
COASTAL
CONVERSATIONS
MOTUNAU BEACH
11 August 2022

Summary

Phase 1

- WHAT IS HAPPENING?

Phase 2

- WHAT MATTERS MOST?

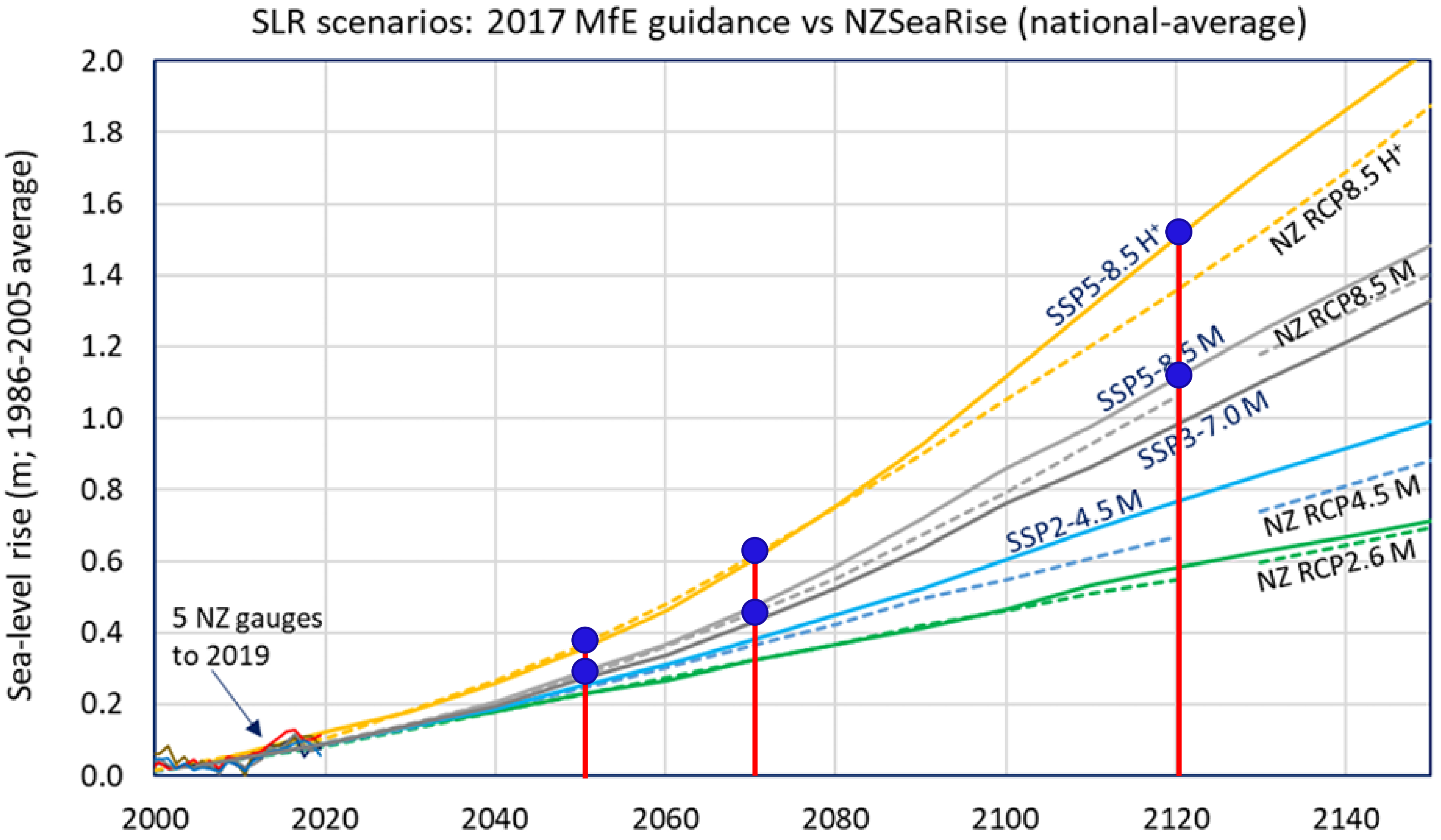
Phase 3

- WHAT CAN WE DO ABOUT IT?

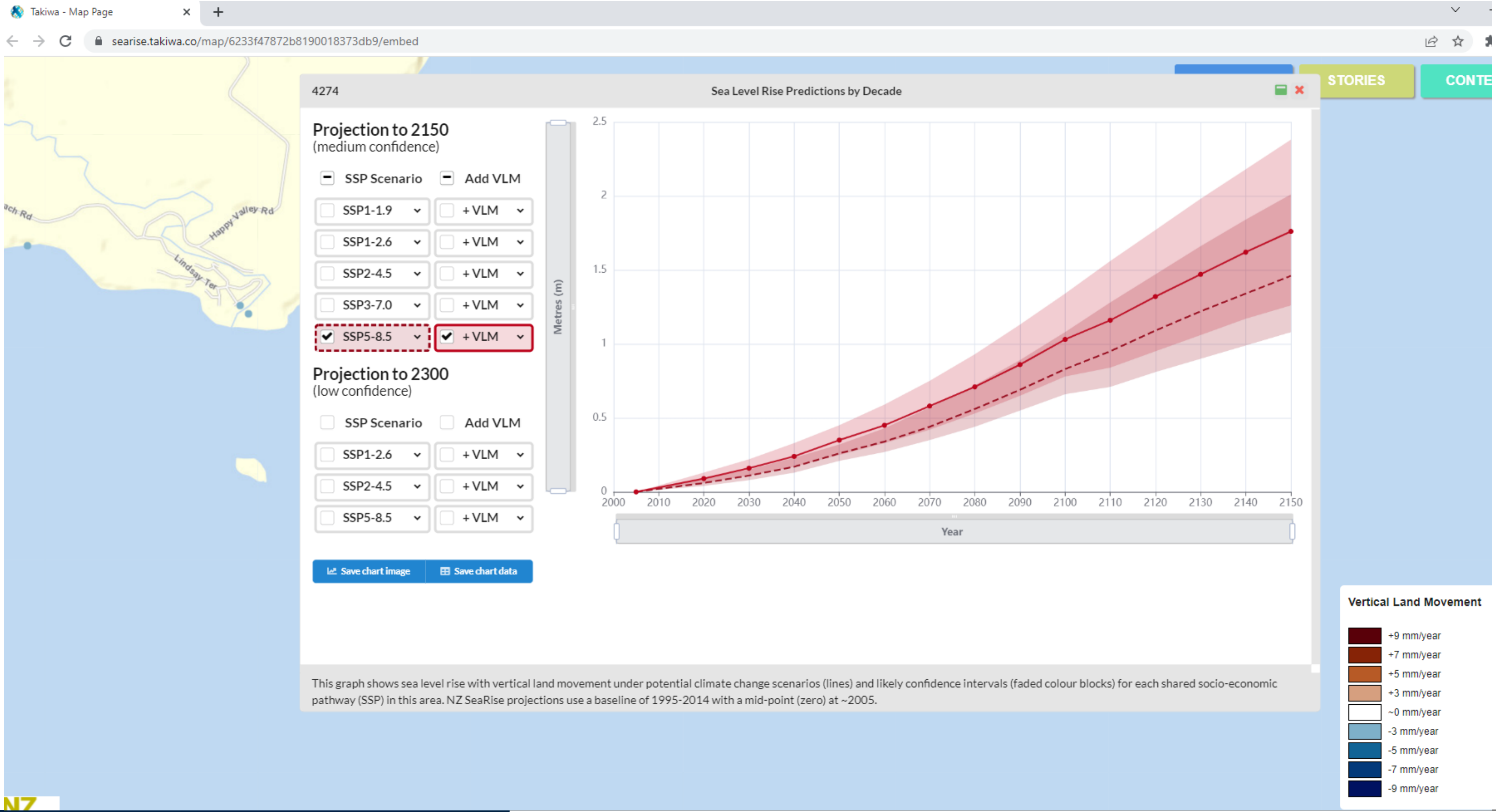
Phase 4

- HOW CAN WE IMPLEMENT THE STRATEGY?

Phase one:
What is happening?

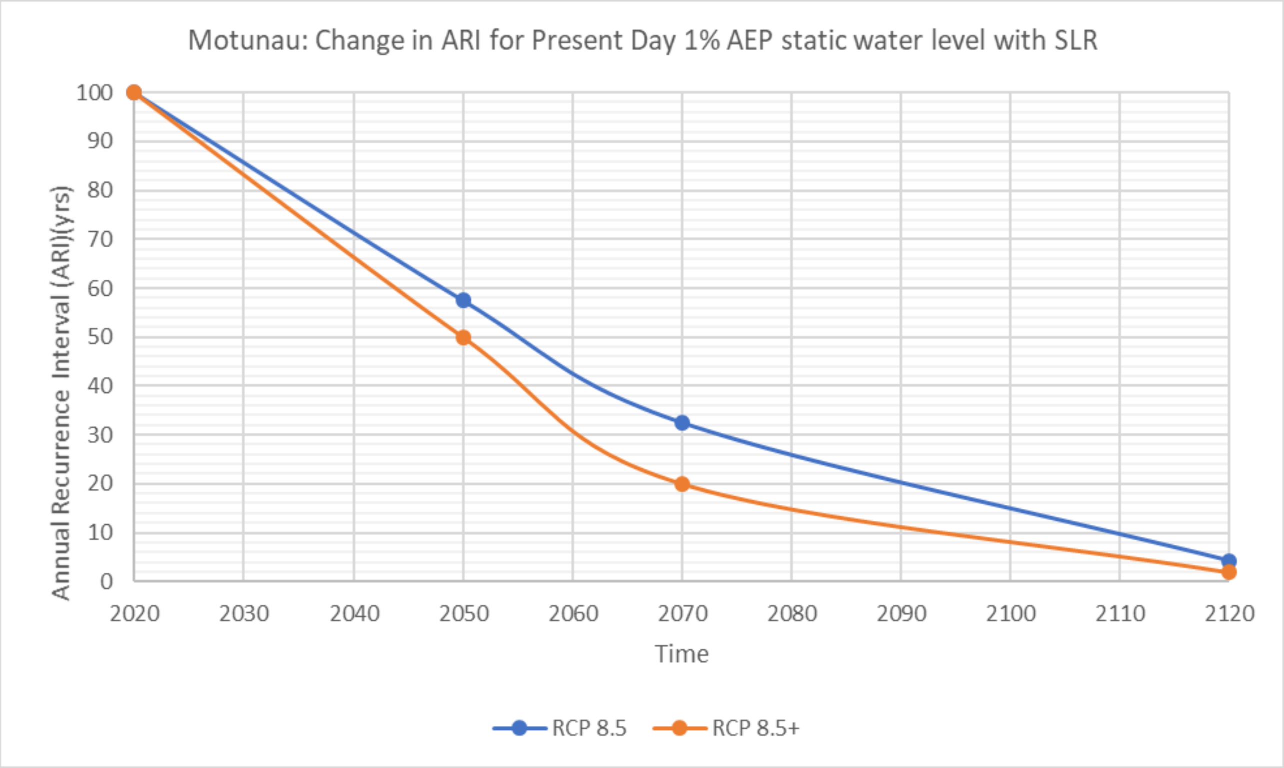


Phase one:
What is happening?



Phase one:
What is happening?

