Coastal Management Project

Coastal Risk Assessment

for

Tasman Bay/Te Tai o Aorere and Golden Bay/Mohua

December 2020

tasman district council | Te Kaunihera o te tai o Aorere

For further information on this report or our Coastal Management Project, please contact:

Coastal Management Project
Tasman District Council
c/o 189 Queen Street
Private Bag 4, Richmond, 7050

Phone: 03 543 8400
Email: tasmancoastalmanagement@tasman.govt.nz
View: tasman.govt.nz/link/coastal-management

Executive Summary

In July 2019, Tasman District Council (the Council) launched its 'Coastal Management Project – Responding to Climate Change' initiative which aims to enable our Tasman Bay/Te Tai o Aorere and Golden Bay/Mohua communities to work towards long-term adaptive planning for coastal hazards and sea level rise. This project follows best practice as set out in the Ministry for the Environment's 2017 Coastal Hazards and Climate Change Guidance.

As part of this project, the Council has prepared a 'first-pass' risk assessment to understand Tasman Bay/Te Tai o Aorere and Golden Bay/Mohua's vulnerability to coastal storm inundation and sea level rise. This assessment identifies a selection of assets, property, infrastructure and facilities (referred to as 'elements at risk') that may be exposed to a present day 1% annual exceedance probability (AEP)[1] coastal storm inundation event and a range of sea level rise scenarios up to 2.0 m. It does not attempt to measure the severity of the hazard, for example if there will be damage and/or whether replacement will be required (where this is possible or appropriate). Rather, it identifies and broadly quantifies elements at risk that may be vulnerable to coastal hazards (e.g. number of buildings or length of road exposed).

This report should be read in conjunction with Council's coastal hazards map viewer, an online map tool which shows the spatial extent of low-lying coastal land which may be vulnerable to coastal storm inundation and sea level rise. More information on the project, including the coastal hazards map viewer, can be found online at tasman.govt.nz/link/coastal-management.

Many factors need to be taken into account when considering how future global warming will contribute to climate change and, ultimately, sea level rise. The scientific consensus is that sea levels will continue to rise and are likely to rise at an accelerated rate over time. Whilst there is some uncertainty as to exactly when a particular increment of sea level will be reached, this report simply quantifies those elements at risk that may become vulnerable to rising sea levels.

Several national agencies have already undertaken work to quantify New Zealand-wide exposure, vulnerability and risks from climate change and sea level rise. These reports are complimentary to the information presented in this report and overall contribute towards a broad understanding of the Tasman District's vulnerability to coastal storm inundation and sea level rise.

The methodology used in this assessment (Section 2) draws on the Ministry for the Environment's best practice guidance, in particular Arotakenga Huringa Ahuarangi: A Framework for the National Climate Change Risk Assessment for Aotearoa New Zealand (2019). The coastline was segmented into seven 'coastal cells' representing smaller geographic areas, to enable meaningful data analysis using readily available datasets. These are Richmond – Waimea, Māpua – Ruby Bay, Motueka – Riwaka, Mārahau – Kaiteriteri, Abel Tasman National Park, Eastern Golden Bay, and Western Golden Bay.

Elements at risk (e.g. assets, property, infrastructure and facilities) that may be vulnerable to coastal storm inundation and sea level rise either now in the present day or in the future were identified (Section 3). These elements have been grouped into the following four overarching 'value domains': human, natural environment, economy, and built environment.

There will be social, cultural, economic and environmental implications for individuals, landowners, businesses, iwi, and the wider community around the entire coastline.

[1] A 1% annual exceedance probability (AEP) event has a 1% chance of occurring in any year.

Some of the key findings of the assessment are:

- Land cover vulnerable to a 1% AEP coastal storm inundation and rising sea levels is dominated by grassland (44%, 3,650 hectares) and coastal indigenous vegetation (25%, 2,106 hectares). The grasslands are typically productive farmland predominantly located in Golden Bay/Mohua and the Waimea Plains, and to a lesser extent Motueka. Coastal indigenous vegetation is primarily located within Abel Tasman National Park (50%, 1,052 hectares) and along the Golden Bay/Mohua coastline (37%, 770 hectares). Other land cover includes urban land (11%, 941 hectares), exotic forestry (10%, 857 hectares) and horticultural land (9%, 760 hectares).
- There are 350 archaeological sites that are vulnerable to coastal storm inundation and sea level rise based on the NZ Archaeological Association's ArchSite records. These sites are spread across Tasman Bay/Te Tai o Aorere and Golden Bay/Mohua, reflecting the rich history of human occupation along much of the coastline. There will be other sites of significance to iwi (including archaeological sites) that are located in vulnerable coastal areas and are not captured within this assessment.
- Council has an extensive network of open spaces and reserves adjacent to the coast, estuaries and river mouths which provide for a range of functions and values. A significant portion (51%, 717 hectares) of the District's open space and reserve zoned land is vulnerable to coastal storm inundation and rising sea levels.
- An estimated 8,400 people are located in low-lying coastal areas that are vulnerable to coastal storm inundation and sea level rise. Approximately 60% (4,970 people) are located in the Motueka – Riwaka coastal cell and a further 12% (990 people) in the Māpua – Ruby Bay coastal cell.
- Whilst Richmond is the District's largest town, much of its urban area is sufficiently inland and elevated to be outside the extent of the mapped coastal storm inundation and sea level rise scenarios. Land adjacent to the Waimea Inlet and on the inlet islands is vulnerable and includes a large area of business and industrial land; recreation, conservation and forestry land uses and water/wastewater pipe infrastructure on Moturoa/Rabbit Island; Bell Island wastewater treatment plant; cultural, recreation and conservation values in and around the inlet and islands; and horticulture and pastoral farming on the Waimea Plains.
- Māpua and Ruby Bay's exposure to coastal hazards is well known and documented. It has the second largest residential area in the District with associated services (e.g. businesses, community facilities, infrastructure) vulnerable to coastal hazards and sea level rise.
- Motueka is the largest town in the District that will be affected by coastal storm inundation and sea level rise. The cost to either repair damages, replace or relocate over the longer term will be significant. There is an extensive number of vulnerable elements at risk including people, homes, tourism accommodation, businesses and industry, Port Motueka, community facilities, and infrastructure. Any damage or inability to use roads which cross low-lying areas (particularly SH60) will impact not only access to Motueka and Riwaka, but also the approaches to Tākaka Hill and access to Golden Bay/Mohua. Horticultural and pastoral land around coastal Motueka and Riwaka is also vulnerable.
- Abel Tasman National Park includes large areas of vulnerable coastal indigenous vegetation as well as some houses/holiday homes and Department of Conservation assets (e.g. Abel Tasman Coast Track, huts, etc.). Road access to the National Park via the road to Mārahau will be affected by rising sea levels.

- There are a number of similarities between Mārahau – Kaiteriteri, Western Golden Bay and Eastern Golden Bay in terms of vulnerability to coastal storm inundation and sea level rise. All include a number of smaller towns and local centres dotted along the coast comprising a mix of homes, tourism accommodation, businesses and industry, Port Tarakohe, and some community facilities. In some areas Council 3 waters infrastructure is present (e.g. water supply, wastewater, stormwater). The road network is critical for access to these coastal communities, and there are sections of roads which are either presently vulnerable or will be in the future due to rising sea levels.
- Coastal storm inundation and sea level rise will have a significant impact on many existing coastal assets (e.g. wharves, jetties, boat ramps, coastal protection structures, ports) simply because of the nature of their design, purpose and location. Over time, rising sea levels will cause coastal assets to be affected by waves or high tides more regularly.
- There are eight closed landfills, in addition to other potentially contaminated land sites, located at or near the coast which could pose an environmental risk if exposed by coastal storm inundation and sea level rise.

This report is a key step in starting to quantify assets, property, infrastructure and facilities ('elements at risk') that may be vulnerable to coastal storm inundation and sea level rise, using readily available datasets. The information presented in this report will be used to help inform future phases of the Coastal Management Project including identifying issues and options for coastal management. There will be other things that are valued by the community which are located at the coast that are not captured within this assessment.

Table of Contents

1. Introduction

1.1 Purpose

In July 2019, Tasman District Council (the Council) launched its 'Coastal Management Project – Responding to Climate Change' which aims to enable our Tasman Bay/Te Tai o Aorere and Golden Bay/Mohua communities to work towards long-term adaptive planning for coastal hazards and sea level rise.

As part of this project, the Council has prepared a 'first-pass' risk assessment to better understand Tasman Bay/Te Tai o Aorere and Golden Bay/Mohua's vulnerability to coastal storm inundation and sea level rise. This assessment identifies a selection of assets, property, infrastructure and facilities, referred to as 'elements at risk', that may be exposed to coastal storm inundation and sea level rise using readily available datasets. It does not attempt to measure the severity of the hazard, for example if there will be damage and/or whether replacement will be required (where this is possible or appropriate). Rather it identifies and broadly quantifies elements at risk that may be vulnerable to coastal hazards (e.g. number of buildings or length of road exposed).

This report sets out the findings of the risk assessment. The information presented will be used to help inform future project phases of the Coastal Management Project including identifying issues and options for coastal management.

1.2 Background

The Coastal Management Project follows best practice as set out in the Ministry for the Environment's 2017 Coastal Hazards and Climate Change Guidance (MfE 2017 Guidance). The guidance has been structured around an iterative 10-step framework, focusing on five key questions, to enable long term strategic planning and decision making for coastal management (Figure 1).

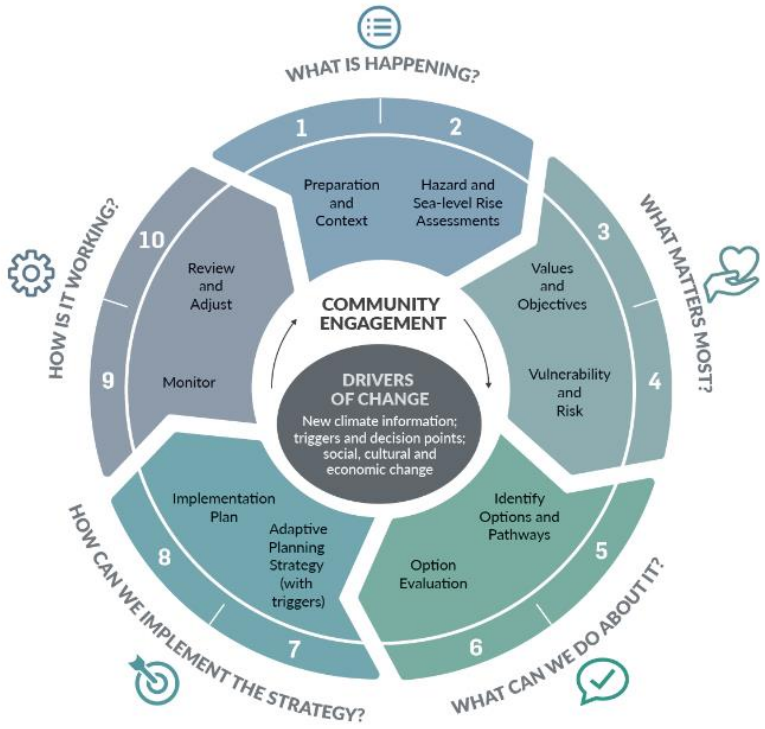


Figure 1: The 10-step decision cycle, grouped around five questions (MfE, 2017)

Phase 1 of the project (July – September 2019) involved undertaking community engagement focussing on the release of a coastal hazards map viewer, an online map tool which illustrates increments of sea level rise up to 2 m, coastal storm-tide inundation and coastal erosion hazards. The engagement also sought to raise awareness amongst our community and develop a common understanding of the information. Feedback was sought on what the community values that may be affected by sea level rise and coastal hazards. The coastal hazards map viewer and associated reports are available on the Council's website at tasman.govt.nz/link/coastal-management.

This report represents Phase 2 of the project, to undertake a coastal risk assessment for Tasman Bay/Te Tai o Aorere and Golden Bay/Mohua focusing on the vulnerability of elements at risk to sea level rise and coastal inundation.

The outputs from the project will be used to inform a number of Council's core functions. For example, the planning aspects will be included in the development of the coastal hazards section of the Aorere ki uta Aorere ki tai - Tasman Environment Plan (our second generation Tasman Resource Management Plan), resource and building consent processes, activity management plans, reserves management plans, and civil defence and emergency management.

1.3 Report Scope: Coastal Hazards Mapping

This coastal risk assessment is based on the mapped coastal storm inundation and sea level rise information shown on Council's coastal hazards map viewer (tasman.govt.nz/link/coastal-management). The map viewer identifies low-lying coastal areas which may be susceptible to coastal hazards using the static level inundation mapping technique. This method is sometimes referred to as the 'bath tub' model (the line that a bath tub would fill to). This technique involves identifying and mapping all land lying below a particular elevation (i.e. water level).

The map viewer shows a range of sea level rise scenarios in 0.5 m increments up to 2.0 m. It also shows the impacts of high tides further elevated by storms, mapped as a present day 1% annual exceedance probability (AEP) joint probability storm-tide event. A 1% AEP joint probability storm-tide is the combination of the tide and storm effects that have a 1% chance of occurring in any year. An example of the coastal hazards map viewer is shown in Figure 2 (over page), which illustrates a 1% AEP coastal storm inundation combined with 1.5 m sea level rise.

The methodology used to develop the sea level rise and coastal hazards information shown on the map viewer is described in the report 'Coastal Hazards Assessment in Tasman Bay/Te Tai o Aorere and Golden Bay/Mohua (2019)'.

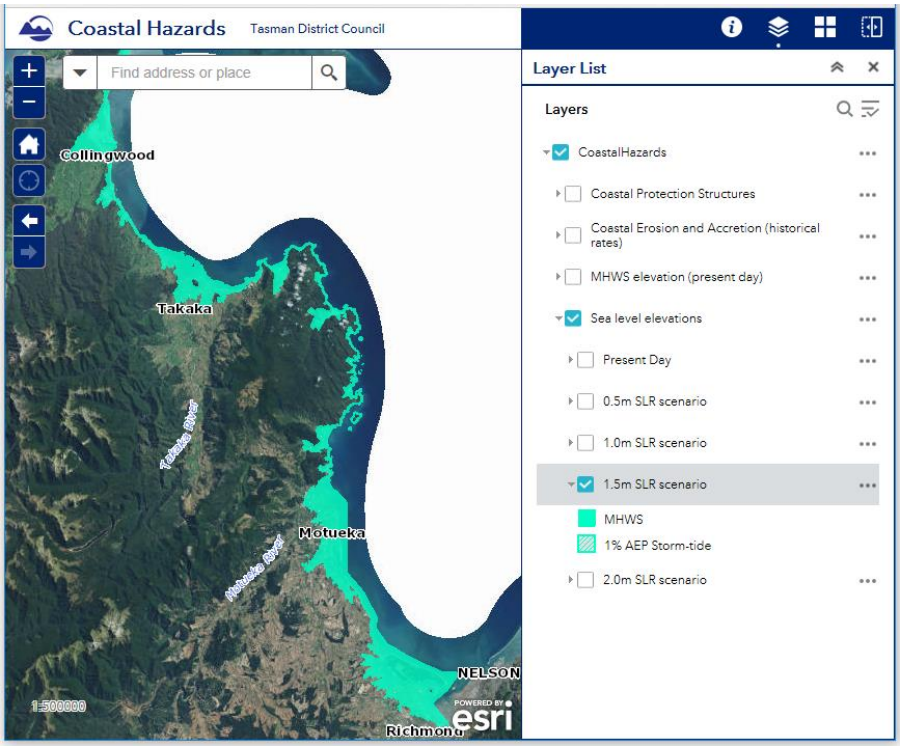


Figure 2: Example of Council's Coastal Hazards Map Viewer (1.5m Sea Level Rise Scenario)

Council's coastal hazards map viewer also shows areas of historical coastal erosion (sediment loss) and accretion (sediment gain), based on a 30+ year record. Further information on coastal accretion and erosion experienced around the coastline (including any intervention measures) are described in the methodology report (noted on the previous page). The Council has not modelled future trends to enable coastal erosion hazard to be included within this coastal risk assessment. How erosion trends or rates will change in a projected climate change sea level rise future is uncertain. However, it is considered that for most localities erosion rates are likely to increase and areas of accretion will likely begin to exhibit an erosion trend. While coastal erosion will be exacerbated by sea level rise, it will remain a localised hazard affecting frontline properties in some locations. As sea level rise progresses coastal inundation hazard will become the more dominant and spatially extensive coastal hazard.

Large damaging tsunami are infrequent events. Tsunami hazard is outside the scope of the Coastal Management Project as the Council does not directly address tsunami hazard in its resource management plans. Instead, the focus is on protection of lives rather than protecting property through providing education and information for evacuation through the Council's civil defence functions. Nelson Tasman Civil Defence has published a series of tsunami evacuation maps which are available at nelsontasmancivildefence.co.nz.

1.4 Limitations and Assumptions

The coastal risk assessment includes a number of limitations and assumptions as described below.

The coastal risk assessment is based on the extent of coastal storm inundation and sea level rise, as mapped in the Council's coastal hazards map viewer. The mapping identifies land below a particular elevation (i.e. the level of the sea at a particular location for a selection of storm-tide and sea level rise scenarios). Where low-lying land is directly connected to the coast it is vulnerable to inundation. Where land is poorly connected to the coast, but identified as low-lying, such land is still vulnerable to other coastal hazards besides inundation. The mapped outputs have a number of limitations and

assumptions, which are detailed the methodology report 'Coastal Hazards Assessment in Tasman Bay/Te Tai o Aorere and Golden Bay/Mohua (2019)'.

While the assessment focuses on coastal storm inundation and sea level rise, it is recognised that there are other hazards that may have an impact in the coastal area, for example freshwater and groundwater inundation, land subsidence as a result of an earthquake, and seismic liquefaction. The combined effects of these natural hazards (where known) should be considered holistically when considering options for coastal management. Additionally, sea level rise will increase the exposure of our coastal land to coastal hazards, creating new hazards in areas that have not previously been exposed.

For clarity, 'vulnerability' is in relation to assets, property, infrastructure and facilities (referred to as 'elements at risk') that we value that are susceptible to the impacts of coastal storm inundation and sea level rise over the longer term. The assessment does not measure the severity or scale of the hazard. For example, the water depth (e.g. 1 cm versus 1.0 m+ depth) has not been differentiated (scale of the hazard). The analysis simply identifies elements at risk located where they may be vulnerable to varying degrees of inundation. Consequently, just because an element at risk is mapped as being vulnerable to coastal inundation and sea level rise, it does not necessarily mean it will be damaged/destroyed and that replacement is required (where this is possible or appropriate).

This is a quantitative risk assessment that relies on readily available datasets, and presents a 'snapshot in time' based on best available information held by Council. Many of these datasets either inform or are part of the Tasman Resource Management Plan (TRMP) and Council's infrastructure Activity Management Plans. Council is starting the TRMP review process and it is likely that some of the TRMP datasets will be updated in due course (e.g. protected trees, heritage buildings and significant natural areas, extent of planning zones) and included in our second generation plan, Aorere ki uta Aorere ki tai - Tasman Environment Plan. Some national datasets have also been utilised including the Land Cover Database administered by Manaaki Whenua Landcare Research (lris.scinfo.org.nz) and the New Zealand Archaeological Association's (NZAA) ArchSite database (archsite.org.nz).

This assessment only identifies vulnerability based on what is known, publicly available and spatially mapped information. There will be a range of special values that Te Tai Ihu iwi hold for the places, the resources, and the history of the District that are not captured within this assessment. Information on archaeological sites are based on the NZAA ArchSite site recording scheme and includes both sites of significance to Te Tau Ihu iwi and post-European sites (refer to Section 3.2.3 for more information).

1.5 Council's Infrastructure Risk and Resilience Work Programme

In 2016, Council in partnership with Nelson City Council, Nelson Tasman Civil Defence Emergency Management Group and other utility providers, prepared the Nelson Tasman Lifelines Report. This report summarises the lifeline infrastructure within Nelson and Tasman – these are the transport, energy, communications and '3 waters' (water supply, stormwater, wastewater) services sectors that are fundamental to our communities and economy. Within the report there are a number of actions identified to improve Council-owned infrastructure resilience.

Council has a risk, resilience and recovery planning work programme in place which will focus on the identification, planning and management of its critical infrastructure assets and lifelines. This will ensure that Council, working in partnership with the community, can make robust decisions regarding the management of infrastructure assets over the longer term, taking into account the

effects of climate change. This report provides an initial overview of Council's infrastructure assets which are vulnerable to coastal storm inundation and sea level rise. More in-depth risk assessment work on the Council's infrastructure assets will be completed in the future to contribute to Council's infrastructure risk and resilience work programme.

1.6 Information from Other Agencies

Several national agencies have previously undertaken a body of work to quantify New Zealand-wide exposure, vulnerability and risks from climate change and sea level rise, being:

- Preparing New Zealand for rising seas: Certainty and Uncertainty (Parliamentary Commissioner for the Environment, 2015). The report identifies that in Motueka approximately 1,043 homes, 117 businesses, and 41km or roads lie less than 1.5m above the spring high tide mark (MHWS level).
- Vulnerable: the quantum of local government infrastructure exposed to sea level rise (Local Government New Zealand, 2019). The report quantifies and values (total replacement value) local government infrastructure exposed to sea level rise (increments of 0.5, 1.0, 1.5 and 3.0 metres). For Tasman, the report identifies roading, 3 waters infrastructure, green spaces, and other facilities which are vulnerable to rising sea levels.
- Risk exposure of Department of Conservation (DOC) coastal locations to flooding from the sea (Department of Conservation, 2019). The report identifies the Abel Tasman Coast Track as one of seven 'icon destinations' which have 10 or more vulnerable assets and/or more than 5% of vulnerable track.
- Coastal Flooding Exposure Under Future Sea-Level Rise for New Zealand (National Institute of Water & Atmospheric Research (NIWA), 2019). This report presents New Zealand's exposure to a 1% AEP coastal flood inundation under present day and future higher sea levels (increments of 0.3, 0.6, 0.9, 1.2 and 3.0 metres). It identifies elements at risk including population, buildings (count and NZD replacement value), infrastructure (transport, electricity, 3 waters) and land cover to provide a representative sample of built assets and land cover types exposed within New Zealand's coastal floodplains for each coastal flood inundation scenario.

These reports are complimentary to the information contained within this report and overall help to provide a broad understanding of the Tasman District's vulnerability to coastal storm inundation and sea level rise.

Also of relevance is the National Climate Change Risk Assessment for New Zealand Arotakenga Tūraru mō te Huringa Āhuarangi o Āotearoa (NCCRA) which was published August 2020. The NCCRA provides a national overview of how New Zealand may be affected by climate change-related hazards, and identifies the most significant risks and opportunities. It also highlights gaps in the information and data needed to properly assess and manage the risks and opportunities. The National Climate Change Risk Assessment will enable central government to prioritise action, including through a national adaptation plan (MfE, 2020). Tasman's risk assessment report draws on the same methodology framework which is discussed further in Section 2 Methodology.

