HURUNUI
District Council

2024

MOTUNAU COASTAL ADAPTATION PLAN

EXECUTIVE SUMMARY

The community have worked towards building adaptation pathways to respond to the changing coastal hazard risk to Motunau Beach. Options considered included no or low intervention approaches through to hard engineering and proactive relocation.

Short term options

There are several things that can be done now to help reduce the risk and the urgency to adapt in the future.

Dune Planting and Maintenance

The dunes provide vital coastal inundation protection to Motunau Beach. As the dunes erode so to does the protection they offer. By protecting and enhancing the dunes you are protecting your key flood defence.

Stormwater Management

An estimated 20% of cliff erosion at Motunau Beach is the result of stormwater causing top down erosion. By managing stormwater runoff we will be able to limit this.

Medium term options

If we identify future actions, we can start working towards implementing them before they are required.

Site specific inundation protection

Some properties at Leithfield Beach are at greater risk of floodwater than others. There are measures that can be taken by individual property owners to reduce this risk.

Wave trip wall

A wave trip wall at the foot of Motunau cliff could help reduce the speed bottom-up erosion by decreasing wave energy. By reducing erosion of the cliff residents will be able to reside in Motunau for longer.

Maintain/Enhance planning provisions

Planning provisions require new houses to be built with a minimum floor height of 400mm above a 1 in 200-year flood event, and also restrict development within the Coastal Hazard Zone. Enhancing these and other provisions will serve to allow for better adaptive planning.

Extension and maintenance of the training wall
Erosion rates have been anecdotally slower when the training wall was in good condition. Modelling suggests that repairing would provide some degree of protection to the cliff in 50% of storm events, potentially reducing the rate of erosion.

Rock toe at Sandy Bay
While costly and challenging, rocks at the toe of the Sandy Bay dunes may help in reducing erosion rates, protecting the Hall Street development for longer.

Long term options

As sea level rises there will be increasing wave energy eroding the cliff at Motunau, as well as the increased likelihood of coastal inundation

Adaptation thresholds for Motunau Beach

Adaptation thresholds describe a situation whereby community values are no longer being protected. We have identified a range of trigger points which determine when we will move from short term options to medium term options.

Dwelling is within 17 m of the edge of the cliff

The edge of the cliff is known to be unstable, and so three years of erosion (three years of annual average erosion (1 m), and one large erosion event (6 m)) has been selected to give sufficient warning. Council will inform residents if their property is within 17 m of the edge of the cliff. This trigger gives property owners time to consider the next steps when their property gets dangerously close to the edge of the cliff.

Significant capital works are required

It is not anticipated that any infrastructure at Motunau Beach will require significant capital works in the next 30 years. If significant capital works are required a trigger point is reached. At this point the community and Council will need to decide if investing in the works is a good investment for the community.

Contamination of wastewater system with saltwater

Two wet wells in Motunau currently channel wastewater to a treatment plant north of the settlement. The contamination of these wells and the treatment plant by saltwater due to sea level rise is a real possibility. The costs associated with altering the wastewater system will be high, and considerations need to be taken into account when looking at whether the cost for this will outweigh the risks if remaining in an area of high coastal hazard.

CONTENTS

1 Introduction 4

1.1 Purpose 4
1.2 Background 5
1.3 Developing an adaptive plan 5
1.4 Changing information 5

2 What is happening? 6

2.1 Uncertainty 6
2.2 Coastal erosion 7
2.3 Coastal inundation (or coastal flooding) 9
2.4 Rising groundwater 10
2.5 Changing risk profile 11

3 What matters most? 12

4 What can we do about it? 13

4.1 The options 14
4.2 The pathways 19

5 How can we implement the plan? 20

5.1 Triggers for change 21

6 Required actions 23

7 References and additional information 25

1 INTRODUCTION

We live on a long narrow island with an abundant coastline. Coastal hazards are part of our reality. The Motunau community have developed this Coastal Adaptation Plan to take control of their future. It sets out how they will adapt to the changing risk over the next 100 years.

It records the outputs of three years of engagement.

1.1 Purpose

This Coastal Adaptation Plan seeks to develop a planned response to coastal hazard risk at Motunau out to the year 2120. In doing so it responds to the following hazards:

- Coastal erosion and cliff collapse,
- Coastal inundation, and
- Rising groundwater.

The community have agreed on an approach for managing this risk. This document outlines the information that informed this discussion, including why particular decisions were reached and how the Plan is to be implemented.

1.2 Background

In 2020 Hurunui District Council (HDC) started a project assessing the current coastal hazards that affect the Motunau community and how these hazards might change over a 30-, 50- and 100-year period.

The project was based off the Ministry for the Environment's Coastal Hazards and Climate Change Guidance 2017 (the MfE Guidance)[1] but was scaled down to an appropriate size for Motunau. The project had four phases:

- What is happening?
- What matters most?
- What can we do about it?
- How can we implement the strategy?

This project is now complete, and the focus moves to implementing the plan.

1.3 Developing an adaptive plan

The MfE Guidance recommends the use of dynamic adaptive pathway planning. An adaptive plan allows us to prepare for the future despite the future being uncertain. It works by preparing multiple pathways that are designed to be dynamic or flexible. This allows the decisions to be revisited as new and improved information becomes available.

The plan is trigger-based, not time-based. These triggers are agreed points where we will revisit our approach or change course. A trigger-based approach means that we don't act until we need to, but we are well prepared to act when we do. The plan sets agreed signals and triggers so we can monitor the change that is occurring and can respond appropriately.

A preferred course of action can be identified now to help guide future investment decisions, but the aim is to leave as many options open as possible. Care needs to be taken when implementing options now that might prevent an alternative option being adopted in future.

1.4 Changing information

The maps and information in this plan are derived from the information available in 2020. Since then, there has been regular updates to the scientific information and national policy guidance. This information has been reviewed throughout the project and does not significantly change the projected hazards.

Doing nothing until we have certainty is not a viable option. By the time we have certainty it will be too late to adapt. An adaptive plan is designed to be agile and accommodate new information as it arises. The information and guidance will continue to be updated. This will be periodically reviewed, and the plan will be amended as required.

[1] (Ministry for the Environment, 2017)

2 WHAT IS HAPPENING?

Motunau is currently at risk of coastal erosion and multiple sources of flooding. These hazards and the risk they pose are summarised below. If you want more detail on any of the hazards, the methodology or the risk the following reports are available:

- Hurunui District Coastline Hazard and Risk Assessment [2]
- Motunau: Upgrade of river mouth training wall [3]

2.1 Uncertainty

We need to plan for an uncertain future. The rate of sea level rise is uncertain. The MfE (2017) Guidance identified four sea level rise scenarios, shown in Figure 1. These are:

- RCP2.6 – low/reduced emission
- RCP4.5 – moderate then declining emissions
- RCP8.5 – continuing status quo high emissions
- RCP8.5+ – continuing status quo high emissions and possible instabilities in the polar ice sheets.

The Hazard and Risk Assessment considered how the hazards might change over a 30-, 50- and 100- year period under the RCP 8.5 and RCP 8.5+ emission scenarios. As time increases the uncertainty in sea level rise increases. We can be fairly certain about the rate of sea level rise over the next 30 and 50 years; there is only small difference between all the highest and lowest sea level rise scenarios. There is much greater uncertainty when looking out 100 years or further.

