Te Tai o Poutini Plan – Section 32 Evaluation

Report Three – Hazards and Risks Ngā Pūmate me ngā Mōrea

Part One

Natural Hazards – Ngā Mōreareatanga Aotūroa – including Coastal Hazards

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Executive Summary

The analysis set out in this report is to fulfil the obligations of the Council under Section 32 of the Resource Management Act (RMA). This s32 evaluation report relates to the Hazards and Risks Section. This is made up of Hazardous Substances, Contaminated Land and Natural Hazards.

Part One: Natural Hazards

A wide range of natural hazards have the potential to adversely affect the West Coast. These include flooding, coastal erosion and inundation, slope instability, tsunami (lake and coastal) and earthquakes. The Urban Form and Development Strategic Objective is of particular relevance to the Natural Hazards Chapter as it specifically seeks to:

3. Recognise the risk of natural hazards whereby new development is located in less hazardous locations…

The Natural Hazards Chapter will assist the Councils to fulfil their statutory functions and responsibilities as required by the RMA through the following proposed objectives, policies and rules:

Objectives to:

- be regionally consistent in approach,
- use a risk-based approach,
- avoid subdivision, use and development where there is a high risk to life,
- manage activities in other areas, while also supporting post natural hazard event response,
- ensure that development and mitigation of hazards does not exacerbate the hazard to others,
- recognise that mitigation can be anything from natural barrier to hard protection structures,
- recognise and provide for the effects of climate change, and its interrelationship with natural hazards.

Policies that:

- address the management of natural hazards generally on the West Coast and specifically in relation to coastal hazards, flood hazards, earthquake hazards, land instability hazards and tsunami (coastal and lake) hazards. There are also location specific provisions in Hokitika and Westport.

Rules that:

- generally avoid new development in severe hazard areas
- manage natural hazard risk in areas that are not severe hazard areas but that are subject to natural hazards
- Recognise existing activities and infrastructure already located in areas subject to hazards

Definitions for:

- Unoccupied buildings
- Critical Response Facilities
- Sensitive Activity
- Greenfield
- Brownfield
- Additions and Alterations
- Natural hazard mitigation activities
- Natural hazard mitigation structure

Overlays on Planning Maps that identify where particular natural hazards need to be managed.

The West Coast Regional Policy Statement directs the Proposed TTPP to assess coastal hazard risk over a 100-year timeframe. When identifying areas that could be susceptible to such hazards, we have also taken into account climate change effects.

Due to the age of the three Operative Plans, they currently have only minimal provisions for natural hazards. Since the development of these plans the management of significant natural hazard risk has become a matter of national importance in the RMA. Buller District Plan Change 138 proposed new

policies, submissions were received, but decisions were not issued on this change. The impact and understanding of the significance of this matter to the West Coast has also increased.

The Proposed TTPP natural hazard provisions are largely new for the three Districts. Existing provisions in the Operative District Plans include:

- Setbacks from the coastal environment for buildings in the rural zones,
- Mapped coastal and flood hazards at Hokitika and the Waiho River in Westland,
- Setbacks from instability hazards at Greymouth,
- Land instability areas in Buller.

The proposed TTPP natural hazard provisions reflect a substantial increase in the areas identified as being at significant risk to natural hazards and include:

- Identification of specific Coastal Hazard Overlays and associated rules in areas at risk from coastal inundation, and severe coastal erosion.
- Standardisation of the setback from the coastal environment for buildings in the Coastal Environment to 100m, in any location where there is not a Coastal Alert or Coastal Severe Hazard Overlay. This is a precautionary approach where the risk is not known.
- Identification of specific Flood Hazard Overlays and associated rules. When identifying areas that are susceptible to flooding, a 1%year Annual Exceedance Probability (AEP) event has been used, which has been modelled to take into account climate change effects.
- A flood plain overlay with subdivision rules in areas where there is known flood hazard, but the level of risk is unknown. This is a precautionary approach.
- Identification of Earthquake Hazard Overlays from the Alpine, Hope, Clarence and Awatere Faults and associated rules. Activities likely to result in loss of life during an earthquake, or for critical post-earthquake facilities are heavily restricted. The location of these faults is known with a degree of certainty, and a recurrence interval of less than 2000 years. There are variable buffers limiting a range of different activities depending on the proximity to the active fault trace to continue to allow for economic wellbeing.
- Identification of lake tsunami overlays proximate to the Alpine Fault across the West Coast.
- Identification of coastal tsunami overlay with rules to discourage critical infrastructure development.
- Identification of areas with unstable land including erosion prone land, debris flow, rockfall and landslide.

The operation and maintenance of existing natural hazard mitigation structures are provided for without having to comply with the earthworks standards of any part of the Proposed TTPP, but new natural hazard mitigation works require consideration of their effects on the hazardscape, including other hazard protection structures. Natural hazard mitigation structure effects on other overlays, such as Outstanding Natural Landscape, are addressed within those overlay chapters.

Note. LIDAR is a method for determining ranges by targeting an object or a surface with a laser and measuring the time for the reflected light to return to the receiver. In the technical work undertaken for this topic it is used as a basis for high accuracy digital elevation models. The data gathering is a multiple year national project. Some parts of the region have been flown, quality assured, and delivered, others are not expected to be flown until 2023.

Part One: Natural Hazards

1. Overview and Purpose

This s32 evaluation report should be read in conjunction with the s32 'Overview Report', which also includes an overview of the s32 legislative requirements, the methodology and approach to the s32 evaluations and the process that the TTPP Committee has undertaken to date through the development of Te Tai o Poutini Plan, including consultation and engagement.

1.1 Introduction to the Resource Management Issue

The West Coast is subject to a range of natural hazards, and people live and own property in areas susceptible to their effects. Effective planning for and management of natural hazards reduces the negative impacts of natural hazards on people, property and other aspects of the environment. Many of the natural hazards are interrelated. Heavy rain may cause flooding and trigger landslides for example.

A key focus of natural hazard planning is risk reduction. By identifying significant risks, TTPP Committee aims to ensure communities are informed about the hazardscape. Through TTPP, the West Coast Councils and Runanga also take steps to ensure these risk are not exacerbated, are avoided where the risk is intolerable, or otherwise reduce the likelihood and magnitude of their impact including by planning for post disaster response.

The Proposed TTPP takes a flexible, risk-based approach to existing development, and a risk reduction approach to new development within identified hazard areas (including avoidance where appropriate). The Plan also advocates an adaptive management approach to manage hazards and the effects of climate change.

Not all natural hazards as defined in the RMA are significant on the West Coast; therefore, it is not appropriate or necessary for TTPP to manage all natural hazards.

The Natural Hazards chapter and this report detail management of risks that present the greatest risk to the West Coast communities in terms of likelihood and consequence, as follows:

1. Flood Plains (Oparara, Little Wanganui, Grey, Taramakau, Inangahua, Arahura, , Mikonui, Kakapotahi, Wanganui, Poerua, Whataroa, Waitangitaona, Waitangiroto, Fox, Cook, Karangaroa, Makaawhio, Paringa, Haast, Okuru, Waiatoto, Arawhata) - these areas are managed through the Subdivision provisions)
2. Flood Hazard – Severe and Susceptibility (Karamea, Mokihinui, Ngakawau, Waimanagaroa, Buller (noting specific Westport provisions), Nile, Grey, Hokitika, Waiho and Haast)
3. Earthquake Hazard Areas (Alpine, Hope, Clarence and Awatere fault lines).
4. Lake Tsunami
5. Land Instability
6. Coastal Inundation and Erosion (Coastal Severe) Areas, and Coastal Inundation (Coastal Alert) Areas
7. Coastal Tsunami Hazard
8. Westport and Hokitika specific provisions

The Proposed TTPP does not include identification and management of the following potential hazards, for reasons outlined in this report:

- liquefaction;
- sedimentation;
- high winds;
- tornadoes;
- drought; and
- fire.

Effects of these risks may be considered in future planning applications such as plan changes and resource consents, including subdivision assessments under Section 106 of the RMA.

Civil Defence Emergency Management (CDEM) also plays a role in hazard management. The reduction and response to natural hazards are key facets of CDEM. TTPP supports that work. The Councils also have functions under the Building Act 2004 in relation to hazard management, including regulating buildings in wind zones and building on land subject to natural hazards. TTPP Committee has used the best information available in relation to natural hazards. However, the quality and detail of information varies, and the West Coast Councils are continuing to work together to gather, assess and refine information so that subdivision, use and development can be well managed.

TTPP Committee expects management of natural hazard risks to have an increased focus in the coming decades, particularly as the uncertainties around the effects of climate change become better understood by territorial authorities and their communities. Central Government legislation is also expected to provide further direction on management.

This report outlines the planning provisions relevant to Hazards 1-8 above with a focus on:

1. Identification and mapping of natural hazards.
2. Managing activities to minimise risk.

It provides an overview of the statutory and policy context, sets out the trends and issues, and summarises specific consultation carried out. It also includes a review of the existing plan provisions and evaluation of alternatives to arrive at recommendations for the most appropriate way(s) to achieve the purpose of the Resource Management Act 1991 (RMA) in relation to natural hazards.

1.2 Statutory and Policy Direction

1.2.1 The Resource Management Act

The Resource Management Act (RMA) sets out the functions of regional councils under Section 30, and the functions of territorial authorities under Section 31.

The RMA requires the West Coast Councils to control any actual or potential effects of the use, development, or protection of land for the purpose of the avoidance or mitigation of natural hazards.

In undertaking its functions, the RMA requires TTPP Committee to recognise and provide for the management of significant risks from natural hazards as a matter of national importance (Section 6).

It also requires the TTPP Committee to have particular regard to the maintenance and enhancement of the quality of the environment, and the effects of climate change (Section 7).

Section 106 of the RMA requires the consideration for all risks from natural hazards in subdivision consent applications, and the relevant Council has the ability to refuse subdivision consent if there is significant risk from natural hazards.

The RMA also states that district plans must give effect to the New Zealand Coastal Policy Statement (NZCPS) and the WCRC's Regional Policy Statement. These functions essentially direct the TTPP Committee to consider how future development may be impacted by natural hazards (including those intensified by climate change) while also avoiding or mitigating natural hazards by recognising that inappropriate land use and development can exacerbate natural hazards and put more people and properties at risk. These matters are relevant when considering natural hazards issues in the development of TTPP.

The RMA, particularly sections 6 and 106, and the NZCPS, encourage taking a risk-based approach to managing natural hazard planning and decision-making under the RMA, taking into account both the likelihood and consequences of natural hazards.

1.2.2 National Instruments

New Zealand Coastal Policy Statement 2010 (NZCPS)

Section 75(3)(b) of the RMA directs that a district plan must give effect to any New Zealand coastal policy statement. The NZCPS deals specifically within the New Zealand coastal environment, and the district plan must give effect to it (s75(3)(b) RMA). In respect to natural hazards its focus is coastal hazards including consideration of climate change.

The key objective and policies in the NZCPS of relevance to managing natural hazards on the West Coast are:

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.*

Supporting this objective are polices including, Policy 3 (precautionary approach), Policy 24 (identification of coastal hazards), Policy 25 (subdivision, use and development in areas of coastal hazard risk), Policy 26 (natural defences against coastal hazards) and Policy 27 (Strategies for protecting significant existing development from coastal hazard risk).

Relevant matters in terms of this topic include:

- priority to maintaining and protecting natural features as defences against coastal hazards to protect coastal land uses;
- the requirement to identify areas in the coastal environment potentially affected by coastal hazards over the next 100 years including consideration of the effects of climate change;
- avoiding redevelopment, or change in use that would increase the risk of adverse effects; discouraging hard protection structures were practicable; and
- identifying long-term sustainable risk reduction approaches, including relocation or removal of existing development and structures at risk.

National Environmental Standards for Telecommunications Facilities 2016 (NES-TF)

Regulation 57 of the NES-TF prevents the TTPP from making natural hazard rules that relates to an activity subject to the NES-TF. This is on the basis that resilience is already factored into telecommunication industry practice, and that they will either avoid hazard areas or engineer structures to be resilient to the hazard risk. As such, activities subject to the NES-TF will not be subject to the rules of the Proposed District Plan.

However, should a resource consent be required under the NES-TF, then TTPP objectives and policies do apply, including those relating to natural hazards.

National Environmental Standards for Plantation Forestry 2018 (NES-PF)

The NESPF does not contain provisions addressing the wildfire risk of plantation forestry. However, there are setback provisions within the NESPF addressing other matters which could influence the degree of risk wildfire represents. These restrictions only apply to afforestation over one hectare and must be for commercial harvesting.

National Water Conservation (Buller River) Order 2001

Section 75(4)(a) of the RMA directs that a district plan must not be inconsistent with a water conservation order. The National Water Conservation (Buller River) Order 2001 is concerned with the outstanding recreational characteristics, wild and scenic characteristics, fisheries and wildlife habitat and outstanding scientific values. It directs in Clause 7 that a resource consent shall not be granted allowing the damming of waters in Schedule 2, Clause 8 places restrictions on alterations on river forms and flow, Clause 9 restricts alteration of lake levels in Lake Rahui and Clause 12 restricts alteration of lake levels in Lake Matiri.

National Water Conservation (Grey River) Order 1991

The National Water Conservation (Grey River) Order 1991 is concerned with the protection of the outstanding natural characteristics of the incised river gorge with a meandering pattern and its outstanding scenic features. The provisions of the Order relate to the retention of the waters of the Blue Grey River in their natural state (Clause 4). Clause 5 relates to preventing the granting of a resource consent for hydro-electric development and damming.

1.2.3 National Planning Standards and/or Guidance Documents

National Planning Standards

The following aspects of the National Planning Standards are relevant to this topic / issue:

1. The National Planning Standards direct, that local authorities must implement the District Wide Matters Standard, including a Hazards and Risks heading.
2. If matters relating to natural hazards (except coastal hazards) are to be addressed in the plan, they must be located in the Natural hazards chapter under the Hazards and Risks heading.
3. The Natural Hazards chapter must include cross references to any coastal hazard provisions in the Coastal Environment chapter, located under the General district-wide matters heading.
4. The Coastal Environment chapter must set out provisions for implementing the local authority's functions and duties in relation to coastal hazards and provide cross-references to any other specific coastal provisions that may be located within other chapters.
5. All the objectives and over half of the policies relating to coastal hazards are those that apply to natural hazards more widely.
6. That provisions to implement these objectives and policies are located in the same chapter as the objectives and policies they give effect to.

Despite the direction that the Coastal Hazards should be included in the Coastal Environment section of TTPP, the proposed Plan does not do this.

There is a close interaction between the flood and coastal hazards. Many of the West Coast settlements are close to river mouths, and along the coast. Flood waters can get trapped through a high tide, or a coastal storm. A coastal storm often interactions with rivers, and waves and coastal water comes up them. Separating out the two sets of hazards hinders that integrated approach to planning. In the case of Westport for example, the two sets of hazards are so intertwined that they require one overlay (the Westport Hazard Overlay). For draft provisions multiple hazard overlays were consulted on, and it became evident that the degree of complexity was too great for coherent management and understanding by the community.

Planning for Development of Land on or Close to Active Faults: A guideline to assist resource management planners in New Zealand (Ministry for the Environment July 2003)

The faults with the shortest recurrence interval on the West Coast are the Alpine, Hope, Clarence and Awatere. These all have a recurrence interval of less than 2000 years. The next Alpine Fault rupture will most likely result in at least a magnitude 8 earthquake. The Awatere fault most recently ruptured with a 7.5 magnitude. The Hope fault was responsible for the 2016 Kaikoura earthquake, with 7.8Mw.

The MfE guidance is concerned with the avoidance and mitigation of risk arising from active fault rupture. It emphasizes the need for a risk-based approach to planning for land use on and near active faults.

Planning and engineering guidance for potentially liquefaction-prone land: Resource Management Act and Building Act aspects (Ministry of Business, Innovation and Employment September 2017)

This document provides guidance for a risk-based process to manage liquefaction related risk in land use planning and development decision-making. The guidance includes matters relating to liquefaction that should be addressed in district plan objectives, policies and rules.

Coastal Hazards and Climate Change: Guidance for local government (Ministry for the Environment December 2017)

Since 2001, the Ministry for the Environment has given local government guidance on how to adapt to coastal hazard risk from climate change, particularly hazard risk associated with sea-level rise. The previous guidance (Ministry for the Environment, 2008) has been widely used by local government and others involved in providing services and infrastructure to coastal areas.

This guidance is a major revision of the 2008 edition and includes the findings and projections of the latest Fifth Assessment Report produced by the Intergovernmental Panel on Climate Change (IPCC). It also includes advances in hazard, risk and vulnerability assessments, collaborative approaches to community engagement and changes to statutory frameworks. It explains adaptive approaches to

planning for climate change in coastal communities, including integrating asset management into such planning.

A guide to implementing the New Zealand Coastal Policy Statement 2010:

Policies 24, 25, 26 & 27 – relate to coastal hazards (Department of Conservation, 2017). The New Zealand Coastal Policy Statement (NZCPS) is a national policy statement under the Act. The purpose of the NZCPS is to state policies to achieve the purpose of the Act in relation to the coastal environment of New Zealand. This guidance document covers the coastal hazard objective and policies of the NZCPS and outlines how the provisions of the NZCPS are to be implemented at a regional and district level.

Other Guidance

Other guidance reviewed includes the following:

Risk-based land use planning for natural hazard risk reduction 2013	GNS Science
Preparing for future flooding: A guide for local government in New Zealand	Ministry for the Environment
Tools for Estimating the Effects of Climate Change on Flood Flow A Guidance Manual for Local Government in New Zealand 2008	Ministry for the Environment
Climate change effects and impact assessment: A Guidance Manual for Local Government in New Zealand - 2nd Edition 2008	Ministry for the Environment
Preparing for Climate Change: A Guide for Local Government in New Zealand. (Red book) 2008	Ministry for the Environment
Preparing for Coastal Change: A Guide for Local Government in New Zealand. (Blue book). 2009	Ministry for the Environment
Coastal Flooding Exposure under future sea-level rise for New Zealand 2019	NIWA and deep south science challenge
New Zealands Next Top Model: Integrating tsunami inundation modelling into land use planning, Saunders, W. S.A., Prasetya, G., and Leonard, G.S. (2011).	GNS Science Miscellaneous Series 34, 42p.
Risk based approach to land use planning. Saunders, W.S.A., Beban, J.G., Kilvington, M. 2013	GNS Miscellaneous Series 67. 97p.
Planning and engineering guidance for potentially liquefaction-prone land. Resource Management and Building Code Aspect	MBIE, Ministry for the Environment Earthquake Commission
Planning for Development of Land on or Close to Active Faults. A guideline to assist resource management planner in New Zealand. Janine Kerr, Simon Nathan, Russ Van Dissen, Peter Webb, David Brunsdon and Andrew King. 2003.	Ministry for the Environment and GNS.

1.2.4 Regional Policy and Plans

West Coast Regional Policy Statement

The West Coast Regional Policy Statement (RPS) Chapter 11 Natural Hazards and Chapter 9 Coastal Environment have a significant bearing on the implementation of Section 6 of the RMA. TTPP is required to give effect to the RPS.

Chapter 11 of the WCRPS provides a framework for managing natural hazard risks on the West Coast. It also sets out the responsibilities of the local authorities in the region for the control of land use to avoid or mitigate natural hazards.

Chapter 9 of the WCRPS addresses the coastal environment and has specific objectives and a policy around natural hazard risk management in this location.

The objectives and policies relevant to this topic and that must be given effect to are:

Objective 9.3, 9.4 and 11.1

Policies 9.6, 9.7, 9.8, 11.1, 11.2, 11.3 and 11.4

Objective 11.1.1 seeks that the risks and impacts associated with natural hazards are avoided or minimised. Objective 9.3.1 seeks that appropriate regard be had to the level of coastal hazard risks for new subdivision use or development. Objective 9.4 relates to existing coastal hazard risks and seeks that they be managed to enable the safety and wellbeing of people and communities.

Policy 11.1 seeks to increase awareness of hazard risks and the adoption of appropriate building controls, including avoiding inappropriate development in hazard prone areas, to reduce the susceptibility of the West Coast community to the adverse effects of natural hazards.

Policy 11.2 recognises that through appropriate planning, the need for protection works can be avoided by siting new subdivision, use and development away from existing or potential natural hazards. Subdivision use and development that may cause or contribute to a natural hazard should be avoided. In some cases activities in an area may cause or contribute to a natural hazard affecting another area. For example, an upstream or inland land or river use can have downstream or downgradient hazard effects on other development. The risk of subdivision, use and development affecting or exacerbating a hazard risk elsewhere needs to be assessed in plan and consent processes.

Policy 11.3 recognises that adverse effects arising from climate change may be significant in certain areas. It directs that when assessing natural hazard risk, councils should use the latest national guidance and the best available information on the impacts of climate change on natural hazard events. Policy 11.4 recognises that there will be situations where modifying the environment to reduce susceptibility to natural hazards will produce benefits to the community in excess of the costs involved in protection or prevention works or programmes. Consideration should be given to the relocation of existing development and infrastructure away from areas prone to natural hazards, however it is recognised that this cannot always occur.

Policy 9.6 recognises that the potential impacts of climate change on coastal processes (and thus natural hazards) are complex, and a risk management approach to coastal hazard management is necessary when considering if coastal subdivision, use and development is suitable in the coastal environment. Policy 9.7 requires that a minimum 100 year timeframe is used for assessing coastal hazard risks, particularly for proposed development in or adjoining areas identified as being high risk for hazards.

Policy 9.8 recognises that there are options to consider for managing coastal hazard effects on significant existing development, including relocation and removal of existing development, as well as hard protection structures. Where resource management action is needed to protect people and property, the RMA provides for councils to take the best practicable option. Decision-makers will need to consider the potential social and economic impacts, including costs, to land and infrastructure owners of options to best manage hazard effects.

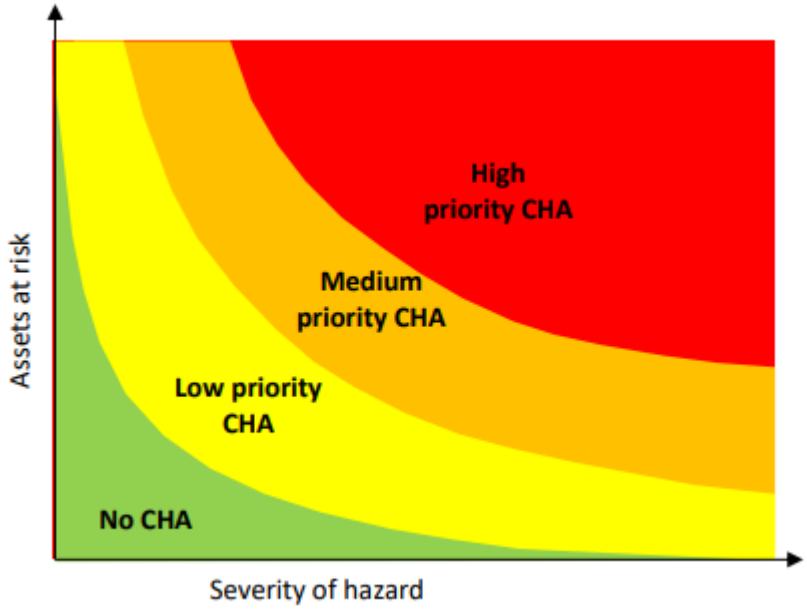
Proposed West Coast Regional Coastal Plan

Section 75(4)(b) of the RMA directs that a district plan must not be inconsistent with a regional plan for any matter specified in s30(1). This includes the control of the use of land for the purpose of avoiding or mitigating natural hazards (s30(1)(c)(iv)).

The relevant objectives of the proposed West Coast Regional Coastal Plan (pWCRCP) seek to ensure that the effectiveness of existing defences against the coast are maintained and that activities do not exacerbate the risk of erosion. The associated policies support the maintenance and upgrading of

coastal protection structures, while ensuring that new coastal defences are appropriately placed so as not to exacerbate potential natural hazards elsewhere.

The pWCRCP identified 26 coastal hazard areas. These have been reassessed post Cyclone Fehi, as areas as outlined in the table below. The Risk Priority Ranking relates to the degree of risk to built structures from the coastal hazard – rather an any particular judgement about the severity of the hazard itself. The coastal processes include the action of waves, tides and longshore currents on the movement of sediments along and perpendicular to the coast. For these natural processes to become hazards something needs to be impacted by them, such as a dwelling, or a highway, which has the potential to be impacted by the natural process. This is appropriate with a risk-based approach it is the significant risk being managed, where people and property are at risk, not where a severe hazard may exist but development does not. Applying a highly restrictive set of planning provisions is not appropriate. This is represented in the below figure.



Area	Type of Coastal Hazard and Risk Priority Ranking
CHA 1 Karamea, from Kohaihai Bluff to Little Wanganui Head	Buildings: Residences around the Karamea/Otumahana Estuary are threatened by erosion and flooding. Road: SH67 Karamea Highway is exposed to erosion as it passes around the backshore of the Karamea/Otumahana Estuary. Sections of the Karamea-Kohaihai Road are exposed to erosion where it passes the Oparara Lagoon and Break Creek. Recreation: DOC Heaphy track facilities are threatened, as is the Golf Course at Karamea. Farmland: Farmland is at threat from erosion and flooding. Erosion: Migration of the Karamea River mouth, Oparara River mouth and Break Creek mouth can directly erode land during migration as well as change the exposure of the backshore to erosion from swell and storm waves. There is also erosion of the open coast by storm waves. Flooding: Wave washover flooding can affect low lying land during storms. The estuary mouths close infrequently but when they do it can result in flooding due to back up of water behind them. Dune blowouts: Dune blowouts can deposit large amounts of dune sand on to land immediately behind the existing dune line.
	Medium**:** Moderate numbers of assets at risk. Existing management measures reasonably effective at reducing risk.

CHA 2 Mokihinui, from Gentle Annie Point to south of Miko	Buildings: Residences at Mokihinui and Gentle Annie are threatened by erosion and flooding. Road: Part of Gentle Annie access road threatened by erosion. Farmland: Farmland is being lost to erosion. Erosion: Long term erosion affects the coastline along this CHA. Erosion rates are higher nearer the Mokihinui River mouth. Mouth migration also threatens to cause erosion to the north bank of the Mokihinui River mouth. Flooding: Wave washover flooding affects land behind the beach
	Medium**:** Ongoing erosion and sea-flooding threatens existing buildings.
CHA 3 Hector , Ngakawau and Granity, from 400m north of Lamplough Stream to the mouth of the Orowaiti Lagoon	Buildings: Residential properties and school in Granity, Hector and Ngakawau are affected by erosion and flooding. In general, property to the west of SH67 in Hector, Ngakawau and Granity is very vulnerable to erosion and flooding. New subdivisions at the south end of the CHA have been set back to allow for continuing erosion. Road: Sections of SH67 (Karamea Highway) are likely to be threatened by erosion and flooding in the future. Farmland: Particularly in the southern half of this CHA significant areas of farmland are being lost to erosion. Erosion: The shoreline in CHA3 is experiencing long term erosion combined with short-medium term (1-20 year time frame) cycles of accretion and erosion. Erosion is caused by wave driven abrasion and transport of material northward exceeding sediment supply from rivers and from the coast to the southwest. Erosion rates vary over the length of the CHA as well as over time due to varying wave conditions and sediment inputs from rivers. Temporal variability is greatest near the mouths of the Ngakawau and Waimangaroa Rivers. Erosion rates in this CHA are sensitive to changes in sediment supply from the southwest (for example: sea-level rise resulting in build-up of beaches and storage of sediment west of the Buller River training walls). Any management practices which affect sediment delivery or movement along the shore within this CHA (i.e., groynes, beach mining or seawalls) have potential to impact on erosion rates/patterns. Flooding: The low-lying coastal land in this CHA is subject to wave washover flooding during storms. This risk is increased by erosion of the gravel barrier at the back of the beach. Extensive property and road flooding occurred during ex-tropical cyclone Fehi. Flood risk will increase with sea-level rise
	High**:** Many buildings at risk in the near future, notably the Granity School. Coastal hazards having a severe impact on communities.
CHA 4 Orowaiti Lagoon	Buildings: Many existing houses around the lagoon shore are at risk from flooding and erosion. This includes properties along Snodgrass Road, Orowaiti Road and in low lying areas of northern Westport. Road: The SH67 bridge approaches have been flooded from the lagoon and have also been affected by erosion requiring protection measures. Other minor roads are also threatened. Various 'paper' roads north of Utopia Road have already been lost to erosion. Farmland: Land north of Utopia Road has been lost to erosion. Some of this land is subdivided. Flooding: There are extensive low-lying areas around the lagoon where properties, roads and farmland are threatened by high tides, storm surges and river floods. Sea-level rise will significantly

	increase this risk in the future. Erosion: Erosion due to mouth migration (generally eastwards) has caused significant land loss in the past and is on-going. Mouth migration can change the exposure of the shore to wave action and can also cause erosion by river flows. Within the lagoon, local wind-waves and river floods can cause bank erosion.
	High: Houses and roads in low lying areas around Orowaiti Lagoon are at significant risk of flooding from the sea (and/or Buller River flood overflows into the Orowaiti). Within the lagoon the erosion hazard is not too severe and can be managed with the use of bank protection. At the lagoon mouth the hazard processes are much more severe and difficult to manage but there are fewer assets at risk
CHA 5 Carters Beach, from the Buller River mouth to a point level with Bradshaws Road	Recreation facilities: The sports fields of the domain are being affected by erosion and wave overtopping. The unsealed access road between the sports fields and beach (Rotary Road) has been truncated and closed due to erosion. Buildings: Low lying properties behind the domain/sports fields are at risk of flooding during high tides/storm surges. New subdivisions at the west end of the CHA have been set back to manage the erosion risk. Airport: Westport Airport runway extends close to the beach which is currently experiencing erosion. If erosion continues the runway may be threatened. Farmland: Farmland to the east and west of Carters Beach is threatened by erosion and flooding Erosion: The coastline at Carters Beach consists of low-lying sands deposited following the construction of the Buller River training walls (as a result of the dominant west-east longshore transport). There is no vegetation nor significant foredune protecting the backshore, and the coastline position is very sensitive to any change in wave climate or sediment supply. The coastline reached a position of maximum advance around 1981 and since then has eroded by approximately 40 m. It is not known whether this is short-medium term variability as the shoreline settles into a new equilibrium or the start of a longer-term trend relating to either/both a change in wave climate and/or a reduction in the supply of littoral drift sand from the south. Flooding: Land along this section of coast is very low lying and is affected by wave overtopping and flooding. Down-drift effects: The dominant west-east longshore transport drives sediment from this CHA past the Buller River training walls towards CHA3. Actions in this CHA (e.g., groynes, sand mining) have the potential to influence erosion rates to the east of the Buller River.
	Medium: Erosion and flooding are currently affecting recreation facilities at Carters Beach. If erosion continues at current rates the risk to buildings and the airport will increase.
CHA 6 Omau	Buildings: Several existing buildings (houses and baches), as well as the access to them is threatened. Several currently subdivided plots of land are threatened. The gardens of several existing buildings are currently being eroded, as are parts of Clifftop Lane. Erosion: The cliffs at Omau are relatively weak compared to those at Cape Foulwind and are they are retreating as the narrow beach at their base is eroded. Erosion rates are more severe at the eastern end of the CHA. As well as retreat of the cliffs by

	progressive toe-cutting and slab failure, consideration needs to be given to the risk of broader, lower angle collapse/landslide.
	Medium: Cliff retreat means that several residences and subdivided plots of land in Omau are likely to be affected by erosion within 50-100 years.
CHA 7 Tauranga Bay, from DOC carpark to houses at south end	Recreation facilities: Road access and parking for the Cape Foulwind Walkway (DoC). Erosion: Creek mouth migration threatens parts of the access road and has caused problems in the past requiring erosion protection. Wave driven erosion is affecting parts of the bay and has threatened the parking area. Flooding: Wave washover flooding affects some areas around the bay
	Low**:** Hazard processes not severe, erosion protection measures effective at present. The value of assets at risk is relatively low and in the long term it would be possible to relocate access to Cape Foulwind Walkway if required.
CHA 8 Nine Mile Beach, from north end of beach to Parsons Hill, south end of beach	Buildings: Generally, buildings along this stretch of coast are adequately set back to manage their exposure to coastal hazards. With further development and continuing erosion there may be increasing hazards to buildings in the future. Road: Parts of Okari Road are threatened by erosion, particularly near the mouth of the Okari Lagoon. Farmland: Farmland behind Nine Mile Beach is being lost to erosion. Some of this farmland has been subdivided for residential development but generally the subdivision sites are adequately set back to manage the erosion risk. Erosion: Northward longshore transport is resulting in long term erosion of Nine Mile Beach. Erosion rates are fastest at the southern end of the beach, although during Fehi and Gita significant erosion occurred at the northern end of the beach. Mouth migration can cause local erosion at much faster rates around the Okari Lagoon mouth and Totara River mouth. Changes or management actions affecting sediment supply to the beach or sediment movement along the beach have the potential to change erosion rates/patterns. Dune Blowouts: The beach is backed by dunes, and dune blowouts can occur as a result of wave/wind action during storms.
	Low**:** Existing buildings and new development set back sufficiently to not be affected in near future. The risk to new development is being adequately managed by setting back buildings appropriately.
CHA 9 Little Beach	Buildings: Several baches are at high risk of erosion and flooding, with little buffer space left between the beach and the buildings. Road: Beach Road is threatened by erosion Erosion: Long term beach erosion affects the whole of Little Beach. Flooding: Wave washover flooding affects low lying land behind the beach.
	Medium: Limited assets affected but several baches threatened by erosion in near future.
CHA 10 Woodpecker Bay, from BS19 672 484 to the south end of Seal Island BS19 649 449	Road: SH6 is threatened by erosion and flooding at several locations. Buildings: Baches are threatened by erosion and flooding.

	Erosion: Woodpecker Bay is a pocket beach with limited sediment supplies (main source Fox River). The erosion focus is towards the centre and northern parts of the bay because these areas have greater exposure to south westerly and westerly swells, and experience greater northerly drift. Northerly swells during Fehi caused extensive damage at the southern part of the bay. Flooding: Wave washover flooding affects the land immediately behind the beach. Extensive flooding and wave washover damage occurred during cyclone Fehi.
	Medium**:** SH6 severely threatened by erosion for an extended distance but few other assets at risk.
CHA 11 Maungahura Point to north end of Meybille Bay	Road: SH6 is very close to the shoreline along the length of this CHA and is threatened in several places. Buildings: Several baches between the SH and coast are exposed to erosion and wave washover flooding. Erosion: Long term erosion is occurring along this coast but at a relatively slow rate. Vulnerability to erosion is very variable along this CHA depending on local conditions (geology, sediment supply and sheltering from waves by headlands or offshore rocks). Flooding: Wave washover at high tides can affect lower lying parts of the road and baches, although generally the shoreline slopes quite steeply behind the beach along this CHA.
	Low**:** Hazard processes not severe, being managed reasonably effectively through sections of protection work where required.
CHA 12 Punakaiki Village from north of the Pororari River mouth to the south end of the beach in front of the Punakaiki Village	Buildings: Much of Punakaiki Village is threatened, including houses and tourist accommodation (hotels, hostels and motor camp). Road: SH6 is threatened by erosion at the Southern end of the CHA. Recreation: The width of the beach and access to the beach are being affected as erosion of the beach occurs in front of the seawall. Erosion: Long term erosion of the beach is occurring in front of the village as a result of wave attack and northward longshore transport. There is also an erosion risk associated with river mouth migration. Flooding: Storm waves overtopping the beach can cause flooding.
	High**:** Continuing erosion very close to buildings in the Village. The recreational value of the beach is being reduced through continuing erosion in front of the seawall.
CHA 13 Punakaiki River beach, from south of Pancake Rocks to Razorback Point	Buildings: Hotel and baches. Road: A short length of SH6 is at risk. Erosion: River mouth migration threatens to erode land at the southern end of the bay. There is little long-term erosion, but short-term shoreline changes do affect the CHA and it is sensitive to any changes in external controls (i.e. sea-level rise or change in sediment supply) which may cause erosion. Flooding: Wave washover flooding affects land behind the beach.
	Medium**:** There is little long-term erosion, but assets located behind the beach have very little buffer space and are very vulnerable to any future changes affecting coastal processes.
CHA 14 Pakiroa (Barrytown) Beach, from just north of Burke	Farmland: Significant areas of farmland are being lost to erosion. Buildings: Development pressure is increasing along this stretch of

Road to just before 17 Mile Bluff at the southern beach end	coast. Various new subdivisions are being proposed and constructed. Setbacks are being applied to manage their exposure to the erosion hazard. Erosion: Long term erosion is the main hazard affecting this CHA. Erosion is being driven primarily by wave driven longshore drift of material from south to north. Erosion rates are highest along the southern to middle parts of the beach with erosion rates reducing further north. There is some accretion at the northern end of the beach. Any management practices which affect sediment delivery or movement along the shore (i.e., groynes, beach mining or seawalls) have potential to impact on erosion rates/patterns. Around creek mouths there are erosion risks associated with mouth migration. Flooding: Wave washover flooding affects land behind the beach and flooding can occur at creek mouths due to migration or blockage.
	Medium**:** Erosion rates are high along parts of this CHA and although there are few high value assets currently at risk there is increasing development/subdivision pressure.
CHA 15 17 Mile Bluff, from the end of CHA14 at 17 Mile Bluff to 10 Mile Creek	Road: SH6 is threatened in several locations along this CHA. Buildings: Several houses/baches to the west of SH6 are at risk. Erosion: Erosion of low-lying areas fronted by beaches as well as slope erosion of steeper parts of the coastline can affect parts of this CHA. Erosion risk is very variable along the CHA depending on local geology and wave exposure. Flooding: Wave washover flooding can affect lower lying portions of this CHA.
	Low**:** Erosion rates are generally low, and the hazard is currently being adequately managed through the use of short sections of armour/seawall.
CHA 16 Rapahoe from 1.5km north of Rapahoe to south of Seven Mile Creek	Buildings: Several properties in Rapahoe are at risk of erosion including residences, the pub and campground. Several undeveloped sections are also at risk. Road: SH6 is exposed to erosion for approximately 1km to the north of Rapahoe. Within Rapahoe, Beach Road is already truncated by erosion Erosion: Long term erosion of the shoreline is occurring as a result of sand and gravel removal (by northward transport and abrasion) exceeding supply (from Seven Mile Creek, cliff erosion and probably also bypassing around Point Elizabeth from the South). Depletion and rollover occur on the remnant beach barrier, while wave attack on the bluff at the northern end threatens the stability of the road around the bluff. Creek mouth migration also poses an erosion risk to both the north and south banks of Seven Mile Creek (including parts of the raised terrace to its south). Erosion rates along this CHA vary significantly, predominantly due to the varying exposure to wave energy and direction (due to the sheltering effect of Point Elizabeth). Flooding: Wave washover flooding occurs during storms when waves overtop the gravel barrier.
	High**:** On-going processes threaten to erode several properties as well as SH6. Sea flooding will become an increasing problem as more erosion occurs.
CHA 17 Cobden from Point Elizabeth Walkway carpark to Grey River mouth	Buildings: Houses in Cobden are threatened by erosion and flooding. Road: North Beach Road in Cobden is threatened by erosion and flooding.

