Selwyn District Council

Advice on Risk-Based Planning for Natural Hazards Topic

06 November 2017

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Appendices

1. Introduction

1.1 Scope and purpose of project

The Canterbury Regional Policy Statement 2013 (CRPS) and the New Zealand Coastal Policy Statement 2010 (NZCPS) promote a risk-based approach to natural hazard and coastal hazard management. The Selwyn District Council (SDC) is reviewing its District Plan and has engaged GHD to provide a report providing advice on risk based planning for natural hazards (Appendix A).

This report involves reviewing SDC's natural hazards database, including reviewing the agreed scope of works for flood investigations SDC has commissioned Environment Canterbury to undertake. A list of the reports to be reviewed and the scope of works for the flood investigations agreed with Environment Canterbury are provided in Appendix A. This report summarises and reviews each report by natural hazard type and evaluates whether it is fit for purpose for land use planning purposes in the District Plan Review.

This report also provides an assessment of the risk-based approach to natural hazard management and provides recommendations in respect to adopting a risk-based approach for Selwyn District's review of its natural hazard provisions.

SDC have defined a risk-based approach as:

- managing risk when there is uncertain or insufficient natural hazard risk information
- managing risk based on the scale of a particular natural hazard event, together with the likelihood of that event occurring and the effects on people and property

SDC have defined a risk-based approach in this way due to the large geographically spread nature of the district, and its sparse population and low level of development in some areas, compared with discrete areas of larger populations in its satellite townships. In the larger populated and developed areas the consequences from natural hazards and therefore the risk could be considerably greater. A risk-based approach will enable the focus of the District Plan Review on natural hazard provisions to gravitate towards the areas where there is greatest risk.

1.2 Scope and limitations

This report has been prepared by GHD for SDC for the purposes of informing its District Plan Review and may only be used and relied on by SDC for the purpose agreed to between GHD and the SDC.

2. Review of Operative District Plan Natural Hazard Provisions

2.1 Setting the scene – Higher Order Planning Documents

Selwyn District Council (SDC) has undertaken a SWOT analysis of the existing natural hazard provisions in the operative District Plan. The SWOT analysis provides an overview and assessment of the provisions against the higher order documents including the New Zealand Coastal Policy Statement 2010 (NZCPS) and the Canterbury Regional Policy Statement 2013 (CRPS)[1]. The SWOT Analysis provided by SDC is included in Appendix B. Since the time of compiling the SWOT analysis it is noted that *"the management of significant risks from natural hazards"* has been added to Section 6 of the Resource Management Act 1991(RMA) as a matter of national importance (s6h).

The main summary finding from the SWOT analysis is that the operative Plan Provisions pre-date changes to the higher order documents and recent amendments to the Resource Management Act and are therefore out of date. In particular, the operative Plan does not specifically:

- adopt a risk-based approach required in both the NZCPS in respect to coastal hazards and the CRPS for natural hazards generally;
- consider climate change;
- manage flood risk for a 1 in 200 year event (0.5% AEP);
- define or avoid development in "high flood hazard areas" (0.2% AEP);
- recognise the role of natural features in providing a defence against natural hazards.

However, some risk-based terminology does exist in the operative Plan, such as acknowledgment of high risk of loss of life or damage to property from inundation in proximity to stopbanks, amongst others.

[1] Note that the Recovery Strategy and the Land Use Recovery Plan are largely subsumed into the CRPS.

3. Review of Current Natural Hazard Information Base & Gap Analysis

3.1 Review of Documents by Natural Hazard Type

3.1.1 Overview

The natural hazard provisions of the District Plan Review rely on the availability of good technical information. Any provisions developed will be required to have an evidential base to support them, and form the foundation of the Section 32 Reporting. In addition, the SDC is pursuing a risk-based approach to managing natural hazards as required by the NZCPS and the CRPS. Consequently, a key part of that approach is the availability of technical information that identifies and assesses natural hazards from a risk – based perspective. The purpose of this section is to summarise and review the available information, identify its appropriateness for land use planning given the risk-based approach to be adopted, identify gaps in that information, and make recommendations on how to address those gaps. The information to be reviewed was provided in Appendix 1 and 2 of the original scope of works and have been included in Appendix A of this report.

It is not known with absolute certainty where and when natural hazards will occur or the actual level of effect that climate change will have on the district. A community such as Selwyn does not have a large technical research base in respect to natural hazards across the District given the limited resources it has. Focusing on the likelihood and consequences of natural hazard events and managing locations and activities most at risk is a way of managing natural hazards where there is limited information and uncertainty and is consistent with the risk-based approach required by the Canterbury Regional Policy Statement.

3.1.2 Information available by natural hazard type

A summary and review of the information in the original scope of works (see Appendix A) is included in the table below. A comment on the appropriateness of this information for inclusion in the District Plan has also been included in the table.