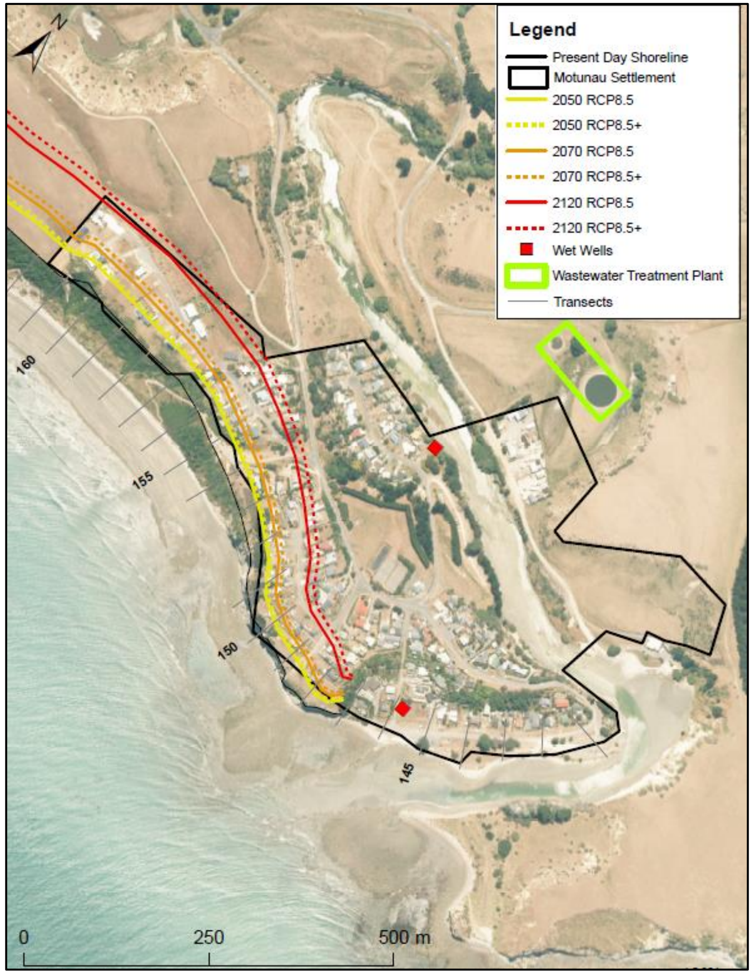
Increase in Frequency of 1 in 100 Year Events with SLR

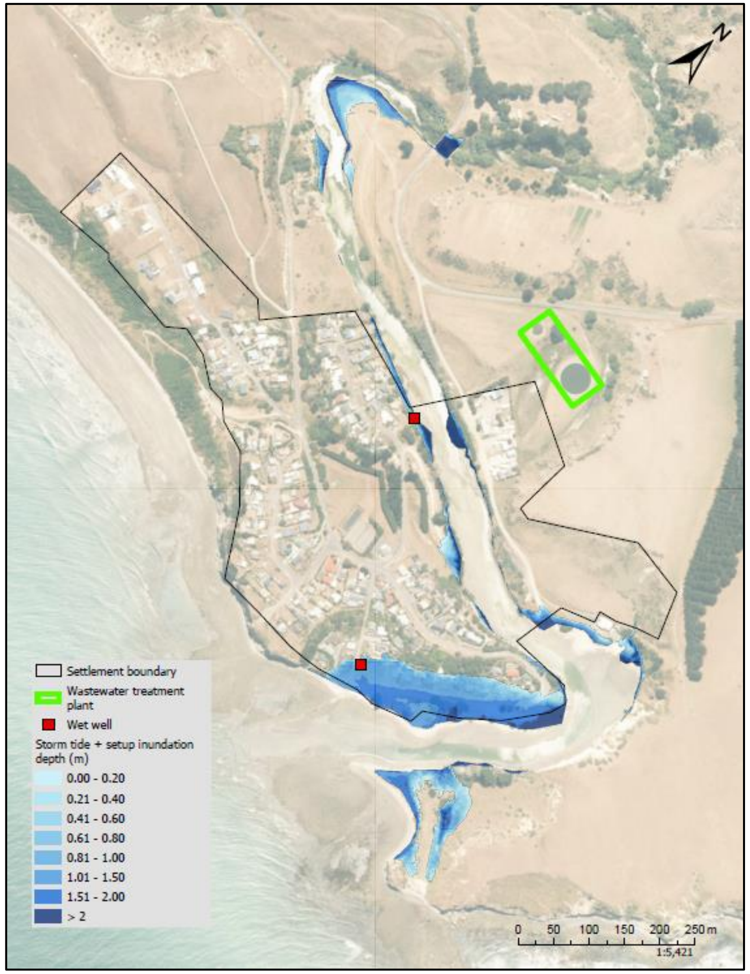


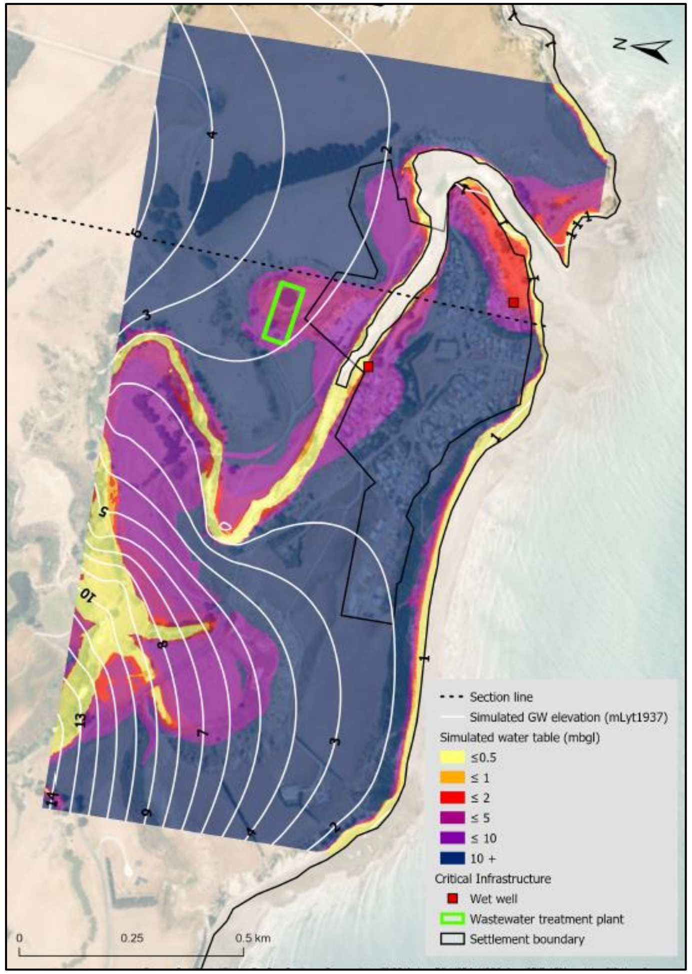
1 in 100 year event could occur every:

- 50-60 Years by 2050
- 20-30 Years by 2070
- 1-5 Years by 2120

Phase one:
What is happening?







Phase two:
What matters most?


What I value most

1 – the most important to you.
2 – the nice to haves but not essential to you.
x – the things that aren't that important.

Visual appearance of my settlement
Cultural or historical significance
Feeling of being on holiday
No flooding on access roads
Family connection with the area
Existing trees and vegetation
Recreation trails
Fishing opportunities
No flood water in my house
No flood water on my property
Ability to get insurance for my house
Who I live next to
Smell or sound of the ocean
Birdlife
Drinking water security
Community feel
Physical access to beach
Uninhibited vehicle access to my property
Easy walking distance to beach
Ability to dispose of wastewater
Space on beach to play and enjoy

I also value...

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The environment is changing, how will you?

Example objectives:

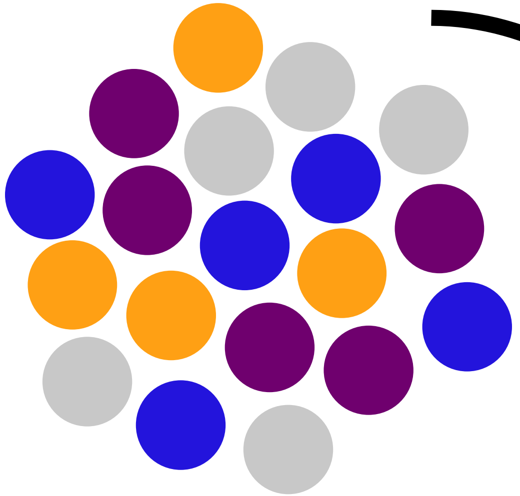
Ensure houses are safe to live in and remain insurable and serviceable.

Provide save access to the coastal marine area for boats and pedestrians.

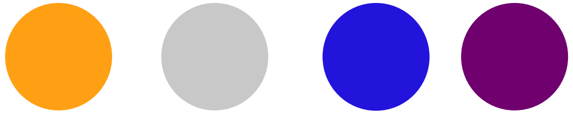
Protect fishing opportunities.

Phase three:
What can we do about it?