	Erosion: Long term erosion of the coastline at Cobden is continuing and is now very close to affecting the road and buildings there. Erosion is driven by an imbalance between the supply of sediment from the Grey River and the coast to the south, and the rate at which sediment is removed from the beach by northward longshore transport and abrasion. Flooding: Wave washover flooding threatens the road and properties
	Medium**:** Ongoing erosion increasingly threatening North Beach Road and houses at north end of Cobden.
CHA 18 Blaketown to Karoro, from the Grey River mouth to between Karoro and South Beach	Airport: The corner of the Greymouth airport runway enclosure at Karoro is threatened with erosion. Recreation: Blaketown beach access is affected by erosion Buildings: Few buildings are currently threatened by erosion although this is a heavily developed CHA and any long-term erosion would cause significant problems. Erosion: Recently, parts of the beach have experienced short term erosion, especially adjacent to the airport runway at Karoro. The causes of this erosion are not fully understood. Down-drift effects: Due to the predominantly South to North drift of sediment, actions in this CHA may affect CHA 17. However, the degree of connectivity between these CHAs, past the Grey River and its training Walls, is not firmly established.
	Medium**:** Few assets currently impacted but any long-term erosion would have significant consequences. There is some uncertainty over the degree to which actions in this CHA affect CHA 17.
CHA 19 South Beach to Camerons	Buildings: Several properties including the school, hotel and houses have been affected by flooding. Road: SH6 and local roads have been affected by flooding in the past. Recreation: Wave washover during storms can damage the access road. Previously recreational access to the beach was restricted during periods when the river mouth had migrated a long way north. Flooding: Flooding caused by mouth migration and/or partial/full closure of the New River / Kaimata mouth presents a significant risk along this CHA. River floods can cause flooding to properties in Paroa when the mouth has migrated a long-distance northwards or is partially closed. Erosion: Erosion can occur during mouth migration when the river is forced to extend parallel to the shore. As wave driven longshore transport deposits material into one side of the river mouth, the river erodes land on the opposite side of the mouth and extends the lagoon. Erosion has historically been less of a problem than flooding. Historically, the mouth of the New River / Kaimata has migrated over almost the full length of this CHA. Currently there is little erosion risk as the mouth is prevented from northward migration, although the rock bund itself is at risk of erosion during severe river flows and waves.
	Medium**:** Although flooding has occurred in the past, the current channel management regime appears to have reduced flood risk significantly.
CHA 20 Taramakau, from Camerons to south bank of Arahura River	Road: Serpentine Road immediately south of the Taramakau is at risk of erosion. The northern end of this road is no longer maintained. Farmland: Farmland on both sides of the Taramakau mouth and along the coast between the Taramakau and Arahura Rivers is at risk from erosion. Buildings: There are currently 2-3

	buildings within 100 m of the beach around the Awatuna/Waimea Creek area. Erosion: Movement of the Taramakau River mouth can cause erosion on either the south or north banks. Prior to 2006 the mouth was offset to the south and caused erosion of farmland and loss of two houses. Before the late 1990's the mouth flowed to the north with significant erosion affecting the north bank. Migration of the mouths of the Arahura River and the smaller creeks such as Serpentine Creek and Waimea Creek can also cause erosion. Northern mouth migration of Serpentine Creek has previously threatened the bend on Serpentine Road. There is also some risk of coastal erosion away from the river mouths. While there is scant information regarding any long-term erosion trend, short-term (months to decades) erosion/accretion cycles are expected associated with storm and recovery cycles and transient imbalances between sediment supply from the Arahura River and further south and losses due to northward longshore transport and abrasion. Little analysis of open coast erosion along this section of coast is currently available. Flooding: Flooding due to storm waves affects parts of this CHA. Constriction or closure of creek mouths can also cause flooding.
	Low**:** Few assets at risk, no management currently carried out.
CHA 21 Hokitika, from south bank of Arahura River to level with end of Golf Links Road, Takutai	Buildings: Parts of the town as well as industrial land and some dwellings on the north of the town are at risk. Recreation: Hokitika beach access, parking and facilities are at risk from coastal hazards. The Sunset Point spit-head is also at risk of erosion, including the historic Tambo Shipwreck. Road: SH6 is not threatened in this CHA but various minor roads are at risk. Farmland: Farmland north and south of Hokitika is affected by coastal processes. Erosion: The position of the coastline at Hokitika has historically experienced fluctuations of up to 200m over years to decadal time scales. Erosional and accretional phases tend to migrate northwards and are influenced by the position and orientation of the river mouth. There has been little long-term trend in erosion or accretion observed at Hokitika. During phases of erosion, rapid retreat of the coastline can occur. North of Hokitika, around Houhou Creek, migration of the creek mouth can cause erosion from the creek or by allowing waves to attack the backshore. Flooding: Wave washover flooding can impact land immediately behind the beach. Dune Blowouts: Dune blowouts can occur as a result of wave/wind action during storms, particularly in the southern part of this CHA.
	High**:** There are many high value assets at risk on a very dynamic coastline. Current management practices seem to be reasonably effective at managing the erosion risk.
CHA 22 Okarito from south side of Lagoon mouth, around the settlement	Buildings: Parts of Ōkārito settlement are at risk from flooding and erosion including houses, hostels, campground and the airstrip. Road: Roads within Ōkārito are affected by flooding. Recreation: Recreation opportunities are affected by flooding, including historic sites and tourist accommodation. Flooding: Flooding from the Ōkārito Lagoon occurs due to closure of the lagoon mouth. The lagoon can close when waves drive

	sediment across the mouth. Erosion: Lagoon mouth migration can cause erosion
	Medium**:** Moderate number of assets affected by flooding from the lagoon. Mechanical opening of lagoon mouth used to manage the risk.
CHA 23 Hunts Beach	Buildings: The settlement at Hunts Beach is becoming more threatened by flooding as the coast continues to erode. Flooding: Flooding by wave washover affects land behind the beach. During ex-cyclone Fehi flooding caused severe property damage. Erosion: Erosion by storm waves and mouth migration can affect Hunts beach. Erosion of the shoreline has been observed over at least the past 25 years.
	Low**:** Whilst Hunts Beach experiences high hazard there are relatively few assets at risk.
CHA 24 Bruce Bay	Road: Approximately 2 km of SH6 runs close behind the beach and is threatened by erosion and flooding. There was severe damage to SH6 during Fehi, with the road washing out. Buildings: Properties (Marae and fishing cabin) on the landward side of SH6 are threatened by wave washover flooding. Erosion: Long term erosion of the coast is occurring as well as cyclic changes associated with changes in the position of the Mahitahi River mouth. Erosion by river flows due to mouth migration can affect the highway adjacent to the mouth. Flooding: Wave washover flooding can affect the highway and properties during storms.
	Low**:** Hazards are severe but other than SH6 there are few assets at risk
CHA 25 Putaiwhenua/Okuru to Waitoto/Waiatoto, from north of Okuru River mouth to south of Waiatoto Lagoon	Buildings: Various residences and undeveloped subdivisions in Okuru are at risk on both the north and south sides of the Okuru Lagoon backshore. Infrastructure: Power pylons on the Waiatoto Lagoon backshore have previously been affected by erosion. The rubbish tip south of Hannahs Clearing has also been threatened with erosion. Farmland: Farmland along this CHA is affected by erosion. Road: Parts of the Jackson Bay Road pass close to the shoreline and/or lagoon backshore and could be threatened by erosion in the future. Erosion: The mouths of the Okuru/Turnbull/Hapuka Rivers and Waiatoto River both migrate over several kilometres of separate sections of this CHA. At both lagoons the position of the river mouth can change the exposure of the lagoon backshore to river flows and wave action which in turn can cause erosion. In addition to erosion as a result of river mouth migration there is also erosion of the open coast on this CHA. Flooding: Lagoon mouth closure can cause flooding of low-lying land and buildings around the lagoons. Wave washover flooding affects parts of this CHA. Dune blowouts: The beach is backed by dunes, and dune blowouts can occur as a result of wave/wind action during storms. Medium**:** Past episodes of erosion have seriously threatened residences in Okuru, the Hannahs Clearing rubbish dump, and the power lines at Waiatoto Lagoon.

CHA 26 Neils Beach, from east of Arawhata River mouth to Jackson Bay	Buildings: Neils Beach has approximately 15 houses. The properties most at risk are approximately 80 m from the current high tide mark (Oct 2015). In Jackson Bay township several low-lying buildings are at risk of inundation. Infrastructure: The north end of the Neils Beach airstrip is within approximately 30m of the beach and is at risk of erosion if the current trend continues Farmland: There is little actively farmed land around Neils Beach. A small paddock owned by a MāoriTrust exists between the houses and the beach and is being actively eroded (Oct 2015). Road: From approximately 1 km West of the Neils Beach turning the Jackson Bay Road passes close to the shoreline and is threatened by erosion. The informal access track from Neils Beach to the Arawhata River mouth has been eroded in places. Erosion: The main hazard affecting Neils Beach is erosion. Over the period 2010-2015 the shoreline at Neils Beach experienced high erosion rates of 3-4 m per year but prior to this the shoreline was much more stable. There is little/no sediment supply passing around Jackson head from the south so the only sediment supplies to this stretch of coastline are from local landslides/streams between Jacksons Bay and Neils Beach and the Arawhata River. For this reason, the stability of the shoreline is very dependent on the position and orientation of the Arawhata mouth and its recent flood history. A westerly mouth location appears to encourage sediment storage on Neils Beach while an easterly mouth "drains" this storage and promotes erosion. It is unclear to what extent the current erosion is part of short-term variability due to river mouth processes or a longer-term trend (e.g. driven by a waning sediment supplies or sea-level rise). Erosion potential at Jacksons Bay township is limited by existing rock/rubble walls, but erosion potential will increase with sea level rise. Flooding: There is likely a risk of flooding from the Arawhata River, particularly if the mouth is constricted by a high beach barrier which is not rapidly eroded on the rising limb of a flood. Also, the risk of sea flooding will increase if the erosion of the foredune fronting the Neils Beach village continues. This is because locally the erosion has already removed the dune crest, lowering the natural protective barrier. Flooding is the main hazard in Jackson Bay township. High sea levels will flood up Seacombe Creek onto the adjoining roads, carpark, and the private property alongside Pier Street. Medium**:** The current erosion rate is high and is starting to threaten parts of the road and runway. There is still a reasonable buffer before any houses will be directly affected by erosion.

Reference: Measures, R. & Rouse, H. (2022) Review of West Coast Regional Council Coastal Hazard Areas, prepared for West Coast Regional Council, NIWA client report CHC2022-081.

West Coast Regional Land and Water Plan

Section 75(4)(b) of the RMA directs that a district plan must not be inconsistent with a regional plan for any matter specified in s30(1). This includes the control of the use of land for the purpose of avoiding or mitigating natural hazards (s30(1)(c)(iv)) and in relation to any bed of a water body, the control of the introduction or planting of any plant in, on, or under that land, for the purpose of avoiding or mitigating natural hazards (s30(1)(g)(iv)).

The relevant objectives of the West Coast Land and Water Regional Plan (WCRLWP) seek to ensure that the effectiveness of existing defences against water are maintained and that activities do not exacerbate the risk of flooding. The associated policies support the maintenance and upgrading of flood control measures, while ensuring that new defences against water are appropriately placed so

as not to exacerbate potential natural hazards elsewhere. The WCRLWP also manages earthworks in high erosion risk areas, but this is limited to the regional council's soil conservation responsibilities, rather than to manage natural hazards.

West Coast Civil Defence Emergency Management Group Plan

West Coast Civil Defence Emergency Management (CDEM) Group Plan 2016-2021 This plan is a strategic document that provides direction on how comprehensive, risk-based emergency management will be implemented in the West Coast region, as required by the Civil Defence Emergency Management Act 2002. Its purpose is to enable the community, local authorities and emergency response organisations to manage hazard and risk, including through risk reduction as an essential component of emergency management.

1.2.5 Poutini Ngāi Tahu Iwi Management Plans

The RMA requires that when preparing a District Plan, the territorial authority must take into account any relevant planning document recognised by an iwi authority and lodged with the territorial authority, to the extent that its content has a bearing on the resource management issues of the district (section 74(2A)). There are three iwi management plans on the West Coast – the Te Rūnanga o Makaawhio Pounamu Management Plan, the Ngāti Waewae Pounamu Management Plan and the Lake Māhinapua Management Plan.

While these documents focus on specific issues they also contain wider information about the overall approach to sustainability and kaitiakitanga of resources and Poutini Ngāi Tahu values. Natural landscapes may have cultural values such as pā, kāinga, ara tawhito (traditional trails), pounamu, mahinga kai, and wāhi ingoa (place names). The traditions of Ngāi Tahu tūpuna (ancestors) are embedded in the landscape.

1.2.6 Other Relevant Legislation

Building Act 2004

The Building Act has a different role to the RMA, and provisions in the Building Act do not replace the responsibility of Councils to act under the RMA. The Building Act concerns a building's construction and the safety and integrity of the structure. Therefore, relying solely on the Building Act to address the adverse effects of natural hazards is not effective. Councils need to consider and develop a policy response in their district plans, with the Building Act being one of the methods that can help avoid or mitigate the risk. The primary purpose of the natural hazard provisions of the Building Act is to ensure consideration is given to how building work affects natural hazards and impacts on the land or other property.

The natural hazard provisions exist so that the risk to the land can be recognised, the effect of the building work considered, and steps taken to mitigate those risks and effects. Where the risks and effects cannot be sufficiently mitigated then the provisions recognise that it may nevertheless be acceptable to build on the land and require notification of the risk on the title to the land and provide councils with immunity (on the basis that the owner is knowingly building on land affected by the natural hazard of inundation for example). Placing a notice on the title ensures that future purchasers and other interested parties are aware that the land is subject to a natural hazard.

Section 71 of the Building Act deals with building on hazard prone land. Under this section, the Council may be obliged to refuse a building consent application on land subject to hazard events including erosion, falling debris, subsidence, inundation or slippage.

Section 73 provides for a notice to be placed on land subject to natural hazards where consent has been granted subject to mitigation of the natural hazards (s72) and will not exacerbate a known natural hazard. EJS-038777-282-2-V1 13.

The Building Code contains standards to ensure that any structure is designed to remain standing in a certain magnitude earthquake.

In relation to flooding, the Code sets a minimum floor height for buildings of 150mm higher than the lower of either: the crown of the road; or the lowest point on the building site. This minimum floor height increases in some instances where a particular cladding type requires it.

The Building Code sets out a series of minimum performance criteria for buildings. However, no existing technology will prevent damage to buildings caused by some natural hazards – for example coastal erosion, crushing by a landslide or being sited across a fault, meaning significant damage can occur even if the Building Code is complied with.

Civil Defence Emergency Management Act 2002

Section 3 of the Civil Defence Emergency Management (CDEM) Act set out the purposes of this Act as including: improving and promoting the sustainable management of hazards in a way that contributes to the social, economic, cultural, and environmental well-being and safety of the public and also to the protection of property; and encouraging and enabling communities to achieve acceptable levels of risk.

Fire and Emergency New Zealand Act 2017

This Act has seen any responsibility held by the Council under the now repealed Forest and Rural Fire Act 1977 transferred to Fire and Emergency New Zealand (FENZ). This responsibility extended to promoting and carrying out fire control measures, making by-laws for the purpose of fire control, and keeping and maintaining a fire plan for the district.

Soil Conservation and Rivers Control Act 1941

Section 10 of the Soil Conservation and Rivers Control Act 1941 sets out the objects of this Act as including:

- the prevention of damage by floods:
- the utilisation of lands in such a manner as will tend towards the attainment of the said objects.

West Coast Regional Council has the responsibility to undertake the actions required by this Act, and so is the primary constructor and maintainer of stopbanks and other defences against water on the West Coast.

Local Government Official Information and Meetings Act 1987 (LGOIMA)

Under the LGOIMA territorial authorities are obligated to issue Land Information Memoranda (LIM) on request. A LIM must include information known to the territorial authority on (amongst other things) the potential erosion, avulsion, falling debris, subsidence, slippage, alluvion (accretion) or inundation related to the site. The territorial authority is not obligated to supply information in a LIM that is included in a district plan.

2.0 Resource Management Issue and Analysis

2.1 Background

2.1.1 The West Coast Hazardscape

The West Coast is subject to a wide range of natural hazards. Due to the historic development patterns on the West Coast, much of the district's population is in close proximity to natural hazard prone areas and consequently communities are particularly at risk to the effects of a natural hazard event.

Coastal Hazards

Coastal erosion and inundation occur in a wide range of areas across the West Coast. The coastally located towns and settlements are particularly vulnerable to these types of hazards.

Coastal tsunami is also a risk for lower lying areas along the coast, and proximate to rivers.

Coastal Erosion Protection Structures

The West Coast Regional Council maintains coastal protection structures at Punakaiki, Hokitika, Okuru and Neils Beach. These are maintained under rating districts. Other structures on the coast are maintained by Waka Kotahi - NZTA, the three district councils and private property owners.

The Punakaiki Village Seawall was built 2005 and has been designed to handle the historically observed tidal fluctuations and surge patterns of the Tasman Sea in the vicinity. The scheme structures will be maintained to the dimensions that they were originally constructed. A seawall fixes the position of the land sea boundary and provides some protection to the land behind from severe inland flooding from major storms and large waves. The main functional elements of a seawall are the elevation of the structure to minimise overtopping, and the armoured face to minimise erosion. The weight and shape of the structure provides the required stability.

The Hokitika Seawall was built to protect Beach Street and the land, dwellings and businesses behind the wall from the threat of sea erosion. The seawall built in 2013 has been designed to handle the historically observed tidal fluctuations and surge patterns of the Tasman Sea in the vicinity. The scheme structures will be maintained to the dimensions that they were originally constructed. The groynes' purpose is to help build a wide sandy beach from Hampden Street to Richards Drive. Consideration will be given to extending the height and length of each groyne to maximize the beach width and sand retention within that area. Through the West Coast Regional Council Long Term Plan process decisions were made to substantially upgrade the sea wall, and river protection works. Design work has been completed, and consent lodged for the first two of three stages (extension and upgrade of the sea wall, upgrade of the river protection works upstream of the State Highway Bridge). The third stage will be lodged late 2022 for the State Highway Bridge downstream.

The Okuru Rating District is set up to

a. Reduce bank erosion on the right bank of the Okuru River between the State Highway and 1250 metres downstream.
b. Reduce further erosion encroachment on the Tasman Sea frontage of the Okuru Township.

The Neils Beach Rating District was formed in October 2016 to fund beach nourishment and coastal protection works. After an initial approach from concerned ratepayers in early 2014, regarding increased erosion along the foreshore fronting the Neils Beach Settlement in South Westland, an initial inspection was carried out on 1 April 2014 by WCRC staff with an informal group of local property owners, to determine the risk and discuss possible future remedial action for the area.

Flood Hazards

With its very high rainfall, well connected rivers and large catchments, flooding is also a very substantial hazard across the whole West Coast, with many rivers known to cause significant flooding issues. Flooding is a key hazard threatening Westport, Greymouth, Franz Josef and Hokitika.

Stopbanks and Defences Against Water

The West Coast Regional Council maintains a network of flood defences and stopbanks. Generally, these structures are managed under a rating scheme with a set level of service. Apart from the Greymouth and Hokitika schemes, the level of service of most of the flood defences is for less than a 1% AEP event.

In the towns of Greymouth and Hokitika there are substantial defences against water – with floodwalls and stopbanks, alongside substantial pumping systems to drain stormwater from inside the stopbanks. In these circumstances whether residual risks require further management was investigated. These issues were workshopped with the district councils, and direction was given that due to the level of investment and service, residual risk from a breach or banks down scenario was not to be factored into natural hazard provisions. The areas outside the stopbanks are however at risk of flooding, and this is addressed within the proposed TTPP flood overlays.

In the case of Westport there are some historic flood defences in place, resolving the ownership of these, and the maintenance requirements and responsibilities is part of a larger project to substantially upgrade the protection works. The decision-making process for the Westport protection alignment is underway, but had not been finalised at the time of notification of TTPP. A technical group have made recommendations to their steering group. The steering group made a decision on the recommended option in June 2022. A business case was approved by West Coast Regional Council and Buller District Council in response to a request from the Minister of Local Government, seeking central government co-investment for adaption. Central government is expected to make a decision on the business case in September 2022. The Westport Rating District Joint Committee also need to make decisions about what assets the rating district wish to have and can afford. Public consultation will also need to be undertaken. Following this, a notice of requirement will be lodged to enable the works to occur, then construction will commence. This is a complicated and interrelated process. The Westport specific natural hazard rules are likely to need to be amended through the decision-making process, from that included in the proposed notified plan. TTPP Committee is intending to make a submission to enable changes to be made to these provisions depending on the outcome of decision making.

Geotechnical Hazards

Earthquake hazards are also very significant on the West Coast with fault rupture, ground level changes and ground shaking all key concerns. Slope instability is also substantial on the West Coast – with significant events triggered by severe rainfall or earthquakes. The combination of the active faults and lakes means that earthquake or landslide induced lake tsunami is also possible.

The Murchison and Inangahua earthquakes in Buller caused widespread ground shaking – and consequently substantial land sliding. The Alpine Fault is a substantial hazard, with an estimated recurrence interval of 340 years. There is an estimated 30% chance of rupture in the next 50 years resulting in land sliding, liquefaction and substantial ground damage (Rattenbury, Cooper, Johnston 1998). Three magnitude 6 and greater earthquakes with the epicentre within or proximate to this area have occurred in the last 70 years and a fault rupture is capable of generating a magnitude 8.1 seismic event.

The Alpine Fault is by no means the only active fault on the West Coast – the Awatere, Clarence and Hope Faults all have recurrence intervals of less than 2000 years and are considered a significant risk due to their recurrence interval and forecast magnitude.

The liquefaction hazard across the district is contingent upon the ground materials, groundwater levels and shaking intensity during earthquakes. There are often discrete areas away from large areas of susceptible ground due to local variances in geological and geomorphological processes. An assessment of liquefaction risk across the West Coast was undertaken in 2021, and this identified that in most parts of the region the risk is low. This report is not suitable for use in a District Plan, as in many locations the number of site-specific records used to generate the risk assessment was insufficient to be able to give an output accurate enough to be suitable for inclusion, so they were classified as low. In consultation with the District Council building control teams it was determined that the measures provided in the Building Code for managing liquefaction through foundation design were sufficient and that additional land use controls are not required.

Wildfire

Wildfire is also an increasing risk on the West Coast – with large areas of dry material such as manuka/kanuka/bracken and gorse being present, peat wetlands and coal mines all being sources. However, based on the overall risk assessment of wildfire on the West Coast it was determined that specific rules for Wildfire were not required. Including an overlay in TTPP was considered on an information basis, but ultimately it was decided that as no land use rules were proposed to address this, that an overlay was not required.

2.1.2 Climate Change

A likely effect of climate change is the exacerbation of natural hazards. Climate change projections for the West Coast (MFE 2017 and NIWA 2017) that could in particular exacerbate natural hazards are:

- Decrease in winter snowfall and earlier spring melt
- Continued loss of glacier ice e.g. Franz Josef glacier is expected to retreat 5km and lose 28% of its mass
- Increased rainfall (Arahura 3-5% increase annually but 6-12% increase in winter; Te Tauraka Waka a Maui (Makaawhio) 4-6% increase annually but 8-16% increase in winter by 2040)
- Increased high rainfall event – with today's 50 year event becoming a 15-30 year event by 2090
- 2-5% increase in windy days by 2090
- Increase in storm intensity, local wind extremes and thunderstorms
- Increase in frequency of ex tropical cyclones making landfall
- 0.3-1m sea level rise by 2090
- Gradual inundation of low-lying marsh and adjoining dry land in spring high tides
- Escalation in frequency of nuisance and damaging coastal-inundation events
- Exacerbated erosion of sand/gravel shorelines and unconsolidated cliffs (unless sediment supply increases)
- Increased incursion of saltwater in lowland rivers and nearby groundwater aquifers raising water tables in tidally-influenced groundwater systems

When considering the potential impacts of climate change on natural hazards, there are key hazards which could be exacerbated:

- Coastal hazards – including increased coastal erosion, increased coastal flooding and increased potential impact of any tsunami.
- River hazards – more heavy rainfall, and a change from snow to rain precipitation during winter increasing the risk of flooding and riverbank erosion.
- Landslides – already a high risk in many parts of the West Coast, increased heavy rainfall increases the risk of landslides

In rural areas, if extreme events such as floods and droughts become more severe and frequent, there will be increased land instability, damage and disruptions to farm operations, and associated increased costs to farmers dealing with stock losses, damage to fencing and other infrastructure.

In urban areas, heavier rainfall may put added pressure on drainage and stormwater systems and increase flooding risks. Housing areas near riverbanks are likely to become more prone to floods. Roading infrastructure might need more maintenance work and new structures such as bridges may need to accommodate higher flood peaks in their design.

The West Coast Councils' Infrastructure planning now considers climate change as an accepted requirement in hazard and planning modelling. Similarly, through the development of Te Tai o Poutini Plan, where there have been updates on the science (e.g., for coastal and flood hazards hazards), a range of climate change scenarios are included in the modelling.

Effects of climate change is now a matter which Councils must give particular regard to under the RMA. This includes taking into account the effects of climate change in the development of TTPP, by planning and preparing for such anticipated effects. It also means that decision-making on proposed subdivision and land developments should consider climate change effects; especially where those effects are likely to exacerbate natural hazards.

2.1.3 Effects based planning

Managing the risk of hazards includes understanding the likelihood of a hazard occurring and the consequences. The Operative District Plans have an effects-based approach, which does not consider that different types of activities could potentially increase the potential for people's health and safety to be at risk from natural hazards. For example, siting a new hospital or school within an area subject to natural hazards is likely to increase the exposure for a large amount of people to natural hazard risk.

2.1.4 Atmospheric related hazards

The West Coast is subject to a number of weather-related hazards including high winds, tornado, drought and fire, which are likely to become more severe and frequent as a result of climate change.

As the effects of climate change are dependent on complex issues, including the ability of humankind to mitigate greenhouse emissions, atmospheric hazards (except flooding) and the impact of these are not able to be quantified.

The Building Act goes some way to managing fire risk (in relation to buildings) and winds (by ensuring design is appropriate to wind zones). It is not possible to predict the locations tornados are likely to impact, to the extent that land use controls can be applied in TTPP to avoid, remedy or mitigate tornado risk.

Drought is more appropriately addressed through infrastructure planning and water allocation planning.

2.1.5 Quantifying the risk

There are some natural hazards, as defined in the RMA, where the risk, including the likelihood and consequences are extremely problematic to quantify or map.

As well as difficulties inherent in quantifying the risk of some hazard types, there are other hazards which may be quantifiable. However, there is a cost to obtain or update the science.

The RMA requirement to manage the significant risks of natural hazards requires some prioritisation of hazards in terms of the significance of the risks, and the TTPP response must consider whether the risks are quantifiable, and the cost of such quantification. It is not economically feasible to obtain new and updated science for all hazards defined in the RMA (or NZCPS) for the Proposed TTPP.

The focus for natural hazards management through the development of TTPP has been on coastal hazards (inundation and erosion), fault rupture, flooding, lake and coastal tsunami and land instability. These are identified as hazards that may pose significant risk to a large number of people and properties.

2.2 Evidence Base - Research, Consultation, Information and Analysis undertaken

2.2.1 Research

The current District Plans have been reviewed, technical advice and assistance from various internal and external experts has been commissioned and utilised, along with internal workshops and community feedback to assist with setting the plan framework. This work has been used to inform the identification and assessment of the environmental, economic, social and cultural effects that are anticipated from the implementation of the provisions. This advice includes the following:

Planning Provisions

Title	**Te Tai o Poutini Plan Technical Update - Natural Hazards and Climate Change Report to TTPP Committee 24 March 2020**
Author	Lois Easton
Brief Synopsis	Outlines the link between natural hazards and climate change and how this could be looked at within TTPP.

Link to Document	https://ttpp.nz/wp-content/uploads/2020/03/TTPP-March-Agenda.pdf

Title	**Te Tai o Poutini Plan – Issues and Options for Natural Hazards Report to TTPP Committee May 2021**
Author	Edith Bretherton
Brief Synopsis	Outlines the planning context and issues in relation to natural hazards. Discusses the use of a risk based approach to natural hazard management. Gives options as to how to manage the different natural hazards on the West Coast.
Link to Document	https://ttpp.nz/wp-content/uploads/2021/05/Agenda-TTPP-Committee-25-May-2021.pdf

Title	**Te Tai o Poutini Plan – Draft Objectives, Policies and Rule Direction for Natural Hazards Report to TTPP Committee August 2021**
Author	Edith Bretherton
Brief Synopsis	Outlines potential objectives and policies and options for approaches to rules in TTPP.
Link to Document	https://ttpp.nz/wp-content/uploads/2021/09/TTPP-Agenda-2-September-2021.pdf

Title	**Te Tai o Poutini Plan – Draft Rules for Natural Hazard Overlays Report to TTPP Committee October 2021**
Author	Edith Bretherton
Brief Synopsis	Further report discussing proposed draft rules for natural hazards.
Link to Document	https://ttpp.nz/wp-content/uploads/2022/01/Agenda-29-October-2021.pdf

Title	**Te Tai o Poutini Plan – Draft Rules for Natural Hazard Overlays Report to TTPP Committee 2 December 2021**
Author	Edith Bretherton
Brief Synopsis	Further report discussing proposed draft rules for natural hazards.
Link to Document	https://ttpp.nz/wp-content/uploads/2021/11/Agenda-2-December-2021.pdf

Subsequent to this report the draft natural hazards consultation document (Part 1 – flood hazards, lake and coastal tsunami) and amended draft overlays and provisions were presented to the Committee on 16 December 2021**.** https://ttpp.nz/wp-content/uploads/2021/12/Agenda-Te-Tai-o-Poutini-Plan-Committee-Meeting-16-December-2021-2.pdf

Following further technical work and workshops with elected representatives Part 2 of the draft natural hazards provisions were taken to the committee for approval to consult.

Title	Te Tai o Poutini Plan – Draft Rules for Natural Hazard Overlays Report to TTPP Committee 29 March 2022
Author	Edith Bretherton
Brief Synopsis	Draft overlays and provisions for Part 2 Natural Hazards – Coastal and Land Instability
Link to Document	https://ttpp.nz/wp-content/uploads/2022/03/TTPP-Agenda-29-March-2022.pdf

The Committee recommended consultation be undertaken on the coastal and land instability hazards.

Title	Te Tai o Poutini Plan – Feedback on the Draft Plan to TTPP Committee 29 March 2022
Author	Lois Easton
Brief Synopsis	Report providing overview of consultation, key themes and seeking direction changes.
Link to Document	https://ttpp.nz/wp-content/uploads/2022/03/TTPP-Agenda-29-March-2022.pdf

Feedback was presented from the part 1 consultation.

Following the 2nd consultation period for natural hazards two reports were taken to the committee recommending amendments to the provisions based on the feedback, and an independent peer review undertaken. One report addressed the general feedback, and another detailing the Westport specific approach.

Title	Te Tai o Poutini Plan – Natural Hazards to TTPP Committee 17 May 2022
Author	Edith Bretherton
Brief Synopsis	Detailed report on feedback received on the draft provisions, and suggested amendments
Link to Document	https://ttpp.nz/wp-content/uploads/2022/03/TTPP-Agenda-29-March-2022.pdf

Title	Te Tai o Poutini Plan – Westport Zoning and Natural Hazard Provisions to TTPP Committee 17 May 2022
Author	Lois Easton
Brief Synopsis	Detailed report back on feedback received and suggested amendments
Link to Document	https://ttpp.nz/wp-content/uploads/2022/03/TTPP-Agenda-29-March-2022.pdf

Alongside this planning advice technical reports have also been used to support the identification and management of the significant risks of natural hazards. These can be found online at https://ttpp.nz/technical-reports/ and include the following:

General

Title	**Geology of the Aoraki area. Institute of Geological and Nuclear Science 1:250 000 geological map 15. 1 sheet + 71 p. Lower Hutt, New Zealand. GNS Science. 2007.**
Author	Cox, S.C.; Barrell, D.J.A (compilers)
Brief Synopsis	Full colour large format geological map illustrates the geology of the Aoraki area. The accompanying illustrated text summarises the regional geology, tectonic development, geological resources, engineering geology and the potential geological hazards.
Link to Document	https://www.gns.cri.nz/Home/Our-Science/Land-and-Marine-Geoscience/Regional-Geology/Geological-Maps/1-250-000-Geological-Map-of-New-Zealand-QMAP/QMAP-text-maps#aoraki

Title	**Geology of the Greymouth area. Institute of Geological and Nuclear Sciences 1:250 000 geological map 12. 1 sheet + 58p. Lower Hutt, New Zealand. Institute of Geological and Nuclear Sciences Limited. 2002.**
Author	Nathan, S.; Rattenbury, M.S.; Suggate, R.P (compilers).
Brief Synopsis	Full colour large format geological map illustrates the geology of the Greymouth area. The accompanying illustrated text summarises the regional geology, tectonic development, geological resources, engineering geology and the potential geological hazards.
Link to Document	https://www.gns.cri.nz/Home/Our-Science/Land-and-Marine-Geoscience/Regional-Geology/Geological-Maps/1-250-000-Geological-Map-of-New-Zealand-QMAP/QMAP-text-maps#greymouth

Title	**Geology of the Nelson area. Institute of Geological and Nuclear Sciences 1:250 000 geological map 9. 1 sheet + 67 p. Lower Hutt, New Zealand: Institute of Geological and Nuclear Sciences Limited. 1998.**
Author	Rattenbury, M.S., Cooper, R.A., Johnston, M.R (compilers).
Brief Synopsis	Full colour large format geological map illustrates the geology of the Nelson area. The accompanying illustrated text summarises the regional geology, tectonic development, geological resources, engineering geology and the potential geological hazards.
Link to Document	https://www.gns.cri.nz/Home/Our-Science/Land-and-Marine-Geoscience/Regional-Geology/Geological-Maps/1-250-000-Geological-Map-of-New-Zealand-QMAP/QMAP-text-maps#nelson

Title	**Geology of the Haast area. Institute of Geological and Nuclear Sciences 1:250 000 geological map 14. 1 sheet + 58 p. Lower Hutt, New Zealand. GNS Science. 2010.**
Author	Rattenbury, M.S.; Jongens, R.; Cox, S.C. (compilers).
Brief Synopsis	Full colour large format geological map illustrates the geology of the Haast area. The accompanying illustrated text summarises the regional geology, tectonic development, geological resources, engineering geology and the potential geological hazards.

Link to Document	https://www.gns.cri.nz/Home/Our-Science/Land-and-Marine-Geoscience/Regional-Geology/Geological-Maps/1-250-000-Geological-Map-of-New-Zealand-QMAP/QMAP-text-maps#haast

Title	**Climate Change Effects and Impact Assessment: A Guidance Manual for Local Government in New Zealand. Ministry for the Environment, 2008**
Author	Ministry for the Environment
Brief Synopsis	This Guidance Manual is designed to help local governments identify and quantify opportunities and hazards that climate change poses for their functions, responsibilities and infrastructure. This is the second edition of the Guidance Manual, and it supersedes the first edition published in 2004. It follows the updated assessment of the science of climate change produced by the Intergovernmental Panel on Climate Change (IPCC) in its Fourth Assessment in 2007.
Link to Document	https://environment.govt.nz/publications/climate-change-effects-and-impacts-assessment-a-guidance-manual-for-local-government-in-new-zealand/

Title	**Preparing for Climate Change: A Guide for Local Government in New Zealand. Ministry for the Environment, 2008.**
Author	Ministry for the Environment
Brief Synopsis	Local authorities have both social and legal obligations to take climate change effects into account in their decision-making. This guide explains these obligations, including those under the Resource Management Act. A key message in the guide is that dealing with climate change effects can be broken down into manageable parts and can easily form part of existing council planning and operational processes. Managing climate change effects does not necessarily require new and additional resources. The guide suggests how councils can carry out simple checks to assess whether climate change effects are likely to be significant for a plan, project or activity. If the effects are likely to be significant, more detailed assessments are recommended and guidance is provided as to how councils might undertake these assessments. Although the guide will help councils identify, scope and respond to climate change in their areas, it does not provide standard solutions for specific situations. Each region, district and community will have its own climate-related vulnerabilities and priorities. The guide does, however, provide some specific tools to help councils identify and respond to climate change impacts including a decision-making framework, case studies and practical checklists.
Link to Document	https://environment.govt.nz/publications/preparing-for-climate-change-a-guide-for-local-government-in-new-zealand/

Title	**Planning and engineering guidance for potentially liquefaction-prone land. Resource Management and Building Code Aspect – MBIE, Mfe, Earthquake Commission .**
Author	Ministry for the Environment, Ministry for Business, Innovation and Employment and the Earthquake Commission.
Brief Synopsis	This document provides guidance for a risk-based process to manage liquefaction related risk in land use planning and development decision-making. While this guidance specifically focuses on liquefaction and its consequences, it is part of a broader objective that buildings and infrastructure be located and built with appropriate consideration of all aspects of the land conditions and natural hazards. This document builds on the understanding that there are equally important parts to be played by resource management land use planning (covered by the Resource Management Act (RMA)) and engineering design (covered by the Building Act).
Link to Document	https://www.building.govt.nz/assets/Uploads/building-code-compliance/b-stability/b1-structure/planning-engineering-liquefaction.pdf

Title	**West Coast Regional Council Asset Management Plans: Karamea, Kongahu, Mokihinui, Punakaiki, Nelson Creek, Red Jacks, Coal Creek, Greymouth, Inchbonnie, Taramakau, Hoktika Seawall, Hokitika Southside, Kaniere, Raft Creek, Kowhitirangi, Vine Creek, Wanganui, Matanui, Whataroa, Waitangitoana, Franz Josef, Lower Waiho, Okuru, Neils Beach**
Author	West Coast Regional Council Operations Team
Brief Synopsis	The Regional Council is required by the Local Government Act 2002 to prepare Asset Management Plans (AMP) for the protection of assets on our rating districts and to review these at least every three years. Each rating district has an AMP that describes how the council intends to manage the rating district on behalf of the affected community and sets out the history of the scheme so there is a record of the major decisions, including expenditure. It identifies the objectives of the scheme as well as the methods of monitoring the condition of the assets, determining the annual maintenance needed to retain the service level and the long-term planning and management goals that are taken into account when delivering the service.
Link to Document	https://www.wcrc.govt.nz/services/special-rating-districts/special-rating-districts

Title	**Hostile Shores, Catastrophic Events in Prehistoric New Zealand and their impact on the Maori Coastal Communities. . Auckland University Press**
Author	Bruce McFadgen
Brief Synopsis	Article detailing natural hazard events and their impact on Māori coastal communities. Tsunami and earthquake events are detailed, with evidence of events from a variety of sources and from across New Zealand including South Westland, and the coast of the South Island generally.

