MITCHELL DAYSH

GREATER WELLINGTON

PREPARING COASTAL COMMUNITIES FOR CLIMATE CHANGE

Assessing coastal vulnerability to climate change, sea level rise and natural hazards

June 2019

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EXECUTIVE SUMMARY

Greater Wellington Regional Council (**Greater Wellington**) and the territorial authorities across the Wellington region recognise the significance of climate change for the region and the importance of understanding the vulnerability of the region's coastal communities to climate change. As a result, the Wellington Region Climate Change Working Group (**WRCCWG**) was established in 2017 and, in early 2018, agreed to progress towards a better understanding of this issue. A sub-group of the Wellington Region Climate Change Working Group was established to:

> *"Prepare a specific plan for a community-led coastal adaptation planning process for the region with governance, resourcing, timeline, regional buy-in and recommended priority areas to be submitted for agreement by councils and the Mayoral Forum prior to commencement of the programme."*

The sub-group agreed that there was merit in assessing the vulnerability of the coastal communities to the long-term effects of climate change. It determined that a high-level coastal vulnerability assessment, with mapping of the coastal units, was an appropriate first step in the process of the larger project. It was further agreed that this high-level assessment would be a desktop exercise, using existing data available from various sources.

This report identifies the high-level vulnerability of different coastal areas within the Wellington region to sea level rise and associated coastal inundation and erosion hazards. This report does not provide individual property data, but rather enables identification of the broad coastal areas that are most vulnerable to climate change effects.

Identifying these communities assists the territorial authorities and Greater Wellington to establish a process for working with the affected communities to develop long-term adaptive strategies. Once the general approach to the community-led process has been agreed, more detailed assessments for each area will be carried out with the communities.

As acknowledged throughout this report, Wellington City Council is excluded from this assessment as it has already carried out a vulnerability assessment of the coastal areas of the city[1].

This report provides the results of a regional scale high-level vulnerability assessment that considers the following effects of climate change induced hazards:

- Coastal inundation (storm surge flooding and sea level rise of 1m) with a 1% annual exceedance probability (**AEP**), which corresponds to the current 100-year return period event;
- Tsunami inundation (modelled by Greater Wellington) for mapping units and elements at risk; and
- Coastal erosion.

1 Wellington City Council - Sea Level Rise Options Analysis 2013

For the purposes of this assessment, Mitchell Daysh worked with Dr Iain Dawe at Greater Wellington to analyse the data sets and map the coastal units. Dr Dawe has also provided the technical coastal science input. The coastal areas of the region have been divided into 34 units (excluding Wellington City) to reflect the different coastal communities and distinctive areas of the coast and to enable a relative comparison of vulnerability. Each geographic unit was assessed in accordance with 24 criteria grouped into 9 areas: Community, Business, Roads, 3 Waters, Lifelines Infrastructure, Māori and cultural, Ecological, Erosion, and Civil Defence and Emergency Management. Each criterion was measured using data primarily sourced from the territorial authorities, Greater Wellington databases, and Statistics New Zealand.

This report shows that the issue of sea level rise impacts will be the most significant in the highly populated settlements along the region's coast and especially where key commercial or industrial areas are included, such as Porirua and Petone/Seaview. The two most vulnerable coastal units for each district in the Wellington region were found to be:

- Paraparaumu and Raumati (Kāpiti Coast District);
- Porirua and Pauatahanui (Porirua City Council);
- Seaview and Petone (Hutt City Council); and
- Palliser and Whakataki (for the joint Wairarapa Districts).

The findings from this assessment will be helpful in guiding decision-making on progressing the development of community-led coastal adaptation strategies across the region. Whilst this report shows that certain coastal communities are more vulnerable than others to a future sea level rise and storm surge scenario, it is important to note that any of the coastal communities identified in this assessment could find themselves at risk of a coastal hazard event. This report highlights that across the region each territorial authority with coastal communities has areas that are vulnerable to the effects of climate change and in line with the MfE Guidance[2], it is recommended that areas with both high risk and vulnerability should be priority planning areas[3].

[2] Coastal Hazards and Climate Change Gudiance for Local Goverment, Ministry for the Enviornment, December 2017

[3] While this report's focus is on vulnerability, the geographic area captured within each of the coastal units shows the areas which are of high risk to coastal hazards and sea level rise.

1. INTRODUCTION

Greater Wellington Regional Council (**Greater Wellington**) and all of the territorial authorities in the region have agreed to work collaboratively to address climate change issues.

On 7 August 2017, a report titled 'Climate change and variability - Wellington Region'[4] was presented by NIWA to a meeting of the Chair of Greater Wellington and the mayors of the city and district councils in the region. At the same meeting, a proposal was made by Greater Wellington to establish a Wellington Region Climate Change Working Group (**WRCCWG**) made up of elected members from all councils in the region, to enable a regional response to climate change issues. Since then, a sub-group of the WRCCWG has been established to focus on climate change and coastal hazards for the region. The sub-group and staff working group representing the councils has determined that the first step in addressing coastal hazards is to complete a high-level region-wide assessment of the vulnerability of the coastal communities to sea level rise and coastal hazards. Identifying the coastal communities most at risk will assist in designing a process for working with the affected communities to develop long-term adaptive strategies.

1.1 BACKGROUND

1.1.1 Natural Hazards in the Wellington Region

The Wellington Region has one of the most physically diverse environments in New Zealand, with a mix of hill country areas and lowlands, large flood plains, and 500km of coastline, all of which is bisected by faults[5]. It is also one of the most populous regions, with over 500,000 residents. With the exception of geothermal activity, the Wellington Region is subject to all of the natural hazards included in the Resource Management Act **(RMA)** (1991) definition[6]. Consequently, the Greater Wellington communities are affected by a wide range of natural hazards.

Much of the region's 500kms of coastline is already subject to coastal erosion and inundation and the various councils and communities are already dealing with the existing coastal hazards.

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[4] The full report, a summary document and explanatory video are all available at www.gw.govt.nz/climatechange

[5] Wellington Regional Policy Statement (April 2013)

[6] Natural hazard means any atmospheric or earth or water related occurrence (including earthquake, tsunami, erosion, volcanic and geothermal activity, landslip, subsidence, sedimentation, wind, drought, fire, or flooding) the action of which adversely affects or may adversely affect human life, property, or other aspects of the environment

People's actions, including ongoing development in areas at high risk from natural hazards, can cause or increase the risk from natural hazards in some circumstances. For example, seawalls or groynes can cause localised erosion of the adjacent shoreline. Stopbanks and seawalls can also create a sense of security and encourage further development, increasing the extent and value of the assets at risk.

Climate change effects have the potential to increase both the frequency and magnitude of natural hazard events that already occur in the region. This will put pressure on existing infrastructure such as stormwater systems and flood protection work. Higher rainfall may also result in higher rates of sedimentation at river mouths and in estuaries, increasing the flood risk in those areas by raising the base level of the river bed.

A major consequence of climate change is sea level rise. An analysis of the long-term trends of local sea level using the tide gauge in Lambton Harbour shows that since the early 20th Century, sea level has been rising at 2.23mm/yr. This amounts to over 0.26m of sea level rise since records began. As the tide range for much of the region is around 1m or less, this amounts to a significant increase in the tide range over the past 125 years. When looking to the future of sea level rise, the Ministry for the Environment Guidance for Local Government – Coastal Hazards and Climate Change acknowledges that deriving a single value for sea level rise is difficult "*given the wide range of sea level trajectories into next century*". The MfE Guidance, however, states that over the next 100 years sea level rise of 1m is "*virtually certain*".

The natural hazards associated with a rise in sea level are coastal erosion and inundation. Sea level rise will put increasing pressure on a beach's ability to absorb the impacts of storm events. If a beach is unable to retreat landward in response to sea level rise, due to development and infrastructure such as roads and houses, it will result in the loss of the beach. As the shoreline adjusts, sediment will be redistributed around the coast and may cause shorelines to form new orientations. Beaches that are currently stable may begin to erode as the shoreline adjusts to a higher water level, while those that are currently eroding may experience an increased rate of retreat.

Other impacts we may expect with a rise in sea level include impeded stormwater drainage; longer periods of surface flooding in low lying coastal areas due to sea levels pushing up groundwater levels; and increased river flooding due to higher water levels at river mouths restricting flood outflows. A higher base mean sea level will also contribute to increasing vulnerability to storms and tsunami[7]. Adapting to the risks of coastal hazards

[7] The geological causes of tsunamis (such as earthquakes, underwater landslides and volcanic activity) will not be directly affected by climate change, however, the coastal effects of tsunamis will be altered somewhat by sea level rise (http://www.mfe.govt.nz/sites/default/files/media/Climate%20Change/coastal-hazards-guide-final.pdf) In addition, the region's coastline is also vulnerable to tsunami. Tsunamis are rare events and tsunami hazard mapping has been undertaken by Greater Wellington. The Wellington Region Emergency

and increased erosion and flooding caused by climate change presents a significant challenge for the region over the coming decades.

Each of the territorial authorities across the Wellington Region have been addressing the issues facing their coastal communities from coastal hazards through their planning documents. Porirua City, for example, is currently preparing a new district plan and as part of that process it has been consulting with its community on how best to plan for future development in and around the coast[8].

1.1.2 National Guidance

The New Zealand Coastal Policy Statement[9] requires Local Authorities to consider and plan for coastal hazards risks. Under Policy 24 (1), Local Authorities are required to:

> *"Identify areas in the coastal environment that are potentially affected by coastal hazards (including tsunami), giving priority to the identification of areas at high risk of being affected. Hazard risks, over at least 100 years, are to be assessed…"*

Storms, wave direction and energy, beach and cliff profiles and geomorphology, and the presence of manmade structures, all contribute to a changing coastline which can present a variety of hazards for those that live, work and play in the coastal environment.

In 2015, the Parliamentary Commissioner for the Environment released a report *Preparing New Zealand for rising seas: Certainty and Uncertainty"*. In this report, the Commissioner notes:

> *"It is certain that the sea is rising and will continue to do so for centuries to come. But much is uncertain – how rapidly it will rise, how different coastal areas will be affected, and how should we prepare."*

She also commented:

> *"Homes are much more than financial equity. Such zoning and any regulations that follow must be based on a fair process and technical assessments that are both rigorous and transparent."*

Management Office (WREMO) co-ordinates civil defence and emergency management services across the region and have prepared maps showing the potential Tsunami hazard zones and evacuation zones. WREMO work with the territorial authorities to educate and prepare the public in the region about what to do in such a rare event.

[8] It is important to note that this vulnerability assessment is not part of the statutory planning process that various councils are currently following to look at planning outcomes for coastal communities for the next 10 years. This report differs from statutory plans (such as district and regional plans) in that it identifies how vulnerable communities will be over a longer (100 year) timeframe and focuses on the various components of vulnerability, rather than focusing on the response to the risk.

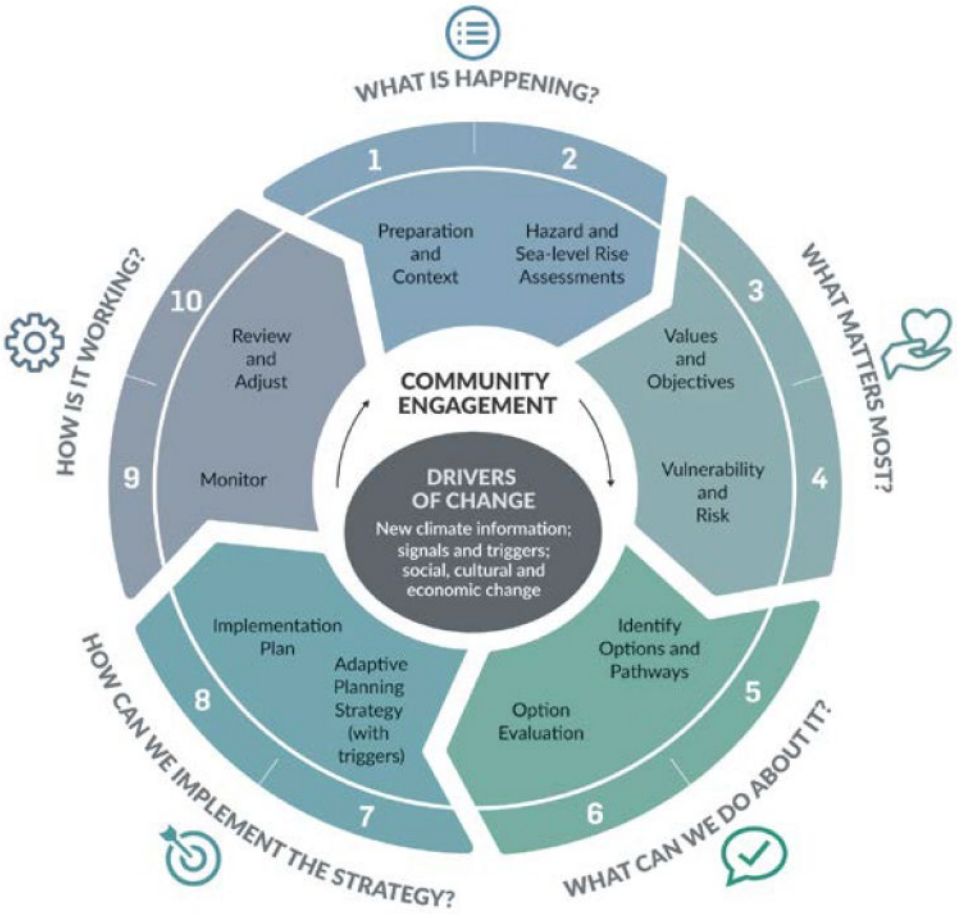
[9] New Zealand Coastal Policy Statement 2010 (NZCPS 2010)

The MfE Guidance was first prepared in 2008 and updated in 2017. It sets out how local authorities should respond to planning for their coastal hazards. The aim of the guidance is to assist decision-makers to manage and adapt to the increased coastal hazard risks posed by climate change and sea level rise. It highlights the impacts that climate change is expected to have on coastal hazards, and it details the impacts that are expected through sea level rise, storm surge, wind and waves. It has been updated to include:

- the latest science and legislation;
- information from the Parliamentary Commissioner for the Environment's 2015 report on sea level rise;
- feedback from stakeholders;
- Advances in hazard, risk and vulnerability assessments;
- Collaborative approaches to community engagement;
- A step by step approach to assessing, planning and managing the increasing risk facing coastal communities.

This guidance is structured around a 10-step framework. The vulnerability assessment step that is the focus of this report is Step 4 of 10 in the decision cycle recommended by MfE (shown by **Figure 1 below**).

Figure 1: The MfE 'Decision Cycle' referred to in 'Coastal hazards and climate change guidance for local government' (2017)



It is anticipated that this process will be iterative and will start in different places, depending on the:

- problem;
- stage you are currently at in the decision cycle;
- drivers of change, such as new climate change information;
- changes needed in triggers (decision points) for switching adaptation pathways; and
- social, cultural and economic change.

The MfE Guidance refers to two definitions of 'vulnerability', one from the Intergovernmental Panel on Climate Change **(IPCC)** and one from an engineering and asset context. The IPCC defines vulnerability as "*the predisposition of a human or biological system to be adversely affected. It thus includes the concepts of sensitivity to*

harm and lack of capacity to effectively cope and adapt"[10]. The second definition of vulnerability is used to mean "*fragility" where, for a given hazard exposure, it is a measure of the physical or financial integrity of buildings, infrastructure or individual assets to perform under hazard exposure and the extent of resulting disruption or reduced levels of service to people*"[11].

The MfE Guidance notes that vulnerability assessments are used worldwide to assess the impacts and implications of coastal climate changes to enable identification of the most vulnerable communities through:

- aggregating information and projections for assessing impacts, implications and adaptive capacity across a wide range of socio-economic, social, environmental and infrastructure domains at national, regional, district and city scales;
- as an input to comparative ranking processes for the parts of the region that are subject to the consequences of the climate change for coastal areas;
- as an input for prioritising identified exposed areas (including sectors, services, settlements or environments) at "*high risk of being affected*" (Policy 24, NZCPS 2010) and areas of existing development "*likely to be affected by coastal hazards*" (Policy 27, NZCPS 2010); and
- as an input for identifying adaptation thresholds for the onset of coastal hazard risk consequences, or triggers for activating decision points when adaptation settings need to be reviewed and adjusted.

The vulnerability assessment in Step 4 is grouped together with risk assessments. Across the Wellington region, considerable work has been undertaken over the years to determine the coastal hazard risk of communities through coastal hazard reports and analysis. The territorial authorities of the region also deal with this risk by identifying where key infrastructure is subject to coastal erosion or inundation. Much of the urban coastal areas of the region are currently subject to some coastal erosion and inundation and are affected by storm surges from time to time.

This assessment is focused on the identification of which coastal areas are most vulnerable to the effects of climate change, including sea level rise and coastal inundation and erosion. This vulnerability assessment relies on existing coastal hazard data and analysis that has previously been completed and subsequently focuses on using various

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[10] IPCC. 2014c. Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part B: Regional Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. VR Barros, CB Field, DJ Dokken, MD Mastrandrea, KJ Mach, TE Bilir, M Chatterjee, KL Ebi, YO Estrada, RC Genova, B Girma, ES Kissel, AN Levy, S MacCracken, PR Mastrandrea, LL White (eds). Cambridge: Cambridge University Press: 688. Retrieved from http://ipcc.ch/report/ar5/wg2/.

[11] NIWA and GNS Science. (n.d). RiskScape. Retrieved from www.riskscape.org.nz (November 2016).

data sources in order to identify the level of vulnerability to these future effects. It is therefore important to distinguish that this is a high-level vulnerability assessment. It is anticipated that more detailed risk assessments will be undertaken as part of the adaptation strategies that are planned to follow this initial assessment.

1.1.3 The Wellington Region Climate Change Working Group Recommendations

The WRCCWG is a non-statutory group which was formed in 2017 with its purpose being *"to provide a forum via which councils and mana whenua from across the Wellington Region can network, discuss issues, share information and where appropriate, achieve a consistent approach across all jurisdictions on climate change mitigation (reducing greenhouse gas emissions) and adaptation (preparing for impacts such as sea level rise, drought and enhanced natural hazards effects)"*. The WRCCWG has representation from each of the territorial authorities; the regional council; and three mana whenua representatives from Ara Tahi. Please refer to the Terms of Reference in **Appendix A** for more information about the WRCCWG.

The WRCCWG considered that it is appropriate to follow the updated MfE Guidance, and the example of the Hawke's Bay Clifton to Tangoio Coastal Hazards Strategy 2120, in moving forward with a community-led coastal adaptation programme for the Wellington region. In summary, the example from the Hawkes Bay is a strategy developed through a community-led process initiated in 2014 and governed by a joint iwi and council committee of elected representatives, supported by a joint Technical Advisory Group (**TAG**). The TAG included planners, engineers and coastal specialists from each council, along with various consultants. The comprehensive and empowering stakeholder engagement process utilised to create the Clifton to Tangoio Coastal Hazards Strategy ensured that the Strategy was a locally-led response to a very complex global issue. More information about the Clifton to Tangoio Coastal Hazards Strategy can be found on the website[12].

The Sub-group of the WRCCWG agreed that a high-level coastal vulnerability assessment, with mapping of the coastal units, was an appropriate first step in the process. In order to facilitate this process effectively, a Reference Group was set up comprising staff from Mitchell Daysh, Greater Wellington and several territorial authorities.

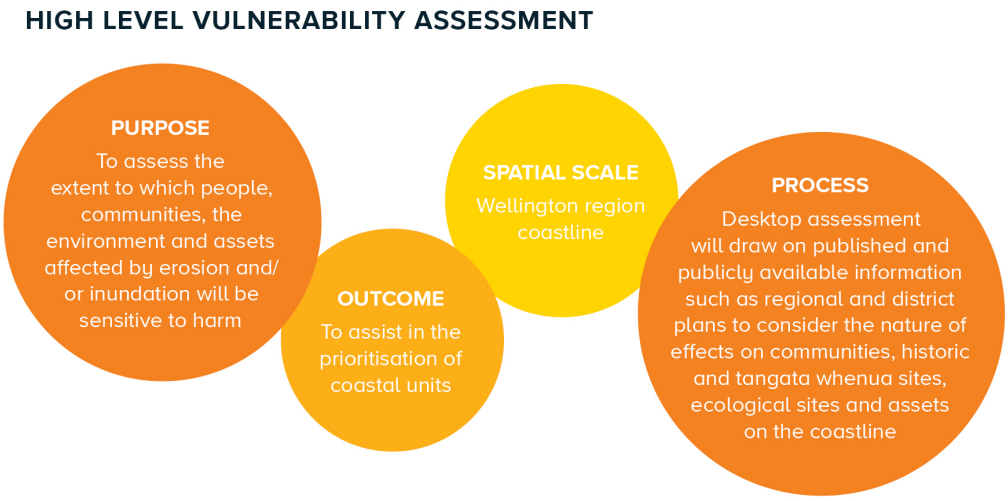
[12] https://www.hbcoast.co.nz/

2. SCOPE AND PURPOSE

The purpose of the assessment is to identify at a high-level, with the use of existing datasets, how vulnerable particular coastal communities are to the effects of climate change in terms of sea level rise and increased coastal inundation and erosion.

Identifying these communities will assist the territorial authorities and Greater Wellington in designing a process for working with the affected communities to develop long-term adaptive strategies.

Figure 2: Components of the Vulnerability Assessment



As shown in **Figure 2** above, the purpose of the vulnerability assessment is to identify which coastal units are most vulnerable to the impacts of sea level rise and coastal climate change hazards in the Wellington region through assessing the extent to which people, communities, the environment and assets are affected by coastal hazards and what their capacity to cope and adapt is. This assessment will enable the region to proceed towards planning and prioritising ways to work with the coastal communities to develop strategies to adapt to the changing climate conditions and effects of sea level rise.

2.1 WELLINGTON CITY

It is important to note that Wellington City Council (**Wellington City**) is a member of the WRCCWG and supports the regional approach to addressing the issues facing the region in relation to climate change and sea level rise, however, they are not included in the analysis of this high-level vulnerability assessment. The reason for this is that Wellington City has already completed a detailed report looking at the risk and vulnerability of the City

to sea level rise. "Sea Level Rise Options Analysis" report[13], prepared by Tonkin & Taylor (June 2013), assesses the impact of sea level rise on each of the coastal suburbs of the city and establishes:

- A range of values, across the four well-beings (cultural values, economic values, environmental values, social values), in areas affected by a range of sea level scenarios;
- The scale of cost of a number of possible response options for mitigating the risks from each sea level rise scenario; and
- Tools for use by Wellington City and the public to interact with sea level rise scenarios and exposure response options.