1.7 Next Steps

This coastal risk assessment report will be used to inform future steps of Council's Coastal Management Project, including:

- identifying if there is a need for a more detailed risks assessment(s) at a local level;

- informing the development of issues and options for coastal management;
- providing background information to help inform the development of the coastal hazards section of Aorere ki uta Aorere ki tai - Tasman Environment Plan, particularly to avoid increasing the risk from redevelopment or change in land use (giving effect to New Zealand Coastal Policy Statement's Policy 25); and
- informing Activity Management Plans and infrastructure funding decisions through Council's Long Term Plan processes.

2. Methodology

2.1 Introduction

The coastal risk assessment methodology draws on best practice guidance provided by the Ministry for the Environment, being:

- Arotakenga Huringa Ahuarangi: A Framework for the National Climate Change Risk Assessment for Aotearoa New Zealand 2019 (NCCRA Framework). This framework can be used by local government, iwi and other organisations to perform their own climate change risk assessments (MfE, 2019).

- Coastal Hazards and Climate Change Guidance (MfE 2017 Guidance). This guidance has been used to help inform the assessment within the coastal hazards context (refer to Section 8.2 of the MfE 2017 Guidance in particular).

Figure 3 illustrates the methodology used to undertake this coastal risk assessment (adapted from the NCCRA Framework). This report sets out the overall findings of the assessment, applying the methodology set out in the following subsections.

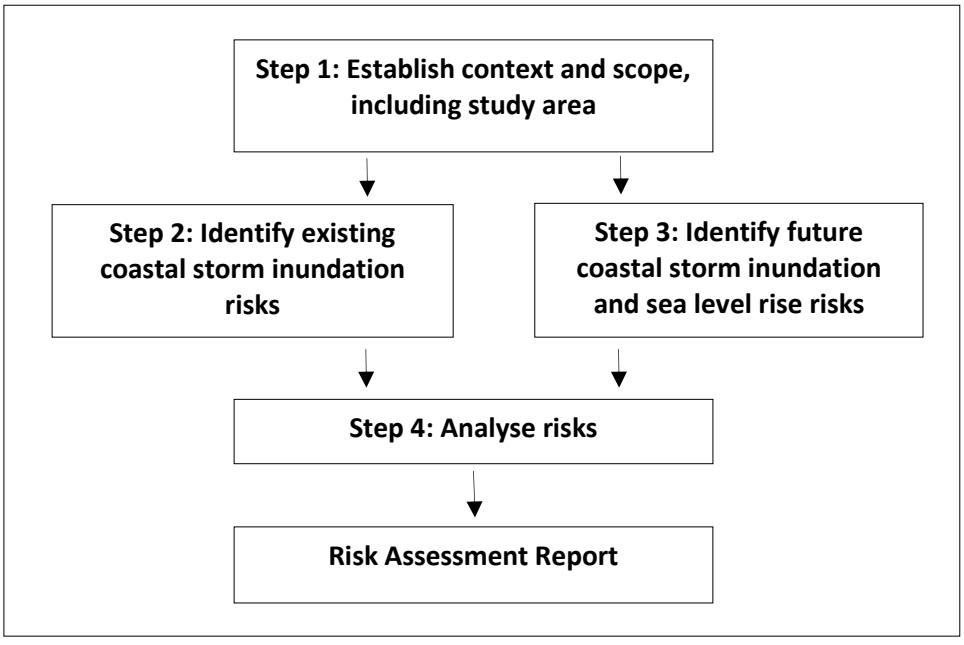


Figure 3: Coastal Risk Assessment Methodology (adapted from the NCCRA Framework (MfE, 2019))

2.2 Step 1: Establish the Context and Scope

Section 1 of this report sets out the context and scope for this coastal risk assessment. Step 1 also includes identifying the spatial scale of the assessment, defining the hazard and elements at risk, as follows.

Spatial Scale of Assessment

The Coastal Management Project covers the area of Tasman Bay/Te Tai o Aorere and Golden Bay/Mohua. For the purpose of this risk assessment the coastline was separated into seven 'coastal cells', each representing smaller geographic 'sub-areas' to enable meaningful data analysis. These coastal cells are:

1. **Richmond – Waimea** (including Richmond, Waimea Plains, Waimea Inlet and islands)
2. **Māpua – Ruby Bay**
3. **Motueka – Riwaka** (including Tasman, Kina Peninsula, Moutere Inlet, Motueka, Riwaka)
4. **Kaiteriteri – Mārahau** (including Tapu Bay, Stephens Bay, Kaiteriteri, Otuwhero Inlet, Mārahau)
5. **Abel Tasman National Park**
6. **Eastern Golden Bay** (including Rangihaeata, Waitapu, Rototai, Pōhara, Ligar Bay, Tata Beach, Wainui Bay)
7. **Western Golden Bay** (including Patons Rock, Parapara, Milnthorpe, Collingwood, Pākawau, Puponga)

Farewell Spit and the northwest coast are not currently included in the Coastal Management Project or this risk assessment, primarily because there is limited LiDAR derived digital elevation coverage for this part of the District's coastline. Whilst there is little coastal development in this area (compared to Tasman and Golden Bays), where present it can be expected to be impacted by coastal hazards and sea level rise similar to elsewhere in the District.

Figure 4 (over page) shows the seven coastal cells used for this assessment.

Defining the hazard – coastal storm inundation and sea level rise

This risk assessment identifies a selection of assets, property, infrastructure and facilities, referred to as 'elements at risk' that may be exposed to:

- a present day 1% AEP (annual exceedance probability) joint probability storm-tide event; and
- a range of sea level rise scenarios in 0.5 m increments up to 2.0 m.

The MfE 2017 Guidance suggests mapping sea level rise increments of 0.1 m or 0.2 m. However, for simplicity of display and community engagement purposes, a larger sea level rise increment of 0.5 m is shown in the Council's coastal hazards map viewer. Council can reproduce these maps at smaller increments of sea level rise (or larger ones) if necessary.

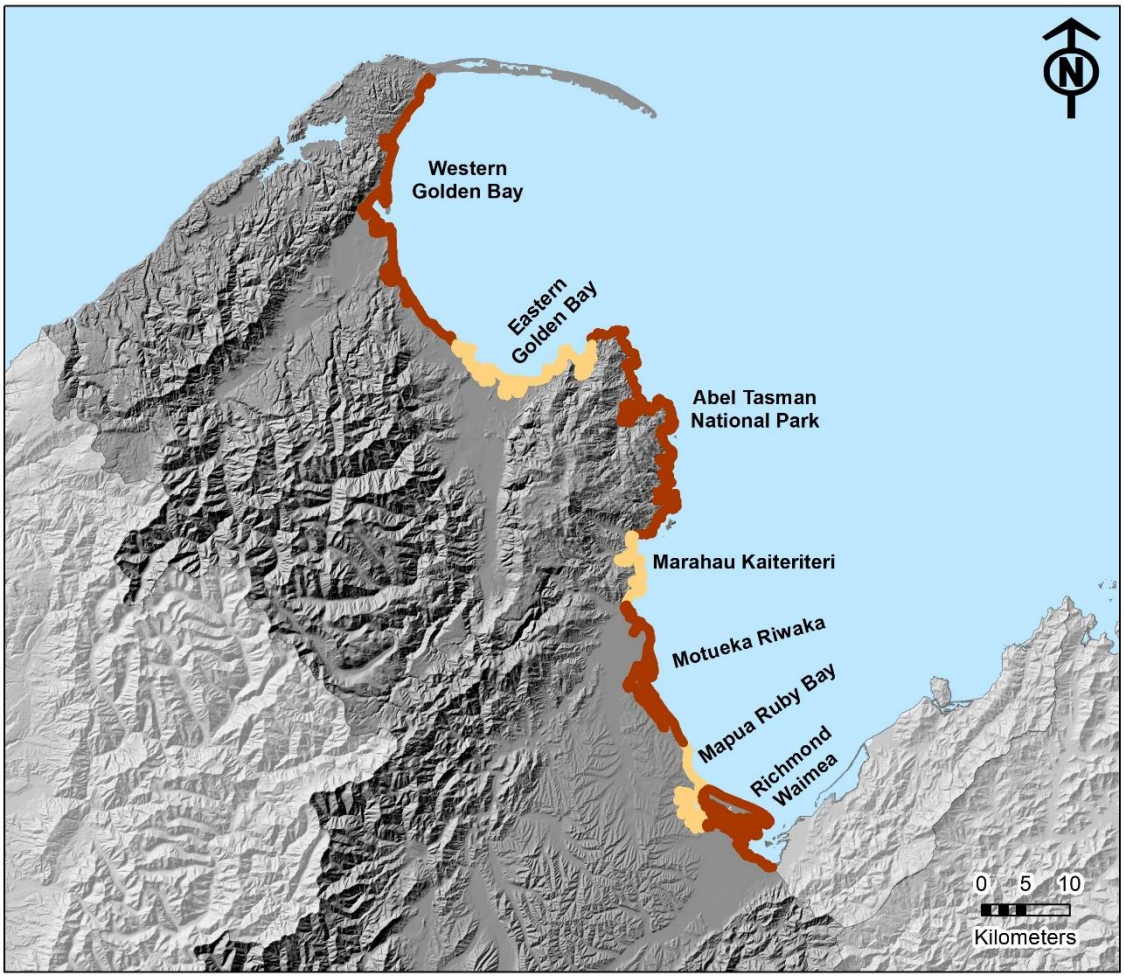


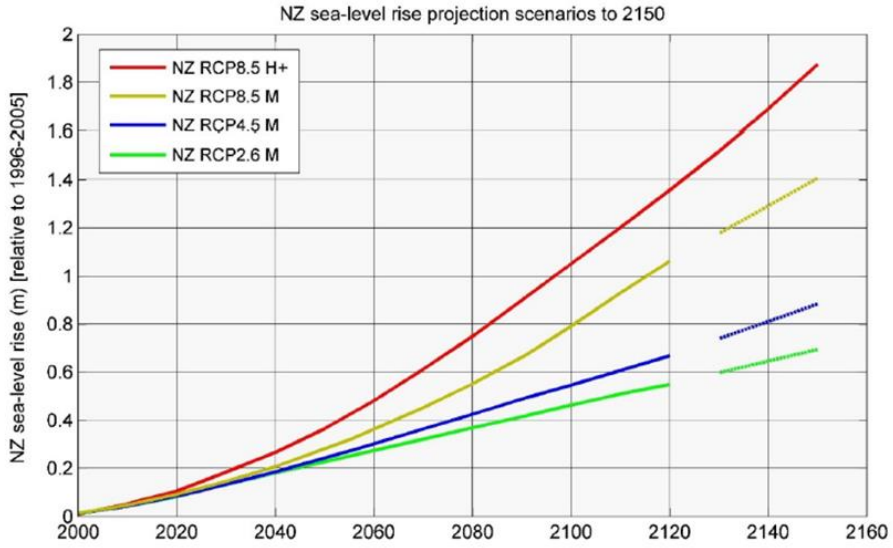
Figure 4: Coastal Risk Assessment Study Area[2]

Sea level rise scenarios and the selection of timeframes to assess risk

Many factors need to be taken into account when considering how future global warming will contribute to climate change and, ultimately, sea level rise. The MfE 2017 Guidance notes that because of the uncertainty about future changes in climate, it is necessary to examine a range of scenarios, known as representative concentration pathways (RCPs). Four RCPs have been developed for New Zealand, representing a range of climate model scenarios and possible sea level rise futures. These are described below and shown in Figure 5:

- a low to eventual net-zero emission scenario (RCP2.6)
- an intermediate-low scenario based on the RCP4.5 median projections
- a scenario with continuing high emissions, based on the RCP8.5 median projections
- a higher H+ scenario, taking into account possible instabilities in polar ice sheets, based on the RCP8.5 (83rd percentile) projections (MfE, 2017).

[2] Note: The two colours used on the map simply distinguish the boundaries between each coastal cell.



New Zealand scenario trajectories are out to 2120 (covering a minimum planning timeframe of at least 100 years), and the NZ H^+ scenario trajectory is out to 2150 from Kopp et al (2014) (K14). No further extrapolation of the Intergovernmental Panel on Climate Change-based scenarios beyond 2120 was possible, hence the rate of rise for K14 median projections for RCP2.6, RCP4.5 and RCP8.5 are shown as dashed lines from 2130, to provide extended projections to 2150. Note: all scenarios include a small sea-level rise (SLR) offset from the global mean SLR for the regional sea around New Zealand.

Figure 5: Four scenarios of New Zealand-wide regional sea level rise projects to 2150 (MfE 2017 Guidance, Figure 27)

For a range of sea level rise increments, the MfE 2017 Guidance identifies a bracketed sequence of years in the future when specific sea level rise increments may be reached in New Zealand (Table 1 below). MfE advises that these sea level rise scenarios should be used for hazard, vulnerability and risk assessments and adaption planning.

Table 1: Approximate years, from possible earliest to latest, when sea level rise increments of 0.5 m (above 1986-2005 baseline) could be reached for various projection scenarios for the wider New Zealand region (adapted from MfE, 2017 (Table 11)).

SLR (metres)	Year achieved for RCP8.5 H+ (83%ile)	Year achieved for RCP8.5 (median)	Year achieved for RCP4.5 (median)	Year achieved for RCP2.6 (median)
0.5	2060	2075	2090	2110
1.0	2100	2115	2170	>2200
1.5	2130	2160	>2200	>2200
1.9	2150	2195	>2200	>2200
2.0*	>2150	>2195	>2200	>2200

*The MfE 2017 Guidance provides increments of sea level rise up to 1.9 m and corresponding time periods when each level could be reached (Table 1). Council has adapted the MfE information to include a sea level rise height up to 2.0 m. Table 1 data applies the greater-than symbol ('>') to denote that the year when this may be reached under each scenario is sometime after those years provided for under 1.9 m sea level rise. This specifically relates to RCP8.5 H+ and RCP 8.5 (median) as the other two scenarios are already at >2200.

The timeframe for each increment of sea level rise is therefore dependant on the RCP selected. For example, based on current information we may expect 1.0 m sea level rise by the years 2100 (RCP8.5 H+), 2115 (RCP8.5), 2170 (RCP4.5) or beyond 2200 (RCP2.6).

This risk assessment does not focus on a particular RCP or timeframe. The scientific consensus is that sea levels will continue to rise and are likely to rise at an accelerated rate over time. Whilst there is some uncertainty as to exactly when a particular increased sea level will occur, the coastal hazards map viewer does identify areas where sea level rise may impact low-lying land. This risk assessment simply quantifies those elements at risk which are located in these areas and may become vulnerable as sea levels rise.

Councils are required to identify areas in the coastal environment that are potentially affected by coastal hazards over at least 100 years (Policy 24, New Zealand Coastal Policy Statement (2010)). This is because many land use planning, asset and infrastructure decisions that are made today have long lifetimes, for example:

- Houses – no less than 50 years (Building Act 2004) but more appropriately 80-100+ years
- Infrastructure pipes – 80 years (average)
- Road infrastructure
    - Road – 50 years (average)
    - Bridge – 100 years (average)
    - Road corridor – permanent
- Subdivision – permanent

The decisions we make today will affect our children, grandchildren and future communities. All four RCP scenarios and their timeframes can be considered – even at this high level of assessment – to help inform the development of our long-term adaptive planning approach.

Elements at Risk

Our coastal environment holds significant environmental and cultural values, provides employment and economic opportunities, numerous recreational activities and experiences, as well as being a great place to live.

The NCCRA Framework notes that to identify the risks a hazard presents, we need to understand what is at stake, what we value and want to protect (MfE, 2019). This assessment identifies a selection of assets, property, infrastructure and facilities, referred to as 'elements at risk', that may be exposed to coastal storm inundation and sea level rise over the longer term. The elements at risk can be grouped into four overarching 'value domains' as shown in Table 2 (over page). Appendix 1 provides further details on each of the elements of risk including data sources.

As previously noted in Section 1.2 Background, Phase 1 of the Coastal Management Project sought community feedback to identify community values that may be affected by coastal storm inundation and sea level rise, recognising that the areas, objects and experiences that are valued will be different for each person. Respondents were asked to rank their top five values (from a prescribed list of 12 values) that they were concerned may potentially be affected by coastal storm inundation and sea level rise. Using a weighed score method, the top five values identified were:

1. Homes (residential buildings and property)
2. Lifeline infrastructure
3. Coastal species and habitats
4. Natural character and coastal landscapes
5. Businesses

Appendix 2 sets out the 12 community values and how they correspond to the four value domains and elements at risk assessed in this report. A small number of community values fit within the

human value domain but are experienced-based in their nature, for example 'appeal of the area as a nice place to live' and 'access to and enjoyment of sandy beaches at high tide'. These qualitative values are not included in the scope of this report. Commentary on the vulnerability of the top five community identified values is presented in Section 3 of this report.

Table 2: Elements at Risk

Value Domain	Elements at Risk
Human *Social and cultural aspects of human values*	Estimated population
	Marae
	Archaeological sites
	Heritage buildings
Natural Environment *Considers aspects of the natural environment*	Protected trees
	TRMP Planning Zones • open space and recreation • conservation
	Significant natural areas
	Land Cover Database • coastal indigenous vegetation
Economy *Considers businesses and livelihoods through land cover and land use zonings*	Land Cover Database • urban • horticultural land • exotic forest • grassland
	TRMP Planning Zones • residential • rural residential • rural • business and industrial
Built Environment *Considers physical assets such as 'three waters' infrastructure, roads, and buildings, coastal assets, and closed landfills*	3 Waters Infrastructure • water supply • wastewater • stormwater
	Roads
	Buildings (e.g. homes, tourist accommodation, business premises, community facilities)
	Community facilities (e.g. schools, fire stations, playgrounds)
	Coastal assets • wharves/jetties • boat ramps • coastal protection structures • ports
	Closed landfills
	Contaminated land

2.3 Step 2: Identify the Existing Risk

Like elsewhere around New Zealand's coast, many parts of Tasman District's coastline is vulnerable to coastal hazards including coastal storm inundation. Ex-tropical cyclones Drena (1997) and Fehi (2018) are two notable examples of storm surge events which caused significant damage along parts of our coastline.

Step 2 of the assessment involved identifying what elements at risk that may already be vulnerable to present day coastal hazards (coastal storm inundation under a 1% AEP joint probability storm-tide event). Section 3 details the combined outputs from Steps 2 and 3.

2.4 Step 3: Identify Future Risks

Sea level rise will increase the exposure to coastal hazards, creating new hazards in areas that have not previously been exposed.

Step 3 of the assessment involved identifying what elements at risk may be vulnerable to sea level rise and coastal storm inundation (a 1% AEP joint probability storm-tide event (present day)) in the future. Refer to Section 3 which combines the outputs for Steps 2 and 3.

2.5 Step 4: Analyse Risks

Step 4 provides a qualitative analysis of the elements at risk from present day and future of coastal storm inundation and sea level rise scenarios (as set out in Steps 2 and 3). It draws together commentary from each of the four value domains to identify overall risks for each across the seven coastal cells.

The MfE 2017 Guidance states that risk is widely understood to mean *likelihood x consequences*, and this meaning is embedded in standards documents worldwide. It recommends that for New Zealand coastal areas, risk can be evaluated by focusing on 'consequences' (e.g. direct damage, affected number of people, indirect disruption and reduction in services, etc.) under different sea level rise and coastal hazard scenarios (the 'likelihood').

Section 4 presents the results of this step and includes identifying where there is a need for more in-depth risk assessment(s).

3. Identifying the Existing and Future Risk Exposure

3.1 Introduction

In this section we identify elements at risk that may be vulnerable to coastal storm inundation and sea level rise either now in the present day or in the future. The results have been combined together to enable an easy comparison of what is currently vulnerable versus what may be exposed as sea levels rise into the future. The findings are presented under the four overarching value domains of human, natural environment, economy and built environment, as set out below. Appendix 1 sets out the details of the datasets used.

This assessment focuses on 'vulnerability' and does not consider the severity of the hazard at a particular location. For example, for coastal inundation hazard it simply identifies elements at risk present within areas potentially subject to inundation. No assessment of the depth, flow velocity or duration of the inundation hazard (i.e. the severity of the hazard) and how that might impact the elements of risk has been made.

Given the nature of some of the elements at risk, there will be some overlaps in the results presented. For example, if you were interested in understanding the vulnerability of trees to sea level rise, a number of elements at risk could be considered (including protected trees, significant natural areas, conservation zone, coastal indigenous vegetation land cover, exotic forestry land cover, etc). Each of the elements at risk contributes information to enable a broad understanding of the Tasman and Golden Bays' vulnerability to coastal storm inundation and sea level rise.

It is recommended that this section is read in conjunction with use of the Council's coastal hazards map viewer, which maps the location and extent of low-lying coastal land which is vulnerable to coastal storm inundation and sea level rise. The same colour scheme is used to represent the different increments of sea level rise in both the coastal hazard map viewer and the graphs used in this report to enable easy visual comparison. The coastal hazards map viewer can be accessed at tasman.govt.nz/link/coastal-management.

3.2 Human Value Domain

This value domain considers both social and cultural aspects of human values as represented by four representative elements. There will be other aspects of human values located within the coastal environment, which are not included within this assessment and are valued by the community.

Through the 2019 community engagement, a number of respondents commented in general on the impact that the effects of climate change may have on people's health and wellbeing. Stress, anxiety and a loss of sense of security were identified by some respondents. Others commented on social impacts, for example future generations not being able to enjoy the area and changes to communities as we know them today. These issues are outside the scope of this quantitative assessment, however, it is recognised that social vulnerabilities as a result of climate change require further exploration as identified in the National Climate Change Risk Assessment (MfE, 2020).

3.2.1 Population

Statistics New Zealand estimates that the population of Tasman District was 56,400 as at June 2020. Under medium-growth population scenario, Tasman's population is projected to increase by 7,200 between 2023 and 2033, to reach 65,300. Across the 30 years from 2023 to 2053, Tasman's population is projected to increase by 18,700, to reach almost 77,000. The Motueka, Moutere-Waimea and Richmond Wards are projected to experience the greatest growth in population (Jackson, 2019). This population growth is in line with projected estimates of new dwellings.

Property-specific population and residential dwelling statistics are not readily available to determine the number of people living in low-lying coastal areas vulnerable to coastal storm inundation and sea level rise. A population estimate was determined based on the number of buildings (Section 3.5.3) and applying the following calculation:

Estimated population	=	Number of buildings (see Section 3.5.3)	X	1.51 people (average number of people per building - District wide) [3].

The number of people per building (1.51 people) is not the same as household size (i.e. number of people per dwelling – 2.5 from the 2013 Census). This is because not all of the counted buildings are dwellings with some used for other purposes such as businesses and industrial premises. For the purposes of this risk assessment it is assumed that proportion of dwellings to other buildings along the coastal area is similar to that across the whole District.

An estimated population of 8,400 people are located in low-lying coastal areas in Tasman Bay/Te Tai o Aorere and Golden Bay/Mohua that are vulnerable to coastal storm inundation and sea level rise (Figure 6). Approximately 60% of these people are located in the Motueka – Riwaka coastal cell (approximately 4,970 people), with a further 12% of people in the Māpua – Ruby Bay coastal cell

[3] Calculated by dividing the June 2020 District wide population estimate (56,400 people) by the District total number of buildings greater than 60m^2 (37,300 buildings at 2019). Results have been rounded.

(approximately 990 people). These two coastal cells account for nearly three quarters of the people located in vulnerable coastal areas across Tasman and Golden Bays.

