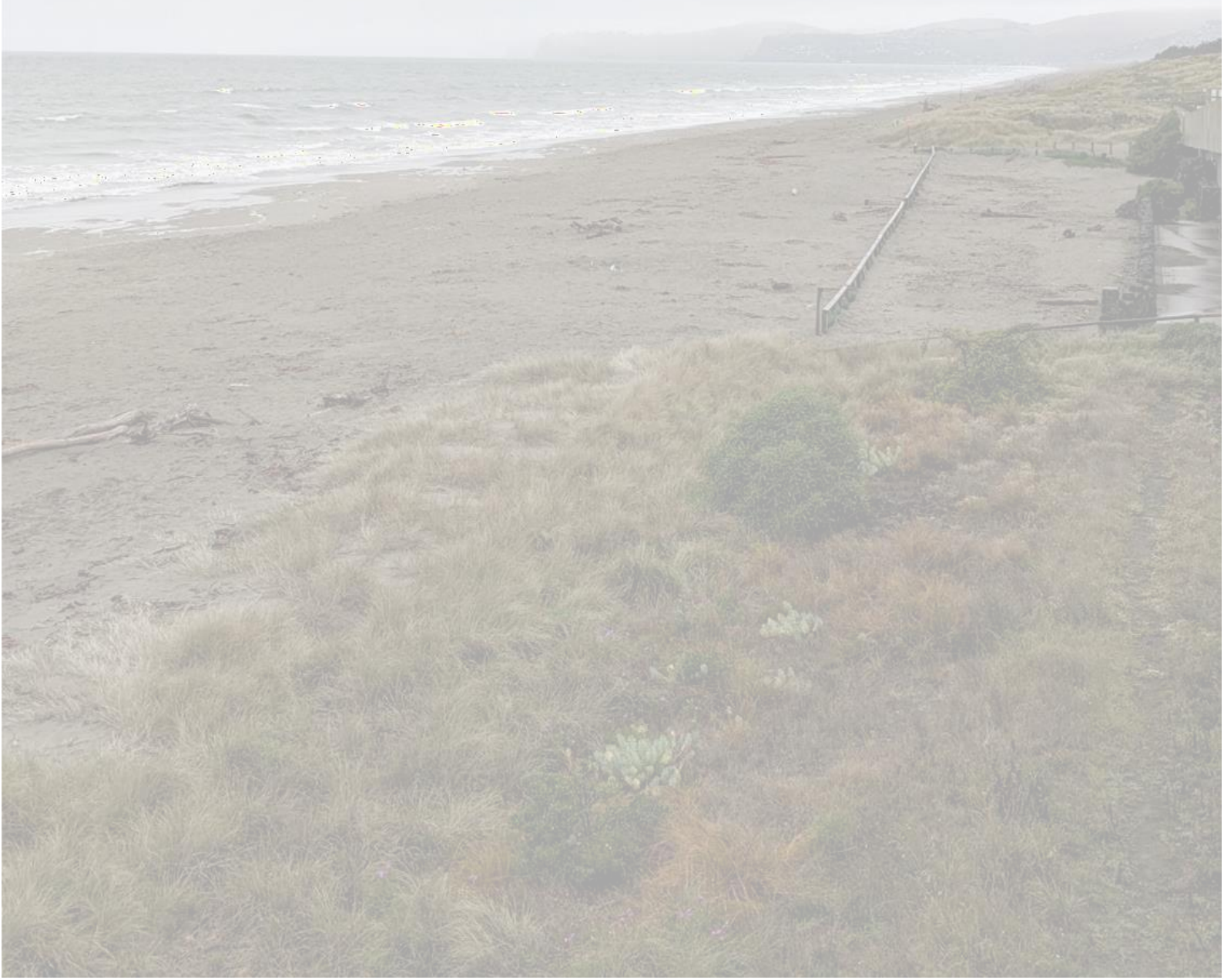


# Seatoun School

## Coastal Inundation Adaptive Pathway Report



# Adaptive Pathway: Seatoun School

This adaptive pathway has been prepared for the Ministry of Education by WSP NZ Ltd. and is intended to advise possible adaptation pathways and give an indicative timeframe of these pathways in current and future climates.