The report provided Wellington City with information on their vulnerable communities (in a suburb by suburb basis) and the Council has now progressed this work with a community-led coastal adaptation strategy in Makara. With the willingness of the local Makara community, after they were affected by ex-Cyclone Gita, Wellington City Council established a panel of Makara Beach Community representatives in 2018. A community endorsed plan was developed, setting out how the Makara beach community can prepare for, and adapt to, sea level rise, storm surges and coastal erosion.

[13] https://wellington.govt.nz/~/media/services/environment-and-waste/environment/files/61579-wcc-sea-level-rise-options.pdf

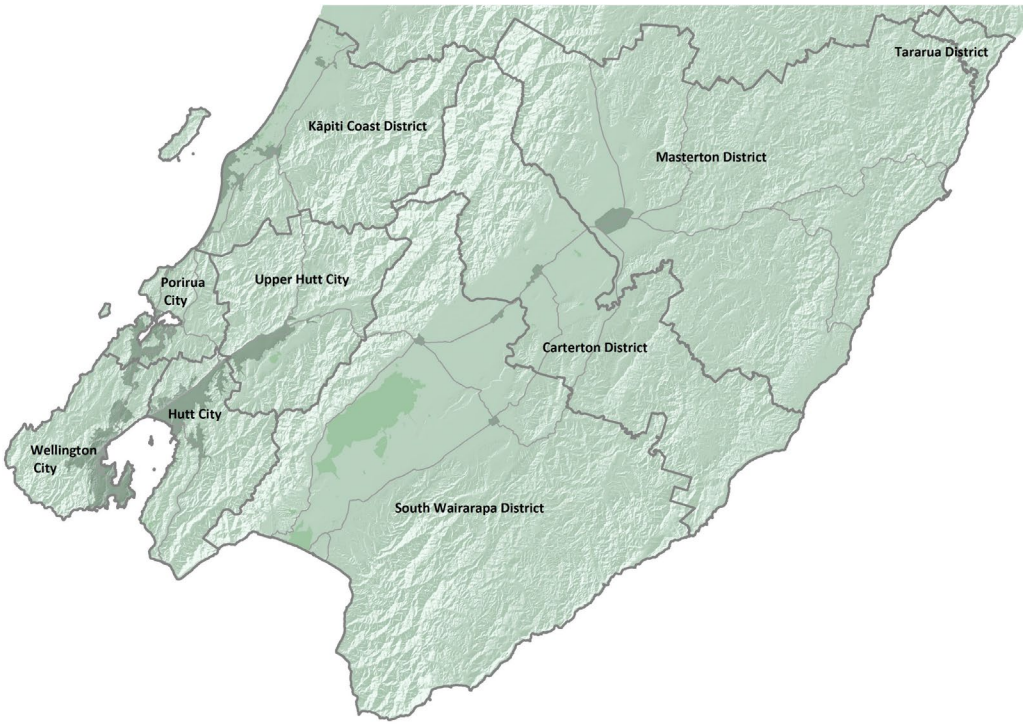
3. WELLINGTON REGIONAL CONTEXT

The Wellington region has 500km of coastline and includes the following territorial authorities with coastlines and coastal communities:[14]:

- Kāpiti Coast District Council
- Porirua City Council
- Wellington City Council
- Hutt City Council
- South Wairarapa District Council
- Carterton District Council
- Masterton District Council

Figure 3 shows the boundary lines of each territorial authority within the Wellington region.

Figure 3: Territorial authorities within Wellington region



The following section from the Regional Policy Statement for the Wellington region (**RPS**) (2013) provides initial context to the different parts of the Wellington coastline:

[14] Note: Upper Hutt City Council is the only territorial authorities within the Wellington region with no coastline. A small part of the Tararua District is also in the region but none of their coastline is included.

"From Ōtaki around to the Wairarapa, the region's coastal environment contains significant habitats for a wide variety of plants and animals, and also provides for a diverse range of activities. The character ranges from the largely rural Wairarapa coast to the highly developed urban areas around Wellington and Porirua Harbours. The Kāpiti coast has sandy beaches and is experiencing rapid population growth. The south coast is rugged, yet because of its proximity to the Hutt Valley and Wellington city, is a popular place to visit.

Tangata whenua have strong links with the coastal environment, value its mauri, its mana and all it offers. The region's identity and significance to Māori are closely intertwined with the coastal environment. Many sites within the coastal environment are associated with iwi histories, traditions and tikanga. For example, mahinga mātaitai (places to gather seafood) and tauranga waka (canoe landing places). Some of these sites embody spiritual and sacred values, such as urupa (burial places). Of particular concern to tangata whenua is the discharge of human and other wastes into the coastal environment, which causes a loss of mauri of the water body.

As well as its cultural importance, the coastal environment is important to the regional community for recreation and general enjoyment. It is also the location of many activities and structures that require a coastal location. Significant infrastructure – such as Centreport, the Cook Strait cable and other transmission infrastructure, and several state highway and rail corridors – is located in the coastal environment. This infrastructure is essential to the community's economic and social wellbeing."

The **RPS** outlines that due to Wellington's geography and population, our communities are affected by a wide range of natural hazards. Noted as the three potentially most damaging and costly natural hazard events that can occur in the region are earthquakes, flooding and tsunami. Other natural hazards that are identified as having more localised and frequent impacts include; flooding and inundation, landslips and coastal erosion. **Figure 4** below shows the flooding effects of the May 2015 storm on the Wharemauku Stream, Kapiti.

Figure 4: Photograph showing the degree of flooding experienced on the Wharemauku Stream in Kāpiti[15]

The **RPS** notes that people's actions, including mitigation measures and ongoing development in areas at high risk from natural hazards can cause or increase the risk from natural hazards. There are some different coastal defence or coastal mitigation structures located along the Wellington coastline, as well as sections which have natural coastal edges. **Figure 5** and **Figure 6** below show different examples of coastal defence structures in the Wellington region. In addition, **Figure 7,** further below, shows the issues facing a subdivision located in the Wairarapa due to the increasing erosion occurring on the land.

[15] Photo taken May 2015.

Figure 5: Photograph showing groynes and stepped riprap at Te Kopi, Wairarapa[16]

Figure 6: Photograph showing the Paekakariki seawall in Kāpiti[17]

[16] Photo taken 2005.

[17] Photograph taken 2013.

Figure 7: Photograph showing the high erosion risk of a subdivision in Whatarangi, Wairarapa[18]

The coastal areas of the Wellington region are diverse and hold special value to iwi. Development has occurred along parts of the coastline with coastal settlements, towns and cities. This coastline is also valued for its amenity and recreation opportunities. Each of the different parts of the coastline will be impacted by the effects of climate change. Protecting the values of the coastal margins will be an important factor in future decisions around mitigation of these effects or looking towards options for adaptation.

3.1 REGIONAL AND DISTRICT PLANNING DOCUMENTS

The preservation of natural character in the coastal environment is a matter of national importance in the Resource Management Act 1991. Regional councils are charged with controlling the use of land for the purpose of the avoidance or mitigation of natural hazards (section 30 RMA 1991), whilst territorial / district councils are charged with controlling the effects of the use of land for the avoidance or mitigation of natural hazards (section 31 RMA 1991).

[18] Photo taken 2005.

The regional and district planning documents that are relevant to consider when assessing the effects of climate change comprise:

- Wellington Regional Policy Statement[19]
- Greater Wellington Proposed Natural Resources Plan[20]
- Wellington Region Natural Hazards Management Strategy[21]
- Wellington City District Plan[22]
- Kāpiti Coast District Plan[23]
- Hutt City District Plan[24]
- Porirua District Plan[25]
- Wairarapa District Plan[26]

3.1.1 Wellington Regional Policy Statement

The **RPS** sets out the framework and priorities for resource management in the Wellington region.

The RPS recognises that in relation to built infrastructure on the coastal edge:

> "*seawalls alter sediment movement along beaches and estuaries and can cause erosion problems in some areas and deposition problems in others*" and that "*the implications of sea level rise on the coastal environment also need to be considered when looking at the potential effects of new subdivisions, use and development*".

The regionally significant issues specified in the RPS include consideration of:

1. Effects of natural hazards;
2. Human actions which can increase risk and consequences from natural hazards; and
3. Climate change which will increase both the magnitude and frequency of natural hazard events.

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19 http://www.gw.govt.nz/assets/Plans--Publications/Regional-Policy-Statement/Regional-Policy-Statement-full-document.pdf

20 http://www.gw.govt.nz/assets/Plans--Publications/Regional-Plan-Review/Proposed-Plan/Proposed-Natural-Resources-Plan-for-the-Wellington-Region-July-2015.pdf

21 http://www.gw.govt.nz/assets/council-publications/Draft-Natural-Hazards-Management-Strategy-15-09-16.pdf

22 https://wellington.govt.nz/your-council/plans-policies-and-bylaws/district-plan

23 https://www.kapiticoast.govt.nz/Your-Council/Planning/District-Plan-Review/appeals-version---proposed-district-plan/

24 http://www.huttcity.govt.nz/Your-Council/Plans-publications-and-bylaws/District-Plan/

25 https://poriruacity.govt.nz/your-council/city-planning-and-reporting/district-plan/operative-district-plan/

26 https://mstn.govt.nz/documents/council-plans/wairarapa-combined-district-plan/

The relevant objectives relating to natural hazards include:

- Objective 19: The risks and consequences to people, communities, their businesses, property and infrastructure from natural hazards and climate change effects are reduced
- Objective 20: Hazard mitigation measures, structural works and other activities do not increase the risk and consequences of natural hazard events
- Objective 21: Communities are more resilient to natural hazards, including the impacts of climate change, and people are better prepared for the consequences of natural hazard events

These objectives then link to the corresponding policies and methods, which include advising on inappropriate subdivision and development in areas of high risk from natural hazards (in district and regional plans), minimising the risks and consequences of natural hazards, and minimising the adverse effects of hazard mitigation measures.

This vulnerability assessment is consistent with the objectives relating to natural hazards, particularly Objective 21. In order for communities to become resilient to natural hazards, those communities first need to understand their vulnerabilities before they can prepare and have a plan to respond to the impacts of climate change and coastal hazard events.

3.1.2 Greater Wellington Proposed Natural Resources Plan

The Greater Wellington Proposed Natural Resources Plan **(PNRP)** was released in June 2015. The management of natural hazards, including flooding hazard and coastal erosion, was identified as a key natural resource management issue across the region. It acknowledges that a risk-based approach to natural hazards means taking account of the likelihood of natural hazard events occurring, the vulnerability and exposure of the site, the severity and consequences of potential hazard events, and the costs and benefits of acting and not acting.

The objectives in the PNRP are largely similar to the objectives in the RPS, however, Objective O21 also gives direction that "*inappropriate use and development in high hazard areas is avoided*" and Objective O22 states that "*hard engineering mitigation and protection methods are only used as a last practicable option*".

Two methods for achieving the above objectives in the PNRP are Method 3 – the Wellington regional hazards management strategy, and Method 4 – that Greater Wellington will develop regional guidance for managing the impacts from sea level rise.

This assessment is seen as a key step in enabling the management of impacts of sea level rise. In addition, the GIS database utilised in the PNRP has been utilised in this assessment through the mapping of the Wellington region's biodiversity and mana whenua sites.

3.1.3 Wellington Region Natural Hazards Management Strategy

The Wellington Region Natural Hazards Management Strategy (2017) provides a regional framework to inform planning documents on the management of natural hazards. It is paired with an implementation and action plan designed to carry out the objectives in the strategy in order to ensure that there is a consistent understanding of the types of natural hazards and options for their management. The aim of the strategy is that "*the communities of the Wellington region work together to understand and reduce risks form natural hazards to survive and thrive in a dynamic world*".

The key actions which are proposed in this document include:

- Working together as councils – to strengthen the multi-council approach of working collaboratively and collectively;
- Develop and maintain a regionally consistent information base about natural hazards (and community exposure to them);
- Develop, fund and co-ordinate agreed natural hazards research programmes;
- Provide for ongoing community resilience through education and information about long-term risk reduction across a range of natural hazards; and
- Encourage better understanding of risks by all stakeholders on an ongoing basis.

It is considered that this assessment provides a regionally consistent information base about coastal hazard vulnerability, and that this provides the necessary information to work towards improving those coastal communities' resilience.

3.1.4 Wellington City District Plan

Wellington City has a District Plan that has been operative since 2000. This document acknowledges that the natural environment has values that are important to Wellington, but some natural processes pose a hazard to Wellington and must be considered in line with the principles of emergency management. The flood hazard area is noted on the maps, which means the area of land that would be inundated during a 1 in 100-year flood event.

Objective 4.2.10 states that Wellington City aims to avoid or mitigate the adverse effects of natural and technological hazards on people, property and the environment. Policy 4.2.10.1 looks to identify hazards that pose a significant threat. Policy 4.2.10.3 states that Wellington City will "*ensure that buildings and structures in Residential Areas do not exacerbate natural hazards, particularly flood events, or cause adverse impacts on natural coastal processes*". Policy 4.2.10.4 also directs that Wellington City will 'ensure that critical facilities are located to avoid, remedy or mitigate the adverse effects of hazards' and Policy 4.2.10.5 states that Wellington City will 'ensure that the adverse effects of

hazards on the natural environment arising from a hazard event are avoided, remedied or mitigated'.

Rules included in the District Plan are aimed at protecting the coast, such as through the Residential Coastal Edge overlay. There is a design guide which applies within the Residential Coastal Edge to acknowledge the fundamental character attributes of the areas. The Residential Coastal Edge covers the pockets of residential development dotted around the coast from Point Jerningham, into Evans Bay, around the Miramar Peninsula, and along the south coast to Owhiro Bay.

3.1.5 Kāpiti Coast District Plan

Kapiti Coast District Council ("**Kapiti Coast District**") notified the Proposed District Plan (PDP) in 2012 and originally this included coastal hazard provisions. In 2014 and 2017 the Council formally withdrew all of their coastal hazard provisions from the Proposed District Plan. Some of the Operative District Plan provisions relating to coastal hazards still apply in relation to development along the coast.

3.1.6 Hutt City District Plan

Hutt City Council ("**Hutt City**") has a District Plan (City of Lower Hutt District Plan) which has been operative since 2004.

The District Plan acknowledges that Lower Hutt is susceptible to a number of natural hazards due to its location and wide variety of physical features such as steep hills, coastal areas and faults. Four main types of natural hazards are present and provided for in the plan, which includes flood and coastal hazards. The presence of human settlement close to an active fault, steep hills, coastal areas and rivers has increased the potential impacts of these hazards.

Objective 1.10.11 aims to avoid or mitigate the vulnerability and risk of people and development to natural hazards. The corresponding policy aims:

- To limit the scale and density of development in areas where the risk of flooding is medium to high
- To manage areas susceptible to coastal hazards such as coastal erosion and sea level rise

The District Plan also acknowledges that "*extensive resource studies have been carried out for the Petone and Pencarrow Coastal areas*".

Through Section 5B.1.1.2B, the District Plan also aims to ensure that the design and layout of developments in the Petone Mixed Use Zone "*avoids or mitigates the effects of sea level rise, taking into account rises to such levels as a result of climate change*".

3.1.7 Porirua City District Plan

Porirua City Council ("**Porirua City**") is currently undertaking a full review of their District Plan. As part of this review, there is a requirement to identify areas that could be impacted by coastal hazards over the next 100 years, and to appropriately manage these areas.

Porirua is proposing to build resilience in Porirua to coastal hazards through robust research and consultation with the community. Porirua City Council has engaged the Focus Resource Management Group to help them to understand the coastal hazard risk in Porirua and develop an adaptive management approach to address this risk.

At the time of writing, the evidence base was at the draft stage, although consultation is ongoing with local communities on the coast including: Titahi Bay, Plimmerton, Pukerua Bay, Pauatahanui and Paremata. More information can be found on the coastal hazards page of the Porirua City Council website[27].

The Operative District Plan (1999) includes coastal objectives and policies. It also begins with a description of the coastal resources in the district:

> *"Coastal landforms and the effects of coastal processes give the City its distinctive form. To the west, the City is bounded by the Tasman Sea extending from the steep coastal scarps north of Pukerua Bay to the remote steep sided cliff areas just south of Rock Point. Along this coast are popular recreational beaches such as Plimmerton and Titahi Bay with long established beach-front residential properties and structures, such as boatsheds. This coastline comprises a range of outstanding coastal landscapes from steep scarps, shallow harbours and inlets and sandy beaches with associated foredune complexes (Mana Esplanade area). Many of the more valued areas of the coast have been protected by reserves such as Whitireia Park Reserve.*
>
> *The City also has an important harbour divided in two by the Mana Esplanade reclamation which supports State Highway No. 1 and the North Island Main Trunk Railway line. The southern arm of the harbour bounds the City Centre.*
>
> *Most of the original harbour edge has been modified by reclamations to allow for the construction of road and rail lines on the eastern side, and to the south and west by commercial and residential development. In the northern part of this arm of the harbour, and adjacent to Whitireia Park, are the Onepoto boat sheds.*
>
> *Pauatahanui Inlet forms the eastern part of the Porirua Harbour and is the larger of the harbour's two inlets. It is rated as a site of national significance in the Minister of Conservation's "Sites of Special Wildlife Interest" (SSWI) database."*

[27] https://poriruacity.govt.nz/your-council/city-planning-and-reporting/district-plan/reviewing-our-district-plan/coastal-hazards/

Objective C10.2 is to minimise any adverse effects of buildings and activities on the coastal margin. The corresponding policies include:

- C10.2.1: To only allow buildings in the coastal margin which require a coastal location.
- C10.2.2: To avoid, remedy or mitigate any adverse environmental effects of buildings and structures on the coastal margin.

3.1.8 Wairarapa District Plan

The three Wairarapa District Councils (Masterton, Carterton and South Wairarapa ("**Wairarapa Districts**")) have prepared a Combined District Plan, under the RMA. It was the first Combined District Plan in New Zealand and the first 2nd generation plan to become fully operative (2011).

The Combined District Plan acknowledges that the Wairarapa is susceptible to a range of natural hazards, including earthquakes and fault ruptures, flooding, river and coastal erosion, and slips. While the predominant rural nature of the Wairarapa fortunately diminishes the overall potential risks from natural hazards, there are areas where activities and development are located within areas subject to the effects of natural hazards, particularly urban areas. It also acknowledges that the frequency and intensity of natural hazards may change as a result of the effects of climate change.

Objective NH1 aims to manage activities and development within areas at significant risk from natural hazards, to avoid, remedy or mitigate the adverse effects of those hazards.

NH1 Policies include:

(a) Identify areas at significant risk from the effects of natural hazards and update as new information becomes available.

(b) Control the location and design of land use and subdivision in identified areas of significant risks from natural hazards to avoid remedy or mitigate adverse effects, with the controls appropriate to the level of risks.

(c) Manage the type, location and design of new activities and development to avoid, remedy or mitigate the adverse effects of natural hazards to prevent unnecessarily exacerbating the risks to life, property and the environment from the effects of natural hazards.

(d) Avoid as practicable the siting of new 'lifeline' infrastructure and services within areas of significant risks from natural hazards.

(e) Manage the use, storage, transportation and disposal of hazardous substances in areas subject to natural hazards to avoid, remedy or mitigate adverse effects from hazardous substances to the environment, and to the health and safety of people.

(f) Ensure that where development occurs within areas of significant risks from natural hazards, property owners and/or occupiers are appropriately informed of the risk.

(g) Raise awareness and educate people about the risks of natural hazards, and help them prepare, design and plan for the occurrence of natural hazard events through the provision of information and advice.

(h) Ensure a precautionary approach is taken in relation to planning for and adapting to the effects of natural hazards caused by long term shifts in climate and the possibility of sea level rise on both the natural environment and existing and future development.

(i) Where existing subdivision, use or development is threatened by a coastal hazard, coastal protection works should be permitted only where they are the best practicable option for the future. The abandonment or relocation of existing structures should be considered among the options. Where coastal protection works are the best practicable option, they should be located and designed so as to avoid adverse environmental effects to the extent practicable.

(j) The ability of natural features such as beaches, sand dunes, wetlands and barrier islands, to protect subdivision, use or development should be recognised and maintained, and where appropriate, steps should be required to enhance that ability.

In addition, in the Foreshore Protection Area and Coastal Environment overlays, there are assessment criteria which links to the risks from natural hazards.

4. SEA LEVEL RISE

4.1 SEA LEVEL RISE PREDICTIONS

Sea level rise predictions are important to include in coastal assessments. The International Panel on Climate Change released its Fifth Assessment Report in 2013/14[28] and found that warming of the climate system is unequivocal. The atmosphere and oceans have warmed, the amounts of snow and ice have diminished, and sea level has risen. The IPCC expects sea level to rise up to a metre by the end of the century, whilst identifying that about 70% of the coastlines worldwide are projected to experience sea level change within ±20% of the global mean; and it is very likely that there will be a significant increase in the occurrence of future sea level extremes in some regions by 2100.

Adapting to coastal climate change often focuses on the three main type of coastal hazards which are exacerbated by climate change:

- Coastal erosion caused by storms, sea level rise, and changes in long-term sediment processes
- Coastal inundation caused by storms and changed climate conditions, or by gradual persistent inundation from high tides due to sea-level rise
- Rising groundwater and salinisation in coastal lowlands caused by sea level rise

Tsunami risk and flood risk are additional hazards that can compound an area's coastal hazard risk, however, planning for climate change-related coastal hazard risk reduction will also help manage tsunami and flood effects. An assessment of coastal vulnerability, therefore, should consider the potential for areas to experience more than one of these hazards at the same time, particularly as sea level rises.

The most recent IPCC report Global Warming of 1.5°C, January 2019 further outlines the issues associated with the effects of global warming and sea level rise.

The Parliamentary Commissioner for the Environment (PCE) recognised in her report 'Preparing New Zealand for rising seas: Certainty and Uncertainty' that over the past century, the average global sea level has risen by about 20cm, and that in New Zealand sea level rise is projected to rise by about 30cm between 2015 and 2065.

As recognised in the MfE Guidance, whilst climate change and sea level rise are not in themselves hazards, they will exacerbate already occurring natural processes that drive coastal hazards. Sea level rise is therefore of great relevance for long-term decisions

[28] https://www.ipcc.ch/site/assets/uploads/2018/02/SYR_AR5_FINAL_full.pdf

made in coastal areas and rising sea level in past decades is already affecting human activities and infrastructure in coastal areas.

4.1.1 Sea Level Rise in Wellington

Greater Wellington have commissioned various reports in order to understand the impact that climate change (including sea level rise) will have on the Wellington region, ranging from investigating storm surge susceptibility to monitoring greenhouse gas inventory and climatic projections.