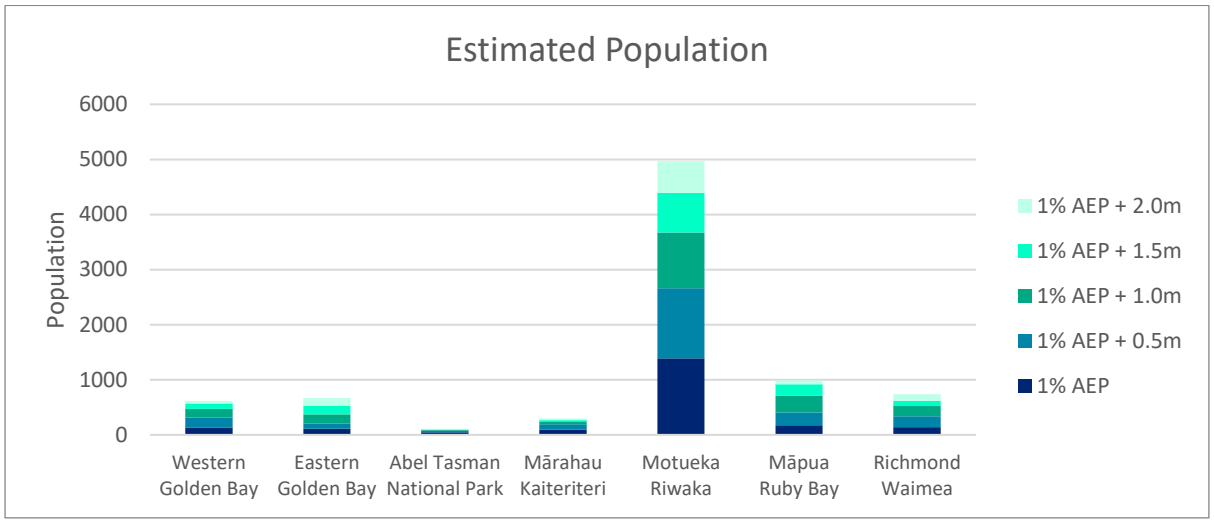


Figure 6: Estimated Population Vulnerable to Coastal Storm Inundation and Sea Level Rise

The number of people present within each of the coastal cells is a reflection of the towns and local centres located in these areas. For example, only a small number of buildings (largely homes and holiday accommodation) are located within Abel Tasman National Park coastal cell, whereas a significant area of urban Motueka is within the Motueka – Riwaka coastal cell. Richmond is the largest town in the District, however, its urban area is largely outside of the mapped coastal storm inundation and sea level rise scenarios. In each of the coastal cells the increase in estimated population per increment of sea level rise is largely consistent.

Whilst this information is only indicative, it does provide a useful comparison between the different sections of the coast. This coastal population estimate is based on present day data only and assumes no further growth/infill development in these vulnerable areas as sea levels rise over time.

3.2.2 Te Tau Ihu Iwi and Marae

The interests of Te Tau Ihu iwi in the coastal environment are diverse. The cultural, spiritual, historical and traditional relationships that Te Tau Ihu iwi have with the coastal environment within Tasman District is important. Nationally, climate change and any adaptation response will present new challenges for iwi, hapū, whānau and Māori enterprise.

The following eight iwi are tangata whenua in Te Tau Ihu (the top of the South Island), namely:

- Ngāti Kuia
- Ngāti Rārua
- Ngāti Tama ki Te Tau Ihu
- Te Ātiawa o Te Waka-a-Māui
- Ngāti Kōata
- Ngāti Toa Rangatira
- Ngāti Apa ki te Rā Tō
- Rangitāne o Wairau

Tasman District also covers the northern-western part of the Ngāi Tahu takiwā (tribal area/territory). Murchison is within the Ngāi Tahu takiwā and Ngāti Waewae are the Papatipu Rūnanga on this

north-western side. For the purpose of this report, it is recognised that the Ngāi Tahu takiwā does not extend to the Tasman coastline.

There are two marae located within the Tasman District. Te Āwhina Marae is located on Pah Road, Motueka, and Onetahua Marae is located on Pōhara Valley Road, Pōhara. Both marae are located sufficiently inland to be not included within the mapped extent of coastal storm inundation and sea level rise scenarios shown on the Council's coastal hazards map viewer.

There will be a range of special values that iwi hold for places, the resources, and the history of the District. Some sites of significance to iwi are captured within this assessment through the element at risk of 'archaeological sites' under Section 3.2.3. However, it is acknowledged that there will be other sites of significance to iwi (including other archaeological sites) that are located in vulnerable coastal areas and are not included in this assessment. For example, Te Tau Ihu iwi will have sites that are private information to individual iwi (e.g. not in the public domain), in addition to a number of unknown or unrecorded archaeological sites located across the District.

3.2.3 Archaeological Sites

The Tasman District has a rich and diverse history of human occupation along the coastline. This includes sites of interest to Māori (including wāhi tapu, middens, pits, terraces, caves, rock shelters, working areas, horticulture areas, urupā and artefact findspots) and post-European sites (including a range of activities such as gold mining, forestry, burial-cemetery, and historic-domestic sites).

In the 1950s the New Zealand Archaeology Association (NZAA) initiated a site recording scheme for archaeological sites[4] and today the scheme is managed through an online portal known as ArchSite. The locations of over 60,000 sites across New Zealand are identified and these records are used for research purposes and for the protection and management of these sites (NZAA, 2020). The cultural heritage sites listed in Schedule 16.13C of the TRMP were based on the NZAA records for sites located in the Tasman District at that time. Since Schedule 16.13C became operative, the NZAA site recording scheme (ArchSite) has been continuously updated with additional sites added as they are identified, while the Schedule 16.13C has remained unchanged. This assessment draws on the more up to date information contained in the NZAA's ArchSite.

Based on the NZAA's ArchSite records, there are 350 archaeological sites within Tasman and Golden Bays that are vulnerable to coastal storm inundation and sea level rise (Figure 7). The bulk of sites are vulnerable to the present day 1% AEP coastal storm inundation, with increasing numbers of sites being exposed in line with sea level rise. The largest number of sites are in the Motueka – Riwaka coastal cell, however a significant portion are also located in Golden Bay. The Motueka – Riwaka coastal cell has 54 sites in the mapped extent of the present day 1% AEP coastal storm inundation and a total of 94 sites in the mapped extent of a 1% AEP coastal storm inundation and 2.0 m sea level rise scenario.

[4] NZAA's ArchSite website states that "*For the purposes of ArchSite, an archaeological site is defined as any specific locality where there is physical evidence for human occupation or activity in the past, that is or maybe able to be investigated by archaeological techniques. Note that there is no cut-off date for sites that may be recorded in ArchSite, so it may include sites that do not meet the definition in the Heritage New Zealand Pouhere Taonga Act 2014.*" (Viewed on 23/11/2020, www.archsite.org.nz/About.aspx).

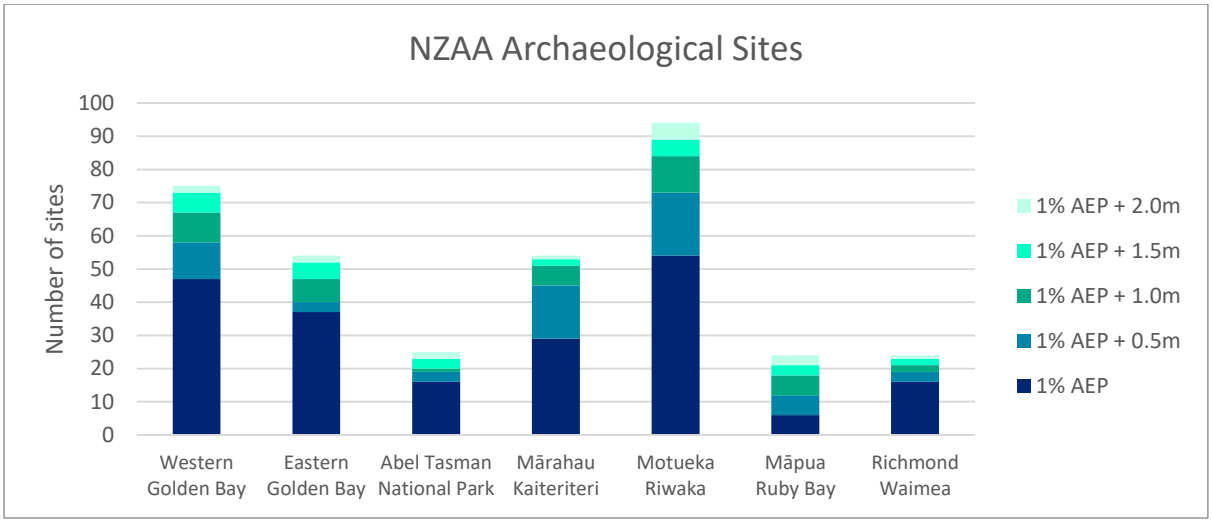


Figure 7: NZAA Archaeological Sites Vulnerable to Coastal Storm Inundation and Sea Level Rise

Both the NZAA's ArchSite records and Schedule 16.13C of the TRMP are starting points for identifying archaeological sites which may be vulnerable to coastal storm inundation and sea level rise. Through development of the Aorere ki uta Aorere ki tai - Tasman Environment Plan, TRMP Schedule 16.13C will be updated, including taking into account information obtained through the Treaty of Waitangi settlement legislation for Te Tau Ihu iwi and from the relevant iwi environmental plans (Cudby, 2020). This will be addressed working in partnership with Te Tau Ihu iwi.

The National Climate Change Risk Assessment identified nationally that there is very limited research on the sensitivity of cultural heritage sites, including Māori cultural heritage, to climate change and that further research is required to understand where sites are and how they could be affected (MfE, 2020). Locally, this will be an ongoing discussion working in partnership with Te Tau Ihu iwi.

3.2.4 Heritage Buildings

Heritage buildings are listed in Schedule 16.13A of the TRMP. There are a total of 127 buildings scheduled across the District, of which 12 are Category I and 115 are Category II buildings. Approximately three quarters of the buildings and structures on Schedule 16.13A are also listed on Heritage New Zealand Pouhere Taonga's (HNZPT) Heritage New Zealand List/Rārangi Kōrero. The remaining quarter have a Council but not HNZPT listing (Cudby, 2020).

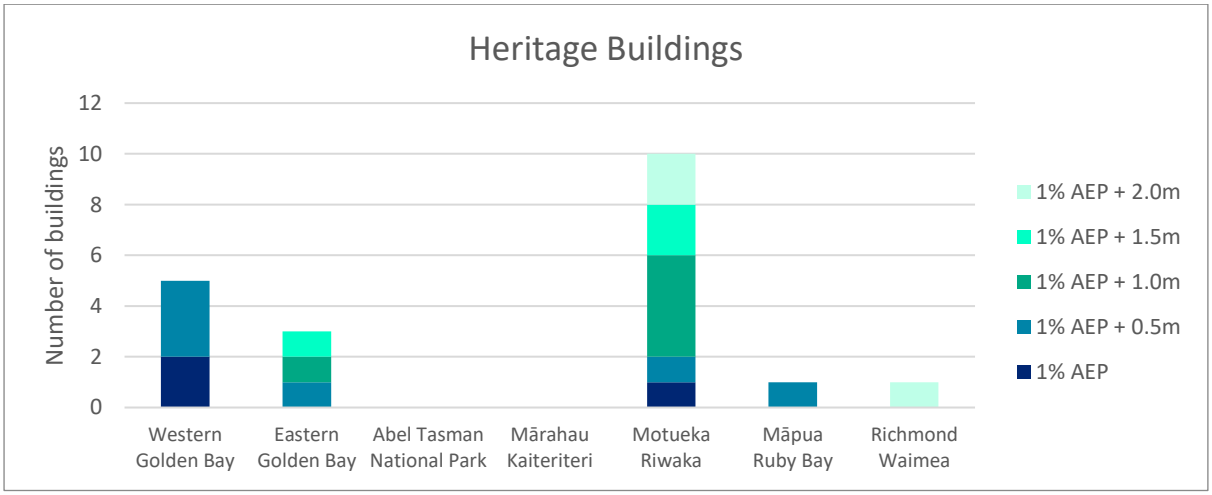


Figure 8: TRMP Heritage Buildings Vulnerable to Coastal Storm Inundation and Sea Level Rise

Of the 127 heritage buildings listed in the TRMP, 20 buildings (16%) are vulnerable to coastal storm inundation and sea level rise (Figure 8). Abel Tasman National Park and Mārahau – Kaiteriteri have no vulnerable heritage buildings. Western Golden Bay and Motueka – Riwaka coastal cells have 2 and 1 heritage buildings respectively that are vulnerable to the present day 1% AEP coastal storm inundation. The remainder of the heritage buildings will become vulnerable to rising sea levels over time. Motueka – Riwaka has the largest overall number of buildings exposed (10 buildings).

It is noted that there are some important heritage buildings and structures that may warrant protection but are not currently listed within Schedule 16.13A of the TRMP. Some buildings and structures are located within the existing coastal environment area and may already be vulnerable to coastal storm inundation due to their location and purpose. Examples include Motueka Quay, Waitapu Wharf and the Motueka Saltwater Baths. The exposure of such structures will be exacerbated with rising sea levels. This issue will be considered further through the development of the Aorere ki uta Aorere ki tai - Tasman Environment Plan (Cudby, 2020).

3.2.5 Summary: Human Value Domain

- Approximately 8,400 people are within the low-lying coastal area vulnerable to coastal storm inundation and sea level rise. Nearly three quarters of this estimated population is within the coastal cells of Motueka – Riwaka (60%), and Māpua – Ruby Bay (12%).
- There are two marae located within the District, Te Āwhina Marae in Motueka and Onetahua Marae in Pōhara. Both marae are located sufficiently inland to not be exposed to the mapped coastal storm inundation and sea level rise scenarios.
- There are 350 archaeological sites that are vulnerable (based on the NZAA's ArchSite records) indicating a rich history of human occupation along the Tasman coastline. The bulk of sites are exposed to the present day 1% AEP coastal storm inundation, with increasing numbers of sites being exposed in line with sea level rise. The Motueka – Riwaka coastal cell has the largest number of archaeological sites in vulnerable locations (94 sites). There will be other archaeological sites/sites of significance to iwi which are not captured within this assessment that may be located in vulnerable coastal areas.
- Of the 127 heritage buildings in the District listed in the TRMP, 20 are vulnerable (16%) with half of the vulnerable buildings (10) being located within the Motueka – Riwaka coastal cell.

3.3 Natural Environment Value Domain

The impacts of coastal inundation and sea level rise on the natural environment have been assessed using a selection of datasets, namely: protected trees, significant natural areas, planning zones (open space and recreation zones, conservation zone) and indigenous vegetation land cover.

There will be other aspects of the natural environment which are not included in this assessment that are valued by the community for their biodiversity and ecological qualities and may be exposed to coastal storm inundation and sea level rise. Work by a number of agencies and groups to identify vulnerable coastal habitats and key species and to plan for managed ecological retreat is ongoing.

Through the 2019 community engagement, respondents ranked 'coastal species and habitats' as being their third highest value that they are concerned will be affected by coastal storm inundation and sea level rise. The vulnerability of this value is considered through a number of elements at risk within this natural environment value domain. 'Natural character and coastal landscapes' was ranked by respondents as their fourth highest value, and some aspects of this value are also considered within this section.

3.3.1 Protected Trees

Schedule 16.13B of the TRMP contains a large list of protected trees across the District, reflecting the community interest in the amenity and historic value that these trees can provide. There are 575 entries listed in the schedule, although some single entries cover multiple trees and/or stands of trees. Schedule 16.13B has been amended a number of times to add trees that warrant protection and delete trees that are dead, dying or have been removed (Cudby, 2020).

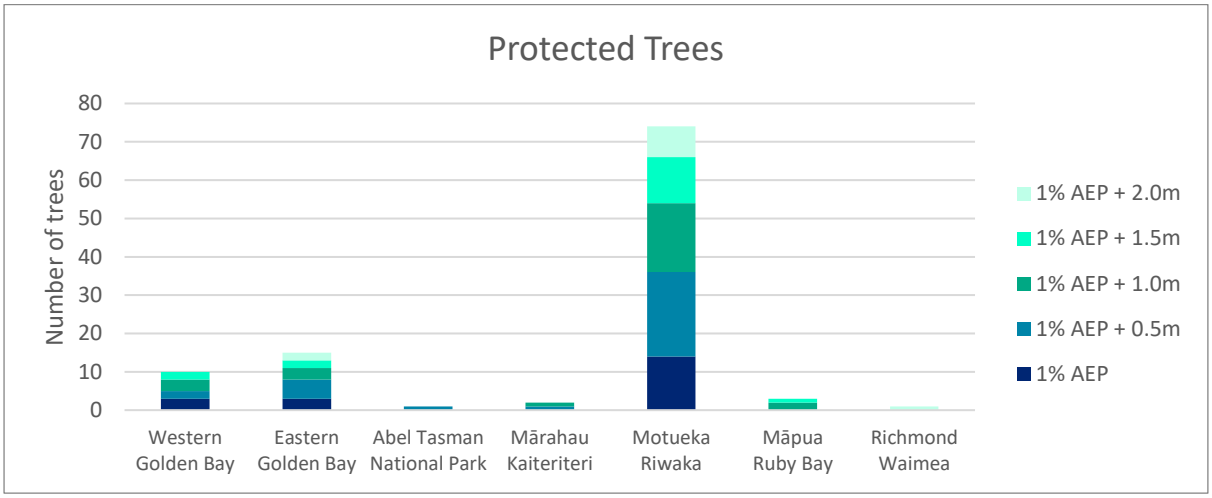


Figure 9: TRMP Protected Trees Vulnerable to Coastal Storm Inundation and Sea Level Rise

Of the 575 protected trees listed in the TRMP, 106 trees (18%) are in locations vulnerable to coastal storm inundation and sea level rise (Figure 9). The Motueka – Riwaka coastal cell contains a significant majority of the protected trees located in vulnerable coastal locations (70% or 74 trees). There are several protected trees lining the coastal road reserve along Motueka Quay which are vulnerable to the present day 1% AEP coastal storm inundation and 0.5 m sea level rise, and a number of other protected trees located throughout the rest of Motueka and Riwaka which may become vulnerable as sea levels rise.

3.3.2 Significant Natural Areas

Significant natural areas (SNAs) are listed in Schedule 18.1A of the TRMP. The TRMP defines SNAs as "an area of indigenous vegetation or indigenous fauna habitat that has been assessed as significant according to the ecological criteria in Schedule 10C, and listed in Schedule 18.1A". There are a total of 24 SNAs scheduled, with two being partially within public conservation land and the remainder (22) being within private land. Ten of the SNAs are also subject to QEII National Trust covenants, although it is noted that the boundaries of most of the covenants are not consistent with/do not fully cover the SNAs (Cudby, 2020).

The District's SNAs cover a total area of approximately 1200 hectares, and of this approximately 1.1 hectares (0.1%) may be vulnerable to coastal storm inundation and sea level rise within Tasman Bay and Golden Bay. The majority of this (0.9 hectares) is located near the mouth of O'Connor Creek within the Richmond – Waimea coastal cell.

Like other schedules within the TRMP, through the development of the Aorere ki uta Aorere ki tai - Tasman Environment Plan Schedule 18.1A will be reviewed. Matters that require further assessment include ensuring that the existing SNA boundaries are accurate, and that all other areas within the District that warrant protection as SNAs are identified (Cudby, 2020). It is not currently

known if there are any candidate areas for inclusion as a significant natural area that are vulnerable to coastal storm inundation and sea level rise.

3.3.3 Open Space and Recreation

The TRMP open space and recreation zones have been combined to represent this element at risk. The recreation zone includes areas that enable active recreation including parks and sports grounds, while the open space zone is primarily for low key informal recreation. These areas often have multifunctional purposes including places for recreation; amenity, historic and cultural values; and biodiversity corridors. At some locations stormwater assets are found within these zones. Open space and recreation zone areas located along the margins of freshwater bodies (such as rivers and wetlands) and the coast provide a key role in enabling public access to these special areas.

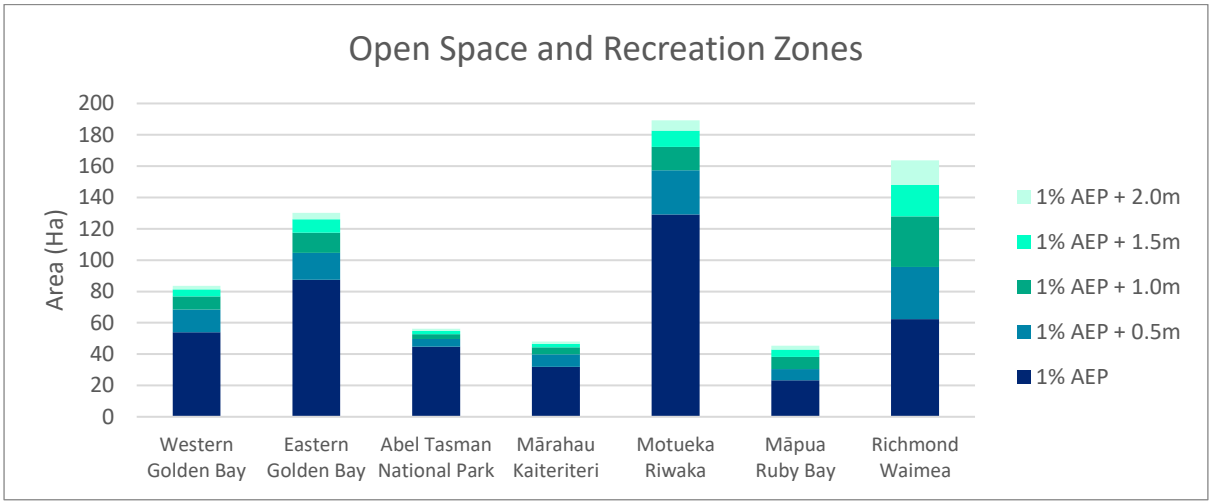


Figure 10: TRMP Open Space and Recreation Zones Vulnerable to Coastal Inundation and Sea Level Rise

The District's open space and recreation zones cover a total area of 1,400 hectares, and of this 717 hectares (51%) is exposed to coastal storm inundation and sea level rise within Tasman and Golden Bays (Figure 10). A significant proportion (60%) of open space and recreation zoned land is vulnerable from the present day 1% AEP coastal storm inundation. This is a reflection of Council's extensive network of open spaces and reserves along the margins of the coast, estuaries and river mouths. The Motueka – Riwaka coastal cell has the largest area of vulnerable open space and recreation zoned land (189 hectares), but there are significant areas of open space and recreation zoned land present throughout the District's coastline, in particular the Richmond – Waimea coastal cell (164 hectares).

The vulnerable open space and recreation zoned land in Motueka – Riwaka includes the coastal margin along Kina Peninsula, Motueka, the Motueka River delta (the rivermouth, the 'Kumaras' estuary, and Raumanuka Scenic Reserve) and coastal Riwaka. The Motueka golf course is zoned recreation and is also vulnerable to coastal inundation and sea level rise.