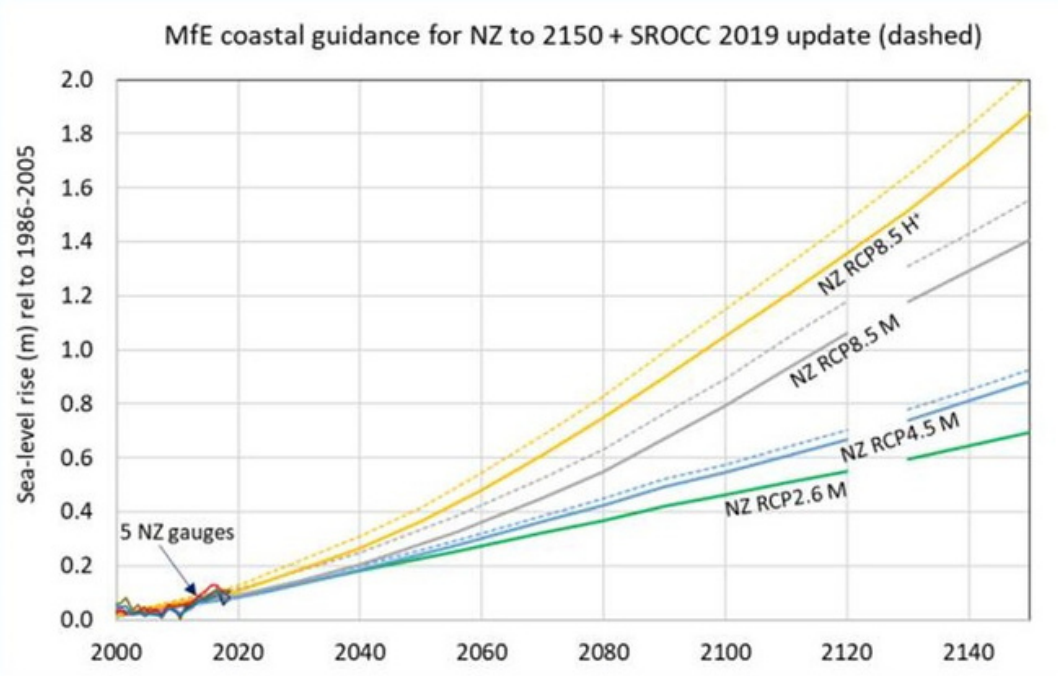


Figure 1: Sea Level Rise scenarios (Ministry for the Environment, 2022)

[2] (Jacobs, 2020)
[3] (Jacobs, 2022)

2.2 Coastal erosion

The coastal erosion assessment considered where the shoreline might be in 2050, 2070 and 2120. The assessment considered the historical shoreline trend, the effects of accelerated sea level rise, and the short-term erosion rate. Some additional work was completed to understand the causes of cliff collapse and the anticipated angle the cliff would need to retreat to before providing a stable slope. [4]

Cliff erosion at Motunau is the result of a combination of two processes:

1. Wetting and drying processes of the mudstone cliff as a 'top-down' erosion process; and
2. Cliff toe erosion and cliff oversteepening as a 'bottom-up' erosion process.

Cliff erosion tends to occur sporadically or after specific events instead of at a consistent rate.

Figure 2: Projected Shoreline Positions in 2050, 2070 and 2120

[4](Jacobs 2022)

If toe stabilisation work is carried out the cliff will continue to erode another 26 m to 70 m in the order of decades prior to finding a stable angle of around 30 – 40 degrees. It is anticipated that the cliff will continue to retreat at a slower rate until it eventually finds an angle of approximately 15 degrees.

Figure 3: Map showing predicted angles of cliff stability

2.3 Coastal inundation (or coastal flooding)

The Parade is subject to coastal inundation. The footprint of the area inundated does not change much over the next 100 years due to the elevation of the terrace. The depth of flood water however is anticipated to increase from 0.69 m for a 1 in 100-year event today to 1.3 m for a 1 in 100-year event in 2050, 1.8 m in 2070 and 2.2 m by 2120.

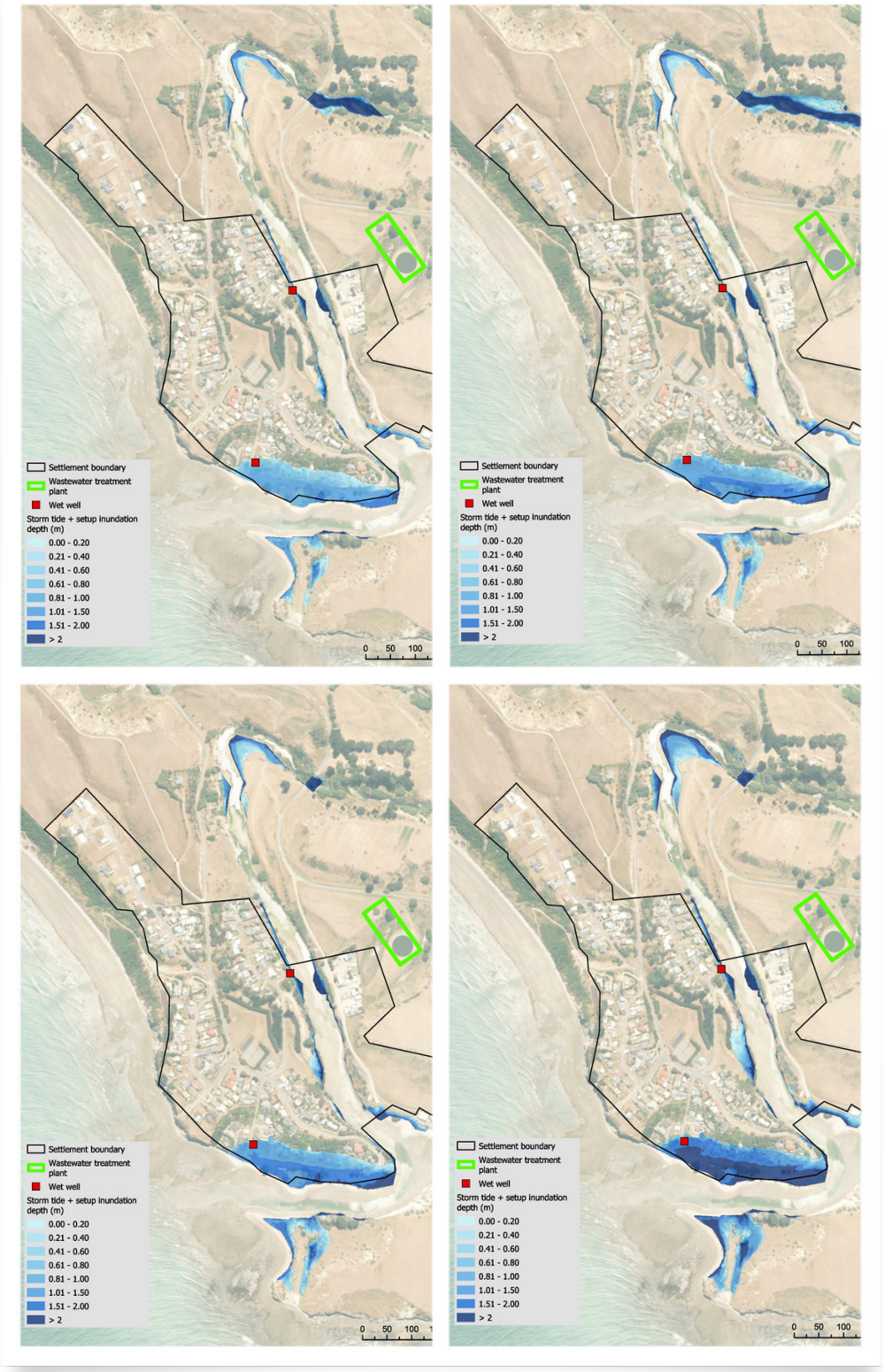


Figure 4a, b, c and d: Coastal Inundation in 1 in 100-year event under RCP 8.5 in 2020, 2050, 2070 and 2120

2.4 Rising groundwater

Shallow groundwater has the potential to affect house foundations and infrastructure. The majority of the Motunau settlement is elevated on the high terrace. The depth to groundwater over most of the settlement is >10 m Below Ground Level (BGL) and remains this way for the next 100 years. On the lower river mouth terrace, the current depth to groundwater is in the range 5-10 m BLG. With 100 years of sea level rise this reduces to 1 m BGL and <0.5 m BLG along the foreshore.