A key report published in 2012 for Greater Wellington (Lane, et al., 2012) assessed total storm inundation along the Wellington Region's shoreline from storm-tide and wave setup inside the wave breaking zone. Inundation by storm-tides was modelled for present day sea levels, and for sea-level rise increments of 0.5 m, 1.0 m and 1.5 m. The model simulations showed that the coastline south and east of the Wellington Harbour (particularly the Wairarapa Coast) is exposed to the largest waves, with significant wave heights of over 6 m in places during some of the storm events simulated. In contrast, the Kapiti Coast receives smaller waves with significant wave heights less than 3 m in the storm events analysed. The storm surge contribution is similar to the tidal contribution in parts of the region, with simulated storm surge for the historic events contributing up to 0.33 m in Wellington Harbour and 0.65-0.71 m along the Kapiti Coast. As sea levels rise, total storm inundation levels will threaten low-lying areas of Wellington Central City, potentially large areas of Petone and Seaview, and to a limited extent Evans Bay and smaller areas of the Miramar Peninsula.

At the time of writing, the most up-to-date sea level rise predictions for the next 100 years for the Wellington region are provided by the work undertaken by NIWA for Greater Wellington[29], entitled 'Climate Change and variability – Wellington Region 2017' and 'Update on relative sea-level rise and vertical land motion: Wellington Region'. These reports state that Wellington Harbour has risen by 2.23mm/year since the early 20th century. The 'Update on relative sea-level rise and vertical land motion: Wellington Region' provided updated findings on the complexities of vertical land motion. It was found that there was a decrease of annual mean sea level from 2016 to 2017 of 60mm. This is mostly attributable to the ongoing post-earthquake (post-seismic) uplift following the November 2016 Kaikoura earthquake. This information highlights the need for monitoring of the vertical land motion and the annual mean sea level rise in the Wellington region. It was

[29] http://www.gw.govt.nz/assets/Climate-change/Climate-Change-and-Variability-report-Wlgtn-Regn-High-Res-with-Appendix.pdf

therefore concluded that due to this variability, it may be a few decades before it is clear which sea level rise trajectory Wellington is tracking towards[30].

4.2 INFRASTRUCTURE EXPOSED TO SEA LEVEL RISE

Local Government New Zealand **(LGNZ)** has recently published a report 'Vulnerable: the quantum of local government infrastructure exposed to sea level rise' (January 2019), which has provided useful information on the impact on local government infrastructure that will be potentially at risk of inundation at different sea level rise scenarios (e.g. 0.5, 1.0, 1.5 and 3m). According to this study, as much as $14 billion of local government infrastructure is at risk from sea level rise. A summary of this report is provided in **Appendix B**. Whilst this report is useful to refer to in conjunction with this report, it is important to acknowledge that our criteria did not include the monetary value of all Council infrastructure at risk across the region.

4.3 SCENARIO UTILISED FOR THIS REPORT

This assessment has not included an analysis against the four scenarios of anticipated sea level rise referred to in the MfE Guidance (which indicate a range of possible sea-level futures). The approach used in this report has been to identify the coastal units as those areas that are impacted during a 100-year storm event (with 1 metre rise in sea level)[31]. This area also generally aligns with the orange tsunami zones identified by Greater Wellington. This includes those parts of the coast which would be affected by a tsunami that generates a 5m wave for the Wellington region. These two considerations have been used as the landward boundary of the coastal units and was considered by the WRCCWG and the Reference Group to be adequate for the purpose of identifying the vulnerability of the coastal communities.

As discussed earlier, the MfE Guidance acknowledges that sea level rise of up to 1 metre is "*virtually certain*" in the foreseeable planning timeframe. The 1m sea level rise value for coastal hazard planning was also supported by the Independent Review Panel that reviewed the Tonkin & Taylor coastal hazard assessment for Christchurch[32]. It is anticipated that as the work programme progresses, a more detailed assessment of risk using the various scenarios will be undertaken to further ground truth the effect of climate change and sea level rise on specific communities. In addition, as discussed above in 4.1.1, it is unknown which trajectory Wellington will align with in regard to sea level rise.

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[30] This is in reference to the representative concentration pathway scenarios referred to in the MfE Guidance: RCP2.6, RCP6.0 and RCP4.5 and RCP8.5.

[31] http://www.gw.govt.nz/assets/Climate-change/Sea-Level-Variability-and-Trends-in-the-Wellington-Region2012.pdf

[32] Kenderdine, S.E.; Hart, D.E.; Cox, R.J.; de Lange, W.P.; Smith, M.H. (2016) Peer review of the Christchurch Coastal Hazards Assessment Report. Review report produced for the Christchurch City Council, 18 August 2016, 74 pp.

Accordingly, the 100-year storm event (with 1 metre rise in sea level) was considered an appropriate scenario to base the assessment upon. For more detail on the background research and key reference documents, a summary a range of national, regional and territorial sources is provided in **Appendix B**.

5. METHODOLOGY

5.1 APPROACH TO THE WELLINGTON REGION HIGH LEVEL COASTAL VULNERABILITY ASSESSMENT

The analysis took account of the relevant sections of the MfE Guidance, having regard for the desired outcome – a high level, regionally focused document that assessed the relative vulnerability of coastal communities to the effects of a modelled sea level rise/storm event scenario in order to inform future decision-making in this area.

The methodology undertaken included:

1. Collation and assessment of existing coastal hazard and coastal plan related reports, research papers, datasets, maps, plans, strategies and documents;
2. Analysis of current coastal hazard impacts on the region;
3. A desk-top modelling exercise in which GIS layers, primarily sourced from the participating regional and territorial authorities, were used to assess the extent to which coastal communities in the region were exposed to the sea level rise/storm surge scenario of which areas are affected in a 1 in 100-year storm event with 1m sea level rise;
4. The desk-top modelling exercise was used to divide the regional coastline into 34 units (excluding Wellington City) that were aligned to a combination of natural features and were within the area administered by a single territorial authority;
5. Information was added to the core sea level rise/storm surge GIS database by adding existing GIS datasets[33] as layers that were deemed appropriate to inform a high-level assessment of vulnerability, and which matched to a defined grouping that was considered as relevant;
6. These additional criteria were each mapped onto the regional coastline information allowing for the value of each unit to be ranked from low to high vulnerability;
7. The values of each criteria were summed, thereby providing the overall ranked results for each coastal unit;
8. Sensitivity analysis[34] was conducted of the different coastal areas in the region to the potential existing and future impacts from sea level rise and climate change effects in order to identify communities at risk; and

[33] These are the 24 criteria discussed in Section 5.1.2.

[34] Sensitivity is the degree to which a built, natural or human system is directly or indirectly affected by a given hazard exposure, and the changes in climate conditions that result in climate impacts on built and natural systems (e.g., sea level rise as a result of projected climate change).

9. The overall results were colour coded and then mapped onto the coastal units to enable each territorial authority to get an understanding of the vulnerabilities of their communities.

10. The result of this is a 'heat map', where those areas which have multiple levels of high vulnerability across the criteria will be clearly shown district-by-district.

The basis of this high-level vulnerability assessment was to identify 34 units (excluding Wellington City) and to undertake a process of assessing those units against 24 varied criteria. A detailed GIS dataset has subsequently been created from the process of assessing the individual coastal units against the criteria. The collating of all of this information together into an easily accessible format, enables a visual description of the different coastal units across the Wellington region in terms of vulnerability levels.

5.1.1 Process of Separating Coastal Units

Thirty-four (34) coastal units were established in order to separate the coastal units out in the Wellington region (with the exception of Wellington City). It was important that the coastal units created made sense to be grouped together because they were geographically linked. This meant that each unit would be similar in its geomorphic characteristics and subsequently have a similar level of hazard. The coastal units were established by Dr Iain Dawe (Greater Wellington), with input from the Reference Group and the WRCCWG sub-group, and generally follow the logical identified coastal communities and distinct areas of the coastline of the region. Greater Wellington had access to a variety of GIS datasets and each coastal unit was then classed as a separate 'mesh block' in the GIS database for the project.

The coastal units set up are shown below in **Table 1** and **Figures 8-13**.

Table 1: Coastal Units referred to in the Vulnerability Assessment

No.	Coastal Unit	Territorial Authority	Features of this Unit
1	Ōtaki	Kāpiti Coast District Council	The northern point of the unit is the edge of the boundary with Horowhenua District (before Waikawa Beach). Unit includes the beachfront area of Ōtaki Beach, Ōtaki River mouth and floodplain, and the Waitohu Stream. In total this area includes 7.74km of coastline and encompasses the natural beach environment of Ōtaki River mouth and beach.

No.	Coastal Unit	Territorial Authority	Features of this Unit
2	Te Horo	Kāpiti Coast District Council	Northern extent is from south of the Ōtaki River mouth. The southern point is area north of Peka Peka and encompasses 4.65km of coastline. This coastal area includes the rocky beach at the northern end of Te Horo and extends to the sandy beach which has been subject to an era of accretion along the coast towards Peka Peka.
3	Peka Peka	Kāpiti Coast District Council	This unit extends from north of Peka Peka towards Waikanae Beach. 5.47km of coastline.
4	Waikanae	Kāpiti Coast District Council	Northern point is an area north of Waikanae Beach through to the southern bank of the Waikanae River area before Paraparaumu Beach. Unit includes Waikanae River and estuary, and the Waimeha stream. 4.36km of coastline.
5	Paraparaumu	Kāpiti Coast District Council	Northern point is an area south of the Waikanae River. Southern point is area north of Raumati Beach. Unit includes a bend in the coastline. 4.69km of coastline.
6	Raumati	Kāpiti Coast District Council	Northern point is area north of Raumati Beach. Southern point is area north of Queen Elizabeth Park. Unit includes Wharemauku Stream. 4.63km of coastline.

No.	Coastal Unit	Territorial Authority	Features of this Unit
7	Queen Elizabeth Park	Kāpiti Coast District Council	Greater Wellington boundaries of Queen Elizabeth Park. 3.48km of coastline.
8	Paekākāriki	Kāpiti Coast District Council	Northern point is area where Queen Elizabeth Park turns into Paekākāriki. Southern point is area before Centennial Highway (where jurisdiction changes from Kāpiti Coast District Council to Porirua City Council). 4.03km of coastline.
9	Centennial Highway SH1	Porirua City Council	Northern point is area where Paekākāriki turns into Centennial Highway Southern point is area before Pukerua Bay (where Centennial Highway inclines up). 4.37km of coastline.
10	Pukerua Bay	Porirua City Council	Northern point is area before Pukerua Bay. Southern point is area before Waireka. Unit is a natural focus with a walkway (Waireka Point Walk). 2.88km of coastline.
11	Wairaka	Porirua City Council	Northern point is area before Waireka. Southern point is area before Plimmerton. Similar to Pukerua Bay, there is a walkway that the public can access on the coastline. 4.99km of coastline.
12	Plimmerton	Porirua City Council	Northern point is Hongoeka Bay. Southern point is area before South Beach Road. 4.5km of coastline.

No.	Coastal Unit	Territorial Authority	Features of this Unit
13	Mana	Porirua City Council	Northern point is area from South Beach Road. Southern point is Ivey Bay. Coastal Unit takes in western part of Cambourne. 2.92km of coastline.
14	Pauatahanui Inlet	Porirua City Council	Unit is the Pauatahanui arm of the Porirua Harbour (east of the Mana Unit). 16.87km of coastline.
15	Aotea	Porirua City Council	Northern point is the Paremata side of Ivey Bay. Unit is the strip of land on the eastern side of Porirua Harbour, ending at the southern end of State Highway 1 past Papakowhai. This Unit is the road / rail corridor (Kiwirail, NZTA). 4.63km of coastline.
16	Porirua	Porirua City Council	Unit is the western side of Porirua Harbour, with the eastern point being the area west of State Highway 1. Unit includes Porirua CBD. Unit includes area up until Onepoto Road. 4.13km of coastline.
17	Whitireia	Porirua City Council	Unit includes Onepoto Road as it turns from Porirua Harbour around to Rocky Bay. 6.3km of coastline.
18	Titahi Bay	Porirua City Council	Northern point of the Unit is Rocky Bay. Southern point of the Unit is the first cove after Titahi Bay. Limited beach and dune sands over a rock shore. platform formed by historic cliff erosion. 2.7km of coastline.

No.	Coastal Unit	Territorial Authority	Features of this Unit
19	Porirua South Coast	Porirua City Council	Northern point of the unit is after the first cover after Titahi Bay. Southern point is where the jurisdiction changes from Porirua City Council to Wellington City Council. 7.58km of coastline.
20	Wellington Coast	Wellington City Council	Includes following suburbs[35]: Lyall Bay, Central Wellington, Island Bay, Owhiro Bay, Pipitea, Seatoun, Makara, Makara Beach, Te Aro, Breaker Bay, Kilbirnie, Miramar, Maupuia, Oriental Bay, Karaka Bays, Wellington Gateway, Hataitai, Rongotai, Houghton Bay, Ohariu, Mt Victoria, Roseneath, Moa Point, Strathmore Park, Thorndon.
21	Petone	Hutt City Council	Western point begins when State Highway 2 changes from the jurisdiction of Wellington City Council to Hutt City Council. Eastern point is the western side of the Hutt River mouth. Unit is a flat, sandy beach. 5.32km of coastline.
22	Seaview	Hutt City Council	Western point is the eastern side of the Hutt River mouth. Southern point is the start of Point Howard. 4.82km of coastline.
23	Lowry	Hutt City Council	Northern point is from the entrance to Point Howard.

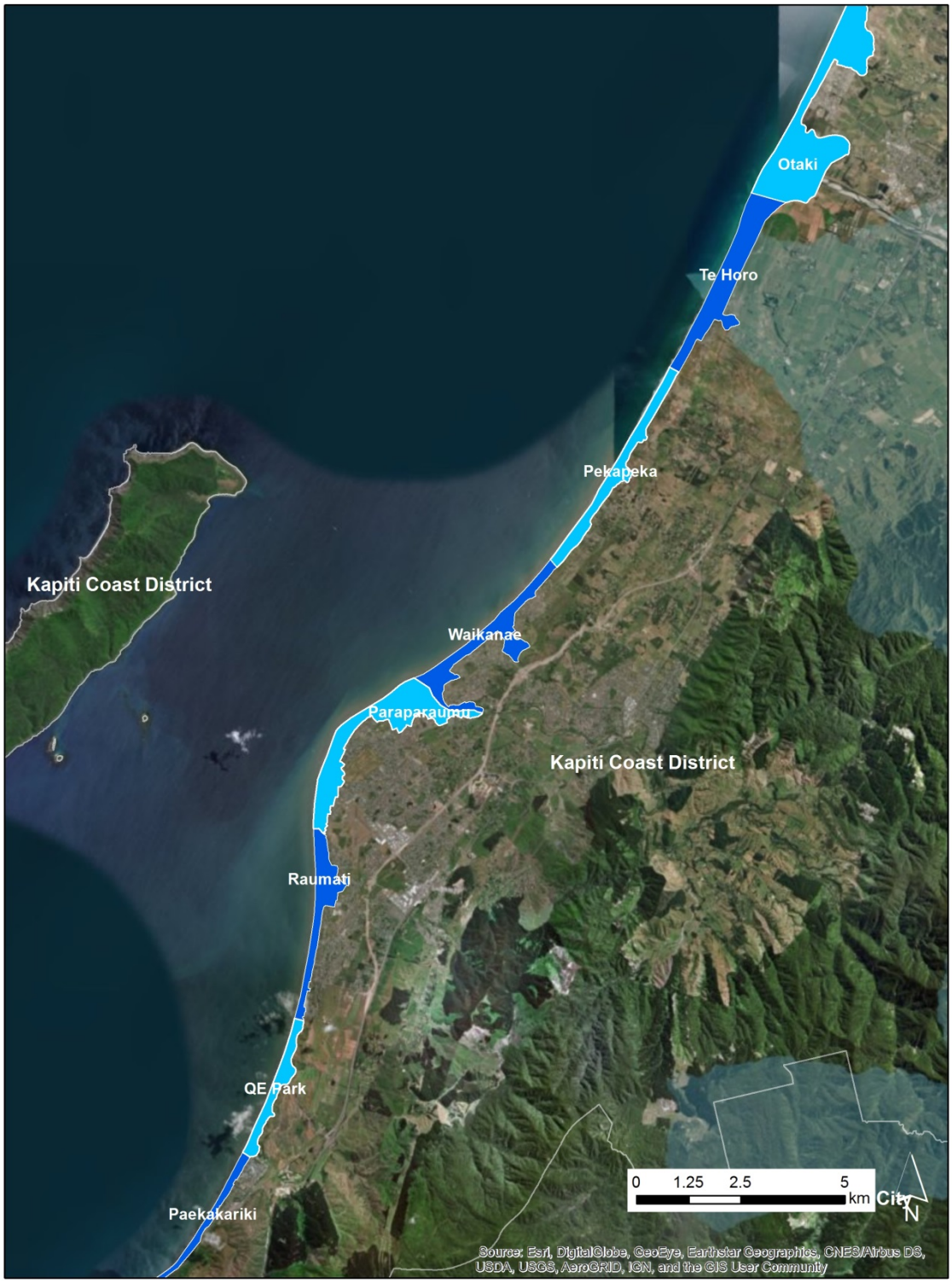
[35] https://wellington.govt.nz/~/media/services/environment-and-waste/environment/files/61579-wcc-sea-level-rise-options.pdf

No.	Coastal Unit	Territorial Authority	Features of this Unit
			Includes York Bay and Mahina Bay. Southern point is the end of Sunshine Bay. This stretch of coast consists of a series of embayed beaches separated by rocky headlands. North of Days Bay, the beaches are narrow, and sediment starved with angular yellow brown coloured greywacke cobbles and pebbles and thin veneers of sand in the foreshores. 3.76km of coastline.
24	Eastbourne	Hutt City Council	Northern point is the start of Days Bay. Southern point is the end of Eastbourne, before Pencarrow (Robinson Bay). Days Bay Beach is a 750m long crescentic embayment intersected a 140m long wharf near the centre of the Bay. North of the wharf the beach is narrow and sandy with a 100m long section of sea wall in the back-beach area, adjacent to the wharf. South of the wharf, the beach is wider (~30m) and grades from sand in the middle of the Bay, to gravel in its southern reaches. Is a large gravel beach which has been building up over the past few decades. 4.65km of coastline.
25	Pencarrow	Hutt City Council	Northern point is the start of Pencarrow (Point Arthur). Southern point is past the Pencarrow Lighthouse. Robinson Bay is approximately 1.6km long and has a concrete sea wall that spans 1km of its length. Unit includes coastal walkway / cycleway and Bus Barns. 6.95km of coastline.

No.	Coastal Unit	Territorial Authority	Features of this Unit
26	Turakirae	Hutt City Council	Northern point begins after the Pencarrow Lighthouse. Unit curves around the eastern side of Wellington until it meets Onoke. 20.8km of coastline.
27	Onoke	South Wairarapa District Council	Western point begins at Onoke beach. Unit includes Lake Onoke and the Ruamahanga River Mouth. Eastern point is the end of Onoke beach. Unit is a mix of sand and gravel beach, primarily populated by baches. 22.11km of coastline.
28	Palliser	South Wairarapa District Council	Western point is the end of Onoke beach where the coastline turns south. Unit includes Whatarangi and Ngawi. Eastern point is Cape Palliser. Unit includes a mix of small communities which face various degrees of hazards. The geology struggles for vegetation. 30.59km of coastline.
29	South Wairarapa coast	South Wairarapa District Council	Western point is Rocky Point. Includes White Rock and Pahaoa. Eastern/Northern point is Honeycomb Rock. Unit has only a few settlements (run holding stations) and limited road access. 68.29km of coastline.

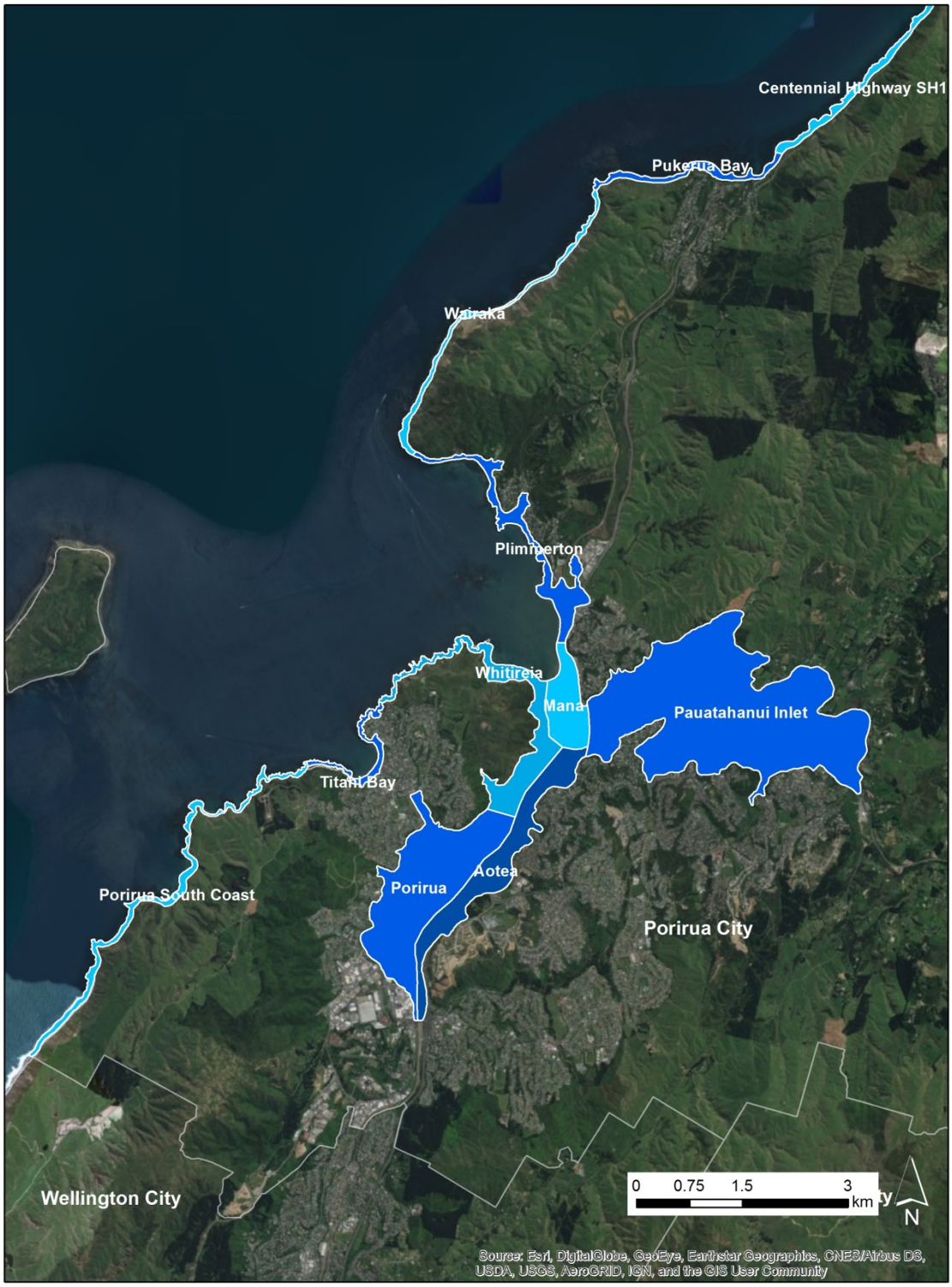
No.	Coastal Unit	Territorial Authority	Features of this Unit
30	Flat Point	Carterton District Council	Southern point is Glenburn. Includes Waimoana. Northern point is Flat Point. 30km of coastline.
31	Uruti	Masterton District Council	Southern point is Kaiwhata River. Northern point is Uruti Point. Unit is building up with recent subdivisions. 15.51km of coastline.
32	Riversdale	Masterton District Council	Southern point is the southernmost point of Riversdale. Northern point is the northernmost point of Riversdale. Unit is an established community. 8.58km of coastline.
33	Whareama	Masterton District Council	Southern point is the Whareama River. Northern point is Otahome. 22.48km of coastline.
34	Castlepoint	Masterton District Council	Southern point is the southernmost point of Castlepoint. Northern point is the northernmost point of Castlepoint. Unit is an established community. 5.15km of coastline.
35	Whakataki	Masterton District Council	Southern point is Whakataki. Northern point is Mataikona, where the Masterton District Council jurisdiction ends, and the Manawatu-Wanganui jurisdiction begins. 15.8km of coastline.