Within the Richmond – Waimea coastal cell, the areas of vulnerable land are largely associated with the open space zoned coastal margins on the Waimea Inlet and Best and Rough Islands, and the recreation zoned land of Richmond A & P showgrounds and Greenacres Golf Club (Best Island).

3.3.4 Conservation

The TRMP conservation zone includes the conservation estate administered by the Department of Conservation, and some areas of Crown land which is vested in the Council for management. The conservation zone is a very large and important resource within the District and includes the three national parks (Abel Tasman, Kahurangi and Nelson Lakes). Areas of conservation zone near the coast include Abel Tasman National Park, parts of Moturoa/Rabbit Island and numerous scenic reserves.

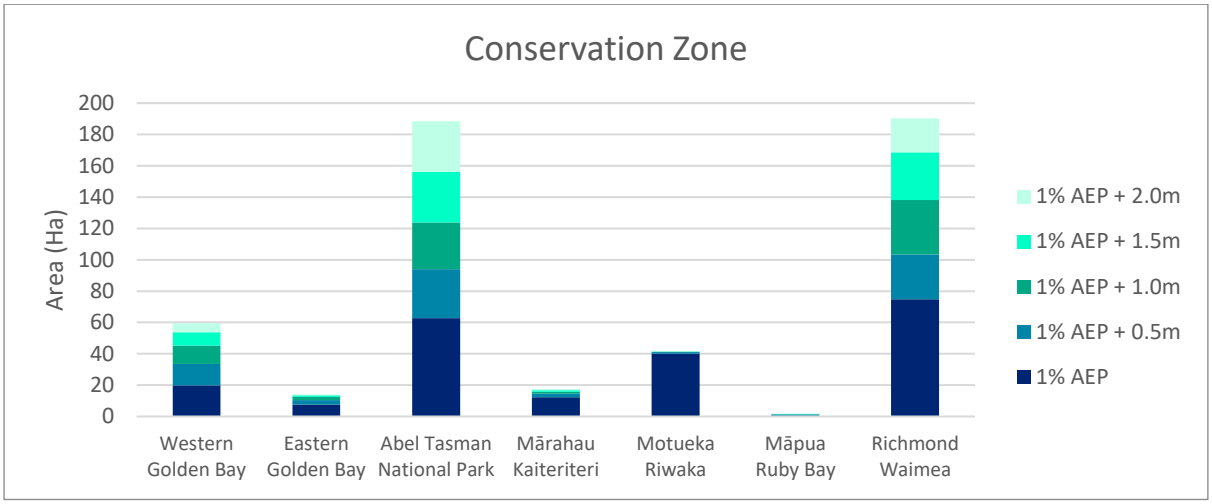


Figure 11: TRMP Conservation Zone Vulnerable to Coastal Storm Inundation and Sea Level Rise

Over 180 hectares of Abel Tasman National Park's sandy beaches and estuaries are exposed to coastal storm inundation and sea level rise (Figure 11). Proportionally this is a small area in comparison to the Park's extensive coastal boundary, as much of the Park has steep rocky coastline and limited low-lying coastal areas such as sandspits and estauries. Some of these low-lying areas will include sections of the Abel Tasman Coast Track and assets (including huts) administered by the Department of Conservation (DoC). Refer to Section 1.6 regarding DoC's national assessment of their asset vulnerability including within Abel Tasman National Park.

The Richmond – Waimea coastal cell includes a large area of vulnerable conservation zoned land due to the extensive reserve areas of Moturoa/Rabbit Island, which is Crown land vested in Council. Elsewhere, there are conservation zoned areas in Western Golden Bay (including Parapara sandspit, Milnthorpe and Puponga) and Motueka – Riwaka where the Motueka sandspit makes up the majority of conservation zoned land in that coastal cell. Waves can result in seawater overtopping the Motueka sandspit during a present day storm-tide.

3.3.5 Coastal Indigenous Vegetation

The New Zealand Land Cover Database (LCDB), administered by Manaaki Whenua Landcare Research, was used to assess the extent of indigenous vegetation in areas vulnerable to coastal storm inundation and sea level rise. The following LCDB classes were combined to represent coastal indigenous vegetation:

- Broadleaved indigenous hardwoods
- Fernland
- Flaxland
- Herbaceous freshwater vegetation

- Indigenous forest
- Manuka and/or kanuka
- Matagouri or grey scrub

The LCDB is a multi-temporal, thematic classification of New Zealand's land cover, containing 33 mainland classes. The LCDB can be used for a range of purposes including environmental monitoring, trend analysis and infrastructure planning (Manaaki Whenua Landcare Research, 2020).

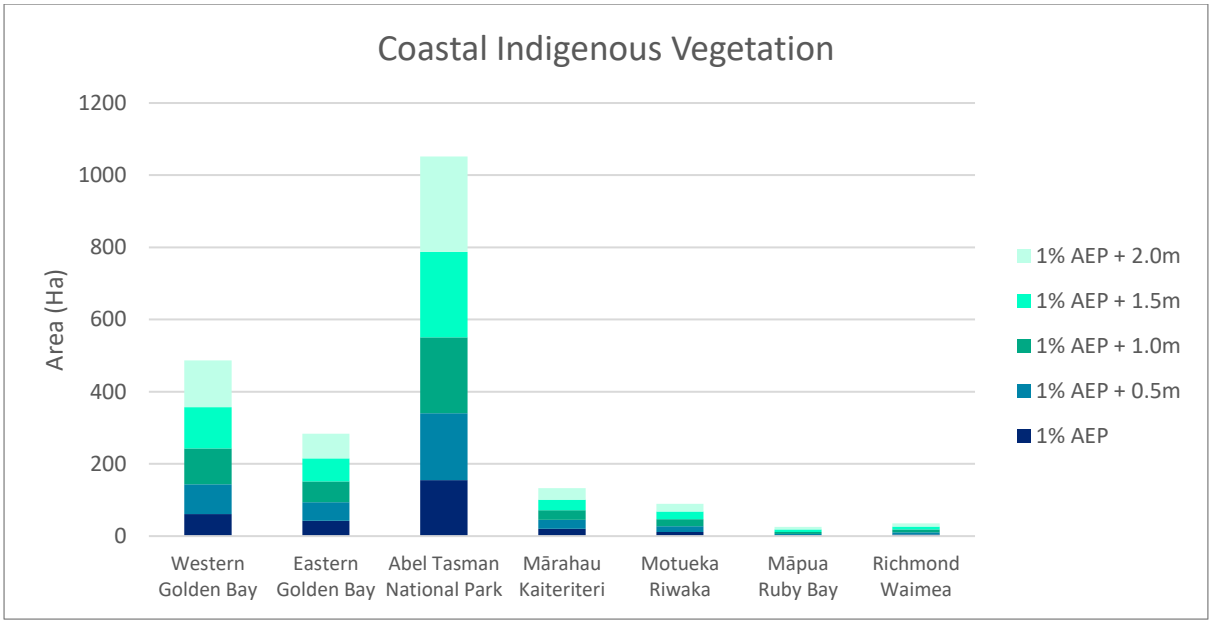


Figure 12: LCDB Indigenous Vegetation Vulnerable to Coastal Storm Inundation and Sea Level Rise

The majority (50%) of the coastal indigenous vegetation vulnerable to coastal storm inundation and sea level rise is located along the Abel Tasman National Park coastline, with the Golden Bay coastline accounting for a further 37% (Figure 12). The limited extent of coastal indigenous vegetation around Tasman Bay/Te Tai o Aorere (e.g. Richmond to Mārahau) is a reflection of there being little indigenous vegetation remaining along the coastal margins. Much of the flat and low-lying coastal land around Tasman Bay/Te Tai o Aorere has been developed and used for primary production (e.g. high producing pasture, horticulture, exotic forestry) or urban development.

3.3.6 Summary: Natural Environment

- Of the 575 protected trees located across the District (includes single trees or stands of trees under individual listings), 106 trees (18%) are exposed. Majority of these are in the Motueka – Riwaka coastal cell.
- Of the District's significant natural areas, only 1.1 hectares is vulnerable to coastal storm inundation and sea level rise and is located in the Richmond – Waimea coastal cell.
- The Council's extensive network of open space and recreation zoned land along the margins of the coast, estuaries and river mouths, results in a total of 717 hectares being vulnerable to coastal storm inundation and sea level rise. A significant proportion (60%) of open space and recreation zoned land is vulnerable to the present day 1% AEP coastal storm inundation.
- Conservation zoned land near the coast includes Abel Tasman National Park coastal cell, parts of Moturoa/Rabbit Island (Richmond – Waimea coastal cell), and numerous scenic reserves along the coastline. Both Abel Tasman National Park and Moturoa/Rabbit Island each have over 180 hectares of conservation zone land that is vulnerable.

3.4 Economy Value Domain

This value domain considers businesses and livelihoods, through land cover and land use planning zones.

Through the 2019 community engagement, respondents ranked 'homes' as being their top value that they are concerned will be affected by coastal storm inundation and sea level rise. 'Businesses' were ranked by respondents as their fifth highest value. The vulnerability of both these community identified values are assessed through a number of elements at risk within this economy value domain.

3.4.1 Land Cover

For the economy value domain the LCDB land coverage for urban, horticulture, exotic forest, and grassland (pasture) were considered. This land cover provides an indication of the extent of the urban areas and primary production industries that may be vulnerable to coastal storm inundation and sea level rise around Tasman Bay/Te Tai o Aorere and Golden Bay/Mohua.

Urban Land

Urban land is represented by LCDB classes:

- 'built-up area (settlements)' (e.g. areas of commercial, industrial or residential land use, including associated infrastructure and amenities)
- 'urban parkland/open space'.

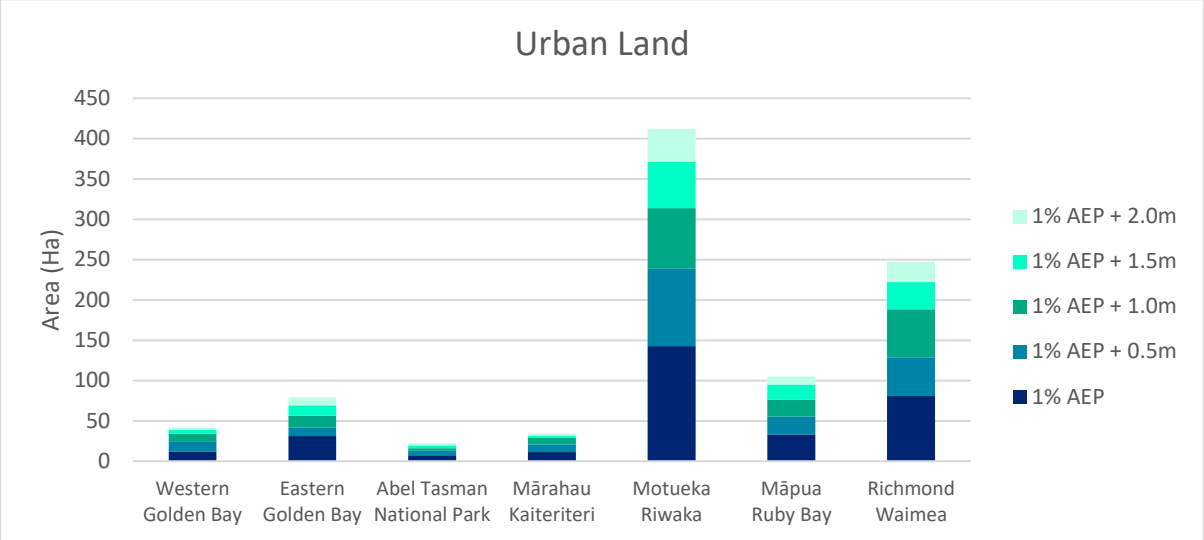


Figure 13: LCDB Urban Land Vulnerable to Coastal Storm Inundation and Sea Level Rise

Over two thirds of the urban land vulnerable to coastal storm inundation and sea level rise is located in the Motueka – Riwaka (412 hectares) and the Richmond – Waimea (247 hectares) coastal cells, being 44% and 26% respectively of all of the vulnerable urban land (Figure 13).

While Richmond is the largest town in the District, its residential areas are largely outside the extent of the mapped coastal storm inundation and sea level rise scenarios. The urban land that is vulnerable in this cell essentially comprises of industrial land near the Waimea estuary, parts of the A & P showgrounds and public reserves on Moturoa/Rabbit Island and Rough Island. In contrast, a

much greater portion of the vulnerable urban land in the Motueka – Riwaka coastal cell comprises residential areas.

Horticultural Land

Horticultural land is represented by LCDB classes:

- 'orchard, vineyard or other perennial crop'
- 'short-rotation cropland' (e.g. market gardening).

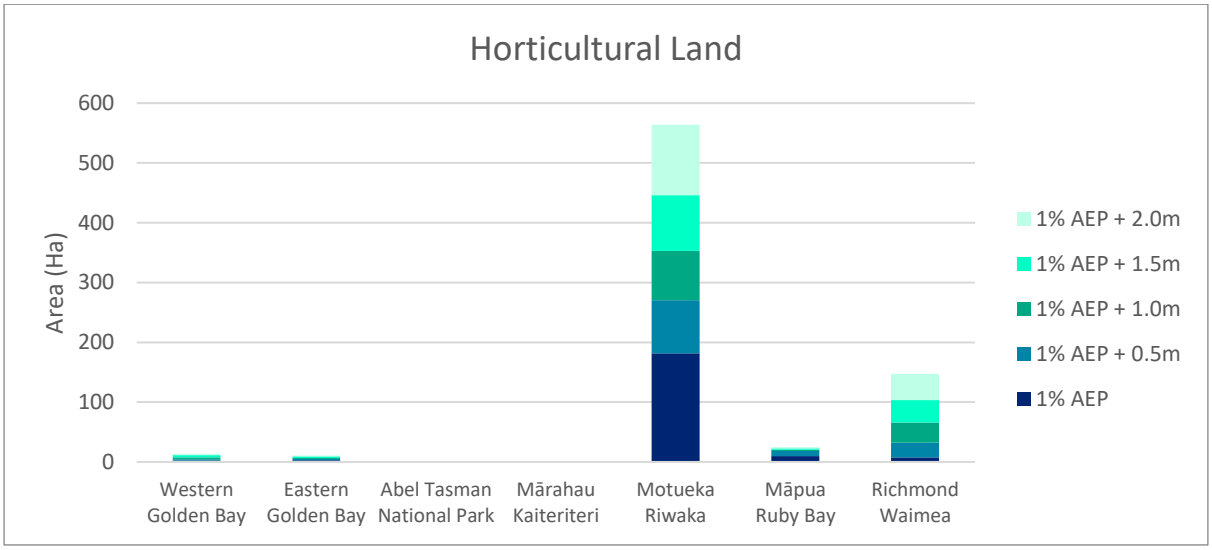


Figure 14: LCDB Horticultural Land Exposed to Coastal Storm Inundation and Sea Level Rise

The Motueka, Riwaka and Waimea plains are extensively used for horticulture and hence essentially all of the horticultural land in the District which is vulnerable to coastal storm inundation and sea level rise is found in these areas (Figure 14). The Motueka – Riwaka coastal cell contains the largest area of vulnerable horticultural land (564 hectares). Some of the horticultural land in the Riwaka area is very low-lying and is presently protected by a system of privately constructed and maintained tide banks and pumping stations. Agricultural use of coastal land elsewhere in the District is dominated by pastoral farming (see Figure 16).

Exotic Forest

Exotic forestry land is represented by the LCDB classes:

- 'deciduous hardwoods' (e.g. exotic woodlands)
- 'exotic forest'(e.g. commercial forestry areas)
- 'forest - harvested'

Moturoa/Rabbit Island is included within the Richmond – Waimea coastal cell and has significant areas of exotic forestry which is vulnerable (768 hectares). This coastal cell accounts for nearly all of the exotic forestry vulnerable to coastal storm inundation and sea level rise (Figure 15). Parts of the Moturoa/Rabbit Island forests are used for the disposal of biosolids from the Bells Island wastewater treatment plant.

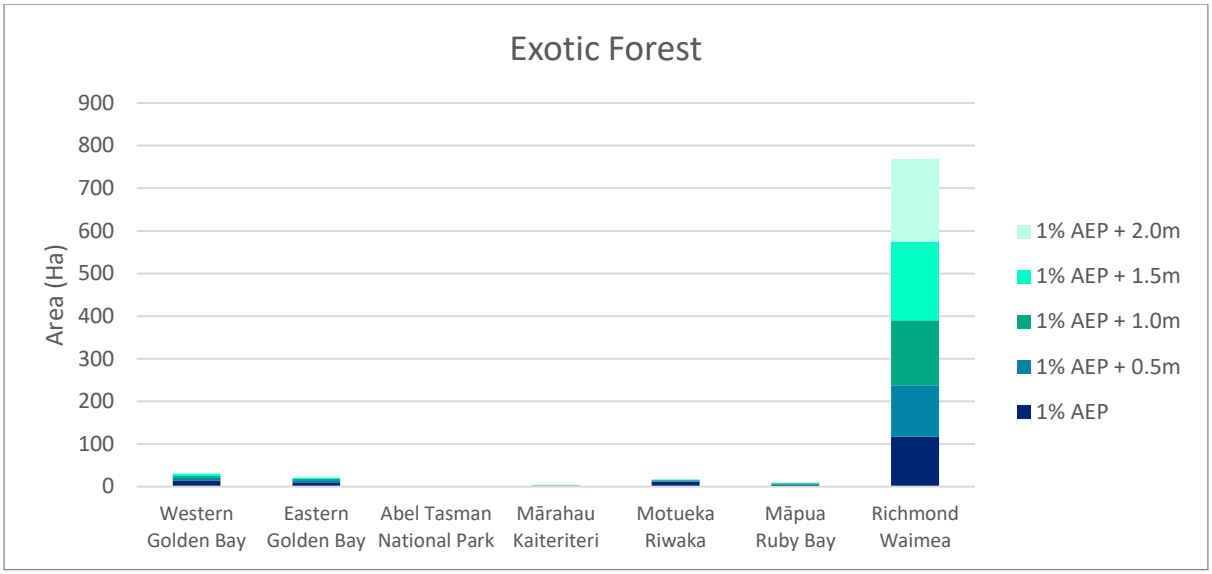


Figure 15: LCDB Exotic Forest Exposed to Coastal Storm Inundation and Sea Level Rise

Grassland

Grassland combines the LCDB classes:

- 'high producing exotic grassland' (e.g. grasses typical of intensive grazing management)
- 'low producing grassland' (e.g. grasses typical of extensive grazing management or non-agricultural uses).

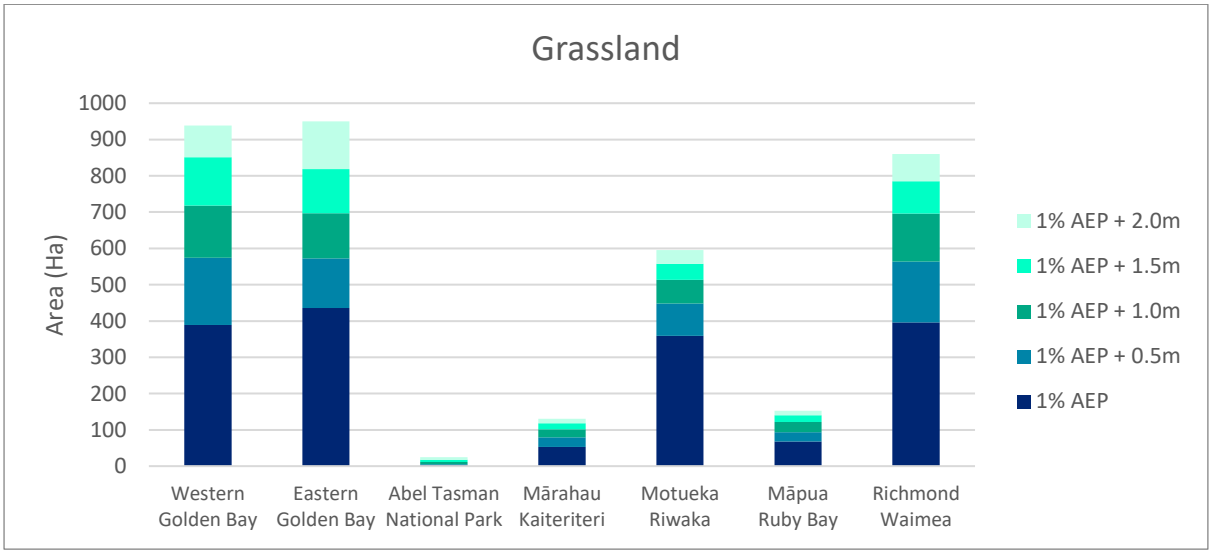


Figure 16: LCDB Grassland Exposed to Coastal Storm Inundation and Sea Level Rise

The coastal cells of Western Golden Bay (938 hectares), Eastern Golden Bay (950 hectares), Richmond – Waimea (860 hectares) and to a lesser extent Motueka – Riwaka (595 hectares) all have significant areas of grassland exposed to coastal storm inundation and sea level rise (Figure 16).

Within each coastal cell, approximately half of the grassland is vulnerable during a present day 1% AEP coastal storm-tide event. This vulnerability increases incrementally with sea level rise. This is a reflection of where there is pastoral farming, it is typically undertaken right to the edge of the

coastal margin. Parts of the coastal margin of the Waimea Plains (Richmond – Waimea coastal cell) is protected by a system of privately constructed and maintained tide banks.

Land Cover: Totals

Of the four land covers which have been analysed within the economy value domain, grassland accounts for 59% of land cover (3,650 hectares) which is vulnerable to coastal storm inundation and sea level rise (Figure 17). The bulk of this is classed as high producing exotic grassland (97%) typical of pastoral farming, with the remainder being low producing and/or non-agricultural uses. The other three land covers are of a similar size: urban land (15%, 941 hectares), exotic forestry (12%, 857 hectares) and horticultural land (12%, 760 hectares). The vulnerability of urban land, including potential costs to either repair or replace (where appropriate), are likely to be significant. Horticultural land, exotic forestry and grassland will be able to recover from one-off coastal storm inundation events, however the impact of sea level rise will lead to these land uses over time becoming unprofitable (due to salinization of crops) or becoming encroached by the sea and every day high tides.