Link to Document	https://www.wcrc.govt.nz/repository/libraries/id:2459ikxj617q9ser65rr/hierarchy/Documents/Publications/Natural%20Hazard%20Reports/West%20Coast/West%20Coast%20Excerpts%20Hostile%20Shores%20B%20McFadgen%202008.pdf

Title	**Improving resilience to Natural Disasters: A West Coast Lifelines Vulnerability and Interdependency Assessment: Main Report. West Coast Civil Defence Emergency Management Group. August 2017.**
Author	David Elms, Ian McCahon and Rob Dewhirst
Brief Synopsis	The West Coast of New Zealand is particularly vulnerable to natural disasters. Not only do its geology and topology mean there is a high risk of earthquake and storm events, but also its communities are held together physically by a far-flung network of fragile connections. The risk of a major earthquake resulting from rupture of the Alpine Fault is well understood. But there could be other major earthquakes such as the historic earthquakes at Murchison, Inangahua and Arthur's Pass. It is impossible to predict the extent, locality and nature of an earthquake – even an Alpine Fault event. All that can be said is that a major event will happen, and that because its nature and location are unknown beforehand, it is necessary to expect the unexpected. This is also true of storms. Major storm events are expected because of the interaction between the predominantly westerly winds and the high Southern Alps. But some storms are particularly severe either because of their immediate intensity or because they cover an unusually wide area. Again, what exactly would happen cannot be predicted. A third type of natural event – a tsunami – is rare but could be devastating to coastal areas. Thus West Coast communities and their related economies will have to deal with severe naturally occurring disasters whose unpredictability requires a need for resilience. Community resilience depends on a robust and resilient infrastructure. Accordingly, the prime focus of the present report is on achieving resilient infrastructure.
Link to Document	https://www.resorgs.org.nz/west-coast-resilience/

Title	**Reducing risk through the management of existing uses: tensions under the RMA. Lower Hutt (NZ): GNS Science. 131p. (GNS Science report; 2019/55). Grace ES, France-Hudson BT, Kilvington MJ.**
Author	Grace ES, France-Hudson BT, Kilvington MJ.
Brief Synopsis	Many communities in New Zealand face risks from natural hazards that are either increasing due to climate change, or where new knowledge has revelated the hazard has greater probability, magnitude or likely impact. The RMA provides for the management of natural hazards through land use planning, however, to-date there have been few examples of local authorities using the RMA to reduce risk to existing developments by modifying existing uses. Local authorities are not merely driven by a requirement to response to the content of the RMA but need the RMA to provide them with the tools

	and the guidance to act in a way that their obligations to community wellbeing and safety demand. The article explores three questions: 1. What are the options for managing existing use under the RMA for the purpose of risk reduction? 2. Why have there been so few examples of managing existing use for risk reduction to date? 3. What further steps may be necessary to bring clarify and certainty to a very difficult issue with many competing views and imperatives.
Link to Document	https://www.gns.cri.nz/static/download/existinguses/SR2019-55-AD-Reducing-risk-through-the-management-of-existing-uses-tensions_FINAL.pdf

Title	**Risk-based land use planning for natural hazard risk reduction 2013, GNS GNS Miscellaneous Series 67. 97p.**
Author	W.S.A Saunders, J.G Beban, and M Kilvington
Brief Synopsis	Planners have a responsibility to ensure that the safety and security of present and future communities are not compromised by urban growth and development. As such, land use planning is often described as an opportune tool for reducing or even eliminating risks relate to natural hazards. Many land use planning provisions are based around a likelihood assessment, such as a 1/100 year event, or based on "acceptable level risk" which is not defined. As likelihood alone does not give the full picture of the impact or consequences of a natural hazard event, and acceptable risk has no standard definition, many developments are being approved which have increased or potentially increased risks. To assist planners to define levels of risk, and to include natural hazard risk in land use planning, a five-step risk-based approach has been development with an associated engagement strategy.
Link to Document	http://tools.envirolink.govt.nz/assets/Uploads/RISK-R7-120Risk-based20land-use20planning20for20natural20hazard20risk20reduction.pdf

Title	**Tools for estimating the effects of climate change on flood flow: A guidance manual for local government in New Zealand. 2010.**
Author	Ministry for the Environment
Brief Synopsis	The main aim of this guidance manual is to help local authority staff – including river managers, engineering staff and asset managers – to manage and minimise the risks posed by increased flood risk due to climate change. More specifically, the manual provides good practice guidance for incorporating climate change impacts into flow estimation.
Link to Document	https://environment.govt.nz/publications/tools-for-estimating-the-effects-of-climate-change-on-flood-flow-a-guidance-manual-for-local-government-in-new-zealand/

Title	Preparing for future flooding: A guide for local government in New Zealand. 2010. Ministry for the Environment.
Author	Ministry for the Environment
Brief Synopsis	Preparing for Future Flooding is a summary of the Ministry's technical report 'Tools for Estimating the effects of climate change on flood flow'. It provides an overview of the expected impacts of climate change on flooding such as changes in rainfall, temperature, sea-level, storminess and sediment transport processes. It provides good practice information and guidance to help local authorities incorporate climate change impacts into flood risk management planning through providing examples of approaches local government has taken.
Link to Document	https://environment.govt.nz/publications/preparing-for-future-flooding-a-guide-for-local-government-in-new-zealand/

Title	Proposed Waikato District Plan – Evidence for Defended Areas and 1D/2D mapping used for Flood Plain Management Area.
Author	Rick Liefting
Brief Synopsis	Evidence statement from Mr Liefting, Team Leader of Regional Resilient in Integrated Catchment Management, Waikato Regional Council.
Link to Document	https://www.waikatodistrict.govt.nz/docs/default-source/your-council/plans-policies-and-bylaws/plans/district-plan-review/hearings/hearing-27c/council-section-42a-reports/hearing-27c---evidence---rick-liefting-defended-areas.pdf?sfvrsn=145f8ec9_2

Title	Environmental Waikato Technical Report 2006/48.
Author	Christopher Turbott and Andrew Stewart
Brief Synopsis	Managed retreat is not well understood in the New Zealand context. This report characterises managed retreat and reviews the main options available for implementation. The report found that managed retreat would need to be implemented as a long-term strategy. It may take several generations to for it to become a normal response to coastal hazards. Councils would need to comprehensively integrate managed retreat strategies into long-term urban growth, infrastructure and reserves planning, as well as regulatory planning.
Link to Document	https://www.boprc.govt.nz/your-council/plans-and-policies/plans/regional-plans/regional-natural-resources-plan/awatarariki-fanhead-matata-proposed-plan-change-17

Title	Awatarariki Fan Head. Plan Change 17 and Plan Change 1.
Author	Bay of Plenty Regional Council
Brief Synopsis	Proposed Plan Change 17 was publicly notified on 19 June 2018 and eight submissions plus two further submissions were received. Submissions were heard at a public hearing from 2 to 4 March 2020 and the hearing panel of independent commissioners released their decisions on 1 April 2020.

Link to Document	https://www.boprc.govt.nz/your-council/plans-and-policies/plans/regional-plans/regional-natural-resources-plan/awatarariki-fanhead-matata-proposed-plan-change-17

Wildfire

Title	**New Zealand Wildfire Threat Analysis – workbook for. 2011**
Author	National Rural Fire Authority
Brief Synopsis	Detailed threat analysis with methodology and output maps
Link to Document	NA – Hardcopy only

Fault

Title	**Offshore faulting and earthquake sources, West Coast, South Island. June 2013.**
Author	Phillip Barnes, NIWA
Brief Synopsis	Major West Coast coastal towns and many small coastal communities could be at risk from potential earthquakes on offshore faults and tsunamis. This report attempts to characterise active faulting and potential earthquake sources off the Westland coast. This report presents the results of following the identification of marine active faults and their characterisation as potential earthquake sources. To undertake this work extensive marine seismic reflection profiles, together with exploration well and seafloor bathymetry data were used.
Link to Document	https://envirolink.govt.nz/assets/Envirolink/1237-WCRC114-Offshore-faulting-and-earthquake-sources-West-Coast-stage-2.pdf

Title	**Mapping and fault rupture avoidance zonation for the Alpine Fault in the West Coast region, *GNS Science Consultancy Report* 2009/18. *47*p.**
Author	Langridge, R.; Ries, W.
Brief Synopsis	Mapping of the Alpine Fault and Fault Avoidance Zones about the rupture trace has been undertaken using a Geographic Information System (GIS) utilising a number of mapping resources. These are principally: QMap geological maps (which include active fault line data), University of Otago online Alpine Fault mapping; RTK-GPS topographic maps and sketch maps from student theses and scientific papers. In addition, a considerable amount of linework review has been undertaken by the authors using these sources, aerial photographs and orthophotographs. Several case studies of priority areas show how the Fault Avoidance Zones are created. These areas are located where the Alpine Fault traverses near: Maruia River, Haupiri River, Inchbonnie, Toaroha River, Franz Josef and Haast. The GIS dataset on the accompanying CD, provides coverage at the appropriate scale and includes cadastral information, with respect to fault location1 .
Link to Document	https://www.wcrc.govt.nz/repository/libraries/id:2459ikxj617q9ser65rr/hierarchy/Documents/Publications/Natural%20Hazard%20Reports/Alpine%20Fault/Mapping%20and%20fault%20rupture%20avoidance%20zona

	tion%20for%20the%20Alpine%20Fault%20in%20the%20West%20Coast%20region%20R%20Langridge%20April%202010.pdf

Title	**Mapping and fault rupture avoidance zonation for the Alpine Fault in the West Coast region, *GNS Science Consultancy Report* 2009/18. *47*p.**
Author	R. Sutherland, D. Eberhart-Phillips , R.A. Harris , T. Stern , J. Beavan , S. Ellis1 , S. Henrys , S. Cox , R.J. Norris , K.R. Berryman , J. Townend , S. Bannister , J. Pettinga , B. Leitner , L. Wallace , T.A. Little , A.F. Cooper , M. Yetton , M. Stirling .
Brief Synopsis	Geological observations require that episodic slip on the Alpine fault averages to a long-term displacement rate of 2-3 cm/yr. Patterns of seismicity and geodetic strain suggest the fault is locked above a depth of 6-12 km and will probably fail during an earthquake. High pore-fluid pressures in the deeper fault zone are inferred from low seismic P-wave velocity and high electrical conductivity in central South Island, and may limit the seismogenic zone east of the Alpine fault to depths as shallow as 6 km. A simplified dynamic rupture model suggests an episode of aseismic slip at depth may not inhibit later propagation of a fully developed earthquake rupture.
Link to Document	https://ui.adsabs.harvard.edu/abs/2007GMS...175..235S/abstract

Title	**Designing and implementing a fault avoidance zones strategy for the Alpine Fault in the West Coast region. Proceedings from the North Pacific Conference on earthquake Engineering. April 2011.**
Author	R Langridge, M Trayes, and W Ries..
Brief Synopsis	GNS Science has been working closely with West Coast Regional Council to develop a Fault Avoidance Zone (FAZ) for the Alpine Fault in its region. An initial FAZ of width 100-340m has been presented and has been disseminated. This report recognises priority areas where existing communities by my affected by the proximity to the zone of deformation along the fault.
Link to Document	https://www.nzsee.org.nz/db/2011/202.pdf

Title	**Mapping and fault rupture avoidance zonation for the Alpine Fault in the West Coast region 2009/18 March 2010. GNS Science Consultancy Report**
Author	R. Langridge W. Ries
Brief Synopsis	Report recommending mapping and zonation be adopted by West Coast Regional Council and its three Territorial Land Authorities on the West Coast (Buller, Grey and Westland Districts). The Fault Avoidance Zones defined in this study act as a guide to the presence of the Alpine Fault within those areas. This may be particularly useful for the placement and consent of future developments. In addition to GIS-based mapping some field fault checking has been undertaken to confirm fault locations in some key areas. Several paleoseismic trenches have been excavated across the Alpine Fault during the last 12 years, as part of research and

	thesis studies into the activity of the fault. These trenches generally confirm the location and activity of the Alpine Fault as shown in the GIS.
Link to Document	https://www.wcrc.govt.nz/repository/libraries/id:2459ikxj617q9ser65rr/hierarchy/Documents/Publications/Natural%20Hazard%20Reports/Alpine%20Fault/Mapping%20and%20fault%20rupture%20avoidance%20zonation%20for%20the%20Alpine%20Fault%20in%20the%20West%20Coast%20region%20R%20Langridge%20April%202010.pdf

Tsunami

Title	**Large Earthquakes and the Abandonment of Prehistoric Coastal Settlements in 15th Century New Zealand**
Author	James R. Goff and Bruce G. McFadgen
Brief Synopsis	This paper reports on the effects of large earthquakes and related events, such as tsunamis, on prehistoric coastal settlements in New Zealand. It is based on field observations at several well-established archaeological sites around the Cook Strait region and on literature reviews. We identify three broad periods of seismic activity in New Zealand since human occupation of the islands: 13th century, 15th century, and the 1750s to 1850s. The most significant, from a prehistoric human perspective, is the 15th century. Using examples from the Cook Strait region, we suggest that the abandonment of coastal settlements, the movement of people from the coast to inland areas, and a shift in settlement location from sheltered coastal bays to exposed headlands, was due to seismic activity, including tsunamis. We expect similar patterns to have occurred in other parts of New Zealand, and other coastal areas of the world with longer occupation histories.
Link to Document	https://onlinelibrary.wiley.com/doi/abs/10.1002/gea.10082

Title	**Assessing Tsunami Hazards New Zealand Coast, Science of Tsunami Hazards, Volume 21, Number 3, Page 137 (2003)**
Author	Goff J and Walters R. A
Brief Synopsis	An assessment is made for tsunami hazards along the New Zealand coast by searching for long-wave resonances for the range of periods spanned by tsunami and short-period storm surges. To accomplish this, a high-resolution model of the southwest Pacific is used to simulate the effects of these waves in an oceanic domain extending over 40° in latitude and 50° in longitude. This paper describes the results of such a simulation for waves with a period in the range of 15 to 300 minutes. The locations where wave resonances occur are compared with historical and geological evidence in order to evaluate the concurrence of the locations. A search of geological data was undertaken, and the results of palaeotsunami studies were compared with model predictions to determine the general utility of using resonance patterns to assess tsunami hazards.
Link to Document	https://library.lanl.gov/tsunami/213/walter.pdf

Title	Tsunami evacuation zone boundary mapping: West Coast Region, GNS Science Consultancy Report (2014/307. 24p 2014.
Author	Leonard, G.S.; Lukovic, B.; Power, W.L.
Brief Synopsis	Evacuation zone development following MCDEM Tsunami Evacuation Zones guidelines and the Leonard method. This has been further detailed for the harbours and validated against the 2011 Kohoku tsunami. Near-shore offshore maximum wave height amplitudes from all tsunami sources around the Pacific Ocean were then doubled to give a credible at shore on-shore maximum run-up height above high tide.
Link to Document	https://www.wcrc.govt.nz/repository/libraries/id:2459ikxj617q9ser65rr/hierarchy/Documents/Publications/Natural%20Hazard%20Reports/Tsunamis/2014_GNS_Power_Tsunami%20evacuation%20zone%20boundary%20mapping_West%20Coast%20Region_CR_2014-307.pdf

Title	Expanding the proxy toolkit to help identify past events — Lessons from the 2004 Indian Ocean Tsunami and the 2009 South Pacific Tsunami, Earth-Sci. Rev. (2011)
Author	Goff-Chague C., Schneider J-L, Goff, J.R, Howes-Dominey, D., Strotz, L.
Brief Synopsis	Some of the proxies used to identify palaeotsunamis are reviewed in light of new findings following the 2004 Indian Ocean Tsunami and the 2009 South Pacific Tsunami, and a revised toolkit provided. The new application of anisotropy of magnetic susceptibility (AMS) to the study of tsunami deposits and its usefulness to determine the hydrodynamic conditions during the emplacement of tsunami sequences, together with data from grain size analysis, are presented. The value of chemical proxies as indicators of saltwater inundation, associated marine shell and/or coral, high-energy depositional environment, and possible contamination, is demonstrated and issues of preservation addressed. We also provide new findings from detailed studies of heavy minerals. New information gathered during the UNESCO — International Oceanographic Commission (IOC) International Tsunami Survey of fine onshore sediments following the 2009 South Pacific Tsunami is presented, and includes grain size, chemical, diatom and foraminifera data. The tsunami deposit varied, ranging from fining-upward sand layers to thin sand layers overlain by a thick layer of organic debris and/or a mud cap. Grain size characteristics, chemical data and microfossil assemblages provide evidence for marine inundation from near shore, and changes in flow dynamics during the tsunami.
Link to Document	https://www.wcrc.govt.nz/repository/libraries/id:2459ikxj617q9ser65rr/hierarchy/Documents/Publications/Natural%20Hazard%20Reports/New%20Zealand/Proxy%20tools%20for%20past%20tsunami%20ID%20Chague-goff%20et%20al%20ESR%202011.pdf

Title	New Zealands Next Top Model: Integrating tsunami inundation modelling into land use planning, GNS Science Miscellaneous Series 34, 42p. 2011.
Author	Saunders, W.S.A.; Prasetya, G. and Leonard, G.S.
Brief Synopsis	Some of the proxies used to identify palaeotsunamis are reviewed in light of new findings following the 2004 Indian Ocean Tsunami and the 2009 South Pacific Tsunami, and a revised toolkit provided. The new application of anisotropy of magnetic susceptibility (AMS) to the study of

	tsunami deposits and its usefulness to determine the hydrodynamic conditions during the emplacement of tsunami sequences, together with data from grain size analysis, are presented. The value of chemical proxies as indicators of saltwater inundation, associated marine shell and/or coral, high-energy depositional environment, and possible contamination, is demonstrated and issues of preservation addressed. We also provide new findings from detailed studies of heavy minerals. New information gathered during the UNESCO — International Oceanographic Commission (IOC) International Tsunami Survey of fine onshore sediments following the 2009 South Pacific Tsunami is presented, and includes grain size, chemical, diatom and foraminifera data. The tsunami deposit varied, ranging from fining-upward sand layers to thin sand layers overlain by a thick layer of organic debris and/or a mud cap. Grain size characteristics, chemical data and microfossil assemblages provide evidence for marine inundation from near shore, and changes in flow dynamics during the tsunami.
Link to Document	https://www.wcrc.govt.nz/repository/libraries/id:2459ikxj617q9ser65rr/hierarchy/Documents/Publications/Natural%20Hazard%20Reports/New%20Zealand/Integrated%20Tsunami%20Modelling%20with%20Land%20Use%20Planning%20GNS%202011.pdf

Lake Tsunami

Title	**Seiche Effects in Lake Tekapo, New Zealand, in an Mw8.2 Alpine Fault Earthquake**
Author	Xiaoming Wang, Caroline Holden, William Power, Yaoru Liu and Joshua Mountjoy.
Brief Synopsis	This study investigates the potential for seismic seiches in Lake Tekapo, New Zealand, triggered by ground shaking from an Mw8.2 Alpine Fault earthquake. Synthetic ground motions are used as a forcing boundary to drive lake water motions by further developing a tsunami simulation model—COMCOT—and coupling it with earthquake simulation model outputs. Our modelling results reveal that lake water oscillations are mobilised immediately by the ground movement and further amplified by cross-lake seiches. Amplitudes of lake oscillations can reach up to 4.0 m in the lake's narrow southern arm, over 1.0 m along the shore of Lake Tekapo township, and about 1.5–2.5 m along many other parts of the lake shore. Large-amplitude water oscillations quickly attenuate in the first 5–10 min after the earthquake due to their relatively short periods, while long-period oscillations continue for a long time, albeit with much smaller amplitudes. Spectral analysis clearly reveals that the ground motions trigger both fundamental and higher modes in the lake whose oscillation periods are consistent with theoretical estimates. We find that large-amplitude lake water oscillations are better correlated with low-frequency, less energetic ground motion content than with high-frequency large-amplitude ground motions. Ground motion-triggered lake oscillations are large enough to pose potential threat to tourists, residents, boats and infrastructure both in the lake water and onshore near the waterfront. In contrast, vertical co-seismic displacements in the lake area, the conventional mechanism for tsunami generation, are too small to trigger tsunami waves of concern.
Link to Document	Hard copy only – Pure and Applied Geophysics vol 177, pages 5927-5942 (2020)

Title	**Geotechnical Site Suitability Assessment, Proposed Subdivison, Lake Poerua.**
Author	Golder and Associates
Brief Synopsis	Revised report in response to GNS peer review of original report, including extensive further field work and analysis. The geotechnical assessment was undertaken to understand site suitability for a proposed subdivision for 24 parcels at Lake Poerua.
Link to Document	https://ttpp.nz/wp-content/uploads/2022/04/Golder-Geotech-Lake-Poerua-Subdivision.pdf

Title	**Natural Hazards Risks for the Lake Poerua Area**
Author	Mary Trayes, Natural Hazards Analyst, WCRC
Brief Synopsis	Overview report of the risks with building and development at Lake Poerua
Link to Document	https://ttpp.nz/wp-content/uploads/2022/04/WCRC-Natural-Hazards-Risks-for-Lake-Poerua-Area.pdf

Title	**Review of Proposed Lake Poeura Subdivsion, Grey District, GNS Science, December 2006**
Author	Langridge, R, M., and Hancox, G. T.
Brief Synopsis	Review of consulting reports on behalf of Grey District Council, in relation to a proposed subdivision along the southeastern edge of Lake Poerua, adjacent to the Alpine Fault, South Island
Link to Document	https://ttpp.nz/wp-content/uploads/2022/04/Review-of-Lake-Poerua-Subd-GNS-2006.pdf

Coastal

Title	***Review of West Coast Region Coastal Hazard Areas, v2. NIWA. February 2022.***
Author	Measures, R. and Rouse, H.
Brief Synopsis	Review and assessment of Coastal Hazard Areas (CHA) for the West Coast Region, prepared for the Regional Coastal Plan, updated following Cyclone Fehi. CHAs have been identified and prioritised based on a risk assessment which considers not only the level of hazard, but also assets at risk. Extensive stretches of the West Coast which experience high levels of hazard from erosion and flooding have not been included in CHAs because they have no/few assets at risk. Similarly, CHAs may be given low priority because of the small amount of at-risk assets, even though the hazards are severe.
Link to Document	ttps://ttpp.nz/wp-content/uploads/2022/04/CHA_2022-Measures-and-Rouse.pdf

Title	*Omau Cliffs Subdivision, Geotechnical Assessment Report. WSP*
Author	Torben Fischer
Brief Synopsis	Geotechnical report prepared for a proposed subdivision at Omau / Cape Foulwind. This report summarises the findings of the geotechnical investigation and assessment of Lot 1 to 23 and presents development conditions and recommendations for future works within the lots in terms of allowable building areas, earthworks, stormwater and foundations.
Link to Document	https://ttpp.nz/wp-content/uploads/2022/04/Geotech-WSP-2021_8_20_Omau_Cliffs_Subdivision_GAR_ALL.pdf

Title	**Mapping for priority coastal hazard areas in the West Coast Region, March 2022**
Author	Bosserelle, C. and Allis, M
Brief Synopsis	Detailed assessment of areas identified in the proposed Regional Coastal Plan as Coastal Hazards Areas to inform development of TTPP overlays. This study maps areas susceptible to coastal erosion and inundation, it does not include other hazards such as tsunami or river flooding. Coastal erosion and inundation hazards were assessed, and hazard area mapped. The erosion hazard assessment is completed using a hybrid-probabilistic approach that accounts for available shoreline data and derived trends but also allow for expert judgment to account for effect that are difficult to quantify and/or where no/limited data is available. The study also mapped land exposed to coastal flood inundation from extreme storm-tides, wave setup and sea level rise. Inundation hazard assessment is completed using a hydrodynamics model for Westport/Orowaiti area and static ("bathtub") for other CHA.
Link to Document	https://ttpp.nz/wp-content/uploads/2022/04/WCRC_CHA_Report_1.1_Final.pdf

Title	**Coastal Communities Hazard Mitigation**
Author	Terry Hume and Paula Blackett
Brief Synopsis	This paper will discuss elements of the debate over coastal erosion mitigation based on recent surveys of coastal communities in New Zealand. We describe the key factors important in determining outcomes including the role of power, value of relationship building, resource availability, local authority alignment, and the necessity of good scientific input, and also identify some issues relevant to the insurance industry
Link to Document	Coastal Communities Hazard Mitigation T Hume 2007.pdf (PDF, 112.5KB)

Title	**Coastal Hazard in the West Coast Region**
Author	J. L. Benn and D.M. Neale
Brief Synopsis	This report examines coastal hazards in the West Coast Region, what processes cause them, and planning/management options available to address them.

Link to Document	Coastal Hazards in West Coast Region Benn and Neale 1992.pdf (PDF, 6.1MB)

Title	**Differential Uplift of the Shoreline NW Sth Island**
Author	P Suggate
Brief Synopsis	Discontinuous Pleistocene cliff-backed shorelines up to 220 m in altitude, and Holocene shorelines up to 12 m, border much of 125 km of coast from Westport to Hokitika in northwest South Island, New Zealand. The coastal terraces arc up to 10 km wide were cut on soft Tertiary sediments but are narrow or absent on gneiss. By analogy with post-glacial shoreline development, Pleistocene shorelines are accepted as having been formed at the times of attainment of high interglacial sea levels. Past intraregional correlations assumed minimal differential uplift, but, as with glacial outwash surfaces inland, the raised shorelines are deformed by folding. Correlations are helped by the relations of shoreline deposits to glacial outwash gravels in the south, and by a few radiometric, mainly radiocarbon, dates. Correlations with high sea levels of deep-sea Oxygen Isotope Stages are made using the best fits of the altitudes of local sequences of shorelines to the altitudes expected assuming constant rates of uplift for each sequence. Uplift rates are between 0.5 and 0.2 m/kyr, and the uplift pattern substantially matches that of uplift of Miocene to lower Quaternary sediments. The shorelines correspond to high sea levels within Oxygen Isotope Stages 15, 13, 11,9 (two), 7 (two), 5 (two) and 1
Link to Document	Differential Uplift of the Shoreline NW Sth Island P Suggate 1992.pdf (PDF, 1.1MB)

Title	**Maori environmental knowledge in natural hazard management and mitigation**
Author	Darren King and James Goff
Brief Synopsis	Based on a long and close association with the land and its resources, Māori have developed a detailed knowledge of local natural hazards. This includes oral histories and traditions that record past catastrophic hazard events, place names that designate areas that are high hazard risk and environmental indicates that inform about the safety and viability of activities linked to changes in the environment. Some of the contributions this knowledge can make to management and mitigation are highlighted.
Link to Document	Maori Environment Knowledge - Natural Hazards King and Goff GNS Client Report 2006.pdf (PDF, 1.6MB)

Title	**The shoreline erosion problem: lessons from the past**
Author	Orrin H. and Pilkey Terry Hume
Brief Synopsis	Around the world there are some spectacular examples of the damage caused by retreating shorelines. And there are equally spectacular examples of the expense to which some governments will go to hold their shorelines in place. More than 80% of the world's shorelines are eroding at rates varying from centimetres to metres per year. In undeveloped areas, of course, a retreating shoreline is no problem. Usually, we are not even aware that it is happening, though often there

	are signs of erosion such as fresh cliffs in sand dunes or trees that have fallen onto a beach. Erosion only becomes a problem when a humanmade structure is threatened.
Link to Document	NIWA Coastal Research Learning from the Past 2006.pdf (PDF, 1MB)

Title	**Rates of coastal erosion and accretion in New Zealand**
Author	Jeremy Gibb
Brief Synopsis	Rates of coastal erosion and accretion for New Zealand are calculated for the period since early European colonisation. Methods used for calculating rates from cadastral plans, vertical aerial photographs and field measurements are described, evaluated, and illustrated with examples. The most natural reference line for measurements of shoreline changes and for defining the seaward boundary of land is the seaward limit of land vegetation. Measurements made from air photographs and plans at scales larger than 1:4000 have errors less than ± 1 m. As scales become small, errors increase proportionately. Along depositional shorelines, erosion and accretion generally occur at 0.5-4.0 m.y-1 . Maximum erosion and accretion rates are 25.4 m.y-1 at North Kaipara Head and 68.9 m.y-1 at Farewell Spit respectively. Cliff recession generally occurs at 0.25 - 1.0 m.y-1 with maximum rates of 2.25 m.y-1 for mudstone cliffs at Cape Tumagain and 3.46 m.y-1 for conglomerate cliffs at Ngapotiki.
Link to Document	https://www.wcrc.govt.nz/repository/libraries/id:2459ikxj617q9ser65rr/hierarchy/Documents/Publications/Natural%20Hazard%20Reports/New%20Zealand/Rates%20of%20Coastal%20Erosion%20and%20Accretion%20in%20NZ%20JG%20Gibb%201978.pdf

Title	**Coastal Communities Hazard Mitigation**
Author	T Hume
Brief Synopsis	This paper will discuss elements of the debate over coastal erosion mitigation based on recent surveys of coastal communities in New Zealand. We describe the key factors important in determining outcomes including the role of power, value of relationship building, resource availability, local authority alignment, and the necessity of good scientific input, and also identify some issues relevant to the insurance industry.
Link to Document	Coastal Communities Hazard Mitigation T Hume 2007.pdf

Title	**Managing and adapting to coastal erosion at Granity, Ngakawau and Hector**
Author	Michael Allis, NIWA
Brief Synopsis	This report has been prepared for West Coast Regional Council (WCRC) to aid the decision-making processes associated with ongoing erosion problems at the villages of Granity, Ngakawau and Hector. The advice relates to ongoing coastal erosion issues along the frontage and options for coastal defence structures aimed at protecting residential land and property.

Link to Document	Coastal Erosion WCRC Granity, Ngakawau and Hector.pdf (PDF, 4.3MB)

Title	**Managing and adapting to coastal erosion on the West Coast: Granity**
Author	Doug Ramsey, NIWA
Brief Synopsis	The report outlines a number of potential measures, as a basis for future discussion between the Regional Council and Granity residents, that could assist in reducing the impact and/or slowing down the rate of coastal retreat of the gravel barrier along the village frontage, with particular emphasis on the most at risk section at the northern end of the village. The suggestions are intended to be achievable options, a number of which could be implemented by the local property owners and are based on the discussions held with a number of affected residents and staff at the Regional Council. Other suggestions are larger scale activities that would require contractors and coordination.
Link to Document	Granity Coastal Management NIWA 2006.pdf (PDF, 1.8MB)

Title	**Managing and adapting to coastal erosion on the West Coast: Granity**
Author	Michael Allis, NIWA
Brief Synopsis	This memo letter provides an update to "Managing and adapting to coastal erosion at Granity, Ngakawau and Hector" with recent site observations and further guidance.
Link to Document	Granity,Ngakawau and Hector addition information NIWA Dec 2016.pdf (PDF, 1.1MB)

Title	**Managing and adapting to coastal erosion on the West Coast: Ngakawau and Hector**
Author	Doug Ramsey, NIWA
Brief Synopsis	This memo letter provides an update to "Managing and adapting to coastal erosion at Granity, Ngakawau and Hector" with recent site observations and further guidance.
Link to Document	Hector Ngakawau Coastal Report NIWA 2007.pdf (PDF, 2MB)

Title	**The influence of structures on erosion of the north bank of the Mokihinui River mouth**
Author	D M Hicks J Bind, NIWA
Brief Synopsis	This report provides advice on the causes of recent erosion of the true right (northern) bank at the Mokihinui River mouth. The advice was sought by West Coast Regional Council (WCRC) after local concern that this erosion has been influenced by historic river training and coastal protection works. The investigation included a field inspection, compiling a history of river and coastal protection, analysis of shoreline and riverbank shifts at the river mouth and changes in river mouth

	configuration from aerial and satellite imagery, and inspection of river flow, sea level, and wave records.
Link to Document	The influence of structures on erosion of the north bank of the Mokihinui River mouth NIWA 2019.pdf (PDF, 3.7MB)

Title	**Review of Carters Beach Erosion for Buller District Council**
Author	I Goss, OCEL
Brief Synopsis	This report sets out a review of coastal processes along Carters Beach, including the township and to the east of the Buller River walls. This review has been requested due to recent erosion of the shoreline, impinging on the domain frontage, and coastal road.
Link to Document	Carters Beach Erosion Review for Buller District Council Ocel Consultants 2006.pdf (PDF, 1.5MB)

Title	**Managing and adapting to coastal erosion at Carters Beach**
Author	Michael Allis, NIWA
Brief Synopsis	This report has been prepared for West Coast Regional Council (WCRC) to aid the decision-making processes associated with ongoing erosion problems at the village of Carters Beach. The investigations undertaken include a site visit, digitisation and analysis of historical shoreline positions off aerial photographs and review of recent relevant literature. There is nothing to suggest the erosion rate at Carters Beach has increased since the 2006 assessment, rather, it is the awareness of the erosion problem that is increasing as the coastline advances towards community assets and the township.
Link to Document	Managing and adapting to coastal erosion at Carters Beach - Niwa Report 2017.pdf (PDF, 3.1MB)

Title	**Coastal Erosion and Inundation at Punakaiki Village (Pororari Beach) Westland 1983 - 1986**
Author	R M Kirk, Department of Conservation
Brief Synopsis	This report concerns the nature, present extent and likely future impacts of coastal erosion and saltwater inundation hazards at Punakaiki Village. It arises because on ongoing concern about these hazards and the effects on properties at the village since at least the early 1980's.
Link to Document	Coastal Erosion Punakaiki Village DOC Rpt by R Kirk 1988.pdf (PDF, 2.6MB)

Title	**Punakaiki Seawall Impacts – Technical Note**
Author	Doug Ramsey, NIWA
Brief Synopsis	This technical note is part of a rate of advice to aid decision making associated with ongoing erosion problems across the region. The purpose is provide advice for to the West Coast Regional Council Consent team with regard to the retrospective resource consenting of the recently constructed seawall, potential future extension and height increase.