Figure 8: Kāpiti Coastal Units[36]



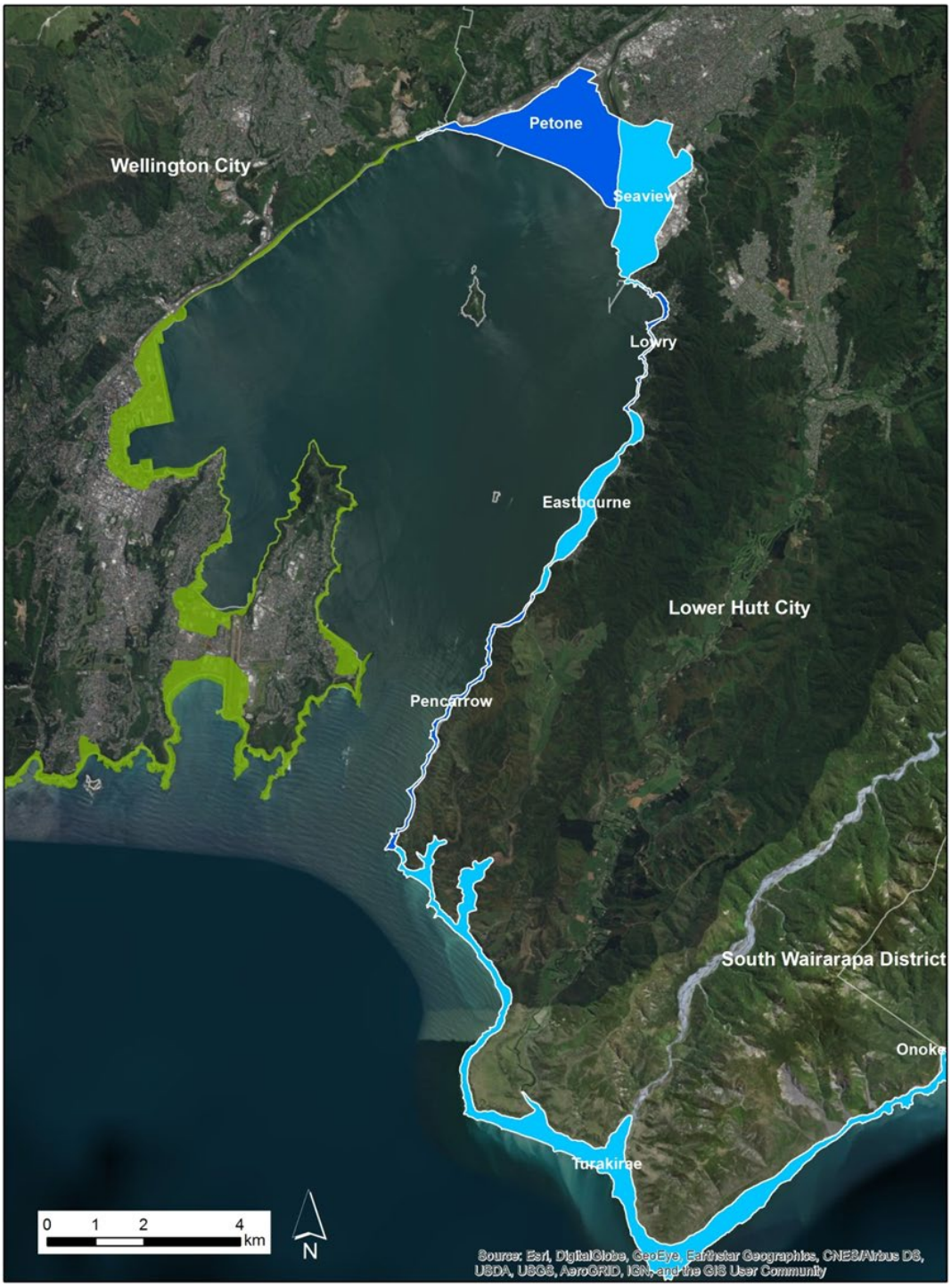
[36] The two shades of blue above are to differentiate between each coastal unit and they do not have any further meaning.

Figure 9: Porirua Coastal Units[37]



[37] The two shades of blue are to differentiate between coastal units, and they do not have any further meaning.

Figure 10: Hutt Coastal Units[38]



[38] The two shades of blue are to differentiate between coastal units, and they do not have any further meaning.

Figure 11: South Wairarapa Coastal Unit[39]

[39] The two shades of blue are to differentiate between coastal units, and they do not have any further meaning.

Figure 12: Central Wairarapa Coastal Units[40]

[40] The two shades of blue are to differentiate between coastal units, and they do not have any further meaning.

Figure 13: North Wairarapa Coastal Units[41]

[41] The two shades of blue are to differentiate between coastal units, and they do not have any further meaning.

5.1.2 Criteria

Twenty-four (24) criteria were selected as representative of important components that will be affected by increases in sea level rise and coastal erosion over time.

The 24 criteria have been grouped into the following nine categories:

- Civil Defence Emergency Management Services (CDEM) (2 criteria)
- Community (3 criteria)
- Business (2 criteria)
- Roads (3 criteria)
- 3 Waters (3 criteria)
- Lifelines infrastructure (5 criteria)
- Māori and cultural (2 criteria)
- Ecological (3 criteria)
- Erosion[42] (1 criteria)

5.1.2.1 Ranking

Each coastal unit within the Wellington region was assessed against all of the criteria.

The data for each coastal unit was evaluated against each other in order to assign a ranking between 1 and 5 to reflect the level of vulnerability for that criterion from sea-level rise and coastal hazards. The categorisation of scores into the 1-5 ranking meant that a ranking of 1 meant 'low vulnerability', through to a ranking of 5 being 'very high vulnerability'.

Each ranking is relative to the spread of data captured within each dataset, making them specific to the Wellington region (with the exception of Wellington City). In addition, the quality of the infrastructure or the hazard defence or hazard mitigation structures was not assessed as part of the ranking. It is anticipated that this will be investigated in future studies.

The criteria are shown below in **Table 2**, including the vulnerability ranking and grouping.

[42] Acknowledging that the other hazards are captured in the risk assessment due to the setting of coastal units according to coastal inundation (storm surge flooding and sea level rise) with a 1% annual exceedance probability (AEP) this corresponds to the 100-year return period event and Tsunami inundation.

Table 2: Criteria assessed in the Vulnerability Assessment

No.	Criteria	Description / Data used	Ranking Explanation 1: low vulnerability 2: low-moderate vulnerability 3: moderate vulnerability 4: high vulnerability 5: very high vulnerability				
			1	2	3	4	**5**
1	Multiple Deprivation Index / Social Resilience (Community)	The New Zealand Index of Multiple Deprivation 2013 IMD[43]	1-2	3-4	5-6	7-8	9-10
2	Population (Community)	Number of people residing in area. (Statistics NZ 2013 Census data)	500 and under	500-1000	1000-2000	2000-4000	Over 4000
3	Mana whenua sites (Māori and cultural)	Mana whenua sites (mana whenua site area as a % of total land in the coastal unit) – utilising the Greater Wellington proposed Natural Resources Plan (PNRP) data[44]	Under 2%	2-10%	10-25%	25-40%	Over 40%

[43] The New Zealand Index of Multiple Deprivation (IMD) is a set of tools for identifying concentrations of deprivation in New Zealand. It measures deprivation at the neighbourhood level, it is comprised of 28 indicators grouped into seven domains of deprivation: Employment, Income, Crime, Housing, Health, Education and Access to services and sets an index of between 1-10, which 1 being the least deprived and 10 being the most deprived.

[44] These sites are “sites with significant mana whenua values”.

No.	Criteria	Description / Data used	Ranking Explanation 1: low vulnerability 2: low-moderate vulnerability 3: moderate vulnerability 4: high vulnerability 5: very high vulnerability				
			1	2	3	4	**5**
4	Historic sites (Māori and cultural)	Number of sites captured by New Zealand Archaeological Association (NZAA)	0	1-5	5-15	16-30	Over 30
5	Business activity (Business)	% of commercial land versus residential land (LINZ land and capital values from September 2018)	0-1	2-9.99	10-25	25-80	Over 80%
6	Business value (Business)	Commercial capital value (LINZ Digital Cadastral database September 2018, NZD)	0-100,000	100,000 – 30 million	30 million – 1 billion	1 billion – 10 billion	Over 10 billion
7	Residential value (Community)	Residential capital value (LINZ Digital Cadastral database September 2018, NZD)	0	1-1 million	1 million -100 million	100 million-1 billion	Over 1 billion
8	Community services (CDEM)	Greater Wellington-held information on number of schools, hospitals, medical centres, and civil defence sites	0	1-2	3-4	5-6	Over 6

No.	Criteria	Description / Data used	Ranking Explanation 1: low vulnerability 2: low-moderate vulnerability 3: moderate vulnerability 4: high vulnerability 5: very high vulnerability				
			1	2	3	4	**5**
9	Emergency services (CDEM)	Greater Wellington-held information on number of ambulance centres, medical centres, civil defence sites, and fire stations	0	1-2	3-4	5-6	Over 6
10	Bulk Fuel storage (Lifelines)	New Zealand Lifelines Infrastructure Vulnerability Assessment: Stage 1, September 2017	No	-	-	-	Yes
11	Sewer Mains Network (3 Waters)	Greater Wellington data (mains in metres)	0-1000	1000-7000	7000-15000	15000-30000	30000+
12	Water Mains Network (3 Waters)	Greater Wellington data (mains in metres)	0	1-1000	1000-2500	2500-10000	Over 10000
13	Stormwater Mains Network (3 Waters)	Greater Wellington data (in metres)	0-1000	1000-7000	7000-15000	15000-30000	30000+
14	Electricity Lines (Lifelines)	Greater Wellington data (in metres)	0-1000	1000-7000	7000-15000	15000-30000	30000+

No.	Criteria	Description / Data used	Ranking Explanation 1: low vulnerability 2: low-moderate vulnerability 3: moderate vulnerability 4: high vulnerability 5: very high vulnerability				
			1	2	3	4	**5**
15	Gas lines (Lifelines)	Greater Wellington data (in metres)	0	1-200	200-1000	1000-5000	5000+
16	Telecoms (Lifelines)	Lifelines data (using rough count of cell towers and cell kiosks[45])	0	1	2-3	4	Over 4
17	Roads (All) (Roads)	Greater Wellington – Greater Wellington Study 2017: Total length of road (km)	0-2.5	2.6-5	5.1-8.8	8.9-39	Over 40
18	Roads (Priority) (Roads)	Greater Wellington – Greater Wellington Study 2017: Total length of priority road (km)	0-1	1.1-2.5	2.6-5	5.1-9.9	Over 10
19	Only access (Roads)	Greater Wellington – Greater Wellington 2017	No	-	-	-	Yes
20	Hazard mitigation structures (Infrastructure)	Greater Wellington data of Defence Structures – (% of shoreline defended)	0-1%	1.1-10%	10.1-30%	30.1-50%	Over 50%[46]

[45] Locations not included in the final report due to Lifelines' confidential mapping system.

[46] Significant proportion of community is reliant on existing hazard mitigation structures.

No.	Criteria	Description / Data used	Ranking Explanation 1: low vulnerability 2: low-moderate vulnerability 3: moderate vulnerability 4: high vulnerability 5: very high vulnerability				
			1	2	3	4	**5**
21	Erosion (Erosion)	Greater Wellington data / reports from storm events[47]	1	2	3	4	5
22	Environmental sites (Ecological)	DOC Ecosites (% of ecosites area compared to coastal area unit)	0-0.99%	1-10.9%	11-25%	25.1-50%	Over 50%
23	Significant bird sites (Ecological)	PNRP data (%)	0%	0.1-3%	3.1-10%	10.1-30%	30.1 over %
24	Coastal biodiversity (Ecological)	PNRP data (%)	0%	0.1-1.99%	2-10%	10.1-30%	30.1 over %

5.1.3 Sensitivity Analysis

When undertaking a complex analysis that involves many different indices, it is important to ensure that the individual indicators within the dataset are not overly influencing the results. Sensitivity analysis examines uncertainties within the system and looks at how variables interact with each other within the model. A sensitivity analysis was undertaken to test whether or not particular indicators were unduly weighting the final outcomes and if so, whether a multiplier needed to be introduced to balance the various influences.

[47] All beaches experience some erosion from time to time, therefore, there is a need to distinguish between long term erosion and short-term events. It is recommended to do further research on future erosion in later stages. These rankings are based on empirical data.

This involved firstly introducing a multiplier of between 1 and 3 to the nine groupings (refer to Section 5.1.2 above) and secondly, by introducing the multiplier to each of the 24 criteria. In this way, the weightings could be varied to test the effect on the overall scores and to draw out whether, for example, the environmental or the infrastructure data was skewing the results. By the opposite reasoning, it was also a way to check whether bringing out more emphasis on various indices, such as the social indicators, made a difference to the results.

It was found that no one particular indicator or sets of like indices were unduly skewing the final outcomes. Part of the reason for this is because the sheer number of indicators (24) means that mathematically no one variable has the opportunity to dominate the final metric. Equally, in selecting the groupings of criteria the various areas were well represented as far as could be achieved within the limitations of the available datasets (e.g. more datasets were available from the lifelines infrastructure grouping).

Given that the sensitivity analysis did not alter the final outcomes, it was not considered necessary to apply any weighting. Therefore, the raw scores were able to be used to develop the 'heat maps' using the scores of the criteria to show the ranking.

5.1.4 Approach Used

As a high-level assessment, the process was a desktop assessment using existing data available from various sources. The assessment does not include individual property-level data.

This report is designed to assist in the future decision-making on identifying priority areas. The assessment carried out was 'top down' rather than 'bottom up' and therefore no engagement with community has been undertaken. Further analysis is anticipated to be carried out in the next stages of the process and through the development of a community-led programme. This analysis is likely to include aspects referred to in the MfE Guidance, such as assessment of the four representative concentration pathway scenarios, assessment of the adaptive capacity of the coastal area (which would analyse the capacity of a community to effectively cope and adapt) and more in-depth assessment of the economic, social, cultural and environmental effects. For example, this report has relied on the Greater Wellington PRNP data to locate the mana whenua sites at risk as it was the most up-to-date dataset available. This particular dataset, however does take into account the values associated with those sites, therefore, a cultural impact assessment would be completed prior to developing each community-led strategy in order to gain a greater understanding of the cultural effects.

It is also acknowledged that the scope of this vulnerability assessment is focused on coastal hazards and sea level rise, and it therefore does not assess or report on vulnerability in relation to these other hazards. In addition to increasing sea level rise, the likelihood of other natural hazards (such as tsunamis, surface water and ground water

flooding, landslides and the consequences of earthquakes including liquefaction) are all matters that the regional council and territorial authorities of the Wellington region are required to consider and plan for. When deciding how to respond to sea level rise, it will be necessary to also think about the various effects of these other hazards when assessing responses in particular areas.

6. FINDINGS

6.1 REGIONAL OVERVIEW

As a result of collating, ranking and analysing all of the data sets a regional 'heat map' has been developed. The 'heat map' shows which coastal units in the region are more vulnerable than others to sea level rise and coastal hazards exacerbated by climate change. As noted earlier, this report's purpose is to enable the WRCCWG to better understand the level of vulnerability in the different areas of the region's coastline and to assist in setting priorities to move forward to work with communities affected by these issues to develop coastal strategies.

The overall findings across the region include:

- That the extent of infrastructure and population size captured within a coastal unit were major influencers in terms of a higher vulnerability score for a coastal unit;
- When looking district-by-district, the two most vulnerable geographic units for each district are: Paraparaumu and Raumati (Kāpiti Coast District), Porirua and Pauatahanui (Porirua City Council), Seaview and Petone (Hutt City Council), and Palliser and Whakataki (for the joint Wairarapa Districts);
- Within each district, there was significant variance in the vulnerability assessment results which demonstrates that there is benefit in separating districts into coastal units because, not only does it allow geographic areas to be grouped in terms of similar geography, but it also shows that the intensity, attributes and uses of the coastline can differ even when units are in close proximity to the other;
- Having a mix of social, economic, cultural and environmental datasets created a comprehensive and balanced assessment of the vulnerability of each coastal unit, and that the sensitivity analysis carried out did not change the results or rankings region-wide; and
- Regardless of whether a coastal unit was found to be highly vulnerable or less vulnerable, it is important to acknowledge that all of the coastal units assessed are at risk from coastal hazards and sea level rise and subsequently would benefit from continuing the 10-step framework (as per the MfE Guidance)[48].

[48] It is important to note that being located within the coastal unit boundaries alone means that these communities are at risk from coastal hazards and sea level rise. In addition, each coastal unit has certain elements of vulnerability due to what is captured within their coastal unit which can be explored in more depth during the community-led decision-making process.

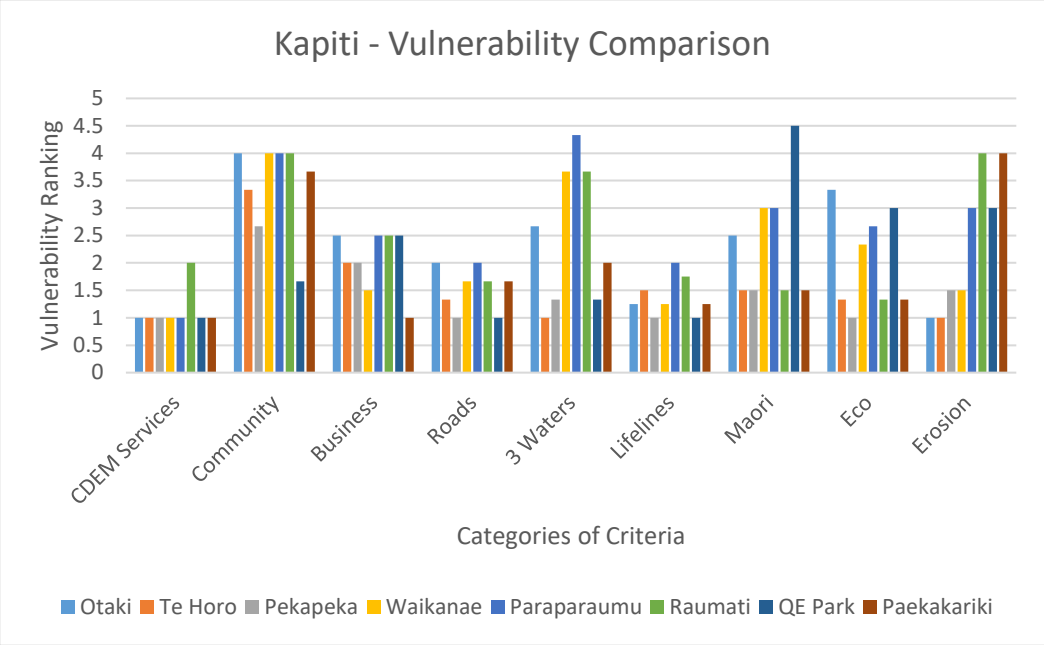
Please refer to **Appendix C** for a copy of the region-wide 'heat map' (**Figure C1**) followed by each district's 'heat map'[49] in **Figures C2-7** which are referred to throughout this chapter. These maps show the "heat map" results in the units of each district. The full spreadsheet of the results of each coastal unit across the 24 criteria is also attached **Appendix D**.

6.2 DISTRICT COMMENTARY

The following commentary aims to provide an overview on how vulnerable the coastal systems are by district to the effects of climate change and coastal hazards.

6.2.1 Kāpiti Coast District

Figure 14: Kāpiti District Comparison showing degree of vulnerability in terms of the nine groupings of criteria



The results show that there is a high variance across the different coastal units of the Kāpiti Coast (**with reference to Figure C2 in Appendix C**). The coastal unit which has emerged as the most vulnerable is Paraparaumu[50]. As shown in **Figure 14** above, Paraparaumu is a coastal unit which comes out consistently high across the criteria under

[49] The scale in the legend for these heat maps is organised into nine categories based on the total numbers attributed to each coastal unit. This allows for consistency when comparing the heat maps district by district.

[50] Paraparaumu is sixth most vulnerable when compared to the other 33 coastal units across the District that are under assessment in this report.

assessment. In particular, it has a high amount of infrastructure captured within the area of the coastal unit (including 3 waters, roading and lifelines infrastructure).

Raumati was found to be the second most vulnerable unit within Kāpiti. It has the highest result in terms of CDEM facilities at risk in Kāpiti, has a high number of community and business criteria potentially at risk, and is also of high risk of erosion.

Ōtaki had moderate results overall in terms of vulnerability, however, it is noted that it had the highest Index of Multiple Deprivation score in the district (meaning that the social resilience of this coastal unit is a factor to consider).

