consent CRC180614 with the same conditions. This latest consent is due to expire in June 2040.

HDC staff met representatives of the MFA in October 2022, who indicated that under their existing consent it was possible to build the existing training wall up to 2 m in elevation and extend 20 m in length to assist with protecting the cliff, and that they had 250 1 m^3 concrete blocks available to undertake this work. However, this perception of being able to increase the height and length of the training walls is not supported by the consent conditions given above.

2. Existing Protection from Training Wall

Due to limitations of the lidar, except for the landward 50 m, it is not possible to determine the elevation of the existing training wall level or platform in the vicinity of the wall. This landward section of the wall has elevations in the range of 0 m to 0.5 m LVD, and cross-section elevations of the wall above the platform are a similar range. It is assumed that outer wall has lower elevations as the platform reduces in elevation seaward, and greater height reduction of the original structure. The outer platform has an assumed elevation of -0.5 m LVD.

The present design storm water level (1% AEP storm tide ex wave set up) across the shore platform was calculated as being 1.88 m LVD. Depth limited waves across the platform (assuming outer edge platform elevation of -0.5 m,) only added wave set up of 0.04m to these water levels (for depth limited wave height of 1.86 m).

Therefore, to provide full protection to for present design storm water levels, the training wall would need to be in the order of 1.4 m higher at the landward end of the wall, and more likely over 2 m at the

seaward end of the wall. Over the 180 m length of the wall, to provide a slope wall cross-section, this top-up would require more than the 150 blocks that the MFA have available.

Sea level rise is projected to add 0.23 - 0.32 m to these water levels over the next 30 years, (RCP8.5 & RCP8.5+ scenarios) and to add 0.4 – 0.56 m for the same scenarios over the next 50 years. Therefore, to provide full protection to the increased design storm water levels over the next 50 years (plus small increase in wave set-up for larger depth limited waves – up to 2.3 m in 50 years time), the training wall would need to be built to elevations in the order of 2.3 – 2.5 m LVD, with heights above the adjacent platform being possibly up to 3 m at the northern end of the wall.

As shown in Figure 2, if the existing training wall was raised to the above levels, the current wall length and alignment would offer the following protection distances along the cliff.

- For an inshore southerly wave approach: Cliff protection limited to in the order of 65 m west of the base of the training wall.
- For an inshore SSE wave approach direction: Cliff protection for in the order of 140 m west of the base of the training wall.
- For SE inshore wave approach direction: Cliff protection for in the order of 280 m west of the base of the training wall.
- For ESE inshore wave approach direction: Cliff protection extended for whole length of the cliff (approximately 400 m) and along the eastern proportion of Sandy Bay.

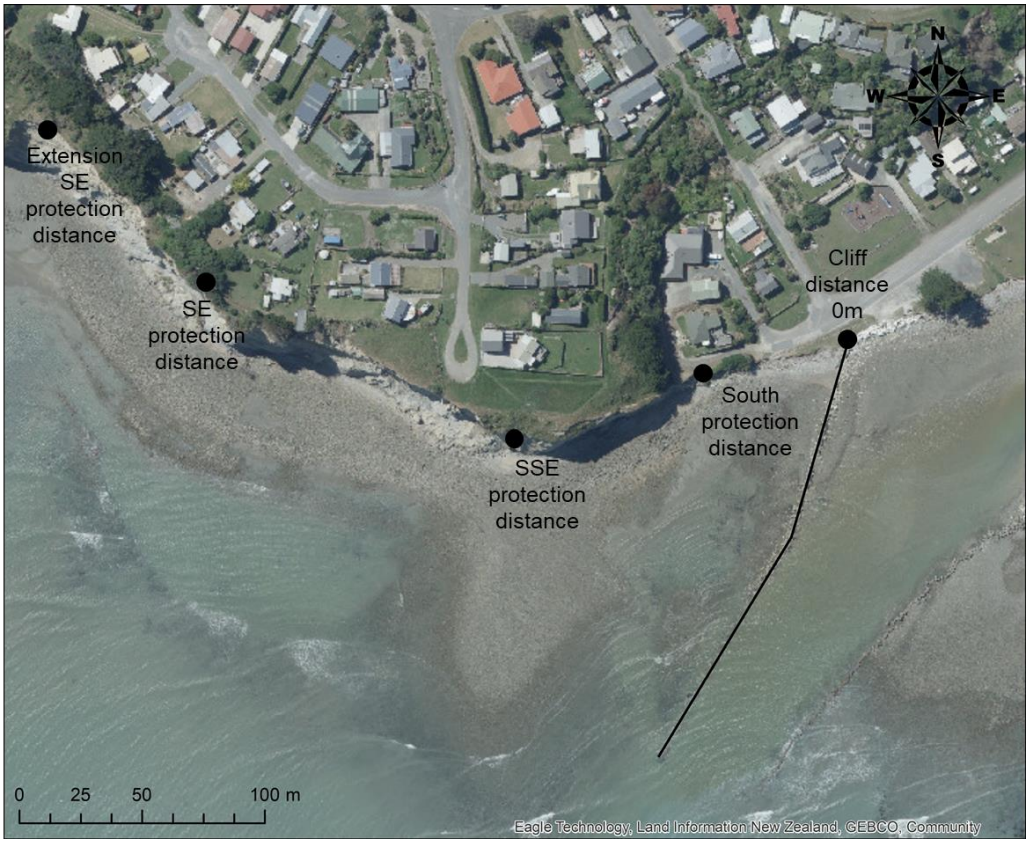

Figure 2: Protection lengths for repaired training wall raised to required design height for 1% AEP storm tide protection and for 20 m extension of the wall