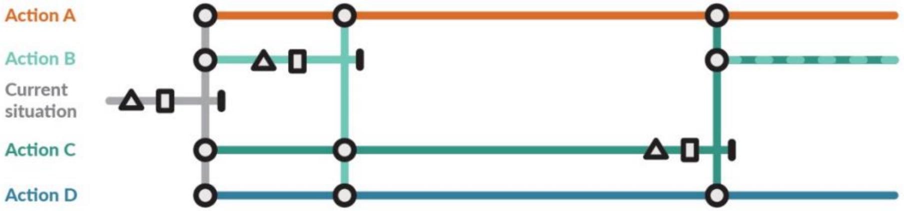
Long list of options



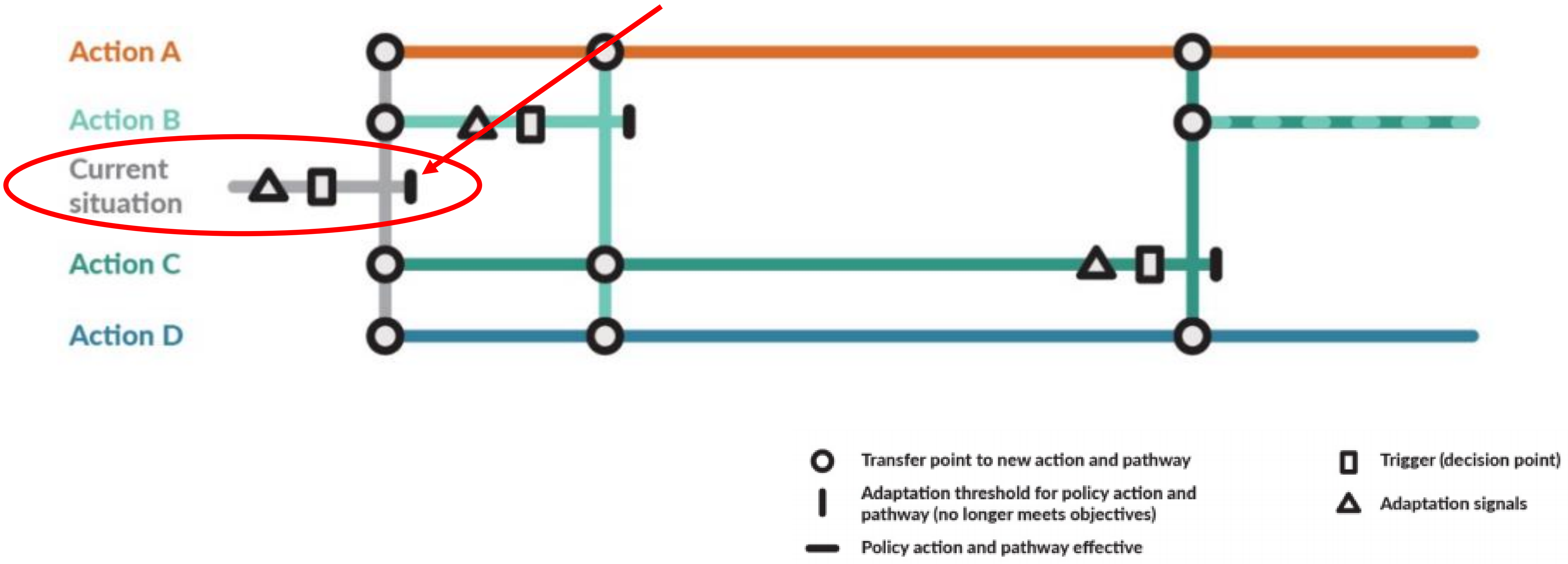
Short list of options



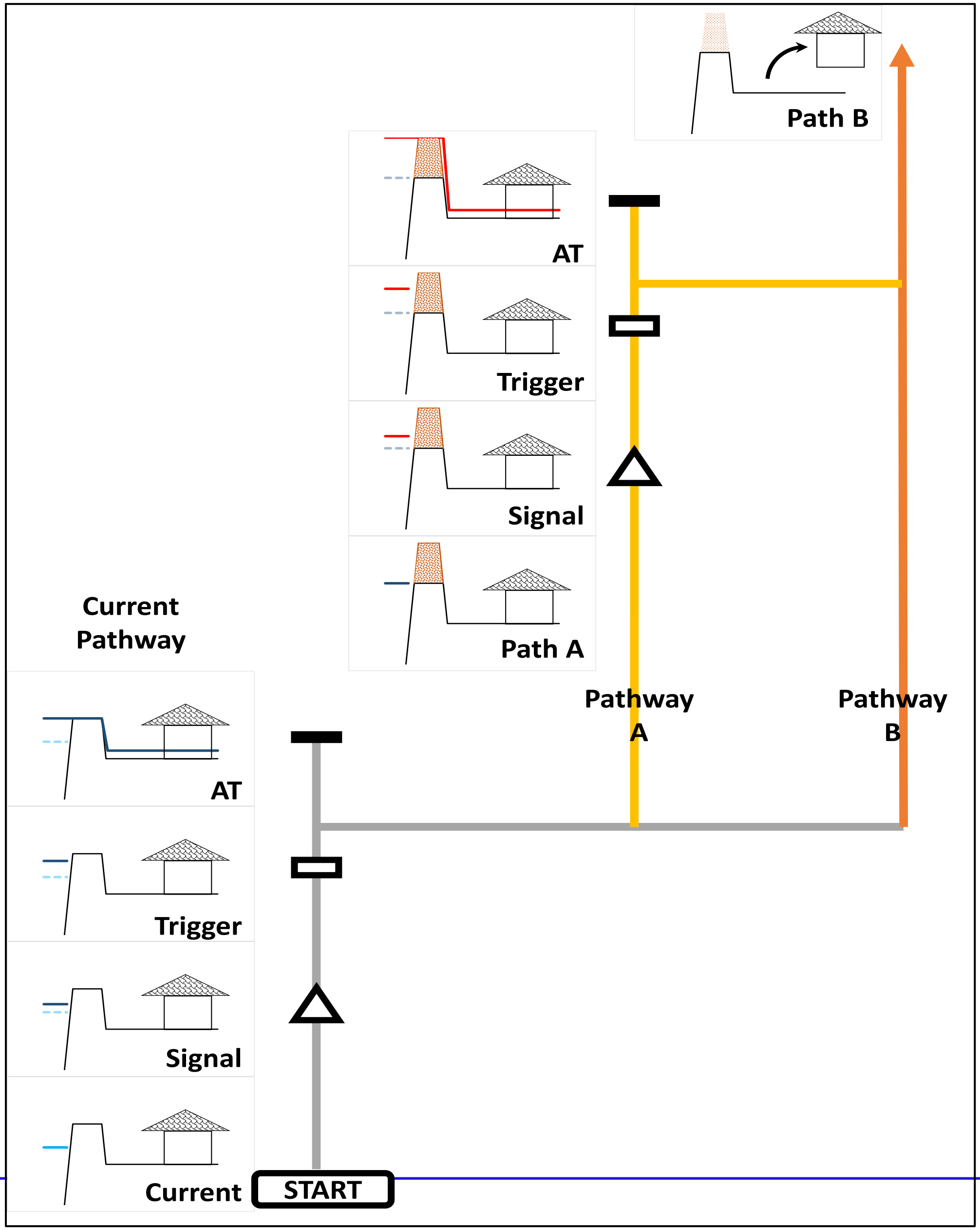
Proposed adaptive plan



Phase three:
What can we do about it?



An example adaptation pathway



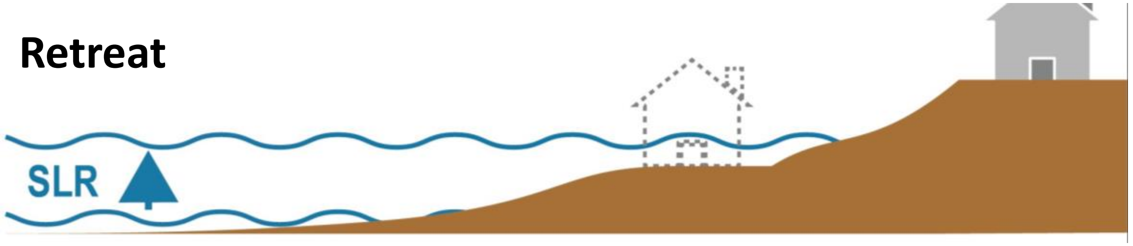
Phase three:
What can we do about it?

Types of options

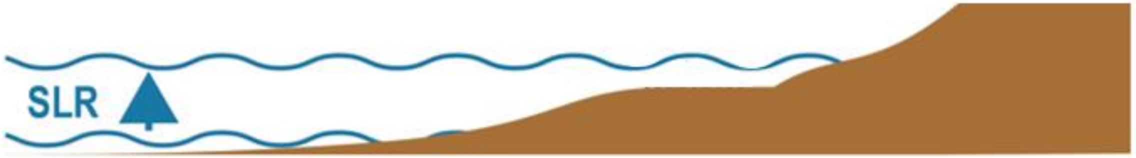
Accommodate

Protect

Retreat



Avoid



Hurunui Coastal Hazard Assessment

Motunau Cliff Protection

Hurunui District Council

August 2022

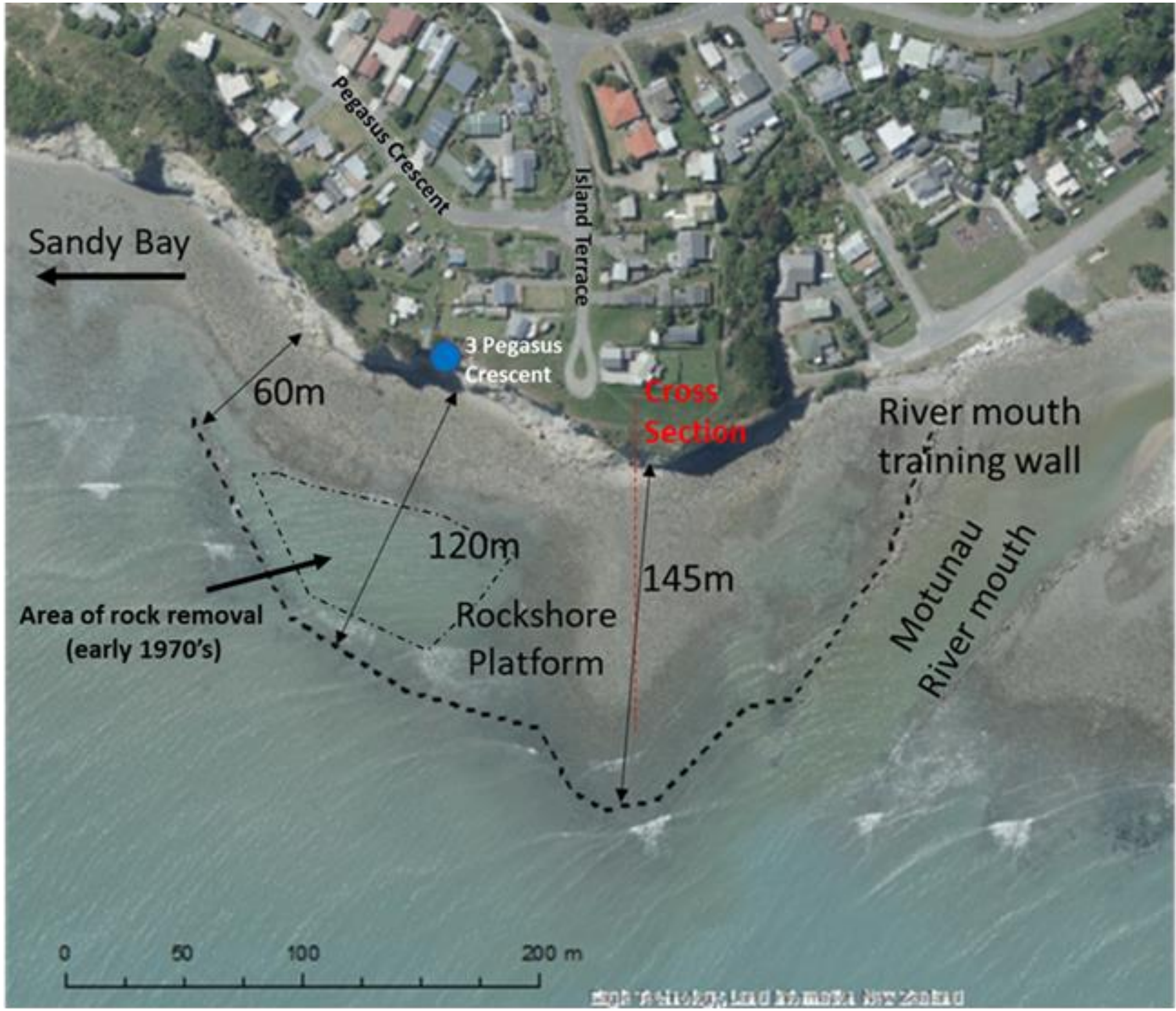
Jacobs Challenging today. Reinventing tomorrow.

Agenda

- Site Overview
- Long List Assessment
- Short Listed Options (4) and Concept Designs
- Costings
- Consenting
- Slope Stability Assessment
- Stormwater Run-off Assessment

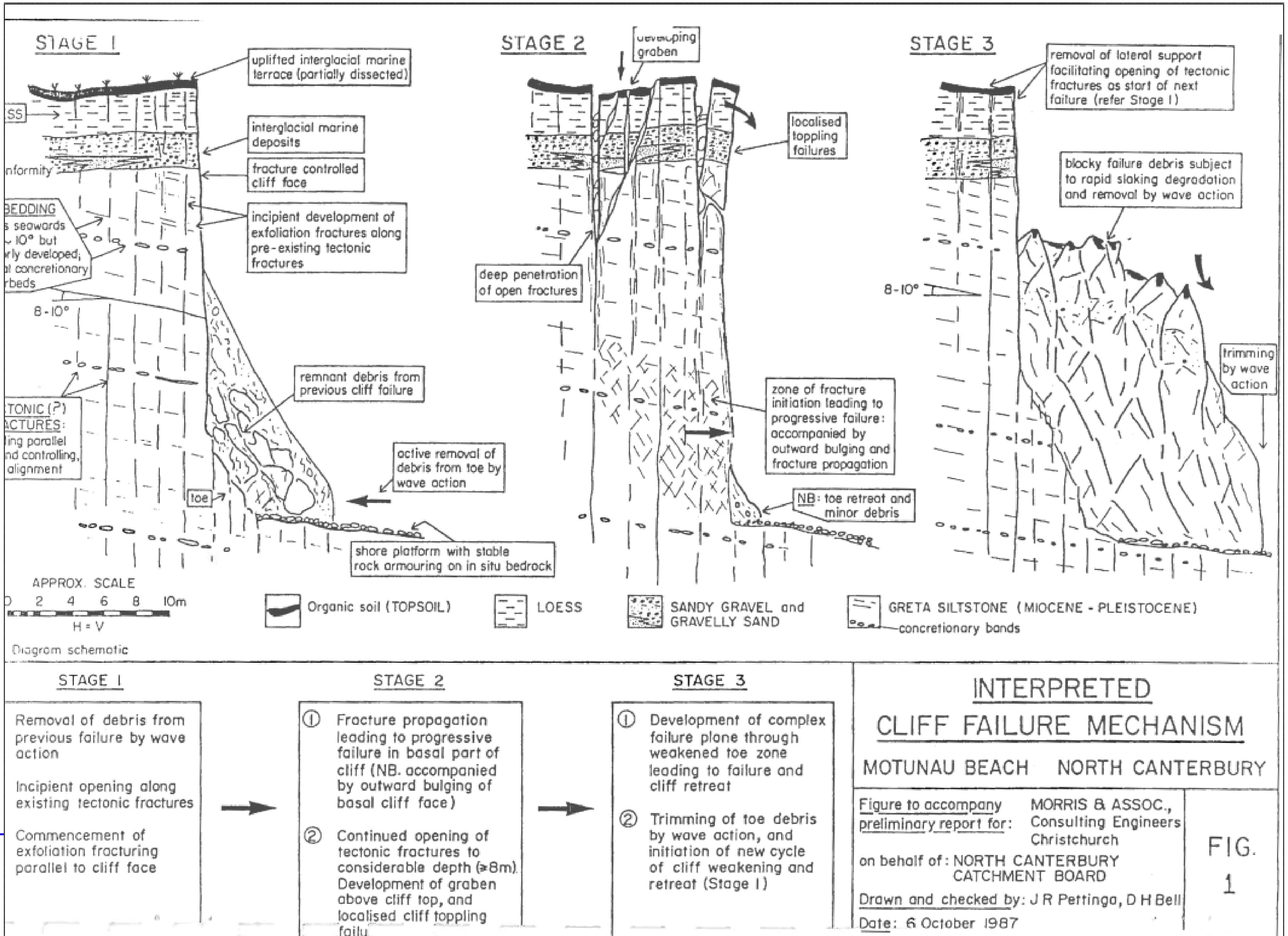
Motunau

- Cliffs approx. 25-40 m elevation.
- Erosion of the cliff caused by:
  - Wetting/drying processes of the mudstone cliff as a 'top-down' erosion process, and
  - From cliff toe erosion and cliff oversteepening and a 'bottom-up' erosion process.
- There is temporal and spatial variation in erosion rates across the cliff due to erosion being episodic rather than gradual.
- Cyclic pattern of erosion:
  - waves remove debris from cliff toe
  - Fractures on top of cliff, opening to depth leading to failure of base of cliff
  - cliff failure and retreat
- The foreshore consists of a rock platform which provides a level of natural protection to the cliffs
- The bed level across the Rock platform is generally between -0.5mLVD and +1mLVD
- The rock platform limits the size of the waves which are able to reach the base of the cliff with wave breaking which dissipates incoming wave energy
- Extraction of rock from a localised area of the foreshore has resulted in deeper water in some areas; refer smaller dotted are on figure.