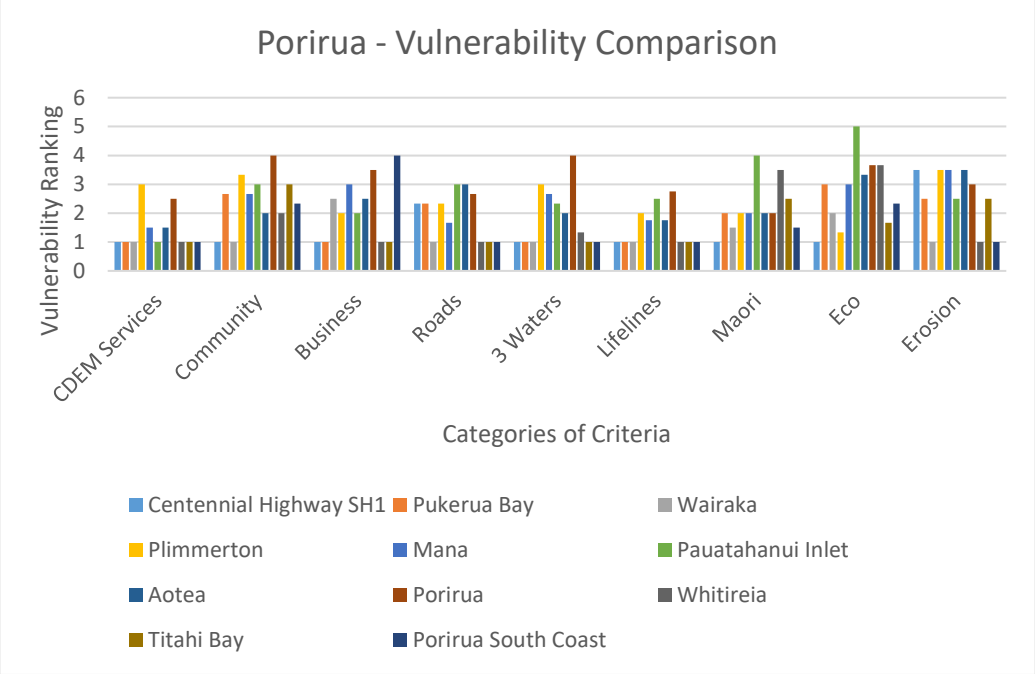
Paekākāriki and Waikanae also had moderate results overall. Paekākāriki was captured as having high vulnerability in terms of coastal erosion, but, as much of the village has been built into the steep dune country, it sits at an elevation that affords a level of protection from storm surge and coastal flooding. Thus, the amount of infrastructure and housing at direct risk is lower than at Paraparaumu. However, it is important to note that this risk is kept in check by existing sea walls and ongoing maintenance and upgrading of these sea walls by Council to mitigate the risk from coastal erosion. Without this, unchecked erosion would see the undermining of infrastructure and the failure of The Esplanade. It is noted however, that the residences and road are protected by existing sea walls and that Kāpiti Coast District Council are currently working through options for replacing a portion of the existing seawall at Paekākāriki as it was damaged by heavy seas in February 2017. In addition, the Council has put in interim protection measures to protect Council sewer assets at Paraparaumu and will continue to maintain the seawall at Raumati, until the replacement arrangements are determined.

The majority of the Queen Elizabeth Park coastal unit is within land used for a Wellington Regional Park, therefore, in terms of infrastructure it featured as low vulnerability. Queen Elizabeth Park has, however, the highest results in terms of Māori and cultural sites and ecological criteria at risk in the district. It also has quite a high rate of erosion and no existing coastal defences. Overall, it had moderate results.

Te Horo and Peka Peka were found in this assessment to be the least vulnerable coastal units within the Kāpiti district.

6.2.2 Porirua City

Figure 15: Porirua– District Comparison showing degree of vulnerability in terms of the nine groupings of criteria



The results of the vulnerability assessment show that there is a high variance within Porirua City as a district, with the coastal units captured within Porirua Harbour being largely found to be more vulnerable than those along the coastline (**with reference to Figure C3 in Appendix C**). The coastal unit which has emerged as the most vulnerable within the district is Porirua[51]. As shown in **Figure 15** above, Porirua featured highly across the criteria and particularly high in terms of community (with the highest IMD score in the region), business, lifelines infrastructure and 3 waters. It is relevant to note that this area is largely part of the section of reclaimed land formed during the industrial land redevelopment in the late 1960s.

Pauatahanui Inlet was found to be the second most vulnerable unit within Porirua[52] as it was the highest score for the district in terms of both Māori and cultural criteria and

[51] Porirua is the third most vulnerable when compared to the other coastal units under assessment in this report.

[52] Pauatahanui Inlet is the fifth most vulnerable when compared to the other coastal units under assessment in this report.

ecological criteria (it is identified as the only large estuarine wetland left in the lower half of New Zealand's North Island and contains three important management areas[53]).

Plimmerton, Aotea and Mana featured moderately overall in the vulnerability assessment. Plimmerton was found to have the highest amount of CDEM services at risk, Aotea had a high level of roading at risk, and all three had similarly high levels of coastal erosion risk in the district and region.

Pukerua Bay, Whitireia, Titahi Bay and Porirua South Coast featured in the moderate/low level in terms of vulnerability across the criteria. However, Whitireia was found to have a high level of Māori and cultural criteria at risk and Porirua South Coast did have a high result in terms of business at risk.

Centennial Highway SH1 and Wairaka were found in this assessment to be the least vulnerable coastal units within the Porirua district, and when compared to the other coastal units region-wide. Centennial Highway SH1 was identified as a coastal unit which is experiencing high levels of erosion; however, it is acknowledged that NZTA take responsibility to invest in removal of loose material and rock fall fence maintenance.

There are coastal units in Porirua that rank moderate/low in terms of vulnerability under these criteria but are exposed to existing risk from coastal erosion and flooding. This risk is likely to increase with further sea level rise. Coastal communities such as Plimmerton, Pukerua Bay, Golden Gate, Pauatahanui and Titahi Bay have housing and infrastructure that was historically built very close to the sea. Porirua City Council is currently working with these communities to develop adaptive management approaches to address these risks.

6.2.3 Wellington City

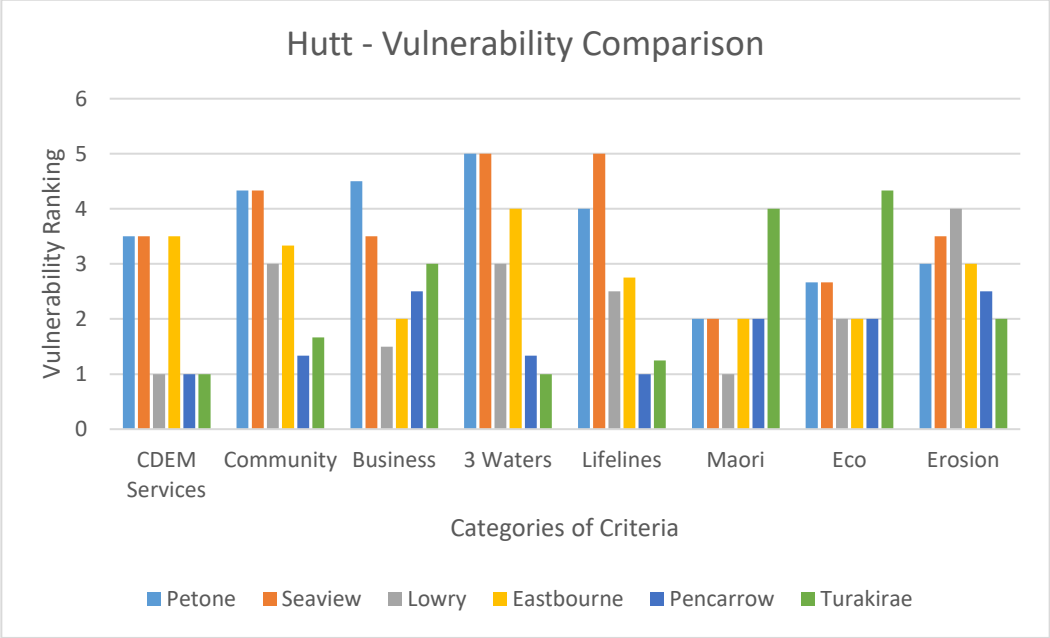
Wellington City Council commissioned Tonkin & Taylor to complete a Sea Level Rise analysis in 2013 and have completed the Wellington Resilience Strategy. These reports have enabled Wellington City Council to progress work in relation to coastal strategies and resilience for the City.

The Tonkin & Taylor report provided an assessment of five scenarios of sea level rise against the four well-beings (namely, cultural, economic, environmental and social) for each of the City's coastal suburbs. The areas that were found to have the highest impacts across the four well-beings included Wellington CBD, Makara Beach, Kilbirnie and Breaker Bay.

[53] Namely, Pautahanui Wildlife Reserve, Duck Creek Scenic Reserve and Horokiwi Wildlife Reserve.

6.2.4 Hutt City

Figure 16: Hutt City – District Comparison showing degree of vulnerability in terms of the nine groupings of criteria



The results show that there is also a high variance within Hutt City (**with reference to Figure C4 in Appendix C**). The coastal units which have emerged as the most vulnerable within the district are Seaview, closely followed by Petone[54]. As shown in **Figure 16** above, both Seaview and Petone have a high vulnerability across all the criteria including CDEM services, community, business, 3 waters and lifelines infrastructure. This is largely due to the significant area that is captured within the 1m sea level rise with a 100-year storm event (as shown in Figure C4 in Appendix C), and that this area captures a large population and development in terms of infrastructure, housing and businesses which has experienced significant investment over time. In addition, Seaview includes the regional fuel storage tanks facility (lifelines infrastructure), higher erosion risk and a higher IMD deprivation score, whereas Petone has more vulnerability due to the level of business development at risk.

Eastbourne was found to be the third most vulnerable unit within the Hutt City[55] as the area includes the low-lying village/settlement which is reliant on a single road in and out.

[54] Seaview is the most vulnerable and Petone is the second most vulnerable when compared to the other coastal units under assessment in this report.

[55] Eastbourne is the third most vulnerable when compared to the other coastal units under assessment in this report.

This has resulted in high vulnerability in terms of CDEM services, community, 3 waters, lifelines infrastructure, and high risk of coastal erosion.

Lowry Bay was found to be moderately vulnerable as a coastal unit as it has similar issues to Eastbourne in that it is reliant on a single road in and out, along this road there is significant infrastructure that is at risk (3 waters and lifelines infrastructure), and it is at high risk of erosion. .

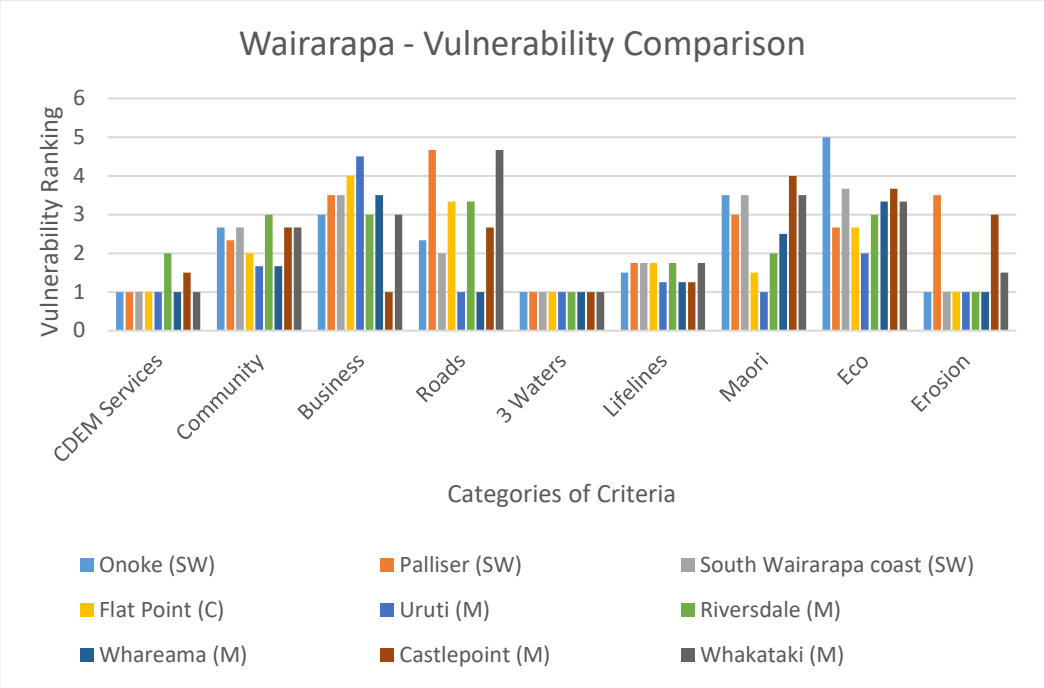
Turakirae was found to be in the moderate/low level in terms of vulnerability across the criteria. It was the most vulnerable coastal unit in terms of potential effects on Māori and cultural indicators and ecological indicators in the Hutt District, but these scores were balanced out because the unit was largely low on the other categories. This is mainly due to the limited infrastructure and population that is located within this coastal unit.

Pencarrow is the least vulnerable coastal unit in the Hutt Valley, and was also ranked low when looking at the coastal units' region-wide. Whilst it is still ranked as low vulnerability, as shown in **Figure 16** above, it does still have some indicators which should be taken into account such as risk on business, reliance on a single road and potential effects on Maori and cultural, and ecological indicators.

6.2.5 Wairarapa Districts

The three Wairarapa District Councils (Masterton, Carterton and South Wairarapa) are discussed together in this sub-section. This is considered appropriate as the three councils have a combined District Plan, and Carterton only has one coastal unit assessed as part of this report.

Figure 17: Wairarapa – District Comparison showing degree of vulnerability in terms of the nine groupings of criteria



The results of the vulnerability assessment show that there is a moderate variance within the Wairarapa as an area (**with reference to Figures C5-C7 in Appendix C**). The coastal unit which emerged as the most vulnerable within the Wairarapa is Palliser (South Wairarapa)[56]. As shown in Figure 17 above, this is due to the vulnerability of this coastal unit related to roads (with a combination of single access and priority roads at risk) and erosion risk.

Whakataki (Masterton) is the second most vulnerable coastal unit when looking across the coastal units of the Wairarapa. Similarly, it is reliant on a single access road which is also a priority road, and it comes out as moderately vulnerable across the majority of the indicators.

[56] Palliser is the seventh most vulnerable unit when compared to the other coastal units under assessment in this report.

Onoke (South Wairarapa), Riversdale (Masterton), Castlepoint (Masterton) and the South Wairarapa Coast (South Wairarapa) were assessed as moderately vulnerable when looking across the indicators. It is acknowledged that Castlepoint (Masterton) was assessed as having high erosion risk and the highest vulnerability in terms of Maori and cultural indicators in the Wairarapa. In addition, Riversdale (Masterton) was most vulnerable in terms of the community grouped criteria. Onoke (South Wairarapa) and South Wairarapa Coast (South Wairarapa) also had the highest vulnerability when considering ecological indicators.

Flat Point is the only coastal unit from Carterton assessed, and it came out in the moderate/low level in terms of vulnerability across the criteria. There are pockets of larger landholdings which are at risk and there is a single access road, however, the social resilience of this coastal unit was found to be high in terms of the IMD deprivation score.

Whareama and Uruti are the least vulnerable coastal units in the Wairarapa and were also ranked low when looking at the coastal units' region-wide. Whilst they are ranked as low vulnerability, as shown in Figure 17 above, there are still some indicators which should be taken into account. For example, Uruti has high vulnerability when it is assessed against the business grouped criteria. Whareama also has vulnerability when it is assessed against the business grouped criteria, and it has some Māori and cultural and ecological indicators at risk.

7. CONCLUSION

This high-level coastal vulnerability assessment is an important first step in the Wellington region's response to the effects of coastal hazards and sea level rise. The analysis has encompassed consideration of coastal inundation, tsunami inundation, and coastal erosion. It is acknowledged that while more detailed assessments are necessary in order to better understand the risks and vulnerabilities of each coastal unit, it is considered that this more specific work is best undertaken during the development of community-led coastal adaptation strategies.

The work undertaken in this vulnerability assessment provides a range of information, including:

- A GIS database that includes a broad range of vulnerability assessment criteria for the Wellington region (except for Wellington City) to identify the extent of sea level risk, accompanied by analysis to understand why certain areas are more vulnerable to coastal hazards and sea level rise;
- Identification of where the impact of coastal hazards and sea level rise will have the highest consequence (when looking across the 24 criteria, or the 9 groupings);
- Confirmation that the overall rankings of each coastal unit were not altered through sensitivity analysis and, therefore, did not require weighting to take place; and
- Information relating to coastal units of the region to assist Greater Wellington and the various district councils in Wellington to make decisions at the political level about which coastal units to progress first towards the development of community-led coastal adaptation strategies.

8. RECOMMENDATIONS AND FUTURE STEPS

This report considers at a regional scale the level of vulnerability to sea level rise and coastal hazards of the coastal units of the region. This is an important step in enabling the WRCCWG to progress developing a programme for community-led coastal adaptation strategies across the region. It is very likely that over the next 100 years sea level will rise by 1m and the risk of a 100-year storm event is currently present. However, there are decision making and community engagement processes which can allow coastal communities to engage with the technical experts and understand the options available to them before choosing the pathway they want to take to prepare for these changes. Addressing and understanding realities of coastal hazard risks and sea level rise is a challenge, but it is also an empowering process as it enables communities to work together towards becoming more resilient to those issues.

It is important to note that the vulnerability assessment is an early stage of the MfE Guidance process and that one of its key purposes is to provide sufficient information in order for local government to proceed towards the development of subsequent adaptive responses. It is therefore recommended that the information provided in this vulnerability assessment (which helps to define the problem) is utilised as the first stage in the process and that a programme is developed to commence Steps 5-10 of the MfE Guidance.

Each council will need to make decisions on whether and when it will embark on a community-led process in one or more of the identified coastal areas. It is acknowledged that this decision may relate to a variety of considerations, including where in the plan preparation process the councils are currently, what funding provisions are in place in the Long Term and Annual Plans, and the preparedness of communities to engage in this process.

Any of the coastal communities identified in this vulnerability assessment could find themselves at the misfortune of a coastal hazard event which has the potential to exacerbate the vulnerability of a coastal unit (such as Makara Beach when ex-Cyclone Gita occurred in 2017). For example, there is uncertainty in terms of where tropical cyclone events that come from the Pacific would make landfall, which makes all of the Wellington region vulnerable (as a particular weather event and the location it hits exacerbates the risk), however, in line with the MfE Guidance, areas with both high risk and vulnerability should be priority planning areas. Subsequently, the results presented in this report will assist the city and district councils in understanding which of their coastal areas are more vulnerable and the reasons why.

It is important that those ‘at-risk’ communities progress towards adaptive management processes which will help them to become more resilient to those events. The selection of which coastal units to proceed with first across the Wellington region will be a decision for Greater Wellington and each council of the region who will need to consider the results of this vulnerability assessment.

APPENDIX A

Wellington Region Climate Change Working Group Terms of Reference

Wellington Region Climate Change Working Group

Terms of Reference

1. Purpose

To provide a forum via which councils and mana whenua from across the Wellington Region can network, discuss issues, share information and where appropriate, achieve a consistent approach across all jurisdictions on climate change **mitigation** (reducing greenhouse gas emissions) and **adaptation** (preparing for impacts such as sea level rise, drought and enhanced natural hazards effects).

2. Background

Councils in the Wellington Region are addressing a broad range of climate change related issues with individual councils implementing initiatives designed to reduce emissions and adapt to the impacts of a changing climate.

At a meeting in August 2017 representatives from councils across the region agreed that each council would benefit from participating in a regional working group that would provide coordination, facilitate joined up action and enable consistent leadership, advocacy and communications in relation to climate change.

3. Membership:

The Wellington Region Climate Change Working Group (the Working Group) will include one main and one alternate elected member from each council in the Wellington region[1] and three mana whenua representatives from Ara Tahi.[2]

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[1] Greater Wellington Regional Council; Wellington City Council; Hutt City Council; Upper Hutt City Council; Porirua City Council; Kapiti Coast District Council; Masterton District Council; Carterton District Council; South Wairarapa District Council

[2] Ara Tahi is a leadership forum of Greater Wellington Regional Council (GWRC) and its six mana whenua partners who meet to discuss strategic issues of mutual interest (Ara Tahi membership comprises two representatives from each mana whenua authority, two GWRC Councillors and GWRC's Chief Executive).
GWRC will appoint up to three representatives from Ara Tahi, one each representing: East Coast: Wairarapa; West Coast: Otaki to Porirua; Central: Wellington and Hutt Valley. Ara Tahi representatives are entitled to receive GWRCs standard daily meeting fee and mileage allowances for each meeting they attend.

4. Arrangements

The Working Group is a collaborative work group made up of representatives from each of the councils of the Wellington Region and mana whenua; it is not a joint committee, and any recommendations of the Working Group would be for consideration by each council[3]

The workload will be shared across the councils of the region – arranging and hosting meetings on a roster basis.

The Working Group will meet four times a year, on a quarterly basis.

The Working Group will agree at the beginning of each year where and when meetings are to be held. At any time during the year a member of the Working Group or a council officer can make a recommendation that the meeting date or location should change. The request will need to receive support from the majority to change.

5. Participation

Main and/or alternate council representatives will attend meetings and participate in activities relevant to their council. They will report to their respective councils about Working Group activities and will champion recommendations as appropriate their council.

Ara Tahi representatives will attend meetings and participate in activities relevant to their allocated area (East Coast: Wairarapa; West Coast: Otaki to Porirua; Central: Wellington and Hutt Valley). They will report to Ara Tahi and will champion recommendations as appropriate to their allocated area.

When relevant, additional Councillors from each council and/or representatives of the six mana whenua partners represented by Ara Tahi are welcome to attend meetings.

Relevant stakeholder groups can be invited to attend meetings.

6. Chair

A Chair and Deputy Chair will be elected by the main representatives (an alternate may vote on behalf of an absent main representative). A new Chair and Deputy Chair will be elected at least once every triennium following local government elections.

[3] Including any consultation process that is appropriate to that council

7. Administrative support:

Each council will ensure that the representatives participating in the Working Group are sufficiently supported by officers from their council. Greater Wellington Regional Council will support the Ara Tahi representatives in this regard.

Each council will provide reports and advice to the Working Group as required.

Secretariat support (i.e. developing the agenda and associated content) for meetings will be provided by Greater Wellington Regional Council. The host council will provide administrative support (i.e. venue, catering and logistical support).