Table 1: Information Summary and Review by Natural Hazard Type

NATURAL HAZARD	Reports Reviewed or Currently Commissioned	Summary/Review and Evaluation of appropriateness for land use planning in the District Plan
Liquefaction	Review of Liquefaction Hazard in Eastern Canterbury, including Christchurch City and parts of Selwyn, Waimakariri and Hurunui Districts (ECan Report R12/83 – December 2012).	The first of the two reports reviewed provides a detailed understanding and investigation into liquefiable land in Eastern Canterbury (including the Selwyn District). It reviews existing knowledge regarding liquefaction hazard drawing upon the observed effects from the Canterbury Earthquakes, the resulting engineering and legislative responses, and the state of knowledge of near-surface geological materials that underlie the eastern Canterbury area. The mapping in the report distinguishes land that may be susceptible to damaging effects of earthquake indicated liquefaction (including lateral spreading) from land where liquefaction damage is unlikely in future earthquakes. It excludes part of Christchurch City, which were prescribed a technical category (TC) rating by MBIE. The statement on page 7 states that standard foundation investigations (as specified in NZS3604) will normally be adequate for residential construction in the "damaging liquefaction unlikely" zone. The important conclusion from this is that the overall risk of damage in this zone from liquefaction is considered to be low. A map is provided which delineates much of the District to be in an area where damage from liquefaction is considered to be "unlikely" and shows the eastern-most part of the District where "liquefaction assessment needed". See first map in Appendix C. It is noted that the project area covered by this report is only part of Selwyn District. However, to the extent that the lines on the map produced can be translated with accuracy on to the Selwyn District Planning Maps this information is useful for land use planning purposes. ECan gave this information to Christchurch City Council as a GIS layer at a higher resolution for use in the Replacement District Plan. Liquefaction potential for the most of the District was classed as nil, very low, or low in an earlier map produced by Yetton and McCahon (2006) (see second map in Appendix C). Only the low-lying areas around Banks Peninsula and Lake Ellesmere were considered to have moderate liquefaction susceptibility, with the boundaries not being precisely located. The report notes that given the complex sedimentary environment the boundaries between the zones are likely to be more variable than shown on the map with "tongues" of gravel (lower susceptibility) extending into silt-dominated sediments (higher susceptibility). The separation of

NATURAL HAZARD	Reports Reviewed or Currently Commissioned	Summary/Review and Evaluation of appropriateness for land use planning in the District Plan
		low-risk from moderate risk is essentially the distinction between lowland and swamp soils, as distinct from the gravelly soils of the Waimakariri fan, and coincides with the western extent of flood ponding in the Tai Tapu/Greenpark area). This report is a letter/report providing advice in respect to subdivision where geotechnical stability including liquefaction issues may arise. In particular it emphasises that west of the line in the Liquefaction Map in the first report reviewed above ("damaging liquefaction unlikely") the land is underlain with predominantly deep gravel soils and for much of it, also deep ground water levels, and the possibility of liquefaction over much of this area is extremely low. Consequently, the report identifies that in the area identified as being "Area of low to very low geotechnical hazard" (see Map in Appendix C) ground conditions are competent for building foundations (which includes the liquefaction unlikely area). The letter/report recommends that in this area small subdivisions up to 15 lots need not have geotechnical investigations at subdivision consent stage and can be delayed until building consent stage. For subdivisions larger than this, the report recommends that geotechnical investigations should be done at subdivision stage. The report identifies that on some properties there remains a low risk that geotechnical issues may be undiscovered, but will be picked up at building consent stage. In addition, the approach recommended in the report relies on the proposed developer to report on Section 106 of the Act, which provides an added safeguard. All areas of the District outside the mapped area (containing Prebbleton and Lincoln and the rest of Selwyn District west of the high terraces) subdivision is required to have a geotechnical report which follows MBIE guidelines and includes subsurface testing. The report further recommends all plan changes be required to provide a geotechnical assessment regardless of their location in the District.
	Geotechnical Reporting for Subdivision Applications Geotech Consultancy Ltd, Letter:July 2013	The report adopts a risk-based approach that is reasonable given the sparsely populated nature of the district and the presence of large rural and rural residential blocks. The map, if available at a higher resolution in GIS than provided in the letter report appropriate to use for land use planning purposes. The map covers the whole District. The definition of small subdivisions, being up to 15 lots in this report, needs further consideration