This adaptive pathway document is required to be read with the "Guidance Document: Adaptive Pathway to Coastal Inundation" (WSP, 2023).

## Site Overview

School Name	Seatoun School
School ID	2987
MoE Region	Central South
Number of buildings on school site	3

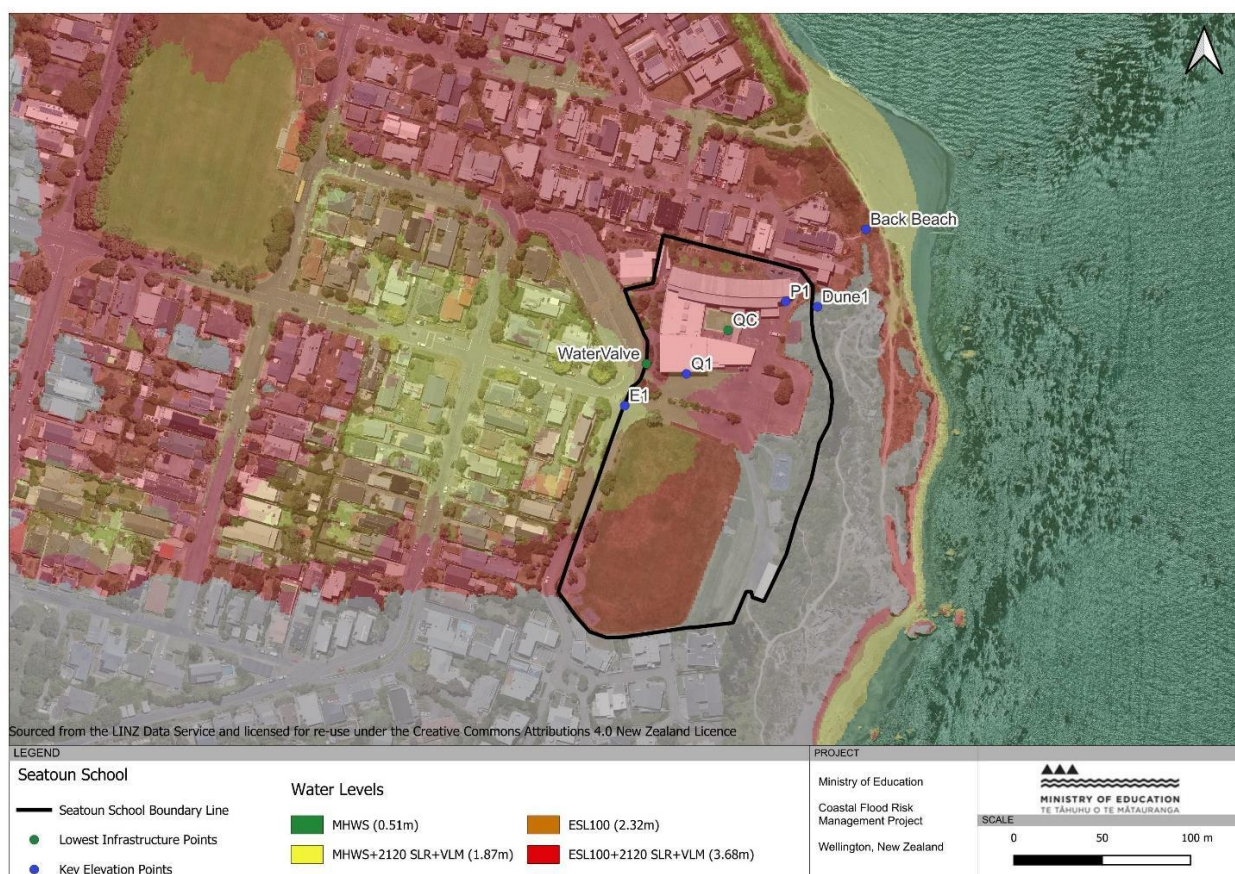


Figure 1 - Map of Seatoun School with the indicative inundation zones based on land elevation from LiDAR.