8. Objectives

The objectives of the Working Group encompass climate change **mitigation** (reducing greenhouse gas emissions) and **adaptation** (preparing for impacts such as sea level rise drought and enhanced natural hazards effects). The objectives are:

a. Provide a forum for the region's councils and mana whenua to network, discuss issues, share information and build capability

b. Provide a regional forum for dialogue with stakeholders

c. Provide oversight of strategies, plans, research and initiatives being implemented or developed by councils within the region[4] and where appropriate, align these activities to achieve greater consistency and efficiency

d. Utilise the full range of skills and capabilities available in the region's local authorities and amongst other organisations to address the economic, social, environmental and cultural opportunities and consequences related to climate change

e. Initiate joint projects/initiatives/campaigns that impact on, or require the active involvement of more than one local authority (by for example sharing capacity, budgets or joint steering committee)

f. Enable the development of regionally consistent recommendations that could be considered and adopted by each council individually (within a timeframe that meets individual councils' needs)

g. Act as a reference group to ensure consistent, integrated and coherent messaging for climate change related outreach and awareness-raising activities

[4] Including the climate change related work progressed via the Regional Natural Hazards Management Strategy

h. Provide a platform for joint advocacy and leadership – enabling the region's councils to speak with one voice when appropriate[5] (for example by advocating to central government through the preparation of joint submissions on policy proposals)

i. Enable the development and dissemination of joint communications to the public

[5] This approach would be consistent with that set out in the LGNZ Local Government Leaders Climate Change Declaration 2017

B

APPENDIX B

Background Information Sources

1.1 NATIONAL SOURCES

The New Zealand Coastal Policy Statement (2010)

- The New Zealand Coastal Policy Statement requires Local Authorities to consider and plan for coastal hazards risks.
    - Relevant objective: 5: "*To ensure that coastal hazard risks taking account of climate change, are managed by locating new development away from areas prone to such risks; considering responses, including managed retreat, for existing development in this situation; and protecting or restoring natural defences to coastal hazards*".
    - Relevant policies:
        - Policy 24 (1), Local Authorities are required to: "*Identify areas in the coastal environment that are potentially affected by coastal hazards (including tsunami), giving priority to the identification of areas at high risk of being affected. Hazard risks, over at least 100 years, are to be assessed…"*
        - Policy 25, in areas potentially affected by coastal hazards over at least the next 100 years:

            (a) avoid increasing the risk of social, environmental and economic harm from coastal hazards;

            (b) avoid redevelopment, or change in land use, that would increase the risk of adverse effects from coastal hazards;

            (c) encourage redevelopment, or change in land use, where that would reduce the risk of adverse effects from coastal hazards, including managed retreat by relocation or removal of existing structures or their abandonment in extreme circumstances, and designing for relocatability or recoverability from hazard events;

            (d) encourage the location of infrastructure away from areas of hazard risk where practicable;
            (e) discourage hard protection structures and promote the use of alternatives to them, including natural defences; and
            (f) consider the potential effects of tsunami and how to avoid or mitigate them.
        - Policy 26, Natural defences against coastal hazards:

            (1) Provide where appropriate for the protection, restoration or enhancement of natural defences that protect coastal land uses, or

sites of significant biodiversity, cultural or historic heritage or geological value, from coastal hazards.

(2) Recognise that such natural defences include beaches, estuaries, wetlands, intertidal areas, coastal vegetation, dunes and barrier islands.

- Policy 27, Strategies for protecting significant existing development from coastal hazard risk: which provides a range of options for reducing coastal hazard risk that should be assessed ranging from 'do-nothing' to hard protection and managed retreat.

Lifelines – noting report 'New Zealand Lifelines Infrastructure Vulnerability Assessment: Stage 1', September 2017[1]

- This Stage 1 report provides a summary of information on New Zealand's critical lifelines infrastructure and vulnerability to hazards gathered from existing reports and inputs from New Zealand Lifelines Council (NZLC) members.
- This report is intended to provide strategic oversight of all infrastructure services (energy, transport, telecommunications, water) in New Zealand, raise awareness particularly with regard to inter-dependencies, and contribute to raising the resilience of infrastructure to meet our community needs.
- The report refers to Wellington in certain sections including:
    - Nationally significant infrastructure: there is a main telecommunication exchange, Centreport, high volume road (SH1), Hutt River water supplies / Wellington Water and an international airport.
    - An example of an infrastructure 'hotspot' is Thorndon in Wellington.
    - Transmission Gully referred to as a major project which will increase the resilience of nationally significant infrastructure.
    - The highest capacity transmission line in New Zealand is the 350kV HVDC line from Benmore to Haywards (Wellington), loss of which would result in loss of transmission capacity between the North and South Island.
    - The main control room for Transpower is in Wellington.
    - There is a critical fuel supply facility in Wellington – Seaview Wharf which is seismically vulnerable and dependent on road access and the facilities at Kaiwharawhara.
    - SH 1 and 2 into Wellington are vulnerable, particularly to seismic activity and flooding (SH 2 between Petone and Ngauranga was identified in a 2017 NZTA / GWRC study as the most vulnerable stretch of road in Wellington).

[1] Noted that the GIS mapping was referred to by Lifelines but it is unable to be publicly shared.

- The national rail network is important for commuter rail in Wellington and an outage of the rail network leads to heavy road congestion.
- Wellington's water supply is supplied from sources on the outskirts of the City and transmitted by trunk mains – around 20% from dams in Te Marua, 50% from the Hutt Aquifer and 30% from Wainuiomata. In Wellington, these mains pass through high risk fault areas and studies have been shown that a major Wellington Fault quake could cause damage taking up to three months for restoration of bulk supplies to parts of the City
- In Wellington the potential to be isolated from the main supply chain in Palmerston North is a noted vulnerability for the region.
- Petone / Seaview Critical Areas – includes fuel offloading / fuel storage for Wellington plus regionally significant assets for water, gas, electricity, wastewater and telecommunications.
- Thorndon Critical Area – a number of critical utilities within a narrow corridor traversing the Wellington Fault with much in liquefaction-prone reclaimed land.

<u>Preparing New Zealand for rising seas: Certainty and Uncertainty, Parliamentary Commissioner for the Environment (November 2015).</u>

- This report is about how the rising level of the sea will affect New Zealand. It describes the main impacts of sea level rise and examines current efforts by central and local government to prepare. The Commissioner sought an overhaul of the current approach and has made recommendations to the Government.
- Wellington context
  - Wellington has about 100 houses that are lower than 50 centimetres above the spring high tide mark, but there are many more at slightly higher elevations.
  - Most low-lying areas in Wellington are on the floodplain of the Hutt River – in Petone, Seaview, and Waiwhetū. The more pressing issue for this area is river and stream flooding. However, rising sea level will exacerbate such river floods by reducing the fall to the sea.
  - There are also small pockets of low-lying land in the Wellington Central Business District, Kilbirnie, Eastbourne, and around Porirua Harbour. Some of these areas have been reclaimed from the sea, so are generally more vulnerable to sea level rise.
  - Sections of State Highway 1 near Porirua Harbour, Cobham Drive (the main road to the airport), and Marine Drive (the only road to Eastbourne) are low-lying. An upgraded sea wall that reflects waves back out to sea has been proposed for Marine Drive. The Esplanade that runs around the south coast of Wellington is generally higher, but is often pummelled by huge storm waves.
  - The rail line that runs around the top of the harbour is 2 to 3 metres above the spring high tide mark, but has nonetheless been damaged by high seas in the past. Trains do not have alternative routes, and when a storm washed out the

seawall protecting the track in June 2013, it took almost a week to restore the service.
    - Wellington's airport has been built on reclaimed land that is more than 3 metres above the spring high tide mark.
- 1 - Take direction on planning for sea level rise out of the New Zealand Coastal Policy Statement and put it into another National Policy Statement, such as that envisaged for dealing with natural hazards.
- 2 - Direct officials to address the matters raised in this investigation in the revision of the 2008 MfE Guidance Manual[2].
- 3 - In revising central government direction and guidance on sea level rise, include protocols for the procurement of elevation data, and work with Land Information New Zealand and other relevant agencies to create a national repository for LiDAR elevation data.
- 4 - In revising central government direction and guidance on sea level rise, set standards for the use of IPCC projections of sea level rise to ensure they are used clearly and consistently across the country.
- 5 - In revising central government direction and guidance on sea level rise, specify planning horizons that are appropriate for different types of development.
- 6 - In revising central government direction and guidance on sea level rise, specify that 'best estimates' with uncertainty ranges for all parameters be used in technical assessments of coastal hazards.
- 7 - In revising central government direction and guidance on sea level rise, include a standard process for council engagement with coastal communities.
- 8 - In revising central government direction and guidance on sea level rise, specify that councils develop whole coast plans for dealing with sea level rise, and expand coastal monitoring systems to enable adaptive management
- 9 - Establish a working group to assess and prepare for the economic and fiscal implications of sea level rise.

<u>The Case for New Climate Change Adaptation Funding Instruments, Jonathan Boston and Judy Lawrence (August 2017)</u>

- The paper discusses the funding of climate change adaptation in New Zealand and, in particular, the need for new funding instruments that can focus on risk reduction and thus complement existing disaster response funding.
- To avoid policy inconsistencies and the risk of moral hazard, adaptation funding must be well integrated with decision making on regional and district planning and infrastructure investment. Hence, such funding must be part of a wider policy response to the effects of climate change

[2] Now superseded by the 2017 MfE Guidance.

- As part of any comprehensive plan to enhance the country's capacity to adapt to climate change in a cost-effective and equitable manner, there is a good case for establishing a new national, publicly-administered fund that is pre-event and preventative (i.e. it is designed to reduce climate change risk exposure over time as risk profiles increase). Such a fund could complement existing post-event funding mechanisms, such as the Natural Disaster Fund administered by EQC and private insurance arrangements.

LGNZ 'Managing natural hazard risk in New Zealand – towards more resilient communities: A think piece for local and central government and others with a role in managing natural hazards' (October 2014)

- The think piece 'Managing natural hazard risk in New Zealand – Towards more resilient communities' finds there is a need for a national approach to managing risk from natural hazards including principles for hazard reduction.
- The think piece pinpoints two core ideas. The first is the need for issue and place-specific responses to natural hazards, rather than a one size fits all approach. The second is the need for integration and collaboration to develop and deliver effective responses across the many players.
- Local government's contribution to managing natural hazard risk and the effects of climate change is fundamental to achieving sustainable management that meets the needs of current and future generations.

New Zealand College of Public Health Medicine – Policy Statement on Climate Change (November 2013)

- Human-caused climate change is a serious and urgent threat to health and health equity globally and in Aotearoa New Zealand.
- As a result of climate change, New Zealand will face many adverse impacts on health, with disproportionate health impacts for Māori. There will be new health and social pressures relating to climate migrant and refugee populations arriving in New Zealand and flow on effects from changes in the global economy.
- Public health medicine professionals call for strong and urgent action on climate change that improves population health, accords with Te Tiriti O Waitangi (The Treaty of Waitangi), and creates more equitable, just and resilient societies in New Zealand and worldwide.
- Expected health impacts in NZ include:
    - Increased stress and mental health issues, including suicide, related to loss of livelihood (e.g. farmers with drought).
        - Sources of increased stress will likely affect Māori at least as much as total population with additional impacts relating to loss of coastal land, urupa (cemetery), marae (meeting house), and other sites of significance
    - Mental health concerns for people affected by extreme weather events and forced migration.

- Psychological impacts on young people who may suffer anxieties about potential catastrophic climate change, not unlike those experienced by children growing up with the fear of nuclear war.
- Immediate trauma from extreme weather events.
    - Many Māori communities are situated in coastal areas that are vulnerable to sea level rise, storms and storm surges, erosion, and landslides
- Indirect health impacts in weeks to months after extreme event (from e.g. pre-existing medical conditions, mental health, conflict)
- Increased likelihood that mosquito vectors could establish in New Zealand, which could lead to local transmission of mosquito-borne diseases (e.g. dengue fever, Ross River virus, Chikungunya, West Nile virus).
    - The Māori population is concentrated in North Island, with many communities situated near the coast. These areas (e.g. Northland, Bay of Plenty) are at higher risk for the establishment of mosquito vectors of public health concern
- Heavy rainfall events can transport faecal contaminants into waterways. People can subsequently be exposed to pathogens through drinking water and recreation (e.g. swimming, contaminated shellfish).
- Possible increase in incidence of leptospirosis through contact with flood contaminated surface water.
- Increased temperature, and both high and low rainfall, may have impacts on parasitic diseases (e.g. cryptosporidiosis, giardiasis) particularly in the context of agricultural intensification in NZ.

<u>New Deep South Challenge, Lisa Ellis - 'How should the risks of sea-level rise be shared?' (2018)</u>

- This working paper answers the question of how, in a principled way, we in New Zealand should distribute the risks of sea-level rise.
- Each available course of action, including “no action,” has ethical implications for New Zealand society.
- Ethically robust policies for adapting to sea-level rise are resilient across time, space, and other conditions because they build ethical evaluation into dynamic adaptive policy planning.
- Common fundamental value in the literature: do not transfer risk to the most vulnerable.
- Paavola and Adger adopt a Rawlsian “maximin” strategy that is popular in the global justice literature, advising policy to avoid transferring risk to the most vulnerable (Paavola & Adger, 2006). They define vulnerability not strictly as social disadvantage, but as a function of a person’s exposure, sensitivity, and adaptive capacity vis-à-vis climate change (see also Orchiston & Stephenson, 2018).
- Processes that engage community agency should not only ask about people’s choices among a set of options pre-selected by experts, but also about the standards themselves.

(The Hawke's Bay community engagement process did this well, for example, by soliciting stakeholder views on how different kinds of value should be weighted in their multiple criteria decision analysis (MCDA) process (Bendall, 2018)).

- A rough comparison of the outcomes of the assessment panels for the different at-risk communities of Hawke's Bay with these same communities' scores on the New Zealand Index of Multiple Deprivation shows no consistent association between a community's level of deprivation and whether the panel recommended defences like a sea-wall or instead recommended managed retreat (Bendall, 2018).
- One of the key recommendations: Adaptation funding must address both spatial and temporal inequalities, so that we do not transfer risk to the most vulnerable, whether that vulnerability is due to ratepayer capacity, membership in future generations, or another factor.

Coastal Hazards and Climate Change Guidance for Local Government – Ministry for the Environment, December 2017

- This guidance supports councils to manage and adapt to the increased coastal hazard risks posed by climate change and sea-level rise.
- It:
    - provides information on the effects of climate change on coastal hazards, incorporating the latest science and relevant legislation, information from the Parliamentary Commissioner for the Environment's 2015 report on sea-level rise, and feedback from stakeholders
    - recommends a new 'pathways' approach to adaptive planning that is dynamic and flexible. It is designed to be used when there is uncertainty about future physical conditions affecting the coastal environment
    - contains new sections on collaborative approaches to engaging with communities (which is central to the adaptive planning approach) and local government roles and responsibilities
    - outlines a 10-step decision-making process that councils and communities can follow when planning for the effects of climate change on coastal hazards.
    - This 2017 guidance is an update of the 2008 edition.

Vulnerable: the quantum of local government infrastructure exposed to sea level rise – LGNZ (2019)

- This report forms part of LGNZ's wider flagship Climate Change project. The project is focused on supporting councils with their adaptation and mitigation responsibilities, and involves ongoing advocacy to the Government on the tools and resources that councils and their communities need to address climate change.
- The report shows how much infrastructure - including water and road infrastructure, buildings and facilities - would be exposed if the sea level rises by 1.5 metres.

- Water infrastructure was the most costly to replace nationally, exceeding the total cost of building and roading infrastructure at risk. At sea-level rise of 1.5m, the estimated cost of replacement is $4bn.
- The region projected to be hardest hit by a 1.5m was projected to be Canterbury, with $1.6bn worth of infrastructure at risk. Auckland followed at $1.4bn and Hawke's Bay close behind on $1.2bn.
- The data, compiled by using geographic Niwa projections on sea level rise and council information on infrastructure - was not available for all regions.
- No data was provided by local councils for Kaikōura and the Gisborne region. Data on stormwater and Ports of Auckland were not available for the Auckland region.
- The accuracy of the data in five regions - West Coast, Southland, Marlborough, Taranaki and Manawatu-Whanganui regions - was lower due to high-resolution data not being available for those areas.
- Greater Wellington was a noted priority area when looking at exposed local government owned infrastructure.
- In the findings, there are some large jumps in value across elevation increments. This is especially noticeable for Greater Wellington, which has roughly a nine fold increase between the 0.5 and 1.0 metre increments, with the value increasing from $36 million to $320 million.

1.2 REGIONAL SOURCES

1.2.1 Wellington Region

1.2.1.1 Relevant Data

National Institute of Water and Atmospheric Research Ltd (NIWA), written for Greater Wellington – Climate Change and Variability – Wellington Region (2017)

- A climate change report was produced by NIWA in 2017 for the Wellington Region, including high resolution projection maps of climate variables and commentary on impacts of climate change for the region.
- Report shows an increase for Wellington city from six hot days (over 25°C) a year now to 26 days by 2090. In the Wairarapa, that figure goes from 24 days now, to 94 in just over 70 years.
- The report highlights significant impacts and implications with more floods and droughts, and increasing coastal inundation and coastal erosion due to sea level rise.
- Other report findings on the future of the Wellington region's climate include:
    - Autumn is the season likely to warm the most
    - Annual temperatures will increase by 1°C by 2040 and up to 3°C by 2090
    - Frosts in the high elevations of the Tararua Ranges likely to disappear
    - Spring rainfall will reduce by up to 15% in eastern areas by 2090

- Up to 15% more winter rainfall along the west coast by 2090
- The risk of drought will increase significantly in the Wairarapa
- More extreme rainfall events.

National Institute of Water and Atmospheric Research Ltd (NIWA). 2012. Sea level variability and trends- Wellington region. Prepared for Greater Wellington Regional Council.

- Sea-level monitoring in Wellington Harbour since 1990 shows that relative sea level is currently tracking towards a 0.8m rise by the 2090s or circa 1m by 2115 (covering a period of at least 100 years from the present).
- Suggested sea-level guidance for the Wellington Region is based around distinguishing explicitly between existing coastal developments versus new or greenfields development. For existing development, the current best-estimate is a 1 metre sea-level rise to accommodate by 2115, allowing for a bounded flexibility either way, covering a range of 0.7 m to 1.4 m by 2115 depending on the potential consequences (=risk) for the activity or objective and the ability or scope for future adaptation. However, for new or greenfields developments, taking the lead from the NZCPS where future risk avoidance is required and taking into account that sea levels will continue to rise for several centuries, it is suggested that in most cases a sea level rise of at least 1.5 metres (relative to the 1990 baseline) be used, depending on the future risks and potential for future adaptation.
- For vulnerability ("what if") studies to underpin on-going strategic planning processes, sea-level rises of 0.5, 1.0, 1.5 and 2 m, irrespective of the timeframe, would cover the range of plausible estimates of potential sea-level rise for the Wellington region for the foreseeable future.
- Records over 6 years up to 2012 show subsidence varies across the region from around 1mm per year on the Kapiti coast up to between 2 to 3mm per year along the Wairarapa coast.
- A key recommendation: was that risk / vulnerability assessments should take into account that a SLR above 1m by 2090s (or more than 1.3m by 2115) cannot be ruled out, particularly if polar ice-sheet loss continues to accelerate.
- A strategic long-term adaptation plan for the relevant coastal suburb or community should be developed in conjunction with the local community and supported by vulnerability assessments for both coastal hazard exposure and socio-economic sustainability.
- Besides the suggested sea-level rise values for planning and vulnerability assessments, it is recommended that a formal monitoring programme is put in place to track on-going relative sea-level rise in the Wellington region and assess the implications against adaptation objectives.

National Institute of Water and Atmospheric Research Ltd (NIWA). 2012. Assessing the storm inundation hazard for coastal margins around the Wellington region. Prepared for Greater Wellington Regional Council, Kapiti Coast District Council and Wellington City Council.

- This report assesses total storm inundation along the Wellington region's shoreline from storm-tide (a combination of high tide plus storm surge) and wave setup inside the wave breaking zone. The assessment is based on modelling the combined effects of storm-tides and waves for selected storm events with a joint annual exceedance probability (AEP) of 1%.
- The inundation levels and maps in this report do not include tsunami, wave runup or river or stormwater flooding, which may need to be taken into account in more detailed assessments for specific projects.
- Inundation by storm-tides was modelled for present day sea levels, and for sea-level rise increments of 0.5 m, 1.0 m, and 1.5 m (with no specific timeframe for when these rises would be reached).
- The model simulations show that the coastline south and east of the Wellington Harbour (particularly the Wairarapa Coast) is exposed to the largest waves, with significant wave heights of over 6 m in places during some of the storm events simulated. The southern part of Cape Terawhiti is also exposed to large waves. In contrast, the Kapiti Coast receives smaller waves with significant wave heights less than 3 m in the storm events analysed.
- These same scenarios were repeated for the 3 increments in sea-level rise and further inundation maps produced to illustrate the future exposure to coastal inundation. However, in future, the likelihood of present-day inundation (i.e., AEP) will escalate as sea-level rise accelerates. Alternatively, the frequency of the present-day coastal inundation events considered will increase, from an average recurrence interval of 100 years (or 1% AEP) now to occurring around once a year on average for sea-level rises of only 0.2 to 0.3m, depending on the tide range.
- As sea levels rise, total storm inundation levels will threaten low-lying areas of Wellington Central City, potentially large areas of Petone and Seaview, and to a limited extent Evans Bay and smaller areas of Miramar Peninsula. Along the Kapiti Coast, total storm inundation levels elevated by sea-level rise will begin to threaten Otaki Beach, low lying areas of Waikanae, and narrow margins of the Porirua Harbour.

National Institute of Water and Atmospheric Research Ltd (NIWA). March, 2009. Modelling of the 2 February 1936 storm tide in Wellington Harbour

- NIWA undertook modelling of the 2 February 1936 storm tide in Wellington Harbour, which anecdotal evidence suggests was the highest storm tide in Wellington Harbour over the last century. If previous estimates of this storm tide were accurate, inclusion of this event in extreme value analyses would make a large difference to calculated extreme value storm tide probabilities within Wellington Harbour. The storm was re-simulated for the 2090s taking account of potential climate change impacts.
- Climate change simulations show that the combined effects of sea-level rise and potential increases in storm intensity (higher wind speeds and lower atmospheric pressure) could result in storm tide levels of 1.93-2.22m WVD53 from a 200 year ARI storm by the 2090's.

- An important point: while storm tides by themselves are hazardous and can cause inundation of low-lying areas, they also set a higher base level for wave attack or overtopping on the coastline. The joint occurrence of high storm tide levels and waves are therefore of most concern and have resulted in the historically most damaging storms.

Climate Change Strategy: A strategy to guide the Wellington Regional Council's climate change response (October 2015)

- This Strategy is a non-statutory document that is designed to fit with and complement key statutory documents such as the Natural Resources Plan, Regional Policy Statement, Long Term Plan, Regional Land Transport Plan, and non-statutory documents such as floodplain management plans, asset management plans and GWRC's Corporate Sustainability Action Plan.
- As a coastal region, hemmed in to the east, west and south by the sea, the impact of even a small rise in sea level will be significant and expensive for some landowners across the Wellington region. Storms occurring on top of a higher sea level will affect public infrastructure such as transport networks and stormwater systems, as well as private homes and other buildings. In some erosion and flood-prone areas, reliance on increased protection alone will become progressively less feasible. Options such as managed retreat will need to be considered.
- Key risks:
    - Sea level rise, exacerbating the effects of coastal erosion and inundation and river flooding in low lying areas, especially during storm surge.
    - Increased frequency and intensity of storm events, adding to the risk from floods, landslides, severe wind, storm surge, coastal erosion and inundation.
    - Increased frequency of drought, placing pressure on water resources and increasing the risk of wild fire.
- Various issues will arise. E.g.
    - Sea-level rise is likely to impact on coastal species, altering/ moving coastal habitats, changing inundation patterns, and increasing vulnerability to storm surges and tides.
    - The onset of climate change and its predicted impacts on river flow and flooding is expected to further increase the risk to communities along the Hutt River, which is already prone to flooding.
    - Inundation of low-lying coastal land transport infrastructure (road and rail) caused by sea level rise and storm surge.
    - Storm events and heavy rainfall will lead to increased erosion.
- Three overarching objectives:
    - Mitigation: GWRC will act to reduce GHG emissions across all its areas of influence, including its own operations, helping to create the conditions for a smart, innovative, low-carbon regional economy.