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Coastal hazard – inundation and erosion – high coastal hazard risk	Appendix 5 of the Canterbury Regional Policy Statement maps showing revised coastal hazard lines.	These maps provide a seawater inundation zone boundary and two coastal hazard zones: Coastal Hazard Zone 1 and Coastal Hazard Zone 2. Coastal Hazard Zone 1 identifies the landward limit of the active beach system for stable or accretionary shorelines, and for eroding shorelines it includes the active beach system and the area landward of this if erosion continues at its current rate for the next 50 years (projected position of the landward toe of the active beach system). Coastal Hazard Zone 2 is mapped for eroding shorelines only and identifies the area landward of Coastal Hazard Zone 1 that could be part of the active beach system within 50-100 years if the current rate of erosion continues for 100 years. No townships or small settlements, or significant infrastructure lies between the Coastal Hazard 1 and 2 lines, although Taumutu Village, and Rakaia Huts (North and South) lie close to it. The maps are presented at 1:10,000 at A3, and are likely to be available at a reasonably accurate resolution from ECan for placing on the District Planning maps. It is considered that the coastal hazard lines have some limited value for land use planning purposes, delineating as they do, the landward toe of the active beach system over a projected 50-100 year timeframe. The land seaward of these lines can be managed by the District Plan to reduce risk of coastal hazards on people and property. However, there is some issue in respect to the assumption that coastal erosion processes, including the effects of climate change and sea level rise, will continue to increase at historic levels for the next 50-100 years (i.e. in a straight line). This assumption is not supported by more up to date research on climate change and sea level rise including the Intergovernmental Panel on Climate Change (IPCC). This calls into question the suitability of the lines for inclusion in the District Plan. It is considered that these lines do not give proper effect to the NZCPS or the RPS. The CPRS states that the lines provide a "minimum baseline of likely erosion rates however, when the effects of accelerated sea level rise due to climate change are considered these lines may not be adequate for long term planning" .[page 11-9 CRPS].
Flooding – high flood hazard and 1% AEP flood plain	Operative District Plan 2004– Flood mapping and provisions.	The operative District Plan provisions pre date the CRPS Regional Policy Statement and only cover a small proportion of the district being: • Te Waihora (Lake Ellesmere) Flood Area

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and ponding areas		• Lower Plains Flood Area • Wamakiriri A Flood Area This information relies on known historic flood levels for these specific areas and has not been updated for more than 20 years. The RPS requires: • Flood investigations to determine the extent of 0.5% AEP and a 0.2% AEP flood events, with an added allowance for the effects of climate change including sea level rise (where relevant) and the ability to provide flooding information at sufficiently high resolution to determine the depth and speed of flow to identify high flood hazard areas. Best practice also requires the use of up to date LiDAR information, particularly given that the Canterbury Earthquake Sequence (CES) changed land levels. However, for Selwyn District the change is relatively small.
	Development of Design Rainfalls for Selwyn District – Opus International Consultants Ltd, 2009; and Memo: Extended Storm Durations for Selwyn District Opus International Consultants Ltd, 2010.	The 2009 Opus Design Rainfall Report provides tables identifying the depth and duration (10 minute – 24 hours) of rainfall across for various ARI's events across Selwyn District. Four sets of tables are provided. The first set of tables provides site specific historic measured data, the second estimates using HIRDs (high intensity rainfall system) and third and fourth provides two climate change scenarios (for the year 2040 and the year 2090). The 2010 Opus Report provides design rainfall tables for extended (larger) critical storm durations of 36-60 hours based on the site specific historic data set provided in the 2009 report to provide more useful information for engineering design of infrastructure in larger catchments for larger storm durations This information is useful for infrastructure/ urban growth planning and for the development of stormwater management plans but is not specifically appropriate for inclusion in the District Plan except perhaps by reference. Developers will find the information useful where the district plan requires the development of a Stormwater Management Plan prior to development of land via plan change or resource consent. Reference to these design rainfalls in the Plan could achieve a higher level of consistency in the development of Stormwater Management Plans in locations where the Plan requires them to be developed.
		The design rainfalls could also be used to compare/calibrate flood hydrograhs for flood modelling for the 0.5 and 0.2 AEP events required by the RPS.

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	Halswell River/ Huritini Floodplain Investigation (ECan Report R12/68 - June 2013)	The Halswell River/Huritini Floodplain Investigation (ECan - R12/68) utilises 2D flood modelling to estimate flood extent, depths and flood levels for the 50, 200 and 500 year flood events (2%, 0.5% and 0.2% AEP's). The study maps the extent of the modelled events but also identifies low-lying areas where depth of flood waters for the 0.2% AEP is greater than 1m (Appendix E). These areas represent high flood hazard areas as defined in the CRPS. Sensitivity analysis: The modelled results do not include an allowance for climate change and sea level rise. However, the study included a sensitivity analysis of those factors. Climate change: Using current MfE recommendations (now under review see section 3.1.3 below) of 2 degree celsius temperature increase by 2090, resulting in a potential 16% increase in rainfall depths (60 hour, 0.5% AEP) results in an increase in inundation area of about 4km^2, and an average increase in flood depth from approximately 0.6m to 0.7m. The report recommends further flood plain modelling may be required in the future if greater confidence in predictions for climate change occur. Sea level rise: The sensitivity analysis for sea level rise indicated that with a 0.5m sea level rise, Te Waihora would also rise 0.5m. However when associated with modelling of the 0.2% AEP design flood the increase in extent of flooding is only 20 ha. The results of this study are helpful for land use planning in this specific location as the floodplain mapping and predicted flood levels will provide information on appropriate minimum floor levels for proposed buildings in areas of the catchment outside the "high flood hazard" areas. Within the "high flood hazard" areas of the catchment provisions can be developed to avoid inappropriate forms of development such a new urban development. The report recommends that for design purposes a model uncertainty allowance, including climate change, of at least 0.3m be added to the modelled depths. This would also take into consideration site specific matters such as, blockages and waves, and should be taken into account when setting floor levels. Page 21 of the report provides a useful comparison of land levels prior to and after the CES, showing