A high groundwater table also limits the ability for the water to drain away following large rainfall and flood events.

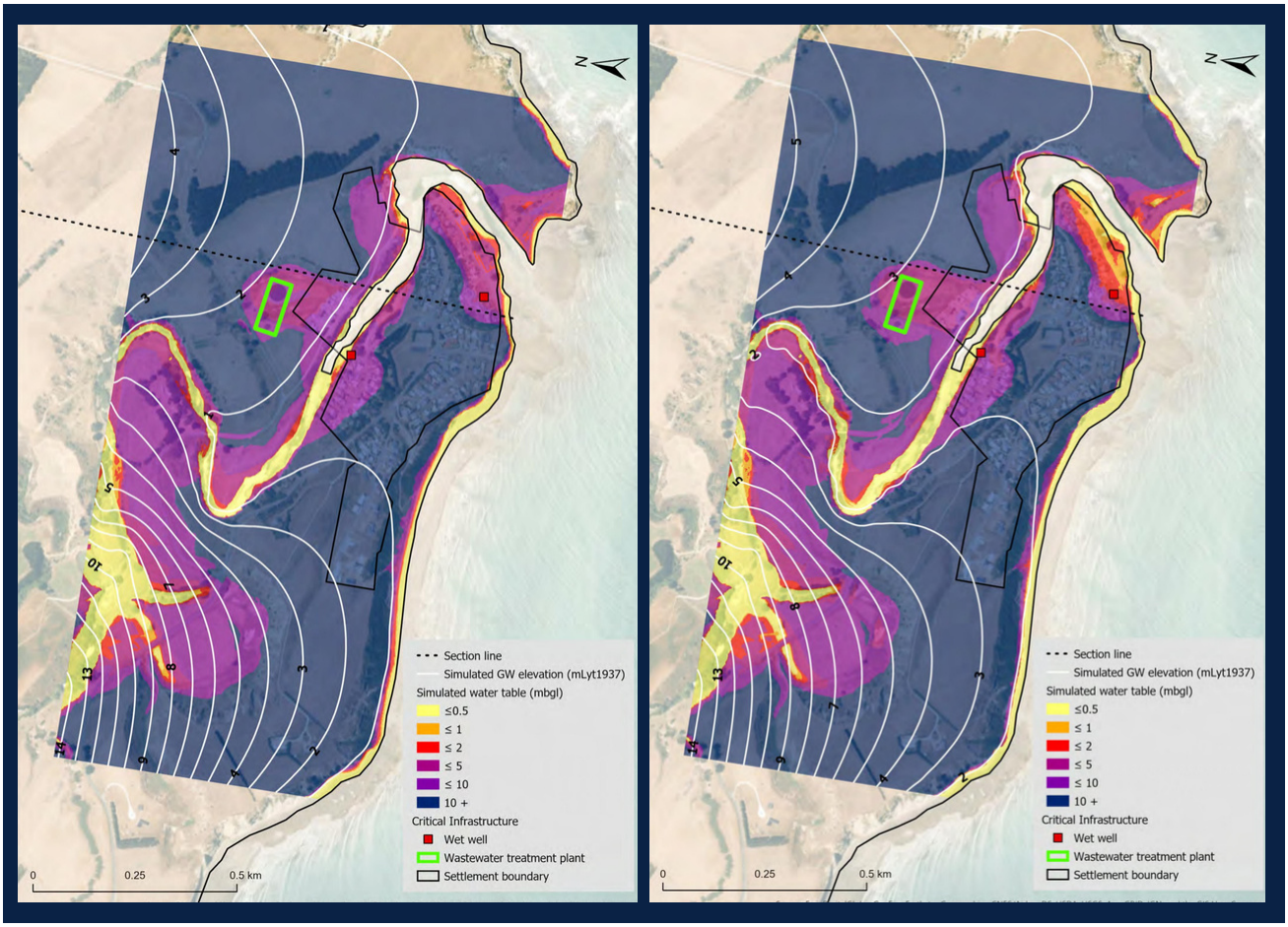


Figure 5a and b: Indicative Average Groundwater Depths under RCP8.5+ in 2020 (left) and 2120 (right)

2.5 Changing risk profile

This risk also changes over time. We know that we are expecting 1 in 100-year events to occur more frequently as sea levels rises. What we consider a 1 in 100-year event today could occur every 50-60 years by 2050, every 20-30 years by 2070 and every 1-5 years by 2120.

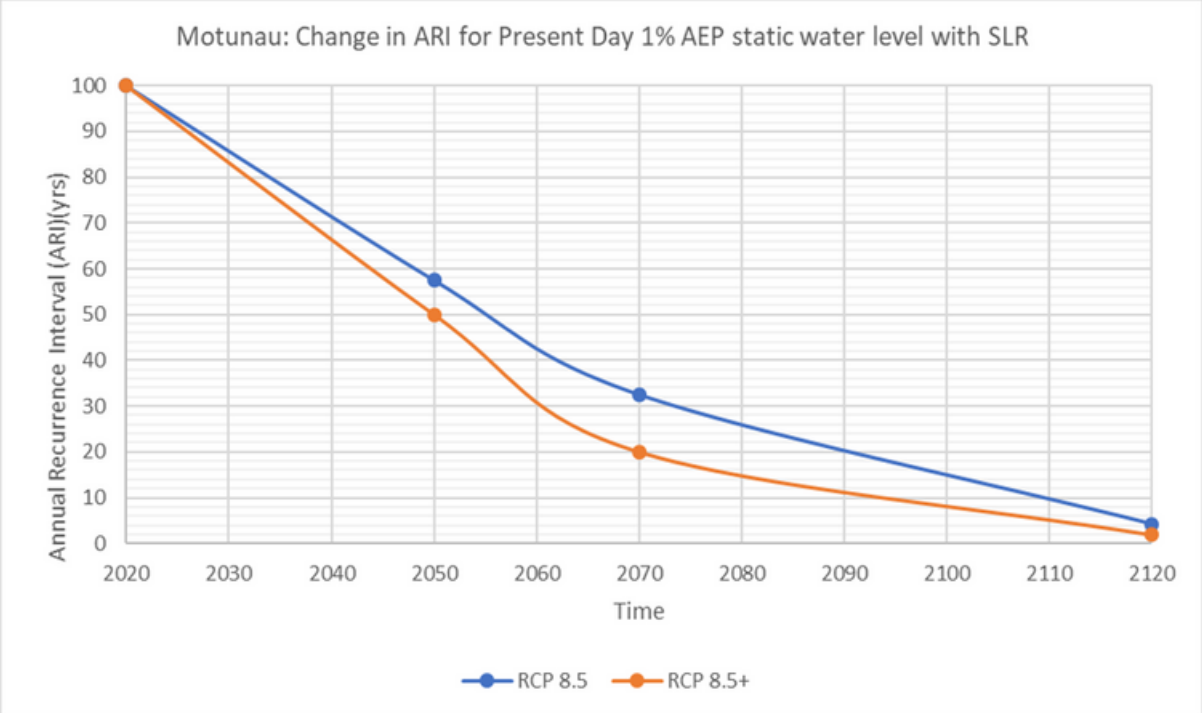


Figure 6: Graph showing the change in frequency of large events

3 WHAT MATTERS MOST?

Motunau is important to everyone for different reasons. Once we understand what these values are, we can use them to build a decision-making framework – effectively those values become the lens in which we look through when assessing various options. They help ensure that what is important to the community remains the priority.