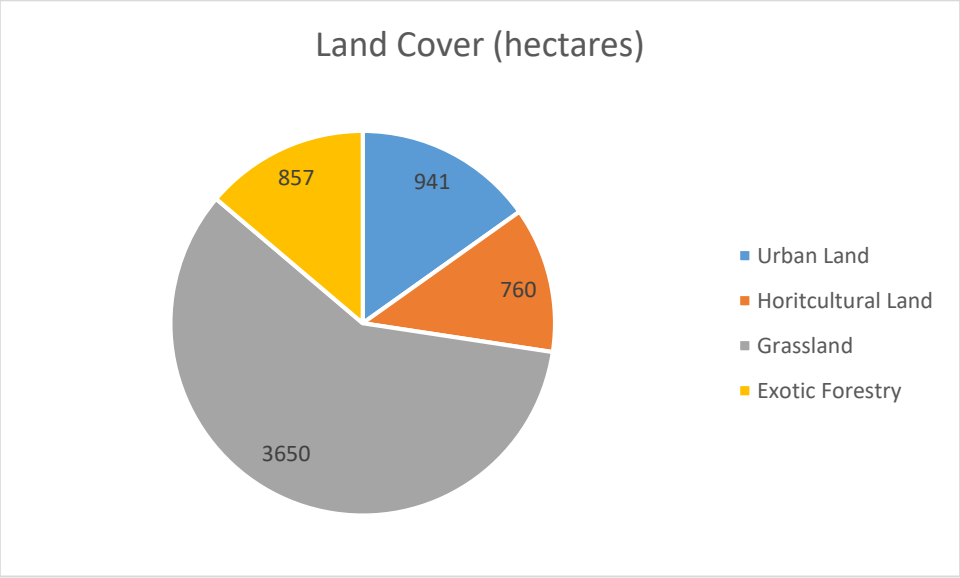


Figure 17: Comparison of Land Cover Vulnerable to Coastal Storm Inundation and Sea Level Rise

3.4.2 Land Use Planning Zones

The analysis of TRMP land use planning zones compliments the Land Cover Database (LCDB) analysis provided in the previous section. The TRMP planning maps identify zones where a particular land use is occurring or is intended to occur. This section considers the areas of various zones or groupings of zones, representing broader land uses, namely:

- Residential
- Rural Residential
- Rural
- Business and Industrial

The individual zones included in each grouping is listed in Appendix 1 (Elements at Risk) of this report.

Residential

'Residential' represents those locations in our urban areas where people live. It comprises the TRMP residential planning zones.

Through the 2019 community engagement, respondents ranked 'homes' as being their top value that they are concerned will be affected by coastal storm inundation and sea level rise. The majority of homes which are vulnerable to coastal storm inundation and sea level rise will be located within the residential zone, however it is recognised that there will also be some homes located in other zones (e.g. rural residential and rural) which will also be vulnerable.

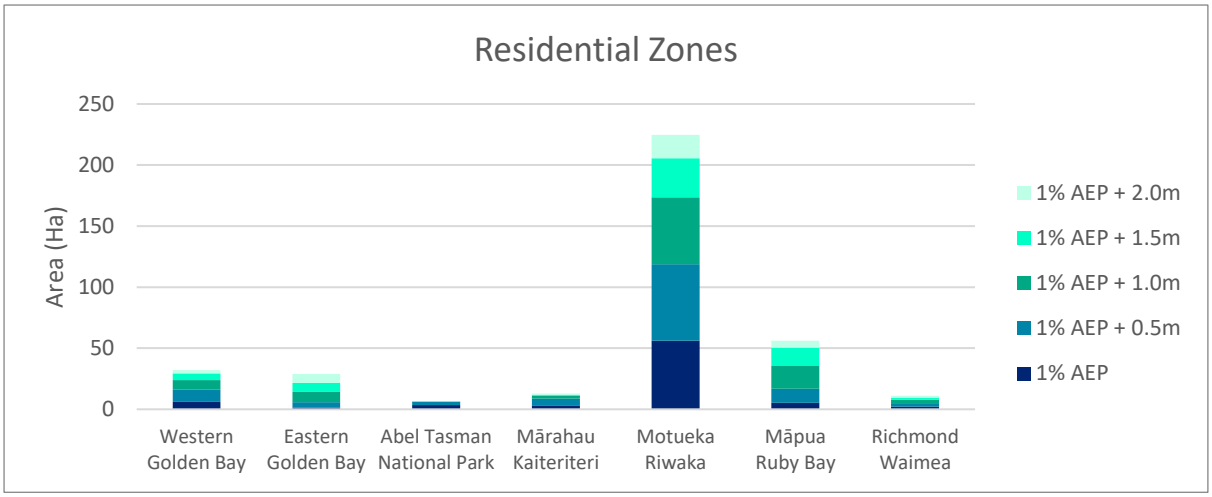


Figure 18: TRMP Residential Zones Vulnerable to Coastal Storm Inundation and Sea Level Rise

The Motueka – Riwaka coastal cell has by far the largest area (225 hectares) of residential zoned land exposed to coastal storm inundation and sea level rise (Figure 18). Combined with the Māpua – Ruby Bay coastal cell (56 hectares) these two coastal cells account for 75% of the vulnerable residentially zoned land in Tasman Bay and Golden Bay. Although Richmond is a much larger settlement than both Motueka and Māpua – Ruby Bay, the Richmond residential area is largely outside the extent of the mapped coastal storm inundation and sea level rise scenarios.

Rural Residential

'Rural residential' includes the TRMP rural residential zones and the Rural 3 Zone. These zones enable low density housing in rural, coastal and peri-urban areas across the District (e.g. lifestyle blocks and rural living opportunities). The Rural 3 zone essentially allows for a degree of rural residential land use within the zone, with the balance areas remaining rural, and is provided for in the Coastal Tasman area (e.g. Appleby Hills to Māriri).

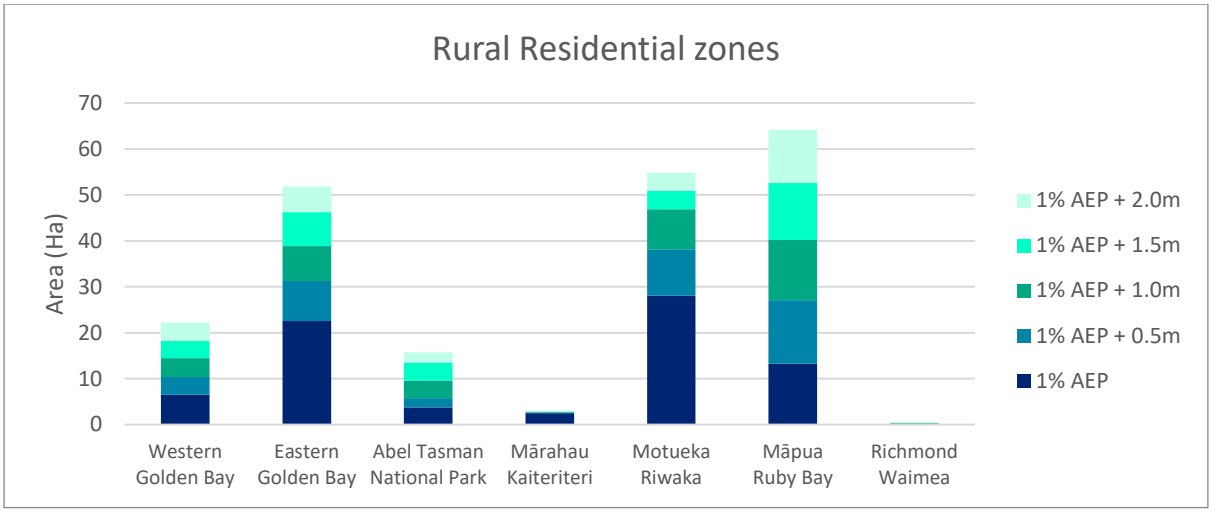


Figure 19: TRMP Rural Residential Zones Vulnerable to Coastal Storm Inundation and Sea Level Rise

The Māpua – Ruby Bay (64 hectares), Motueka – Riwaka (55 hectares) and Eastern Golden Bay (52 hectares) coastal cells account for 80% of the rural residential zoned land vulnerable to coastal storm inundation and sea level rise (Figure 19).

Rural

Large tracts of the District are zoned rural and includes land of varying productivity and versatility. The rural zones also contain rural support industries (e.g. processing plants and pack houses) as well as rural dwellings.

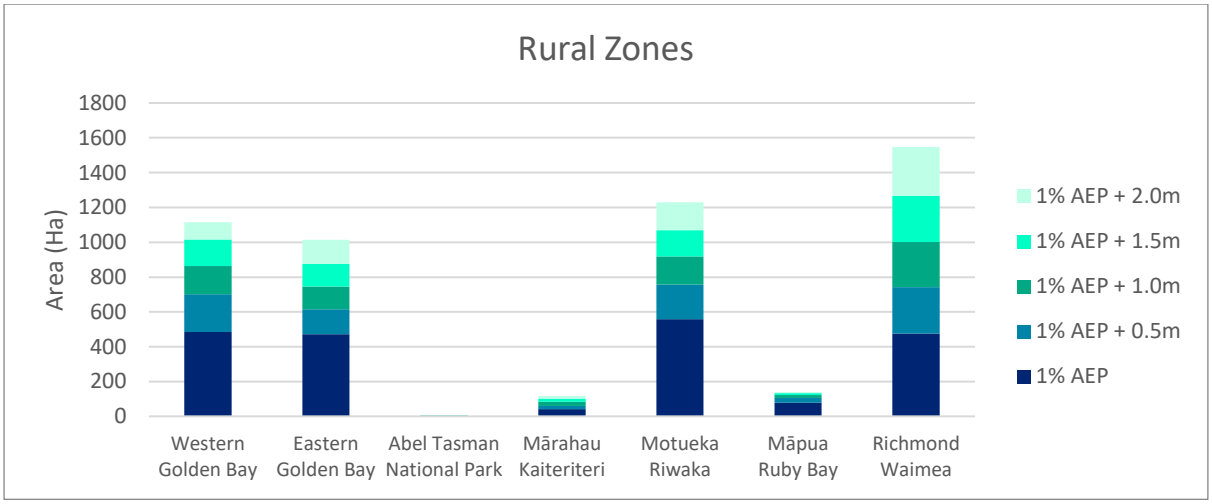


Figure 20: TRMP Rural Zones Vulnerable to Coastal Storm Inundation and Sea Level Rise

The alluvial plains of the main river systems (Aorere, Tākaka, Motueka and Waimea) all extend to the coast and support productive rural land uses. As a consequence the coastal cells containing these alluvial plains account for essentially all of the rural zoned land that is vulnerable to coastal storm inundation and sea level rise (Figure 20).

The Richmond – Waimea coastal cell, which includes Moturoa/Rabbit Island, has the largest area of vulnerable rural zoned land (1,548 hectares). However, the Motueka – Riwaka (1,230 hectares),

Western Golden Bay (1,116 hectares), and Eastern Golden Bay (1,015 hectares) cells also include significant areas.

Business and Industrial

'Business and Industrial' includes the TRMP planning zones that cover commercial, industrial, mixed business and tourist services.

The Richmond – Waimea coastal cell has by far the largest area (274 hectares) of business and industrial zoned land exposed to coastal inundation and sea level rise (Figure 21). This includes over 150 hectares of Bell Island, including the wastewater treatment plant, which is zoned rural industrial. Low-lying areas of Lower Queen Street (zoned mixed business and industrial (rural and light)) and the Beach Road light industrial estate are also vulnerable, and contain some key economic and employment opportunities for both Richmond and the wider District. Parts of this low-lying coastline around the Waimea Inlet are actively managed with coastal protection. Some areas, such as the Beach Road light industrial estate experienced inundation during ex-tropical cyclone Fehi in 2018.

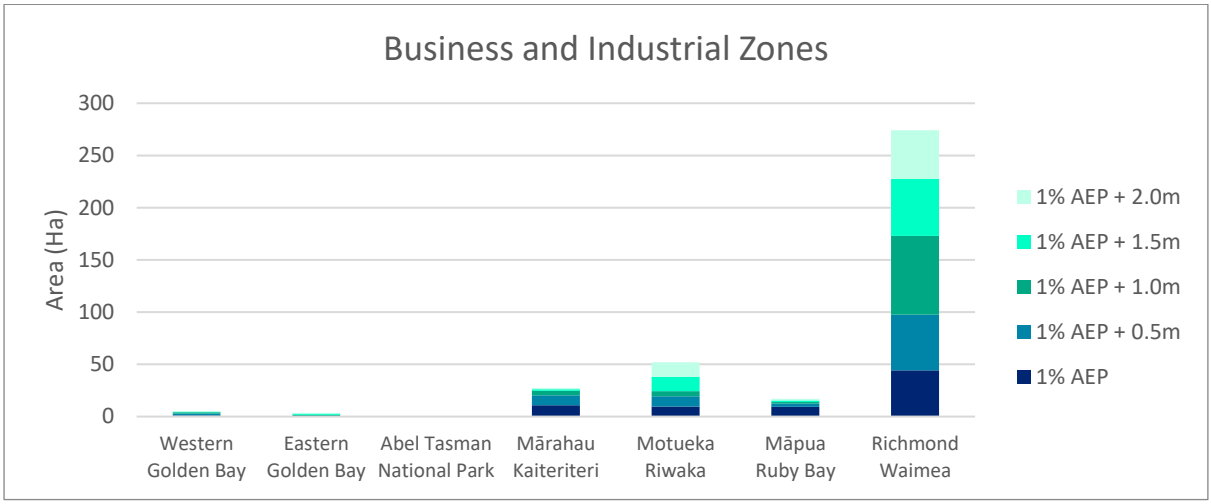


Figure 21: TRMP Business and Industrial Zones Vulnerable to Coastal Storm Inundation and Sea Level Rise

TRMP Zones: Totals

Of the four broader land use groupings of the TRMP planning zones which were analysed within the economy value domain, rural zoned land accounts for 84% of land (5,170 hectares) which is vulnerable to coastal storm inundation and sea level rise (Figure 22).

Residential zones (6%, 373 hectares), business and industrial zones (6%, 379 hectares) and rural residential zones (4%, 212 hectares) account for 16% of vulnerable land. These three zones have significant numbers of elements at risk including people, homes, businesses, infrastructure and community facilities. The vulnerability of elements at risk within these zones, including potential costs to either repair or replace, are likely to be significant.

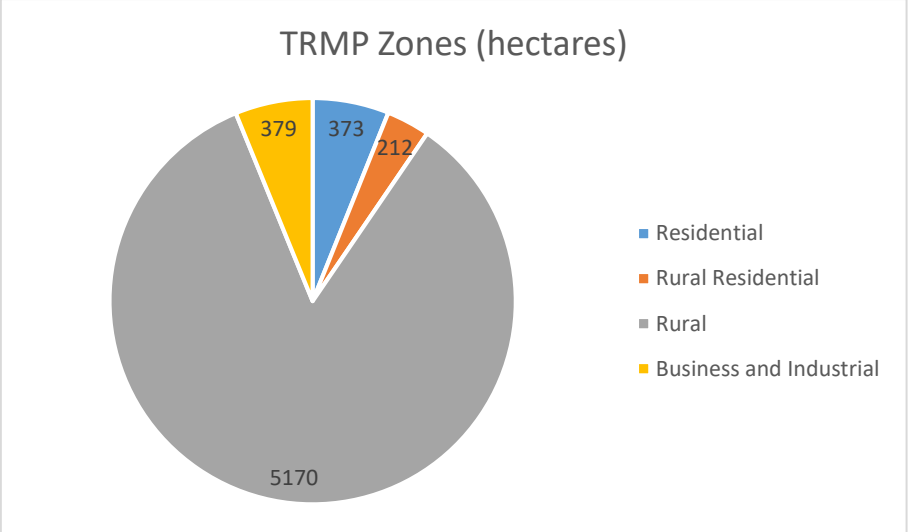


Figure 22: Comparison of TRMP Zones Vulnerable to Coastal Storm Inundation and Sea Level Rise

3.4.3 Summary: Economy

- Analysis of the land cover (LCDB) identifies that grasslands accounts for 59% of the vulnerable land cover (3,650 hectares), with nearly all of this being high producing exotic grassland typical of pastoral farming. The other three land covers are each of similar size: urban land (15%, 941 hectares), exotic forestry (12%, 857 hectares) and horticultural land (12%, 760 hectares). This is consistent with the distribution of the TRMP planning zones, with rural zoned land accounting for 84%, and the residential, business and industrial, and rural residential planning zones accounting for the remaining 16%.
- Over two thirds of the urban land cover vulnerable to coastal storm inundation and sea level rise is located in the Motueka – Riwaka (412 hectares) and the Richmond – Waimea (247 hectares) coastal cells, 44% and 26% respectively of all of the vulnerable urban land. This is similar to the TRMP planning zones, which show significant areas of the Motueka – Riwaka (residential zones) and the Richmond – Waimea (business and industrial zones) as vulnerable to coastal storm inundation and sea level rise. Although Richmond is a much larger town than Motueka, the Richmond residential area is largely outside the extent of the mapped coastal storm inundation and sea level rise scenarios.
- Eastern Golden Bay (52 hectares), Motueka – Riwaka (55 hectares) and Māpua – Ruby Bay (64 hectares) coastal cells account for 80% of the TRMP rural residential zoned land vulnerable to coastal storm inundation and sea level rise.
- Land cover representing primary production reflects the different land use across the coastal cells. The Motueka – Riwaka coastal cell contains by far the largest area of vulnerable horticultural land (564 hectares), compared to other areas. Elsewhere in the District coastal land use is dominated by pastoral farming in Western Golden Bay (938 hectares), Eastern Golden Bay (950 hectares), Richmond – Waimea (860 hectares) and Motueka – Riwaka (595 hectares).
- Moturoa/Rabbit Island, located in the Richmond – Waimea coastal cell, accounts for nearly all of the exotic forestry vulnerable to coastal storm inundation and sea level rise (768 hectares).
- Some primary production land located on the coastal margin of the Waimea Plains and in the Riwaka area is very low-lying and presently protected by a system of privately constructed and maintained tide banks.

3.5 Built Environment Value Domain

The 'built environment' value domain considers physical assets such as infrastructure, roads, buildings (e.g. homes, tourist accommodation, businesses, community facilities), coastal assets, and closed landfills.

Through the 2019 community engagement, respondents highly ranked values that fit within this value domain. Respondents ranked homes (1st), lifeline infrastructure (2nd) and businesses (5th) as values that they are concerned will be affected by coastal storm inundation and sea level rise. The vulnerability of these community identified values are assessed through a number of elements at risk within this section.

3.5.1 3 Waters Infrastructure

'3 waters' infrastructure includes Council-owned water supply, wastewater and stormwater assets. While this assessment focuses on Council-owned infrastructure, it is noted that there will be a number of privately owned and maintained water supplies, stormwater and wastewater systems that will also be exposed to coastal storm inundation and rising sea levels. There is minimal (if any) Council servicing within the Abel Tasman National Park coastal cell.

Urban areas across much of New Zealand rely on 3 waters infrastructure services that were not originally designed with climate change in mind. Coastal urban areas are particularly vulnerable as the effects of sea level rise, coastal storms, extreme rainfall and droughts will impact on these services, resulting in increased failures and decreased levels of service over the coming decades (White et al, 2017). Rising sea levels will make the disposal of stormwater increasingly more difficult, impact on inflows and infiltration to pipes, and affect the salinity of coastal groundwater aquifers. Runoff from extreme rainfall events and coastal storms will place pressure on the stormwater system resulting in flooding. Droughts will affect the supply and demand of drinking water, and affect the performance and maintenance of wastewater systems.

By the nature of their design, some 3 waters infrastructure will be more vulnerable than others to coastal storm inundation and sea level rise as noted in the sections below.

Water Supply

The Council provides and manages a potable water supply (i.e. water suitable for use and consumption by people) to properties within 18 supply schemes across the District. Coastal towns and settlements that are connected to Council's water supply schemes include Richmond, Māpua/Ruby Bay, Motueka, Riwaka/Kaiteriteri, Pōhara and Collingwood. Further detail can be found in Council's Water Supply Activity Management Plan 2018.

Of the 15 water treatment plants located across the District, only the Waimea treatment plant is located near the coast, approximately 800 m away. The Waimea treatment plant is located on land around 6.0 m elevation (NZVD2016 datum) and is above the level expected to be impacted by a 2.0 m sea level rise. A new water treatment plant is also planned for Motueka, and is proposed to be located on Parker Street outside of the mapped extent of the coastal storm inundation and sea level rise scenarios.

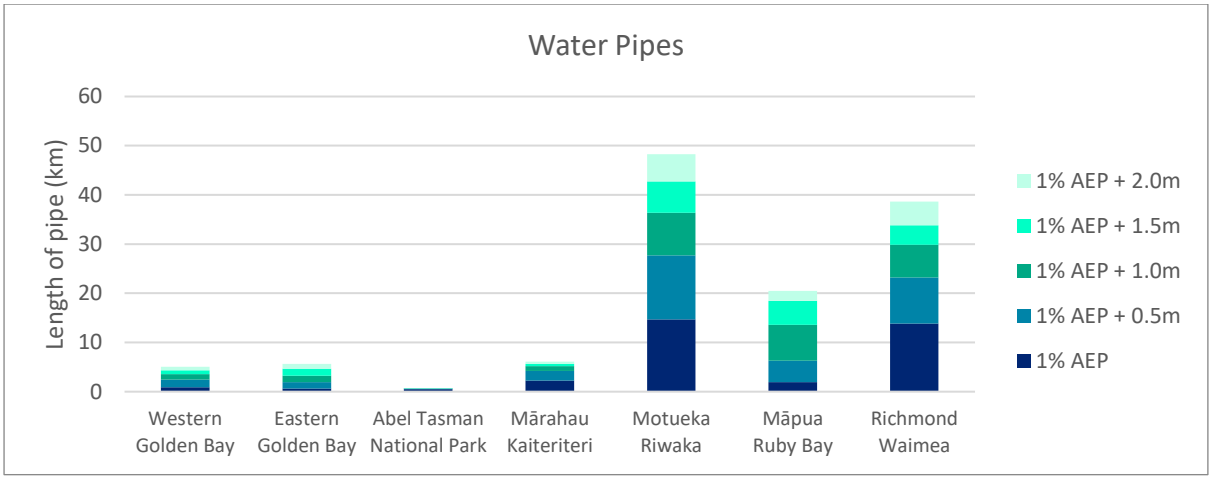


Figure 23: Water Pipes Vulnerable to Coastal Inundation and Sea Level Rise

Water pipes are usually buried and are under positive pressure. Freshwater is more likely to leak from a pipe rather than saline water infiltrating into the pipe.

The Motueka – Riwaka coastal cell has the largest length of water pipes (just under 50 km of pipe) under land that is vulnerable to coastal storm inundation under a 2.0 m sea level rise (Figure 23). Despite the size of Motueka, only parts of the urban area are reticulated and connection to this is on a voluntary basis, with many residents reliant on private bores (which are not included in this assessment). If Motueka was fully reticulated the length of pipe under land vulnerable to coastal storm inundation and sea level rise would be considerably greater.

Richmond – Waimea has the second largest length of pipe under vulnerable land (40 km of pipe). However, the majority of this comprises the trunk mains connecting the Waimea treatment plant to Richmond (pipe runs along the coastline) and to Māpua (pipe runs across Moturoa/Rabbit Island and under the Māpua channel). Māpua – Ruby Bay has approximately 20 km of pipe under vulnerable land. There are limited water supply pipes in the other three remaining coastal cells (less than 6 km per cell) reflecting the limited provision of Council water supply services in these areas.