Link to Document	NIWA Report Punakaiki FINALl DR 2006.pdf (PDF, 903.1KB)

Title	**Managing and adapting to coastal erosion at Cobden Beach**
Author	Doug Ramsey, NIWA
Brief Synopsis	This report has been prepared for West Coast Regional Council (WCRC) to aid the decision-making processes associated with management of Cobden Beach. The investigations undertaken as part of this assessment includes a site visit, review of aerial photographs and recent literature. WCRC requested advice on 1) the likely implications of recent in-situ coastal protection works, and 2) recommendations for effective and feasible options that allow long-term management and protection of infrastructure and properties along the Cobden Beach foreshore.
Link to Document	Cobden Beach Coastal Erosion - Niwa Report 2017.pdf (PDF, 1.3MB)

Title	**Cobden Lagoon and Range Creek flood management review**
Author	Richard Measures, NIWA
Brief Synopsis	The Grey River stopbanks have been effective at protecting Cobden from direct flooding by the Grey River, resulting in significant reductions in flood frequency and depth. However, Range Creek and Cobden Lagoon cause regular flooding to the low-lying parts of Cobden on the north side of the Grey stopbanks. This report assesses the causes of flood risk and potential management options for this area. To inform this assessment various data were analysed including LiDAR-derived topography, aerial imagery and stormwater network GIS data, and water level records. A site visit was undertaken on 2 May 2017, and previous relevant studies were reviewed
Link to Document	Cobden Lagoon and Range Creek flood management review - NIWA 2017.pdf (PDF, 2.2MB)

Title	**Coastal Dynamics and Sedimentation Pt Elizabeth area**
Author	John Pfahlert
Brief Synopsis	An investigation to identify whether the position of the shoreline has in the past and or is presently undergoing erosion or accretion. This allows calculations to be made of the volume of change, and enables predictions of future change as well. Sources and depositional zones for sediment allows further inferences to be made on the direction of sediment travel.
Link to Document	Coastal Dynamics and Sedimentation Pt Elizabeth area J Pfahlert 1984.pdf (PDF, 1.6MB)

Title	**Historical Shoreline Change and Beach Morphodynamics at Rapahoe Bay, West Coast**
Author	Rei Ishikawa
Brief Synopsis	This thesis utilises a range of methodologies to investigate the historical shoreline change and beach morphodynamics at Rapahoe Bay, West

	Coast, New Zealand. Rapahoe Bay is a small embayment located 15 km north of Greymouth and contains a complex and dynamic environment under a dominant swell condition. The objectives of this thesis include the investigation the coastline history through aerial photographs and relevant literature, identify and quantify historical shoreline change and the processes that have induced change, examine the short term and seasonal changes in beach profile, identify and quantify wave and transport process and to test the applicability of the zeta shoreline curve on a composite beach. This combined approach investigates the dynamics and process drivers involved in coastline change.
Link to Document	Historic Shoreline Change Geomorphology Rapahoe Theseis R Ishikawa 2008.pdf (PDF, 10MB)

Title	**Managing and adapting to coastal erison on the West Coast: Rapahoe**
Author	Doug Ramsey, NIWA
Brief Synopsis	This report is one of a number prepared for WCRC to aid the decision-making processes associated with ongoing erosion problems across the region. The report focusses on Rapahoe Village. It relates to long-term coastal erosion associated with the ongoing retreat of the gravel barrier fronting the village. Landward migration of the barrier has previously resulted in the loss of Beach Road north of Statham Street, and now threaten the camp and caravan site and the Forbes House at the northern end of the village.
Link to Document	Managing coastal erosion on West Coast Rapahoe DRamsay NIWA 2006.pdf (PDF, 2.3MB)

Title	**Managing and adapting to coastal erison on the West Coast: Rapahoe**
Author	Michael Allis, NIWA
Brief Synopsis	Coastal erosion is an issue facing several communities on the West Coast. This report addresses coastal erosion at Rapahoe village which threatens property and infrastructure. The West Coast Regional Council (WCRC) has requested an update to a report titled "Managing and adapting to coastal erosion on the West Coast: Rapahoe" (NIWA, 2006). The advice is intended to benefit WCRC, the Rapahoe community and recreational users of the beach by assisting with informing a long-term strategy for managing coastal hazard risk to development at Rapahoe.
Link to Document	Rapahoe Coastal Erosion - Niwa Report 2017.pdf (PDF, 1.2MB)

Title	**Shore protection options for Rapahoe Beach**
Author	Don Neale
Brief Synopsis	Revised report prepared for discussion purposes by the Department of Conservation, Greymouth District Council and West Coast Regional Council.
Link to Document	Shore Protection Options Rapahoe Bch D Neale DOC 1999.pdf (PDF, 6.7MB)

Title	Rivermouth-related shore erosion at Hokitika and Neils Beach, Westland
Author	Murray Hicks
Brief Synopsis	This report provides advice on two hazard situations relating to rivermouth processes: one at Hokitika, the other at Neils Beach in South Westland. At Hokitika, the main issue relates to the southward deflection of the Hokitika River outflow channel behind a bar rooted to Sunset Point on the north bank. This mouth configuration has raised concerns about potential effects on flooding in the Hokitika River estuary and on erosion of the Hokitika foreshore. At Neils Beach, a phase of shore erosion over the past five years or so is consuming the single foredune that protects the Neils Beach settlement and airstrip. Advice was sought on the cause of this erosion and potential mitigation options.
Link to Document	Shore Erosion Hokitika and Neils Beach.pdf (PDF, 5.9MB)

Land Instability

Title	Distribution of landslides in southwest New Zealand
Author	Oliver Korup
Brief Synopsis	This study examines the size distribution of a regional medium-scale inventory of 778 landslides in the mountainous southwest of New Zealand.
Link to Document	Distribution of Landslides Southwest NZ O Korup 2005.pdf (PDF, 814.7KB)

Title	Effects of large deep-seated landslides on hillslope morphology, western Southern Alps, New Zealand
Author	Oliver Korup
Brief Synopsis	Morphometric analysis and air photo interpretation highlight geomorphic imprints of large landslides (i.e., affecting 1 km2) on hillslopes in the western Southern Alps (WSA), New Zealand. Large landslides attain kilometer-scale runout, affect >50% of total basin relief, and in 70% are slope clearing, and thus relief limiting. Landslide terrain shows lower mean local relief, relief variability, slope angles, steepness, and concavity than surrounding terrain. Measuring mean slope angle smooths out local landslide morphology, masking any relationship between large landslides and possible threshold hillslopes. Large failures also occurred on low-gradient slopes, indicating persistent low frequency/high-magnitude hillslope adjustment independent of fluvial bedrock incision.
Link to Document	Effects of Large Deep-Seated Landslides SW NZ O Korup 2006.pdf (PDF, 5.9MB)

Title	Fluvial Response to Large Rock-Slope Failures Southern Alps
Author	Oliver Korup, Alexander L Strom, Johannes T Weidinger

Brief Synopsis	We describe remnants of large (107 –1010 m3) Late Pleistocene to Holocene rockslides and rock avalanches that block(ed) rivers and are preserved in the Himalayas, the Tien Shan, and the New Zealand Southern Alps despite rates of uplift and erosion of up to 10 mm year−1
Link to Document	Fluvial Response to Large Rock-Slope Failures Southern Alps O Korup and others.pdf (PDF, 1.8MB)

Title	**A landslide susceptibility map and landslide catalogue for the West Coast region**
Author	Kevin England
Brief Synopsis	This paper presents two tools for landslide hazard management in the West Coast region of New Zealand. As part of a thesis entitled "A landslide susceptibility model for the West Coast Region, New Zealand", a landslide susceptibility map and a landslide catalogue have been produced. This paper explains the research methodology, limitations and intended uses of these tools. In order to avoid misinterpretation, the study has been carried out in compliance with the "Guidelines for landslide susceptibility, hazard and risk zoning for land use planning", which was published in 2008 by the Joint Technical Committee on Landslides and Engineered Slopes.
Link to Document	Landslide Susceptibility Report 2010 K England.pdf (PDF, 1.2MB)

Title	**Landslide-induced river channel avulsions mountainous catchments South West NZ**
Author	Oliver Korup
Brief Synopsis	Pulsed or chronic supply of landslide debris to valley floors has historically caused substantial aggradation and channel instability in several alpine catchments of SW New Zealand. In this regional investigation of landslide impacts on river morphology, three types of landslide-induced channel avulsion are discerned
Link to Document	Landslide-induced river channel avulsions mountainous catchments South West NZ O Korup 2004.pdf (PDF, 1.8MB)

Title	**Punakaiki Rockfall Study by URS – for Buller District Council**
Author	Matt Howard and Tim McMorran
Brief Synopsis	Study of rockfall hazard associated with limestone cliffs above Punakaiki Village. The study incorporates a review of previous studies, geological mapping, helicopter inspection of cliff, excavation of test pits, review of anecdotal rockfall data and earthquake records, and analysis of rockfall trajectories.
Link to Document	Punakaiki Rockfall Study for BDC URS 2003.pdf (PDF, 10MB)

Westport Specific

Title	Westport 2100 – Recommendations of the Working Group Report to West Coast Regional Council and Buller District Council September 2019
Author	Nichola Costley
Brief Synopsis	Outlines the process of reviewing the Westport Hazardscape and the development of a range of recommendations to improve the resilience of Westport going into the next century.
Link to Document	https://www.wcrc.govt.nz/repository/libraries/id:2459ikxj617q9ser65rr/hierarchy/Documents/Community/Community%20Groups/Westport%202100%20Working%20Group/Report%20to%20Councils%20%E2%80%93%20Recommendations%20of%20the%20Westport%202100%20Working%20Group.pdf

Title	Westport Flood Forecasting roadmap for evacuation warnings. NIWA. June 2019.
Author	Duncan, M. Cattoen, C., Measures, R., and Carey-Smith, T.
Brief Synopsis	A new integrated family health centre is to be built in Westport and, as Westport is vulnerable to flooding, eight hours flood warning is required to enable patients to be moved safely if a flood large enough to cause flooding of Westport is forecast. This Envirolink funded report for the West Coast Regional Council (WCRC) investigates whether a model can be created that will predict a flood eight hours in advance and if not, what warning time could be expected. The report examines whether any new hydrological sites are required to assist the modelling and advises on the most appropriate modelling solution including what real time data can be used. The solution needs to be accurate and robust to give confidence in its use, so the level of confidence in the model needs to be stated. This report also provides the estimated cost to implement the solution, including any new hydrological sites, if required, and recommends the type of model and the inputs necessary. WCRC also require the costs of software, modelling and maintenance and advice on the time frame between completing any hydrological sites and the implementation of the model. Thus, this report is a roadmap of how to proceed with a flood warning system to give eight-hours' notice rather than providing a turnkey solution. The report was funded by Envirolink medium advice grant C01X1831. The report will be used by the WCRC to enable decision making around prioritising of work programmes, and civil defence planning. Further, the report will be used by Westport 2100, a community group, which will be convened in early 2019 to start the process of 100-year+ planning of hazard mitigation in Westport.
Link to Document	https://www.wcrc.govt.nz/repository/libraries/id:2459ikxj617q9ser65rr/hierarchy/Documents/Publications/Natural%20Hazard%20Reports/Buller%20District/Westport/Westport%20-%20flood%20forecasting%20roadmap%20for%20evacuation%20warnings%202019.pdf

Title	Flood Mitigation Options Assessment. August 2015.
Author	Matthew Gardner for LandRiverSea.

Brief Synopsis	The existing hydraulic model of the Buller River has been refined and used to assess a range of flood mitigation options for Westport. The model has allowed for a more detailed representation of the main structures than in previous versions of the model and has also allowed for a degree of blockage on the Buller River Bridge and Nine Mile Road trestle bridge. The options which have been assessed with the model are as follows and are presented in more detail in Section 2. • Option A – Do Nothing (Existing Scenario) • Option B – Extensive Stopbanks and Floodwalls • Option C – Partial Stopbanks and Floodwalls • Option D – Flood Relief Cut • Option E – Extensive Stopbanks and Floodwalls combined with Flood Relief Cut • Option F – Partial Stopbanks and Floodwalls combined with Flood Relief Cut Results for each option have been presented in graphical format with maps of Flood Depth / Extent, Difference in Flood, Section 4 provides details of the flood damages assessment which was conducted using NIWAs RiskScape programme for each option.
Link to Document	https://www.wcrc.govt.nz/repository/libraries/id:2459ikxj617q9ser65rr/hierarchy/Documents/Publications/Natural%20Hazard%20Reports/Buller%20District/Buller%20River%20Detailed%20Options%20Assessment.pdf

Title	**Orowaiti Cut (Westport Flood Protection). 2015.**
Author	Michael Allis, NIWA
Brief Synopsis	This letter report addresses the request for advice about proposed floodway cut options between the Orowaiti River/Lagoon and the Tasman Sea at North Beach to alleviate flooding risk to Westport residents (Figure 1 to 3). The scope of this assessment is intended to be relatively high level, and specifically to consider the impact from coastal processes to inform option development and decision making.
Link to Document	https://www.wcrc.govt.nz/repository/libraries/id:2459ikxj617q9ser65rr/hierarchy/Documents/Publications/Natural%20Hazard%20Reports/Buller%20District/Westport/Orowaiti%20Cut%20%28Westport%20Flood%20Protection%29%20-%20Niwa%20recommendation%20May%202015.pdf

Title	**Flood extents for 1% and 2% AEP floods and potential mitigation measures for 1% AEP flood extents at Westport based on LiDAR. NIWA Client Report, 2010.**
Author	Duncan, M., and Bind, Jo.
Brief Synopsis	https://www.wcrc.govt.nz/repository/libraries/id:2459ikxj617q9ser65rr/hierarchy/Documents/Publications/Natural%20Hazard%20Reports/Buller%20District/Westport/Westport%20Options%20Report
Link to Document	https://www.wcrc.govt.nz/repository/libraries/id:2459ikxj617q9ser65rr/hierarchy/Documents/Publications/Natural%20Hazard%20Reports/Buller%20District/Westport/Westport%20Flood%20Potential%20NIWA%20Study%202010.pdf

Title	**Preliminary Flood Study of the Buller River at Westport. August 2000.**

Author	Connell Wagner Ltd.
Brief Synopsis	The report summarises the work undertaken on behalf of WCRC to carry out a preliminary assessment of the flood risk to Westport from storm flows in the Buller River. The study covers: a qualitative flood history, an analysis of changes in the river bed profile and sediment deposition patterns, and the development of a calibrated Mike11 hydraulic model of the lower Buller River.
Link to Document	https://www.wcrc.govt.nz/repository/libraries/id:2459ikxj617q9ser65rr/hierarchy/Documents/Publications/Natural%20Hazard%20Reports/Buller%20District/Westport/Prelim%20Flood%20Study%20Connell%20Wagner%20Ltd%20Aug%202000%20.pdf

Title	**Buller River Flood Mitigation Options Assessment**
Author	Matthew Gardner, LandRiverSea Consulting.
Brief Synopsis	Comprehensive report detailing the background to the area, the options investigated for Westport protection options, recommendations from those options, analysis of preferred alignment, and a series of maps showing options, depths and preferred alignment.
Link to Document	https://www.wcrc.govt.nz/repository/libraries/id:2459ikxj617q9ser65rr/hierarchy/Documents/Publications/Natural%20Hazard%20Reports/Buller%20District/Westport/Westport%20Options%20Report

Title	**Buller Hydraulic Model Review, March 2022**
Author	Philip Wallace, River Edge Consulting Limited
Brief Synopsis	WCRC commissioned Land River Sea Consulting in 2014 to prepare a hydraulic model of the Buller River and Westport floodplain, and in 2017 to update the model. WCRC has now commissioned River Edge Consulting Ltd to carry out a peer review of the latest version of the report. The particular objectives of the most recent modelling have been to: set building floor levels, design flood protection infrastructure, assess flood mitigation options, asses the impacts of increased future flows and sea levels. This report summarises the peer view process and findings, and makes recommendations for future improvements.
Link to Document	https://www.wcrc.govt.nz/repository/libraries/id:2459ikxj617q9ser65rr/hierarchy/Documents/Council/Meetings%2C%20Agendas%20and%20Minutes/Council%20Meetings/2022/Agenda%20Council%20meeting%2012%20April%202022%20Public.pdf

Title	**Proposal to Hon Nanaia Mahuta, Minister of Local Government. Co-Investment in Westport's Resilience**
Author	John Hutchings
Brief Synopsis	Business case prepared for Minister Mahuta, in response to communication from the minister requesting a case be put forward. The business case details the Westport context, and options, challenges and opportunities facing the community.

Link to Document	https://www.wcrc.govt.nz/repository/libraries/id:2459ikxj617q9ser65rr/hierarchy/Documents/Council/Meetings%2C%20Agendas%20and%20Minutes/Council%20Meetings/2022/Council%20Meeting%20Agenda%2028%20June%202022.pdf

Franz Josef Specific

Title	**Franz Josef Natural Hazards Options Assessment and Cost Benefit Analysis Prepared for: West Coast Regional Council. October 2017.**
Author	Tonkin + Taylor and Ernst and Young
Brief Synopsis	This study concerns itself with the two primary natural hazards with the potential to affect the town. The Waiho River is among the most difficult New Zealand rivers to manage. With bed aggradation rates averaging between 0.16m and 0.2m per annum, it is likely that in 30 years, or sooner as a result of significant storm events, the bed of the river will be equal to, or higher than, the level of Franz Josef township if there is no further intervention. The Alpine Fault runs through the commercial centre of Franz Josef. A rupture of this fault will cause strong ground shaking and deformation of the ground surface around the fault. Despite inherently resilient, low-rise, lightweight, building stock, it is expected that there would be considerable damage to existing buildings as well as the infrastructure that supports the town. Regionally, it is expected that many of the essential services that support Franz Josef would also be cut-off due to road closure (including Arthurs Pass). Additionally, there is the latent presence of an earthquake-triggered large landslide which would significantly compromise all of the value at stake in the town including life, capital values and tourism flows.
Link to Document	https://www.wcrc.govt.nz/repository/libraries/id:2459ikxj617q9ser65rr/hierarchy/Documents/Publications/Natural%20Hazard%20Reports/Westland%20District/Franz%20Josef/Franz%20Josef%20Natural%20Hazards%20Options%20Assessment%20and%20Cost%20Benefit%20Analysis.pdf

Title	**Westland District Council Plan Change 7: Managing Fault Rupture Risk in Westland Section 42A Hearing Report and amended Section 23 March 2015**
Author	Rebecca Beaumont, Westland District Council
Brief Synopsis	Documents required under the RMA for Plan Change 7, including reporting planners s.32 analysis accompanying the notified plan change, and the s42A Hearing Report.
Link to Document	https://www.westlanddc.govt.nz/sites/default/files/Westland%20District%20Council%20Plan%20Change%207-%20Section%2042A%20Report%20and%20Amended%20section%2032.pdf

Title	**Planning for a safer Franz Josef-Waiau community, Westland District: considering rupture of the Alpine Fault, GNS Science consultancy Report 2011/217 61p.**
Author	Langridge, R.M.; Beban, J.G.
Brief Synopsis	Franz Josef is sited at the foot of the rangefront of the Southern Alps, straddling the Alpine Fault and immediately adjacent to the Waiho River. The wider township area is at risk from a number of natural hazard perils including flood, fault rupture, seismic shaking, landslide, debris flow, damburst flood, alluvial fan inundation, liquefaction and lateral spreading. The effects of climate change, sea-level rise or tsunami inundation have not been considered as part of this study. The community of Franz Josef in consultation with the West Coast Regional Council, Westland District Council and other providers need to develop plans to manage or mitigate the serious natural hazards that are likely to occur in the area of the town of Franz Josef in the coming years to decades. Such plans will provide the community with more certainty regarding future life safety, property, infrastructure and investment. The three most significant natural hazard events that we have highlighted are: flooding from the Waiho River, rupture of the Alpine Fault (fault movement plus shaking), and the combined landscape consequences (multi-hazard cascade) posed by an Alpine Fault earthquake event.
Link to Document	https://www.wcrc.govt.nz/repository/libraries/id:2459ikxj617q9ser65rr/hierarchy/Documents/Publications/Natural%20Hazard%20Reports/Westland%20District/Franz%20Josef/GNS%20Final%20Franz%20Josef%20Report%202016.pdf

Title	**Natural Hazard Assessment for the Township of Franz Josef, Westland District. July 2016**
Author	R Langridge, J.D Howarth, W.F Ries, and R. Buxton.
Brief Synopsis	Comprehensive natural hazard assessment for the township. Flooding from the Waiho River remains an ever-present threat to the town. The current floodprotection system (stopbanks) is capable of protecting the main part of the town from modelled 10-, 20-, 50-, and 100-yr flood scenarios. Future flooding scenarios that include further riverbed aggradation need to be mitigated through management of the river. Because of the relatively low elevation of the town relative to the current riverbed, it is imperative that flood-protection measures (e.g., stopbanks), particularly on the north bank of the Waiho River, are maintained. If the town is exposed to flood waters and debris through failure of the stopbank network, then the implications are similar to those observed for the Scenic Circle Hotel during the March 2016 flood event. Large alluvial fans like the mid Waiho River will seek to shift their course and fill in lower-lying areas, for example, the area of the current and suggested new town centre locations are susceptible to flooding if they are not protected. To mitigate the possibility of bed aggradation resulting in serious flooding, it might be useful for the community to consider a relaxation of the river's confinement on the south side of the Waiho River. Such an activity would need to be carefully managed in consultation with hydraulic engineers and other relevant experts, considering the location of State Highway 6, and its bridge abutments, relative to relaxation of the stopbank system.

	The multi-hazard cascade initiated by rupture of, and shaking caused by the next Alpine Fault earthquake event has a likelihood of occurrence of >27% in the next 50 years. The councils and town should consider plans to make the town more resilient to individual and combined perils in the coming years firstly through mitigation but also through planning for civil defence actions designed to cope with a major disaster that could impact up to a few thousand tourists in the peak tourist season. Several other individual hazard perils (non-seismic driven landslides, alluvial fan aggradation, debris flood) are discussed in this report. Each in its own right is manageable if the location, extent, magnitude and severity of the hazard is understood and mitigated. Because fault rupture can be avoided by a relatively small amount of town re-planning, flooding can be mitigated via flood-protection activities, but MM Intensities of >VIII cannot easily be avoided, we recommend that the council undertakes a Cost-Benefit Analysis in consideration of re-locating the town of Franz Josef versus mitigating against the hazards that are likely to seriously impact the town in its current configuration and through preplanning response activities. Nonetheless, at the level of assessment we have undertaken here, the current town site is satisfactory, provided the river is kept from overtopping/scouring the north side stopbank.
Link to Document	https://www.wcrc.govt.nz/repository/libraries/id:2459ikxj617q9ser65rr/hierarchy/Documents/Publications/Natural%20Hazard%20Reports/Westland%20District/Franz%20Josef/GNS%20Final%20Franz%20Josef%20Report%202016.pdf

Title	**Changes in understanding of natural hazard risk and preparedness in Franz Josef Glacier. July 2001**
Author	J Gough.
Brief Synopsis	This report presents the results of a study on community understanding and awareness of natural hazard risk at Franz Josef Glacier in March 2001. The study was a follow-up to a February 1999 study.
Link to Document	https://www.wcrc.govt.nz/repository/libraries/id:2459ikxj617q9ser65rr/hierarchy/Documents/Publications/Natural%20Hazard%20Reports/Westland%20District/Franz%20Josef/Changes%20in%20understanding%20etc%20for%20nat%20haz%20risk%20FJ%20J%20Gough%202001.pdf

Title	**Waiho River: Change Detection Analysis: Analysis of change between 2016 – 2019 LiDAR surveys. July 2019.**
Author	Matthew Gardner (Land River and Sea Consulting) and James Brassington (University of Waikato)
Brief Synopsis	Land River Sea Consulting in conjunction with Waikato University have been contracted by the West Coast Regional Council in order to carry out an analysis of the changes in bed levels which have occurred in the Waiho River Catchment between the periods of 2016 and 2019, as well as commenting on the long-term bed level trend in relation to historic surveys. The comparison is primarily to be carried out between LiDAR datasets collected in July 2016 and April 2019, however commentary is also made on the changes in relation to historic cross section surveys going back to 1983.

Link to Document	https://www.wcrc.govt.nz/repository/libraries/id:2459ikxj617q9ser65rr/hierarchy/Documents/Publications/Natural%20Hazard%20Reports/Westland%20District/Franz%20Josef/2019_LRS_Gardner_Waiho%20River_Analysis%20of%20change%20between%202016%20and%202019%20LiDar%20Surveys.pdf

Title	**Waiho River, Hydraulic Modelling and Analysis. August 2014.**
Author	Matthew Gardner, Land River and Sea Consulting.
Brief Synopsis	The West Coast Regional Council has commissioned Land River Sea Consulting to build a model of the Waiho River based on the 2014 cross section survey data in order to: • Estimate design flood heights for a theoretical 1 in 100, 200 and 400 year event • Estimate the flow required to overtop the southside stopbank. • Investigate the potential for inundation of the Franz Josef township due to overtopping of the right bank upstream of the SH6 Bridge. • Determine the impacts on in channel water levels by widening the channel between the SH6 Bridge and cross section 16 as well as widening the bridge itself. The following report outlines the background to the study, the method adopted and presents the results
Link to Document	https://www.wcrc.govt.nz/repository/libraries/id:2459ikxj617q9ser65rr/hierarchy/Documents/Publications/Natural%20Hazard%20Reports/Westland%20District/Franz%20Josef/Waiho%20River%20Modelling%20Final%20Report.pdf

Title	**Natural hazard assessment for the township of Franz Josef Glacier and its environs. (1998) GNS**
Author	McSaveney, M.J and Davis, T.R.H.
Brief Synopsis	This report discusses the major natural hazards threatening the welfare of the community at Franz Josef Glacier. These include hazards caused by recent changes in the Waiho River, and those due to the proximity of the village to the Alpine Fault, one of the planet's major active geological boundaries. The Callery/Waiho River system is discussed both as a natural system, and as one disturbed by human intervention. Our analysis of the system's behaviour over the last 100 years leads us to a conclusion that is radically different from past studies: we believe that the immediate serious dangers now presented by the river result directly from the well intentioned, well-constructed, but ad hoc works that attempt to hold this powerful river in too small a portion of its historic flood plain. After sixty years of sustained efforts to constrain the river, the Waiho has aggraded to an unprecedented level and now is poised to break out of its channel at one or more of a number of weak points along the riverbanks. The earthquake hazard stands in marked contrast to the river hazard, because this hazard is escalating through natural processes and cannot be reduced. The township straddles a major active fault which is expected soon to produce an earthquake greatly exceeding current building design standards. Analysis of available data on past movements of the Alpine Fault indicates a 10% probability that the next earthquake will strike within 5 years. It will be a Magnitude 8 earthquake, a Great Earthquake on world standards, and it will cause major damage throughout much of South Island, and perhaps beyond. The community at Franz Josef Glacier (and many communities elsewhere) will suffer

	extensive damage, injuries and some fatalities, and may be isolated from substantial outside assistance for several days or perhaps longer.
Link to Document	https://www.wcrc.govt.nz/repository/libraries/id:2459ikxj617q9ser65rr/hierarchy/Documents/Publications/Natural%20Hazard%20Reports/Westland%20District/Franz%20Josef/Nat%20Haz%20Assessment%20Franz%20Josef%20and%20Environs%20WCRC%20Client%20Report%20McSaveney%20and%20Davies%201998.pdf

Title	**Waiho River, 2D Hydraulic Modelling based on LiDAR. November 2016.**
Author	Matthew Gardner, Land River and Sea Consulting.
Brief Synopsis	LiDAR (Light Detection and Ranging) data has been procured for a large area in the Waiho River catchment in June 2016. Due to the lack of detailed topographic data, previous modelling of the Waiho River has been largely 1-dimensional with the most recent modelling being carried out in MIKE11 (Gardner, 2014). With the newly available LiDAR data it has been possible to increase the scope of the modelling to include the entire floodplain as well as the river downstream from the Helipad bank, which was previously excluded from the model scope. This modelling examines the existing flood risk for an estimated 1 in 100 year river flow for the existing scenario, and then examines a range of potential scenarios which include: • Complete removal of South Bank downstream from the SH1 Bridge (i.e. true left bank stopbank) • A breach immediately adjacent to the Mueller Wing of the scenic circle hotel (as occurred in March 2016) • Raising South Bank to an approximate 1 in 100 year flood level.
Link to Document	https://www.wcrc.govt.nz/repository/libraries/id:2459ikxj617q9ser65rr/hierarchy/Documents/Publications/Natural%20Hazard%20Reports/Westland%20District/Franz%20Josef/Waiho%20River%20M21%20Modelling%20Report%20-%20November%202016.pdf

Title	**Waiho River Flooding Risk Assessment for Ministry of Civil Defence and Emergency Management. August 2002.**
Author	Optimix Ltd.
Brief Synopsis	The bed of the Waiho River adjacent to the Franz Josef Glacier township is aggrading and is now higher than the surrounding ground level. The river is constrained to its present alignment by the flood defences constructed along this reach to protect the assets on the adjacent floodplain. At some point, a flood event will occur on the Waiho River that will breach the flood defences and inundate parts of the surrounding area. Optimx has been engaged by the Ministry of Civil Defence & Emergency Management (MCDEM) to investigate the risk to life posed by flood events on the Waiho River to people in the Holiday Park area immediately to the south of the river adjacent to the SH6 bridge, and to assist in the evaluation of proposed risk reduction and response mechanisms.
Link to Document	https://www.wcrc.govt.nz/repository/libraries/id:2459ikxj617q9ser65rr/hierarchy/Documents/Publications/Natural%20Hazard%20Reports/Westland%20District/Franz%20Josef/Waiho%20River%20Flooding%20Risk%20Assessment%20MCDEM%202002.pdf

Title	Long-term management of facilities on an active alluvial fan – Waiho River fan, Westland, New Zealand. Journal of Hydrology. 1997
Author	Davies, T.R.
Brief Synopsis	The Waiho River, and its tributary the Callery River, form a large alluvial fan, at the head of which is sited the Franz Josef Glacier township. The very dynamic geology and the climate cause the river and the fan to be very active, and this results in the township being threatened by aggradation and flooding from the Waiho River. In addition to rainstorm flooding, the fan is also susceptible to the potentially catastrophic results of glacier-burst and landslide dambreak flooding. Traditional methods of river control cannot provide an adequate degree of security for residents, visitors and facilities.
Link to Document	https://www.wcrc.govt.nz/repository/libraries/id:2459ikxj617q9ser65rr/hierarchy/Documents/Publications/Natural%20Hazard%20Reports/Westland%20District/Franz%20Josef/Waiho%20R%20Fan%20flood%20management%20T%20Davies%201997.pdf

Title	Assessment of potential suitability of land for town growth – Franz Josef
Author	Tim Davies, University of Canterbury
Brief Synopsis	Comparative hazard assessment of the existing and proposed Franz Josef settlement, contracted by Westland District Council. Assessment undertaken by Dr Tim Davies and MSc thesis student, Nandhini R.
Link to Document	https://ttpp.nz/wp-content/uploads/2022/07/Franz-Josef-relocation-%E2%80%93-relative-hazard-distributions.pdf

Hokitika Specific

Title	Hokitika River – Hydraulic Modelling and Flood Hazard Mapping, 2020
Author	Matthew Gardner, LandRiverSea
Brief Synopsis	Report details the development of a flood model of the Hokitika River for the reach downstream from the confluence of the Kokatahi River in order to allow a better understanding of the potential flood hazard for a range of return period events • Develop the flood hydrology for the 10, 20, 50 and 100 year return period flood events. • Build a detailed MIKE21 model of the floodplain, based on the recently collected LiDAR and cross section survey • Create maps of flood depth / extent and hazard for all scenarios. • Simulate 3 separate breach scenarios
Link to Document	https://www.wcrc.govt.nz/repository/libraries/id:2459ikxj617q9ser65rr/hierarchy/Documents/Publications/Natural%20Hazard%20Reports/Westland%20District/Hokitika/2020_LRS_Hokitika%20River_Hydraulic%20modelling%20and%20flood%20hazard%20mapping_v2-10-12-2020%20optimized%20for%20web.pdf

Title	Hokitika River Design Flood Levels, December 2010.
Author	Good Earth Matters Consulting
Brief Synopsis	The Hokitika River drains a catchment of approx. 1040km2, much of which is located in the Southern Alps where there is exceptionally high rainfall. The Hokitika River is therefore prone to rapid changes in flow and flooding. However, the rise in river level for a given storm event is currently unknown. WCRC engaged Good Earth Matters Consulting to estimate design flood levels of the true right and true left of the Hokitika River downstream of the Kaniere Bridge for the following return periods: • 1 in 50 year flood • 1 in 100 year flood • 1 in 400 year flood. This information is to be used to assist in determining if the existing banks are sufficient in containing the Hokitika River, and in determining the need for further modelling and appropriate upgrade if necessary.
Link to Document	https://www.wcrc.govt.nz/repository/libraries/id:2459ikxj617q9ser65rr/hierarchy/Documents/Publications/Natural%20Hazard%20Reports/Westland%20District/Hokitika/2020_LRS_Hokitika%20River_Hydraulic%20modelling%20and%20flood%20hazard%20mapping_v2-10-12-2020%20optimized%20for%20web.pdf

Karamea Specific

Title	Karamea floodplain investigation. 2010.
Author	Smart, G. and Bind, J. NIWA
Brief Synopsis	A high resolution 2-dimensional numerical model of the Karamea area was produced to inform the Karamea community about the level of risk they face from flooding. The model was tested on the October 1998 Karamea flood, and the results compared favourably with residents recollections of flood depths during this event. Flood inundation was modelled for 20, 50 and 100 year floods with and without the present overflow spillway at Umere Rd at the upstream end of the floodplain. For the modelled 50 year flood there would be less flooding of Karamea communities if the present Umere Rd spillway was closed (provided that the present stopbanks do not breach). For the modelled 100 year flood there is extensive flooding from water leaving the river at the Umere Road overflow and upstream of the Karamea bridge. Flood banks are overtopped by more than 0.6 m depth of water at several places. This is likely to lead to failure of the flood banks and very serious, rapid-onset flooding. All road access to the township would be cut.
Link to Document	https://www.wcrc.govt.nz/repository/libraries/id:2459ikxj617q9ser65rr/hierarchy/Documents/Publications/Natural%20Hazard%20Reports/Buller%20District/Karamea/Karamea%20Floodplain%20Investigation%20NIWA%202010.pdf

Title	Karamea floodplain investigation. 2010.
Author	Michael Allis NIWA
Brief Synopsis	The township of Karamea is at risk of flooding from the Karamea River due to its location and a reduced level of protection due to aging flood-

	protection banks. Between 2013 and 2015 the Karamea River migrated over 2 km south to exit via the Otumahana Estuary, and it appears to have continued its southward migration since then. The new location of the mouth appears to be causing additional back-up of floodwaters in some areas. The community have also raised concerns that continued southerly migration of the river mouth towards Kongahu may consume private property. The West Coast Regional Council (WCRC) is seeking advice on whether there is any viable action (e.g., river mouth training walls, dredging or a stopbank extension as suggested by the community) that could be taken to restore and maintain the Karamea River mouth at its pre-2013 northerly location (in line with the township), whether any action should be undertaken, and what could be the likely consequences.
Link to Document	https://www.wcrc.govt.nz/repository/libraries/id:2459ikxj617q9ser65rr/hierarchy/Documents/Publications/Natural%20Hazard%20Reports/Buller%20District/Karamea/Niwa%20Report%20on%20Karamea%20River%20Mouth%20Location.pdf

Greymouth Specific

Title	**Evolution of the New River drainage system, Westland. (2001) New Zealand Journal of Geology and Geophysics. Vol. 44: 137 – 143..**
Author	Soons, J. M
Brief Synopsis	The small catchment displays a markedly asymmetrical drainage pattern which reflects its tectonic and quaternary glacial history. Outwash from glaciation, which was the forerunner of the modern drainage pattern. This was further modified through successive glaciations.
Link to Document	https://www.wcrc.govt.nz/repository/libraries/id:2459ikxj617q9ser65rr/hierarchy/Documents/Publications/Natural%20Hazard%20Reports/Grey%20District/Greymouth/New%20River%20Drainage%20J%20Soons%202001.pdf

Title	**Greymouth Flood Wall Upgrade Design Geotechnical Report. 2009.**
Author	Riley Consultants.
Brief Synopsis	Geotechnical input for the design of upgrading works of the flood protection system along the Grey River, downstream of the rain bridge.
Link to Document	https://www.wcrc.govt.nz/repository/libraries/id:2459ikxj617q9ser65rr/hierarchy/Documents/Publications/Natural%20Hazard%20Reports/Grey%20District/Greymouth/Grey%20Floodwall%20Upgrade%20Design%20Geotech%20Report%20Riley%20Consultants%202009.pdf

Title	**Grey River at Greymouth: Hydraulic Review and Assessment of Effects of Options to improve Flood Capacity for estimated T50 and %150 flood discharges. September 2002.**
Author	CH Flood Modelling.

Brief Synopsis	Four options to improve flood protection to Cobden, Greymouth and Blaketown. The effects at Kaiata of the four options under bankfull conditions, and assessment of these effects.
Link to Document	https://www.wcrc.govt.nz/repository/libraries/id:2459ikxj617q9ser65rr/hierarchy/Documents/Publications/Natural%20Hazard%20Reports/Grey%20District/Greymouth/Grey%20River%20Hydraulic%20Review%20etc%20CH%20Modelling%203%20Sept%202002.pdf

Title	**Major Flood Events in Greymouth, New Zealand: 1862 – 1988.**
Author	J L Benn.
Brief Synopsis	Twenty one of the most significant flood events in the Grey River to have inundated the town of Greymouth are described. These are listed in chronological order, from 1862, to the last and most disastrous in September 1988. Where possible, dates, causes, durations, levels, discharges, velocities, damage to property and loss of life and financial cost. Flood alleviations measures used throughout the town's history are also described.
Link to Document	https://www.wcrc.govt.nz/repository/libraries/id:2459ikxj617q9ser65rr/hierarchy/Documents/Publications/Natural%20Hazard%20Reports/Grey%20District/Greymouth/Major%20Flood%20Events%20in%20Greymouth%20NZ%201862%20-%201988%20J%20Benn.doc.pdf

Title	**Tidal and flood influence on water level in Grey Lagoon, Nov 2011.**
Author	D Flew, NIWA
Brief Synopsis	The West Coast Regional Council has asked if tide affects water level in the Grey River during floods. NIWA have analysed water level data recorded in the Grey Lagoon and compared with flows recorded at the Dobson flow recorder site (10 km) upstream. In the analysis, the effect of tide was removed from the water level data, and the water levels also adjusted to account for the effect of atmospheric pressure on sea levels. The pressure adjusted and de-tided water levels were compared with river flow to establish the relationship between flow and change in water depth. This comparison was also made at different tidal water depths to determine the effect of river flow on water level at low, mid and high tides. Am empirical, predictive model was derived that allows estimates of water depth in the Grey Lagoon during floods. The model is used to compare the likely water depths from a 4000 m 3 /s flood at spring and neap high tides. The analysis and model show that the tide does affect water levels during floods, but the tidal change in water level is considerably reduced during floods.
Link to Document	https://www.wcrc.govt.nz/repository/libraries/id:2459ikxj617q9ser65rr/hierarchy/Documents/Publications/Natural%20Hazard%20Reports/Grey%20District/Greymouth/Tidal%20and%20flood%20influence%20on%20water%20level%20in%20Grey%20Lagoon%20965-WCRC86%20NIWA%202011.pdf

2.2.2 Consultation and Engagement

Te Tai o Poutini Plan has been the subject of significant consultation and community engagement. Within that, the natural hazard provisions have been the subject of targeted consultation alongside the overall TTPP consultation and engagement process.

The consultation in particular built upon previous and concurrent consultation processes undertaken by the West Coast Regional Council, West Coast Civil Defence and three District Councils. The Westport 2100 and Franz Josef Strategy Consultations in particular had a particular focus on the natural hazards in these two locations and were the subject of their own individual consultation processes.