To understand what matters most to the community Council undertook a survey asking residents to identify what they valued most.

The following objectives were developed from the feedback received:

- Public and private assets are protected where it is cost effective to do so.
- Safe access is provided to and along the foreshore.
- The Motunau River mouth remains accessible for boating.

4 WHAT CAN WE DO ABOUT IT?

A long list of possible options was developed, which was then narrowed down to a short list of feasible adaptation options that would be suitable to address the hazards at Motunau. The feasibility assessment included how effective, affordable, and consentable options are. The following reports are available:

- Hurunui District Coastal Adaptation Short Listed Options [5]
- Motunau: Upgrade of river mouth training wall [6]
- Planning Options for Coastal Communities [7]
- Exploring Options for Retreat [8]

The short-listed options were included in the Coastal Adaptation Explorer which we used in a community workshop in October 2022, see Box 1 for more information. From the workshop the following options have been included as part of the possible adaptation pathways.

[5](Jacobs, 2022)
[6](Jacobs, 2023)
[7](Hurunui District Council, 2022)
[8](Hurunui District Council, 2022)

4.1 The options

Extension and maintenance of the training wall

The Motunau River has a river mouth training wall that is currently in need of repair. Anecdotally erosion rates were slower when the wall was in good condition.

Modelling suggests that repairing the existing training wall to the required design height for a 1% AEP storm tide with 50 years of sea level would provide some degree of protection for the total length of the cliff in 50% of storm events. The 280 m of the cliff nearest the river mouth would receive some protection for up to 78% 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. [9]

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.

The repair and extension assume that 1 m by 1 m concrete blocks are used.

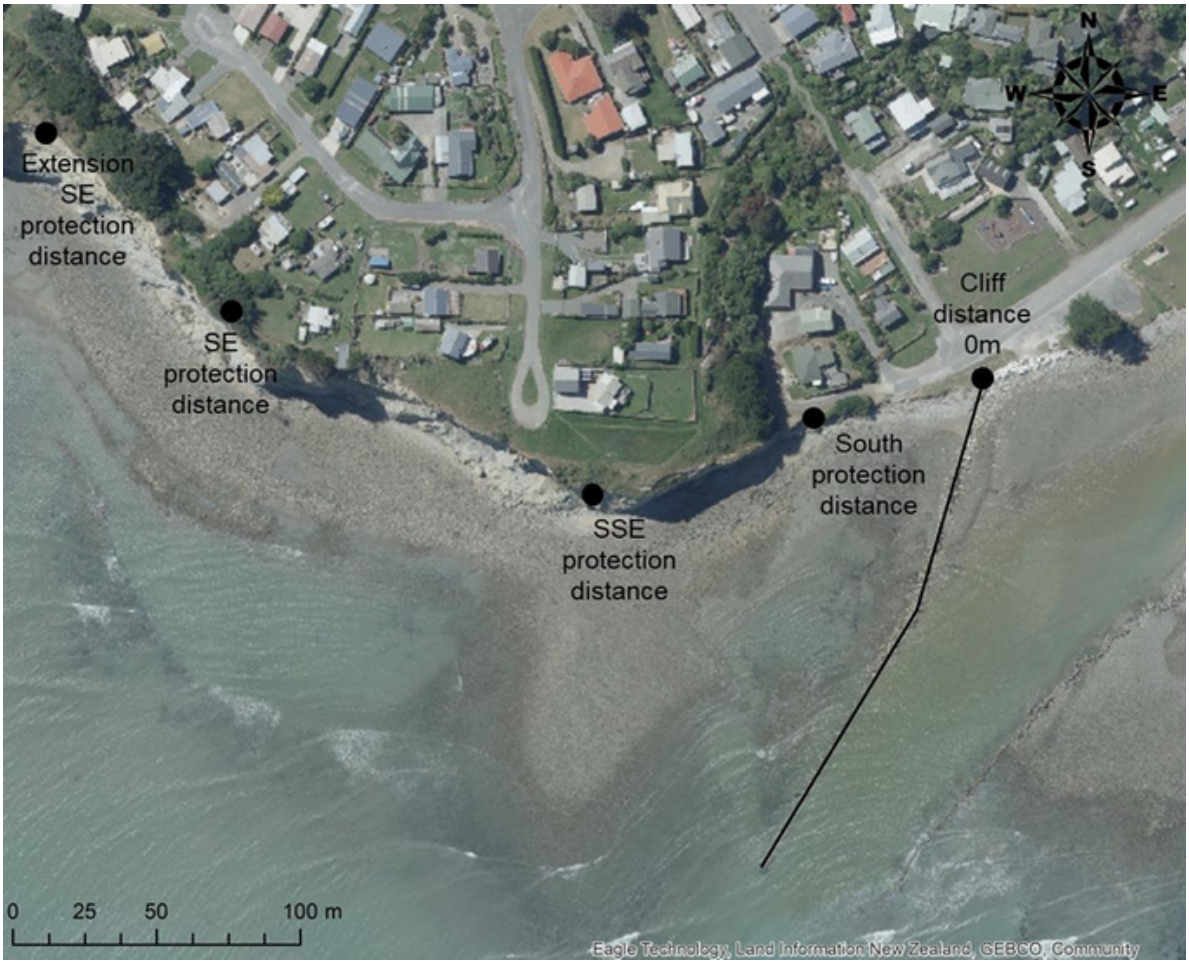


Figure 7: Protection lengths for repaired training wall raised to required design height for 1% AEP storm tide protection and for 20 m extension

[9](Jacobs, 2023)

Additional stormwater management

It is anticipated that cracks at the top of the cliff are responsible for approximately 20% of erosion. Water enters these cracks further weakening the cliff. Stormwater is also an issue more generally in Motunau. New dwellings are required to retain stormwater onsite for events up to and including a 1 in 50-year rainfall event, however much of the development within Motunau predates this requirement.

There is an option to undertake a holistic review of stormwater in Motunau and prepare a list of projects for the community to review and determine which ones they are willing to fund.

Maintain / enhance planning provisions

The current planning provisions require new houses to be built to a minimum floor height 400 mm above the 1 in 200-year food event. The rules also currently restrict or prohibit development within the Coastal Hazard Zone. These provisions help reduce the risk for new development in this area. There are opportunities to improve the provisions to better provide for adaptive planning.

Sandy Bay planting

Sandy Bay is located at the base of a steep slope. During high tide the sea currently reaches the base of the cliff and wave action is beginning to erode the base of the cliff. Planting in this area may provide short-term protection helping to break the wave energy reducing the impact of the waves on the cliff itself. The plants will eventually die as a result of saltwater around their roots or the land they are growing on being eroded away.

Wave trip wall

The primary purpose of a wave trip wall is to reduce the wave energy arriving at the toe of the cliff, lessening the impact of erosion. The wall would have an additional function of trapping cliff debris, which would establish a build up of talus material behind the wall. The wall would need to be approximately 450 m long and placed between 10-20 m from the cliff toe.