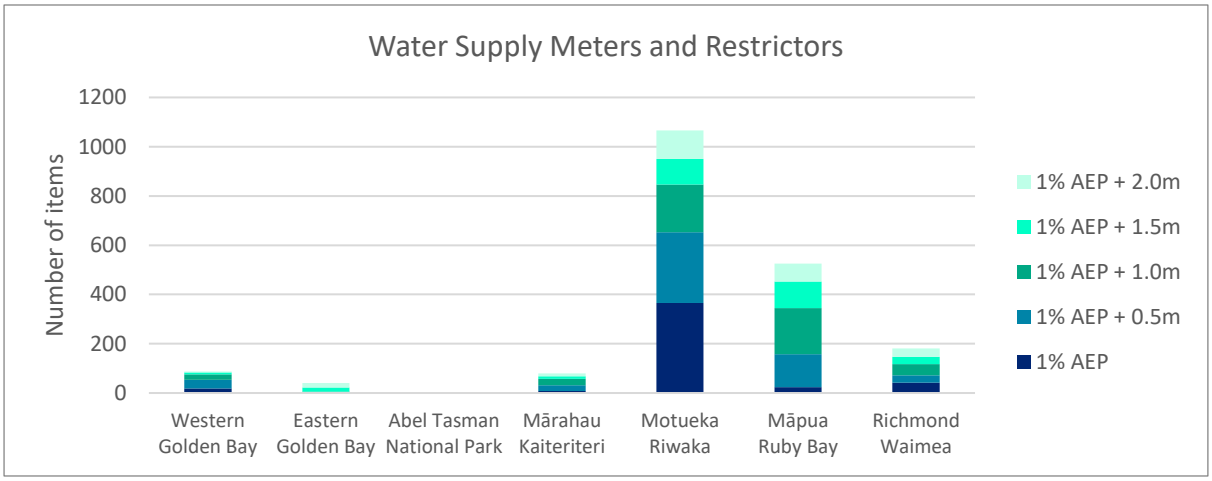


Figure 24: Water Supply Meters and Restrictors Vulnerable to Coastal Inundation and Sea Level Rise

Water meters (urban supply) and restrictors (rural supply) represent the number of domestic and commercial connections to the Council water supply (Figure 24). The Motueka – Riwaka coastal cell has over 1000 connections which may be vulnerable, with over half of these within the 1% AEP coastal storm inundation in combination with 0.5 m sea level rise. If Motueka was fully reticulated the number of water supply meters vulnerable to coastal storm inundation and sea level rise would be greater. Māpua – Ruby Bay has the second highest vulnerability, with approximately 500 connections in total.

Wastewater

The Council provides and manages wastewater collection, treatment and disposal facilities for properties connected to its nine wastewater networks across the District.

The largest wastewater treatment plant (WWTP) in the District is located on Bell Island, which services a number of Tasman towns and local centres (Richmond, Hope, Brightwater, Wakefield, Māpua/Ruby Bay) and parts of Nelson City. It is jointly owned by both Tasman District and Nelson City Councils and is managed by the Nelson Regional Sewerage Business Unit. Both the Bell Island WWTP and the Motueka WWTP (servicing Motueka, Riwaka and Kaiteriteri) are located near the coast and are within the area expected to be vulnerable to coastal storm inundation under predicted sea level rise. Council is starting to consider longer-term options to relocate the Motueka WWTP inland, and will also consider longer term options for Bell Island WWTP during the next Long Term Plan cycle in partnership with Nelson City Council. Council's Wastewater Activity Management Plan 2018 contains further information on the WWTPs.

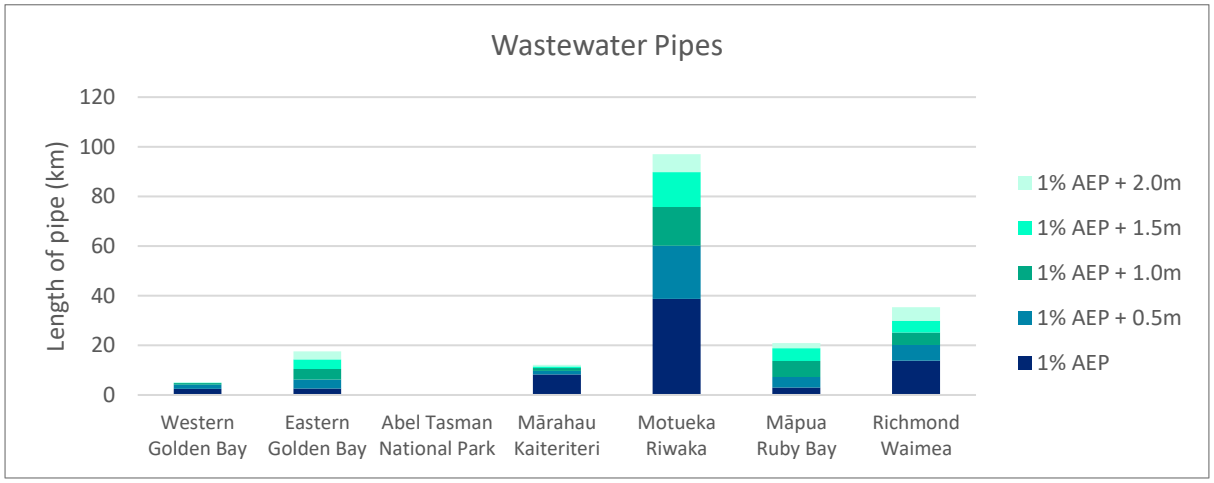


Figure 25: Wastewater Pipes Vulnerable to Coastal Inundation and Sea Level Rise

The Motueka – Riwaka coastal cell has the largest length of wastewater pipeline under land that is vulnerable to coastal storm inundation and sea level rise (approximately 97 km of pipe) (Figure 25). Although Richmond is a larger town than Motueka and has a more extensive service provision, the Richmond urban area is largely outside the extent of the mapped coastal storm inundation and sea level rise scenarios and majority of the wastewater pipes are not vulnerable these hazards.

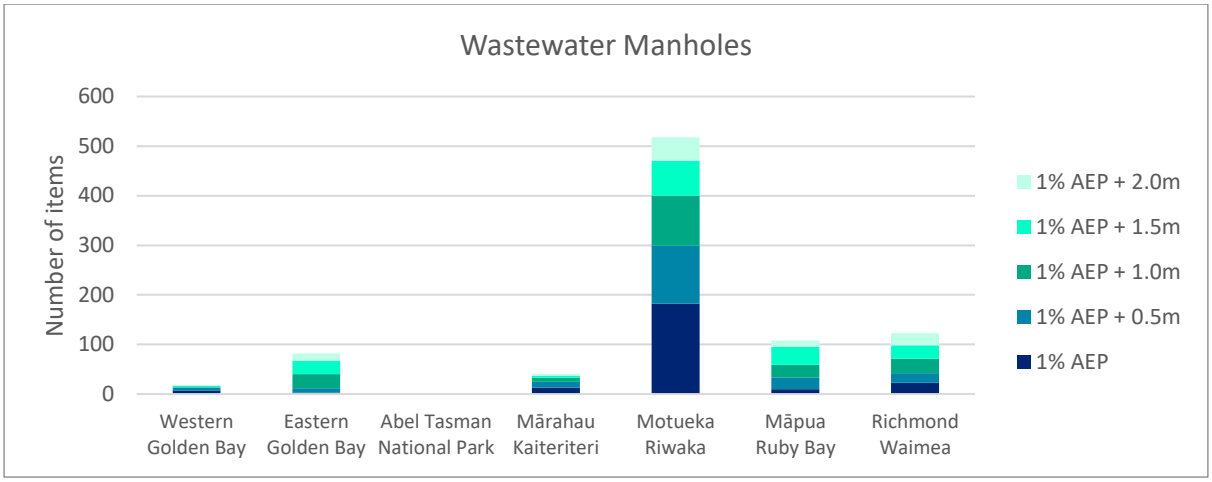


Figure 26: Wastewater Manholes Vulnerable to Coastal Inundation and Sea Level Rise

Manholes provide maintenance access to the pipe network, however as sea levels rise they may also enable seawater infiltration into the network. The number of wastewater manholes vulnerable to coastal inundation and sea level rise displays a similar distribution to the wastewater pipelines, with Motueka – Riwaka coastal cell having the largest number of manholes by some margin (Figure 26).

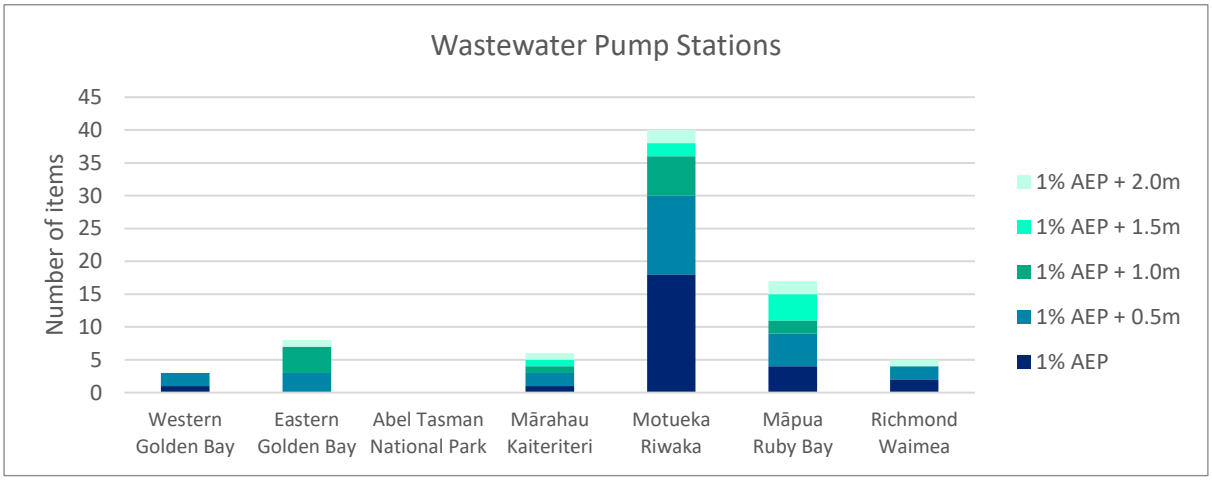


Figure 27: Wastewater Pump Stations Vulnerable to Coastal Inundation and Sea Level Rise

Wastewater pump stations are an above ground asset which will be directly affected by coastal storm inundation and sea level rise. Consistent with other wastewater infrastructure, the Motueka – Riwaka coastal cell has the largest asset vulnerability, with 40 pump stations located within the vulnerable area (Figure 27). The majority of these pump stations are vulnerable in the present day 1% AEP coastal storm-tide and with a 0.5 m sea level rise.

Māpua – Ruby Bay has the second largest number of pump stations with 17 vulnerable, noting that wastewater from this area is pumped to Bell Island WWTP for treatment.

Stormwater

The Council provides and manages stormwater collection, reticulation and discharge systems across the District. Stormwater assets include drainage channels, piped reticulation networks, tide gates, detention or ponding areas, inlet structures, discharge structures and water quality treatment

assets. The Council manages its stormwater activities primarily within 15 Urban Drainage Areas (UDAs). Systems that are outside the UDAs include small communities with stormwater systems that primarily collect and convey road runoff to suitable discharge points. Council's Stormwater Activity Management Plan 2018 contains further information on Council's stormwater systems.

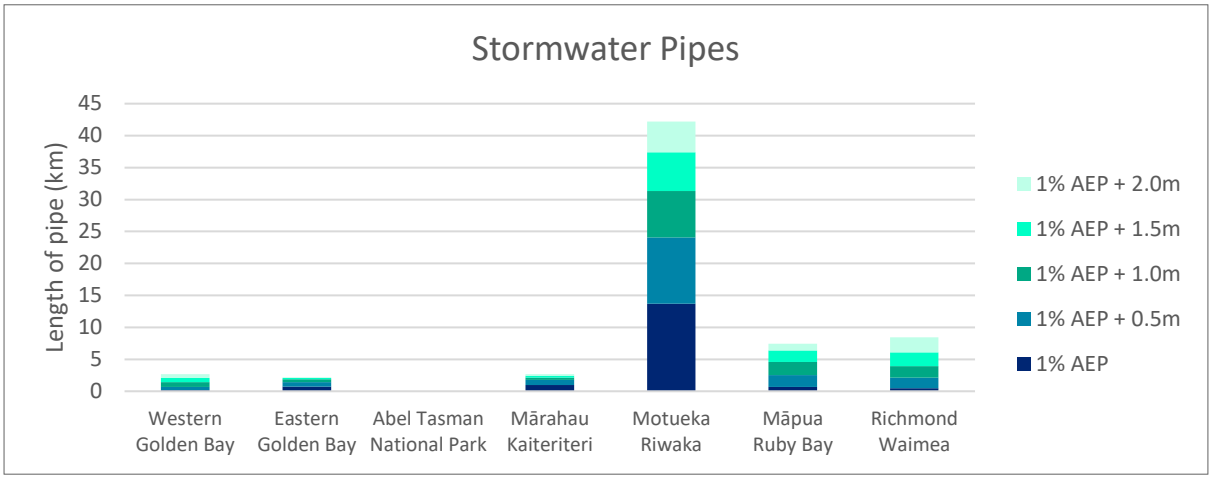


Figure 28: Stormwater Pipes Vulnerable to Coastal Inundation and Sea Level Rise

The Motueka – Riwaka coastal cell has the largest length of stormwater pipeline vulnerable to coastal storm inundation and sea level rise (approximately 42 km of pipe) (Figure 28). Although Richmond is a larger town than Motueka and has a more extensive service provision, the Richmond urban area is largely outside the extent of the mapped coastal storm inundation and sea level rise scenarios and hence the stormwater pipe vulnerability is significantly less.

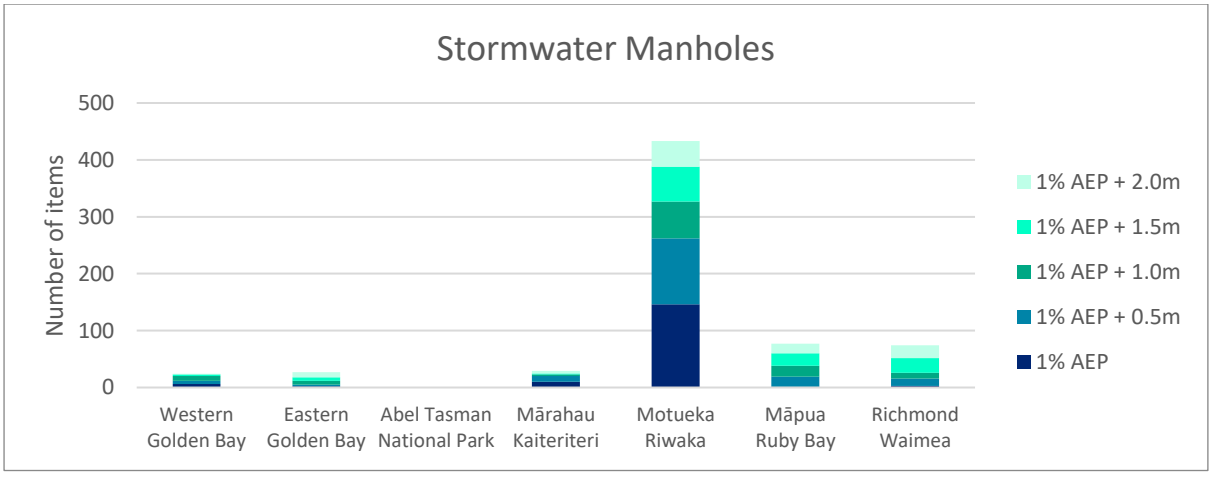


Figure 29: Stormwater Manholes Exposed to Coastal Inundation and Sea Level Rise

The number of stormwater manholes exposed to coastal inundation and sea level rise displays a similar trend to the stormwater pipelines, with Motueka – Riwaka coastal cell having the largest exposure by a significant amount in comparison to other coastal cells (Figure 29). Over half of the manholes in this coastal cell are vulnerable in the present day 1% AEP coastal storm-tide with a 0.5 m sea level rise.

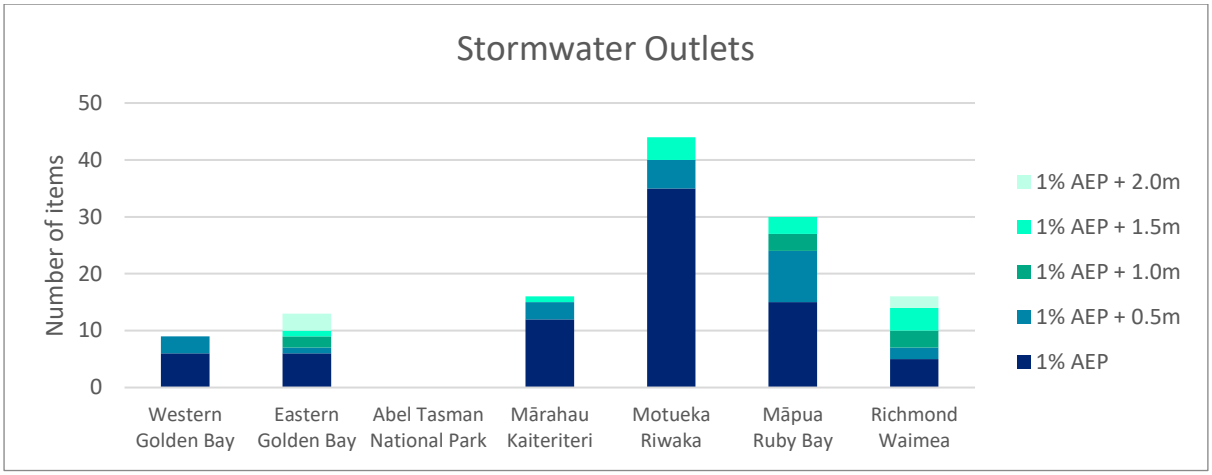


Figure 30: Stormwater Outlets Vulnerable to Coastal Inundation and Sea Level Rise

The Motueka – Riwaka coastal cell has the highest number of stormwater outlets (44) exposed to coastal storm inundation and sea level rise, followed by Māpua – Ruby Bay (30) (Figure 30).

For most coastal cells, the largest proportion of stormwater outlets are affected by the present day 1% AEP coastal storm inundation event, rather than the sea level rise scenarios over the longer term. This is because coastal stormwater systems typically flow under gravity and discharge into to the sea. By necessity the outlets need to be constructed as low as practicable. A number of stormwater outlets are impacted by elevated high tides and storm events under present day conditions and are fitted with flap gates to prevent seawater back flowing into the pipes.

3.5.2 Roads

The extensive road network throughout our District is managed and maintained by both the Council (Council roads) and the New Zealand Transport Authority (NZTA) in relation to state highways (SH 6 and SH 60). The Council's transportation assets include roads (sealed and unsealed), bridges and culverts, footpaths, cycle paths, and streetlights. Council's Transportation Activity Management Plan 2018 contains further information on the District's roading infrastructure.

Of the transportation assets, this assessment focuses on roads only, identifying those sections of the road network that are vulnerable to coastal storm inundation and sea level rise.

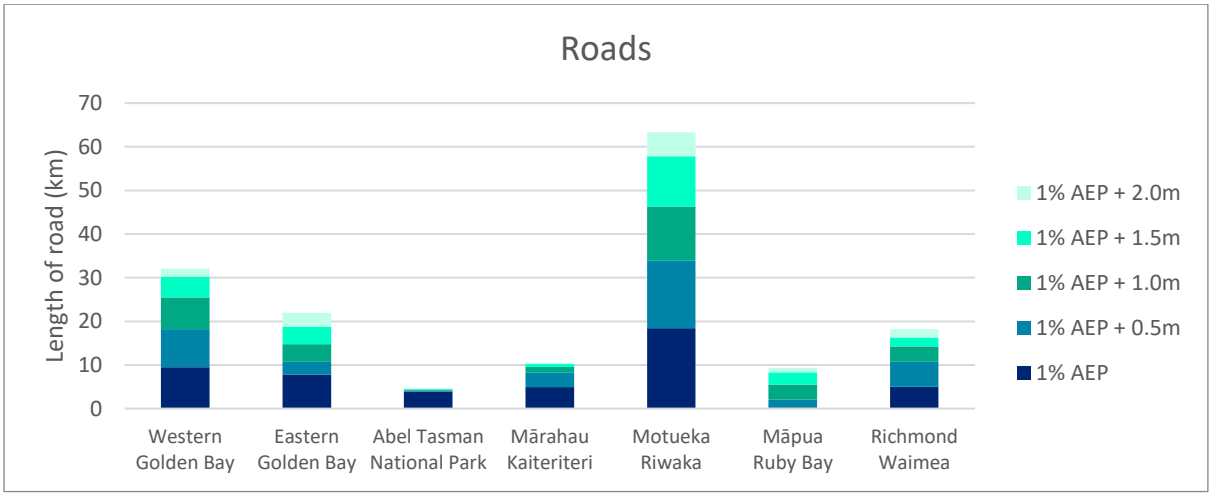


Figure 31: Roads Vulnerable to Coastal Inundation and Sea Level Rise

A total 160 km of roads (Council roads and NZTA state highway) across Tasman and Golden Bays are vulnerable to coastal storm inundation under a 2.0 m sea level rise (Figure 31). The Motueka – Riwaka coastal cell has the largest proportion of vulnerable roads with over 60 km of road length affected.

Damage to a section of road can have wider impacts to some locations of the District where roads provide the key connection to individual properties, rural communities, towns and local centres which themselves may not be exposed to coastal storm inundation and sea level rise. An example of this is the Collingwood-Puponga Road which services a number of communities and is compromised in places during present day storm surges. Similarly, the road to Mārahau provides access to a number of residential properties, tourism-related businesses, and the southern entry to Abel Tasman National Park. In its current location, the Mārahau road will be affected by predicted sea level rise.

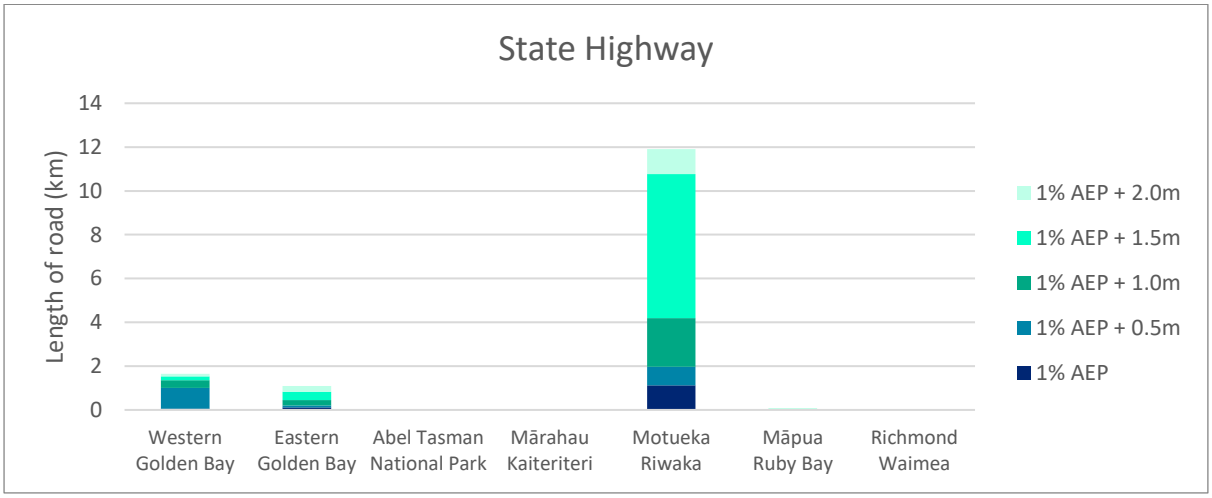


Figure 32: State Highway Vulnerable to Coastal Inundation and Sea Level Rise

Within the Motueka – Riwaka coastal cell approximately 12 km of State Highway 60 is potentially exposed to coastal storm inundation under a 2.0 m sea level rise (Figure 32). Over half of this road length becomes vulnerable under a 1% AEP coastal storm inundation and 1.5 m sea level rise scenario. This will affect movement within the Motueka and Riwaka area, in addition to the approach to Tākaka Hill and Golden Bay beyond.