Interpreted Cliff Failure Mechanism (from RETECH, 1990).

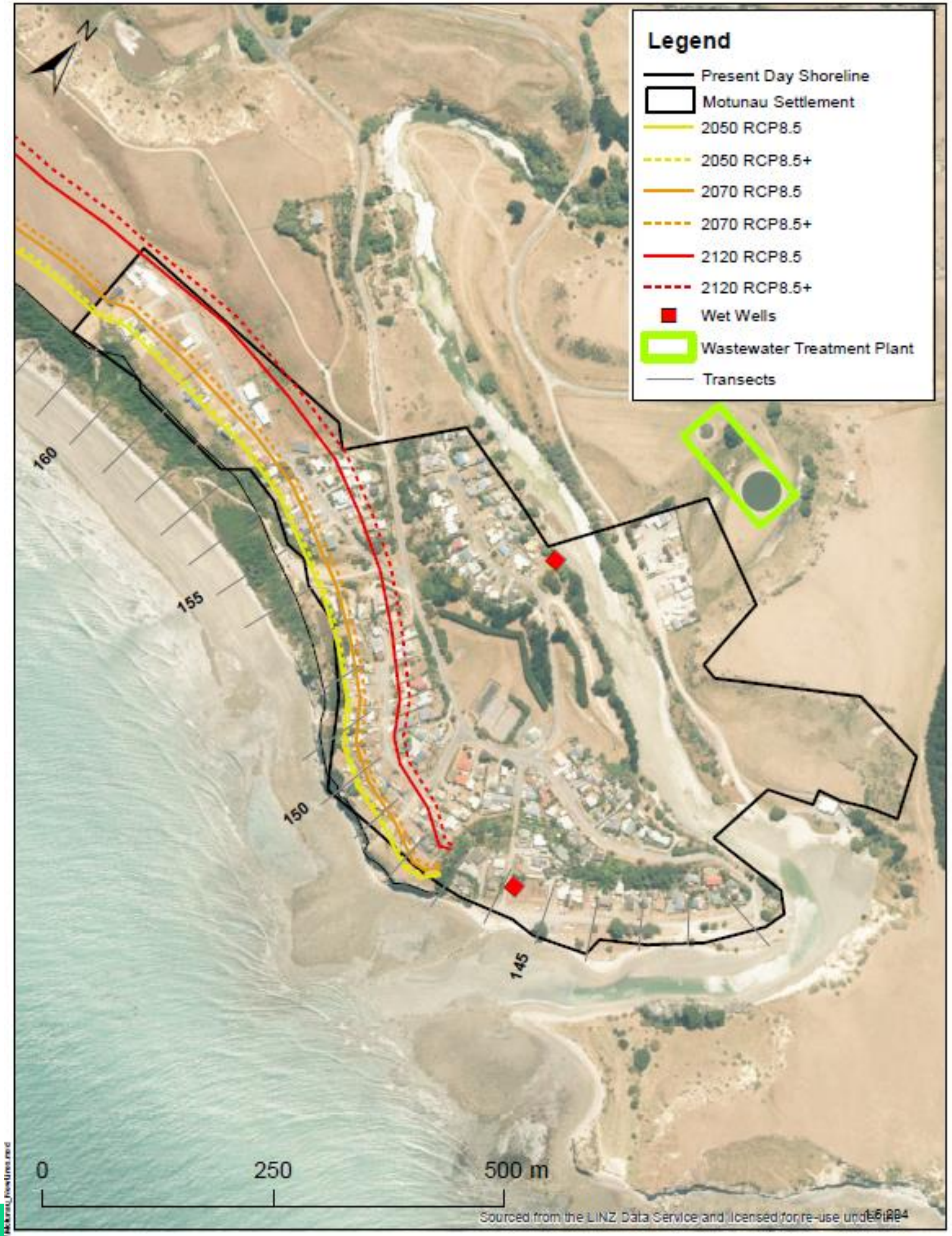
- Cliffs currently undergoing continuous cycles of Stages 1 to 3
- If toe stabilisation occurs the cliffs will undergo one cycle of Stages 1 to 3 before remaining at Stage 3
- Stage 3 will be maintained until the cliff reach angle of repose (natural long-term slope angle of the material type)



Coastal Hazard Assessment "Do Nothing"

From Jacobs (2020)

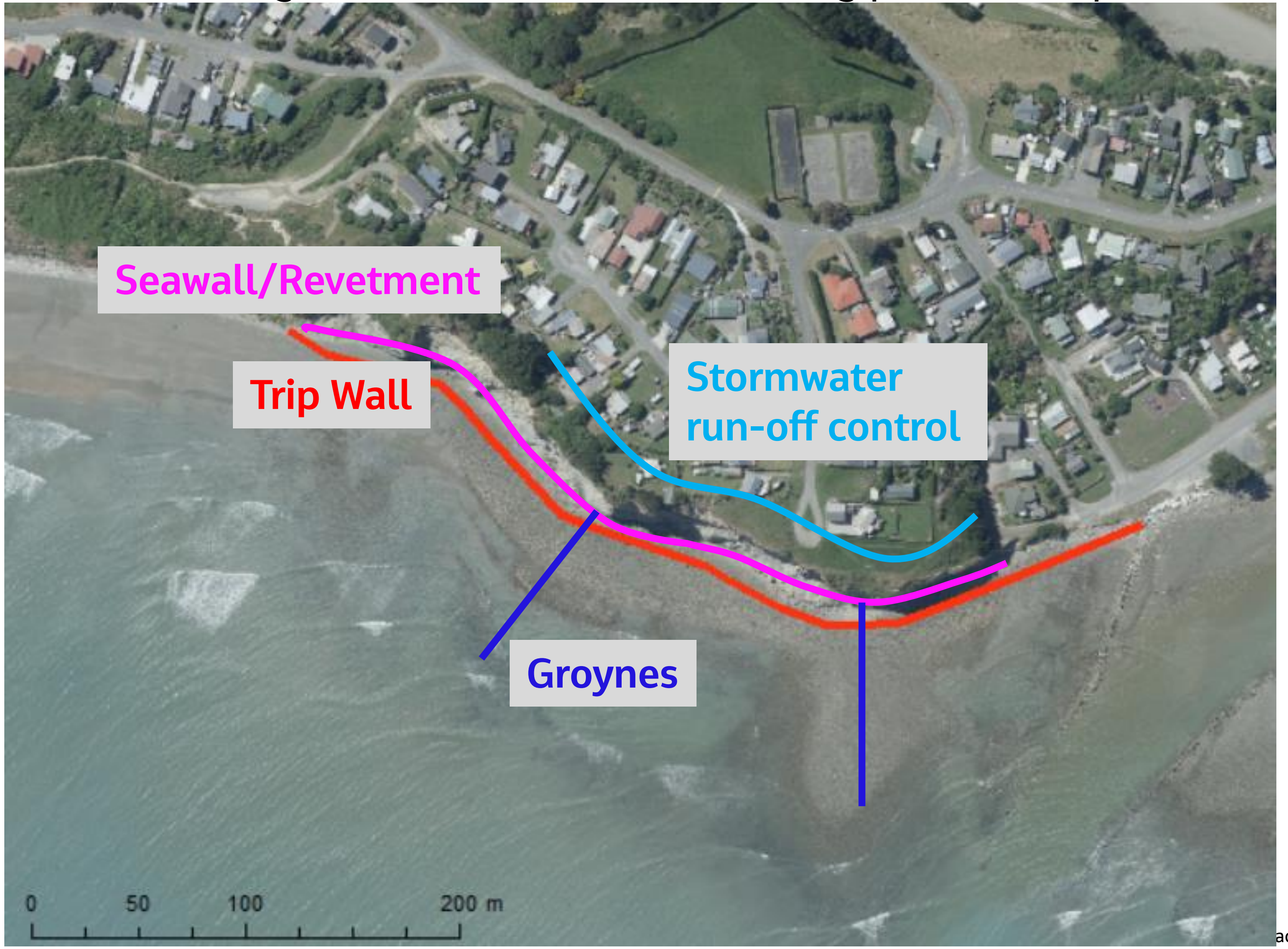
- 20-40 m of erosion over the next 30 years (SLR 0.23-0.32 m)
- 35-60 m of erosion over the next 50 years (SLR 0.4-0.56 m)
- 65-125 m of erosion over next 100 years (1.0 – 1.3 m/yr)



Long List Options Assessment

Long list-short list options assessment assessed strength/weaknesses of the following protection options:

- **Vertical or Stepped Seawalls at the base of cliff**
- **Revetments at base of cliff (Armored Rock)**
- **Wave Trip Wall offset from cliff toe**
- **Groynes**
- **Beach Nourishment**
- **Control of stormwater runoff**
- **Slope re-stabilisation**



acobs 2019

Short-listed Option – Wave Trip Wall

Functional Requirements:

a) Primary purpose is to reduce wave energy arriving at the toe of the cliff, therefore reducing the primary agent of toe erosion, and

b) Additional functionality to trap cliff debris material at the bottom of the cliff resulting in the establishment of a small beach of talus material to further protect the cliff toe from erosion.

Alignment:

- Approximate length of 'wave trip wall' = 450m
- Offset approximately 10m from the toe of the cliff

Interface/Transitions:

- The Western extent of the wave trip wall is to tie into the existing natural shoreline at Sandy Bay at the
- The Eastern extent of the wave trip wall is to tie into the existing river mouth training wall structure

Motunau Cliff Protection – Wave Trip Wall

Shortlisted Options

- The recommended option for slowing future cliff erosion rates at Motunau is a "wave trip wall" placed on the shore platform offset by approx. 10m from the base of the cliff, with the short-list options being **variations in the materials and design**

Option 1: **Armoured Rock Trip Wall** - 30-year design life with ability to adapt to provide protection over a 50-year period.	**Option 2:** **Armoured Rock Trip Wall** - 50-year design life with ability to adapt to provide protection over a 100-year period.
Option 3: **Pre-Cast Concrete Block Trip Wall** - 30-year design life with ability to adapt to provide protection over a 50-year period.	**Option 4:** **Pre-Cast Concrete Block Trip Wall** - 50-year design life with ability to adapt to provide protection over a 100-year period.
	Additional Option: **Westlock Interlocking Concrete Block Wall** - 50-year design life with ability to adapt to provide protection over a 100-year period.