Several variations for a wave trip wall were proposed. Such structures could be designed out of rock or concrete and be designed for either a 30-year or 50-year design period. An example and indicative location are shown in Figures 8 and 9 below. The wall would not prevent erosion of material from the top of the cliff.

The wall would not prevent the cliff from eroding but may help to reduce the rate of erosion.

Figure 8 Indicative location of wave trip wall

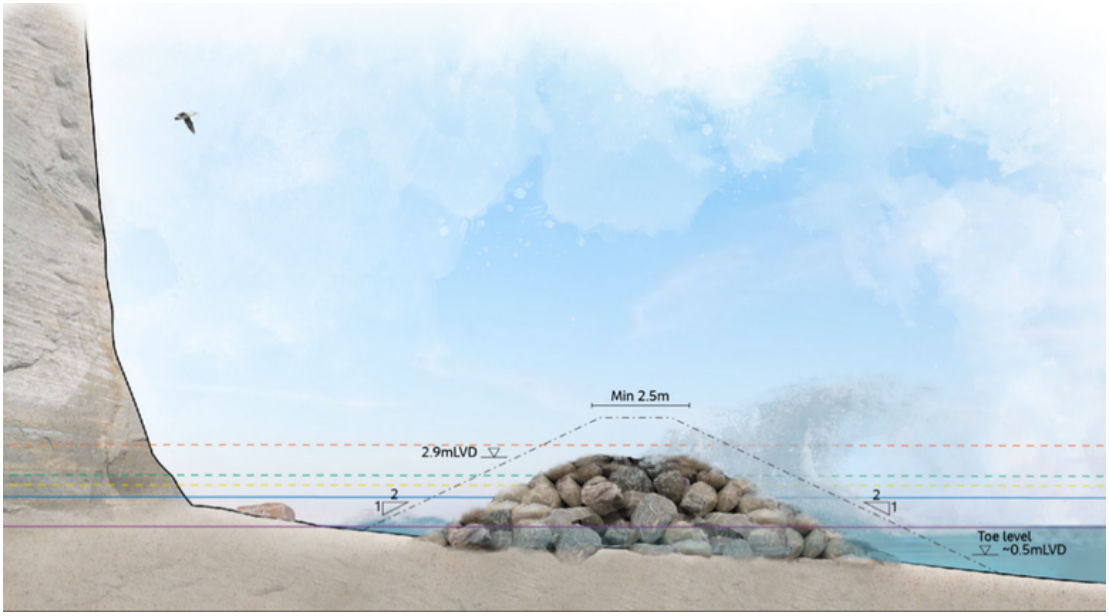


Figure 9 Example of Wave trip wall construction

Proactive Relocation

Managed retreat is an approach to reduce or eliminate exposure to intolerable risk. It enables people to relocate assets, activities, and sites of cultural significance, away from areas at risk from climate change and natural hazards proactively.

Regardless of which options are adopted there are going to be some cliff top properties that still need to retreat over the next 50 years. There is the opportunity for these property owners to work together with Council to develop a structured retreat of the affected properties. There are benefits to working as a collective and this may be preferable to the community.

Site specific inundation protection

Properties on the lower levels of Motunau Beach is primarily at risk of flooding. This can be mitigated at a site-specific level through various options including:

- Raising the floor height
- Waterproofing the dwelling
- Stormwater retention tanks
- Small bunds diverting water away from the dwelling.

Not all properties at Motunau Beach face the same risk and therefore site-specific protection may ensure the risk is tolerable at all sections within the settlement without having to fund larger scale works.

Progressive ad hoc relocation

The risk to cliff top properties varies between properties. Instead of a structured retreat, there is the option that each property owner responds individually. This is done when the increasing risk to their site becomes too great.

Rock toe at Sandy Bay

Rocks can be placed along the toe of the cliff at Sandy Bay. This would involve the placement of approximately 750m of large rocks (Dn = 0.7 m) to reduce the wave energy hitting the cliff directly. There may be significant and costly challenges in getting the rocks to Sandy Bay.

Figure 10: Indicative location of rock toe at Sandy Bay

Box 1: The Coastal Adaptation Explorer

The Coastal Adaptation Explorer allowed those in the workshop to turn on various options and get real time feedback on the costs, benefits, and effectiveness of an option, or combination of options.

The Explorer works by turning on different options on the lefthand side. Options could be turned on now, in 2050, 2070, or 2120. Multiple options could be turned on concurrently or as one option was no longer effective a different option could be turned on at a later timeframe to provide an additional level of protection.

The graphs at the bottom of Figure 11 show the effectiveness of the option compared to the do-nothing option. For Motunau this looked at the ability to protect private property from erosion and flooding, and the ability to protect critical roads

The box in the centre-top shows the financial costs or benefits of an option. The box on the top-right is based on a multicriteria analysis that considered whether the option or combination of options would have a positive effect on a series of criteria relative to the do-nothing option. The criteria were based on some of the values the community had provided as part of Phase 2 of the project. It also considers some more practical issues such as whether an option would be able to be consented and whether an option could be adapted in future.

From the workshop we developed a Draft Adaptive Planning Pathway which we sought feedback on.