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		areas now potentially lower than they were previously.
	Agreed Environment Canterbury Flood Investigation Works for Selwyn District - Project Scope of Works for NH001 2017 (see Appendix 2 in Appendix A of this report) -.	The scope of work agreed with Environment Canterbury is appropriate in respect to the locations targeted for district plan review purposes being those already in the operative Plan: • Te Waihora (Lake Ellesmere) Flood Area • Lower Plains Flood Area • Waimakiriri A Flood Area The output of a single report collating various recent studies on flood risk within Selwyn with accompanying GIS maps based on 0.5% AEP and 0.2% AEP flood events is useful for ensuring that the flood hazard provisions in the existing operative Plan are appropriately updated and give effect to the CRPS for the areas covered. The scope does not appear to discuss the requirement for inclusion of allowances for climate change and sea level rise to be added to the calculations. However, it does require that ECan "identify and describe any climate change scenarios/assumptions used in any flood modelling or reference where this is available in other published reports for Selwyn/Waimakariri, Halswell/Huritini and Waimakariri Rivers". A decision on the appropriate allowance for sea level rise needs to be made by SDC for the purposes of the flood investigations being completed for the District Plan Review in order to give effect to the requirement in the CRPS to take climate change projections including sea level rise into account (Policy 11.3.2). It is noted that the Halswell study reviewed above includes climate change of up to 16% increase in rainfall depth and 0.5m sea level rise to 2090 in its sensitivity analysis but not in its overall output. This is less than MfE Guidelines (see Coastal Hazards and Climate Change – a guidance for Local Government in New Zealand (2008)). While the MfE guidance document is currently under review, it is anticipated that the final review document it will recommend 1m out to 2120. Final flood area mapping of the Waimakariri River breakout area is due by mid-2018 with the other reports due mid October 2017 and this appears to be within the timeframe needed for consultation with land owners and key stakeholders prior to notification of the Proposed Plan as per the updated District Plan Review timetable.
Earthquake	No specific earthquake/seismicity reports reviewed.	Unlikely to feature in the District Plan Review in a specific sense – dealt with by the Building Code and MBIE Guidelines.

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Slope stability	Geotechnical Reporting for Subdivision Applications (Geotech Consultancy Ltd, Letter:July 2013).	This report identifies areas where geotechnical investigations for slope stability will be required for all subdivision consents by virtue of excluding it from the low to very low geotechnical hazard area identified (see Appendix C). The report highlights slope stability issues along the high terrace faces on the Rakaia and Waimakariri Rivers, and potential slope stability and foundation bearing issues within the foothills and mountainous areas. Geotechnical investigations are recommended to be required in these areas for subdivision. As for the evaluation under liquefaction, this information is appropriate to use in land use planning for the District Plan provided the lines of the low and very low geotechnical hazard areas are well defined and able to be included in the District Plan planning maps, and are appropriately separated from the liquefaction areas.
	Arthurs Pass Village Slope Stability Assessment, Report no.1525119_7407-002-R-Rev0 Golder Associates (August 2016)	This report summarises the findings of a slope stability assessment for Arthurs Pass village. The village is identified within the report as being vulnerable to slope instability hazards, particularly following earthquakes, due to its location in the valley below steep slopes containing accumulated rock debris. Arthurs Pass is identified as an area of considerable seismic hazard, but high rainfall is also identified as a frequent triggering mechanism. The village is considered to be at high risk due to the potential for rockfall hazard to isolate the town and directly impact dwellings, vehicles and infrastructure, particularly the state highway and rail link. The village is 25km from the Alpine fault (25 km) and is located close to many other faults. However, the report states that while there is incidence of rockfall affecting various slopes in the Arthurs Pass area, outside the Village, no rockfall has directly impacted the village area. A significant re-alignment of State Highway 73 south of Arthurs Pass Village is underway, which will reduce exposure of road users to slope hazards. Risk quantification was outside the scope of the study but a qualitative assessment of risk was undertaken to identify locations where risk associated with natural hazards may be unacceptably high and warrant further investigation. The most likely rockfall source identified in the report is from road cuts along SH73. The risk to the public and infrastructure from rock fall when using SH73 is assessed as relatively high. The risk from debris flow was considered to be lower (“acceptably low”) as there has been few cases of significant damage from debris flow in the last 80 years.