Motunau Cliff Protection – Wave Trip Wall Design Criteria

Option 1 and 3

Design Wave Conditions: 1%AEP Extreme Wave Conditions

Design Water Level: 1%AEP Storm Water Level + SLR over 30 year period

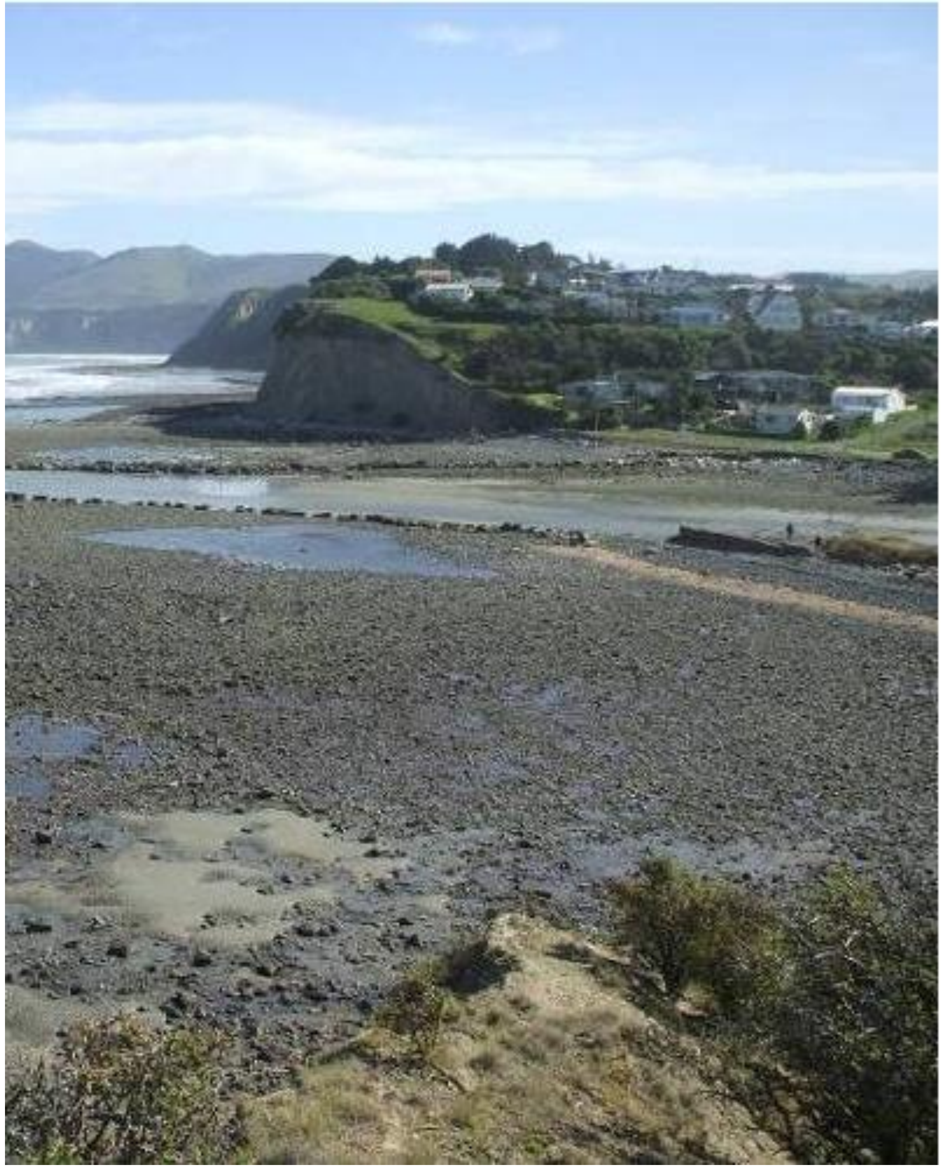
Other: Adaptive design to accommodate top up of crest to protect against SLR over a period of 50 years

Option 2 and 4

Design Wave Conditions: 1%AEP Extreme Wave Conditions

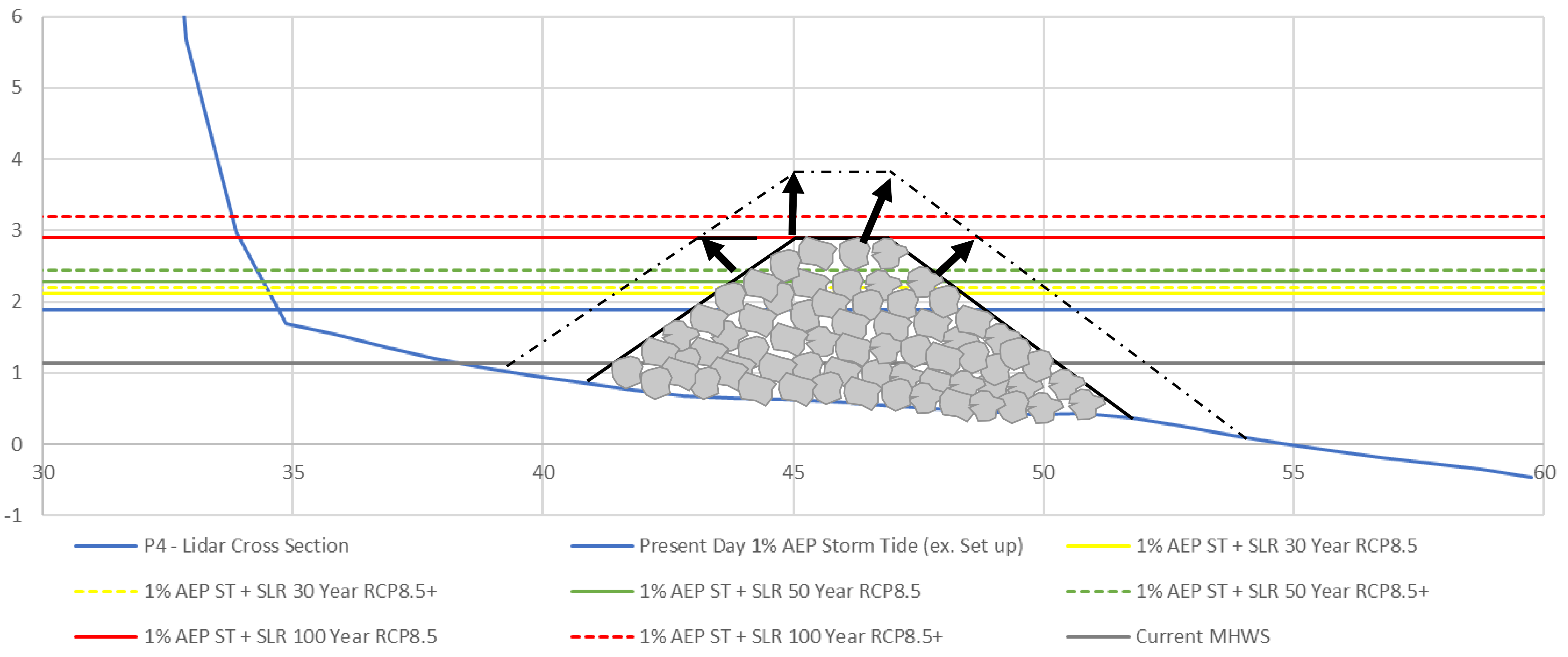
Design Water Level: 1%AEP Storm Water Level + SLR over 50 year period

Other: Adaptive design to accommodate top up of crest to protect against SLR over a period of 100 years

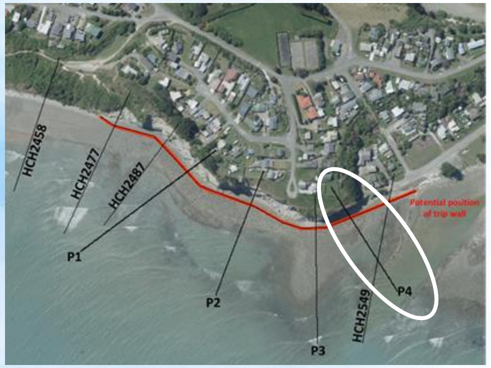


Adaptive Capacity

Designing a structure for 30 years with the specifications it can be adapted after this timeframe to provide a higher level of protection in the future (e.g for 50 years) when needed.



Option 1 Wave Trip Wall
(Rock Armour, 30-Year Design Life)



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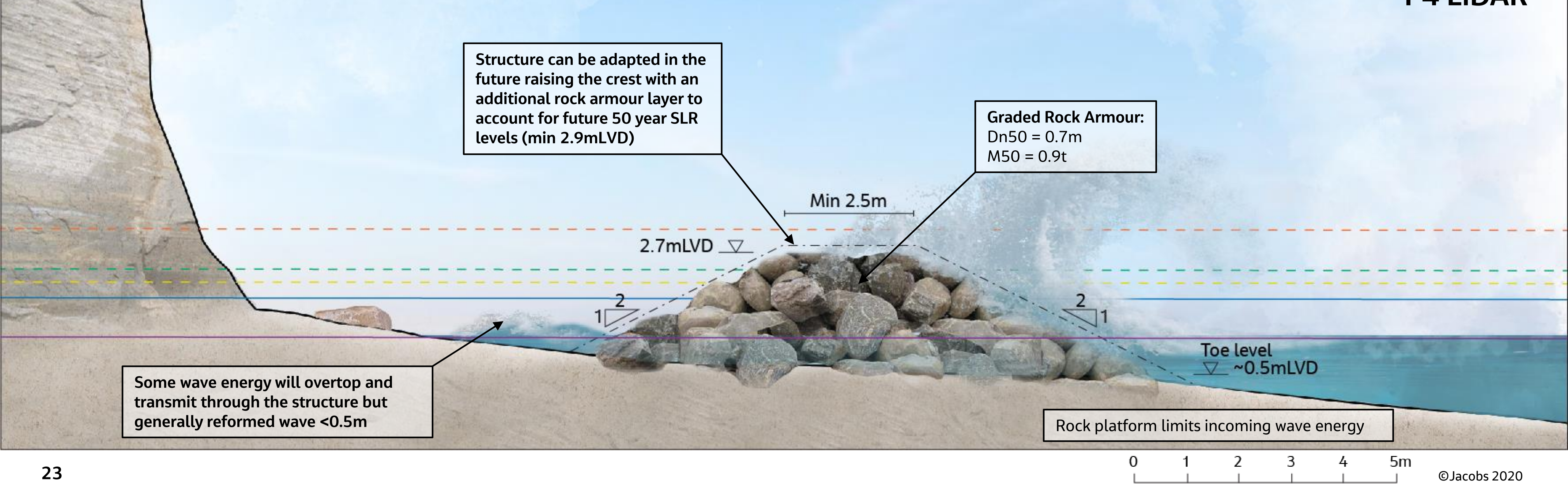
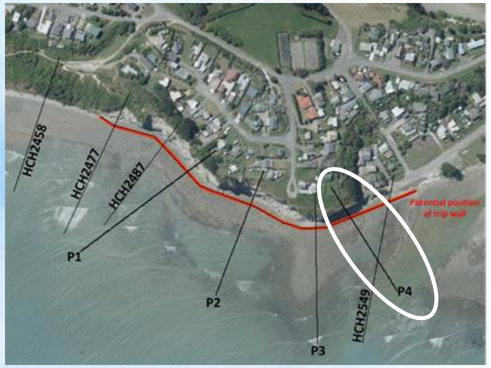


Option 2 Wave Trip Wall (Rock Armour, 50-Year Design Life)

- Current MHWS
- Present Day 1% AEP Storm Tide (ex. Set up)
- 1% AEP ST + SLR 30 Year RCP8.5+
- 1% AEP ST + SLR 50 Year RCP8.5+
- 1% AEP ST + SLR 100 Year RCP8.5+



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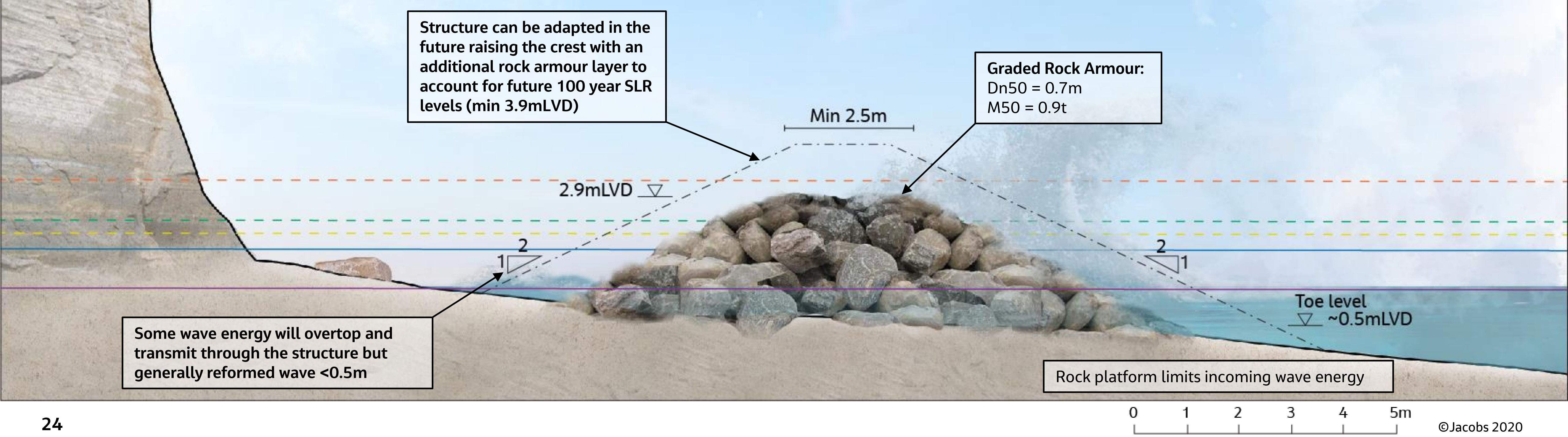
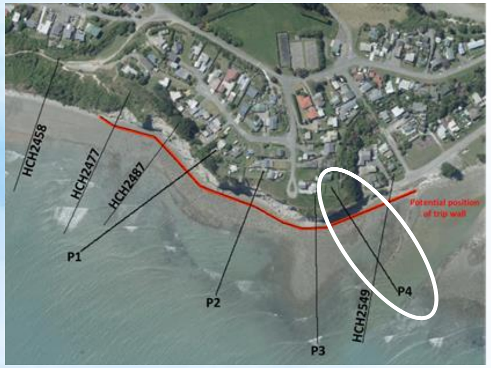