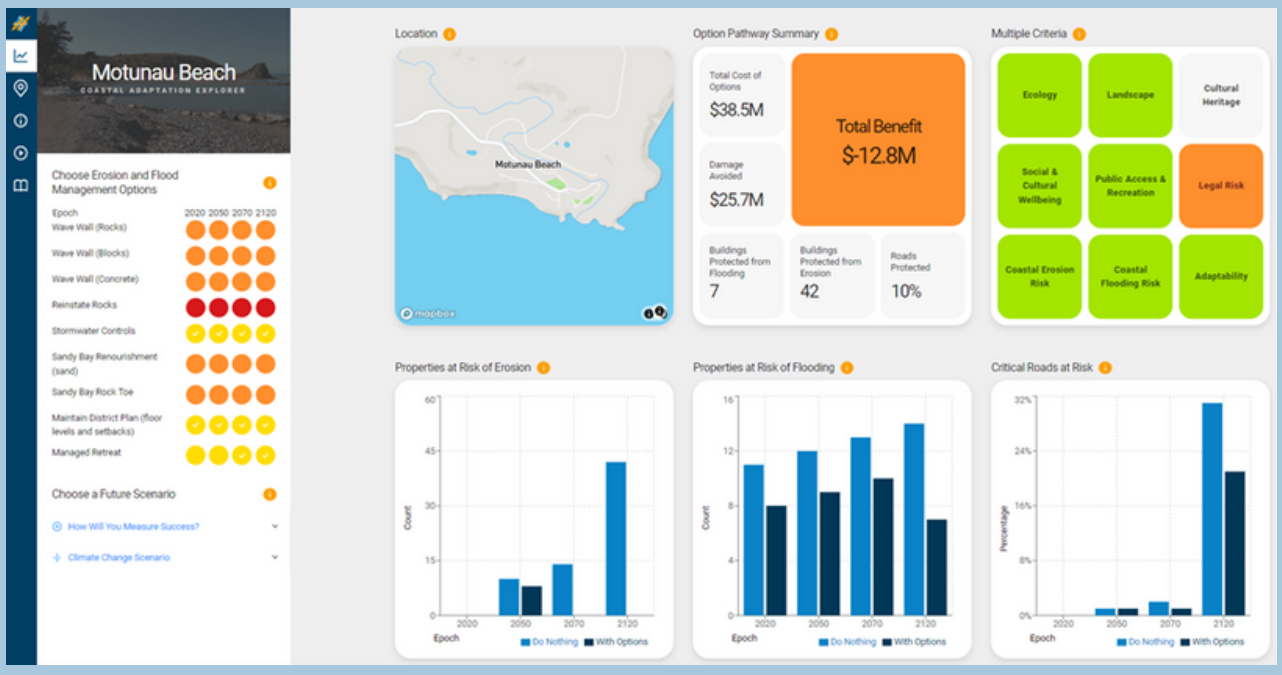
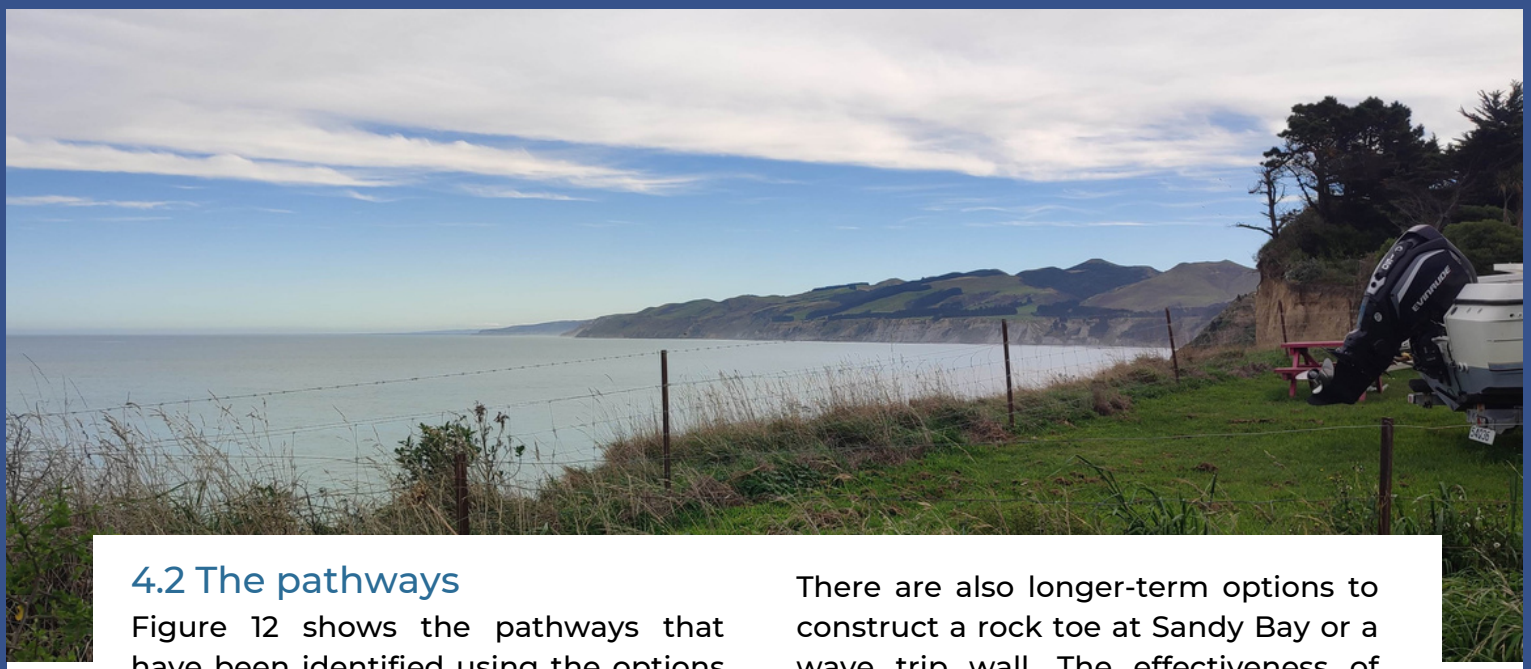


Figure 11: Snapshot of the Options Explorer used to discuss the viability of options with the community



4.2 The pathways

Figure 12 shows the pathways that have been identified using the options set out in Section 4.1 above.

The cliff top properties are currently at risk of coastal erosion. At some point until the cliff stops eroding something will need to be done differently. These options can be split into short- and longer-term options.

In the short-term the following options are affordable and may help to reduce the rate of cliff top erosion:

- extending the existing training wall,
- investigating additional stormwater management,
- enhancing the existing planning rules, and
- planting at Sandy Bay.

There are also longer-term options to construct a rock toe at Sandy Bay or a wave trip wall. The effectiveness of these options may not justify the significant cost and environment effects of constructing these. Currently there is no money available for such projects and the Motunau ratepayers have indicated that this is not something they are willing to fund as a community-wide project.

However, none of these options are anticipated to stop the cliff from eroding. It is inevitable that some properties along the cliff top will need to retreat. This could involve a joined-up approach between affected landowners or an ad hoc approach whereby everyone moves when their dwelling is at imminent risk.

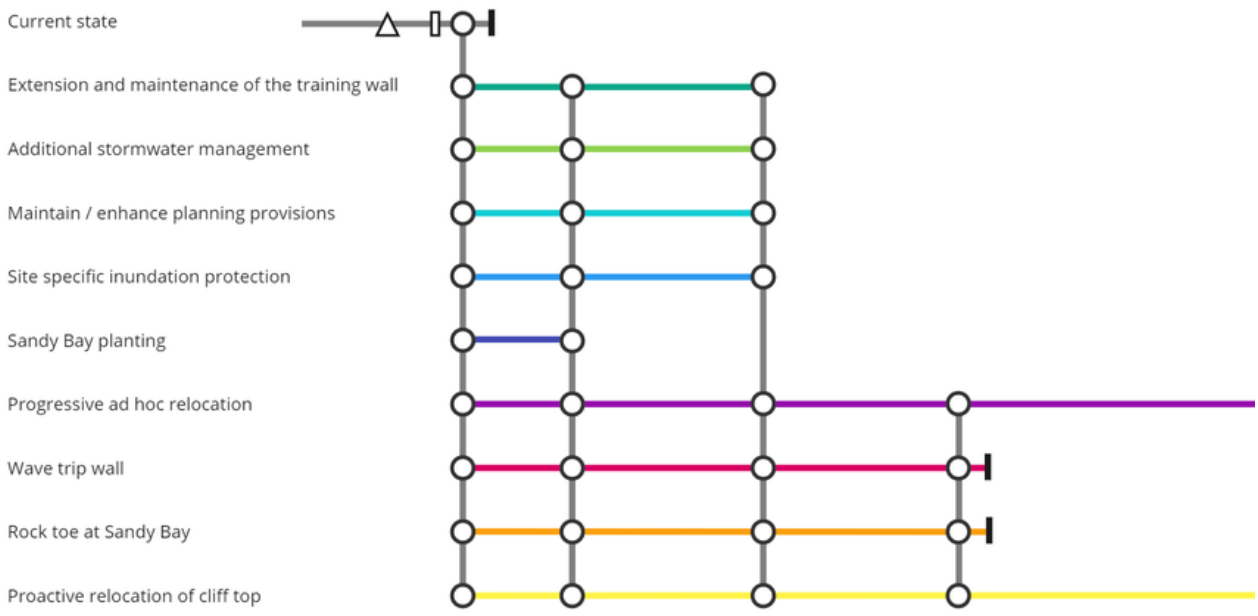


Figure 12: Pathways map for Motunau

5 HOW CAN WE IMPLEMENT THE PLAN?

The community has established an adaptation threshold through the development of their community objectives. This is where the status quo is no longer tolerable, and change is required before we reach this point.