Numerous one on one meetings were held with individual stakeholders during the Plan drafting, with multi-stakeholder workshops also held.

Plan Development Phase

As well as individual stakeholder and interest group meetings and workshops, a questionnaire was available on TTPP website with feedback provided by community members to inform the plan development phase. Feedback from the questionnaire was strongly supportive of the identified issues and approach. The key themes were that the provisions need to be transparent, science based, and communicated well.

Three drop-in sessions were held at Franz Josef in October 2021 to share the pre-draft approach to natural hazard layers.

Draft provisions were shared with DOC, and feedback welcomed pre-draft, no feedback was received.

Hui was held with the Poutini Ngāi Tahu Kaiwhakahare prior to draft provisions writing. This was an opportunity to draw on mana whenua knowledge. Further hui was held in October and November 2021 to work through the draft overlays.

During March 2020 the TTPP team travelled to 12 settlements and towns in Westland and five settlements and towns in Grey for drop-in sessions. Public meetings were also held in Hokitika and Greymouth.

During September 2020 the team completed the roadshow visiting two settlements in Grey and eight settlements and towns in Buller. Public meetings were also held in Reefton and Westport.

A key theme that emerged from this consultation was that natural hazard management is a concern for many communities. Communities are looking for TTPP to provide a consistent and clear way forward for their management, including how to undertake managed retreat.

Westland District specifically raised natural hazards as a major concern at every location visited. Feedback was that a strong clear and consistent approach to natural hazards is needed, and that future development needs to avoid exacerbating the natural hazard risk. Managed retreat options were a focus of discussion at Okarito, Franz Josef and Hokitika.

In the Grey District, natural hazards are also a concern, particularly for coastal communities. The Buller District specific feedback raised the need to be forward thinking and have a plan for retreat

Draft Plan Provisions Consultation Phase

The exposure draft Te Tai o Poutini Plan was made available to the public on 26 January 2022. Alongside this was a "Natural Hazard Companion Document and Maps" which included draft provisions to manage the significant risk from natural hazards, and specific provisions and maps for the flooding, lake and coastal tsunami and fault avoidance overlays. A series of consultation meetings and drop-in sessions were undertaken over late February. Feedback on the draft was able to be provided until 11 March 2022.

The draft Land Instability and Coastal Hazard specific provisions were made available to the public on 4 April 2022. Eight drop-in sessions were undertaken in early April. Feedback was able to be provided until 22 April 2022.

In total 68 pieces of natural hazard specific feedback were received along with nine general pieces of feedback which included comments on natural hazards. 23 pieces of feedback were specifically related

to natural hazard provisions in Westport, and the interrelationship with zoning. An outline of the feedback received and the response to that is attached at Appendix One.

A peer review of the draft provisions was undertaken by an independent planning consultant. This peer review found that the provisions were generally appropriate. Some suggestions were made to improve integration, and to address activities not provided for. Input was also provided by another independent planning consultant who undertook an integration exercise across the plan and made suggestions to improve linkages and for consistency.

Details of feedback received can be found in Appendix one at the end of the Natural Hazard section of this report.

Consultation undertaken by Council outside of TTPP

Westport 2100 Group

In 2017 consultation was undertaken with the Westport Community. This consultation highlighted the Buller River has the largest flood flow of any river in New Zealand, yet Westport currently has very limited flood protection structures. Located next to the river itself, there is a risk of flooding, and depending on its extent, potential for significant damage to property, infrastructure and even threat to life. Flooding experienced by Westport in July 2012 was a 5% AEP flood, peaking at 7516m^3 /second. The largest flood on record was in 1970 which peaked at 8497m^3 /second (around a 2% AEP event). Climate change predictions anticipate more rainfall, resulting in an increase in the size and frequency of floods for the West Coast, and Westport itself. If there are no protection structures in place, a 2% AEP event has the potential to cause $38M in damages. For a 1% AEP event, the cost of damages would increase to $114M.

A total of nine drop-in sessions were held over four days which provided members of the community an opportunity to interact with Councillors and Council staff directly.

In total, 203 feedback responses were received by 1st March. Of the feedback received:

24.6% (50) chose Option A – Do nothing

10.8% (22) chose Option B – Extensive floodwalls

15.8% (32) chose Option C – Partial stopbanks and floodwall

6.4% (13) chose Option D – Flood relief cut to sea from Orowaiti Lagoon

6.4% (13) chose Option E – Combined stopbanks with Orowaiti Cut

6% (12) chose Option F – Partial stopbanks with Orowaiti Cut

30% (61) did not specify a preferred option

The Westport 2100 Group was convened late 2018 with representatives from Te Runanga o Ngati Waewae, Waka Kotahi NZTA, WCRC, BDC, and community members who met monthly to work through the hazards, issues and made recommendations. Topics the group discussed include

- Introduction of the DAPP process
- Cumulative probability
- Flood telemetry and modelling – work in progress and NIWA EnviroLink review
- Flood modelling, assumptions and limitations
- Review of collated observations
- Detailed discussion on DAPP process, implications of hard structures
- Hazard identification and prioritisation
- Impacts of gravel on Westports hazardscape
- Impact of AF8
- Functioning and potential boundary for rating districts

The group identified 32 recommendations, including matters than needed to be specifically dealt with within Te Tai o Poutini Plan.

Following the July 2021 floods in Westport, the need for protection works were accelerated. The Buller Flood Recovery team have been undertaking community consultation. This was initially

supporting immediate needs and has transitioned into a future focus. There have been media releases, and a public information session, where Matt Gardner, of Land River Sea presented the underlying physical environment that has informed the modelling for the town. This event was recorded and continues to be available on social media. Further public consultation is planned.

Franz Josef Natural Hazards

Franz Josef is located amidst a significant hazardscape – the Alpine Fault and the Waiho River are the most severe of these hazards, but there are wider issues with land instability – which is exacerbated by the risks from the Alpine Fault, glacier retreat and severe weather.

The Westland District Council has been working on planning solutions to address the hazardscape at Franz Josef for more than 20 years. The Waiho River is the subject of an existing Flood Hazard Zone put in place in the Operative Westland District Plan. However, with glacier retreat, and increase in sediment being delivered into the river systems, aggradation will continue to increase. The Waiho River is currently confined between stopbanks. Ongoing aggradation means the channel continues to fill. The severity of the flooding has increased in both extent/area and degree of risk. This has been a major focus of community discussion and consultation, particularly after each event.

Westland District Council Future Franz Consultation

The Westland District Council has been leading a consultation process around the future of the Franz Josef community and how to manage the multiple severe hazards facing this community over the period. Consultation over the best option to manage the risks associated with the Alpine Fault, which runs through the centre of the town, has been undertaken over the last 20 years. Following significant consultation, in 2012 the Westland District Council introduced Plan Change 7 to put in place a Fault Avoidance Zone for the Alpine Fault This was then followed by the submissions, further submissions and hearings and decisions. This was appealed and the Westland District Council decided to withdraw the Plan Change.

Following this there has been ongoing consultation with the Franz Josef community led by West Coast Regional Council, GNS (through their 3 year Franz Josef: Developing resilience in a community at risk programme) and the Westland District Council on how best to manage the natural hazards. Severe flooding and ongoing aggradation of the Waiho Riverbed has ensured that managing the severe flood hazard risk, alongside the Alpine Fault has been a major part of those consultations.

The Westland District Council has led the development of a Franz Josef Master Plan and consulted with the community on this. This includes matters which help address the risks of natural hazard such as zoning, and how best to progressively move the township away from the river and the Faultline.

West Coast Regional Council Long Term Plan 2021 - 2031

Public consultation took place from 11 August 2021, with Councillors receiving submissions up until 9.00am 15 September 2021. Council received 621 submissions. A hearing was held on 15 September 2021, where a total of 35 submitters presented.

Following on from the work of the Westport 2100 Working Group, consultation with the Westport community in 2020 led to Council forming a rating district for the area. During this process, a considerable amount of feedback was received about establishing a flood protection scheme to better protect the existing assets of Westport from flood events. WCRC consulted on two potential options to protect against a 1% AEP flood. The scheme will be funded by a 25-year term loan on behalf of the Rating District and the loan serviced by a targeted rate. The rate to undertake either of these two options would not be struck until the 2022/23 financial year. The preferred option presented in the Consultation Document is the option selected by the Westport Joint Committee members, with consideration of the costs and perceived risks. Option 2 is the preferred option of the West Coast Regional Council river engineers, as it provides a higher level of flood protection as presented in the flood projection images in the supplementary information link.

Overwhelming support from submitters for the construction of extensive floodwalls and stopbanks was received from ratepayers within the Westport Rating District through consultation on the 2021-31 Long-Term Plan. Survey and design work will commence in the 2021-22 financial year. This will include a flood modelling review to ensure that the floodwall design meets the recommended level of

service for the 1% annual exceedance probability. Feedback on the other mitigation options submitted during the consultation will be reviewed and presented to the Joint Committee once this has been formed. The Joint Committee will recommend to the Regional Council any additional works for consideration in year 2 of the Long-Term Plan.

Since this consultation and decision-making process, major flood events have occurred in Westport. As a result of this, the need for protection works has accelerated. This is discussed in depth in other parts of this paper.

2.2.3 Poutini Ngāi Tahu Advice

Te Rūnanga o Ngāti Waewae and Te Rūnanga o Makaawhio are the two papatipu rūnanga on the West Coast. They are collectively known as Poutini Ngāi Tahu.

Poutini Ngāi Tahu have had a separate partnership process around the natural hazards topic and provided feedback directly to the TTPP team. During the draft provision drafting sets of provisions were workshopped with Te Rūnanga o Ngāti Waewae and Te Rūnanga o Makaawhio. The regional approach is consistent with a tikawā approach and is supported. During these workshops the historic retreat and advance in pre-pakeha times was discussed. For example, the pa was moved inland at current Westport twice to retreat from flooding.

Both rūnanga are currently considering and undertaking managed retreat. Te Rūnanga o Ngāti Waewae have been pursuing a land swap at Arahura, to provide options for the rūnanga to move, over time, from the current pa which is at sea level and at threat from natural hazards to the terrace with the new marae. Te Rūnanga o Makaawhio have recently completed renovations at Mahitahi following damage to the marae from Cyclone Fehi. Longer term, the rūnanga have expressed a desire to return to living by their awa, this is a complex situation with many legacy land tenure issues to be resolved.

2.3 Operative District Plan Provisions

2.3.1 Buller District Plan

The Buller District Plan has one objective and five policies around natural hazards as follow:

Objective 4.10.6.1. Taking into account community views to reduce the risks to people and communities from natural hazards, and to avoid the establishment of activities which increase the likelihood of natural hazards occurring.

Policy 4.10.7.1. Areas where natural hazards represent a significant threat to the health and safety of individuals and communities and/or to buildings or structures shall be identified as information becomes available and used in the consideration of applications for resource consent.

4.10.7.2. An assessment of natural hazard risk shall be provided where appropriate with all applications for resource consents.

4.10.7.3. Increased public awareness of causes of natural hazards and their potential impacts in specific areas of the District shall be promoted.

4.10.7.4. Mitigation works to minimise the risks of natural hazards to the safety of people and communities shall be assessed according to the degree of risk.

4.10.7.5. Subject to the relevant statutory provisions in the Resource Management Act and Building Act, further development in identified hazard prone locations will be restricted.

Specific hazards are identified on the planning maps for Punakaiki (rock fall), Little Wanganui Subdivision (rock fall and debris flow), Mokihinui (flooding) and Hector-Miko coastline (debris flow). Due to GIS access issues and the format of the Plan, this information is difficult to access.

No rules for natural hazards are in place in the Buller Plan, however the risk of natural hazards to people and development is an assessment criterion on all resource consents.

The explanations and reasons attached to the policies make it clear that a lack of information on natural hazards is a key driver of the approach. Gathering further information was seen as a key priority.

Buller Plan Changes 133-145

Buller District Council notified a package of plan changes in 2016, including updated Natural Hazard provisions. The plan change did not reach decisions stage. The proposed provisions include:

Objective 1 – To avoid or mitigate the adverse effects of natural hazards upon human life, infrastructure, property and the natural environment

Objective 2 – To ensure that development of Westport township recognises and mitigates against the effects of potential flood hazard from the Buller River

Policy 1 – Areas where natural hazard represent a significant threat to human health, the safety of individuals and communities and / or to buildings or infrastructure shall be identified as information becomes available and this information shall be used in consideration of applications for resource consent

Policy 2 – Where the Council does not possess sufficient information concerning a potential natural hazard risk to a site, to require an applicant for resource consent to adequately assess the level of this risk and to provide a site assessment in terms of the specific nature of and likely effects on their property, where the Council has reason to believe that it is necessary.

Policy 3 – Where a natural hazard is likely to impact adversely upon human health and/or safety, property and / or infrastructure, development must not occur unless adequate avoidance or mitigation of natural hazards can be demonstrated.

Policy 4 – New buildings in areas of Westport township, on land prone to high flood risk, shall be located or constructed to mitigate, to an acceptable level, the risks associated with flooding.

Policy 5 – To manage subdivision, development of building and structures within the Coastal Environment on land which may be susceptible to coastal erosion or inundation unless the activity can demonstrate:

a) There will be a significant community benefit
b) There is a functional requirement for the proposed location
c) The activity would not adversely affect the natural character of the Coastal Environment
d) It is relocatable; or
e) That it will not increase the susceptibility of other nearby properties to natural hazards.

2.3.2 Grey District Plan

The Grey District Plan has one objective and four policies around the natural hazards topic as follow:

Objective 9.3.1 The adverse effects of natural hazards on people, property and the environment are avoided, or mitigated.

Policy 9.4.1 To adopt an integrated approach to minimising the potential adverse effects of natural hazards on the community.

Policy 9.4.2 To gather and make available information regarding natural hazards to assist resource management decisions

Policy 9.4.3 Development should not occur in areas that are prone to natural hazards, unless the applicant has shown adequate avoidance or mitigation of natural hazards

Policy 9.4.4 An assessment by an appropriately qualified person will be required, where appropriate, for resource consent applications

Also relevant is a subdivision policy

13.4.3 To restrict subdivision in areas of known natural hazard unless the effects of those natural hazards can be adequately avoided or mitigated.

Apart from this objective and policies the only specific natural hazard provisions in the Grey District Plan are:

- the identification of mitigating the risk of natural hazards as being a key consideration in decisions around Esplanade Reserves and Strips;

- natural hazard assessment requirements as part of resource consents for subdivisions.

The flood of 1988 led to the decision to construct the Greymouth floodwall, but there was very little information available at the time of preparation of the Grey District Plan around the hazardscape in the wider district.

2.3.3 Westland District Plan

There is one objective and two policies for natural hazards in the Westland District Plan.

Objective 3.13.1 Rules for the avoidance and mitigation of natural hazards have been incorporated in the District Plan given that severe hazards pose a significant threat to the built resource and infrastructure of the District and people and communities.

Policy 4.3 A. Urban development should be located in areas of low natural landscape value, low natural hazard risk and areas that do not have high public servicing costs.

Policy 4.14.A Development and subdivision for the purposes of accommodating and/or servicing people and communities should avoid areas of known natural hazard risk unless the risk of damage to property and infrastructure, community disruption and injury and potential loss of life can be adequately mitigated.

The severe flood hazard at the Waiho River is identified in a severe flood hazard zone with associated rules. The presence of natural hazards also influenced zoning provisions in the plan – for example the Otira community is zoned Rural because of the severe land instability risk. Natural hazard assessment is also a significant consideration as part of subdivision consents.

2.3.4 Summary of Operative Plans

The three operative plans all reflect a combination of two factors – a limited level of knowledge around the type and extent of natural hazards on the West Coast and their development being undertaken prior to natural hazards becoming a Section 6 matter in the RMA.

Natural hazards have been a consideration as part of subdivision consents across all three districts. The pressure for coastal development as well as the ad hoc growth of rural lifestyle blocks means that the number of dwellings and extent of community risk has significantly increased over time. Combined with the effects of climate change, which is evident from the frequency of severe weather events effecting the West Coast, the hazardscape is considerably elevated compared with the time at which the three operative plans were written.

2.4 Analysis of Best Practice – How Other Councils are Addressing the Same Issue

A wide review of other district council approaches in New Zealand, to natural hazard management and climate change adaption has been undertaken. Where councils (Selwyn District Council, Queenstown Lakes District Council (QLDC), Porirua City Council and New Plymouth District Council) had recently notified their proposed plans, the supporting s.32 analysis was also studied to understand the approaches taken.

A risk-based approach is used in all except QLDC, there are different hazards and levels of risk in each district. The New Zealand Coastal Policy Statement requires a risk-based approach to coastal hazards, QLDC does not have a coastal environment. A risk-based approach differs from an effects-based district plans which often identified natural hazards on planning maps and regulated (often by prohibiting activities) regardless of the actual risk level. It also differs from district plans where natural hazard considerations were an after-thought once resource consents had been triggered by non-compliance with other rules.

Despite the different types of hazards and the risks, there are broadly speaking some consistencies around New Zealand. Councils that have identified fault avoidance zones, have used a 20m buffer, with activity status consistent with Parliamentary Commission guidelines. The recognition, protection and defence of natural features to mitigate some effects of natural hazards is in all plans reviewed. A precautionary approach to unknown factors, where the hazard, or the impact on the hazard of climate change is commonplace. In regard to infrastructure, and the use of hazard mitigation structures, there is a consistent policy direction to only allow this when it is the only option, and a

shift towards greater consideration of the natural environment, and the long-term sustainability of such structures. Flood zone responses are tied to the level of hazard, sometimes avoidance is required, generally speaking, mitigation through fixed floor levels and evacuation routes are sufficient.

Analysis of Specific Plans

Proposed Porirua Council District Plan (notified August 2020).

Hazards have been identified as

- High: Flood hazard – Stream corridor, Oharui Fault Rupture Zone (20m or closer to the fault), Tsunami hazard (1:100 year inundation extent), Coastal Hazard – Current Inundation, Coastal Hazard – Current Erosion
- Medium: Flood Hazard overland flow path, Pakerua Fault Rupture zone 20m or closer to the fault, Tsunami hazard (1:500 year inundation extent), Coastal Hazard – with 1m SLR, Coastal Hazard – Future Erosion – with 1m SLR.
- Low: Flood Hazard ponding, Oharui Fault Rupture Zone excluding 20m either side of the fault, Moonshine Fault 20m or closer either side of fault), Pakerua Fault Rupture zone excluding 20m either side of the fault, Tsunami hazard (1:100 year inundation extent).

Activities have been classified into hazard sensitive, such as childcare facilities, marae and visitor accommodation, potentially hazard sensitive, a large sports facility, and less hazard sensitive such as non-habitable accessory buildings.

Land stability was the other hazard of major concern to the community. This is addressed through earthworks provisions.

The coastal hazard objectives focus on not significantly increasing risk, and not reducing the ability to recover from an event. Natural features that offer protection and soft engineering are encouraged. The policies form a cascade with less hazard sensitive activities in low hazard areas being enabled, through to restrictions on further highly sensitive activities in high risk areas. Hard protection structures are only allowed when it is to protect significant infrastructure, life or private property at immediate risk, will not impact natural features or create end effects and where soft engineering measures will not provide mitigation of risk.

The general natural hazard provisions are aligned with this. At a rule level, buildings cannot locate in the high flood hazard area, and sensitive or potentially activities and buildings within the fault zones are non-complying. Evacuation routes are required for less risk prone areas.

Proposed Selwyn Council District Plan

There are overlays for coastal erosion, coastal inundation, tsunami, Waimakariri Flood Management, Plains Flood Management. Faults are recognized as "Greendale Fault avoidance overlay", "Fault Investigation" and "Fault Awareness Overlay". Liquefaction is grouped into damage unlikely and damage likely.

The coastal erosion and inundation, and Waimakariri Flood management zone are subject to restrictive provisions, most activities require a non-complying resource consent, as does important infrastructure in the Greendale Fault overlay. Following the 2010 Darfield (Canterbury) earthquake, Environment Canterbury commissioned GNS Science to undertake more detailed mapping of the Greendale Fault, to develop fault avoidance zones for the fault zone and estimate the fault's recurrence interval to help Selwyn District Council make rebuild and future development decisions on and near the fault. The mapping showed areas of well-defined, distributed and uncertain fault rupture deformation varying in width from 15 metres to 300 metres. A fault avoidance zone was created by placing a 20 metre buffer around the fault rupture deformation areas, as per the Ministry for the Environment guidelines Planning for development of land on or close to active faults ("the MfE guidelines") The Greendale Fault Avoidance Overlay covers the land identified in this fault avoidance zone.

The other overlays require the hazards to be considered as a matter of control or discretion. There is a more nuanced approach for the flood plains, residential and earthworks are permitted, subdivision is restricted discretionary and hazard mitigation works are discretionary.

New use is to be avoided in areas where hazard levels are unacceptable, infrastructure should only be located in hazard areas where there is no reasonable alternative, and risk to people, property and the environment are not exacerbated. Avoid policies are used for high hazard areas and sensitive activities. Hazard mitigation works must consider climate change over at least 100 years and must consider the impacts of works on the environment. There are very strong policies around coastal hazards, avoidance of hard protection structures, except for existing significant infrastructure, if they are necessary there must be significant public or environmental benefit. Flood hazard policies are also directive, with a 200 ARI design being required, and protection of evacuation routes.

The fault policies require avoidance of the Greendale Fault zone for community facilities, infrastructure, and Major Hazard facilities, similarly within the fault investigation and fault awareness overlay these are restricted as are subdivision and rezoning.

Proposed New Plymouth District Plan

The proposed plan uses a risk-based approach for natural hazards, replacing the previous effects based approach. The focus for natural hazards management through the District Plan Review has been on coastal hazards (flooding and erosion) and stormwater flooding as high risk. Coastal hazards are addressed with three overlays, with specific objectives.

- Proposed Coastal Environment Area Areas with coastal values that need to be protected from development, and areas that could be impacted by coastal hazards resulting from increased rates of sea level rise associated with climate change.
- Proposed Coastal Erosion Hazard Area Areas expected to be affected by erosion and land instability within 100 years, if erosion continues at current rates. Management of these areas is based on a directive and precautionary approach.
- Proposed Coastal Flooding Hazard Area Areas around low-lying river mouths. Siting and design is required to avoid or mitigate effects of flooding.

The Natural Hazards chapter includes: Flood Plain Area, Flood Detention Area/Spillway, Fault Hazard Area, Volcanic Hazard Area and Stormwater Flooding Area. The Building Act and CDEM are considered appropriate methods for addressing: Tsunami, Volcanic activity other than high risk lahar/flooding, Liquefaction, Drought, and high winds.

For development in flood hazard areas, the Proposed Plan allows for some activities to occur as a permitted activity but requires particular design considerations. Demolition and removal of, and alterations to, buildings and structures are permitted activities. New buildings are permitted in flood hazard areas where floor levels are managed (with the minimum floor level being above the flooding predicted to occur in a one percent AEP flood event, plus 500mm freeboard), buildings are relocatable, and buildings do not impact flood water.

New buildings (excluding accessory buildings) and structures (including network utilities) will require a Restricted Discretionary resource consent within the Fault Hazard Area. The fault hazard area is 20m either side of the Inglewood and Norfolk faults. Building additions in this area will only trigger resource consent if the building changes result in intensified use of the site, or the number of people likely to occupy the site.

Christchurch District Plan 2017

Risk-based approach that considers the various scales of a particular natural hazard event (e.g., different magnitude earthquakes and different intensities and durations of rainfall events) together with the likelihood of that particular event occurring and the effects that it would cause, particularly on people and property.

In areas where risk from natural hazards is considered unacceptable and the risks cannot be practically reduced to acceptable levels, new activities are generally to be avoided. In areas where risk may be able to be mitigated to acceptable levels, Council may require site specific assessment. Where risk is considered to be acceptable and similar to the levels of everyday risks faced, no intervention is required by the District Plan.

Thames Coromandel District Plan – Appeals Version 2019

Adopts the risk-based approach developed by GNS Science, that combines the consequence table with likelihood to determine a risk matrix of acceptable, tolerable and intolerable risk.

There is a specific directive that development should be 'future proofed' to allow retreat and/or relocation of structures and buildings where there is a potential future hazard risk in the next 100 years. The natural hazards section applies to all natural hazard risks in the District, not just those identified on the Overlay Planning Maps. For example, while there are map overlays for flooding and coastal erosion, the rules for tsunami inundation do not have corresponding overlays on the planning maps.

Flood mapping is based on modelling of a 1% AEP rainfall event, combined with a spring high tide level, including the effects of a 20% increase in rainfall intensity by 2080 and a 0.5m increase in sea level by 2100.

The Current Coastal Erosion Line (CCEL) is based on existing coastal erosion risk and does not factor in sea level rise or other climate change effects. Site-specific assessment of coastal erosion and coastal inundation risks is recommended for resource consent applications triggered by the CCEL. Future Coastal Process Line (FCPL) is also applied in the coastal environment that corresponds to a possible chance of erosion risk in 2100. It factors in the effect of 0.9m of sea level rise relative to 1990.

Non-complying and prohibited activity statuses apply to new dwellings in specific coastal areas. Council also applies conditions to indemnify themselves from liability associated with the failure of any coastal defence structure where dwellings, accessory buildings and additions are constructed in specific areas identified as at risk from coastal erosion and inundation.

2.5 Summary of Issues Analysis

The operative provisions are no longer fit for purpose and do not meet the thresholds required for acceptable RMA practice in 2022. Management of significant risk from natural hazards became a matter of national importance in the mid-2010s, well after the plans became operative. Buller District Council (BDC) undertook Plan Change 139 to address this but did not reach a decision stage. Westland District Council (WDC) undertook Plan Change 7 to address fault avoidance in Franz Josef, but the plan change was withdrawn at the Appeals stage.

A strong theme from community consultation for TTPP has been a concern about the lack of clarity and region wide consistency in our plans. There is a general understanding and acceptance of natural hazards, but frustration and anxiety about how and when they will be addressed.

The operative plans use an activity-based approach, this is common in first generation plans. However, with management of natural hazards becoming a s.6 matter, and with the direction from the New Zealand Coastal Policy Statement and supporting guidance documents, a risk-based approach is more appropriate, and is used in most second and third generation plans.

More data is now held by the councils which allows better understanding of natural hazards and their impacts. However, as this data was not used to develop the operative plan provisions, applicants are having to complete individual assessments when it might not be necessary, and there is insufficient ability to consider this new data. This is ineffective and inefficient. It also exacerbates known significant risks to life and property.

Protection works have impacted the hazardscape, for example the upgrades of the Waiho River floodwalls. The walls were built to protect the township from flooding. However, the river aggrades at an extreme rate, sometimes meters in days. This means that the channel fills in, and the walls need to be built higher. With increased height, the width must also be increased to provide stability. The rates of aggradation are likely to increase as more sediment is released as the Franz Josef glacier recedes. The use of protection works has increased over the region since the operative plans were drafted, and this will increase into the future. An appropriate framework to consider the effects is required.

The operative plans do not identify the following natural hazards

- Land stability and resultant landslides, debris flows, except in a small area of Greymouth, Little Wanganui and Granity to Mokihinui
- The Alpine Fault and other active faults,
- Flooding, except the Waiho flood zone, no other areas are identified in RMA plans,
- Coastal areas subject to flooding, erosion, inundation, storm surge and tsunami above mean high water springs, except in Hokitika town centre, and in all plans a blanket setback is applied in rural areas,
- Wildfire,
- Liquefaction.

2.6 A Risk Based Approach

In terms of a district plan, a risk- based approach for natural hazards will require provisions in the District Plan tailored to the risk that the natural hazard presents. This means that the actual level of risk (to the extent that it can be accurately determined quantitatively or qualitatively) is the trigger point for regulatory intervention.

In a risk-based approach varying provisions and standards are applied in different locations, or areas, based on the level of risk of specific or multiple natural hazards occurring. If the risk in a particular area is low then no or minimal intervention in the Plan is warranted. In areas where a particular natural hazard risk is determined to be moderate or high, intervention, through the implementation of provisions, is likely to be targeted in the district plan to those areas. Alternatively, the risk can be managed by other methods outside the district plan (for example: warnings systems and evacuation under CDEM).

This differs from the traditional approaches in district plans which often identified natural hazards on planning maps and regulated regardless of the actual risk level. It also differs from district plans where natural hazard considerations were an after-thought once resource consents had been triggered by non-compliance with other rules (e.g. subdivision rules).

The adoption of a district wide risk-based approach to natural hazards is not something that can be done within a short time frame. For a region like the West Cost which has a large geographical area ranging from very sparsely populated, and often uninhabited, to small villages and satellite towns and varying exposure to natural hazards, there is a need to prioritise known high risk areas over known low risk areas. Detailed assessments can also be prioritised for areas where it is important to resolve uncertainty and lack of information (such as new greenfield areas). This is an inherent part of the risk-based approach.

3.0 Scale and Significance Evaluation

The level of detail undertaken for the evaluation of the Proposed District Plan provisions has been determined by an assessment of the scale and significance of the implementation of these provisions. The scale and significance assessment considers the environmental, economic, social and cultural effects of the provisions.

	Minor	Low	Medium	High
Degree of change from the Operative Plans				x
Effects on matters of national importance (s6 RMA)				x
Scale of effects – geographically (local, district wide, regional, national)				X
Scale of effects on people (how many will be affected – single landowners, multiple landowners, neighbourhoods,				X

the public generally, future generations?)				
Scale of effects on those with particular interests, e.g. Tangata Whenua			x	
Degree of policy risk – does it involve effects that have been considered implicitly or explicitly by higher order documents? Does it involve effects addressed by other standards/commonly accepted best practice?	x			
Likelihood of increased costs or restrictions on individuals, businesses or communities			X	

3.1 Explanation Summary

In summary:

- The degree of change from the Operative District Plans is high. The hazards managed by the Proposed TTPP significantly expand the range currently managed by the Operative Plans. Compared to the Operative Plans, the Proposed TTPP is more restrictive in a range of respects (such as specifying hazard sensitive activities and avoiding their locating in hazard areas).
- The proposal relates to the required recognition and provision for management of the significant risks from natural hazards as a matter of national importance (Section 6). It also requires TTPP Committee to have particular regard to the maintenance and enhancement of the quality of the environment, and the effects of climate change (Section 7). Section 106 requires the consideration for all risks from natural hazards in subdivision consent applications.
- The proposal will affect communities and individuals. The Proposed TTPP is a key tool to reduce vulnerability to risk, to increase the communities' resilience to and recovery from disasters and encouraging connectedness and well-being.
- The scale of effects on people is moderate. All the areas identified within the Proposed TTPP overlays are known areas of significant natural hazard risk. As much as they have been able (e.g. through Building Consent mechanisms and existing Operative Plan provisions) the three district councils have already been managing the natural hazard risk and applying requirements such a geotechnical design and freeboard allowances. By accurately mapping the areas subject to the most significant risk this targets the provisions better. Buildings and land affected by the proposed mapped areas are owned by private landowners who may raise concerns with the restrictions on their private property rights, and with hazards identified on their properties due to resale and insurance implications. However, the TTPP restrictions only come into effect if the landowners are proposing activities that trigger rules in the TTPP. In the majority of instances, the restrictions will have little effect on the day-to-day operation and function of businesses and residences. Many landowners are already aware of being within a hazard area. From a public good perspective, future generations will benefit greatly from the improved management of natural hazards.
- Poutini Ngāi Tahu are actively considering the impacts of natural hazards on their whenua. Both papatipu runanga have long term aspirations to provide safe options for the future, with a lower hazard risk.
- The management of significant risks from natural hazards is a s6 RMA matter that is one of the district council functions under ss31(1)(b)(i) and 74(1)(b) RMA, and must be undertaken to give effect to the NZCPS and the WCRPS. Provisions to manage natural hazards have the

potential to affect a wide range of people. Additional consenting information requirements can impose additional costs, however the costs to people and the environment could also be high if hazards are not appropriately managed.

- Overall, it is considered that the scale and significance of the proposal is high. The level of detail in this report corresponds with the scale and significance of the environmental, economic and cultural effects that are anticipated from the implementation of the Natural Hazards provisions.

4.0 Evaluation

4.1 Evaluation of Proposed Objectives

This section of the report evaluates the proposed objectives as to whether they are the most appropriate to achieve the purpose of the Act.

Objectives	Appropriateness to Achieve the Purpose of the Act
Existing Objectives Buller Plan Change Objective 1 – *To avoid or mitigate the adverse effects of natural hazards upon human life, infrastructure, property and the natural environment* Buller Plan Change Objective 2 – *To ensure that development of Westport township recognises and mitigates against the effects of potential flood hazard from the Buller River*	These objectives all take different approaches to management of natural hazards. None of them respond to the requirement of s6 (h) of the RMA to "manage the significant risks of natural hazards". They also do not consider climate change, which is required by s7 (i) of the RMA. The objectives also fail to acknowledge that certain activities are vulnerable to risks, and there is no common recognition of hazard areas in objectives. While the Buller objective includes the recognition of risk – this is substantially tempered by the "taking into account community views" – which is not a risk-based approach to the management of natural hazards. Overall, the existing objectives are not considered effective in meeting the requirements of the RMA.
Grey District Plan Objective: *Objective 9.3.1 The adverse effects of natural hazards on people, property and the environment are avoided, or mitigated.*	
Westland District Plan Objective: *Objective 3.13.1 Rules for the avoidance and mitigation of natural hazards have been incorporated in the District Plan given that severe hazards pose a significant threat to the built resource and infrastructure of the District and people and communities*.	
Proposed TTPP Objectives: Natural Hazards Chapter *NH – O1 To use a regionally consistent, risk-based approach to natural hazard management.* *NH – O2 To reduce the risk to life, property and the environment from natural hazards, thereby promoting the well-being of the community and the environment.* *NH – O3 To only locate critical infrastructure within areas of significant natural hazard risk where there is no reasonable alternative, and to design infrastructure so as not to exacerbate natural hazard risk to people and property*. *NH – O4 To ensure the role of hazard mitigation played by natural features that*	These objectives are considered the most appropriate to meet the purpose of the Act because they: • Specifically reference a risk-based approach to natural hazard management – recognising the direction in s6 (h) of the RMA; • Give effect to the relevant sections of the RMA and the higher order documents listed in this report; • Focus risk management on risks to life, property and the environment and thereby identify the significant matters for consideration; • Recognise the public benefit of critical infrastructure, and that they may have no option but to located in areas of significant natural hazard risk; • Provide clear and measurable direction for decision makers; • Are achievable given the clear nature and intent and can be given effect to through provisions;

minimise impacts of hazards including wetlands and dunes is recognised and protected. *NH – O5 To recognise and provide for the effects of climate change, and its influence the frequency and severity of natural hazards.* *NH – O6 Measures taken to mitigate natural hazards do not create or exacerbate adverse effects on other people, property, infrastructure and the environment.*	• Are consistent with the directives in the WCRPS. The objectives are appropriate in terms of Section 5 of the RMA, which recognises that sustainable management includes meeting the economic, social and health and safety needs of people and communities, including future generations. This includes consideration of the effects management tools specified in Section 5(c), as well as the Councils' function under Section 31 to avoid or mitigate natural hazards. It also seeks to deliver resilient communities where development does not result in an increase in risk to life and property from natural hazards, and to sustain the physical resources of the community. Reducing the exposure of people and property to risk from natural hazard events and potential climate change will result in less impact on people and communities and enable the natural environment to respond and adjust in a natural way, safeguarding the life supporting capacity of ecosystems. A flexible risk-based approach is considered appropriate, with a risk management approach to existing development and infrastructure, and a risk reduction approach to new development (including avoidance where appropriate). This acknowledges that some activities and people are currently lawfully established within areas potentially subject to natural hazards. It would be inefficient and inappropriate to not allow continuation (or minor expansion) of such activities. However, it is prudent to avoid significantly increasing activities, the number of people, and the value of property in hazard areas. For example, an extension to an existing house is a different matter to a greenfield subdivision, or a new hospital or school proposing to locate in a hazard area.

Evaluation of Alternative Options	Appropriateness to Achieve the Purpose of the Act
Retain the approach of the Operative Plans	Failure to take a risk-based approach to natural hazards fails to protect people, property and the environment from likelihood and consequences of natural hazards occurring and its impact on environment, including people and property. Not taking an activities-based approach could result in activities involving larger numbers of people, and people more vulnerable to hazards, being exposed to risk. It is short sighted to ignore consideration of the long-term effects of climate change and not appropriate for sustainable management. The status quo in terms of the operative plan provisions were prepared prior to Natural Hazards being identified as a s6 matter, are based on outdated data (over 20 years old) and modelling and do not enable the Councils to meet their functional requirement to protect communities from the significant risks of natural hazards.
Remove hazard provisions from the District Plan and rely on other methods, including the Building Act and Building Code, Emergency Management/Civil Defence planning and response, infrastructure planning including physical hazard protection works	This is not considered an appropriate response given the national importance of managing the significant risks of natural hazards and the large hazardscape on the West Coast. It is not affordable for example to expect that defence structures are able to be built in all locations for all hazards – and neither would that comply with higher order documents such as the NZCPS. There are some locations where there is an inherent natural hazard risk such that many land uses are inappropriate. While the management of natural hazards involves organisations and activities outside of the RMA, land use planning is a critical component in hazard management.
Summary The proposed objectives and policies set a framework that seeks to recognise, avoid, remedy and mitigate the significant risks of natural hazards on the environment, people and property by managing activities based on sensitivity to hazards, with consideration of the likelihood and consequences; restricting certain activities in identified hazard areas; controlling the design and location of activities to minimise exposure to risk; and encouraging the use of natural defences against natural hazards. They also require broader consideration of a wider range of issues related to hazard risks. The proposed objectives are in accordance with the purpose and principles of the RMA and reflect the district councils' role and functions in respect of Natural Hazards. They support a long-term and manageable flexible risk-based approach, including a precautionary approach to new development and hazard sensitive activities and are aligned with best-practice throughout New Zealand.	