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		Despite the potential consequences, the likelihood of rock avalanche affecting Arthurs Pass Village is also low (occurring once every several thousand years). Future development outside the existing village footprint is unlikely, due to lack of relatively flat areas, but Maori Flat is a potential location (though likely it is in the National Park) The Village only ever has a small proportion of buildings permanently occupied. The report provides useful advice for land use planning in respect to Arthurs Pass village. The overall risk to the Village itself appears to be low but only due to the small scale of the village and small resident population. This risk will increase if future infill within the existing village footprint (due to increased resident and visitor numbers) occurs. A small area was identified for potential village growth at Maori Flat, although ownership of that land was uncertain. The main concern is debris flow and rockfall hazard affecting rail and road links which has the potential to isolate the Village. The report identifies civil defence and evacuation planning as the main mitigation method alongside earthmoving equipment on standby and regular maintenance of drainage channels, with little required in the way of regulation in the District Plan. The report noted that the presence of larger visitor numbers or the entrapment of a passenger train during a rockfall event in Arthurs Pass would have a different risk profile.
	Geotechnical Summary Report – Porters Expansion Project 12 July 2010 – URS plus review by Clive Anderson for SDC, dated 09 June 2010.	This report evaluates constraints placed on development of the Porters Village Base Area and Crystal Basin Ski Area by: • Active faulting; • Slope instability; • Flood hazard; and • Snow avalanche. It also looks at geotechnical suitability of the land for the proposed development. No geomorphic evidence of active surface faulting was found in the Village Base Area, and if a fault was present it is judged to be a long Recurrence Interval (RI) and the risk posed by surface faulting deemed acceptably low. A Fault Avoidance Zone (FAZ) for the Torlesse Fault was determined to pass through a small area of the Village Base. No active faulting was found in the Crystal Basin Ski Area.

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		No significant slope stability constraints were found in the area. Avalanche hazard for the proposed Village Base was considered to be negligible. The Crystal Basin was considered less likely to be affected by avalanche than the current Porter Ski area, and it was recommended that infrastructure for the development be located outside of any known avalanche paths. The report states that avalanche hazard could be managed by conventional engineering design and ski area management (i.e. avalanche control work). Overall, the report found that the risk posed by natural hazards was deemed acceptably low. It is noted that geotechnical assessment of existing ski area, access road to Crystal Basin and proposed ski trails and roading and earthworks within Village Base Area were outside the brief of the report. With the Alpine Fault being approximately 50 km to the northwest the area is characterised by high seismic hazard and numerous active faults capable of producing large magnitude earthquakes. Typical peak ground accelerations of 0.4 for 150 year and 0.5g for 475 year return period events were calculated for the area. Using the MfE Guidance, Fault Avoidance Zones (FAZ) were identified for all active or potentially active faults in the vicinity for the proposed Village Base Area at a scale of 1:10,000. The defined FAZ for the Torlesse Fault was found to extend through the proposed Village Base Area. However, the lack of reliable paleo-seismic data on faults within the valley introduced a major uncertainty in this MfE risk assessment method. Overall because of the low RI of the Torlesse and Cheeseman Faults it was determined that a range of residential buildings, temporary accommodation and cafes would be acceptable in this location (outside the FAZ). Clive Anderson Review: The review by Clive Anderson of the Porter Report indicated that the full extent of avalanche hazard in the Crystal Basin was not fully understood and data was still being collected. The reviewer considered there was potential for injury or fatality consequences of an uncontrolled avalanche affecting the new ski field which could be much higher than currently exists for the Porters Ski Field. Mr Anderson also considered there was likelihood of a strong earthquake causing rockfall, but no specific