To determine when we need to act, trigger points have been developed. These are based on the lead time to implement various options. The lead time to implement retreat on an ad hoc basis is anticipated to be up to 3 years. The trigger needs to be activated before then to ensure we have time to adapt prior to the threshold being reached.

5.1 Triggers for change

The most significant risk to properties at Motunau is the erosion of the cliff. The erosion process is irreversible, and the triggers need to reflect this. Most of the proposed options can occur immediately and are there is limited benefit in waiting.

However, managed retreat of cliff top properties only needs to occur when the risk is too great. It is assumed that property owners need at least 3 years to remove their dwelling once the trigger point is reached.

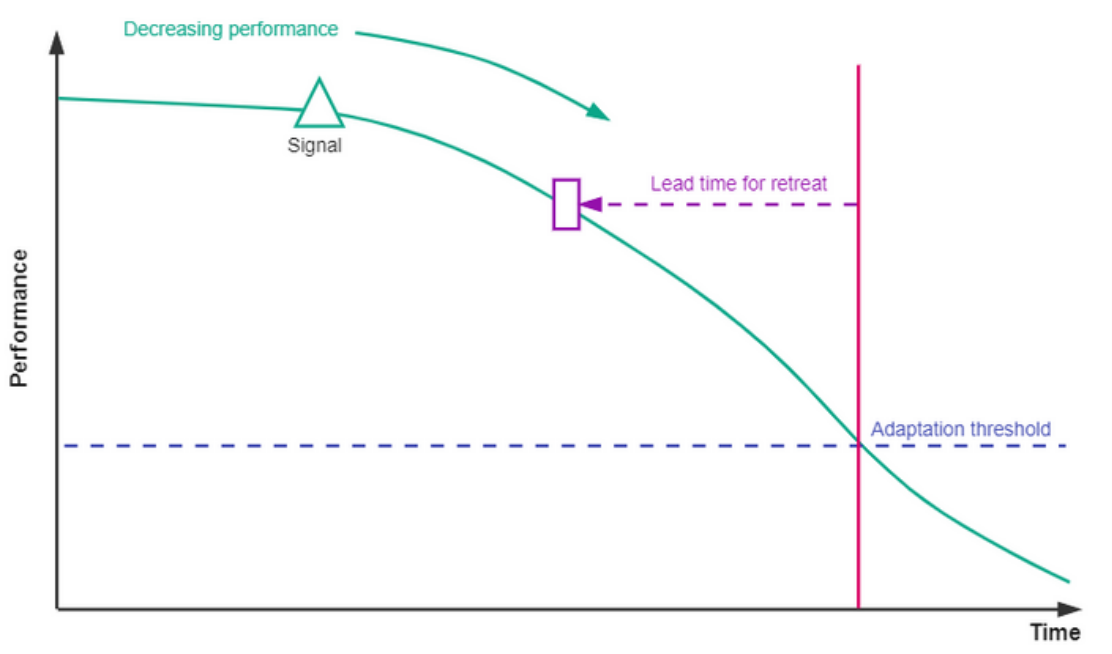


Figure 13: Graph showing the lead time for options relative to the decreasing performance of options. Adapted from (Ministry for the Environment, 2017)

Trigger: Dwelling is within 17 m of the edge of the cliff

The high cliff at Motunau has an average annual erosion rate of 0.26 m / year. However, erosion of the Motunau cliff is episodic and not consistent. In an extreme event or series of significant events the maximum amount of anticipated erosion is 6 m.

The edge of the cliff is also known to be unstable and access to the very edge of the cliff is not recommended. To provide three years warning for retreat the trigger includes three years of average erosion (1 m), provides for one large event (6 m), and an additional 10 m safety buffer to the edge of the cliff.

If your dwelling is within 17 m from the edge of the cliff Council will send you a letter advising that the annual drone survey records your dwelling as being within this setback and that you need to make plans to remove the dwelling within the next 3 years.

Additional drivers for retreat:

- A geotechnical assessment states that it is no longer safe to reside at a particular property. Such assessment may be undertaken, or required, after a significant event.
- A significant event may cause a large amount of cliff to collapse. The short term erosion rate provides over half of the required setback. If one event significantly reduces this setback there may not be sufficient setback should another significant event occur within the 3 year period to retreat. Due to the risk to life retreat may be required immediately. The setback can be confirmed by an additional drone survey.

Trigger: Significant capital works are required

It is not anticipated that any infrastructure along the cliff in Motunau will require significant capital works in the next 30 years. If significant capital works are required a trigger point is reached. At this point the community and Council will need to decide if investing in the works is a good investment for the community.

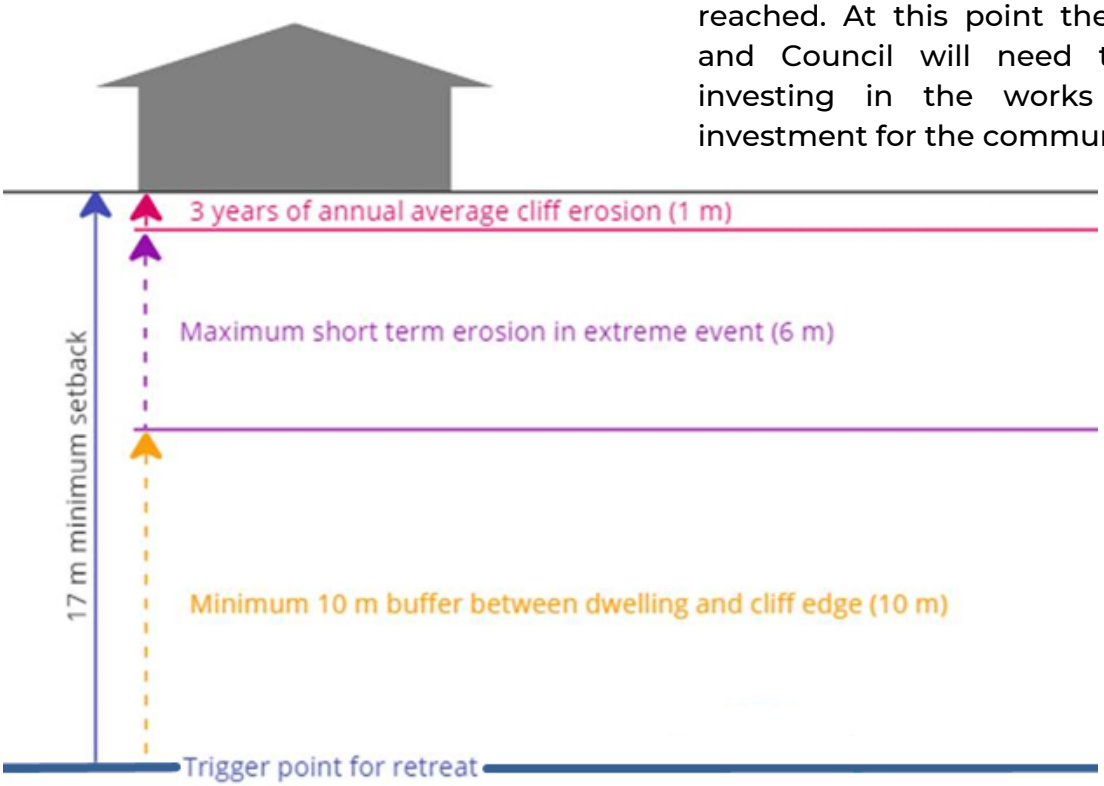


Figure 14: Trigger-based setbacks for retreat

Trigger: Contamination of wastewater system with saltwater

Currently, wastewater is channeled to a treatment plant north-east of Motunau River via two wet wells. Due to the effects of climate change, it is likely that these wet wells will become increasingly inundated with salt water, leading to increasingly saline water being pumped into treatment plant pond. The environmental and ecological impacts of this mean that this wastewater solution may no longer be viable, and a new course of action for the community will need to be explored.