Latitude	-41.326459
Longitude	174.836841
Community Setting	School grounds are slightly higher than the community area to the west, however, is likely to have similar flooding from the coast. The surrounding water bodies are the Wellington harbour / Te Whanganui-a-Tara and Cook Strait / Te Moana-o-Raukawa.
Community Emergency Hub	Yes – Seatoun School is a Community Emergency Hub.
General Subsidence/Tectonics information	The Seatoun area is subsiding at a current rate of -3.47 mm per year (Site 2513) (NZSeaRise Takiwa Programme, 2022).

## Key Elevation Points

Note: Points are in NZVD 2016.

Access / Egress Points	Vehicle and Pedestrian Access (E1) – 2.20 m	
Lowest Finished Floor Levels	Block Q (Q1) – 2.59 m	Block P East Entrance (P1) – 2.58 m
Lowest Infrastructure levels	Water Valve (WaterValve) – 1.96 m	Q Block Courtyard (QC) – 1.88 m
Coastal Defences	Small, vegetated dune (Back Beach) – 2.90 m	Middle of dune (DUNE 1) – 4.33 m

## Water levels (current and future)

Note: Points are in NZVD 2016.

MHWS	0.51 m	ESL100 + 2050 SLR (+VLM) <sup>1</sup>	2.72 m
MHWS + 2120 SLR (+VLM) <sup>2</sup>	1.87 m	ESL100 + 2070 SLR (+VLM) <sup>3</sup>	2.95 m
ESL100 <sup>4</sup>	2.32 m	ESL100 + 2120 SLR (+VLM) <sup>5</sup>	3.68 m

<sup>1</sup> This reference level is the ESL100 (2.32 m) with the 2050 (+VLM) SLR scenario (0.40 m) added to it.

<sup>2</sup> This reference level is the MHWS (0.51 m) with the 2120 (+VLM) SLR scenario (1.36 m) added to it.

<sup>3</sup> This reference level is the ESL100 (2.32 m) with the 2070 (+VLM) SLR scenario (0.63 m) added to it.

<sup>4</sup> This ESL100 water level point (Paulik et al., 2020) is located along the south coast and may be a conservative estimate of the true ESL100 water level event that may be experienced at Seatoun School. This ESL100 point was chosen as it was the closest point to the school

<sup>5</sup> This reference level is the ESL100 (2.32 m) with the 2120 (+VLM) SLR scenario (1.36 m) added to it.