4.2 Description of the Proposed Provisions

4.2.1 Description of the Proposed Overlays

Coastal Hazard Overlays

There are four Coastal Hazard Overlays – the Coastal Tsunami Overlay, the Coastal Hazard Severe Overlay, the Coastal Hazard Alert Overlay and the Coastal Setback Overlay.

Coastal Tsunami Overlay

A tsunami is a natural phenomenon consisting of a series of waves generated when a large volume of water in the sea, or a lake, is rapidly displaced. The impacts of a tsunami occur when they reach land and result in violent flooding, often due to the energy reaching far inland of normal coastal flooding. This in turn results in devastating damage to property, injuries and loss of life. Principal sources of tsunami are earthquakes, underwater landslides, lakeside or coastal landslide, and underwater volcanic eruptions.

Tsunami sources have three categories; distant source (more than 3hrs travel time to NZ), regional source (1-3 hours travel time), and local 0-60mins travel time, most sources are less than 30 mins travel time. The NZCPS specifically requires the identification of tsunami hazards as part of natural hazard identification

Tsunami modelling for evacuation planning was commissioned by the West Coast Regional Council Civil Defence Team. This provides modelling to a level considered sufficient to inform both Civil Defence and Land Use Planning requirements. A large set of tsunami sources was investigated, and 330 tsunami inundation simulations were undertaken for the coastal towns.

The modelling of worse case scenarios, local or distant rupture, combined with Cape Foulwind Fault delivers the following:

- Hokitika township 7-10m wave in Hokitika (8m if just Cape Foulwind fault ruptured). All land, within 300-500m of the current shoreline would be inundated.
- Greymouth township up to 15.9m, with waves up the Grey River of 5m. Inundation within 1km of shoreline.
- Westport township is 8m. Westport could experience 3-5m uplift if the Cape Foulwind fault ruptured simultaneously, which reduces some of the inundation risk.

These heights are based on a 2,500 year recurrence. Cape Foulwind Fault as a stand-alone has a 7600 to 30,600 year recurrence. This is a high level of risk. These recurrence intervals, while appearing quite large, are frequent on a geological timescale.

The Coastal Tsunami Overlay is proposed to cover only the areas which are at the greatest risk of coastal tsunami from this analysis – the "red" areas. The significant risk we propose to manage through TTPP is around the location of "Critical Response Facilities". "Critical Response Facilities" means in relation to natural hazards *hospitals, fire, rescue, police stations, buildings intended to be used in an emergency for shelter, operations or response, hazardous or explosive material storage, aviation control towers, air traffic control centres, emergency aircraft hangars, fuel storage, major dams, community scale potable water treatment facilities and wastewater treatment facilities.*

This tsunami overlay is intended for land use purposes, not for evacuation purposes.

The overlay extends over 1808 titles, and a total area of 6559 hectares. Of this total area, 2149 hectares is private land.

Coastal Hazard Severe and Alert Overlay

To identify coastal hazard areas a literature review was undertaken of central government guidance, other district plans, and reports held by the West Coast Regional Council (WCRC). Internal discussions took place with Civil Defence, District Council Building Control and Resource Consent staff, and Regional Council Operations staff. Input was also provided by treaty partners and the community on areas of greatest concern.

WCRC has some RMA natural hazard responsibilities and has been undertaking work with NIWA to identify the coastal hazard areas for the proposed Regional Coastal Plan (pRCP). The pRCP does not

give an inland extent of the hazard areas. Following Cyclone Fehi the report was reviewed, and amendments made to priority areas. This is detailed in the research section of this paper.

Field visits were undertaken by officers to familiarize themselves with the current environment and physical landscape. The location of the active coastal area was also considered. The existing district plans use mean high-water springs (MHWS) as a seaward line from which to then measure an inland set back. As the coast is highly dynamic, and MHWS was found to often not be where data sets suggested it would be.

The areas identified as high priority from the pRCP NIWA report were discussed with planning staff and operations staff across the four councils and iwi, and these were agreed as reflecting their areas of greatest concern. These are the areas where the amount of people, property and environment at risk is the highest.

Expert opinion was sought from NIWA to understand the risk from coastal inundation and coastal erosion. High resolution data is required for such assessment, in most of the priority areas LiDAR was available, and has been used. For those areas where LIDAR was not available - Punakaiki, north of Ngakawau, and Haast Beach to Jacksons Bay, satellite STRM was used. Shapefiles were produced which were then used to draw overlays. Full details of the methodology are contained in the Measures and Rouse (2022) report.

A different process has been undertaken for Hokitika which is summarised below:

Hokitika Coastal Inundation

- Digital Elevation Models (DEM) of land topography sourced (light detection and ranging (LiDAR) where available, Space Shuttle Radar Topography Missions (STRM) where not). This gives us a current height of land above sea level.
- Effects of storm-tides, wave setup and tidal elevations (e.g., mean high water springs) estimated to calculate extreme sea-level elevations – this is to understand the size of waves expected in a 1% Annual Exceedance Probability event.
- Adjustments for vertical land movement applied – this allows changes in the height above sea level to be considered into the future.
- Sea level rise at 0.2m increments added to the extreme sea level elevations. This allows us to see what the impact on extent is of various scenarios.
- Spatial mapping of extreme storm-tide + SLR elevations onto land to identify future coastal flood inundation areas.

Note – see detail under the Hokitika Overlay – this data was not used in Hokitika for reasons explained in that section.

Westport specific inundation modelling

- In the Westport and Orowaiti area the inundation output was then calibrated against Cyclone Fehi as robust data from that event is held. The outputs from the model are slightly more extensive than Cyclone Fehi. This supports the validity of the modelling as Cyclone Fehi was less than a "1 in 100-year event".

Outputs were provided in shapefiles for each of the 0.2m increments.

Note – see detail under the Westport Overlay – this data was not used in Westport for reasons explained in that section.

Coastal Erosion

- Historic aerial photography was scanned and georeferenced to analyse changes to the coastline over time. This was combined with an allowance for short term fluctuations and / or backshore slope collapse to model erosion over time.

- Outputs from this were then reviewed to account for geomorphological features and underlying geology. This will pick up for example where there is sandy beach underlain by bedrock. The rate of erosion may be rapid through sand but then substantially slower once bedrock is reached.
- Outputs were provided in shapefiles of a 50 year erosion line and a 100 year erosion line.

The coastal inundation data was provided in 0.2m sea level rise increments. In order to provide for sea level rise, over 100 years, 1m of sea level rise was used. This approach is supported in the NIWA report and is general practice in many New Zealand councils. Erosion shapefiles were also produced with a 100 year timeframe. This is appropriate to give effect to the New Zealand Coastal Policy Statement (NZCPS). The erosion and inundation extents were considered together and amended to reflect the most inland extent. This is appropriate as a precautionary approach is required.

The areas identified as low and medium risk in the NIWA report were subject to inundation modelling. As with the high-risk areas LiDAR was used where available, and STRM where not. Erosion modelling was not undertaken due to time and budget constraints, however, as the risk is lower this is considered appropriate.

The shapefile output was then translated into planning overlays. This was done by careful review of the shapefiles to plot overlay extents. The most landward line (erosion or inundation) was used. This is appropriate in a coastal setting to apply the precautionary approach. Coastal hazard areas that are identified in the pRCP as "high" have been identified as "coastal severe", and "medium or low" as "coastal alert". The classification is related to risk and assets threatened and is appropriate and consistent with a risk-based approach.

Using the coastal alert overlay, as a buffer, landward of the coastal severe overlay was discussed at the internal workshops. However, after considering the NIWA data and methodology in more detail this has not been undertaken. The reason for this is that the erosion line provided is for 100 years. While accepting that we are directed by the NZCPS to identify coastal hazards for at least 100 years, setting an arbitrary line with no evidential basis is not good practice. With the variety of physical environments along the West Coast coastline, and how those impact coastal dynamics means picking a setback distance would likely result in it either being too restrictive where the coastline is hard metamorphic rock (for example gneiss), or insufficiently restrictive where it is soft sediment.

Where gaps occur laterally within the coastal severe overlay, due to the vector provided by lagoons, rivers and wetlands, coastal alert has been applied.

A summary table of the number of properties and total land area follows:

Hazard Overlay	Titles	Total Area Private	Total Area Public
Coastal Alert	2152	3366.21 hectares	2286.61 hectares
Coastal Severe	406	1034.21 hectares	1174.07 hectares

Hokitika Coastal Hazard Overlay

The Hokitika beachfront area is identified in the operative Westland District Plan as a coastal hazard area. Hokitika is identified in the pRCP NIWA report as at high coastal hazard risk. Since the report was updated, WCRC has gone through a long-term plan process. Through that process a commitment has been made to upgrade the existing river and coastal protection structures. The consent for the upgrade to the sea wall, and some of the flood wall extension has been lodged. It is anticipated that the design for these structures will have been finalised before this plan becomes proposed. As such, a coastal hazard overlay has not been applied to the Hokitika beachfront currently. The upgrade to the section between the State Highway bridge and Sunset Point will not be lodged prior to notification. Consultation will be underway in late 2022, with consent lodged in 2023.

The coastal hazard inundation risk has been modelled by NIWA and Land River Sea (LRS) and shows the town centre as being at risk from storm surge up the Hokitika River and over the existing bank. To recognize this risk, while also acknowledging that funding has been secured, and the location of

properties to be protected by the remaining upgrade are known, a Hokitika specific provision has been developed.

The extent of this overlay is as per the outputs from LRS, for a 100 year annual recurrence interval with 1m sea level rise. This rule will no longer be triggered once the final section of the wall is in place and certified.

The overlay applies to 433 titles and an area of 42 hectares. All the titles are private land.

Westport Hazard Overlay

Through early overlay development work parts of Westport were included in the Flood Severe, Flood Susceptibility, Coastal Severe, and Coastal Alert overlays. Following draft plan consultation, a bespoke overlay and provisions were developed, which recognise the future planned works and the substantial natural hazard risk while protection works are being planned and funded. The extent of this overlay is, as discussed in earlier sections of this report, aligned with the West Coast Regional Council Long Term Plan. Political, community and financial decision making is underway, and it is extremely likely that this overlay will need to be amended further down the plan development track.

This overlay applies to 2888 titles, and an area of 1842.46 hectares. 1721.84 hectares are private land.

Coastal Hazard Setback Overlay

This overlay is located in coastal areas where there has not been location - specific analysis of the risks and likelihood of coastal hazards. The limited budget available for technical work on TTPP meant that it was not possible to assess the entire coastline of the West Coast in detail, instead the priority was placed on areas already identified in the pRCP as being at risk from natural hazards. There was also a lack of quality recent digital elevation models such as LiDAR.

Due to the dynamism of coastal processes, and the knowledge that there are existing coastal erosion and inundation issues outside of the specifically identified overlay areas, the Coastal Hazard Setback Overlay puts in place a precautionary buffer – continuing the practice of the operative district plans.

Within the operative plans this setback is 150m (Buller), 100m (Grey) and 200m (Westland) respectively in rural zones. Accordingly, in keeping with a precautionary approach, and recognising the clear directives of the NZCPS, the Coastal Hazard Setback Overlay has been set at 100m from Mean High-Water Springs (MHWS). This setback has also provided consideration of coastal natural character.

Outside of the identified coastal hazard areas (Little Wanganui head to north end of Gentle Annie, Charleston's Waitakere / Nile River to Fox River north, Fox River south to Meybelle Bay, Maybelle Bay to Truman Track, Coast Road between Ten Mile and Rapahoe north, Point Elizabeth, Takutai to North Okarito, South Okarito to Hunts Beach, Hunts Beach to Bruce Bay north, Bruce Bay north to the true right of Haast River, Jacksons Bay south to the southern territorial boundary) there is a rule within the zone rules or coastal environment rules, that where there is no coastal hazard overlay, an assessment for RDA resource consent of coastal hazard will be triggered.

The overlay applies for 287 titles, and an area of 7127 hectares. Of the total area, 1417 hectares is private land.

Flood Hazard Overlays

There are three flood hazard overlays – the Flood Hazard Severe Overlay, the Flood Hazard Susceptibility Overlay and the Flood Plain Overlay.

Flood Hazard Severe Overlay

The Flood Hazard Severe overlay is located in areas where there is extreme natural hazard risk due to the depth and speed of water and transport of debris. This overlay is found in four locations – on the Buller River inland of Westport, Greymouth/Grey Valley, Hokitika/Kaniere and the Waiho River/Franz Josef.

In each of the four locations where the overlay is identified substantial flood modelling has been undertaken. Very detailed flood models (built with LIDAR so with a high degree of accuracy) have been developed for the towns of Greymouth, Hokitika and Westport.

In the Westport, Greymouth and Hokitika locations the overlay substantial depth and flow flood modelling has been undertaken. The purpose of the modelling was to

- Set building floor heights
- Designing flood protection infrastructure
- Assess flood mitigation options
- Assess the impacts of increased future flows and sea levels.

The methodology is detailed in the reports referenced in the research section earlier in this document.

The outputs from the models have been used to demarcate "severe" as to where water is more than 2m of depth in a 1% Annual Exceedance Probability (AEP) event and / or moving at a velocity of 2metres/second or more. In the draft Plan overlay, the outputs had been interpreted and contiguous polygons drawn. There was some feedback about the accuracy of this, so in the proposed TTPP overlay, the original Land River Sea shapefiles were used. This means there may be sites which have multiple parts which are severe / susceptible, it does however represent the most accurate extent possible. The area of Westport has not been included in this overlay – it is within the Westport Hazard Overlay, only the areas outside of the Westport Hazard Overlay are identified as Flood Severe Overlay.

In the case of Franz Josef/Waiho River Severe Flood Overlay, the same modelling work as for the other locations has been completed. However, this was delivered after the deadline for inclusion in the proposed TTPP. Therefore, earlier data has been relied upon.

The severe area is largely consistent with the area identified in the operative Westland District Plan. Since the Westland District Plan became operative there has been further monitoring of the bed profile, and modelling to inform upgrades to protection works. These outputs, alongside a separate project, completed as part of Westland District Council's future Franz Josef Development, by the University of Canterbury has been used to hand draw the polygon.

There are 864 titles within the Flood Severe Hazard Overlay, with a total area of 9811.8 hectares, of which 4850.70 is private land.

Flood Hazard Susceptibility Overlay

The Flood Hazard Susceptibility overlay was developed for those areas where development has occurred and there is likely further development in the future. While there is some risk from flooding, this risk is lower than in "severe" and can be mitigated more easily. This is recognized by less restrictive rules.

Areas included in this overlay are; Haast, Franz Josef, Kokatahi, Kaniere, Hokitika, Greymouth, Reefton, Westport, Waimangaroa, Granity / Hector / Ngakawau. Mokihinui – Seddonville and Karamea.

In areas where detailed data is held, which has informed the severe overlay, this same methodology and data has been used. Those areas are Kaniere, Hokitika, Greymouth, Grey Valley and areas around Westport. The hazard category, as referred to in the severe overlay section used were H1 – H4

In the area around Franz Josef, the overlay has been informed with the Future Franz work discussed in the severe overlay, and observations during various flood events.

In Haast, Reefton, Waimangaroa, Ngakawau, Seddonville – Mokihinui and Karamea were mapped using flood data held by the West Coast Civil Defence Team from previous events.

There are 1696 titles, and a total land area of 10891.91 hectares, of which 6473.78 hectares is private land.

Flood Plain Overlay

The Flood Plain' overlay was developed for areas where development could occur in the future, but where modelling is not held and a precautionary approach is being applied, principally at the subdivision stage. These flood plains have been identified through expert input from the West Coast Regional Council River Engineers, Civil Defence, District Council Asset, Building Control and Planning teams. If a subdivision consent is sought in these areas, a requirement for a hazard assessment is triggered. This ensures that the flood risk is understood, and mitigation measures undertaken.

The following table summarises the locations and data sources

Location	Data Sources
Oparara and Little Wanganui	Civil defence records of extent of flooding Geological maps
Inangahua and Upper Buller Gorge	Civil defence records of extent of flooding Geological maps
Blacks Point to Inangahua	Civil defence records of extent of flooding Geological maps
Upper Grey Valley and Haupiri	Civil defence records of extent of flooding Geological maps Rating district information on protection works and extent of flooding
Taramakau and Awatuna	Civil defence records of extent of flooding Geological maps Rating district information on protection works and extent of flooding
Arahura	Civil defence records of extent of flooding Geological maps
Kokatahi and Kowhitrangi	Civil defence records of extent of flooding Geological maps Rating district information on protection works and extent of flooding
Harikahi and Whataroa	Civil defence records of extent of flooding Geological maps Rating district information on protection works and extent of flooding
Fox Glacier to Paringa	Civil defence records of extent of flooding Geological maps
Haast Beach to Arawhata	Civil defence records of extent of flooding Geological maps Rating district information on protection works and extent of flooding

The geological maps consulted are the GNS QMap series

Oparara and Little Wanganui

These large catchments are largely within the DOC estate. Where they emerge onto the coastal plain they become sinuous. The interaction between the coast and the river often results in surface flooding when a flood event coincides with a coastal storm / high tide. For example, during the February 2022 rain event, the Little Wanganui Subdivision was isolated due to the road being flooded by the river. 4WD and heavy vehicle access was possible in emergency. This situation continued for several days until roading contractors could undertake repairs. Considering the geology of the area, is late Quaternary alluvium and colluvium, and is described as "Unconsolidated to poorly consolidated mud, sand, gravel and peat of alluvial and colluvial origin". A geomorphological assessment is not easily achievable as the area has been heavily modified for primary production.

Inangahua and Upper Buller Gorge

These areas are where large catchments have some space to spread out into a flood. During the July 2021, and January / February 2022 flood events, these areas experienced significant flow and damage.

From a geomorphological perspective overflow channels are visible on aerial photograph, as well as areas where sediment has aggraded. This supports the assertion that the area is a flood plain, not a constrained river. The Buller River is reconstrained in the lower Buller gorge, potentially increasing the flood risk in the Inanghua area.

Blacks Point to Inangahua

This area experienced flooding in February 2022 storm, including damage to the landfill in Reefton, and the state highway. There have been numerous flood events in Rosstown, and in Reefton. Historic Reefton flooding resulted in the town changing orientation, the main street used to the be Strand by the river, but following flooding, was reorientated, making Broadway the main thoroughfare. Considering the geology of the area is late Quaternary alluvium and colluvium, and is described as "Unconsolidated to poorly consolidated mud, sand, gravel and peat of alluvial and colluvial origin".

Upper Grey Valley and Haupiri

The Upper Grey Valley and Haupiri area also experience flooding. During the July 2021 flood event, substantial surface flooding occurred towards the coast and Rapahoe, upstream flooding paddocks and roads at Coal Creek and further inland. Various parts of the State Highway network were closed over several days. A life was sadly lost recently when Gloriavale Christian Community member was washed away in flood waters. Considering the geology of the areais late Quaternary alluvium and colluvium and is described as "Unconsolidated to poorly consolidated mud, sand, gravel and peat of alluvial and colluvial origin". There are several rating districts in the valley. The purposes for these highlight the flooding issues.

The Nelson Creek Rating District was formed in 1981 by the Westland Catchment Board after considerable work was carried out by landowners over the previous 20 years to protect the lower Nelson Creek area upstream of the State Highway bridge from severe flooding and erosion.

Protection works on Red Jacks Creek have been in place since 1945 to prevent flood inundation of farmland and the main road. The Red Jacks Creek Rating District classification was adopted by the Westland Catchment Board in 1986 as a result of a further request from landowners for protection of the right bank upstream of the State Highway bridge.

Inundation of the area known as the Coal Creek Flats has occurred since pre-European occupation of the area. The Coal Creek Rating District was established in 1957 after a request was made to establish river protection to prevent further erosion of exposed riverbank.

Taramakau and Awatuna

The Taramakau River and the Awatuna River are large catchments, particularly the Taramakau and as such, may receive substantial flows. The geology of the area is late Quaternary alluvium and colluvium, and is described as "Unconsolidated to poorly consolidated mud, sand, gravel and peat of alluvial and colluvial origin". The flood risk is highlighted by the rating district purpose. The

Taramakau Settlement Separate Rating District area was first proposed by the Westland Catchment Board in 1962 after farmland in the area suffered serious erosion from flood events over the previous 13 years. In 1977 a revised scheme was proposed to protect a further 12.2 kilometres of land from flooding. This was adopted by the Westland Catchment Board in 1984.

Arahura

The Arahura River catchment is also large, and while a large proportion is within the mountains, there is a broadening of the river to a plain once it emerges from this constriction. Flood events have occurred over many years, and there has sadly been some loss of life. There are rock protection works at the Arahura Pa, protecting the settlement, and transport infrastructure. There are long term aspirations to establish papakainga development on the terrace, where the marae is situated to alleviate natural hazard risk.

Kokatahi and Kowhitirangi

This area is a large flood plain, where the rivers widen out from the mountains, before being constrained again towards Kaniere. There are numerous rating districts which have been created to protect from flood risk.

- The Kaniere Rating District was established in 1995 after consecutive floods eroded the true right bank of the Hokitika River immediately upstream of the road bridge, threatening houses, and the approaches of the Kaniere Road Bridge.
- The Raft Creek Rating District was established by the Westland Catchment Board in 1960 after an investigation into the drainage of the swampy area in the lower Kokatahi area surrounding Raft Creek. The initial proposal was to drain the area, including the deep peat swamp in the middle. However, an economic report prepared by the Department of Agriculture suggested the deep peat swamp areas would not be suitable for dairy farming.
- The Kowhitirangi Flood Control Scheme (Rating District) was established in 1958 as a result of requests for flood protection and maintenance of existing flood and erosion protection works. The very first flood and erosion protection work on the Kowhitirangi River was constructed in 1907 with some of this still evident today.
- The Vine Creek Rating District was established in 1966 as a result of the build-up of large quantities of detritus from the Alpine Fault shatter zone that spread out onto the flats below causing severe flooding and frequent silting of pastures. Vine Creek is a 10m wide excavated diversion channel that flows parallel to Diedrichs Road into the Kowhitirangi River.

The geology of the area is late Quaternary alluvium and colluvium and is described as "Unconsolidated to poorly consolidated mud, sand, gravel and peat of alluvial and colluvial origin".

Harihari and Whataroa

In Westland there is more land between the foot of the mountains, and the ocean. This means there is space for rivers to expand, which can result in flooding. This is visible in the geology of the area, with the flood plain, consisting of late Quaternary alluvium and colluvium, and is described as "Unconsolidated to poorly consolidated mud, sand, gravel and peat of alluvial and colluvial origin, shown in pale yellow.

The Hari Hari Flat Protection Scheme (now the Wanganui Rating District) was established in 1962 with the first work on the Wanganui River being carried out as early as 1913. The Wanganui Rating District consists of flood and erosion protection works on the left and right banks of the Wanganui River, and a drainage scheme in part of the Poerua Valley, Wanganui River, La Fontaine, Hari Hari Township and Lower La Fontaine.

The Whataroa Rating District was formed in November 2011 to fund unforeseen and urgent emergency river protection works. The Whataroa Rating District consists of flood and erosion protection works and extends from the State Highway Bridge downstream for 1.6 kilometres on the true left bank. The area protected is predominantly dairy farming with some dry-stock properties. Community infrastructure such as roads, power and telephone lines all derive benefit from the river control system.

Fox Glacier to Paringa

The area from Fox Glacier township to Paringa is subject to flooding, consisting of late Quaternary alluvium and colluvium and is described as "Unconsolidated to poorly consolidated mud, sand, gravel and peat of alluvial and colluvial origin, shown in pale yellow.

This coastal plain is at the end of large catchments, and there is space for flood water to span out and interact with coastal wetlands. This can restrict and restrain flood water.

During the December 2019 rain event, the Fox River to Haast area was isolated due to flood and landslides. While not constrained in the way the Waiho River is in Franz Josef, the potential for the river to carry large and rapidly rising quantities of water, along with substantial amounts of debris and glacial ice, underscores the potential flood risk to the flood plain. During this rain event the landfill at Fox Glacier was damaged, this led to significant amounts of waste being deposited along the coast to the north. Local volunteers joined forces with DOC and the defence force to recollect the waste, and repair work has been undertaken at the landfill site.

Haast Beach – Arawhata

The area from Haast Beach to Arawhata is similar to the Fox Glacier to Paringa area, several large catchments, interacting with the coastal plain. There are also lagoons and wetland systems. The delivery of sediment here, consisting of late Quaternary alluvium and colluvium, is described as "Unconsolidated to poorly consolidated mud, sand, gravel and peat of alluvial and colluvial origin, shown in pale yellow.

There are regional council rating districts in the area:

- The Okuru Rating District was established in 1998 after local ratepayers requested a proposal to protect the western area of the Okuru Township from the Okuru River. Works did not commence on the rating district until August 2000 as a result of a reduction in erosion threat due to fewer flooding events and alignment of the river mouth to the north and south along the general Okuru foreshore area.
- The Neils Beach Rating District was formed in October 2016 to fund beach nourishment and coastal protection works. After an initial approach from concerned ratepayers in early 2014, regarding increased erosion along the foreshore fronting the Neils Beach Settlement in South Westland, an initial inspection was carried out on 1 April 2014 by WCRC staff with an informal group of local property owners, to determine the risk and discuss possible future remedial action for the area.

This overlay applies to 1907 titles, with a total area of 79,589.48 hectares, of which 19,7377.39 is private land.

Lake Tsunami Overlay

Records of lake tsunami have been found in several lakes on the West Coast. Lake tsunami can be triggered by a large amount of sediment entering the lake rapidly, such a landslide or rock fall. Ice fall could also trigger in the same way. A large earthquake, such as one resulting from an Alpine Fault rupture is another potential source. Studies in Queenstown Lakes District are seeking to understand the risk of an Alpine Fault rupture triggered tsunami to lake-based communities. Risk from Lake Tsunami is an emerging area of natural hazard understanding. Queenstown Lakes have undertaken research and assessments from Alpine Fault risk. This approach has been replicated for the West Coast as the fault is unaware of regional council boundaries.

A buffer of 5m from the lake edge was included in the draft. There are no private properties within this buffer, the zoning is open space. The lakes included in this overlay are Lake Daniells, Lake Brunner, Lake Haupiri, Lake Poerua, Lake Kaniere, Lake Mapourika, Lake Paringa, Lake Moeraki, and Lake Ellery.

The overlay applies to 9 private titles, with a total area of 58 hectares.

Land Instability Alert Overlay

The tectonic position, and physical environment of the West Coast means that slope instability is inevitable. An active tectonic boundary, associated rapid uplift, combined with high rainfall, has

resulted in the potential for massive amounts of sediment to be delivered to the rivers, the foot of slopes, and the low-lying lands. These processes are in part what drive the massive aggradation of the Waiho River. Slope instability is widespread in all rock units underlying sloping ground. Some failures are very slow, generally resulting from weak, water-saturated ground. Schist foliation is a common failure plane for slow, large scale movement. These combined physical environment elements mean that the West Coast has a significant risk from land instability.

The risk from land instability is arguably a greater threat than coastal hazards as there is little opportunity to evacuate, relocatable homes not possible, and as witnessed by the Matata case, can be extremely costly if development is allowed to happen in high risk areas. We must also be mindful that any managed retreat discussions do not move people away from the coast, and closer to a hazardous slope. Slope failure can be triggered by rainfall, ground shaking, or may just collapse when there is no longer the strength to hold it together. The December 2018 weather event triggered numerous largescale slips at Mt Hercules. This resulted in the highway being closed, and isolated Whataroa. Slips also closed the road between Franz and Fox, and the Haast Pass. The Waiho Bridge washed away. The road was able to be opened to allow hundreds of stranded tourists to leave Franz and Fox. Milk trucks were able to get to Whataroa after a few days, and power was restored, a huge relief to farming community, and their herds. It took more than six months for the highway to be repaired, huge amounts of stabilizing was required. This event highlights the impact of landslides.

The original intent and approach to land instability was to include two layers; land instability – high, and land instability – alert. Unfortunately, as decisions on the West Coast Regional Council (WCRC) Long Term Plan were issued later than expected, the New Zealand specialist has committed to other projects. CDEM are leading a two year program for this work. This work did not commence until May 2022.

The original intent and approach to land instability was to include two layers; land instability – high, and land instability – alert. Unfortunately, as WCRC Long Term Plan decisions were issued later than expected, the New Zealand specialist was unable to complete this project. Expert input to inform this overlay was delayed until at least May 2022. This was too late for inclusion in the draft or proposed plan.

Therefore, only a land instability – alert has been developed. This overlay has been developed using existing natural hazard reports held by the WCRC, and the Erosion Prone areas identified in the WCRC Land and Water Plan, the existing Buller District Council Little Wanganui overlay, and areas along State Highway 6 and 73 that have rock fall protection structures / active slips.

Areas included in the overlay are Little Wanganui subdivision, Granity to Mokihinui, parts of the Coast Road (north of Fox River, Maybelle Bay, 14 Mile, 10 Mile, Rapahoe Bluff), Greymouth Erosion Prone area, Otira and Knights Point.

This overlay applies to 1978 titles. The total area is 24497 hectares, 10851 of which is private land.

Earthquake Hazard Overlay

The Earthquake Hazard Overlays apply to the Alpine, Awatere, Hope and Clarence active faults. The overlay is applied at 20m, 50m, 100m, 150m and 200m either side of the active fault trace.

In Westland the majority of the Alpine Fault and associated Earthquake Hazard Overlay lies to the east of existing settlements within the vegetated steep hillside land managed by the Department of Conservation. Areas where the fault crosses open valleys include Grassy Creek in Haast, and the Paringa River next to the State Highway Bridge including the South Westland Salmon Farm. The fault line passes to the east of Fox Glacier and behind Harihari. The areas that have been subject to academic study such as the Toaroha and Kokatahi River valleys containing data of increased accuracy and therefore reduced margins of uncertainty. The fault traverses further through the Southern Alps and runs along the Taramakau River valley near farmland beside the Taipo River before crossing the Taramakau River.

In Grey District the Faultline runs from the Taramakau River through Inchbonnie and immediately adjacent to Lake Poerua. It then runs parallel with the Lake Brunner Road to east of Rotomanu before crossing the Crooked River and passing through Haupiri. From Haupiri the faultine continues through land managed by the Department of Conservation and into Buller District.

In Buller District the Alpine Fault mainly traverses Department of Conservation Land. It crosses farmland east of Springs Junction where the Awatere Fault joins it before passing into more Department of Conservation land and into the adjacent Tasman District.

The Awatere Fault is located in Buller District east of S. Springs Junction, where State Highway 65 and State Highway 7 meet are proximate to the fault. There are DOC scenic areas, with some associated tourism development, camp sites and motels as well as rural activities.

The Clarence Fault is located in Grey District east of Haupiri and is entirely located on Department of Conservation land. While DOC land is less likely to be developed, due to an ongoing review of stewardship land, and noting that being under DOC management does not preclude development, the Clarence Fault has been included in these provisions.

The Hope Fault is located across Grey and Westland Districts in the Taramakau River valley and is proximate to State Highway 73 and the National Grid line. The area is largely rural with the Jacksons settlement proximate to the Alpine and Hope fault junction.

The Alpine Fault trace has been identified at a 1:10,000 scale in the locations of Franz Josef, Inchbonnie, Haupiri and Styx Toaroha by GNS.For the remainder of the Alpine Fault, and for the Hope, Clarence and Awatere faults the exact location of the fault is not as well known. The exception to this is the Awatere fault at Springs Junction and Maruia where it has been identified at a 1:10 000 scale by GNS. The fault line location and earthquake hazard overlays has been developed based on data from the GNS Active Faults database.

The confidence intervals for the faults being included are all "H" – representing high. This means the fault has a well constrained recurrence interval (usually based on fault-specific data) that is well within a specific fault-avoidance class, or fault has such a high slip rate that it can be confidently placed within the ≤ 2000 year fault-avoidance class.

National guidance "Planning for Development of Land on or Close to Active Faults" prepared by Ministry for the Environment, suggests a buffer of 20m either side of a fault where it is well known, and larger buffers where it is less well defined.

It is noted that intense deformation and secondary ruptures are common as a result of fault movements. The 20m buffer is a suggested distance from the primary plane of the fault rupture. These effects can occur because near-surface weak materials deform instead of breaking cleanly, and structures built near an area of fault rupture can cause surface rupture to divert around them unpredictably.

The terminology used in the guidelines and often used in GNS reports regarding definition of a "fault avoidance zone" is in regard to the area in which a fault is most likely to be, it is not an area which the effects of the fault should be avoided. This difference in interpretation has come about through different specialists having different meanings for the same terms, and working through this with GNS, who helped develop the guidelines has been extremely beneficial. The 20m fault avoidance zone is simply the 20m in which the active fault is likely located, and by no means the area in which the effects of its rupture are likely to be experienced. Once this was understood, a name change was recommended to the committee, to ensure better clarify in use of terms. Hence the change of name from Fault Avoidance Zone to Earthquake Hazard Zone from draft to proposed.

The Earthquake Hazard overlay should be considered a spatial extent where the fault will rupture and where most secondary deformation (other fault traces, ground shaking, warping, folding, overthrusting) will be located. This is not meant to represent a zone of complete ground devastation, but rather a zone where building control and planning should take into account the likely presence of fault deformation. This level of buffering may be considered quite conservative in many areas with respect to the actual faulting and deformation that will occur.

Buffers beyond 20m have also been proposed. This reflects several factors:

- All of the faults considered in TTPP Earthquake Hazard zones have large, predicted magnitudes, this means, when they rupture it is highly likely that there will be deaths and destruction. The amount of surface rupture is likely to be substantial. Therefore, 20m is nowhere near sufficient to manage the significant risk from these faults.

- The Alpine Fault has been extensively studied, its exact location is well understood when considered in its physical context; native vegetation, under aggraded riverbeds, and under streets It is however a complex and extensive fault. The active trace is mapped, but this does not mean that that is where it will rupture in the future, it is the most informed estimate.
- The other faults that are being addressed as well studied in part, and less well studied in other parts.
- While the Ministry guidelines suggest 20m, and notwithstanding the confusion in interpretation, this has been treated as a minimum by other councils, the Proposed Selwyn District Plan has a fault avoidance overlay of up to 300m.

The number of titles, total land and private land area in each buffer width is detailed below. The figures are cumulative. The 20m titles and area are included in the 50m figures.

Overlay	Titles	Total Hectares	Private Hectares
20m	431	2,879.63	564.57
50m	371	6,939.71	1,309.15
100m	390	13,223.59	2,370.98
150m	428	19,098.40	3,303.01
200m	453	24,737.11	4,183.01

Differences between the TTPP Fault Avoidance Overlay and the Abandoned Plan Change 7

There are several key differences between the Westland District Council Plan Change 7 (PC7), and the Proposed TTPP Earthquake Hazard Overlays. The key differences are listed, with reasons for those following.

Overall Approach and Framework

- Managing risks from significant natural hazard risks was inserted into the RMA while PC7 was already in progress. With this change, district plans must do more to manage significant risk.
- The now operative RPS was notified March 2015. PC7 preceded this, with the hearing report being completed in March 2015. Therefore, the now operative RPS was not given effect to in PC7 due to timing.
- PC7 was a settlement specific plan change, TTPP is a region wide district plan. Rules need to be appropriate for a wider variety of activities and development patterns, including areas which currently have little or no development.
- In 2010, the Institute of Geological and Nuclear Science predicted that the probability of an Alpine Fault earthquake event, with a fault rupture to the surface occurring, was 20% within the next 30 years. Along the fault rupture, it is estimated that there will be approximately 8-9 metres of horizontal displacement on the west (Australian plate) side, and 1-2 metres of vertical uplift on the east (Pacific plate) side. Land deformation is predicted to be greater on the vertical uplift or "hanging wall" side of the fault rupture. More recent analysis of data from 20 previous earthquakes along 350 kilometres of the fault shows the probability of that earthquake occurring before 2068 is about 75%.

Buffer width and Fault Location

PC7 buffer widths were derived from Langridge 2010. PC7 has a total wide of 190m. The Langridge 2010 report details the construction of these buffers. It is stated that surface faulting along the Alpine Fault will at some time in the future cause severe damage to houses and businesses through Franz Josef. Under the current recommendations of the Guidelines, owners and occupiers of existing dwellings are not penalised for. At this juncture, there is a significant difference between the faulting mapping at the southwest edge of Franz Josef by Otago University and that which is currently shown as the location of the fault by WCRC (see Fig. 19). This reflects differing interpretations of the mapped or inferred fault location. Where the fault scarp is clear, e.g. at the petrol station, there is little variance in the fault location. We have assigned a Horizontal Location uncertainty of ± 50 m, with an Asymmetric buffer for the hangingwall side of the fault, and a margin of safety of ± 20 m,

the total width of the FAZ through Franz Josef township is 190 m (Figs. 10, 20). This width encompasses both sets of line data and therefore, in this case, the FAZ should contain the true location of the Alpine Fault along its length. This level of buffering may be considered quite conservative in many areas with respect to the actual faulting and deformation that will occur. However, it is conservative due to the nature of the uncertainties in locating the fault and its deformation

It is detailed that with this buffer approach, all building types, except those defined building importance category 1 under the Building Act, should be non-complying. The exception being timber residential dwellings, where the fault line is Distributed, & *Uncertain – constrained or Distributed, & *Uncertain – constrained, this is discretionary.

PC7 proposed two separate zones. To differentiate between the two distinct zones proposed through the two separate reports, the 2010 FRAZ identified throughout the Westland District has been labelled the "General Fault Rupture Avoidance Zone". The updated FRAZ created by further study undertaken as part of the 2011 report is labelled the "Franz Josef/ Waiau Fault Rupture Avoidance Zone" and replaces the original "General Fault Rupture Avoidance Zone" in this location.

The General Fault Rupture Avoidance Zone is an area of between 20 and 200 metres wide located on either side of the Alpine Fault as it runs through the length of Westland District. This zone is the area that is predicted to be seriously affected by fault rupture during an earthquake on the Alpine Fault. The zone has been created and mapped by the Institute of Geological and Nuclear Sciences (GNS) utilising data from a number of sources. The width of this zone depends firstly on the type of fault at any given point and therefore its performance during an earthquake event, and secondly, variations in the accuracy of data available at any particular location.