Relocating the wastewater network for the community would be costly, and the Council and community will need to decide on whether the investment is worth it in the long term.

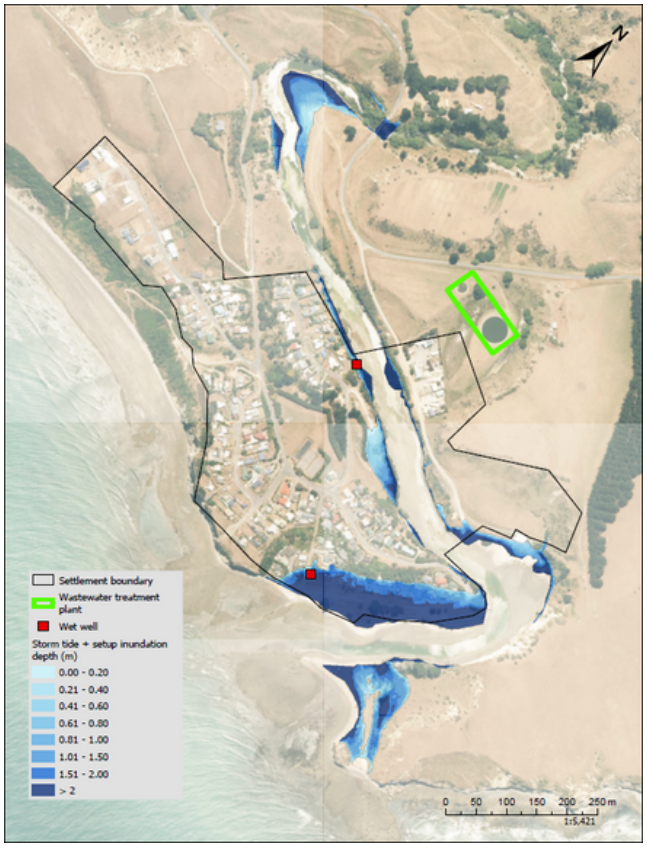


Figure 15: Location of wet wells (red dots) and wastewater treatment plant (in green) in Motunau in relation to 100 year RCP 8.5+ scenario.

6 REQUIRED ACTIONS

Action: Holistic review of Motunau stormwater

Stormwater management has been identified by the community as an outgoing issue at Motunau. A site walk over with community members was undertaken 4 May 2023 to identify key areas of concern within the settlement. The issues identified will be written up with quick wins identified and longer-term projects priced up and included as part of the Long Term Plan.

WHO: Hurunui District Council
FUNDED BY: Hurunui District Council
STATUS: Ongoing

Action: Student project

It is estimated that coastal erosion of the toe is responsible for around 80% of cliff failure and water penetration at the top of the cliff is responsible is for the remaining 20%. However, there is still limited understanding of the exact causes of cliff failure. Improved monitoring of the cliff top and wave patterns will help to refine the cliff top erosion models. This would provide greater clarity to property owners on the lifetime on their dwellings. The project may have the additional benefit of proposing new options for reducing the rate of erosion.

WHO: University of Canterbury
FUNDED BY: Environment Canterbury
STATUS: Proposed but awaiting a suitable student

Action: CoastSnap monitoring

CoastSnap is a community monitoring program where people can use their mobile device to take a photo of the beach state from a fixed point. The observations can be used to track changes in the shoreline. A stand was installed on the Sandy Bay Walkway in November 2022.

To use the CoastSnap stands anyone can place their phone sideways in the cradle and take a photo. These can be uploaded on the CoastSnap app, shared via social media with the hashtag #CoastSnapMotunau or emailed to coastal@hurunui.govt.nz.

Photos gathered will be compiled to form a time lapse where we can view and measure the change over time.

WHO: Hurunui District Council
FUNDED BY: Hurunui District Council
STATUS: Installed

Action: Shoreline monitoring

Environment Canterbury currently undertake annual State of the Environment monitoring. This currently includes annual shoreline profiles. There is an opportunity to compliment this with a topographical drone survey of the Motunau cliff to better understand the rate and causes of cliff failure.

WHO: Environment Canterbury
FUNDED BY: Environment Canterbury
STATUS: Committed to

Action: Review new information and update Coastal Adaptation Plan

The future is uncertain. This Plan has been developed using the best information available at the time of preparing the Plan. The information this Plan relies on is constantly being refined and updated. It is appropriate that the content of this Plan is periodically reviewed to ensure it remains fit for purpose. This may include:

- Considering updated sea level rise predictions, their impact on coastal hazards and the need to adapt.
- Updating possible options if new technologies or legislation emerge.

WHO: Environment Canterbury (science) and Hurunui District Council (policy and engagement)
FUNDED BY: Environment Canterbury (science) and Hurunui District Council (policy and engagement)
STATUS: Committed to

Action: Changes to the Long-term Plan

Funding for adaptation actions needs to be included in the Long-Term Plan. This will be notified in May/June 2024.

PREPARED BY: Hurunui District Council
FUNDED BY: Hurunui District Council
STATUS: Awaiting completion of adaptation planning

Conditional Action: Plan Change to the Regional Coastal Environment Plan and Hurunui District Plan

The existing Coastal Plan rules are not fit for purpose and require changes to allow for adaptive planning and continued enjoyment. There are opportunities to streamline the consenting process for property owners. If managed retreat is to be undertaken there are additional planning changes required to implement this.

PREPARED BY: Hurunui District Council
FUNDED BY: Hurunui District Council and Environment Canterbury
STATUS: Awaiting completion of adaptation planning and the Climate Adaptation Act

7 REFERENCES AND ADDITIONAL INFORMATION

Hurunui District Council. (2022). Exploring Options for Managed Retreat. Amberley: Hurunui District Council.

Hurunui District Council. (2022). Planning Options for Coastal Communities. Amberley: Hurunui District Council.

Hurunui District Council. (2023, May 22). Community Meeting Presentation. Motunau: Hurunui District Council.

Jacobs. (2020). Hurunui District Coastal Hazards and Risk Assessment. Christchurch: Jacobs.

Jacobs. (2021). Hurunui District Coastal Citizen Science Options. Christchurch: Jacobs.

Jacobs. (2022). Hurunui District Council Adaptation Short Listed Options Report. Christchurch: Jacobs.

Jacobs. (2023). Motunau: Upgrade of river mouth training wall. Christchurch: Jacobs.

Jacobs; Hurunui District Council. (2020, September 21). Community Meeting Presentation. Motunau: Hurunui District Council.

Jacobs; Hurunui District Council. (2021, May 22). Community Meeting Presentation. Motunau: Hurunui District Council.

Jacobs; Hurunui District Council. (2022, August 11). Community Meeting Presentation. Motunau: Hurunui District Council.

Jacobs; Hurunui District Council. (2022, October 26). Community Meeting Presentation. Motunau: Hurunui District Council.

Jacobs; Hurunui District Council. (2023, February 9). Community Meeting Presentation. Motunau: Hurunui District Council.

Ministry for the Environment. (2017). Coastal Hazards and Climate Change Guidance for Local Government. Wellington: Ministry for the Environment.

Ministry for the Environment. (2022). Interim guidance on the use of new sea-level rise projections. Wellington: Ministry for the Environment.