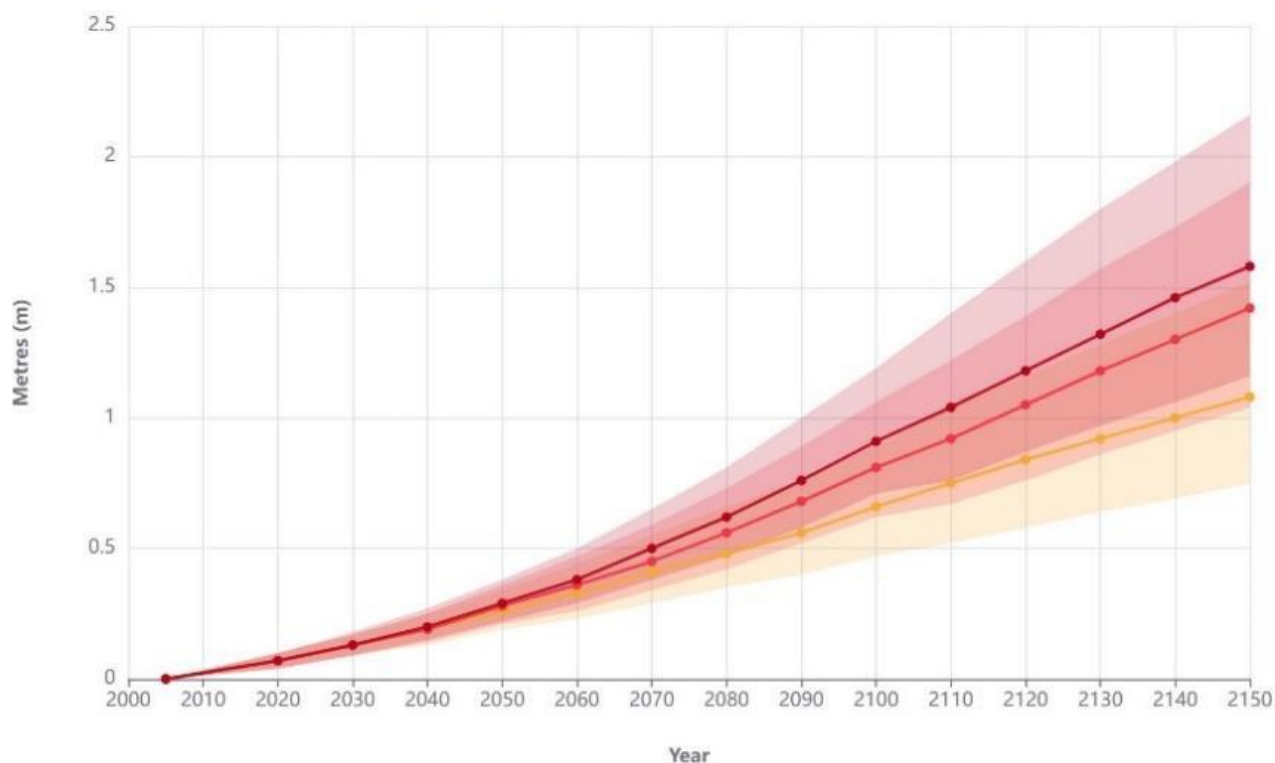


Figure 2 - Sea level rise (SLR) increments<sup>6</sup> with vertical land movement under potential climate change scenarios (SSP2-4.5+VLM in orange, SSP3-7.0+VLM in red and SSP5-8.5 in deep red) and likely confidence intervals (faded colour blocks) (NZSeaRise Takiwa Programme, 2022). MfE (2022) recommends that the median (p50) SSP3-7.0+VLM is used.

## Background / Summary of Coastal Inundation Risk

### Local, district regional adaptation and infrastructure plans

The readily available relevant local, district and regional plans that provide guidance to understand and adapt to climate risks applicable to Seatoun School are listed in the Appendix C of this document and summarised below.

Greater Wellington Regional Council (GWRC) and Wellington City Council (WCC) are in the process of undertaking risk assessments and establishing adaptation plans for the area, to ensure community resilience to climate change in the future. These adaptation plans will identify plans of potential adaptation actions to climate change and sea level rise that consider potential measures over time. Currently, there is no specific evidence (as of yet) in these plans regarding works to the Seatoun/Wellington Harbour coastline adjacent to the school.

It is recommended that Seatoun School and the Ministry of Education liaise with these parties to collaborate on appropriate mitigation/adaptation strategies for the school and its community and mana whenua.

<sup>6</sup> Sea level rise increments added to MHWS and ESL100 are the median values on the NZSeaRise programme charts as there are associated confidence intervals associated with each scenario.

## Risk of Coastal Inundation (Past/Current/Future)

See Appendix B for further information.