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		assessment had been completed to date. He considered the risk of rockfall could be reduced to an acceptable level by use of conventional engineering measures, combined with rockfall trajectory analysis. Mr Anderson confirmed the area is subject to significant seismic hazard with numerous faults capable of generating large earthquakes in western Canterbury that could cause severe ground shaking at Porters Ski Area. Including potential topographic amplification effects. The report makes contrary statements about the activity of the Torlesse and Cheeseman Faults and the possibility of lower RI's. However these are further explained and dismissed in a review by GNS which explains the difference between the RI from the New Zealand National Seismic Hazard model and that determined by geomorphic and geological evidence. The risk of a dam break of the snow –making reservoir was considered by Mr Anderson to have potential to have a severe impact on people and infrastructure below the reservoir as a result of avalanche, leading to overtopping or failure. The Geotechnical Summary Report and the review by Clive Anderson are both of a level of detail to be useful and appropriate for land use planning and generally adopt a risk-based approach.
Fault-lines	Greendale Fault: Investigation of surface rupture characteristics fault avoidance zonation (ECan/GNS Science Report 2011/121, R11/25 – May 2011))	This report provides detailed mapping and seismic information on the Greendale Fault. The information is appropriate for land use planning purposes as it is of sufficient scale to enable mapping of the fault rupture zone and the development of associated provisions in the District Plan Review. The report indicates that the recurrence interval (RI) is only preliminary and that further work is being undertaken by PhD studies.
	General Distribution and Characteristics of Active Faults and Folds in Selwyn District (ECan/GNS Report 2012/325, R13/27 – July 2013)	This report identifies 24 areas in Selwyn District where faults and folding with a ground surface expression occur. The scale of the mapping of these faults and folds (1:250,000) identified mean that the information is not suitable to include as fault avoidance zones in the District Plan, and more investigations would be required. The information in its current form may be useful for inclusion at a policy level for plan changes and resource consent considerations for new development and subdivision. Figure 6 in the report shows that many of the active faults (with the exception of Greendale) are located in isolated areas in hill country and in the Mountain areas.

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		Conclusion: There is enough information to include provisions on the Greendale Fault (mapping and policy/rules). In the other areas where faults occur the information is only at a scale suitable for identifying policy "areas" where fault rupture hazard might need to be a consideration in Plan Changes and resource consent applications for new development. These policy areas could be identified within the District Plan but could also remain outside the Plan and be used as an alert layer in assessments required under section 106 for new subdivision development. This level of consideration is particularly appropriate for faults occurring in isolated areas in the District where levels of development are low.
Tsunami	Hikurangi Subduction Zone and Wairarapa Fault Tsunami modelling for the Canterbury Coast (ECan Report R15/130 – October 2015); and Updated Inundation Modelling in Canterbury from a South American Tsunami (ECan Report R14/78 – November 2014)	The two tsunami reports (distant Mw 9.485 earthquake originating in the subduction zone off Peru and near source regional events in the Hikurangi subduction zone and the Wairarapa Fault) provide a good overview of the parts of the Selwyn Coast likely to be affected by near (local/regional) and distant source (South America) tsunami. Both reports assume arrival of the Tsunami at MHWS. In the local/regional case the modelling identifies it takes up to 2 hours for the tsunami to arrive at Rakaia. Inundation is relatively minor and concentrated to the river mouths and coastal strip, with speeds around 2m/s. This study found both "near source" and "distant source" wave heights will be relatively small, with inundation largely affecting a relatively small low lying areas immediately on the coast. The risk posed by tsunami hazard on the Selwyn District Coast is low particularly compared to the area north of the Banks Peninsula (Christchurch City) and is likely a sheltering effect. While there are settlements at Taumatu and Rakaia River mouth there are not large populations or infrastructure investment on the immediate coastline. The report identifies its main purpose to help inform evacuation planning and emergency management. Return periods are in the order of 2,500 years and represent an extreme scenario. The report recommends that the information not be used for detailed land use planning because land use planning generally uses a shorter return period (up to 500 years) but that it could be useful at the strategic planning level alongside other natural hazard information for strategic and infrastructure planning to highlight areas of vulnerability.

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		Hikurangi Subduction Zone Rakaia mouth • maximum inundation depths 2m • maximum low speed up to 2m/s. Taumutu • inundation minimal • maximum speeds less than 2m/s. Wairarapa Fault Model • Taumutu minimal inundation at flow speeds less than 1m/s • Rakaia mouth (including Rakaia Huts) minimal inundation, over the gravel barriers at speeds less than 1m/s. Appropriateness for land use planning purposes: the information is useful at a policy level, but is not appropriate for use for mapping or development of rules. It is noted that there is some potential overlap with coastal inundation and coastal erosion hazards if setback provisions are considered. The distance source (subduction zone off Peru, South American) tsunami modelling also indicated that land inundation in Selwyn District coastal areas is likely to be confined to river mouths and the coastal strip. Depths at the gravel barrier were inundated up to 2.5 m with the edges of the lagoon inundated including the seaward part of North Rakaia up to 2.5m. Maximum flow speeds were generally less than 3m/s at Taumutu and faster at Rakaia Mouth being up to 4m/s and overtopping the dunes. The modelling indicated the first waves would arrive 14-15 hours after the fault rupture and the largest waves would arrive between 17-20 hours. The report states that with the high return period of 2500 years the information represents an extreme scenario appropriate for evacuation planning and emergency management and not intended for land use planning. Overall, the risk from tsunami is relatively low (see Appendix D).