Elsewhere in the District the only parts of State Highway 60 that are vulnerable are relatively short sections of highway at the approaches to the Tākaka River bridge (Eastern Golden Bay), the Parapara estuary causeway (Western Golden Bay) and a very small section near the Waimea Inlet near Māpua (Māpua – Ruby Bay).

It is recognised that cycle paths also play a key role in the movement of people around the District (as active transport) and can be included in a future revision of this assessment once the data becomes available.

The effects of climate change (including more frequent and severe rainfall events, coastal storms, and sea level rise) are leading to more frequent and more significant service disruptions across the roading network that take longer and cost more to fix. Ex-tropical cyclone Fehi (1 February 2018) generated a storm surge and waves that coincided with a very high tide causing approximately $650,000 of damage to transportation infrastructure (including both roads and Tasman's Great Taste

Trail). Very little rainfall occurred during Fehi and the roading damage was solely from coastal inundation and wave action.

3.5.3 Buildings

A count of building was undertaken to understand the level of coastal storm inundation and sea level rise vulnerability to homes, tourist accommodation, business premises, community facilities, etc. This assessment uses the LINZ building outline dataset. All buildings less than 60m^2 were excluded as these typically comprise minor and ancillary buildings such as garden sheds, garages, sleepouts and outbuildings. It is highlighted that this information is indicative only as the building count is based on present day data, and assumes no further growth or infill development in these areas over time.

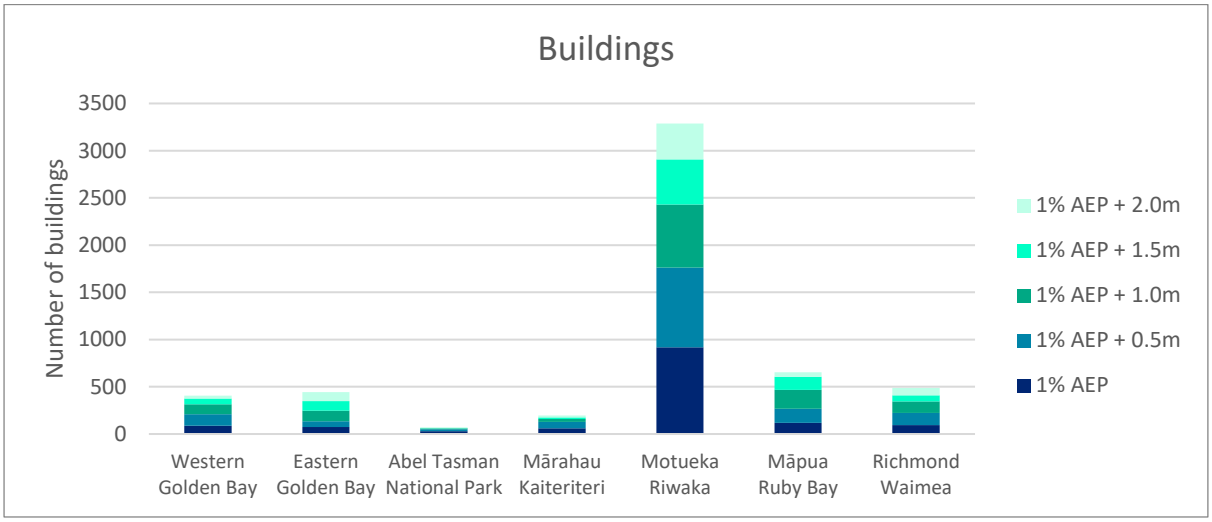


Figure 33: Buildings Vulnerable to Coastal Inundation and Sea Level Rise

Of a total 37,300 buildings (excluding buildings <60m^2) in the district, approximately 5,500 buildings (15%) are vulnerable to coastal storm inundation and sea level rise (Figure 33). The Motueka – Riwaka coastal cell has by far the largest number of vulnerable buildings, with a count of approximately 3,300 buildings. Māpua – Ruby Bay has the second largest building count (approximately 650 buildings), while the remaining coastal cells all have less than 500 vulnerable buildings.

Although Richmond is the District's largest town, the urban area is largely outside the extent of the mapped coastal storm inundation and sea level rise scenarios and hence building vulnerability is significantly less than Motueka.

3.5.4 Coastal Assets

Council's coastal assets provide many public benefits including provision of access to the coastal environment, coastal protection, navigational aids, and ports. Key Council-owned coastal assets include:

- 2 wharves (Riwaka and Māpua)
- 4 jetties (Best Island, Mārahau, Māpua, Motueka, Moutere Inlet)
- 20 water access ramps
- 40 individual permanent coastal protection sites protecting 27 km of coastline
- Aids to navigation (structures)

- Ports
  - Port Māpua
  - Port Motueka (part-owned by Talley's Group who is a major operator at the port)
  - Port Tarakohe (port and marina owned and operated by Council as a commercial operation)

Some previously Council-owned structures have been transferred to other parties. Examples include the wharf at Motueka which was transferred to the Talley's Group and other minor structures such as wharves/jetties at Collingwood, Milnthorpe, Waitapu and Mangarakau which currently belong to the Department of Conservation. There are also a number of wharves and jetties which are privately owned and maintained, as well as some which are in derelict condition and have no clear owner. Refer to the Council's Coastal Assets Activity Management Plan 2018 for further information.

There are significant lengths of coastal protection structures along the Tasman Bay and Golden Bay coastline, built on both public and private property, to protect land, buildings and/or community assets (roads, parks and reserves, etc.) from coastal erosion and/or inundation. These structures include intermittent rock, bunds or stopbanks, revetments or walls, and causeways, and are built from a variety of materials. Some protection structures are Council owned and maintained, while others have been privately erected and not all of them have formal authorisation. Areas where such coastal protection structures are present are shown on the Council's coastal hazards map viewer.

Coastal storm inundation and sea level rise will have a significant impact on many existing coastal assets simply because of the nature of their design, purpose and location (either in the sea, or adjacent to the sea). Over time, rising sea levels will cause coastal assets to be overtopped by waves or high tides more regularly as the location of 'every day tides' (mean high water spring mark) moves inland. How individual beach profiles respond to rising seas and inundation, and subsequent coastal erosion (or accretion) will depend on a number of factors such as beach materials, slope, or the presence of coastal assets including coastal protection structures.

3.5.5 Community Facilities

As well as open space and reserve land and the coastal assets described above, there are various community facilities that are vulnerable to sea level rise and coastal storm inundation. These include:

- 5 schools
  - Māpua School
  - Motueka Steiner School and Kindergarten (High Street and Wallace Street campuses)
  - Motueka South School
  - St Peter Chanel School
  - Riwaka School
- 3 fire stations
  - Māpua Fire Station
  - Kaiteriteri Fire Station
  - Collingwood Fire Station
- 1 hospital (Motueka Community Hospital)
- 1 museum (Collingwood)
- 15 play grounds

There will be other community facilities and services valued by the community that are not included in this list that may also be vulnerable to sea level rise and coastal storm inundation.

3.5.6 Closed Landfills and Contaminated Land

Coastal storm inundation and rising sea levels may have implications for the District's closed landfills and contaminated land sites that are located near the coast, as detailed below.

Closed Landfills

The Council provides a comprehensive range of waste management and minimisation services across the District, including five resource recovery centres located at Richmond, Mariri, Tākaka, Collingwood and Murchison. The locations of the Richmond and Mariri resource recovery centres are within the 1% AEP coastal storm inundation and 2.0 m sea level rise, and the Tākaka centre is located directly adjacent to the mapped extent of this scenario.

There are 23 known sites within the District that were historically used to dispose of various materials including domestic waste, rubble, farm waste, scrap metal, etc. Some of these sites were natural low points in the topography and have been filled by previous landowners or used as community tips, others have been historic fly tipping locations and at some sites the material has been deposited above the natural ground level. Since the disposal of material at these sites has ceased, each of the sites have been covered and restored to varying degrees and are classified as 'closed landfills'. Eight of these closed landfills are located within the coastal environment, including the closed landfill at the Richmond Resource Recovery Centre, Robinson Rd (Mariri), Aporo Rd (Tasman), Kina Beach Road, Old Wharf Rd (Motueka), Lodder Lane (Riwaka), Pah Point (Kaiteriteri), and Rototai (Tākaka). Refer to the Council's Waste Management and Minimisation Activity Management Plan 2018 for further information.

Coastal hazards and sea level rise have the potential to expose old landfills at the coast. Nationally, there is an increasing awareness of the environmental risk they pose, particularly after a March 2019 flood event exposed an old Fox Glacier landfill and spread rubbish for kilometres along the West Coast. A multi-agency response to nationally identify risks from old landfills is underway, led by the Ministry for the Environment and regional councils in collaboration with Local Government New Zealand and the Department of Conservation (RNZ, 2019).

Locally, the closed landfill site at the Richmond Resource Recovery Centre has had coastal protection for the last 30 years, and additional rock was placed in early 2017 to repair and improve existing rock protection around the centre and the Great Taste Trail, which runs around the perimeter (Gee, 2019).

Contaminated Land

In addition to closed landfills, it is acknowledged that there may be other contaminated land sites in the District which could pose an environmental risk if exposed by coastal storm inundation and sea level rise. An example is the former Fruitgrowers' Chemical Company site at Māpua, which was formally New Zealand's worst contaminated site due to pesticide pollution. The site was remediated in 2008 and Council's monitoring of the site is ongoing.

3.5.6 Summary: Built Environment

- By the nature of their design and location, some 3 waters assets will be more vulnerable to coastal storm inundation and sea level rise than others. Motueka – Riwaka coastal cell has the largest amount of Council-owned water supply (pipes, water meters and restrictors), wastewater (pipes, manholes, pump stations) and stormwater (pipes, manholes, outlets) assets that are vulnerable. This is in part due to the size of the town and the amount of low-lying vulnerable urban land (as identified in the economy value domain), and also amount of Council

services available in comparison to other smaller coastal communities with limited service provision (particularly some Golden Bay and Abel Tasman National Park communities). If Motueka had full water supply reticulation (there is a large reliance on private residential bores), the length of pipe under land vulnerable to coastal storm inundation and sea level rise would be considerably greater.

- A total 160 km of roads (Council roads and NZTA state highway) across Tasman and Golden Bays are vulnerable to coastal storm inundation under a 2.0 m sea level rise. The Motueka – Riwaka coastal cell has the largest proportion of vulnerable roads, including approximately 12 km of State Highway 60. The vulnerability of some sections of the road will have wider impacts in some locations where the road network provides the key connection between communities which themselves may not be exposed to coastal storm inundation and sea level rise. For example, the Collingwood-Puponga Road services a number of communities, and is compromised in places during present day storm surges, and will be affected by rising sea levels.
- The Motueka – Riwaka coastal cell has by far the largest number of buildings (e.g. homes, tourist accommodation, businesses, community facilities) that are vulnerable to coastal storm inundation and sea level rise, with a count of approximately 3,300 buildings. Māpua – Ruby Bay has the second largest building count (600 buildings), while the remaining coastal cells all have less than 500 vulnerable buildings. Although Richmond is a larger town than Motueka, the Richmond urban area is largely outside the extent of the mapped coastal storm inundation and sea level rise scenarios.
- Coastal storm inundation and sea level rise will have a significant impact on many existing coastal assets simply because of the nature of their design, purpose and location (either in the sea, or adjacent to the sea). Examples include wharves, jetties, water access ramps and ports (at Māpua, Motueka, Tarakohe). Over time, rising sea levels will cause coastal assets to be overtopped by waves or high tides more regularly as the location of 'every day tides' (mean high water spring mark) moves inland.
- Coastal storm inundation and rising sea levels may have implications for the District's eight closed landfills that are located within the coastal environment. There may be other contaminated land sites in Tasman and Golden Bays which could also pose an environmental risk if exposed by coastal storm inundation and sea level rise.

4. Risk Assessment for Coastal Cells

The MfE 2017 Guidance states that risk is widely understood to mean *likelihood x consequences*, and this meaning is embedded in standards documents worldwide. It recommends that for New Zealand coastal areas, risk can be evaluated by focusing on 'consequences' (e.g. direct damage, affected number of people, indirect disruption and reduction in services, etc.) under different sea level rise and coastal hazard scenarios (the 'likelihood').

Section 3 identifies elements at risk that may be vulnerable to coastal storm inundation and sea level rise either now in the present day or in the future. The results consider what is currently vulnerable versus what may be exposed in the future as a result of rising sea levels. The information is presented under the four value domains: human, natural environment, economy and built environment.

This section draws on the information presented in Section 3 to provide an overall assessment of risk for each coastal cell in Tasman Bay/Te Tai o Aorere and Golden Bay/Mohua. As a first pass risk

assessment, this report provides a qualitative understanding of risk, highlighting key vulnerabilities. It stands to reason that the more elements at risk that are vulnerable to coastal storm inundation and sea level rise, the greater the financial impact in terms of repairs or replacement costs.

This section also identifies where there is a need for detailed risk assessment(s) at a local level. Detailed risk assessments include quantifying the vulnerability of elements at risk in terms of financial costs, ability to cope with the impacts or rate of change, and consequences, etc. Both NIWA and Local Government New Zealand have already completed work at a national scale to quantify replacement values for buildings, facilities and infrastructure that may be exposed to a range of sea level rise scenarios up to 3.0 meters (refer to Section 1.6 for more information and links to reports). It is also noted that through the development of the Aorere ki uta Aorere ki tai - Tasman Environment Plan, cost benefit analysis will need to be undertaken to assess the economic implications of any options for future planning provisions in response to coastal hazards and sea level rise.

4.1 Richmond – Waimea

The Richmond – Waimea coastal cell includes Richmond, the Waimea Plains, Waimea Inlet and islands. Although Richmond is the District's largest town, the residential area is sufficiently inland and elevated such that it is largely outside the extent of the mapped coastal storm inundation and sea level rise scenarios. Consequently, the risk to the population, buildings (including homes), community facilities and infrastructure is generally low in comparison to the size of the town.

Richmond's key urban vulnerability is its business and industrial zoned land, which includes over 100 hectares in the Lower Queen Street mixed business and industrial (rural and light) areas, and the Beach Road light industrial estate. Coastal storm inundation events will impact some of these properties with varying degrees of damages and costs for individual businesses as seen during ex-tropical cyclone Fehi. The ongoing and increasing vulnerability of this business and industrial zoned land to sea level rise has significant longer-term implications for the District in terms of employment and economic wellbeing and Council should consider the need to undertake a detailed risk assessment for this area.

Parts of the coastal margin of the Waimea Inlet either side of the Waimea River mouth are presently protected from a present day 1% AEP coastal storm inundation by a system of constructed and maintained tide banks (largely in private ownership). These tide banks primarily protect a mixture of low-lying pastoral farming with some minor areas of the business and industrial land.

Areas of open space, recreation and conservation zoned land within the coastal margins of the Waimea Inlet, Best Island, Rough Island, Moturoa/Rabbit Island are vulnerable to the present day 1% AEP storm-tide. Progressive sea level rise over time will exacerbate the vulnerability of these land uses in these locations, in addition to causing new risks in other locations within the coastal cell. Rising sea levels will affect horticultural land on the Waimea Plains, and an extensive area of Council-owned exotic (plantation) forestry on Moturoa/Rabbit Island (767 hectares).

Vulnerable 3 waters infrastructure assets are located in or near the Waimea Inlet. This includes the Bell Island wastewater treatment plant (jointly owned with Nelson City Council) and the water trunk mains pipe connecting the Waimea treatment plant to Richmond (mains pipe runs along the coastline) and connecting to Māpua (mains pipe runs across Moturoa/Rabbit Island and under the estuary channel to Māpua). The vulnerability of these assets increases incrementally with rising sea levels over time, and may result in damage, indirect disruption or a reduction in services. This will

have a significant impact on households and businesses within the Richmond-Nelson and Māpua areas that rely on this servicing.

4.2 Māpua – Ruby Bay

The Māpua – Ruby Bay coastal cell includes the Māpua coastal plain, Ruby Bay and the adjoining rural residential and rural areas. It is the second smallest of the seven identified coastal cells.

The Māpua and Ruby Bay urban area covers much of the coastal plain and extends up onto the surrounding hills. The coastal plain is relatively low-lying and significant areas are vulnerable to the present day 1% AEP storm-tide. This vulnerability will increase with rising sea levels. This area is predominately residential houses, with some tourist accommodation, businesses and community facilities (including the Māpua Wharf precinct). This coastal cell has the second largest vulnerability (after Motueka – Riwaka) for a number of urban elements at risk, including: population (approximately 990 people), residential zoned land (56 hectares), and buildings (approximately 650) including Māpua School and Māpua Fire Station. This coastal cell contains the largest area of vulnerable rural residential zoned land (64 hectares).

Council assets and infrastructure located in this area include 3 waters infrastructure, roads, open space and recreation zoned land (such as the Māpua water front park) as well as the wharf structure itself and a number of buildings in the wharf precinct. The Council owned and now remediated former Fruit Growers' Chemical Company site at Māpua extends to the present day shoreline and will be subject to rising sea levels and site groundwater levels into the future.

The Māpua and Ruby Bay coastal cell has 24 archaeological sites located within the area potentially impacted (based on NZAA ArchSite records). The number of vulnerable sites is relatively evenly distributed across the range of mapped sea level rise scenarios. This contrasts with the coastline elsewhere in Tasman and Golden Bays where a greater proportion of these vulnerable archaeological sites are concentrated in the area exposed to a present day 1% AEP storm-tide.

Coastal hazards are well documented in Māpua – Ruby Bay, including the effects of ex-tropical cyclones Drena (1997), Yali (1998) and Fehi (2018). Through TRMP Plan Change 22 (operative in 2015), the Council worked with the community to address coastal processes and the hazards they pose. Consequently, the future expansion of the town has been provided for away from the low-lying coastal land between Māpua and Ruby Bay. The TRMP identifies a 'Coastal Risk Area' which provides a number of planning controls including prohibiting further subdivision and the construction of no new habitable buildings in this area in recognition of the coastal hazards present. The 2017 MfE Guidance identifies this plan change as an example of current good practice planning for coastal hazards.

4.3 Motueka – Riwaka

The Motueka – Riwaka coastal cell includes Tasman, Kina Peninsula, Moutere Inlet, Motueka, and Riwaka. Areas of Motueka and Riwaka are very low-lying and consequently this coastal cell has by far the largest number of elements vulnerable to coastal storm inundation and sea level rise compared to the other coastal cells, as detailed below.

Motueka has the largest area of residential zoned land (e.g. houses) and associated Council infrastructure assets which are vulnerable. Many of the vulnerable elements at risk are largely urban in nature, including: estimated population (4,970 people), residential zoned land (225 hectares), buildings (approximately 3,300 buildings), and business and industrial zoned land (52 hectares) including Port Motueka. There are also four schools and a community hospital located in this coastal cell which are vulnerable.

There is a significant amount of Council's 3 waters infrastructure located within this coastal cell in comparison to other areas. Much of this vulnerable infrastructure is located within the eastern Motueka township area, and to a much lesser extent the other local centres within the coastal cell. Many Motueka residents rely on private water supplies, typically groundwater bores tapping the relatively shallow unconfined aquifer, and there will be implications (e.g. functionality, damage or costs) for these private supplies which are not captured in this assessment. If the Motueka reticulated water supply were to be extended to the properties with a private supply, the number of vulnerable Council water supply assets would be considerably greater.

Given the low-lying topography and rising sea levels, Council has started to consider asset resilience. A new water treatment plant is planned to be located outside the mapped extent of the coastal storm inundation and sea level rise scenarios on Parker Street. Council is also considering longer-term options for relocating the Motueka wastewater treatment plant inland.

Over 60 km of roads within this coastal cell are vulnerable to coastal storm inundation and sea level rise. State Highway 60, which accounts for approximately 12 km of these vulnerable roads, provides access to and through Motueka and Riwaka. State Highway 60 where it approaches Tākaka Hill (and connects Golden Bay) crosses low-lying land, particularly through Riwaka. Any damage or inability to use these roads as a result of inundation will have significant impacts, not only to Motueka and Riwaka, but also on the wider Golden Bay community.

The Motueka – Riwaka coastal cell has the largest number of archaeological sites, historic buildings and protected trees that are vulnerable, in comparison to other cells. There are 54 archaeological sites in the mapped extent of the present day 1% AEP coastal storm inundation and 94 sites in the 1% AEP coastal storm inundation and 2.0 m sea level rise scenario (based on NZAA ArchSite records). There are a total of 10 heritage buildings and 74 protected trees that are vulnerable. Te Āwhina Marae, located on Pah Street, is located outside the mapped extent of the coastal storm inundation and sea level rise scenarios.

There is over 180 hectares of open space and recreation zoned land within this coastal cell that is vulnerable, with the greatest proportion being vulnerable to the present day 1% AEP coastal storm-tide (129 hectares). Conservation zoned land in this coastal cell largely comprises the Motueka sandspit. The sandpit currently affords some neighbouring coastal properties a level of natural protection against wave action and coastal storm inundation. However, the presence of the sandspit should not be relied upon, given that it is a dynamic feature and it is not known how it will respond to future storm events and rising sea levels. Historically the sandspit has dissipated and reformed periodically.

The Motueka and Riwaka plains are extensively used for horticulture, and pasture of varying quality. Of this, 564 hectares of horticultural land and 595 hectares of pasture are vulnerable to the 1% AEP coastal storm inundation and 2.0 m sea level rise scenario. Some of the horticultural land in the Riwaka area is very low-lying and is presently protected by a system of privately constructed and maintained tide banks and pumping stations. Progressive sea level rise over time will exacerbate the vulnerability of these land uses in these locations, in addition to causing new risks in other locations within the coastal cell.

There are a number of closed landfills located near the coast at Robinson Road in Mairiri, Aporo Road in Tasman, Kina Beach Road and Old Wharf Road in Motueka, and Lodder Lane in Riwaka. These closed landfills may be vulnerable to coastal storm inundation particularly as sea level rise.

Overall, the vulnerability of the Motueka – Riwaka coastal cell to coastal storm inundation and sea level rise is significant in comparison to other coastal cells and Council should consider the need to undertake a detailed risk assessment for this area.

4.4 Mārahau - Kaiteriteri

The Mārahau - Kaiteriteri coastal cell is the smallest of the coastal cells and includes Mārahau, Otuwhero Inlet, Kaiteriteri, Stephens Bay and Tapu Bay. Low-lying coastal areas that may be vulnerable to coastal storm inundation and sea level rise include pockets of residential and rural residential zoned land (16 hectares), business and industrial zone - which includes tourist services (27 hectares), and rural zoned land (116 hectares). Council infrastructure (where provided) is also vulnerable within these zones. The road leading into Mārahau provides access to a number of residential properties, tourism-related businesses, and the southern entry to Abel Tasman National Park. In its current location, sections of the Mārahau Road will be impacted by sea level rise.