Period	Vulnerability	
	MHWS	ESL100
Current	Low	Medium
Short-term (Present-2050)	-	High
Medium-term (2050-2070)	-	High
Long-term (2070-2120)	Low	High

## Other Hazards

### School anecdotal evidence

No recorded or anecdotal flooding from coastal inundation based on on-site conversations with the school principal and administration, or limited search online.

### Infrastructure

No existing infrastructure (stop banks, State Highway, railways) is located between the school and the coast.

### Other types of flooding

No recorded or anecdotal flooding on school site from fluvial, pluvial nor stormwater sources. Based on on-site conversations with the school principal and administration some ponding and stormwater flooding has been recorded along Burnham Street and Dorset Cove coinciding with high tides. It can be expected that this flooding will worsen with the predicted impact of sea level rise, and in time may impact access to the school.

### Erosion

No significant evidence of erosion of coastline during on-site surveys. Vegetated back beach and cliff provide some resistance of the back beach to current erosion rates. More detailed investigations into the erosion trends of the stretch of coastline is required to make an accurate judgement on the erosion potential of the beach, particularly with increasing sea levels.

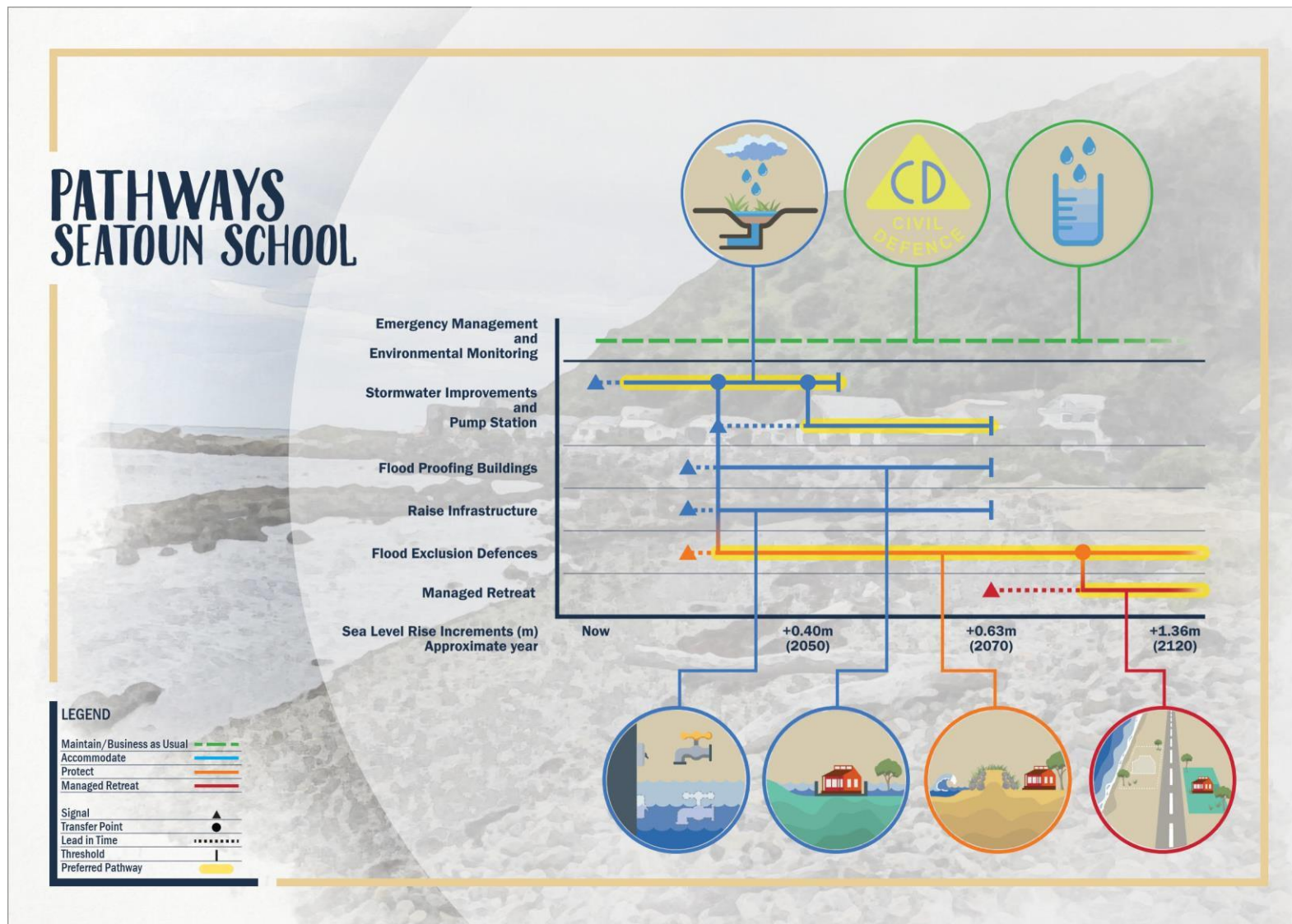


Figure 3 – Coastal Inundation Adaptation Pathway infographic for Seatoun School.

## Preferred Adaptive Pathway





The preferred adaptive pathway for Seatoun School has been suggested due to its practicality, taking the school's current vulnerability into consideration, as well as any future increase in vulnerability with predicted rises in sea level. The pathway anticipates the possibility of future community-level conversations and activities that the Ministry of Education and school should be aware of, and consider contributing to as well.

The short-term pathway for Seatoun School should be considered as it should help address the small-scale flooding issues, through relatively minor cost-effective options. In the future, the long-term pathway for Seatoun School could be to establish exclusion defence structures (temporary or permanent) around the school, which will allow the school site to continue to be used.