    - Adaptation: Risks from climate change-related impacts are managed and resilience is increased through consistent adaptation planning based on best scientific information.
    - Engagement and Awareness: Community awareness of climate change mitigation and adaptation solutions increases and organisations and individuals know what they can do to improve the long term resilience and sustainability of the region.
- Relevant policies include:
    - Consider the effects of climate change as an integral part of planning and decision-making
    - Increase long-term adaptive capacity through the use of adaptive planning tools and techniques
    - Identify key climate change information requirements
    - Implement planning and policy measures that increase long-term resilience to climate change impacts

Update on relative sea-level rise and vertical land motion: Wellington region, NIWA: Prepared for Greater Wellington Regional Council (December 2018)

- This Report provided updated findings for the Wellington region on the complexities of vertical land motion.
- The results in this report highlight the critical role of monitoring both VLM via the Global Navigation Satellite System (GNSS) and annual MSL in the Wellington region and the urgent need nationally to bolster long-term GNSS monitoring systems. Specifically, the key need is in coastal areas—especially actively tectonic areas or those urban or peri-urban areas subject to ongoing subsidence from nontectonic processes (e.g., sedimentary basins such as former river deltas, groundwater pumping, and large-scale drainage networks in low-lying areas). LINZ currently are coordinating efforts to investigate the co-location of several existing sea-level gauges in New Zealand with GNSS monitoring to improve the coverage of VLM measurements (compared with the extensive GeoNet network which is focused on tectonic effects).
- In general, the Wellington region is subsiding at rates of between 2–5 mm/year. However, this subsidence is offset by Slow Slip Events (SSE) that periodically uplift the region by as much a 1 mm/year (averaged over 20 years). In addition to these ongoing subduction zone processes, the region has been displaced by recent large earthquake events. Coseismic deformation during events has created subsidence of up to 40 mm while the postseismic displacement has caused uplift of up to 50 mm. Note that the postseismic displacement is an ongoing adjustment process that will contribute more uplift (or subsidence), albeit at a decreasing rate, for the foreseeable future.
- While it is possible to estimate the secular subsidence (long term) and estimate with less certainty the SSE rate; it is not possible to determine the displacement of future earthquake events.

- However, the dynamic adaptive pathways planning (DAPP) approach adopted in MfE Coastal Guidance can also cover the uncertainty posed by unknown future seismic VLM. The DAPP process maps out alternative pathways or adaptation options, and then monitoring progress towards predefined triggers (or decision points) before switching pathways for a coastal area. Monitoring (e.g., number of damaging floods, SLR reached, insurance withdrawn etc.,) and reviewing the situation over the intervening time are crucial elements of this adaptive approach so that the switch to another pathway is undertaken in a timely manner—not too early, and not too late.

1.3 TERRITORIAL SOURCES

1.3.1 Wellington City

Tonkin and Taylor (June 2013) 'Sea Level Rise Options Analysis', Report prepared for Wellington City Council

- An assessment of the impact of sea level rise has been carried out for each coastal suburb, considering the impact on each of the four 'well-beings' – social, cultural, environmental and economic. This analysis was carried out for five sea level rise scenarios ranging from 0.6 metres (m) to 3.0 m plus a storm event with a 1% chance of occurring each year, recognising that the consequences of the highest scenarios may be so significant that they should be considered in current planning processes.
- A sea level rise of 1 m over the next 100 years is considered likely. Two scenarios are used in the study: Scenario 1: 0.6m sea level rise and Scenario 2: 1.5m sea level rise.
- Scenario 1
    - The effects of a 0.6 m rise in sea level are typically limited to the vicinity of the coastal fringe. Areas that are temporarily affected by coastal storms at present may become more frequently inundated and some areas may become permanently inundated. With no responses to the issue of sea level rise impacts will be the most financially significant in the highly urbanised suburbs of the Central Business District (CBD), Oriental Bay, Hataitai and Pipitea due to the high level of infrastructure development along the coast at these locations. Large areas of the low-lying suburb of Makara Beach will be inundated in this scenario. This will also significantly impact the Makara Estuary, one of the largest and valued salt marshes in the Wellington area, as well as the ecologically unique Makara foreshore reserve. Whilst some plant communities and species may be able to migrate upstream to match the rise in sea level, others may not be able to adapt at a rate that keeps up with the changing levels and could be adversely affected.

- Scenario 2
    - A 1.5 m rise in sea level has a much more widespread impact. At this level large areas of the CBD would be inundated, along with much of the low lying area of

Kilbirnie. Impacts will also be most financially significant in these suburbs, with damage to land, buildings and infrastructure of around $5bn in the CBD area alone.

- Analysis
    - Data used for the four focus areas: Population, community facilities, community connectivity, social equity.
    - Environmental – used sites of environmental significance, whether threatened species identified as nationally or regionally important.
    - Economic – amount of damage to land, building and infrastructure assets in suburb
    - Cultural – amount of Maori sites affected and whether they are of regional significance, and heritage sites
    - Used a 0 to 5 scale
- Options for responding: Non-intervention, managed retreat, hold the line (defend), accommodate or expand into the coastal zone.
- Rising sea levels may increase the likelihood or consequence of other natural hazards, including surface water and groundwater flooding, landslides and the consequences of earthquakes including liquefaction.
- This study recommended that WCC develop a Sea Level Rise Adaptation Strategy (Strategy).

Wellington City Council, 'Wellington Resilience Strategy'. March 2017.

- The strategy sets out a blueprint to enable Wellingtonians to better prepare for, respond to, and recover from disruptions. It is designed to maintain and build on the resilience momentum that has been generated to date.
- Three goals support the strategy: that people are connected, empowered and feel part of a community; that decision making is integrated and well informed; and that homes, natural and built environment are healthy and robust.
- Included a series of actions such as:
- Action: Develop a communications and engagement strategy for the Adaptation Plan
    - The project will start conversations with communities about climate change and especially sea level rise to make the process of developing our Adaptation Plan more inclusive and reflective.
    - The project will maximise the use of natural infrastructure to protect the coast from storm damage and preserve our beaches and dunes, which are essential to Wellington's quality of life.
- Action: Encourage climate adaptation actions
    - Work with the education, arts and sports sectors to develop new, creative and engaging ways of communicating about climate change and take every opportunity to communicate about sea level rise

    - Modify the Low Carbon Challenge to include climate change adaptation initiatives that promote environmental restoration and community cohesion
    - Introduce a Wellington climate change adaptation fund to help cover the future costs of infrastructure redevelopment and other works required to deal with the effects of sea level rise.
- Leverage transportation investment to improve Wellington's resilience
    - Advisory project, where the Council will be an active partner and resilience champion for the following projects:
        - Coastal cycleways: improving cycle network and coastal defence
        - Petone to Ngauranga link: addressing vulnerability of link between Hutt and central Wellington
        - Let's Get Wellington Moving: reducing congestion in the central city
        - Future of the Port: reducing vulnerability of the port

1.3.2 Kapiti Coast

Carley et al June 2014 Coastal Erosion Hazard Assessment for the Kāpiti Coast: Review of the Science and Assessments Undertaken for the Proposed Kāpiti Coast District Plan 2012

- The Kāpiti Coast District Council (KCDC) appointed a Panel of Experts to assist them in resolving issues raised concerning methodologies and the resulting coastal hazard zones developed in the reports by Coastal Systems Ltd (CSL, 2008a, 2008b, 2008c, 2012).
- Based on its review, it is the opinion of this Panel that the hazard lines recommended by CSL are not sufficiently robust to be incorporated into the Proposed District Plan, and those completed by Lumsden in 2003 need to be updated to account for more recent analyses of the ocean processes, in particular the higher rates of rising sea levels that are now projected by climatologists. With the results of their analyses having complimented one another, respectively having focused on the long-term trends of rising sea levels and the progressive erosion of the Kāpiti shores, and the short-term destructive impacts of extreme-storm events, it is this Panel's recommendation that these contributions by both should be considered by KCDC in the development of more robust hazard lines to be included in their District Plan.
- Recommendations:
    - That the time series of shoreline changes derived by CSL for the 68 sites along the Kapiti Coast be analysed to separate the respective contributions produced by sea-level rise during the 20th century, and that produced by gains and losses of beach sand at that site, its sediment budget, eliminating the "double counting" of the rise in sea level from the projected 50- and 100-year hazard zones.
    - Undertake analyses of beach-sediment budgets to determine the gains and losses of the beach sand that should account for the shoreline changes found in the CSL determinations, including particular attention given to the rivers, the

principal source of the beach sand, and how global warming or human environmental impacts could change the volumes of sand being contributed to the Kāpiti beaches.

- Compare the sediment budget analyses with the projected rates of rising sea levels to assess if and when the accretion of its central cuspate shore might revert to erosion and eventually disappear, exposing the properties along that shore to storm impacts.
- The analyses by Lumsden (2003) be updated to include the additional wave hindcast data available from the MetOcean reports, and the increased sea levels that are now projected by climatologists, with the revised results used for the short-term factor in the Kapiti Coast's hazard lines, replacing CSL's "fluctuation" values.

1.3.3 Hutt City

Decadal shoreline stability in Eastbourne, Wellington Harbour, David Olson (A thesis submitted to Victoria University of Wellington, in partial fulfillment of the requirements for the degree of Master of Science in Physical Geography (December 2009).

- Eastbourne in Wellington has changed from a retreating sandy beach to an advancing gravel beach, although the sea has been rising for a hundred years or so.
- This thesis examined spatial and temporal morphological change through such a system in Eastbourne, Wellington Harbour, New Zealand. This site has only recently prograded following several decades of erosion.
- The most significant finding to come out of this study relates to whether the change currently observed along Eastbourne's shoreline is a short-term beach adjustment to a gravel pulse, or a more permanent adjustment relating to longer term changes in supply and/or transport processes. The temporal results of this research have indicated a more permanent change to the morphology and sedimentology of this coastline.

1.3.4 Porirua

At the time of writing there was no publicly accessible research available on the Porirua coastline.

1.3.5 Other Territorial Authorities in Wellington Region

Wairarapa Coastal Strategy Group, 2004. Wairarapa Coastal Strategy, 2004. 'Caring for our coast – a guide for coastal visitors, residents and developers'.

- The Strategy is a joint initiative of the Masterton, Carterton, and South Wairarapa District Councils, Rangitaane o Wairarapa, Ngati Kahungunu o Wairarapa, and Greater Wellington Regional Council.

Wairarapa Coastal Strategy Group, 2002. Coastal Hazards in the Wairarapa, Wairarapa Coastal Strategy Technical Report

- On the Wairarapa Coast, the type of natural hazards and the undeveloped nature of the coast mean it is not usually practical to use structures such as seawalls to lessen the effect of hazards. A better approach is to use careful planning to avoid placing people or new development in known hazard areas.
- Issue: There is the potential for loss of life and damage to property and infrastructure on the Wairarapa Coast due to the natural processes of coastal erosion, tsunami, storm surge, storm wave attack and sea level rise. Land based hazards such as flooding, wind storms, erosion, landslide or rockfall can also occur.
- For existing buildings or infrastructure, it is recommended to explore the option of moving them away from the hazard area; consider “soft” engineering solutions like dune protection; and, only as a final resort, use “hard” protection structures to protect community infrastructure and public health and safety.

C

APPENDIX C

Heat Maps

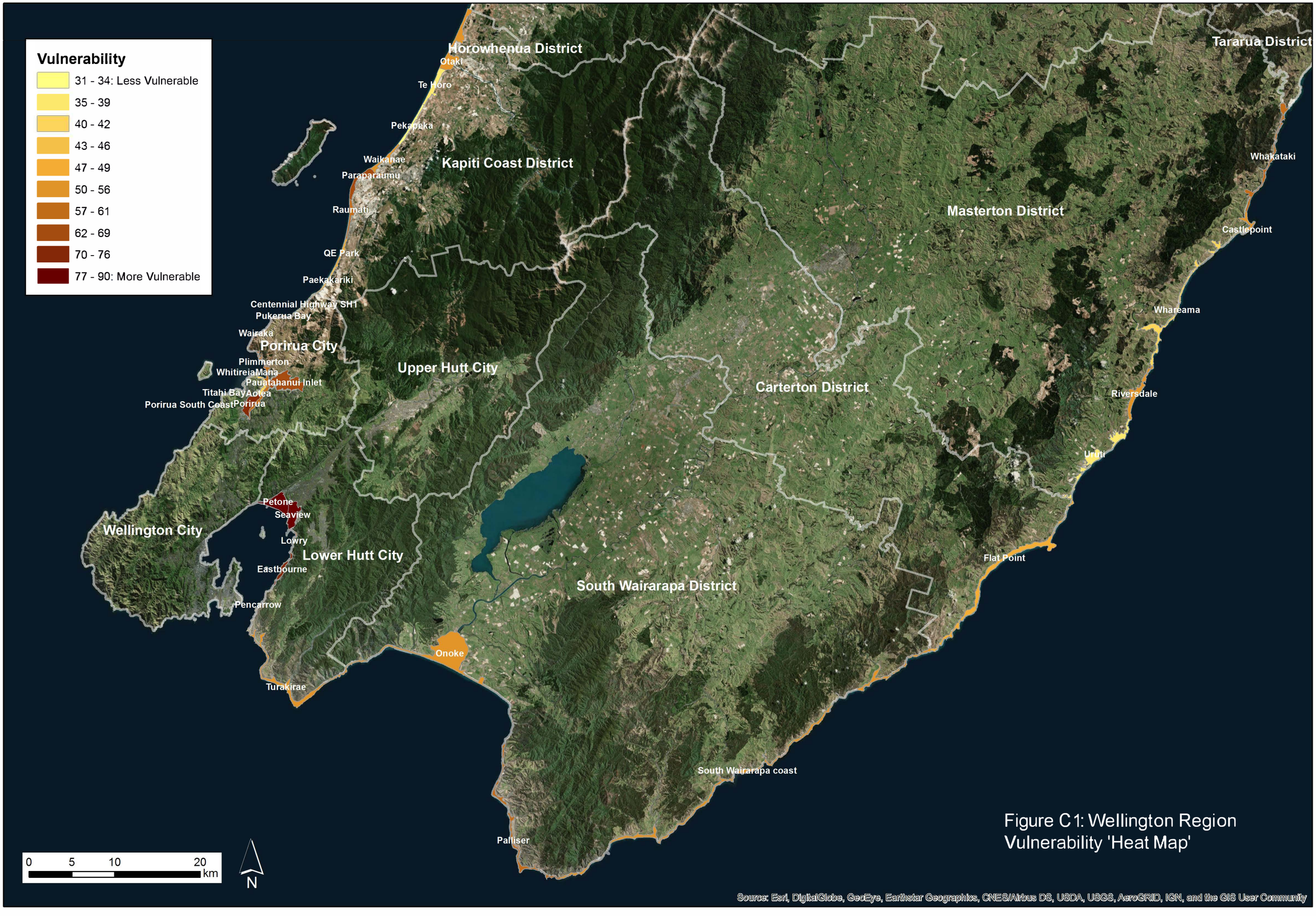
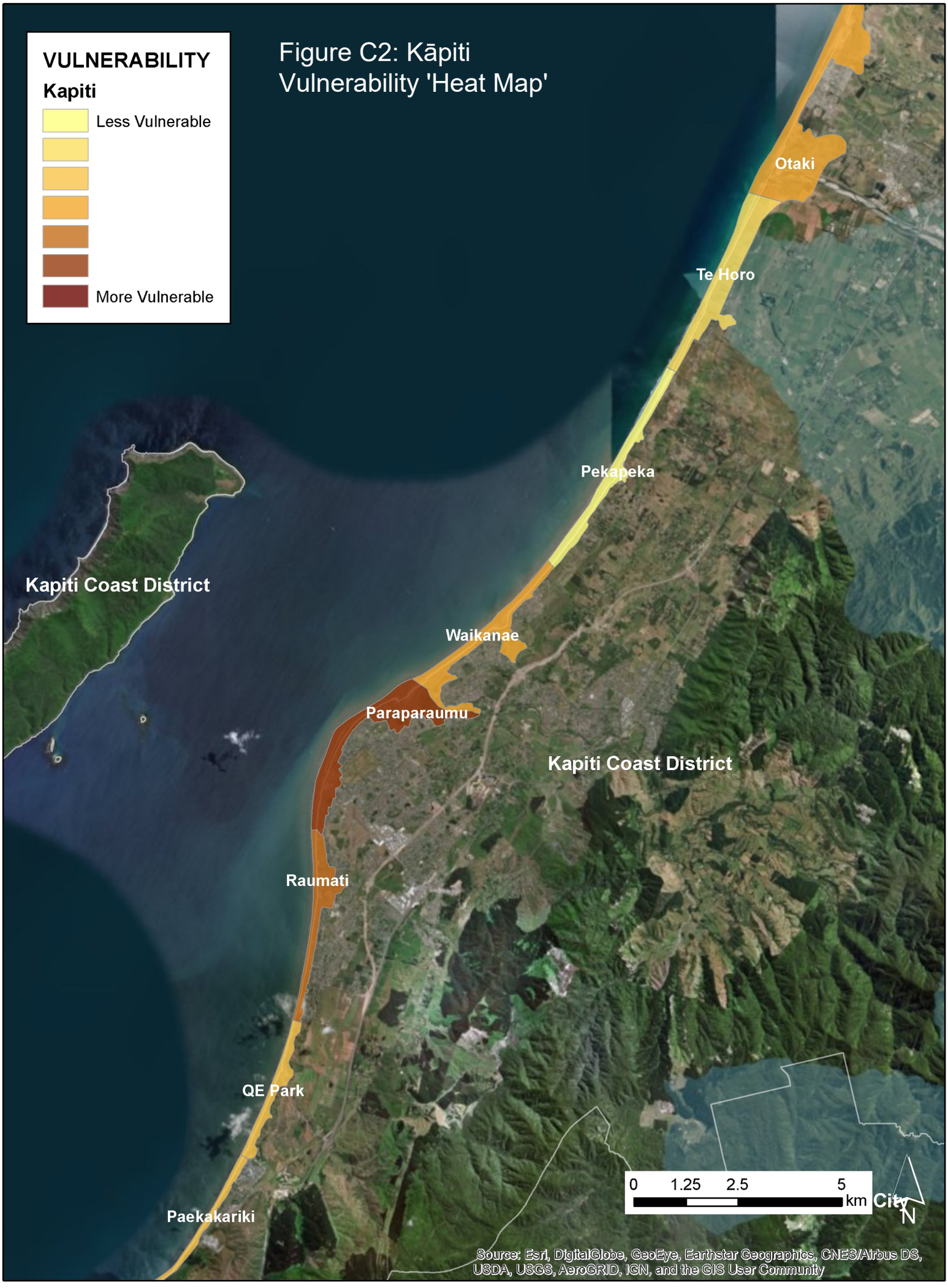
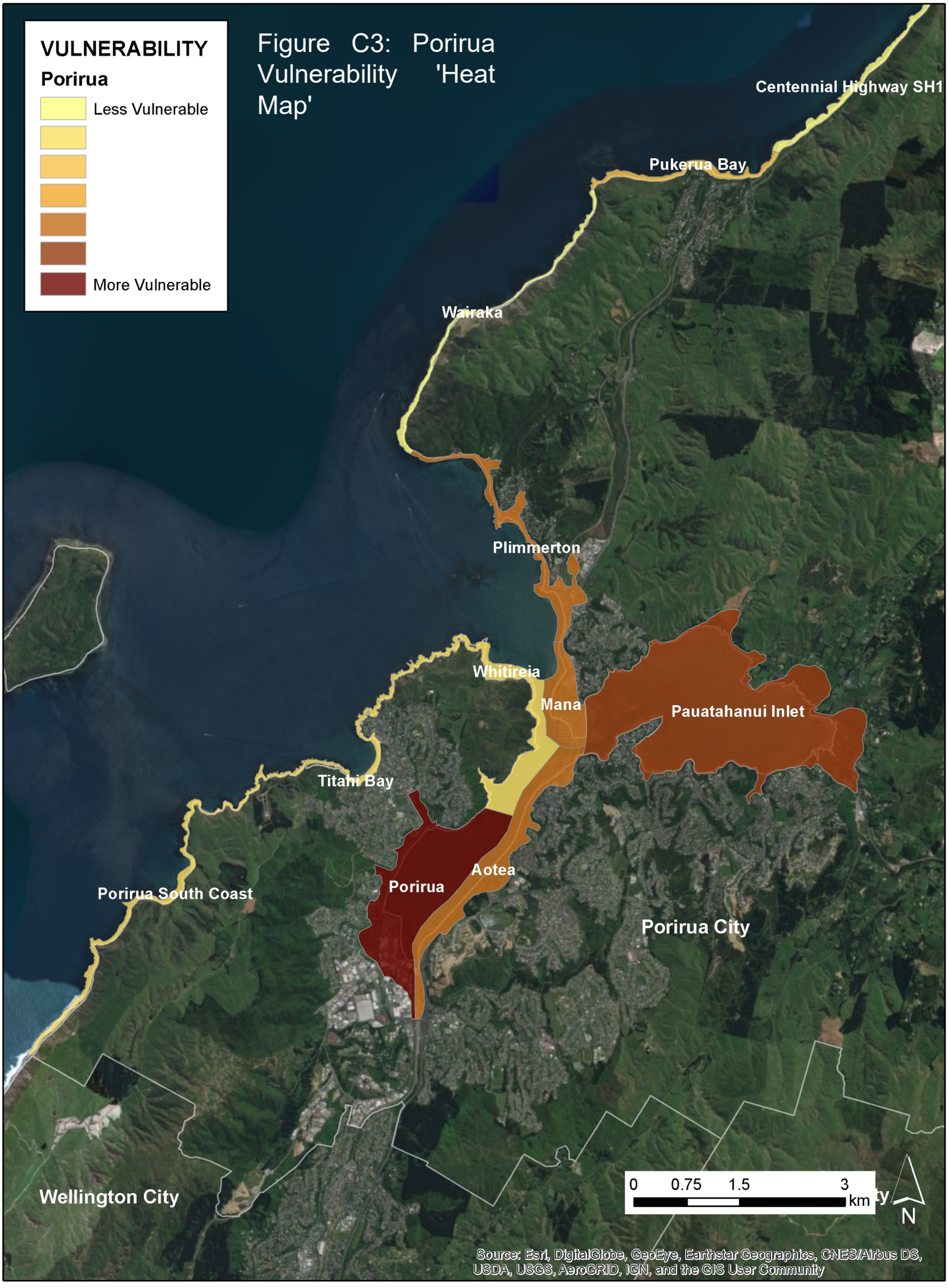
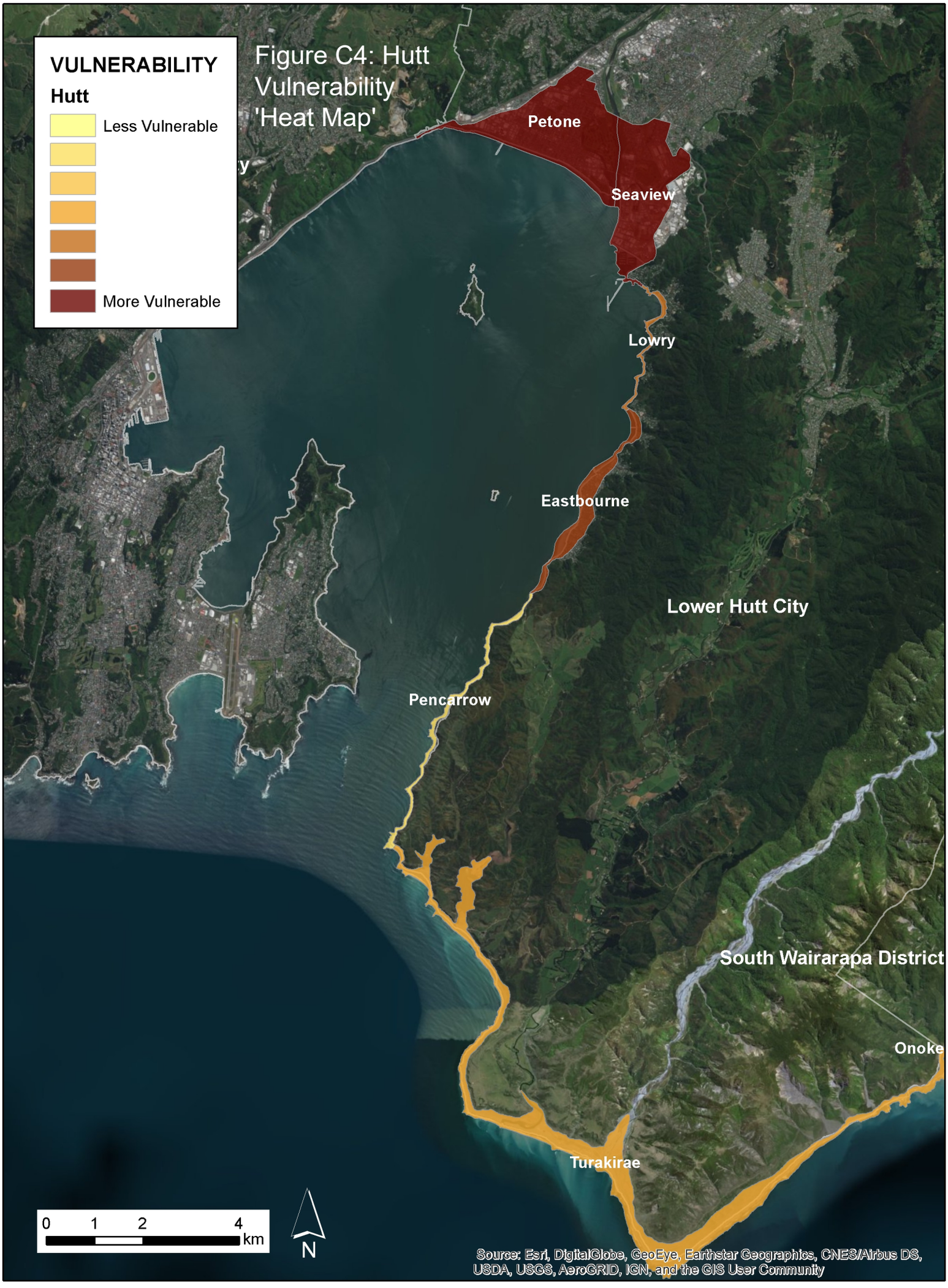