In the 2011 Langridge report, avoidance buffers of between 130 – 500m for the Stony Creek / Tartare area. This highlights the complexity of the Alpine Fault, indeed, of faults in general, and challenges in precisely pinpointing active trace location. The proposed TTPP approach is consistent with the buffer widths put forward in the General Fault Rupture Avoidance Zone. The Franz Josef / Waiau Fault Rupture Avoidance Zone is not considered appropriate to be applied to the entire West Coast region. Applying the Franz Josef / Waiau Fault Rupture to Franz Josef in TTPP is not considered appropriate as management of significant nature hazards is now a s6 matter, and as noted in the 2011 report, may be too conservative.

Since the report was released GNS have undertaking further sampling, and the arguments as to where the Alpine Fault is in Franz Josef have been further resolved. Therefore, the level of uncertainty in the Franz Josef area is reduced. The other faults being addressed in TTPP uncertainty have not been reduced. The safety margin of 20m is extremely conservative, when considering the likely horizontal displacement of 8-9m. And as noted earlier, the 20m buffer in the guidelines, and in the Langridge report was intended to be a fault corridor, not a land use restriction area. The proposed TTPP provisions are extremely restrictive immediately proximate to the fault reflecting this safety margin. Beyond this, cascade of buffers is considered appropriate for the faults addressed in TTPP, this is due to the likely rupture and deformation and the work undertaken for PC7. It is acknowledged that having more nuanced widths may be appropriate from academic perspective. However, having differing widths between Stony Creek and Franz Josef, for example, is not efficient or effective. This would likely cause a great deal of confusion for plan users, and ongoing debate as to where the transition should be.

Provisions

- PC7 did not put forward objectives and policy amendments. An amendment to a policy explanation was suggested. TTPP has general and specific objectives and policies
- PC7 put forward two zones, general fault rupture avoidance zone (GFRAZ) and Franz Josef / Waiau Fault Rupture Avoidance Zones (FJWFPAZ)
    - Under GFRAZ a permitted activity for non-residential buildings, with an expert report confirming the building is located entirely outside of the fault rupture area.
    - Under GFRAZ a controlled activity, for residential buildings with an expert report confirming the building is located entirely outside of the fault rupture area.
    - Under GFRAZ, any new building, extension, alteration that increase the scale of effects of an activity within a building located within the GFRAZ is non-complying.

    - Under FJWFPAZ only temporary buildings are permitted for commercial and residential activities. All other buildings, additions and alterations, or changes to the scale of activity are non-complying.
- The proposed rules under TTPP are much more numerous and nuanced. Using defined groups of activities, based on the Building Act categories, but amended to be suitable for the West Coast context, and the types of activities proximate to the fault lines. Closest to the fault line, those activities, such as medical facilities, that are likely to be needed in recovery are most restricted. The same approach has been taken for those most likely to result in substantial environmental damage, such as wastewater plants. Some activities, such as residential dwellings, are restricted closest to the fault, but this is relaxed the further from the fault line they are. Unoccupied buildings are permitted in all areas.
- PC7 uses building importance categories. This is aligned with the guidance. These were used as a starting point for the TTPP provisions. Working with CDEM, the community, and infrastructure stakeholders these were refined. For example, in the Building Importance Category 4, electricity generation is included. This was considered in a pre and post-earthquake context in Franz Josef. With renewable energy resources having to locate proximate to the energy source, generation, transmission and distribution assets are often proximate to faults, and may cross them. Restricting these would result in communities not having electricity, or having electricity transmitted from a greater distance, with an increase financial and environmental cost. Electricity will also be required post-earthquake. Restricting this would cause further harm, not reduce risk to life substantially. It is accepted that some lives could potentially be lost by powerlines dropping on people. There is less than minor environmental risk. Therefore, these were removed from the definition and restrictions. Major dams however remain in the definition as the potential risk to life, property and the environment is significant. A run of the river hydro scheme does not pose the same threat.

4.2.2 Description of the Proposed Policies and Rules

Policies

There are fourteen policies that support the objectives for Natural Hazards. These policies address the following matters:

- Identification of natural hazard overlays;
- Direction on using a precautionary approach, managing of natural hazards and assessment matters;
- Overlay specific policies to manage the significant hazard within that overlay including avoidance of severe life risk, and management options within some lower risk activities / overlays;
- Location policies for the Hokitika and Westport specific overlays

The risk to communities, infrastructure and the environment from natural hazards on the West Coast is significant. However, the ability to continue to function is also needed to provide for wellbeing. Therefore, a risk-based approach has been taken. This allows some activities, with lower risk, to be less restricted in some areas.

The general natural hazard provisions set out direction for assessment and management of natural hazards. The overlay specific policies are focussed on the risk from the natural hazard, and consideration of how to manage that risk. This is analysed in detail in the next sections of this analysis. For example, within the Earthquake Hazard overlay activities that are likely to result in significant risk to life – such as residential activities are highly restricted. Commercial and Industrial activities are not restricted to the same degree. Critical response facilities are restricted, to as best as is possible, ensure we can respond to natural hazard events.

Rules

The proposed TTPP rules are summarised in the tables below. The general principle is that less risky activities (e.g. unoccupied buildings) are generally Permitted, and more risky activities (e.g. sensitive activities) require resource consent. Where the risk is very high (i.e. severe hazard areas) then the level of resource consent is generally Discretionary or Non-complying. Subdivision is also substantially restricted in order to avoid future development occurring and increasing the significant risks to people, property and the environment.

Rule Summary – Flood, Land Instability, Tsunami and Coastal Hazard Overlays (note this is a simplified summary for analysis purposes – refer to the full TTPP to determine the exact rule status of an individual activity as this will be contingent on a range of performance standards). The following activities are Permitted (with standards) in all these overlays:

- Reconstruction of lawfully established buildings
- New and existing natural hazard mitigation structures
- Repairs and maintenance of existing buildings
- New unoccupied buildings

Activity	Flood Susceptibility	Flood Severe	Land Instability	Lake Tsunami	Coastal Alert	Coastal Severe	Coastal Setback	Coastal Tsunami	Hokitika Coastal	Westport
New commercial and industrial buildings	Permitted – freeboard required	Permitted – freeboard required	Permitted	Permitted	Permitted – freeboard required	Permitted – freeboard required	Permitted	Permitted	Permitted – freeboard required	Permitted – freeboard required
Buildings for critical response facilities	Permitted – freeboard required	Permitted – freeboard required	Permitted	Permitted	Permitted – freeboard required	Permitted – freeboard required	Permitted	Non-complying	Permitted – freeboard required	Permitted – freeboard required
Additions and Alterations for sensitive activities	Permitted – freeboard required	Permitted where no increase in area for sensitive activities	Permitted	Permitted where no increase in area for sensitive activities	Permitted where no increase in area for sensitive activities	Permitted where no increase in area for sensitive activities	Permitted	Permitted	Permitted	Permitted – freeboard required
New Buildings for sensitive activities	Permitted – freeboard required	Non-complying	Restricted discretionary	Restricted discretionary	Discretionary	Non-complying	Restricted Discretionary	Permitted	Permitted – freeboard required	Permitted – freeboard required
Subdivision	Restricted Discretionary	Discretionary	Restricted Discretionary	Restricted Discretionary	Restricted Discretionary	Discretionary	Restricted Discretionary	Restricted Discretionary	Controlled	Discretionary

Rule Summary – Earthquake Hazard Overlays

Activity	20m Buffer	50m Buffer	100m Buffer	150m Buffer	200m Buffer
Reconstruction of lawfully established buildings	Permitted	Permitted	Permitted	Permitted	Permitted
New and existing natural hazard mitigation structures	Permitted	Permitted	Permitted	Permitted	Permitted
New unoccupied buildings	Permitted	Permitted	Permitted	Permitted	Permitted
Repairs and maintenance to existing occupied buildings	Permitted	Permitted	Permitted	Permitted	Permitted
Additions and Alterations to existing occupied buildings	Non-complying	Restricted Discretionary for residential Discretionary for Commercial and Industrial	Restricted Discretionary for residential Discretionary for Commercial and Industrial and Community Facilities, Educational Facilities and Health Facilities	Restricted Discretionary for residential, commercial and industrial buildings Discretionary for Community Facilities, Educational Facilities and Health Facilities	
New residential buildings	Non-complying	Restricted Discretionary	Restricted Discretionary	Restricted Discretionary	Restricted Discretionary
New commercial & industrial buildings	Non-complying	Discretionary	Discretionary	Restricted Discretionary	Restricted Discretionary
New community facilities, educational facilities and health facilities	Non-complying	Non-complying	Discretionary	Discretionary	Restricted Discretionary
Buildings for critical response facilities	Non-complying in Brownfield areas Prohibited in Greenfield areas	Non-complying in Brownfield areas Prohibited in Greenfield areas	Non-complying in Brownfield areas Prohibited in Greenfield areas	Non-complying in Brownfield areas Prohibited in Greenfield areas	Non-complying in Brownfield areas Prohibited in Greenfield areas

4.3 Evaluation of General Natural Hazard Policies and Rules

Option	Benefits	Costs	Efficiency and Effectiveness	Risk of acting/not acting
Option A: status quo	• There is no increase in the number of properties identified as being impacted by hazards. • More flexibility in what type of activities can take place in a hazard area.	• The cost of hazard assessment falls on the applicant. • Failing to act on information now held creates a potential liability issue for councils when life is lost / property damaged.	• May no longer be efficient to require information to be collected at resource consent time, as much more data is now held; digital elevation data and flood models for example. • The current approach to mitigation structures only considering the risk from mitigation structures fails to take into account NZCPS requirements, or RMA requirements.	• The risk of continuing the status quo is that hazards are not being efficiently and effectively managed under the operative provisions. • There is much more information available as to the actual risk and properties affected and not using this up-to-date information for land use planning could result in substantial loss and damage of properties or even death.
Option B: Proposed Plan General Policies and Rules	• Pathways for consideration of natural hazard structures on natural hazard overlays can be considered. • Clearly set out information requirements and considerations when assessing applications within hazard areas, including the need to factor in climate change.	• Increased costs of obtaining technical expertise to assess compliance with permitted standards, and in assessing development in hazard prone areas. • Reduced development opportunities and potential constraint on some activities for areas identified at risk from natural hazards. • Insurers may react to hazard identification of some properties	• Assessment of impacts undertaken consistently across the region. • Identification undertaken • With more protection structures in place, and more likely to be needed in the future, having a clear pathway and consent considerations is required. • Gives effect to the NZCPS and the RMA s6 (h) requirements	• There is considerable national experience with use of overlays for natural hazards and it is now regarded as normal good practice. • Allowing consideration of end effects from natural hazard structures in overlays reduces the chance of a risk being transferred.
Option C: Methods outside TTPP (e.g. Building Act/ Code, emergency management/civil defence	• Provides flexibility for use of land. • Sharing information increases community	• The level of risk of some hazards is so severe that death or total loss of property could occur if new activities were able to	• In terms of physical hazard protection works they are an important part of the mix of measures, but the West Coast cannot afford to protect every	• Allowing development to occur in hazard areas is likely to have legal and financial risk. It would be a failure to meet

planning and response, physical hazard protection works)	preparedness for a natural hazard event. • Avoid duplication of controls between Regional Council and District Councils, as well as where other legislation/ regulations may effectively address the risk.	continue to occur in these locations as building regulations and other non-regulatory methods do not effectively avoid or mitigate the risks.	town, settlement – and dwelling from all significant hazards. In some cases (e.g. Waiho River, Alpine Fault) there are no physical hazard protection works that can protect at risk properties within a 50 year timeframe and the speed of the event (e.g. fault rupture) provides no opportunity for Civil Defence measures.	Council's obligations under the RMA and the NZCPS
Quantification Section 32(2)(b) requires that if practicable the benefits and costs of a proposal are quantified. The evaluation in this report identifies where there may be additional cost(s), however the exact quantification of the benefits and costs discussed was not considered necessary, beneficial or practicable.				
Summary: The benefits of identifying areas where natural hazards occur outweigh the costs, as development can then be either avoided or managed to remedy or appropriately mitigate the risk. Not identifying areas where natural hazards need to be managed results in avoidable costs when those natural hazard events occur. The proposed provisions are considered to be the most effective means of achieving the objective(s) as together they will: • give effect to the NZCPS and WCRPS • enable the councils to fulfil their statutory obligations, particularly s6(h) of the RMA • ensure that adverse effects of natural hazards are managed appropriately by identifying the areas where these need to be managed • enable the councils to effectively administer TTPP and to monitor the outcomes of the proposed provisions in a clear and consistent manner.				

4.4 Evaluation of Options around Natural Hazard Overlays

Option	Benefits	Costs	Efficiency and Effectiveness	Risk of acting/not acting
Option A: status quo Westland –Waiho River Severe Flood Hazard Zone (with associated rules) and Hokitika Coastal erosion overlay within the Hokitika Policy Unit. Coastal setback for buildings of 100m/150m/200m in the Rural Zone Buller – Mapped Little Wanganui Subdivision rockfall and debris flow, Punakaiki rockfall, Mokihinui flooding and Hector – Miko coastline debris flow hazard areas. Where resource consents are required, these mapped hazards are considered. Grey – no overlays	• There is no increase in the number of properties identified as being impacted by hazards. • More flexibility in what type of activities can take place in a hazard area.	• Using out-dated science means a large number of properties which are potentially at risk from natural hazards are not identified. • Approach doesn't recognise that allowing hazard sensitive activities (i.e. school or hospital) to locate in an area prone to natural hazards will increase the consequences of natural hazards. • The limited consideration of climate change and the need to plan for the long term, including adaptive management could result in increased exposure of people and property to risk in the future. This could result in increased costs to the community. • The level of risk of some hazards not identified in the operative plans is so severe that death or total loss of property could occur if new activities were able to continue to occur in these locations.	• The status quo is ineffective because areas of significant hazard – including those that have been afflicted by severe hazards destroying property in recent years are not identified. • The coastal setbacks included within the operative plans only apply in Rural Zones, and there are no setbacks for development in place in some coastal areas with very severe hazards. • In some locations there is also sufficient information to better identify the area where the significant risk exists. In those areas unnecessary hazard assessments and restrictions are in place.	• The risk of continuing the status quo is that hazards are not being efficiently and effectively managed under the operative provisions. • There is much more information available as to the actual risk and properties affected and not using this up-to-date information for land use planning could result in substantial loss and damage of properties or even death. • The most significant cost relating to the retention of the current situation is the continued development of additional activities in a location known to be at significant risk during an earthquake event. This will increase the risk to occupants of buildings and the potential for loss of life and significant injury. • Clearly identifying the areas subject to hazard risk enables certainty for those not subject to this risk. This will allow Franz Josef to continue to expand, providing continued economic growth to the

				District, whilst also facilitating development outside of the area of hazard
Option B: Proposed TTPP Overlays 1. Coastal Tsunami 2. Lake Tsunami 3. Earthquake Hazard 4. Coastal Severe 5. Coastal Alert 6. Coastal Hazard Setback 7. Flood Hazard Severe 8. Flood Hazard Susceptibility 9. Flood plain 10. Land Instability Alert 11. Westport Specific 12. Hokitika Specific	• Known properties which are prone to natural hazards are identified via maps in TTPP. This ensures property owners, developers and the community have access to the information about the risk of natural hazards. • Building activities in flood areas ensure floor levels are managed, flood waters are not impacted, and adaptation (relocation) can occur. • Avoiding the establishment of hazard sensitive activities in areas at risk from natural hazards will limit exposure of additional people and property to significant risk. • Avoiding hazardous facilities in hazard prone areas will reduce the risk of harm to people and the environment, in hazard events. • Clearly set out information requirements and considerations when	• Increased costs of obtaining technical expertise to assess compliance with permitted standards, and in assessing development in hazard prone areas. • Reduced development opportunities and potential constraint on some activities for areas identified at risk from natural hazards. • Insurers may react to hazard identification of some properties and refuse to insure them – however the frequency of events on the West Coast may already have alerted insurers to the issues as some properties have been rebuilt in previous events and been flooded again. • Effect on land values for those properties identified in particularly the Coastal Severe, Flood Severe and Earthquake Hazard overlays.	• Is efficient as reduces the need for unnecessary natural hazard assessments where the actual area of risk is clearly defined in the overlays. • The rules operate only where the natural hazard overlay falls. This means that if a property owner has a large site with land within a natural hazard overlay and also land outside of it, then the rule only applies to that part of the property within the natural hazard overlay • Gives effect to the NZCPS and the RMA s6 (h) requirements	• There is considerable national experience with use of overlays for natural hazards and it is now regarded as normal good practice. • The large amount of technical work done on the extent of the hazard areas, and degree of risk has been verified in many instances through the extent and areas affected by actual natural hazard events on the West Coast and there is a good degree of certainty around the accuracy of, in particular, severe hazards.

	assessing applications within hazard areas, including the need to factor in climate change. • Over time social disruption in natural hazard events will be reduced as TTPP provisions help reduce the risk to people and property. • Over time reduction in requirements for insurers/uninsured homeowners to pay out on destroyed and damaged properties as aspects such as freeboard requirements, and managed retreat are put in place. • Loss of life in Earthquake Hazard overlay will reduce over time. • Identifying areas where new subdivision and development should be avoided will reduce the pressure to expand the extent of flood and coastal protection works – which are a significant cost to communities and can in themselves have significant environmental and cultural impacts.			

Option C: Methods outside TTPP (e.g. Building Act/ Code, emergency management/civil defence planning and response, physical hazard protection works)	• Provides flexibility for use of land. • Sharing information increases community preparedness for a natural hazard event. • Avoid duplication of controls between Regional Council and District Councils, as well as where other legislation/ regulations may effectively address the risk.	• Approach doesn't recognise that allowing hazard sensitive activities (i.e. school or hospital) to locate in an area prone to natural hazards will increase the consequences of natural hazards. • The level of risk of some hazards is so severe that death or total loss of property could occur if new activities were able to continue to occur in these locations as building regulations and other non-regulatory methods do not effectively avoid or mitigate the risks.	• This approach isn't effective because the measures outside the TTPP aren't able to stop people locating and building in all hazardous locations. For example, under the Building Code people can still build on a fault line. • In terms of physical hazard protection works they are an important part of the mix of measures, but the West Coast cannot afford to protect every town, settlement – and dwelling from all significant hazards. In some cases (e.g. Waiho River, Alpine Fault) there are no physical hazard protection works that can protect at risk properties within a 50 year timeframe and the speed of the event (e.g. fault rupture) provides no opportunity for Civil Defence measures.	• Allowing development to occur in hazard areas is likely to have legal and financial risk. It would be a failure to meet Council's obligations under the RMA and the NZCPS
Quantification Section 32(2)(b) requires that if practicable the benefits and costs of a proposal are quantified. There have been benefit studies undertaken in relation to some of the hazards. A substantial study was undertaken of the costs of either defending Franz Josef (from the Waiho River) or moving the whole town (to Lake Mapourika which is also further from the Alpine Fault) which indicated costs in the order of hundreds of millions. The cost of building up the stopbank at the Waiho River to give a further 10 years flood protection is tens of millions of dollars. The cost of building flood defences at Westport was estimated at $10m in the Long-Term Plan. The business case for adaption has increased that cost to $54 million. has been The evaluation in this report identifies where there may be additional cost(s), however the exact quantification of the benefits and costs discussed was not considered necessary, beneficial or practicable.				
Summary:				

The benefits of identifying areas where natural hazards occur outweigh the costs, as development can then be either avoided or managed to remedy or appropriately mitigate the risk. Not identifying areas where natural hazards need to be managed results in avoidable costs when those natural hazard events occur.

The proposed provisions are considered to be the most effective means of achieving the objective(s) as together they will:

- give effect to the NZCPS and WCRPS
- enable the councils to fulfil their statutory obligations, particularly s6(h) of the RMA
- ensure that adverse effects of natural hazards are managed appropriately by identifying the areas where these need to be managed
- enable the councils to effectively administer TTPP and to monitor the outcomes of the proposed provisions in a clear and consistent manner.

4.5 Evaluation of Policies and Rules in Relation to Flood Hazard Overlays

Option	Benefits (Quantified where possible)	Costs (Quantified where possible)	Efficiency and Effectiveness	Risk of acting/not acting
Option A: status quo Westland –Two general natural hazard policies. Waiho River Severe Flood Hazard Zone specific Rules Consideration of flooding part of the assessment of Subdivision Consents Buller – Five general natural hazard policies. Where resource consents are required, these mapped hazards are considered. Flood hazard considered as part of subdivision assessment Grey – Four general natural hazard policies. Flood hazard considered as part of subdivision assessment	The same number of landowners will be subject to rules if the status quo approach continues. These landowners are already familiar with these rules.	Development extremely likely to occur in areas with flood risk. Without understanding the risk it will be unlikely to be appropriately managed, resulting in potential loss of life, damage to property and to the environment in future flood events.	Use of out of date and incomplete data is neither effective nor efficient.	- The evaluation under section 32 must consider the risk of acting or not acting if there is uncertain or insufficient information about the subject matter of the provisions in the proposal. - It is considered that while there is certain and sufficient information about the provisions in this approach because they have been in place since the Operative District Plans came into effect in the early 2000s it is likely to be out of date and incomplete.

Option B: Proposed TTPP Flood Severe Overlay Flood Susceptibility Overlay Flood Plains Overlay	The extent of flood overlays is clearly identified in all districts Clear policy framework guiding mitigation and assessment of hazard. Rules most restrictive where the activity exposes the most vulnerable to the greatest risk to life, but without restricting all activities. Consistent rules direct mitigation, such as finished floor levels. For the Flood Plains overlay rules only relate to subdivision.	Increased cost of development by requiring up front mitigation, rather than relying on hard protection at a later date. Development severely constrained in severe flood areas.	Using a regionally consistent approach to overlay identification ensures equity, and that the greatest efficiency gains can be achieved from a combined district plan. Setting finished floor levels where detailed modelling is held minimises the cost to developers as they do not have to undertake their own modelling. Where development pressure is low, a precautionary approach ensures mitigation occurs, but does not require modelling of the multitude of West Coast rivers which would be extremely costly. Gives effect to the West Coast Regional Policy Statement and New Zealand Coastal Policy Statement	- The evaluation under section 32 must consider the risk of acting or not acting if there is uncertain or insufficient information about the subject matter of the provisions in the proposal. - It is considered that while there is certain and sufficient information about the provisions in this approach because the flood modelling held has been rigorously peer reviewed. - In addition, feedback on the draft provisions did not raise any fundamental issues with acting in the manner proposed, except in the Westport township. Therefore, there is a low risk of acting in the manner proposed.
Option C: Methods outside TTPP (e.g. Building Act/ Code, emergency management/civil defence planning and response, physical hazard protection works)	Provides flexibility for use of land. Sharing information increases community preparedness for a natural hazard event. Avoid duplication of controls between Regional Council and District Councils, as well as where other legislation/ regulations	With the complexity and dynamism of the West Coast hazardscape it is extremely unlikely that depending on other methods would manage the significant risk to life from natural hazards into the future.	Relying on civil defence is not efficient or effective as the impact on community wellbeing from being repeatedly evacuated is significant. The cost of hard protection works is also substantial and there is a limited amount that any community can afford, allowing development and relying on hard protection is likely to become increasingly unaffordable.	It is considered that there is certain and sufficient information about the provisions in this approach because Councils already undertake these activities and will continue to do so as part of their wider obligations.

	may effectively address the risk.		The building act is a key tool, however, it relates to the structural integrity of a building, and does not consider, for example, the impact on the environment when a landfill is situated in a highly flood prone area, and likely to result in substantial management issues.	

Quantification Section 32(2)(b) requires that if practicable the benefits and costs of a proposal are quantified.

A substantial study was undertaken, led by Tonkin and Taylor, to look at the costs defending Franz Josef from the Waiho, and from Alpine Fault, or relocation of the town. This cost benefit was undertaken in 2017, which was prior to covid, and the impacts of that on tourism projections have of course not been included. There are also assumptions around cost of gravel, which the report highlight are assumptions not absolutes.

The outcome of the CBA is that, relocating the town was the most cost effective. This was based on approx. $300 million of compensation, development of new township, land purchase, state highway alignment, against $120 million of benefit from the avoidance of injuries, death, property including infrastructure damage and disruption to tourism from flood and earthquake. The options of defending, and accepting the hazards returned a similar cost benefit ratio.

The CBA did not resolve who would pay compensation or set up a new town. No funding was available, and it was unacceptable to the community. Since 2017 further investment has been made to Franz Josef, and to protection structures.

The evaluation in this report identifies where there may be additional cost(s), however the exact quantification of the benefits and costs discussed was not considered necessary, beneficial or practicable.

Summary:

The benefits of identifying areas where natural hazards occur outweigh the costs, as development can then be either avoided or managed to remedy or appropriately mitigate the risk. Not identifying areas where natural hazards need to be managed results in avoidable costs when those natural hazard events occur.

The proposed provisions are considered to be the most effective means of achieving the objective(s) as together they will:

- give effect to the WCRPS and the NZCPS
- enable the councils to fulfil their statutory obligations, particularly s6(h) of the RMA
- ensure that adverse effects of natural hazards are managed appropriately by identifying the areas where these need to be managed
- enable the councils to effectively administer TTPP and to monitor the outcomes of the proposed provisions in a clear and consistent manner.

4.6 Evaluation of Policy and Rules in Relation to Coastal Hazard Overlays excluding Coastal Tsunami

Option	Benefits (Quantified where possible)	Costs (Quantified where possible)	Efficiency and Effectiveness	Risk of acting/not acting
Option A: status quo Westland –Two general natural hazard policies. Coastal natural hazards considered as part of assessment of Subdivision Consents. 200m coastal setback in rural zones Buller – Five general natural hazard policies. Where resource consents are required, the Hector - Miko mapped hazards are considered. Coastal hazards considered as part of subdivision assessment 150m coastal setback in rural zones Grey – Four general natural hazard policies. Coastal hazards considered as	The same number of landowners will be subject to rules if the status quo approach continues. These landowners are already familiar with these rules.	Development extremely likely to occur in areas with coastal risk. Without understanding the risk it will be unlikely to be appropriately managed, resulting in potential loss of life, damage to property and to the environment in coastal storm events. Risk from coastal erosion to properties and the environment will not be appropriate managed.	A blanket setback in all areas of risk is likely to underestimate risk in some areas, and overestimate in others. Aside from the identified area in Hokitika town centre there is no identified risk in settlements.	- The evaluation under section 32 must consider the risk of acting or not acting if there is uncertain or insufficient information about the subject matter of the provisions in the proposal. - It is considered that while there is certain and sufficient information about the provisions in this approach because they have been in place since the Operative District Plans came into effect in the early 2000s it is likely to be out of date and incomplete.

part of subdivision assessment 100m coastal setback in rural zones				
Option B: Proposed TTPP <u>Coastal Severe</u> <u>Coastal Alert</u> <u>Coastal Setback</u>	The extent of coastal overlays is clearly identified in all districts. The coastal severe and coastal alert overlays use the most up to date available elevation data, climate change projections, vertical land movement, therefore providing a high degree of certainty. The coastal setback is a precautionary approach, in areas which have been ranked less than low risk in the proposed Regional Coastal Plan. Clear policy framework guiding mitigation and assessment of hazard. Rules most restrictive where the activity exposes the most vulnerable to the greatest risk to life, but without restricting all activities.	Increased cost of development by requiring up front mitigation, rather than relying on hard protection at a later date. Development severely constrained in severe coastal areas.	Using a regionally consistent approach to overlay identification ensures equity, and that the greatest efficiency gains can be achieved from a combined district plan. Defining extents of coastal hazards using as detailed modelling is held minimises the cost to developers as they do not have to undertake their own modelling. Where development pressure is low, a precautionary approach ensures mitigation occurs. Gives effect to the West Coast Regional Policy Statement and New Zealand Coastal Policy Statement	- The evaluation under section 32 must consider the risk of acting or not acting if there is uncertain or insufficient information about the subject matter of the provisions in the proposal. - It is considered that while there is certain and sufficient information about the provisions in this approach because the coastal severe and coastal alert modelling held has been technically peer reviewed. - In addition, feedback on the draft provisions did not raise any fundamental issues with acting in the manner proposed. Therefore, there is a low risk of acting in the manner proposed.

	Consistent rules direct mitigation. Coastal hazard risk in settlements is recognised.			
Option C: Methods outside TTPP (e.g. Building Act/ Code, emergency management/civil defence planning and response, physical hazard protection works)	Provides flexibility for use of land. Sharing information increases community preparedness for a natural hazard event. Avoid duplication of controls between Regional Council and District Councils, as well as where other legislation/ regulations may effectively address the risk.	With the complexity and dyanamism of the West Coast hazardscape it is extremely unlikely that depending on other methods would manage the significant risk to life from natural hazards into the future.	Relying on civil defence is not efficient or effective as the impact on community wellbeing from being repeatedly evacuated is significant. The cost of hard protection works is also substantial and there is a limited amount that any community can afford, allowing development and relying on hard protection is likely to become increasingly unaffordable. The building act is a key tool, however, it relates to the structural integrity of a building, and does not consider, for example, the impact on the environment when a landfill is situated in a highly flood prone area, and likely to result in substantial management issues.	It is considered that there is certain and sufficient information about the provisions in this approach because Councils already undertake these activities and will continue to do so as part of their wider obligations.
Quantification Section 32(2)(b) requires that if practicable the benefits and costs of a proposal are quantified. Given the assessment of the scale and significance of the proposed changes above it is considered that quantifying costs and benefits would add significant time and cost to the s32 evaluation processes. The evaluation in this report identifies where there may be additional cost(s), however the exact quantification of the benefits and costs discussed was not considered necessary, beneficial or practicable.				
Summary:				

The benefits of identifying areas where natural hazards occur outweigh the costs, as development can then be either avoided or managed to remedy or appropriately mitigate the risk. Not identifying areas where natural hazards need to be managed results in avoidable costs when those natural hazard events occur.

The proposed provisions are considered to be the most effective means of achieving the objective(s) as together they will:

- give effect to the NZCPS and WCRPS
- enable the councils to fulfil their statutory obligations, particularly s6(h) of the RMA
- ensure that adverse effects of natural hazards are managed appropriately by identifying the areas where these need to be managed
- enable the councils to effectively administer TTPP and to monitor the outcomes of the proposed provisions in a clear and consistent manner.

4.7 Evaluation of Policy and Rules in Relation to Coastal Tsunami Overlay

Option	Benefits (Quantified where possible)	Costs (Quantified where possible)	Efficiency and Effectiveness	Risk of acting/not acting
Option A: status quo Westland – Coastal Tsunami not identified as a significant natural hazard of concern. Buller – Coastal Tsunami not identified as a significant natural hazard of concern. Grey – Coastal Tsunami not identified as a significant natural hazard of concern.	No restriction on activities due to coastal tsunami	Development extremely likely to occur in areas with coastal tsunami risk. Without understanding the risk it will be unlikely to be appropriately managed, resulting in potential loss of life, damage to property and to the environment from coastal tsunami.	Continuing to not address this hazard is not effective or efficient.	- The evaluation under section 32 must consider the risk of acting or not acting if there is uncertain or insufficient information about the subject matter of the provisions in the proposal. - It is considered that while there is certain and insufficient information about the provisions because there are no provisions in Operative District Plans.
Option B: Proposed TTPP	The West Coast is better prepared to respond and recover from coastal tsunami. The policy, and rules, focus on critical response facilities only. This ensures we are not restricting activities unnecessarily, while being prepared to recover from tsunami by locating those critical	The proposed overlay is substantially smaller than the tsunami evacuation zones. Making the tsunami overlay the same as the evacuation zones would likely mitigate the full hazard, however, this would be the majority of the private land on the West Coast,	Using recently compiled data, and focussing on response and recovery, rather than a full extent of possible inundation follows a risk-based approach and is considered efficient and effective.	- The evaluation under section 32 must consider the risk of acting or not acting if there is uncertain or insufficient information about the subject matter of the provisions in the proposal. - It is considered that while there is certain and sufficient information about the provisions in this approach because the coastal tsunami modelling has been undertaken at a regional level and follows national guidelines for the

	facilities outside of the area most likely to be substantially inundated	significantly impacting social and economic wellbeing. The return period for that event is tens of thousands of years.		level of modelling required for regional land use planning. - In addition, feedback on the draft provisions did not raise any fundamental issues with acting in the manner proposed. Therefore, there is a low risk of acting in the manner proposed.
Option C: Methods outside TTPP (e.g. Building Act/ Code, emergency management/civil defence planning and response, physical hazard protection works)	Provides flexibility for use of land. Sharing information increases community preparedness for a natural hazard event. Avoid duplication of controls between Regional Council and District Councils, as well as where other legislation/ regulations may effectively address the risk.	These methods would not address which buildings are where, and would not put the community in the best possible position to recover from a coastal tsunami	Relying on civil defence is not efficient or effective. Civil defence work consistently with communities to have in place tsunami evacuation zones and plans in place.	It is considered that there is certain and sufficient information about the provisions in this approach because Councils already undertake tsunami evacuation planning and will continue to do so as part of their wider obligations.
Quantification Section 32(2)(b) requires that if practicable the benefits and costs of a proposal are quantified. Given the assessment of the scale and significance of the proposed changes above it is considered that quantifying costs and benefits would add significant time and cost to the s32 evaluation processes. The evaluation in this report identifies where there may be additional cost(s), however the exact quantification of the benefits and costs discussed was not considered necessary, beneficial or practicable.				
Summary: The benefits of identifying areas where natural hazards occur outweigh the costs, as development can then be either avoided or managed to remedy or appropriately mitigate the risk. Not identifying areas where natural hazards need to be managed results in avoidable costs when those natural hazard events occur. The proposed provisions are considered to be the most effective means of achieving the objective(s) as together they will:				

- give effect to the NZCPS and WCRPS
- enable the councils to fulfil their statutory obligations, particularly s6(h) of the RMA
- ensure that adverse effects of natural hazards are managed appropriately by identifying the areas where these need to be managed
- enable the councils to effectively administer TTPP and to monitor the outcomes of the proposed provisions in a clear and consistent manner.

4.8 Evaluation of Policy and Rules in Relation to Earthquake Hazard Overlays

Option	Benefits (Quantified where possible)	Costs (Quantified where possible)	Efficiency and Effectiveness	Risk of acting/not acting
Option A: status quo Westland –Two general natural hazard policies. Earthquake hazards considered as part of assessment of Subdivision Consents. Buller – Five general natural hazard policies. Earthquake hazards considered as part of subdivision assessment Grey – Four general natural hazard policies. Faultlines identified on planning maps. Earthquake hazards considered as part of subdivision assessment	No restriction on land use activities due to earthquake hazard	Development extremely likely to occur in areas with earthquake risk. Without understanding the risk it will be unlikely to be appropriately managed, resulting in potential loss of life, damage to property and to the environment from earthquake.	Continuing to not address this hazard is not effective or efficient.	- The evaluation under section 32 must consider the risk of acting or not acting if there is uncertain or insufficient information about the subject matter of the provisions in the proposal. - It is considered that while there is certain and insufficient information about the provisions because there are no provisions in Operative District Plans.
Option B: Proposed TTPP	The West Coast is better prepared to respond and recover from earthquakes. The policy, and rules, are most restrictive to	The provisions provide for the health and safety of residents and visitors in accordance with the purpose outlined above. The provisions seek to	Using a regionally consistent approach to overlay identification ensures equity, and that the greatest efficiency gains can be achieved from a combined district plan.	- The evaluation under section 32 must consider the risk of acting or not acting if there is uncertain or insufficient information about the subject matter of the provisions in the proposal.

	on critical response facilities and residential activities. This means we reduce our risk to life, property and the environment, and as well placed as possible to respond and recover from earthquakes. Commercial and industrial activity is less restricted, this means that the economic impact of restrictions is less severe, but that the risk to life is still appropriately managed. A previous plan change, initiated by Westland District Council, to put in place earthquake hazard areas in Franz Josef ultimately failed as it was unpalatable to the community. TTPP approach is different to the Plan Change approach to try and resolve some of those issues.	avoid exposure to increased levels of risk from fault rupture. Alongside mitigating the risk to life and safety, restricting development within an area of known hazard also reduces the economic costs of an earthquake event through reducing the amount of investment within the zone. Future development across the region will also be able to consider where the active faults are, and potentially avoid them. Natural hazards are devastating to the social fabric of the community. Reducing the potential impact of a fault rupture event increases the resilience of the region, thus providing for the social, economic and cultural wellbeing through reducing this risk.	The identification of active fault traces has been refined repeatedly, and the Alpine Fault in Franz Josef is arguably one of the most investigated in New Zealand, if not the world. Outside of Franz Josef, and for the other faults addressed in TTPP, an acceptable level of accuracy ensures the overlay is used effectively and efficiently. Alternately, transferring the cost to landowners, for them to undertake their own investigation, while such high-quality data is available would not be.	- It is considered that while there is certain and sufficient information about the provisions in this approach because active fault traces are mapped to an appropriate level the coastal tsunami modelling has been undertaken at a regional level, and follows national guidelines for the level of modelling required for regional land use planning. - In addition, feedback on the draft provisions did not raise any fundamental issues with acting in the manner proposed. Therefore, there is a low risk of acting in the manner proposed.
Option C: Methods outside TTPP (e.g. Building Act/ Code, emergency management/civil	No restriction on land use activities	Through community consultation, the lack of action addressing this hazard has stymied	Relying on civil defence is not efficient or effective. Civil defence work consistently with communities in preparation, as does AF8. Land use planning is	In addition, feedback on the draft provisions did not raise any fundamental issues with acting in the manner proposed. Therefore, there is

defence planning and response, physical hazard protection works)		investment, particularly in Franz Josef.	another component and is not mutually exclusive. The building code does not address earthquake risk, aside from foundation design.	a low risk of acting in the manner proposed.

Quantification Section 32(2)(b) requires that if practicable the benefits and costs of a proposal are quantified. Given the assessment of the scale and significance of the proposed changes above it is considered that quantifying costs and benefits would add significant time and cost to the s32 evaluation processes. The evaluation in this report identifies where there may be additional cost(s), however the exact quantification of the benefits and costs discussed was not considered necessary, beneficial or practicable.