The preferred adaptive pathway is subject to monitoring of the site and community, and monitoring of how the preferred pathway responds to sea level rise, by the Ministry of Education. As it is adaptive, it also suggests/assumes that the Ministry of Education will review the pathway options at regular intervals (*at least* every 10 years), before significant changes to school site, or, after a coastal inundation event.





The preferred adaptive pathway suggested for Seatoun School considers the coastal inundation (flooding) risk and does not consider/include the impact of pluvial and fluvial inundation, the erosion of the coastal shoreline, the demographic changes associated with the school such as the school roles, and the forthcoming asset management interventions to enhance current school assets.

### Preferred Adaptive Pathway – Short Term (Present-2050)



Pathway Approach	Accommodate and Protect	 
Preferred Pathway	<p>Consider stormwater improvements to the school site such as flap and non-return valves, and also the construction of a pump station to help drainage of the school site (to reduce current exposure to other flooding hazards to the site).</p> <p>Consider building of flood exclusion defences (temporary or permanent) around school site allowing for continued community access to the school site.</p>	 
Trigger Points	Stormwater improvements could be triggered when leakages, blockages or inundation occurs to infrastructure or buildings that impacts the operation of the school at the preferred level of service.	

	<p>The building of the flood exclusion defences could be triggered when coastal waters cause flooding to the lowest point of the school site. An indicative timeframe for this trigger could occur from 2030.</p>	
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### Preferred Adaptive Pathway – Medium Term (2050-2070)

Pathway Approach	Accommodate	 
Preferred Pathway	<p>Consider maintaining or upgrading the stormwater improvements and flood exclusion defences implemented in the short-term to ensure reduced exposure to coastal inundation</p> <p>Consider constructing a pump station to help drainage of school site</p>	 
Trigger Points	Continued maintenance of the stormwater and flood exclusion defences should occur from when they are implemented. Should flooding continue to occur, increase the level of service of these stormwater improvements. .	