Figure C1: Wellington Region Vulnerability 'Heat Map'


VULNERABILITY
Kapiti
Less Vulnerable
More Vulnerable
Figure C2: Kāpiti
Vulnerability 'Heat Map'
Otaki
Te Horo
Pekapeka
Kapiti Coast District
Waikanae
Paraparaumu
Kapiti Coast District
Raumati
QE Park
Paekakariki
0 1.25 2.5 5
km
City
N
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community


VULNERABILITY
Porirua
Less Vulnerable
More Vulnerable
Figure C3: Porirua Vulnerability 'Heat Map'
Centennial Highway SH1
Pukerua Bay
Wairaka
Plimmerton
Whitireia
Mana
Pauatahanui Inlet
Titahi Bay
Aotea
Porirua
Porirua South Coast
Porirua City
Wellington City
0 0.75 1.5 3
km
N
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community


VULNERABILITY
Hutt
Less Vulnerable
More Vulnerable
Figure C4: Hutt Vulnerability 'Heat Map'
Petone
Seaview
Lowry
Eastbourne
Lower Hutt City
Pencarrow
South Wairarapa District
Onoke
Turakirae
0 1 2 4 km
N
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

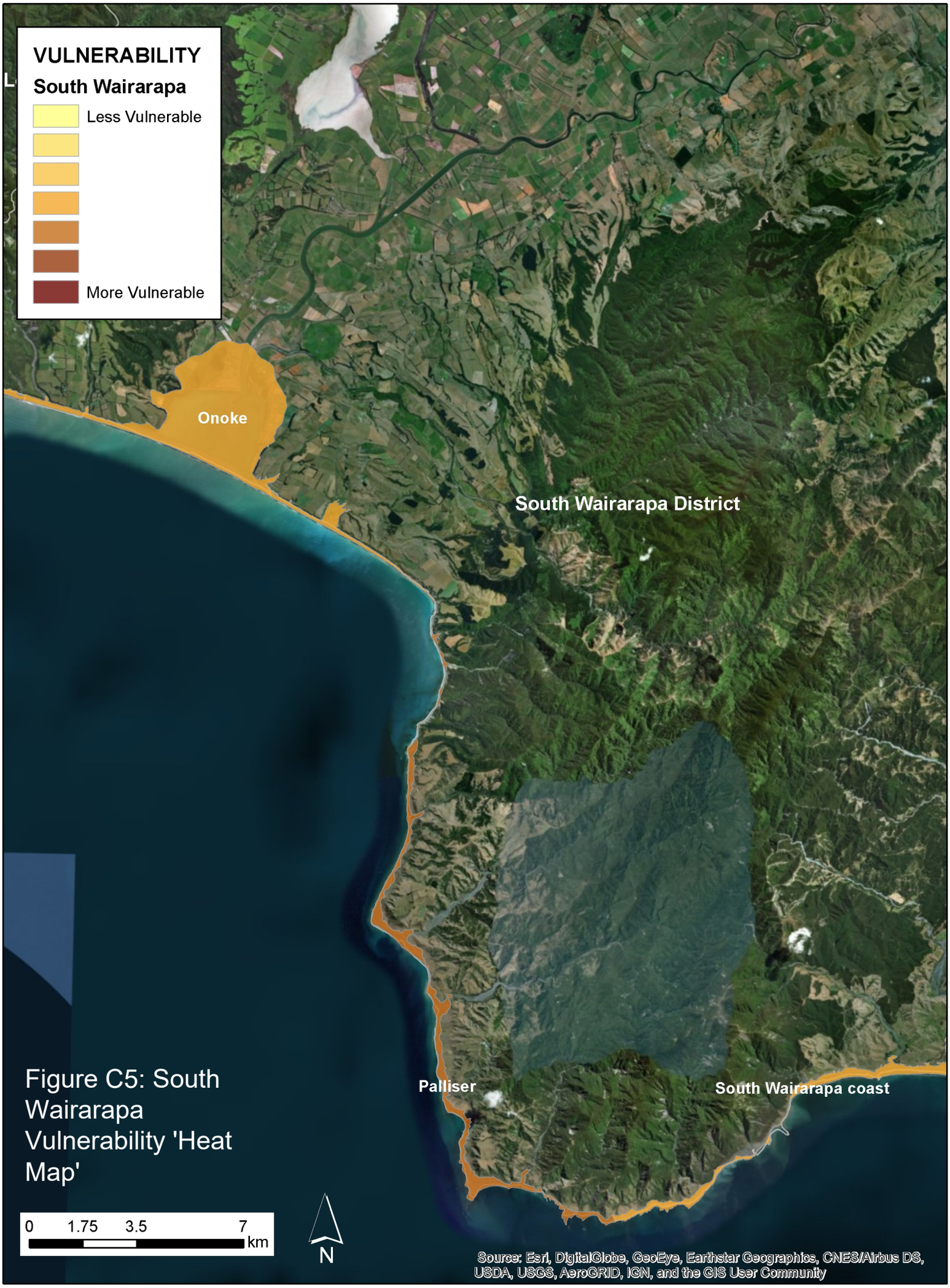


Figure C5: South Wairarapa Vulnerability 'Heat Map'

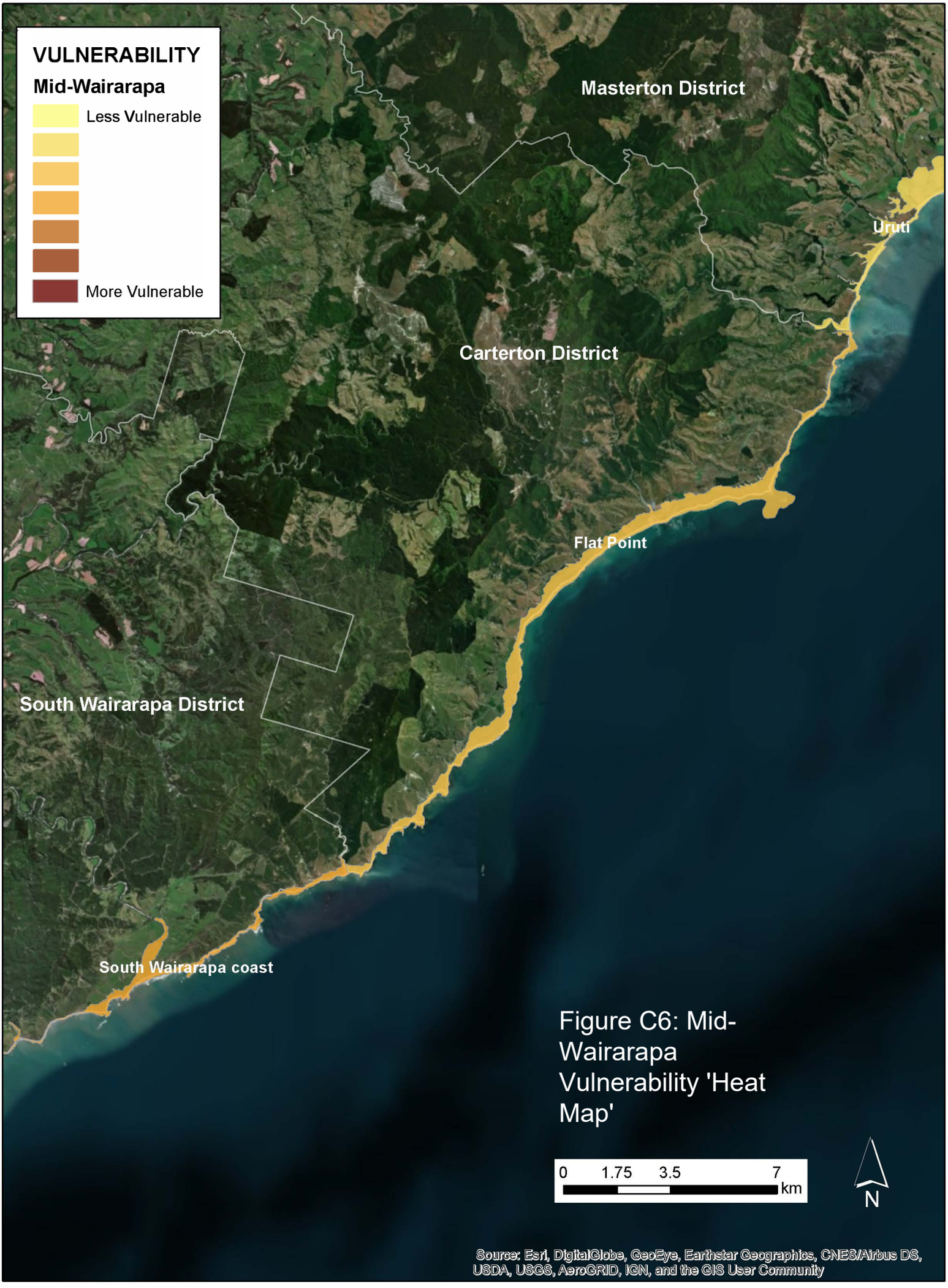


Figure C6: Mid-Wairarapa Vulnerability 'Heat Map'

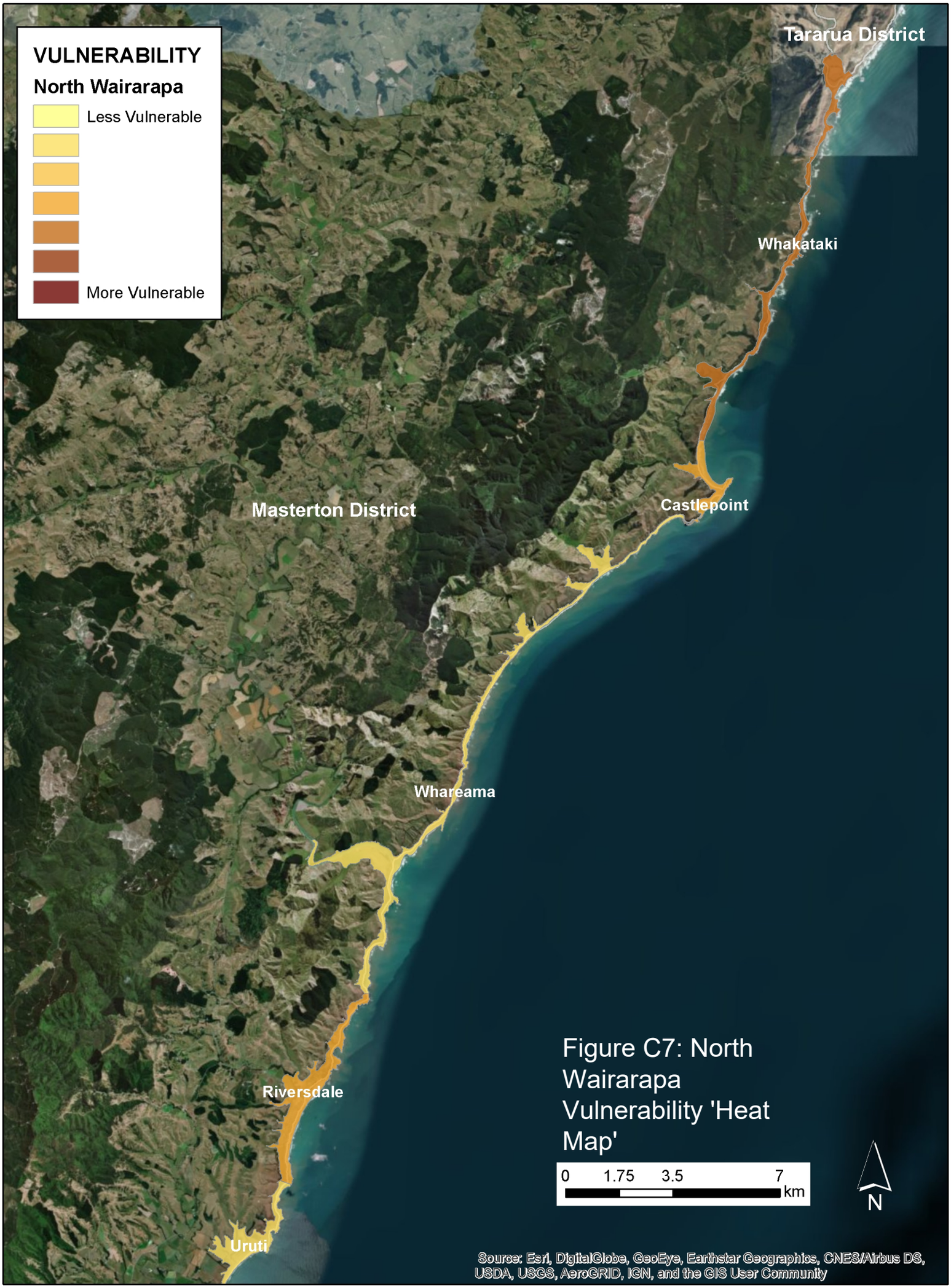


Figure C7: North Wairarapa Vulnerability 'Heat Map'

D

APPENDIX D

Summary of Vulnerability Assessment Criteria Scoring

Results Spreadsheet

No	Unit	Name	GRAND TOTAL	Population SCORE	IMD SCORE	Community services SCORE	Emergency services SCORE	Prpty resident cap val SCORE	Prpty bus cap val SCORE	Prpty bus tot area prcnt SCORE	Roads m SCORE	Roads priority m SCORE	Single access SCORE	Water SCORE	Sewer SCORE	Stormwater SCORE	Telecoms SCORE	Electricity SCORE	Gas SCORE	Fuel storage SCORE	Defence structures prcnt SCORE	Mana whenua SCORE	NZAA SCORE	DoC Ecosites SCORE	Birds SCORE	Coastal bio SCORE	Erosion hazard
1	K_01	Otaki	55	4	4	1	1	4	3	2	3	2	1	4	2	2	1	2	1	1	1	3	2	3	4	3	1
2	K_02	Te Horo	38	4	3	1	1	3	2	2	2	1	1	1	1	1	1	1	3	1	1	1	2	1	1	2	1
3	K_03	Pekapeka	34	3	2	1	1	3	2	2	1	1	1	2	1	1	1	1	1	1	1	1	2	1	1	1	2
4	K_04	Waikanae	54	5	3	1	1	4	2	1	3	1	1	5	3	3	1	2	1	1	1	3	3	2	2	3	2
5	K_05	Paraparaumu	66	5	3	1	1	4	3	2	4	1	1	5	4	4	3	3	1	1	3	4	2	3	4	1	3
6	K_06	Raumati	59	5	3	3	1	4	3	2	3	1	1	5	3	3	2	3	1	1	5	1	2	1	1	2	3
7	K_07	QE Park	47	1	3	1	1	1	2	3	1	1	1	2	1	1	1	1	1	1	2	5	4	5	1	3	4
8	K_08	Paekakariki	46	4	3	1	1	4	1	1	2	2	1	4	1	1	1	2	1	1	5	1	2	2	1	1	3
9	P_01	Centennial Highway SH1	33	1	1	1	1	1	1	1	3	3	1	1	1	1	1	1	1	1	5	1	1	1	1	1	2
10	P_02	Pukerua Bay	44	3	2	1	1	3	1	1	1	1	5	1	1	1	1	1	1	1	2	2	2	3	5	1	3
11	P_03	Wairaka	31	1	1	1	1	1	1	4	1	1	1	1	1	1	1	1	1	1	1	1	2	4	1	1	1
12	P_04	Plimmerton	59	4	2	3	3	4	2	2	3	3	1	4	3	2	2	4	1	1	4	2	2	1	1	2	3
13	P_05	Mana	57	3	2	1	2	3	3	3	2	2	1	4	2	2	1	4	1	1	4	1	3	4	2	3	3
14	P_06	Pauatahanui Inlet	69	4	1	1	1	4	2	2	4	4	1	3	2	2	1	4	4	1	3	3	5	5	5	5	2
15	P_07	Aotea	57	2	1	2	1	3	2	3	4	4	1	2	2	2	3	2	1	1	5	2	2	3	5	2	2
16	P_08	Porirua	76	4	5	4	1	3	4	3	4	3	1	4	3	5	2	5	3	1	3	3	1	5	5	1	3
17	P_09	Whitireia	41	1	4	1	1	1	1	1	1	1	1	1	2	1	1	1	1	1	1	4	3	5	5	1	1
18	P_10	Titahi Bay	38	2	4	1	1	3	1	1	1	1	1	1	1	1	1	1	1	1	3	3	2	3	1	1	2
19	P_11	Porirua South Coast	39	2	4	1	1	1	3	5	1	1	1	1	1	1	1	1	1	1	1	1	2	5	1	1	1
20	H_01	Petone	87	5	3	5	2	5	5	4	5	3	1	5	5	5	5	5	5	1	4	2	2	2	3	3	2
21	H_02	Seaview	90	5	4	5	2	4	4	3	4	4	1	5	5	5	5	5	5	5	5	2	2	2	3	3	2
22	H_03	Lowry	59	4	1	1	1	4	1	2	2	3	5	4	3	2	4	4	1	1	5	1	1	4	1	1	3
23	H_04	Eastbourne	72	5	1	5	2	4	2	2	4	3	5	5	4	3	4	5	1	1	4	2	2	4	1	1	2
24	H_05	Pencarrow	39	1	2	1	1	1	2	3	3	1	1	1	2	1	1	1	1	1	3	1	3	4	1	1	2
25	H_06	Turakirae	53	2	2	1	1	1	2	4	4	2	1	1	1	1	1	2	1	1	2	4	4	5	5	3	2
26	SW_01	Onoke	56	3	2	1	1	3	3	3	3	3	1	1	1	1	1	3	1	1	1	5	2	5	5	5	1
27	SW_02	Palliser	61	2	2	1	1	3	4	3	4	5	5	1	1	1	1	4	1	1	3	2	4	3	1	4	4
28	SW_03	South Wairarapa coast	53	3	2	1	1	3	4	3	4	1	1	1	1	1	1	4	1	1	1	2	5	4	4	3	1
29	C_01	Flat Point	49	2	1	1	1	3	4	4	2	3	5	1	1	1	1	4	1	1	1	1	2	3	3	2	1
30	M_01	Uruti	37	2	1	1	1	2	4	5	1	1	1	1	1	1	1	2	1	1	1	1	1	4	1	1	1
31	M_02	Riversdale	54	3	2	3	1	4	4	2	3	2	5	1	1	1	1	4	1	1	1	3	1	3	3	3	1
32	M_03	Whareama	42	2	2	1	1	1	3	4	1	1	1	1	1	1	1	2	1	1	1	3	2	4	3	3	1
33	M_04	Castlepoint	54	3	2	2	1	3	1	1	1	2	5	1	1	1	1	2	1	1	3	5	3	4	4	3	3
34	M_05	Whakataki	60	3	2	1	1	3	3	3	4	5	5	1	1	1	1	4	1	1	1	4	3	3	3	4	2