3.1.3 National Guidance Documents on Natural Hazards and Climate change

There are a number of guidelines and documents that are being prepared by Central Government now and are awaited by a number of Local Authorities preparing 2nd Generation District Plans. These are outlined in the table below:

Of considerable importance to the Natural Hazard Topic is the National Policy Statement on Natural Hazards. This NPS is currently being prepared following the natural hazards being elevated to a matter of national importance in the RMA[2].

Table 2 – National Policy Statement on Natural Hazards and other Guidance Documents Awaited

Document	Date due	Comments
Ministry for the Environment Guidance on Climate Change to replace the now out-of-date Coastal Hazards and Climate Change - A Guidance Manual for Local Government (2008)	Later 2016 – early 2017	This document is likely to provide a consistent approach nationally on the appropriate allowances to be made for sea level rise and temperature increases in flood modelling and modelling for coastal erosion and inundation. It has been delayed several times.
Department of Conservation – Guidance Note on Policy 24 of the NZCPS	Late 2016	This document is critical for an understanding and consistent approach to the management of coastal hazards required by Policy 24 of the NZCPS. Policy 24 requires the identification of areas of the coastal environment potentially affected by coastal hazards (including tsunami), assessed over at least a 100 year period, taking into account sea level rise, potential for inundation, cumulative effects of sea level rise, storm surge and wave height under storm conditions, fluctuations in erosion and accretion and overall the effects of climate change. The Guidance is still being finalised, with DoC currently consulting with Regional Councils nationally. No new timeframes have been set down.[3]
National Policy Statement on Natural Hazards (NPS)	Now late 2108	MfE recently took a paper to Parliament with problem definition and key challenges to work through. Parliament was not comfortable with the approach and has sent the working group back to work on a more prescriptive set of principles and a clearer indication of what the NPS will look like before any engagement with councils and others takes place (very high level at least). MfE is now rewriting the paper and developing policies using feedback from the Natural Hazards Special Interest Group and some planning consultants.[4]

[2] Section 6 RMA *(h) the management of significant risks from natural hazards.*

[3] Sarah McRae, DoC, 07/08/2017
[4] David Berg, MfE 04/08/2017

3.2 Mahaanui Iwi Management Plan

The Mahaanui Iwi Management Plan (2013) is the culmination of 3 years of collaborative work by the six Runanga for the area between Hurunui River and Hakatere being:

- Ngāi Tūāhuriri Rūnanga
- Te Hapū o Ngāti Wheke (Rāpaki)
- Te Rūnanga o Koukourārata
- Ōnuku Rūnanga
- Wairewa Rūnanga
- Te Taumutu Rūnanga

The relevant Runanga for Selwyn District are:

- Te Taumutu Rūnanga
- Ngāi Tūāhuriri Rūnanga

The relevant policy guidance or outcomes anticipated in the Mahaanui Iwi Management Plan (2013) in respect to managing natural hazard risk (including climate change) specific to Selwyn district matters are outlined in the table below:

Table 3: Natural Hazard and Climate Change Provisions of the Mahaanui Iwi Management Plan 2013

Flooding		
Objectives	Policy	Commentary
5.3 (3) Water and land are managed as interrelated resources embracing the practice of Ki Uta Ki Tai, which recognises the connection between land, groundwater, surface water and coastal waters.	WM12.5 To require that all waterways in the urban and built environment have buffers or set back areas from residential, commercial or other urban activity that are: (a) At least 10 metres, and up to 30 metres; and (b) Up to 50 metres where there is the space, such as towards river mouths and in greenfield areas.	This policy does not directly refer to reducing the risk of flooding but the policy could limit development in potentially flood prone areas.
	WM12.6 In the urban environment, it is accepted that waterways may have existing exotic vegetation along margins (e.g. exotic specimen trees in waterside reserves). However the objective is still to promote native riparian vegetation, as taonga valued for flood control, the maintenance of water quality, mahinga kai and cultural well-being.	Promotes native vegetation for riparian margins and flood control.
	WM12.12 To require that any plantings associated with flood protection works is undertaken using indigenous species.	Promotes native vegetation for riparian margins and flood protection, noting that Ngā rūnanga oppose the use of willows (and general weedy species) for flood protection methods.
	WM12.16 To advocate for buffer zones on braided river margins that are least the width of the river itself, as a buffer against land use and development.	Does not directly refer to reducing the risk of flooding but the policy may limit