### Preferred Adaptive Pathway – Long Term (2070-2120)





Pathway Approach	Managed Retreat	
Preferred Pathway	Consider the managed retreat of the school to a site at a higher elevation and away from all coastal flood hazards.	
Trigger Points	<p>The managed retreat of the school could be triggered when the flood exclusion defences no longer provide protection to the school or when coastal inundation impacts the continued operation of the school. An indicative timeframe for when this could be triggered and investigations into new site outside of hazard zones is from 2070.</p>	




## Appendix A: Adaptive Pathways

### Short-list Options Considered

Note: Refer to Appendix A in the Guidance Document (WSP, 2023)

	Guidance document reference	Options considered
Short Term	A & B & C 	All current coastal inundation management activities continue. Maintain existing infrastructure such as cleaning drains and continue current emergency management and environmental monitoring activities to existing level of service.
	D 	Consider stormwater improvements on the school site such as flap and non-return valves (to reduce current exposure to other flooding hazards to the site).
	D 	Consider flood proofing buildings and repurposing finished floor levels of lowest buildings.
	D 	Consider raising infrastructure at risk
	M 	Consider building flood exclusion defences around the school allowing for continued community access.
Medium Term	D 	Consider stormwater improvements on the school site such as constructing a pump station to help drainage of the school site.
	M 	Consider maintaining or increasing the level of service of the building flood exclusion defences around the school allowing for continued community access.

Long Term	<p>O</p> 	<p>Consider the managed retreat of the school to new school site from all flood and coastal hazards.</p>
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## Appendix B: Risk of Coastal Inundation (Past/Current/Future)

### Current Vulnerability to MHWS:

Seatoun School has a low vulnerability to coastal inundation under current MHWS (0.51 m). No buildings or infrastructure surveyed are vulnerable to coastal inundation as they are at an elevation above the referenced level for MHWS.

### Long Term (2070-2120) Vulnerability to MHWS with SLR:

Seatoun School has a low vulnerability to coastal inundation under MHWS with the SSP3-7.0+VLM 2120 SLR scenario (1.87 m). No buildings, infrastructure or access points surveyed are vulnerable to coastal inundation as they are at an elevation above the referenced level for this predicted event.

### Current Vulnerability to ESL100:

Seatoun School has a medium vulnerability to coastal inundation under the current day ESL100 scenario (2.32 m). The vulnerable buildings and infrastructure surveyed below the referenced level for this predicted event are:

- All infrastructure (except for the water tanks, stormwater manhole (QG) and the fire sprinkler inlet room).
- All school access points.

### Short term (Present Day – 2050) vulnerability to ESL100 with SLR:

Seatoun School has a high vulnerability to coastal inundation under ESL100 with the SSP3-7.0+VLM 2050 SLR scenario (2.72 m). The vulnerable buildings and infrastructure surveyed are below the referenced level for this predicted event:

- All infrastructure surveyed.
- All FFL's of buildings surveyed.
- All school access points.

### Medium term (2050-2070) Vulnerability to ESL100 with SLR:

Seatoun School has a high vulnerability to coastal inundation under ESL100 with the SSP3-7.0+VLM 2070 SLR scenario (2.95 m). The vulnerable buildings and infrastructure surveyed below the referenced level for this predicted event:

- All infrastructure surveyed.
- All FFL's of buildings surveyed.
- All school access points.

### Long term (2070-2120) Vulnerability to ESL100 with SLR:

Seatoun School has a high vulnerability to coastal inundation under ESL100 with the SSP3-7.0+VLM 2120 SLR scenario (3.68 m). The vulnerable buildings and infrastructure surveyed below the referenced level for this predicted event:

- All infrastructure surveyed.
- All FFL's of buildings surveyed.
- All school access points.

# Appendix C: Local, district and regional adaptation and infrastructure plans

## MfE's National Adaptation Plan:

The National Adaptation Plan outlines a programme of work to support communities to better understand the climate impacts that affect them and adapt to build their resilience.