The vulnerability of these areas and Council infrastructure will increase over time with rising sea levels resulting in damage, indirect disruption and a reduction in services. Additionally, there will also be implications (e.g. functionality, damage or costs) for private infrastructure assets which are not captured in this assessment. For example, rising sea levels will affect the already high water table at Mārahau which will impact on private stormwater and wastewater systems.

Open space and recreation zoned land (48 hectares) and conservation zoned land (18 hectares) are vulnerable, with two thirds of this being vulnerable to the present day 1% AEP coastal storm-tide.

Approximately 200 buildings in this coastal cell are vulnerable to coastal storm inundation and sea level rise. These buildings include homes, tourist accommodation, business premises and community facilities.

Te Tau Ihu iwi have a strong association and high levels of occupation within the area, particularly at Mārahau where more recent discoveries of cultural finds during new development highlights this. There are 54 archaeological sites (based on NZAA ArchSite records) within this coastal cell which are vulnerable. Over half of these archaeological sites are vulnerable under the present day 1% AEP coastal storm-tide scenario.

4.5 Abel Tasman National Park

Given the national park status, the Abel Tasman National Park coastal cell has minimal development and infrastructure servicing in comparison to the other coastal cells. The National Park has over 1000 hectares of indigenous vegetation land cover which is vulnerable.

The key elements at risk are also the key qualities that draw both residents and tourists alike to visit and stay in the National Park every year. Much of the National Park is within the TRMP conservation zone although there are some small areas of open space and recreation zoned land. These zones nominally extend to the mean high water spring tide mark and hence will be affected by the 1% AEP storm-tide and sea level rise. The extent land that is affected within the National Park is tempered somewhat by the steep rocky nature of much of the coastline and limited low-lying coastal areas.

Some of these low-lying areas may include sections of the Abel Tasman Coast Track and assets (including huts) administered by the Department of Conservation (refer to Section 1.6). A total of 72 buildings are vulnerable, with nearly three quarters of these being within the 1% AEP coastal storm inundation and 0.5 m sea level rise scenario. These buildings are a mixture of homes/holiday homes, tourist accommodation and businesses.

Based on NZAA ArchSite records, there are 25 archaeological sites in this coastal cell, with the bulk of these vulnerable to the present day 1% AEP coastal storm-tide scenario.

As noted for the Mārahau – Kaiteriteri coastal cell, the southern entrance to the National Park is via the road to Mārahau. In its current location, the Mārahau road will be affected by predicted sea level rise which will affect access to both Mārahau and the National Park.

The National Park is a significant draw card to the Tasman District. The vulnerability of elements at risk, both now and in the future with rising sea levels, will have a direct impact on landowners and businesses operating in and near the Park, as well as broader social, cultural, environmental and economic impacts for the District as a whole.

4.6 Eastern Golden Bay

The Eastern Golden Bay coastal cell includes the coastal communities of Rangihaeata, Waitapu, Rototai, Pōhara, Ligar Bay, Tata Beach, and Wainui Bay.

The predominant coastal land cover within this coastal cell is grassland (950 hectares), typically associated with pastoral farming. Nearly half of this land cover is vulnerable during the present day 1% AEP coastal storm-tide event. This is also reflected in the TRMP planning zones with just over 1000 hectares of rural zoned land vulnerable to the 1% AEP coastal storm-tide and 2.0 m sea level rise.

This coastal cell also includes open space and recreation (130 hectares), and conservation (18 hectares) zoned land is vulnerable. As these areas are largely located along the existing coastal margins and river mouths, including the Tākaka golf course, two thirds of this zoned land is vulnerable to the present day 1% AEP coastal storm-tide scenario.

Development has historically taken place along the coastal margin and in some areas like Pōhara, Ligar Bay and Tata Beach, is now extending inland on to the adjacent hills. There are pockets of low-lying and vulnerable rural residential (51 hectares) and residential (29 hectares) zoned land located within Eastern Golden Bay. A number of elements at risk which are largely located within urban and peri-urban areas include: population (approximately 670 people), buildings including homes, tourist accommodation and business premises (443 buildings), protected trees (15), heritage buildings (3), and business and industrial zoned land including Port Tarakohe (3 hectares). The vulnerability of these elements at risk incrementally increases with sea level rise.

Onetahua Marae, located on Pōhara Valley Road, is located outside the mapped extent of the coastal storm inundation and sea level rise scenarios. Based on NZAA ArchSite records, there are 54 archaeological sites that are vulnerable, with over two thirds of these sites being vulnerable to the present day 1% AEP coastal storm-tide event.

There are limited 3 waters infrastructure in some of the coastal communities within Eastern Golden Bay, with some of these assets being low-lying and vulnerable to coastal storm inundation and sea level rise. In addition to Council owned assets, it is recognised that there will be implications (e.g. functionality, damage or costs) to privately owned and maintained 3 waters assets which are not captured in this assessment.

Approximately 22 km of roads are vulnerable to a 1% AEP coastal storm-tide and 2.0 m sea level rise. A low-lying section of SH 60 where it approaches the Tākaka River bridge (around Waitapu) will become increasingly vulnerable to predicted sea level rise which will have significant implications for accessing Western Golden Bay. Additionally, low-lying sections of Abel Tasman Drive near the coast are vulnerable, which will affect access to areas along the coast including Pōhara, Port Tarakohe,

Ligar Bay, Tata Beach and Wainui Bay. Any damage or inability to use these roads as a result of inundation will have significant impacts on the wider Golden Bay community, in terms of access to homes, businesses, recreational and special places, and broader social, cultural, environmental and economic impacts for the district as a whole.

4.7 Western Golden Bay

The Western Golden Bay coastal cell includes the coastal communities of Patons Rock, Parapara, Milnthorpe, Collingwood, Pākawau, and Puponga. The area is largely rural land with strip development adjacent to the coast, with some low-lying development located on sandspits (e.g. Totara Avenue, Parapara and Collingwood).

A total of 938 hectares of grassland, typically associated with pastoral farming, is vulnerable to coastal storm inundation and sea level rise, with over 40% (389 hectares) of this being vulnerable to a present day 1% AEP coastal storm-tide event. This pattern is reflected in the TRMP rural zones, which include just over 1,100 hectares of vulnerable zoned land. A total of 487 hectares of coastal indigenous vegetation is also vulnerable.

There are pockets of low-lying and vulnerable rural residential (22 hectares), residential (32 hectares), and business and industrial (5 hectares) zoned land. Other elements at risk which are largely located in urban and peri-urban areas include: population (approximately 615 people), buildings including homes, tourist accommodation, business premises and community facilities (407 buildings), and 10 protected trees.

Based on NZAA ArchSite records, the Western Golden Bay coastal cell has the second largest number of known archaeological sites that are vulnerable to sea level rise. The majority of sites are vulnerable to the present day 1% AEP coastal storm-tide event (47 sites), and a further 28 sites are vulnerable to a 2.0 m sea level rise. Five heritage buildings are vulnerable to a 1% AEP coastal storm inundation and 0.5 m sea level rise.

There is minimal 3 waters infrastructure in coastal locations within Western Golden Bay, with only Collingwood having all three services present. In addition to Council owned assets there will be some low-lying privately owned and maintained 3 waters assets that have not been captured in this assessment.

Approximately 32 km of roading is vulnerable to a 1% AEP coastal storm-tide and 2.0 m sea level rise. In particular, the Collingwood-Puponga Road services a number of communities and is compromised in places during present day storm-tide events. The vulnerability of the road will increase as sea levels rise. Any damage or longer-term inability to use this road as a result of inundation will have significant impacts on the Western Golden Bay community, in terms of access to homes, businesses, recreational and special places, and broader social, cultural, environmental and economic impacts for the district as a whole.

Collingwood's central business district (CBD) is located on a short, stubby sandspit. This area is low-lying and vulnerable to the present day 1% AEP coastal storm-tide and rising sea levels, in addition to other natural hazard processes such flooding from the Aorere River and coastal accretion/erosion. The CBD includes a mix of homes, businesses and community facilities including the fire station and museum. The vulnerability of this area to natural hazards may result in physical damage or disruption, which will affect business and service provision (including economic impacts) that are relied upon for Collingwood and the wider Western Golden Bay area.

5. Risk Assessment Summary

This section provides an overall summary of the key vulnerable elements at risk to coastal storm inundation and sea level rise within Tasman Bay/Te Tai o Aorere and Golden Bay/Mohua. There will be social, cultural, economic and environmental implications for individuals, landowners, iwi, businesses, and the wider community around the entire coastline.

The District is largely rural in nature with a mix of primary production land uses and indigenous vegetation. Land cover data for Tasman and Golden Bays show grassland covering the largest area (44%, 3,650 hectares) that is vulnerable to a 1% AEP coastal storm inundation and rising sea levels. Much of this land is high producing grassland associated with pastoral farming and located in Golden Bay/Mohua, the Waimea Plains, and to a lesser extent, Motueka. Coastal indigenous vegetation is the second largest land cover (25%, 2,106 hectares) and is primarily located within Abel Tasman National Park (50% or 1,052 hectares) and along the Golden Bay/Mohua coastline (37%, 770 hectares). Smaller areas of urban land (11%, 941 hectares), exotic forestry (10%, 857 hectares) and horticultural land (9%, 760 hectares) are also vulnerable. The TRMP land use zonings reflect a similar pattern with large areas of vulnerable rural zoned land, and in comparison small areas of residential, rural residential and business industrial zoned land.

Horticultural land, exotic forestry and grassland will be able to recover from one-off coastal storm inundation events. However, the impact of sea level rise will lead to these land covers being encroached by the sea and every day high tides. How coastal indigenous vegetation, as well as coastal species, respond and adapt to rising sea levels will depend on a number of factors.

Based on the NZAA's ArchSite records, there are 350 archaeological sites that are vulnerable to coastal storm inundation and sea level rise, with the bulk of sites being exposed to the present day 1% AEP coastal storm-tide. These sites are spread right around Tasman Bay/Te Tai o Aorere and Golden Bay/Mohua, which is not unexpected given the rich history of human occupation along the coastline. There will be other sites of significance to iwi (including archaeological sites) that are located in vulnerable coastal areas and are not captured within this assessment. The Ministry for the Environment has identified that nationally there is very limited research on the sensitivity of cultural heritage sites, including Māori cultural heritage, to climate change (MfE, 2020).

Of the District's open space and reserve zoned land, 51% (717 hectares) is vulnerable to coastal storm inundation and rising sea levels, with the greatest proportion being vulnerable to the present day 1% AEP coastal storm-tide. Council has an extensive network of open spaces and reserves along the margins of the coast, estuaries and river mouths which provide for a range of functions and values. How Council responds to asset damage and repair costs (e.g. to signage, play and picnic equipment, plantings, toilets and other facilities), in addition to the loss of land and associated values will need to be strategically managed.

Pockets of urban development are located along the coast, built on coastal plains, sandspits and small peninsulas, in bays. Urban development also includes parts of larger towns such as Motueka. While urban land accounts for a small area of the District overall, its vulnerability to coastal storm inundation and sea level rise will be significant. The cost to either repair damages, replace or relocate over the longer term will be high given that urban land includes homes, businesses and industry, community facilities and infrastructure.

An estimated population of 8,400 people are located in low-lying coastal areas in Tasman and Golden Bays that are vulnerable to coastal storm inundation and sea level rise. Approximately 60% are located in the Motueka – Riwaka coastal cell (approximately 4,970 people), followed by 12% of

people in the Māpua – Ruby Bay coastal cell (approximately 990 people). These two cells account for nearly three quarters of the people located in vulnerable coastal areas across Tasman and Golden Bays.

Although Richmond is the District's largest town, much of the urban area is sufficiently inland and elevated so that it is largely outside the extent of the mapped coastal storm inundation and sea level rise scenarios. However, there are a number of vulnerable elements at risk in low-lying areas adjacent to the Waimea Inlet or on islands in the Inlet. These elements at risk include a large area of business and industrial land; recreation land, conservation land, forestry land, water supply/wastewater pipe infrastructure on Moturoa/Rabbit Island, the Bell Island wastewater treatment plant; cultural, recreation and conservation values in and around the inlet and islands; and horticulture and pastoral farming on the Waimea Plains.

Māpua and Ruby Bay's exposure to coastal hazards is well known and documented. TRMP Plan Change 22 has enabled future expansion of urban development away from the low-lying coastal plain and introduced a number of planning controls to start the process of building longer-term community resilience. This risk assessment has identified that Māpua – Ruby Bay has the second largest residential area with associated services (after Motueka) which are vulnerable to coastal hazards and sea level rise.

Areas of Motueka – Riwaka are very low-lying and consequently this coastal cell has by far the largest number of vulnerable elements at risk in comparison to other coastal cells. Motueka is the largest town in the District that will be affected by coastal storm inundation and sea level rise. The cost to either repair damages, replace or relocate over the longer term will be significant given the extensive elements at risk within the town including people, homes, tourism accommodation, businesses and industries, Port Motueka, community facilities, and infrastructure. Any damage or inability to use roads (particularly SH 60) as a result of coastal hazards will have significant impacts, not only to Motueka and Riwaka, but also on access to Golden Bay. Low-lying horticultural and pastoral land around Motueka and Riwaka is also vulnerable, and an inability to use this land in the longer term will have economic impacts. To better understand the vulnerabilities of the Motueka – Riwaka coastal cell, in combination with other inundation hazards (e.g. river flooding, stormwater, groundwater), the Council should consider undertaking a detailed risk assessment to help inform future work programmes.

The vulnerable elements at risk within the Abel Tasman National Park coastal cell are those key qualities that draw both residents and tourists alike to visit and stay in the Park every year. A large area of indigenous vegetation land cover is vulnerable, as well as some houses/holiday homes and Department of Conservation assets (Abel Tasman Coast Track, huts, etc.). Road access to the Park via Mārahau will also be affected by rising sea levels.

There are a number of similarities between Mārahau – Kaiteriteri, Western Golden Bay and Eastern Golden Bay in relation to their vulnerabilities to coastal storm inundation and sea level rise. These coastal cells are comprised of some of the District's smaller settlements with local centres dotted along the coast. Vulnerable elements at risk include homes, tourism accommodation, businesses (including Port Tarakohe), and some community facilities. Low-lying Council 3 waters infrastructure is vulnerable, where it is provided. Additionally, privately owned and maintained 3 waters assets (which is not included in this assessment) may also be vulnerable. The road network is critical to access these coastal communities, and there are sections of roads which are either vulnerable to the present day 1% AEP coastal storm inundation event or future rising sea levels.

Coastal storm inundation and sea level rise will have significant impacts on many existing coastal assets (e.g. wharves, jetties, ports, boat ramps, coastal protection structures, etc.) simply because of the nature of their design, purpose and location (either in the sea, or adjacent to the sea). Over time, rising sea levels will cause such coastal assets to be overtopped by waves or high tides more regularly as the height and location of 'every day tides' (mean high water spring mark) rises and moves inland respectively.

There are eight closed landfills located at or near the coast which could pose an environmental hazard if exposed by costal storm inundation and sea level rise. The Ministry for the Environment is leading work at a national level to identify risks old landfills at the coast pose (RNZ, 2019). There may be other potentially contaminated land at the coast which may also present an environment hazard if exposed.

6. Bibliography

Cudby, R. (2020). *Tasman Resource Management Plan Efficiency and Effectiveness Evaluation - Chapter 10: Significant Natural Values and Historic Heritage*. Tasman District Council Report.

Gee, S. (2019). *Historic landfill sites across Nelson Tasman at risk of sea level rise*. Stuff. Viewed on 10/08/2020. (https://www.stuff.co.nz/national/113925019/historic-landfill-sites-across-nelson-tasman-at-risk-of-sea-level-rise).

Jackson, N.O. (2019). *Tasman District Council and Wards – Population, Household and Dwelling Projections 2018-2053*. Report Commissioned by Tasman District Council. Natalie Jackson Demographics Ltd. Tairua. November.

Manaaki Whenua Landcare Research. Viewed on 30/10/2020 (https://lris.scinfo.org.nz/layer/104400-lcdb-v50-land-cover-database-version-50-mainland-new-zealand/).

Ministry for the Environment. 2019. *Arotakenga Huringa Āhuarangi: A Framework for* the *National Climate Change Risk Assessment for Aotearoa New Zealand*. Wellington: Ministry for the Environment.

Ministry for the Environment. (2020). *National Climate Change Risk Assessment for Aotearoa New Zealand: Main report – Arotakenga Tūraru mō te Huringa Āhuarangi o Āotearoa*: *Pūrongo whakatōpū*. Wellington: Ministry for the Environment.

New Zealand Archaeology Association (NZAA). Viewed on 30/10/2020 (http://www.archsite.org.nz/About.aspx).

RNZ. (2019). *Plan launched to identify landfill risks after West Coast washout*. Radio New Zealand. Viewed on 10/08/2020 (https://www.rnz.co.nz/news/national/398523/plan-launched-to-identify-landfill-risks-after-west-coast-washout)

Tasman District Council Activity Management Plans 2018, available at www.tasman.govt.nz:

- Water Supply
- Wastewater
- Stormwater
- Transportation
- Waste Management and Minimisation

White, I., *Waikato University*; Belinda Storey, *Victoria University of Wellington*; Sally Owen, *Motu Research*; Rob Bell, *NIWA*; Frances Charters, *University of Canterbury*; Blair Dickie, *Waikato Regional Council*; Liam Foster, *Opus*; Emily Harvey, *M.E. Research*; James Hughes, *Tonkin and Taylor*; Suzi Kerr, *Motu Research*; Judy Lawrence, *Victoria University of Wellington*; Kepa Morgan, *Ngāti Mākino Iwi Authority*; Gavin Palmer, *Otago Regional Council*; Noel Roberts, *WaterNZ*; Adolf Stroombergen, *Infometrics*; and Christian Zammit, *NIWA*. (2017). Climate Change and Stormwater and Wastewater Systems. (Motua Note #28, The Deep South National Science Challenge).

Appendix 1: Elements at Risk

Value domain	Elements at risk	Data Owner/Source	Description
Human	Population	TDC estimate	• Estimate based on number of buildings and calculated average occupancy rates
	Archaeological Sites	New Zealand Archaeology Association	• Recorded sites located in the Tasman District, as at July 2020 (www.archsite.org.nz)
	Heritage Buildings	Tasman District Council – Tasman Resource Management Plan (TRMP) Schedule 16.13A	• Heritage Building: NZ Historic Places Trust Register • Heritage Buildings: Tasman District Council Register
Natural environment	Protected Trees	Tasman District Council - TRMP Schedule 16.13B	
	Open Space and Recreation	Tasman District Council - TRMP zones	• Recreation Zone • Open Space Zone
	Conservation	Tasman District Council - TRMP zone	• Conservation Zone
	Significant Natural Areas	Tasman District Council - TRMP Schedule 18.1A	
	Coastal Indigenous Vegetation	Land Cover Database (LCDB5) Manaaki Whenua - Landcare Research	• Indigenous forest • Broadleaf indigenous hardwoods
Economy	Land Cover	Land Cover Database (LCDB5) Manaaki Whenua - Landcare Research	Urban • Built-up Area (settlement) • Surface Mine or Dump • Urban Parkland/Open Space Horticulture • Orchard, Vineyard or Other Perennial Crop • Short-rotation Cropland Exotic Forest • Deciduous Hardwoods • Exotic Forest • Forest - Harvested Grassland • High Producing Exotic Grassland

Value domain	Elements at risk	Data Owner/Source	Description
			• Low Producing Grassland
	Land use zoning	Tasman District Council - TRMP zones	<u>Residential</u> • Residential zone • Residential Closed zone • Residential Coastal zone <u>Rural Residential</u> • Rural Residential zone • Rural Residential Serviced Zone • Rural Residential Closed Zone • Rural Residential deferred Residential Zone • Rural 3 Zone <u>Rural</u> • Rural 1 Zone • Rural 1 Closed Zone • Rural 1 Coastal Zone • Rural 1 deferred Light Industrial Zone • Rural 1 deferred Residential Zone • Rural 1 deferred Rural Residential Serviced Zone • Rural 1 deferred Tourist Services Zone • Rural 2 Zone • Rural 2 deferred Residential <u>Business and Industrial</u> • Commercial Zone • Central Business Zone • Mixed Business Zone • Light Industrial Zone • Heavy Industrial Zone • Heavy Industrial Closed Zone • Rural Industrial Zone • Tourist Services Deferred Residential Zone

Value domain	Elements at risk	Data Owner/Source	Description
Built Environment	Water Supply	Tasman District Council asset information	• treatment plants • pipes • meters and restrictors
	Wastewater	Tasman District Council asset information	• treatment plants • pipes • manholes • pump stations
	Stormwater	Council asset information	• Pipes • manholes • outlets
	Roads	Tasman District Council asset information	• Council roads • State Highway (NZTA)
	Buildings	LINZ NZ Building outlines dataset	• All buildings with a foot print larger than 60m^2 • GIS Metadata information dated 2019, sourced from LINZ website November 2020.
	Community Facilities	Tasman District Council information	
	Coastal Assets	Tasman District Council asset information	• boat ramps • wharves/jetties • coastal protection structures • ports
	Closed Landfills and Contaminated Land	Tasman District Council asset information	

Appendix 2: Community Identified Values

The table below shows how the community values that were discussed as part of the Coastal Management Project's first round of community engagement in 2019 fits within the framework of 'value domain' and 'elements of risk' which have been assessed within this report.

Community Identified Values	Corresponding Value Domain	Corresponding Elements at Risk
Homes	Economy	Land cover (urban) and land use zoning (residential and rural residential)
	Built environment	Buildings
Businesses	Economy	Land cover (urban) and land use zoning (all zones)
	Built environment	Buildings
Holiday accommodation (e.g. campgrounds, holiday homes)	Economy	Land cover (urban) and land use zoning (all zones)
	Built environment	Buildings
Farming and horticultural land	Economy	Land cover (horticulture, exotic forestry, grassland) and land use zoning (rural residential and rural)
Lifeline infrastructure (e.g. power, roads, utilities infrastructure)	Built environment	Water, wastewater and stormwater infrastructure, roads, coastal assets (ports)
Sacred places and sites (e.g. urupā, wāhi tapu)	Human	Archaeological sites
Beach access (e.g. footpaths, steps, boat ramps)	Built environment	Coastal assets (all)
Access to and enjoyment of sandy beaches at high tide	Natural environment	Land use zoning (open space and reserves, conservation)
	Human	Not assessed, 'enjoyment' is a qualitative assessment
Coastal parks and reserves (e.g. recreation and picnic areas)	Natural environment	Land use zoning (open space and reserves, conservation)
Mahinga kai/wild food species and the ability to harvest them	Natural environment	Significant natural areas, land use zoning (all), land cover
	Economy	Land cover (all) and land use zoning (all)
	Human	Not assessed, traditional and cultural associations with harvesting mahinga kai/wild food is a qualitative assessment
Coastal species and habitats	Natural environment	Protected trees, land use zoning (all), significant natural areas, land cover
Natural character and coastal landscapes	Natural environment	Not assessed, although noted that values associated with some elements at risk will contribute to wider natural character and coastal landscape values
Appeal of the area as a nice place to live	All	Not assessed, although noted that values associated with some elements at risk will contribute to the appeal of the area (a qualitative assessment)