A substantial study was led by Tonkin and Taylor, to look at the costs defending Franz Josef from the Waiho, and from Alpine Fault, or relocation of the town. This cost benefit was undertaken in 2017, which was prior to covid, and the impacts of that on tourism projections have of course not been included. There are also assumptions around cost of gravel, which the report highlight are assumptions not absolutes.

The outcome of the CBA is that, relocating the town was the most cost effective. This was based on approx. $300 million of compensation, development of new township, land purchase, state highway alignment, against $120 million of benefit from the avoidance of injuries, death, property including infrastructure damage and disruption to tourism from flood and earthquake. The options of defending, and accepting the hazards returned a similar cost benefit ratio.

The CBA did not resolve who would pay compensation or set up a new town. No funding was available, and it was unacceptable to the community. Since 2017 further investment has been made to Franz Josef, and to protection structures.

Summary:

The benefits of identifying areas where natural hazards occur outweigh the costs, as development can then be either avoided or managed to remedy or appropriately mitigate the risk. Not identifying areas where natural hazards need to be managed results in avoidable costs when those natural hazard events occur.

The proposed provisions are considered to be the most effective means of achieving the objective(s) as together they will:

- give effect to the WCRPS
- enable the councils to fulfil their statutory obligations, particularly s6(h) of the RMA
- ensure that adverse effects of natural hazards are managed appropriately by identifying the areas where these need to be managed
- enable the councils to effectively administer TTPP and to monitor the outcomes of the proposed provisions in a clear and consistent manner.

4.9 Evaluation of Policy and Rules in Relation to Land Instability Overlays

Option	Benefits (Quantified where possible)	Costs (Quantified where possible)	Efficiency and Effectiveness	Risk of acting/not acting
Option A: status quo Westland –Two general natural hazard policies. Land instability hazards considered as part of assessment of Subdivision Consents. Buller – Five general natural hazard policies. Where resource consents are required, the Little Wanganui subdivision, Hector to Moki mapped hazards are considered. Land instability hazards considered as part of subdivision assessment Grey – Four general natural hazard policies. Land instability hazards considered as part of subdivision assessment.	The same number of landowners will be subject to rules if the status quo approach continues. These landowners are already familiar with these rules.	Development extremely likely to occur in areas with land instability risk. Without understanding the risk it will be unlikely to be appropriately managed, resulting in potential loss of life, damage to property and to the environment in future natural hazard events.	Use of out of date and incomplete data is neither effective nor efficient.	- The evaluation under section 32 must consider the risk of acting or not acting if there is uncertain or insufficient information about the subject matter of the provisions in the proposal. - It is considered that while there is certain and sufficient information about the provisions in this approach because they have been in place since the Operative District Plans came into effect in the early 2000s it is likely to be out of date and incomplete.

Option B: Proposed TTPP	The extent of overlay is clearly identified in all districts Clear policy framework guiding mitigation and assessment of hazard. Rules only apply to new sensitive activities, which appropriately manages life risk without unnecessarily restricting other activities.	Increased cost at start of development as hazard needs to be mitigated, cost of mitigation may be high, or impossible for some types of rockfall hazard.	Information held by the district and regional councils has been used to compile this layer. It is incomplete, and further work is ongoing to catalogue the full land instability risk for the West Coast. However, it would be inefficient to disregard the current information.	- The evaluation under section 32 must consider the risk of acting or not acting if there is uncertain or insufficient information about the subject matter of the provisions in the proposal. - It is considered that while there is certain and sufficient information about the provisions in this approach because existing mapped areas have been included. - In addition, feedback on the draft provisions did not raise any fundamental issues with acting in the manner proposed. Therefore, there is a low risk of acting in the manner proposed.
Option C: Methods outside TTPP (e.g. Building Act/ Code, emergency management/civil defence planning and response, physical hazard protection works)	No restriction on land use activities	Unlikely to reduce life risk sufficiently. There is little if any warning of unstable land moving, therefore leaving it to civil defence response is inappropriate. A property could be inundated far quicker than evacuation could occur.	It is not considered effective or efficient to disregard information held with potentially high risk to life, and damage to property.	In addition, feedback on the draft provisions did not raise any fundamental issues with acting in the manner proposed. Therefore, there is a low risk of acting in the manner proposed.
Quantification Section 32(2)(b) requires that if practicable the benefits and costs of a proposal are quantified. Given the assessment of the scale and significance of the proposed changes above it is considered that quantifying costs and benefits would add significant time and cost to the s32 evaluation processes. The evaluation in this report identifies where there may be additional cost(s), however the exact quantification of the benefits and costs discussed was not considered necessary, beneficial or practicable.				
Summary:				

The benefits of identifying areas where natural hazards occur outweigh the costs, as development can then be either avoided or managed to remedy or appropriately mitigate the risk. Not identifying areas where natural hazards need to be managed results in avoidable costs when those natural hazard events occur.

The proposed provisions are considered to be the most effective means of achieving the objective(s) as together they will:

- give effect to the WCRPS
- enable the councils to fulfil their statutory obligations, particularly s6(h) of the RMA
- ensure that adverse effects of natural hazards are managed appropriately by identifying the areas where these need to be managed
- enable the councils to effectively administer TTPP and to monitor the outcomes of the proposed provisions in a clear and consistent manner.

4.10 Evaluation of Policy and Rules in Relation to Lake Tsunami Overlays

Option	Benefits (Quantified where possible)	Costs (Quantified where possible)	Efficiency and Effectiveness	Risk of acting/not acting
Option A: status quo Westland –Two general natural hazard policies. Lake Tsunami not identified as a significant natural hazard of concern. Buller – Five general natural hazard policies. Lake Tsunami not identified as a significant natural hazard of concern. Grey – Four general natural hazard policies. Lake Tsunami not identified as a significant natural hazard of concern.	No restriction on land use activities due to earthquake hazard	Development likely to occur in areas with earthquake risk. Without understanding the risk it will be unlikely to be appropriately managed, resulting in potential loss of life, damage to property and to the environment from Lake Tsunami. While not identified as a significant risk, a subdivision at Lake Poerua, was subject to an Environment Court process, following it being declined by the Grey District Council. Through that process further investigation was required, and consent notices put in place. This was at cost to the developer, and to the Grey District ratepayer.	Continuing to not address this hazard is not effective or efficient.	- The evaluation under section 32 must consider the risk of acting or not acting if there is uncertain or insufficient information about the subject matter of the provisions in the proposal. - It is considered that while there is certain and insufficient information about the provisions because there are no provisions in Operative District Plans.

Option B: Proposed TTPP.	The extent of overlay is clearly identified in all districts Clear policy framework guiding mitigation and assessment of hazard. Rules only apply to new sensitive activities, which appropriately manages life risk without unnecessarily restricting other activities.	Increased cost at start of development as hazard needs to be mitigated, however, as overlay is only 5m from lakefront, may be possible to simply develop outside of that in most instances.	This is an emerging hazard, with many other regions undertaking work. There is evidence of Lake Tsunami on the West Coast, including the reports forming the Lake Poerua subdivision application. While detailed analysis has not been undertaken on the West Coast, other regions have undertaken this, and it is efficient to take a similar approach here as faults do not observe territorial boundaries.	- The evaluation under section 32 must consider the risk of acting or not acting if there is uncertain or insufficient information about the subject matter of the provisions in the proposal. - It is considered that while there is certain and sufficient information about the provisions in this approach because other regions are responding to the same hazard in the same way. - In addition, feedback on the draft provisions did not raise any fundamental issues with acting in the manner proposed. Therefore, there is a low risk of acting in the manner proposed.
Option C: Methods outside TTPP (e.g. Building Act/ Code, emergency management/civil defence planning and response, physical hazard protection works)	No restriction on land use activities	Unlikely to reduce life risk sufficiently. There is little if any warning of unstable land moving, therefore leaving it to civil defence response is inappropriate. A property could be inundated far quicker than evacuation could occur.	It is not considered effective or efficient to disregard information held with potentially high risk to life, and damage to property.	In addition, feedback on the draft provisions did not raise any fundamental issues with acting in the manner proposed. Therefore, there is a low risk of acting in the manner proposed.
Quantification Section 32(2)(b) requires that if practicable the benefits and costs of a proposal are quantified. Given the assessment of the scale and significance of the proposed changes above it is considered that quantifying costs and benefits would add significant time and cost to the s32 evaluation processes. The evaluation in this report identifies where there may be additional cost(s), however the exact quantification of the benefits and costs discussed was not considered necessary, beneficial or practicable.				
Summary:				

The benefits of identifying areas where natural hazards occur outweigh the costs, as development can then be either avoided or managed to remedy or appropriately mitigate the risk. Not identifying areas where natural hazards need to be managed results in avoidable costs when those natural hazard events occur.

The proposed provisions are considered to be the most effective means of achieving the objective(s) as together they will:

- give effect to the WCRPS
- enable the councils to fulfil their statutory obligations, particularly s6(h) of the RMA
- ensure that adverse effects of natural hazards are managed appropriately by identifying the areas where these need to be managed
- enable the councils to effectively administer TTPP and to monitor the outcomes of the proposed provisions in a clear and consistent manner.

4.11 Evaluation of Policy and Rules in Relation to Westport Hazard Overlay

Option	Benefits (Quantified where possible)	Costs (Quantified where possible)	Efficiency and Effectiveness	Risk of acting/not acting
Option A: status quo Buller – Five general natural hazard policies.	No restriction on land use activities due to combined flood and coastal inundation hazard.	Development likely to continue to occur. Without understanding the risk it will be unlikely to be appropriately managed, resulting in potential loss of life, damage to property and to the environment.	Continuing to not address this hazard is not effective or efficient.	- The evaluation under section 32 must consider the risk of acting or not acting if there is uncertain or insufficient information about the subject matter of the provisions in the proposal. - It is considered that while there is certain and sufficient information about the provisions there are currently no provisions in Operative District Plan.
Option B: Proposed TTPP Provisions Policies and Rules Westport Hazard Overlay	The extent of overlay is clearly identified. Clear policy framework guiding mitigation and assessment of hazard. Rules extremely likely to need amendment to final structural level of service and alignment, but respond to community concerns that the proposed works are not being recognised. The rule allows them to be recognised, while also ensuring the hazard is mitigated until	Development may occur with mitigation that is then subsumed by future protection. However, this will provide a development with further mitigation, and should a breach scenario occur, the development will have some mitigation still in place.	The future planning and hazardscape of Westport have changed while TTPP has been produced. TTPP has done the best to respond to this and allow space for technical work and decision making to occur, while minimising the future potential costs to amend TTPP. The proposed method is in line with the community needs, and current state in terms of longer-term mitigation.	- The evaluation under section 32 must consider the risk of acting or not acting if there is uncertain or insufficient information about the subject matter of the provisions in the proposal. - It is considered that while there is certain and sufficient information about the flood and coastal hazards, there is insufficient information about the level of service and extent of the future protection works. This is because the decision-making process is still underway.

	protection work decisions are made.			
Option C: Methods outside TTPP (e.g. Building Act/ Code, emergency management/civil defence planning and response, physical hazard protection works)	No restriction on land use activities	Mitigation would be required at Building Consent to a 2% AEP, which, as experienced in Westport in recent times, may not be sufficient. Buller District Council did put in place a policy for finished floor levels however, this was withdrawn.	The current situation, of using Building Act, and CDEM is not effective or efficient. It is hugely costly, emotionally and physically, to the Westport community to be continually on alert to evacuate. It is also not efficient to have to regularly stand up emergency centres or to disregard quality modelling.	Feedback clearly identified a need to do something, and that the current situation cannot continue.

Quantification Section 32(2)(b) requires that if practicable the benefits and costs of a proposal are quantified. The "Proposal to Hon Nanaia Mahuta, Minister of Local Government, Co-Investment in Westport Resilience" contains detail on the costs of installing protection structures, and the value of property and infrastructure. This follows in the table below.

NIWA Analysis

WCRC commissioned NIWA to apply the RiskScape model to analyse the direct damage of flooding effects on Westport arising from several climate change and flood magnitude scenarios.[74] NIWA's report concludes that under an ARI100 / RCP6 flooding scenario[75] approximately $400m[76] of damages is estimated to occur to Westport buildings (the cost of the July 2021 flooding was estimated at $88m). The work of NIWA thereby confirms significant cost benefits will arise from the investment of $31m in the proposed Westport flood risk mitigation scheme.

Table 3 - Cost benefit

Model Scenario	Buildings: Sum of Building $Loss ($NZ)	Roads: Sum of Exposure Costs ($NZ)	Rails: Sum of Exposure Costs ($NZ)	Scenario Total ($NZ)	Description of Flood Hazard Model Scenario
Base_ARI100_RCP6 (status quo)	404,927,949	$77,426,220	113,254,863	**$595,609,033**	Future Climate, 100-year ARI event (RCP6 2100) - no protection
OpB_ARI100_RCP6 (preferred option)	$15,490,025	$66,665,094	$26,956,520	**$109,111,640**	Future Climate, 100-year ARI event (RCP6 2100) assuming full

[74] 'Direct Damage Analysis for Scenario Flooding in Westport', NIWA, May 2022
[75] This is the scenario recommended and used by TAG to guide the design of its preferred flood risk mitigation scheme
[76] These damage curves are generic, and the damage estimates can be refined upon detailed design

It is noted that the cost of maintenance and upgrade is not taken into account in the CBA, nor the opportunity cost. Given the assessment of the scale and significance of the proposed changes above it is considered that further quantification of costs and benefits would add significant time and cost to the s32 evaluation processes. The evaluation in this report identifies where there may be additional cost(s), however the exact quantification of the benefits and costs discussed was not considered necessary, beneficial or practicable.
Summary: The benefits of identifying areas where natural hazards occur outweigh the costs, as development can then be either avoided or managed to remedy or appropriately mitigate the risk. Not identifying areas where natural hazards need to be managed results in avoidable costs when those natural hazard events occur. The proposed provisions are considered to be the most effective means of achieving the objective(s) as together they will: • give effect to the NZCPS and WCRPS • enable the councils to fulfil their statutory obligations, particularly s6(h) of the RMA • ensure that adverse effects of natural hazards are managed appropriately by identifying the areas where these need to be managed • enable the councils to effectively administer TTPP and to monitor the outcomes of the proposed provisions in a clear and consistent manner.

4.12 Evaluation of Policy and Rules in Relation to Hokitika Coastal Hazard Overlay

Option	Benefits (Quantified where possible)	Costs (Quantified where possible)	Efficiency and Effectiveness	Risk of acting/not acting
Option A: status quo Westland –Two general natural hazard policies.	No restriction on land use activities due to coastal inundation hazard in this part of the town.	Development likely to continue to occur. Without understanding the risk it will be unlikely to be appropriately managed, resulting in potential loss of life, damage to property and to the environment.	Continuing to not address this hazard is not effective or efficient.	- The evaluation under section 32 must consider the risk of acting or not acting if there is uncertain or insufficient information about the subject matter of the provisions in the proposal. - It is considered that while there is certain and sufficient information about the provisions there are currently no provisions in Operative District Plan.
Option B: Proposed TTPP	The extent of overlay is clearly identified. Clear policy framework guiding mitigation and assessment of hazard. Rules extremely likely to need amendment to final structural level of service and alignment, but, respond to Committee concerns that the proposed works are not being recognised. The rule allows them to be recognised, while also ensuring the hazard is mitigated until	Development may occur with mitigation that is then subsumed by future protection. However, this will provide a development with further mitigation, and should a breach scenario occur, the development will have some mitigation still in place.	It was expected these works would have been completed by the time TTPP was notified, but this has not occurred. TTPP has done the best to respond to this and allow space for technical work and decision making to occur, while minimising the future potential costs to amend TTPP. The proposed method is not effective, efficient, or appropriate, it is however, in line with the community needs, and current state in terms of longer-term mitigation.	- The evaluation under section 32 must consider the risk of acting or not acting if there is uncertain or insufficient information about the subject matter of the provisions in the proposal. - It is considered that while there is certain and sufficient information about the flood and coastal hazards, there is insufficient information about the level of service and extent of the future protection works. This is because the decision-making process is still underway.

	protection work decisions are made.			
Option C: Methods outside TTPP (e.g. Building Act/ Code, emergency management/civil defence planning and response, physical hazard protection works)	No restriction on land use activities	Mitigation would be required at Building Consent to a 2% AEP, which may not be sufficient.	The current situation, of using Building Act, and CDEM is not effective or efficient nor is it to disregard quality modelling.	- The evaluation under section 32 must consider the risk of acting or not acting if there is uncertain or insufficient information about the subject matter of the provisions in the proposal. - It is considered that while there is certain and sufficient information about the flood and coastal hazards, there is insufficient information about the level of service and extent of the future protection works. This is because the decision-making process is still underway.
Quantification Section 32(2)(b) requires that if practicable the benefits and costs of a proposal are quantified. Given the assessment of the scale and significance of the proposed changes above it is considered that quantifying costs and benefits would add significant time and cost to the s32 evaluation processes. The evaluation in this report identifies where there may be additional cost(s), however the exact quantification of the benefits and costs discussed was not considered necessary, beneficial or practicable.				
Summary: The benefits of identifying areas where natural hazards occur outweigh the costs, as development can then be either avoided or managed to remedy or appropriately mitigate the risk. Not identifying areas where natural hazards need to be managed results in avoidable costs when those natural hazard events occur. The proposed provisions are considered to be the most effective means of achieving the objective(s) as together they will: • give effect to the NZCPS and WCRPS • enable the councils to fulfil their statutory obligations, particularly s6(h) of the RMA • ensure that adverse effects of natural hazards are managed appropriately by identifying the areas where these need to be managed • enable the councils to effectively administer TTPP and to monitor the outcomes of the proposed provisions in a clear and consistent manner.				

4.13 Overall Evaluation of the Options to Meet the Objectives

Option	Benefits	Costs	Efficiency and Effectiveness	Risk of acting/not acting
Option A: Modified Status quo - Set policy direction on natural hazard management - Identify natural hazards, and assess through resource consent process. **This option is not recommended**	Plan users and landowners are familiar with current provisions. User pays – if development is sought in hazardous area, the onus is on the developer to provide the assessment and mitigation.	Misalignment with the approach to district wide matters specified in the recently gazetted National Planning Standards (7 Districtwide Matters Standard) Doesn't achieve the strategic objectives identified around Connections and Resilience Doesn't achieve requirements of the RMA requiring the management of significant natural hazards, Costs to developers in applying for resource consents, including associated time and uncertainty Potential limitations on economic growth and employment opportunities due to retention of provisions that are unresponsive to the current and future needs of activities Creates an unnecessary hurdle for small scale activities.	Monitoring shows that the existing approach is not effectively or efficiently achieving the purpose of the RMA. Therefore, this option is not considered to be the most efficient, effective or appropriate option to achieve the objectives.	The current policy framework is uneven across the region, lacks detail and specific direction on management of activities. It would also result in Council failing to comply with the provisions of Part 2 of the RMA (particularly section 6 and 7). It is considered that the risk of acting on these provisions outweighs the risk of not acting. There is sufficient information not to act on this approach.

Option B: Proposed Plan **This is the preferred option**	Aligns with the approach to district wide matters specified in the recently gazetted National Planning Standards (7 Districtwide Matters Standard) Identification of overlays and planning pathways have been provided. Rules provide certainty to owners/operators, neighbours, community and Council. Tailored rules, effects standards and assessment matters provide a clear framework to manage natural hazard activities and seek to strike a balance between efficient use and development and managing significant risk.	Rules may potentially limit some activities and development, particularly if they do not reflect current or future development aspirations Costs to operators of applying for resource consents, including associated time and uncertainty Costs to other parties of participating in resource consent processes if applications publicly notified Costs to Council of monitoring resource consents	The introduction of a standalone Natural Hazards Section aligns with the direction in the National Planning Standards and specifically recognises the significant challenges these present to the West Coast. The provisions give effect to the NZCPS and the RPS. The proposed approach is effective as it identifies natural hazard areas, so development can be considered in that context, rather than leaving it to each development to ascertain. Rules are effective in that they provide a high level of certainty regarding the nature and scale of work and activities that can be undertaken with/ without resource consent. They are also efficient as they enable a case-by-case assessment of the appropriateness of each proposal to be undertaken	The risk of not acting on these provisions would result in Council failing to comply with the provisions of Part 2 of the RMA (particularly section 6 and 7), and the likelihood of continuing inefficient use of natural and physical resources and potential loss of amenity values and quality of the environment. It is considered that there is sufficient information on which to base the proposed policies and methods.
Option C: Non-regulatory approach **This option is not recommended**	Reduced costs to operators could lead to greater economic and employment opportunities in the District	Potential for loss of life, damage to property, and adverse effects on the environment.	Reliance on no rules or performance-based standards would result in activities and associated subdivision and development being unconstrained/ unmanaged.	The risk of acting on the non-regulatory approach means that Council would fail to adequately carry out its duties/requirements under the RMA.

	Provides flexibility to locate activities anywhere on the West Coast	Little to no community involvement in decision-making Inconsistent with national and regional policy direction.	This approach has the potential to result in significant adverse effects, directly from natural hazard events, and also end effects from one hard protection structure interacting with an unprotected area / another protection structure. Defaulting to reliance on a non-regulatory approach would also be ineffective in achieving the objectives.	Under this option it is also highly likely that resource management issues relating to natural hazards would continue to be inadequately addressed, particularly in relation to risk to life, property and the environment, and effects of natural hazard structures on the hazardscape. It is considered that there is sufficient information not to act on this approach

5.0 Summary

This evaluation has been undertaken in accordance with s32 of the Act in order to identify the need, benefits and costs and the appropriateness of the proposal having regard to its effectiveness and efficiency relative to other means in achieving the purpose of the RMA. The evaluation demonstrates that this proposal is the most appropriate option as:

- Natural Hazards are identified in a regionally consistent manner. This reduces the cost to individual developments and provides information to the community.
- The increased used and impact on the hazardscape of protection works are considered
- For development in flood and coastal hazard areas, the Proposed Plan allows for some activities to occur as a permitted activity, but requires mitigation, and in some instances avoidance. This is expected to be more efficient than the Operative Plan which has required resource consents in areas which are no longer subject to flooding. It also reduces the chance of development occurring without sufficient mitigation.
- In areas where development pressure is low, and the natural hazard risk is unknown, a precautionary approach is taken. This means that the cost of modelling the entire region is not born by the ratepayer, but some controls exist to ensure development is appropriate.
- The significant earthquake risk is recognised, and the activities that are most likely to result in loss of life, and inability to respond to earthquake are restricted, while still providing for some activity in areas such as Franz Josef, which are a resident population, and are a significant contributor to regional economic wellbeing. In areas that are less developed, using a regionally consistent approach to earthquake ensures another town like Franz Josef only develops taking into account the hazardscape.
- Hazards that require recognition, but are not as significant, such as lake and coastal tsunami are appropriately managed by only restricting activities that are likely to contribute to increase in life risk / decrease ability to respond post hazard event.
- Existing land instability knowledge is incorporated into TTPP, while further work is undertaken to better understand this hazard.
- Specific provisions for Westport and Hokitika recognise the large urban population, and planned protection works, which is appropriate in the current regional context.
- It recommends a risk-based approach to address the risks associated with natural hazards, an activities-based approach, and a more precautionary approach, to avoid increasing the number of people exposed to risk, and to avoid more vulnerable and less mobile people establishing new activities in hazard-prone areas.
- It ensures climate change and long-term adaptation options are considered when planning activities in hazard areas.
- It protects people, property and the environment, which in turn should provide for the social, economic, or health and safety of the community.

Appendix One: Feedback from Natural Hazards Consultation on Draft Plan Provisions

There are a number of key themes to the feedback, and this is summarised in the table below.

Theme	Feedback
Extent of overlay and impact of protection works	There were several pieces of feedback requesting the extent of the overlay be reviewed. The overlays that were queried where: land instability, coastal setback, coastal severe, flood susceptibility and flood plain. The land instability feedback was that the property should not be included. The coastal setback feedback stated that the properties should not be included due to elevation above sea level. The coastal severe queries requested moving into the coastal alert as elevations are believed to be incorrect, or that natural hazard protection structures have not been correctly taken into account. The flood susceptibility and flood plain queries related to where the boundary between the two sat, and that the property should not be included. Numerous queries, and pieces of feedback queried the impact of protection works on the natural hazard risk, and how this had been considered in the overlay development but did not request specific changes.
Additional Hazard Identification	Feedback was received seeking more natural hazard identification, for example showing more / all faults on the West Coast, and further flood mapping, and further investigation into the location of the Alpine Fault in Franz Josef.
Amending Objectives, Polices and Rules	There were limited comments on objectives and policies with some refinements suggested but general support for the direction. The majority of feedback related to amendment of rules. Attention was also drawn to the lack of integration between District Wide Matters such as Energy, and Natural Hazards. Requests were made to simplify and clarify the rules, use less terms across the overlays, exempt properties from the rules, enable education activities in coastal hazard zones, and to amend "legally established" parameters.
Queries for Operations Team, Clarification	Many requests were received asking the West Coast Regional Council (WCRC) to implement / upgrade protection works.
Westport Natural Hazards	Generally, people opposed the draft Plan provisions for Westport Natural Hazards. Key themes were: • That Westport-specific provisions should be developed, rather than the same rules being applied as other (less developed) flooding areas on the West Coast • That the provisions should recognise the planned Westport protection scheme • That the provisions were too harsh, given the large existing community in the area.

	• That the provisions need to recognise the existence of a large number of residential buildings and provide better for their ongoing modification into the future • That a lower hazard level should be provided for (i.e. 2% AEP event) • That some properties have been wrongly identified as "severe" – or in some cases as "susceptible" That there should be mechanisms to enable modification of the hazard maps within the Plan

Extent of overlay and impact of protection works – Coastal Setback, Coastal Alert and Coastal Severe

Feedback was received on the impact of protection works and the level of hazard mitigation provided; specifically, on the Okuru coastal protection, and the Punakaiki coastal protection. The role of coastal protection structures in natural hazard mitigation is complex and is discussed in the NIWA report. Existing structures that are maintained and have withstood the erosion of ex-Cyclone Fehi have been taken into consideration in the model building. Specifically, these are at the Granity school site and immediately north, in Orowaiti lagoon and in Punakaiki Village.

The Asset Management Plans, written by WCRC for the special rating districts which fund the protection assets have been reviewed for all rating districts.

Specific requests were made for properties to be excluded from the Coastal Setback due to elevation. The overlay does not account for elevation; therefore, it is not appropriate to remove a property due to elevation

No change to the coastal setback overlay was recommended.

Okuru and Hannahs Clearing

Site specific queries, and requests to not be included in overlays were reviewed. Careful checking of the NIWA outputs was undertaken.

The Okuru Rating District 2021 – 2024 Asset Management Plan has also been reviewed. The existing standard, p8., is explained as "The seawall has been designed to handle the historically observed tidal fluctuations and surge patterns of the Tasman Sea in the vicinity. The scheme structures will be maintained to the dimensions that they were originally constructed".

The existing protection is not designed to mitigate current or future tidal fluctuations or storm surge, nor is it designed to mitigate erosion. The objectives of the rating district are to:

a. To reduce bank erosion on the right bank of the Okuru River between the State Highway and 1250 metres downstream.
b. To reduce further erosion encroachment on the Tasman Sea frontage of the Okuru Township".

However, the existing structure does not reduce sufficiently to mitigate the level of hazards that is required to meet RMA statutory obligations.

Another request was to remove a property from the overlay as the owners may seek as part of a subdivision consent to extend the existing protection structure, and vest it with the rating district. Potential additions to this structure have not been considered as there is no design or specifications, and no agreement by the rating district to incorporate the private addition. It is not possible to remodel the coastal hazards without this information.

The extent of the coastal severe overlay at Hannahs Clearing also received feedback. The NIWA modelling output has been carefully checked, and the erosion rates to the south are greater than the north, this has been correctly reflected in the overlay maps.

No changes to the Okuru or Hannahs Clearing coastal hazard overlays were recommended.

Punakaiki

The Punakaiki extent of the Coastal Severe overlay has also been considered. Careful reviewing of the mapping outputs and taking into account the ongoing maintenance of the Punakaiki sea wall, it is

recommended the coastal severe hazard overlay be replaced by coastal alert in part of the northern settlement. This is because storm surge can come up the Pororari River and behind the sea wall causing inundation. The land between these two severe areas is at risk, but the risk to life is not as great as in the severe area. This is consistent with the approach used in other coastal hazard areas.

Feedback was also received asking for consideration of protection works at the southern end of the Punakaiki settlement. This has been reviewed. The inundation extents show between 1 – 3m of water, in a storm event across the site. The digital elevation models used take into account the elevated site. The protection works are in private ownership, and Council has no discretion over their ongoing maintenance (see point 25), amending the extent is not supported.

Change to the classification of coastal hazard at Punakaiki was recommended.

Extent of Overlay – Flood Plain, Flood Susceptibility and Flood Severe

The boundary between the flood susceptibility and flood plain overlay in Haast, specifically at the Haast aerodrome and Haast township was questioned. Also, the feedback suggested that between Haast and Jacksons Bay areas should be demarked flood susceptibility not flood plain. This has been reviewed by WCRC Natural Hazard Analyst. The request to change is not supported. This is because flood information held by WCRC shows some flood risk to the township and surrounding area. While there is potential flood risk between Haast and Jackson Bay, the flood plain overlay is the most appropriate when considering the level of risk and robustness of information held. More detailed technical investigation would be required to accurately apply a flood susceptibility layer between Haast Beach and Jacksons Bay.

The flood susceptibility layer to the north of Franz Josef has been queried. This has been reviewed by WCRC Natural Hazard Analyst. The request to change is not supported. The feedback suggests that the property is protected from the Waiho. The flood susceptibility layer relates to flood risk from the Tartare River, Stoney Creek and the Waiho River including flood risk from landslide dam break.

The flood plain layer overlay at Atarua has incorporated land on a terrace. The feedback suggested this was a mapping error. This has been reviewed by WCRC Natural Hazard Analyst. The request to change is supported.

Change to the extent of the flood plain overlay at Atarua was recommended.

Extent of Overlay – Land Instability

A request was made to amend the extent of the land instability overlay south of Ten Mile Creek, Coast Road. This has been reviewed.

1. The property sits below an area with multiple active slips. The request to change is not supported.
2. Change to the extent of the land instability overlay is not recommended.

Fault Avoidance additions

The addition of further faults to the Fault Avoidance overlay has been considered. GNS manage the national database. There are a substantial number of active faults on the West Coast. The current approach, which is aligned with national guidance, is to only include the faults with a less than 2000-year recurrence interval, where the recurrence is well known, and the fault is well defined.

Applying restrictions in areas where a fault is not well understood, could result in restrictions being applied unnecessarily, it may not manage the risk, and restriction may not be applied where it potentially should be.

Therefore, it is not recommended that further faults are added to the Fault Avoidance Overlays.

Flooding, Coastal and Land Instability Overlay additions

Feedback was received asking for further work to be undertaken to identify flood and land instability hazards.

As has been highlighted in the consultation documents, it has not been possible to undertake the intended work on land instability due to delays in the WCRC long term plan process. The technical

experts that we were hoping to engage to undertake this work were not available until May 2022. There is no budget available to undertake further flood modelling.

Despite these limitations, fine grained robust flooding data is held for the towns most at risk from flooding, with a less restrictive approach for those with lesser risk. The land instability overlay has been created using existing plan provisions, and reports held by WCRC. It will be possible to submit on these layers, and should further robust information be available, be added to the Plan through the submissions and hearing process.

Protection Work requests

Feedback was received, predominantly from Okuru seeking protection works. This has been passed onto the WCRC Operations Team and CEO.

Objectives, Policies and Rules

Some feedback was received on the objective and policies as well as through the peer review. Some amendments are recommended.:

- Additional policy for the Flood Plain overlay which had been inadvertently missed.
- Additional policies for the Hokitika Coastal overlay, and Westport specific approach which were developed after the Objectives and Policies
- Amendment to Policy 3 to add a further step between natural and hard protection structures
- Amendment to Policies 9 and 11 to better recognise the level of risk, and to integrate the policies and rules.
- Tidying up of terminology, cross referencing, and integration across Energy, Infrastructure, Transport, Public Access, Subdivision and Earthworks.

The majority of the feedback on plan provisions relates to Rules.

Key feedback themes / points were:

- Clarification of what is included in existing use rights and changes such as an increase in height to that;
- Clarification as to which rules apply to infrastructure, do the natural hazard rules override the energy ones or not;
- Rules to manage impact of relocation of infrastructure on surrounding hazardscape;
- Provisions for Commerical and Industrial activities in Coastal and Flood overlays;
- Standardisation of engineering requirements in fault avoidance buffers;
- Merging of Fault Avoidance buffers;
- Requests for provisions not to apply to specific properties; and
- Permitted activities to enable development of Education Facilities in Coastal overlays.

An external peer review of the Natural Hazard rules has also been completed and was generally positive. Suggestions were made to improve usability and integration.

The rules have been reviewed and amended as follows.

Coastal Alert and Coastal Severe

In response to feedback and peer review substantive amendments are suggested, these are outlined below:

- The rules have been amalgamated, with differences in activity status for new builds retained. Discretionary for Coastal Alert, and Non-Complying for Coastal Severe.
- The permitted activity for reconstruction of lawfully established buildings has been clarified. The extension to reconstruction has been amended for consistency with the flooding rules – two years for coastal severe, five years for coastal alert. The request to amend this to include an increase in height has not been included as this is beyond what is provided for as existing use rights in the RMA, which must be the same or similar in character, scale and effect to the original.
- The reference to structures has been removed. This had inadvertently captured items such as electricity power poles.

- "Sensitive activities" has replaced references to habitable rooms for consistency with other overlays, and to ensure the rule is targeting the risk.
- The request to enable further development of education facilities as a permitted activity, is not supported. Education facilities includes daycare, schools and tertiary education. It is not consistent with the objectives, nor appropriate to permit development that increases risk to vulnerable people. Maintenance is a permitted activity and this has been made clear through the use of "sensitive activitites" which includes education facilities. The Ministry of Education has designations in place which may allow some development at some sites. The interplay between the coastal hazard layers and Ministry of Education designations has been reviewed. It is noted that the majority of the Hannahs Clearing school is not within the coastal severe overlay, and at least 1/3 of the Granity school is not within the overlay. Schools within the coastal alert have also been reviewed. Karamea Area School is partially within the coastal alert, noting that a new school is nearing completion. Barrytown and Cobden schools are not within this overlay, neither are any of the other Greymouth schools including Blaketown and Paroa. In Hokitika, St Mary's Catholic Primary school is entirely within the Hokitika Coastal overlay. St Mary's Catholic school only has a notice of requirement in place for a designation. The other Hokitika schools are not within the Hokitika Coastal Overlay.
- Specific rules have been drafted for commercial and industrial activities, and critical response facilities. The draft plan was silent on these.

Flood Susceptibility and Flood Severe Overlays

Substantive amendments are recommended to this layer in response to feedback. These amendments are detailed below, and similar to those for coastal severe and coastal alert:

- The rules have been amalgamated, with differences in activity status for new builds retained. Discretionary for Flood Susceptibility, and Non-Complying for Flood Severe.
- The permitted activity for reconstruction of lawfully established buildings has been clarified – two years for flood severe, five years for flood susceptibility.
- The reference to structures has been removed. This had inadvertently captured items such as electricity power poles.
- "Sensitive activities" has replaced references to habitable rooms for consistency with other overlays, and to ensure the rule is targeting the risk.
- Specific rules have been drafted for commercial and industrial activities, and critical response facilities. The draft plan was silent on these.

Fault Avoidance

Amendments to improve integration and plan usability are recommended:

- Removal of references to structures. This may inadvertently restrict infrastructure provision.
- Remove "Network utility Facility". Including this within the definition resulted in many activities being inadvertently restricted, such as powerlines that need to cross the Alpine Fault. This request was received from the energy and infrastructure companies and is supported by WCRC Lifeline Coordinator.
- Specific engineering standards for building within the buffers have not been provided. These may be something that the District Council Building Control teams wish to consider.
- Exempting specific properties from the rules is not supported. It is recognised that some properties have had notices placed on titles requiring seismic engineering design, this does not mean that the rules need not apply.

Amending the name of the overlay from Fault Avoidance to Earthquake Hazard was suggested. This is detailed further in the overlay development section.

Coastal Setback, Coastal Tsunami, Land Instability, Flood Plain, Lake Tsunami and Hokitika Coastal Overlays

Minor amendments to update numbering, terminology and typos are recommended.

Westport Natural Hazard Provisions

In relation to the feedback that a 2% AEP event should be used instead of a 1% event, for District Planning purposes this is inappropriate. As has been discussed in relation to the wider natural hazards topic, the NZCPS and WCRPS require that coastal natural hazard provisions have a 100 year view. In relation to flood hazards, it is normal practice to consider a 1% event and this approach has been used across the West Coast. The use of a 1% event (as a minimum) has also been advised as a requirement from central government for any contribution towards flood defences.

In relation to the feedback seeking that provisions be less harsh at Westport, while some fine tuning of the provisions (particularly where freeboard is used) is possible, the inherent risk to life and property is very substantial in Westport and a high degree of scrutiny and precautionary approach to managing these risks is needed.

In relation to the extent of the flood overlays, and differentiation between flood susceptibility and flood severe, with Westport-specific provisions, one overlay be used rather than two, with the main future differentiation needed about whether the property is protected by the defences.

In terms of how the Plan could allow for modifications to the hazard overlay maps, this is more difficult. Legal advice has been previously obtained which identifies that a Plan Change is the route by which planning maps should be changed, and that the overlays are required to be mapped in the Plan. However, staff note that once the final location and extent of protection of Westport properties is known, the maps will be able to be updated. The Westport Joint Committee Steering Group supported a recommendation to the West Coast Regional Council to use a designation for the structures and works. A designation has immediate legal effect, and TTPP can be updated immediately to show where and what this structure is.