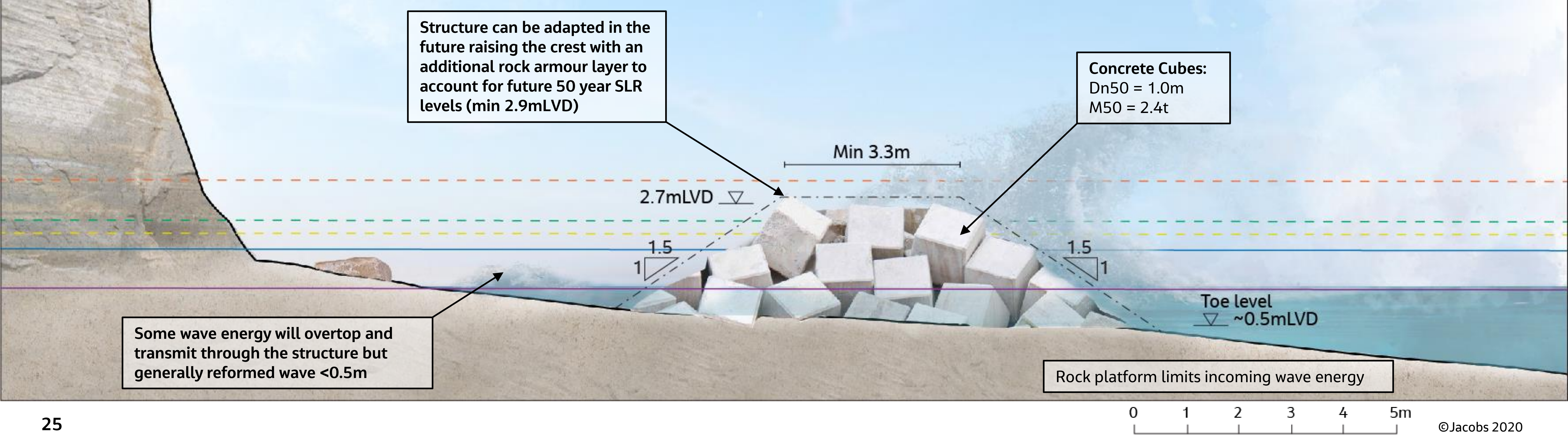
Option 3 Wave Trip Wall
(Cast Concrete Blocks, 30-Year Design Life)

Jacobs

- Current MHWS
- Present Day 1% AEP Storm Tide (ex. Set up)
- 1% AEP ST + SLR 30 Year RCP8.5+
- 1% AEP ST + SLR 50 Year RCP8.5+
- 1% AEP ST + SLR 100 Year RCP8.5+



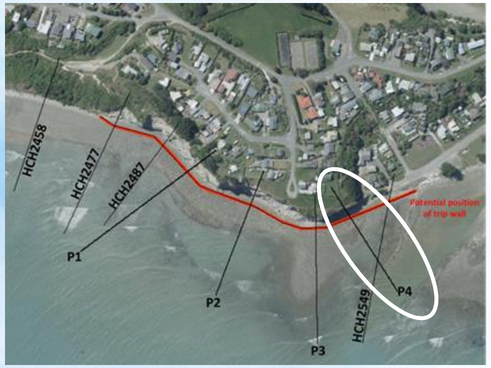
P4 LiDAR



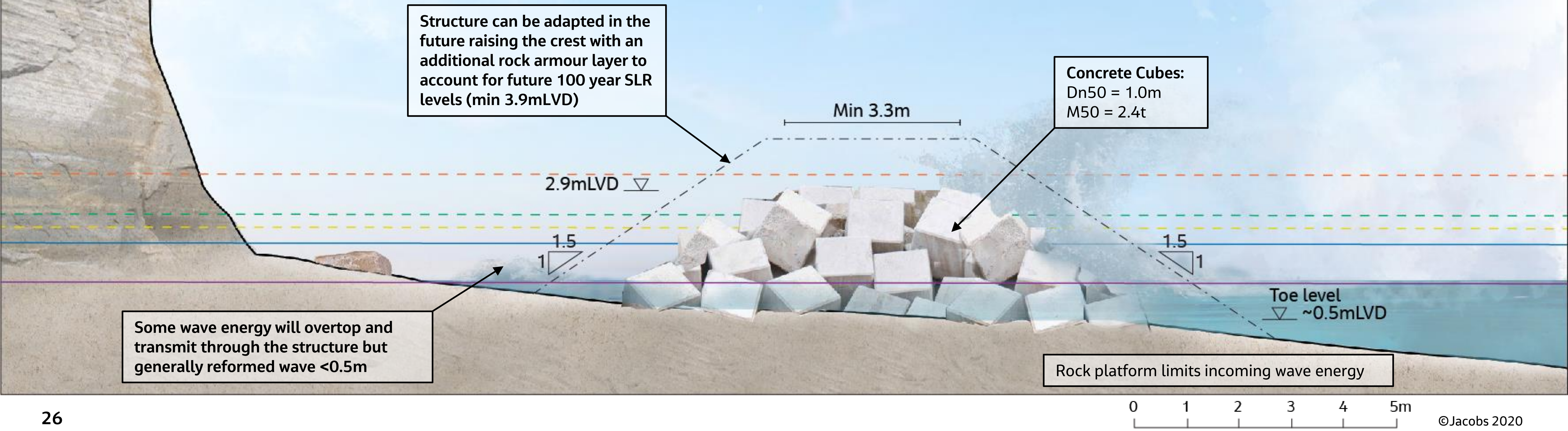
Option 4 Wave Trip Wall
(Cast Concrete Blocks, 50-Year Design Life)

Jacobs

Current MHWS
Present Day 1% AEP Storm Tide (ex. Set up)
1% AEP ST + SLR 30 Year RCP8.5+
1% AEP ST + SLR 50 Year RCP8.5+
1% AEP ST + SLR 100 Year RCP8.5+



P4 LiDAR



Additional Option: Interlocking “Westlock” Concrete Trip Wall

- The wall will be 3 blocks high, consisting of base block ((1.0 m high), and 2 mid blocks (each 0.8 m high) and 1 capping block
- Estimated that the base of the wall will need to sit approx. 800 mm below the sea bed, leaving a 2m high wave trip wall. This can be deeper if required once Geotech has been reported.
- Four wall sections with reinforced joints at each section juncture comprising of 4 additional blocks at the front and 4 at the rear of the wall. Each join would be site poured with marine grade concrete.

Can add addition layer

Costings

Coastal Protection Concept Option	Construction Estimate	Professional Services*	Contingency	Cost/Risk Allowance (tbc)	Budget Estimate	Length (m)	Indicative $/m
Option 1: Rock Wave Trip Wall (30-year design life)	$ 3,260,931	15%	15%	0%	$ 4,240,000	450	$ 9,400
Option 2: Rock Wave Trip Wall (50-year design life)	$ 3,988,527	15%	15%	0%	$ 5,190,000	450	$ 11,500
Option 3: Precast Concrete Block Wave Trip Wall (30-year design life)	$ 2,795,625	15%	15%	0%	$ 3,630,000	450	$ 8,100
Option 4: Precast Concrete Block Wave Trip Wall (50-year design life)	$ 3,360,547	15%	15%	0%	$ 4,370,000	450	$ 9,700
Additional Option: Interlocking "Westlock" concrete trip wall (50 year design life)	$1,740,000 plus transport	15%	15%	0%	$ 2,262,000 plus transport	450	$5,000 plus transport

*** 2.5% allowed for consenting, 5% design, 5% construction monitoring and 2.5% project management**

Assumptions about costings

- The estimate does not include an allowance to cart any material excavated offsite
- No allowance has been made for removal of encountered contaminated material. Actual quantities that will be encountered are unknown
- Jacobs have assumed a minimum allowance of 15% contingency for this project. Jacobs recommend Council review this contingency amount and adopt any additional allowances.
- Rock supply is from quarry in Oxford
- Concrete block supply rates have been provided from a supplier who produces blocks with concrete order excess. This estimate is based on particular production assumptions. Given the number of blocks required it is likely lead times for these concrete blocks will be long. Other suppliers are yet to provide their costs for purpose made blocks. Given the current estimates of concrete block options being considerably higher than rock, no further assessment of concrete block costs has been undertaken.

Consenting

Consenting for this structure will need to meet the Requirements of:

- **NZCPS** :

  Policy 27 - Strategies for protecting significant existing development from coastal hazard risk

- **Canterbury Regional Coastal Environment Plan**

  Likely to be non-complying under Rule 8.5 as is:

  - Structure in an Area of Significant Natural Value
  - Structure >300m in length parallel to MHWS

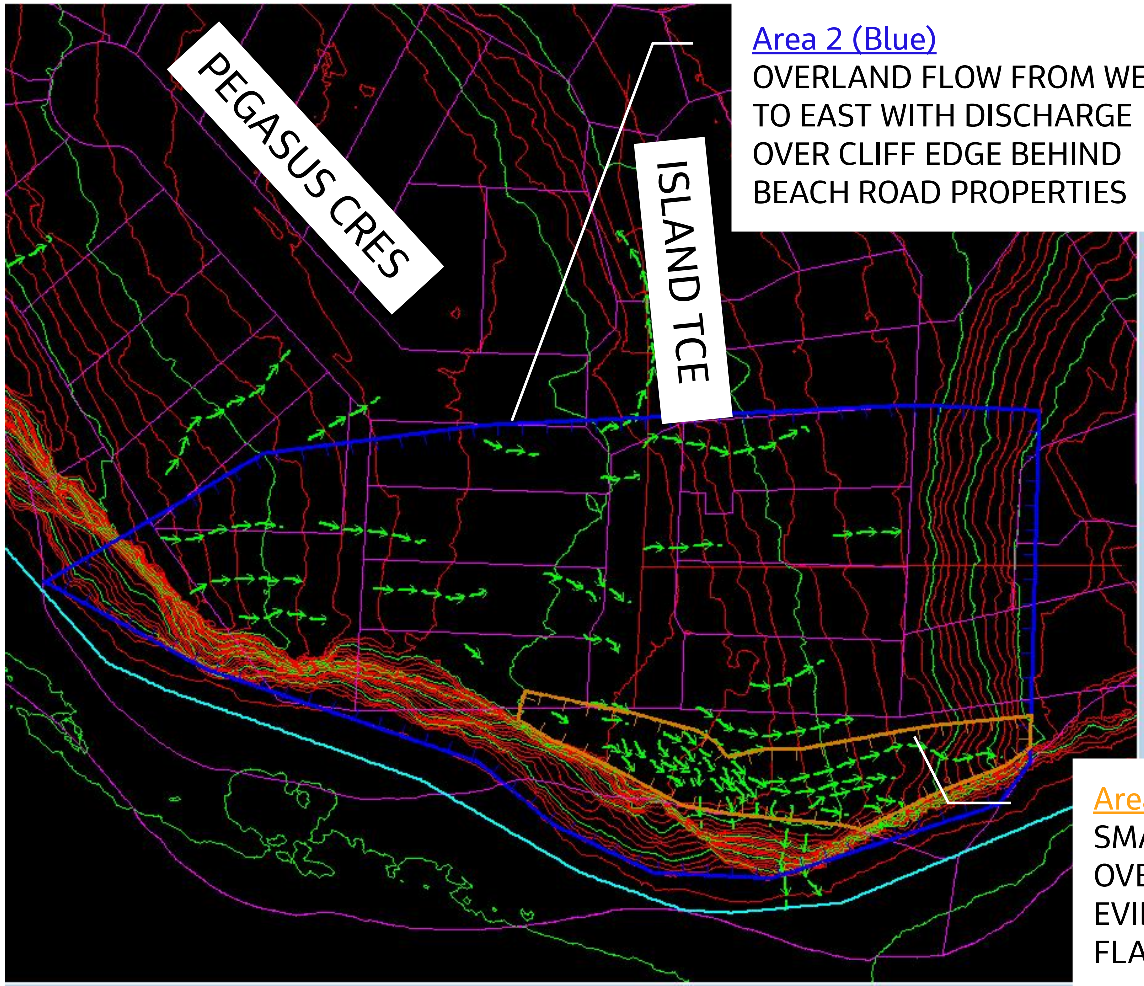
What else would need to be considered for a Resource consent?