## Waka Kotahi New Zealand Transport Agency

Waka Kotahi New Zealand Transport Agency (Waka Kotahi) release 'Tiro Rangi Climate Adaptation Plan' in December 2022. To ensure that the land transport system is resilient with climate change, Waka Kotahi in alignment with the National Adaptation Plan adaptation framework (avoid, protect, accommodate and retreat), will use a combination of these categories to effectively adapt in different locations and over different timescales. These adaptation strategies will be built into long-term planning to avoid ongoing expensive repairs, disruption and declining levels of service (date accessed 18/04/2023).

## Greater Wellington Regional Council and Wellington City Council

Greater Wellington Regional Council (GWRC) and Wellington City Council (WCC) are developing a regional climate change impacts assessment and adaptation plan. The development of Phase 1: The Wellington Regional Climate Change Impact Assessment will bring together a consistent regional evidence base of the climate change risks and impacts over the next century. The assessment will provide findings regarding impacts to the communities, infrastructure, natural ecosystems, economy and governance systems. Phase 2: The Regional Adaptation Plan is to develop an Adaptation Plan in response to the findings in the Impact Assessment. Through the Adaptation Plan, it will inform development in the region to increase community resilience to climate change, and which prioritises the key opportunities for strengthening climate resilient development (date accessed 18/04/2023).

A regional risk assessment for key climate change impacts is being developed which will underpin the subsequent regional approach to climate change impacts, and WCC's work focused on its communities adapting to climate impacts (date accessed 03/04/2023).

## Wellington City Council

Coastal reports commissioned by Wellington City Council (WCC) to help understand coastal hazards and sea level rise in Wellington City such as NIWA 2021, "Coastal hazards and sea-level rise in Wellington City" (date accessed 17/04/2023). Highlights an escalation of coastal hazards for low-lying areas such as Seatoun and makes note of the possibility of coastal inundation via stormwater connections to the coast.

WCC are building their knowledge about the effects of climate change. WCC jointly commissioned the 2019 report Preparing Coastal Communities for Climate Change, which identified the coastal areas of the South Coast vulnerable to climate change, sea level rise and natural hazards (date accessed 03/04/2023).

Over the past few years, WCC have implemented actions to reduce exposure to climate risks. These include making improvements to stormwater infrastructure, maintenance of seawalls, better access to information about future coastal hazards and risks, and they have begun engagement with high-risk communities to begin planning for climate change.



## Glossary and Acronyms

Key term	Definition
Adaptation	The process taken to adjust to the impacts and risks of coastal inundation.
Adaptation approaches and options	Compendium of five approaches of physical climate change adaptation and resilience measures relevant for coastal inundation across Aotearoa New Zealand, which can help to support the Ministry of Education address the climate change impacts to schools from Coastal Inundation.
Annual exceedance probability	Annual Exceedance Probability (AEP) is the probability of an event occurring in any given year. i.e. a 1% AEP means there is a 1% chance in any given year of the event occurring. This means that on average 1 event of this size will occur every 100 years.
Climate change	Large-scale, long-term shifts in the planet's weather patterns and average temperatures
Climate change impacts	The consequences of climate change, both experienced and expected, for natural and human systems and environments.
Coastal inundation adaptation approaches/options	Practical things that can be done to adjust to, prepare for, respond to, and recover from coastal inundation impacts and risks.
Coastal inundation threshold/ reference water level event	Predicted water levels under current and future climate using the current day MHWS and ESL100 at each school location with SLR+VLM in 2050, 2070, and 2120 added.
Coastal inundation vulnerability	Identification of resources at risk from coastal inundation.
ESL100	
FFL	Finished floor levels
MHWS	
Resilience	Capacity to prepare for, respond to, and recover from climate impacts and risks while incurring minimal damage to wellbeing, the economy, and the environment.
Signal/Trigger	A point in time that allows any change that occurs to be monitored and to have a point on which to adapt. Signals/triggers highlight impending changes in risk.
SLR scenarios	
SSP3	
VLM	