Increasing the length of the training wall by 20 m would extend the length of cliff protected from inshore waves by the following amounts:

- For inshore southerly waves: Protection length extended by around 5 m to a total of around 70 m from the base of the training wall.
- For inshore SSE waves: Protection length extended by around 20 m to a total of around 160 m from the base of the training wall, less than half the length of the cliff.
- For inshore SE waves: Protection length extended by around 90 m to a total of around 370 m from the base of the training wall., which covers the majority of the cliff east of Sandy Bay and is only approximately 50 m less that the proposed length of the wave trip wall along the base of the cliff.

Note that the training wall provides no protection for inshore SW, or westerly inshore wave approach directions.

What is required to complete this high-level assessment of protection efficiency of repairing/extending the training wall is to determine the frequency of inshore wave approach from each directional sector, particularly for higher energy waves.

3. Inshore wave climate on the Motunau shore platform

There are no records of inshore wave climate at Motunau, so these have been inferred from modelled deeper water waves obtained from the Hindcast NZ wave Data Tool 1993-2019[1]. The closest hindcast site is located approximately 25 km off the coast of Motunau in 47.6 m water depth.

The resulting wave climate from this site are summarised in Table 1.

Table 1: Summary of wave climate from Hindcast NZ wave data tool.

Direction		Significant wave height		Mean Wave Period		Storm wave approach (taken as significant wave heights ≥ 3)		Mean storm Wave Period	
NE	8.1%	≤ 1m	36.4%	≤ 4 sec	2%	NE	34%	≤ 7 sec	12.3%
E	46.3%	>1m to ≤ 2m	53.8%	>4 sec to ≤ 6 sec	37.8%	E	21%	>7 sec to ≤ 8 sec	20.4%
SE	32.4%	>2 m to ≤ 3 m	8.1%	>6 sec to ≤ 8 sec	44.2%	SE	21%	>8 sec to ≤ 9 sec	47.9%
S	9.3%	> 3 m	1.6%	>8 sec	16%	S	24%	>9 sec to ≤ 10 sec	10%
SW to N	3.9%							> 10 sec	9.2%

For these deep water storm events arriving from the NE through to south directions, the inshore wave approach directions will be modified by refraction off the offshore bathymetry to the south and east of

[1] NZ Wave Data Tool: Hindcast 1993-2019 (uoa-eresearch.github.io) is a high resolution 20-year partitioned hindcast for the New Zealand area developed by João Albuquerque, Jose A. A. Antolínez, Richard Gorman, Fernando J. Méndez, Giovanni Coco.

Motunau shore platform, which needs to be taken into account for determining the potential effectiveness of repair/extension of the training wall.

A high-level single line wave refraction analysis of the deep water storm wave directions indicated that storm waves are refracted to approach the training wall in a much narrower directional band of SSE around to ESE. Refracted inshore wave heights are estimated to be similar to the offshore waves.

Southerly storm waves will also be modified by diffraction around Motunau Island, and all wave approach directions will be diffracted by the tip of the training wall. The analysis of the resulting wave directions and heights from these more complex diffraction processes are beyond the scope of this high-level assessment. However, due to these processes, all areas of the cliff will still be exposed to storm wave action, but with a lower energy wave environment than the refracted storm waves.

4. Resulting cliff protection performance

Taking account of the wave refraction on the storm wave direction distribution and the cliff protection lengths from the training walls gives the following high-level results of the protection efficiency from a repaired training wall to the required design elevations and from a possible extension in wall length by 20 m.

Table 2: Summary of cliff protection performance for storm event directions

Deep Water Storm Wave Approach Direction	Refracted Inshore Wave Approach Direction	% of storm waves	Cliff Protection Lengths for existing wall length	Cliff Protection Lengths for wall length extended by 20 m
South	SSE	18%	140 m	160 m
SSE	SE	9%	280 m	370 m
SE	SE	9%	280 m	370 m
ESE	SE	9%	280 m	370 m
East	ESE	14%	>400 m (Total length)	>400 m (Total length)
ENE	ESE	4%	>400 m (Total length)	>400 m (Total length)
NE	ESE	33%	>400 m (Total length)	>400 m (Total length)

These results indicate that repairing the existing training wall to the required design height for 1% AEP storm tide protection (incorporating 50 years of sea level raise) would provide some degree of protection for the total length of the cliff in 50% of the storm events, and for 70% of the length (i.e. 280 m) for a further 27% of storm events. A 20 m extension of the training wall could increase this protection to over 90% of the cliff having some degree of protection for 80% of the storm events.

However, due to more complex wave diffraction processes around Motunau Island and from the end of the training wall, all areas of the cliff will still be exposed to some degree of storm wave action, but at lower energy than the current situation. Any consideration of how much reduction in wave energy would require a more detailed inshore wave analysis.