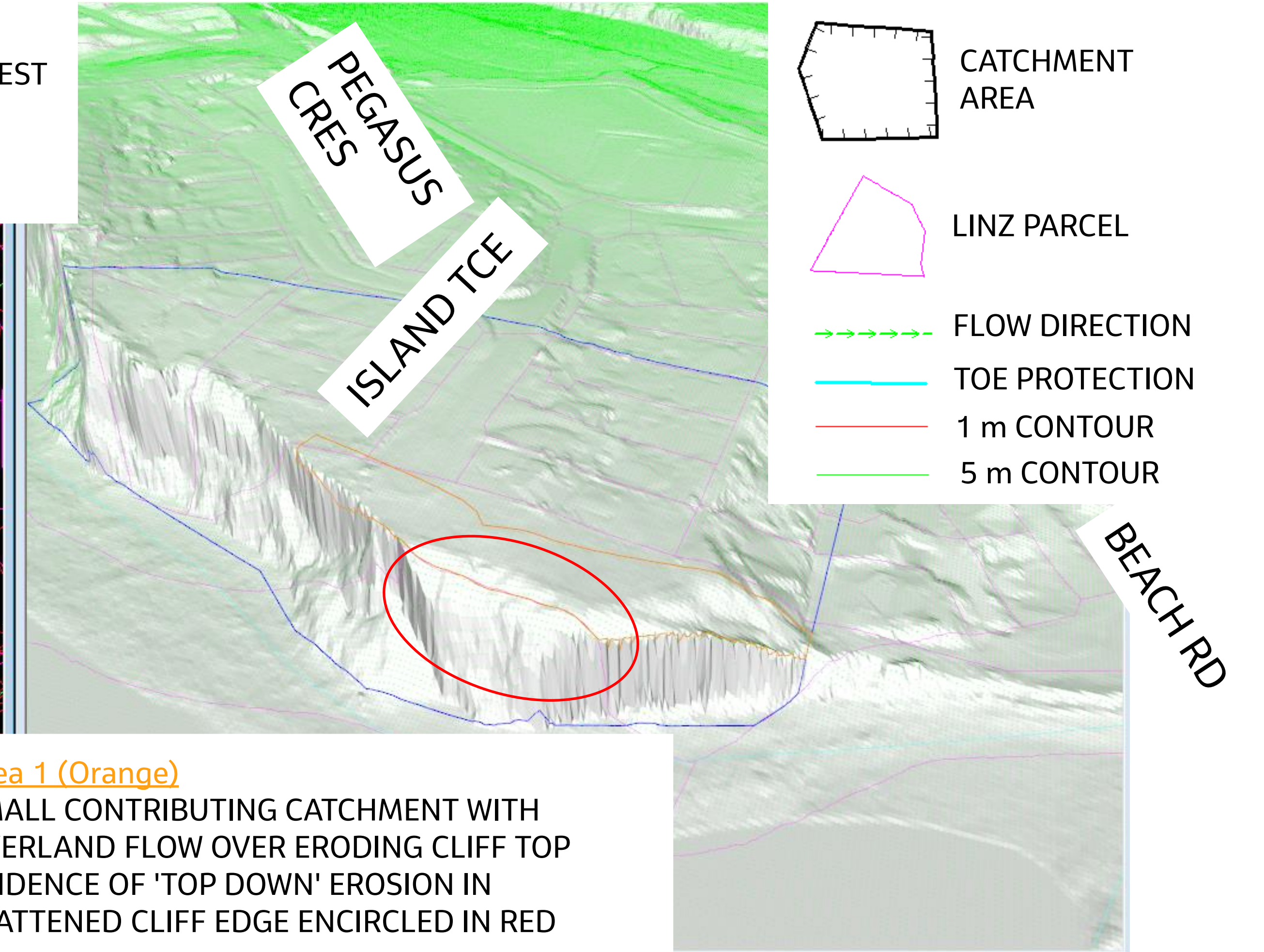
Consideration for:	Potential Options to help get consent:
Detailed Design of Structure	
Tangata Whenua (Cultural Value Assessment)	
Access	Boardwalk along top of structure
Visual Impact Assessment	Rock more likely to be consented as it looks 'natural' compared to concrete cast blocks
Ecology and Water Quality Assessment	Could cast concrete blocks to incorporate ecosystems
Coastal Processes/Natural Hazards Assessment	
Archaeology/Heritage Assessment	
Recreational and Social Values Assessment	Boardwalk along top of structure
Contaminated Land Assessment	

Stormwater Run-off Assessment

Motunau Stormwater - Assessment

- Issue: Stormwater is thought to be a contributor to cliff instability at Motunau Beach



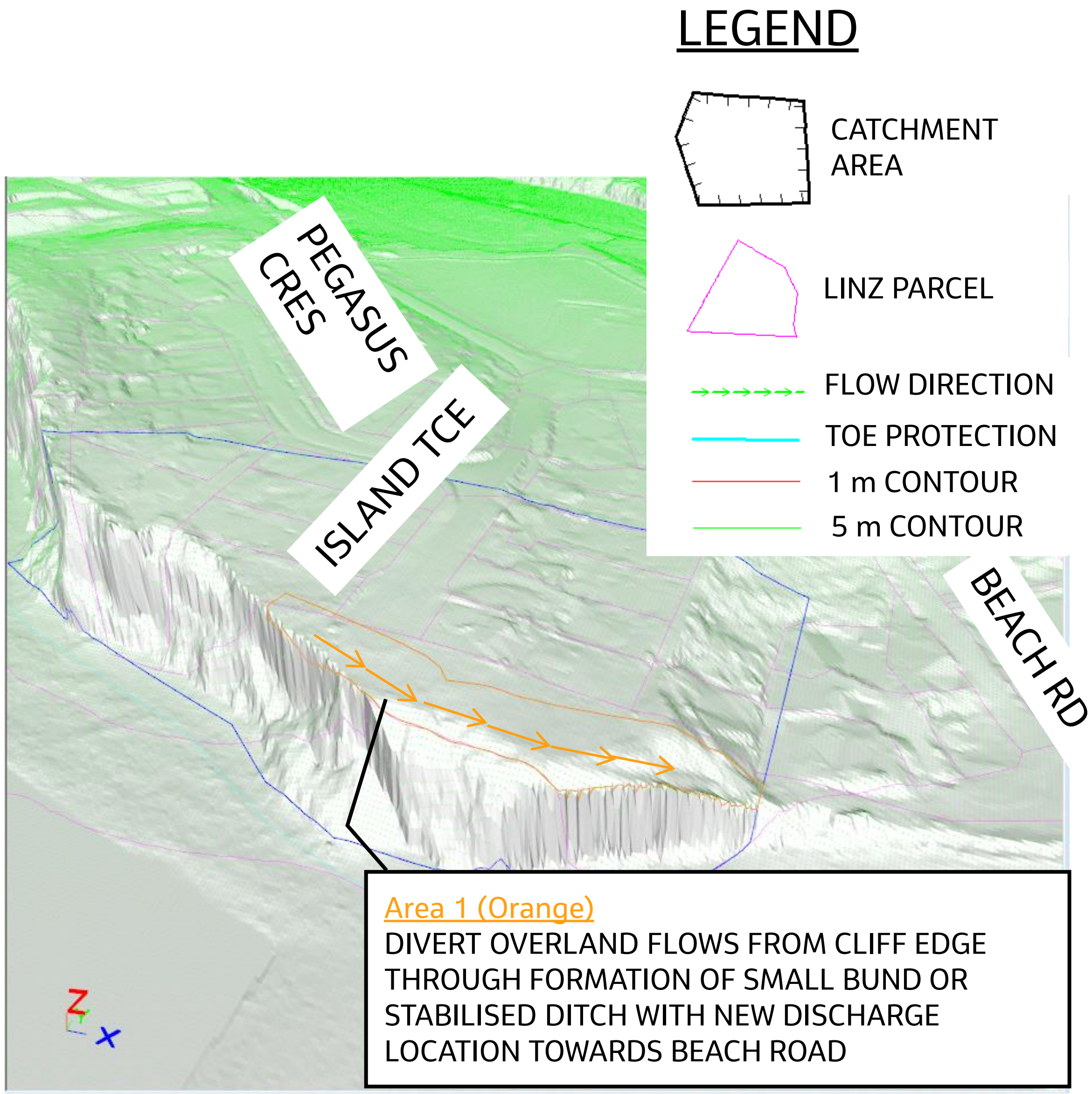


Motunau Stormwater – Option 1

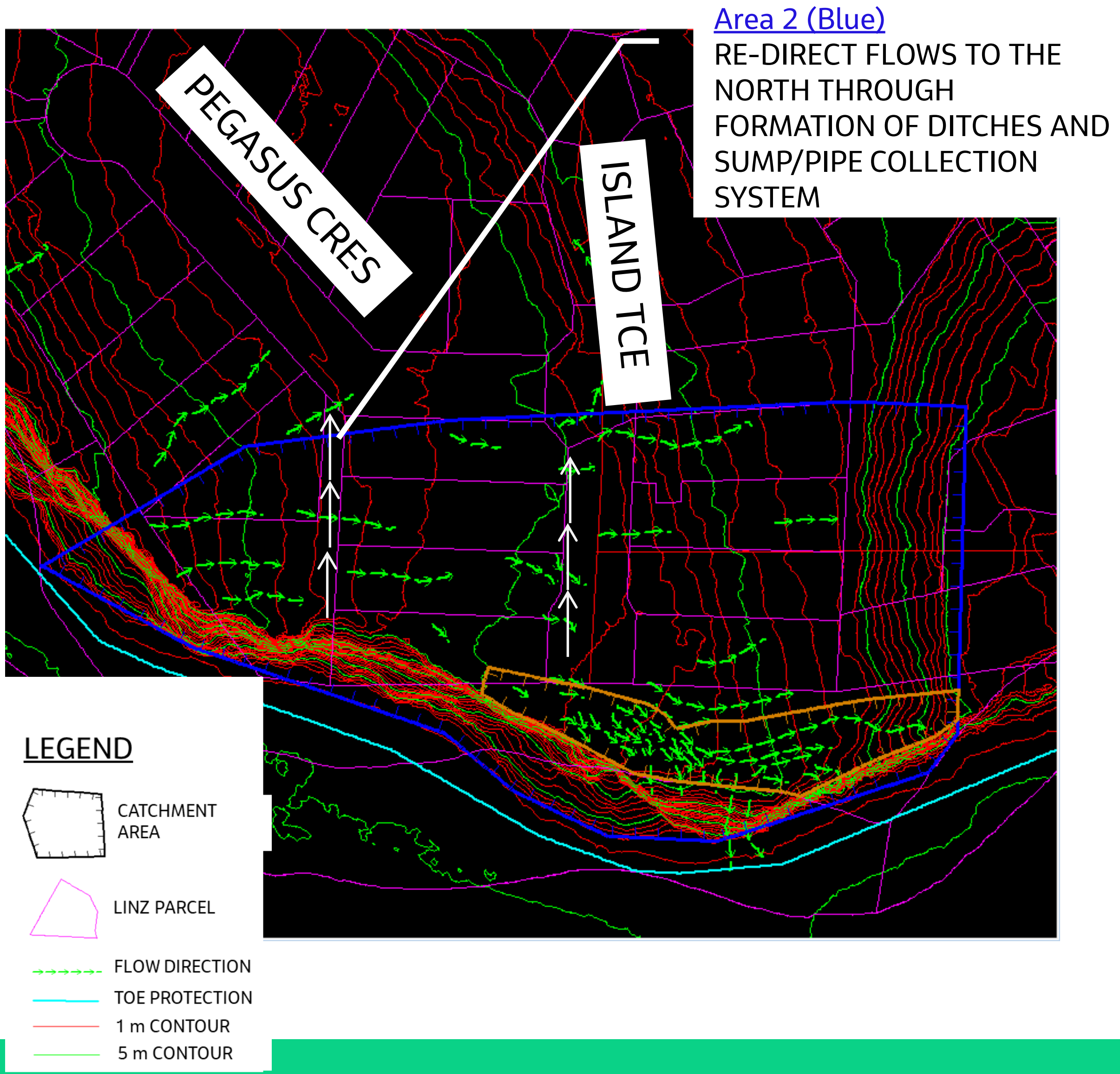
Divert overland flow from discharging over the cliff edge.

This could be achieved through the formation of a small bund or stabilized ditch with a new discharge location to the east towards Beach Road.

Further route details and feasibility for this option will require a site inspection.



Motunau Stormwater – Option 2



Re-direct stormwater flows to the north away from cliff edge.

This could be a roadside collection ditch combined with a sump and piped into the existing stormwater collection system at the intersection of Island Terrace and Pegasus Crescent.

This could divert flows north in two locations: through the private property of #3 Pegasus Crescent (with property owner consent), and within the road reserve at Island Terrace.

Slope Stability Assessment

Motunau Cliff Material

- Approximately 4 m of loess at top of cliffs
- Approximately 4 m of marine gravels and sands under loess
- Greta Formation underlying gravels
  - Mudstone
  - 1.8 to 5.3 million years
  - Weak and friable
  - Weakly consolidated
  - Susceptible to slaking (breakdown of soil due to wetting and drying cycles)
  - Deteriorates and loses strength with weathering

Slake Durability Index Test

- Tests the resistance of rock to weakening when subjected to two cycles of drying and wetting
- Motunau rock samples had a slake durability index, I_{d1}, of 0% after one cycle of drying and wetting
- I_{d1} = 0% means the rock broke into particles smaller than 2 mm after one cycle (lowest score possible)
- With continued weathering this weak rock will eventually become a soil

Angle of Repose

- 15 slopes of Greta Formation investigated to estimate angle of repose
- Three slope types
- Long-term natural angle of repose estimated to be 15°

Category	Average Angle of Slope
Slope affected by recent coastal erosion	73°
Coastal slope	31°
Non-coastal slope	15°

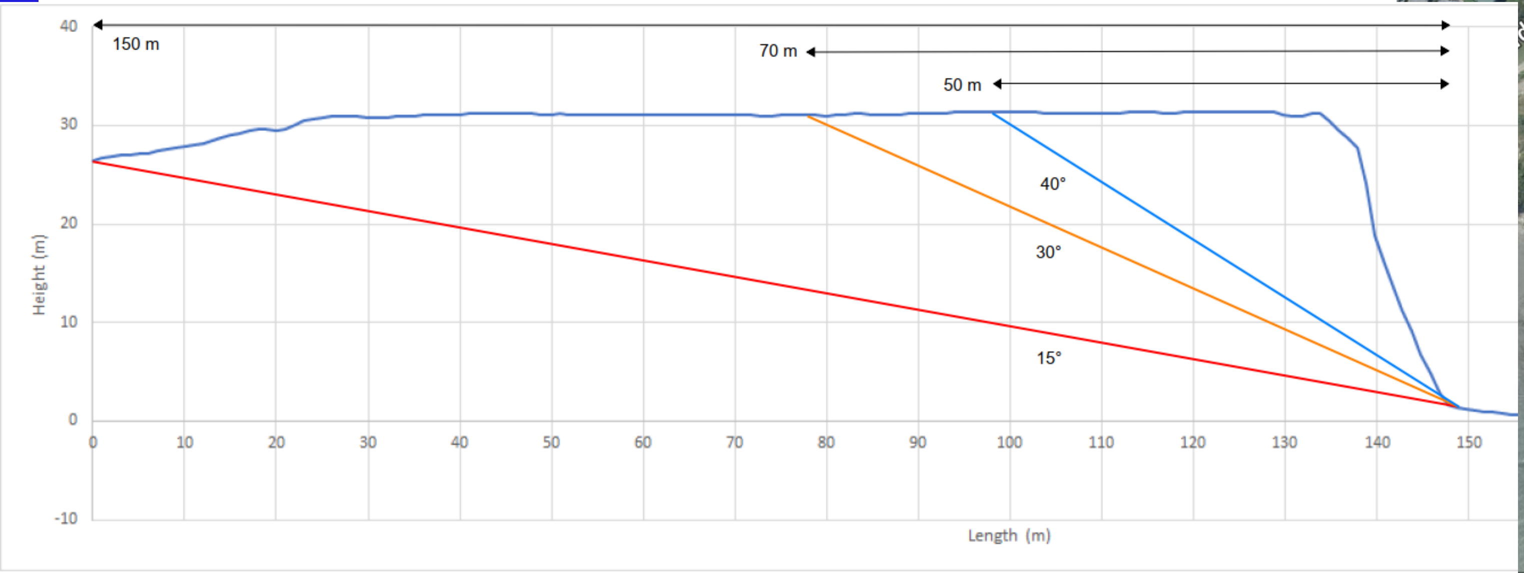
Inferred Effect of Coastal Toe Stabilisation

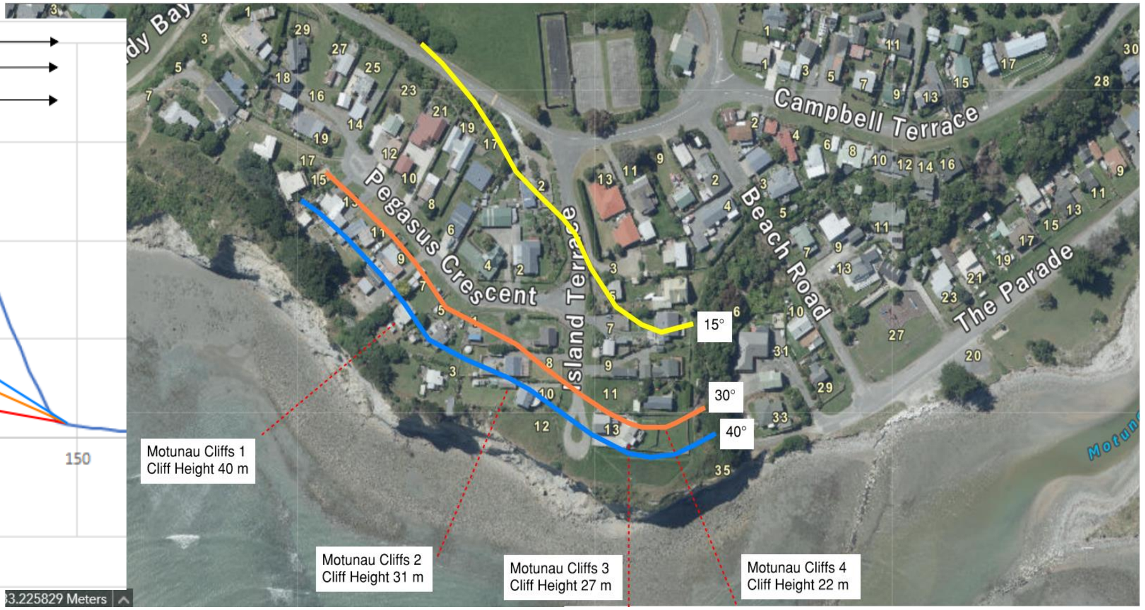
- Motunau cliffs will eventually regress to the long-term angle of repose 15° (estimated in the order of centuries or longer)
- Sandy Bay slopes have been stable with minor erosion for at least 70 years
- Regression of Motunau cliffs from a slope of 70° to a slope of ~30°-40° may be reached within an estimated time period of decades
- Regression process will be influenced by significant rain events, stormwater, infiltration and seismic events
- These above influences make the time frame approximation difficult to constrain

Inferred Effect on Properties Above the Cliff

- Table shows regression distance from the toe of the cliffs with toe stabilisation

Cliff Cross Section	Slope Regression for 15°	Slope Regression for 30°	Slope Regression for 40°
Motunau Cliff 1	150 m	70 m	50 m
Motunau Cliff 2	116 m	54 m	37 m
Motunau Cliff 3	101 m	47 m	32 m
Motunau Cliff 4	82 m	38 m	26 m





Slope Stability Summary

- Conservative approach is to assume that the cliffs will regress to ~30° to 40° in the order of decades
- If toe stabilisation is carried out the slope will regress approximately 26 m to 70 m from the toe in the order of decades
- Regression process will be influenced by significant rain events, stormwater, infiltration and seismic events
- These above influences make the time frame approximation difficult to constrain
- Slope will likely regress to approximately 15° in the order of centuries or longer

Slope Stability Recommendations

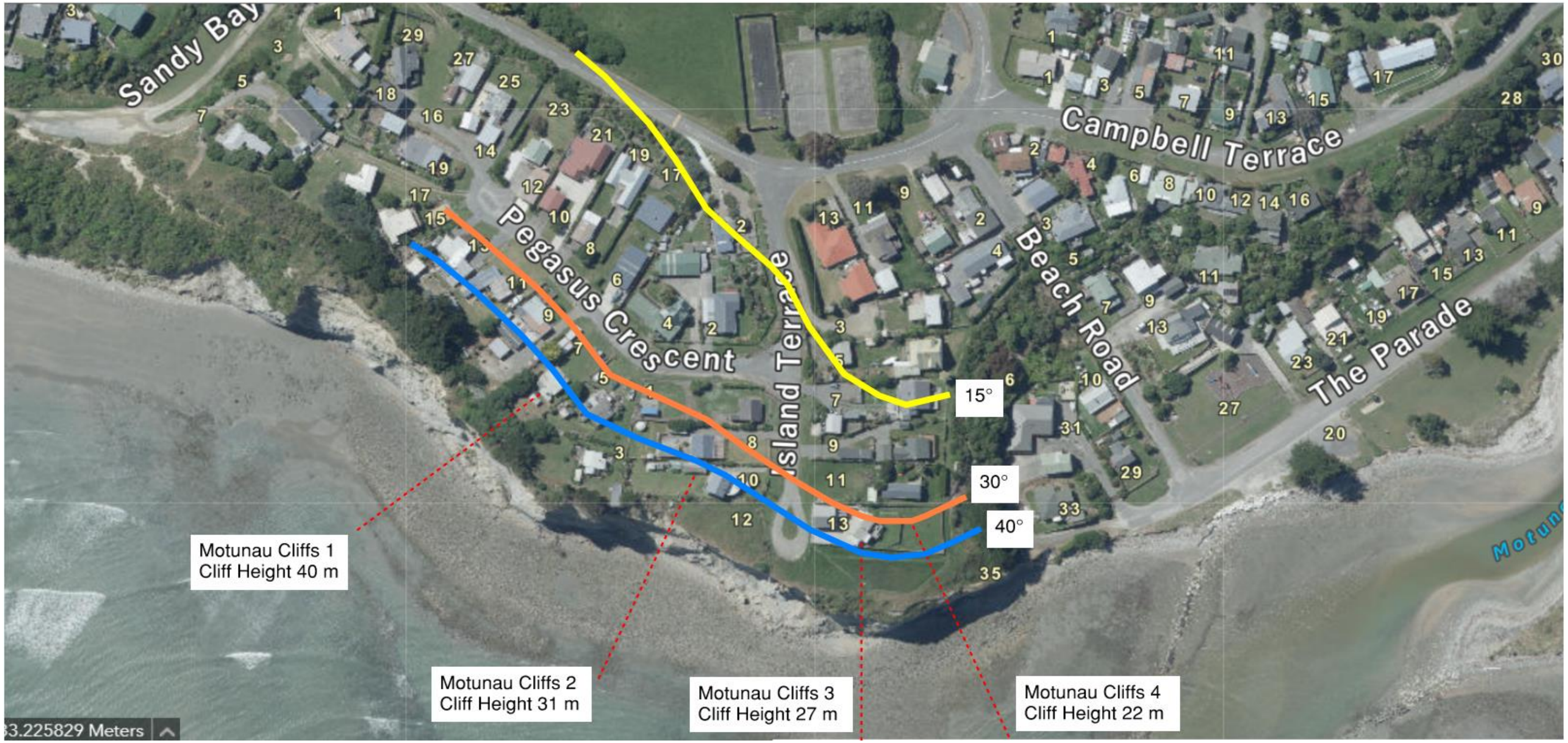
- Retain vegetation where possible
- Control surface water runoff
- Monitor residential properties for tension cracks
- Engineering geologist or geotechnical engineer to carry out a site visit to investigate tension cracks and current regression of the cliffs

Conclusions

- Protecting the toe of the cliff will slow down erosion, but there are still processes acting at the top of the cliff which will result in the cliff continuing to erode.

- Applying toe protection and stormwater control options will still not prevent cliff erosion, it will only slow the rate and buy time.

Who pays?
Motunau



Who pays?
Motunau

Annual rates increase (including GST)	Most Exp	Least Exp
Scenario 1 - properties seaward of the orange line	16,226	11,349
Scenario 2 - properties seaward of the yellow line	6,490	4,539
Scenario 3 - shared across Motunau	2,352	1,645
Scenario 4 - shared 50-40-10		
- seaward of yellow	8,113	5,674
- seaward of orange	4,327	3,026
- remainder of Motunau	369	258

Where to now?

Thank you

References

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