Flooding		
		development in potential flood prone areas.
	WM12.18 to support sustainable gravel extraction as part of floodplain and river management in the takiwā, provided…	
	WM13.1 To recognise and protect all wetlands, waipuna and riparian areas as wāhi taonga that provide important cultural and environment benefits, including but not limited to: (a) Mahinga kai habitat; (b) The provision of resources for cultural use; (c) Cultural well-being; (d) The maintenance and improvement of water quality; and (e) Natural flood protection	Recognises value of wetland as natural flood protection.
	WM15.1 To oppose the planting of willows and poplars along waterways, for erosion control or otherwise.	Ngā rūnanga oppose the use of willows (and general weedy species) for flood protection methods.
	WM15.2 To promote healthy riparian margins along waterways, vegetated with native species, as a means to protect waterway health and prevent the establishment of weedy species in riverbeds and margins.	Promotes native vegetation for riparian margins and flood protection, noting that Ngā rūnanga oppose the use of willows (and general weedy species) for flood protection methods.
	TW4.3 To work with local authorities and the Department of Conservation to address the effects of lake margin land use and settlement on the cultural health of Te Waihora by: (a) Securing a protected wetland margin around the lake to provide a buffer from land use and lake level changes;	Policy provides for a buffer between Te Waihora and properties.

Coastal erosion		
Objectives	Policy	Commentary
5.6(8) Coastal cultural landscapes and seascapes are protected from inappropriate use and development	TAN6.4 To require that Ngāi Tahu cultural and historic heritage sites are protected from: a) Inappropriate coastal land use, subdivision and development; b) Inappropriate structures and activities in the coastal marine area; c) Inappropriate activities in the marine environment, including discharges; and d) Coastal erosion.	Effects of coastal erosion on cultural sites of significance is identified in this policy would also relate to the Cultural Landscapes/Sites of Significance and coastal environment chapters of the plan.
	TAN7.3 To require a precautionary approach towards proposed activities whose effects on the coastal	

Coastal erosion		
	environment are uncertain, unknown or poorly understood.	
	TW10.1 To encourage research on the nature, extent and effects of coastal erosion on the Te Waihora and Taumutu coastline, in particular: (a) An analysis of historical data, including maps, aerial photos and Ngāi Tahu oral history, to improve understandings of changes to the Taumutu coastline over time, including Te Koru; (b) Relationship between changes to the volume and size of sediment being transported down the Rakaia River, due to low flows, and erosion of the Taumutu coastline; (c) Relationship between coastal erosion and lake opening activities: are lake opening activities affecting erosion rates and will erosion rates necessitate a change in the location of the opening; and (d) The potential risk to sites of significance, including the Hone Wetere Church and urupā as a consequence of coastal erosion processes.	Particular focus on coastal erosion in relation to Te Waihora and Taumutu. Coastal erosion is identified in the IMP in regards to the effects on ancestral sites.

Climate Change and Sea level Rise		
Objectives	Policy	Commentary
5.6(2) The role of tangata whenua as kaitiaki of the coastal environment and sea is recognised and provided for in coastal and marine management.	R3.3 To require that local authorities recognise and provide for the potential effects of climate change on resources and values of importance to Ngāi Tahu, for example: (a) Effects of sea level rise on coastal marae and coastal wāhi tapu, including urupā;	Recognises that sea level rise may impact on coastal sites of cultural significance.
	TW4.3 To work with local authorities and the Department of Conservation to address the effects of lake margin land use and settlement on the cultural health of Te Waihora by: (e) Prohibiting activities such as creation and use of offal pits, establishment of lifestyle block developments, and permanent settlement on lake margin land below 1.8 m above sea level.	Relates to Te Waihora but relates to area of Selwyn coastline.

Opening/closing Te Waihora		
Objectives	Policy	Commentary
(7) Lake management, including lake level management, reflects living with the lake, rather than forcing the lake to live with us.	R3.3 To require that local authorities recognise and provide for the potential effects of climate change on resources and values of importance to Ngāi Tahu, for example: (e) Lake management regimes, including the opening of Te Waihora and Te Roto o Wairewa to the sea;	The IMP states "Coastal erosion, sea level rise and changes to the productively of inshore fisheries are all potential effects of climate change that will have a direct and significant impact on tāngata whenua."
	TW5.1 To require that lake level management and lake openings are jointly managed by Ngāi Tahu and Environment Canterbury, recognising Ngāi Tahu as tāngata whenua, Treaty partner and owner of the Te Waihora lake bed	Policies indicate iwi wish to be more involved in decision making regarding opening Te Waihora.
	TW5.2 To continue to pursue a lake opening regime that provides for improved recognition, protection and enhancement of mahinga kai (fisheries) values and other outstanding cultural characteristics associated with Te Waihora. This means: (a) A process of managed lake openings that allow for: (i) Increased fish recruitment; (ii) Higher and fluctuating lake levels; (iii) Salinity maintained at a higher level than current regime allows; (iv) Longer duration of openings when required for fish values; and (v) Allowing the lake to be tidal for longer periods of time. (b) The investigation of opening the lake at the southern end of Te Koru, in addition to, or instead of, the current site. (c) Adaptive management, allowing the lake to be opened on a seasonal, opening-by-opening basis, guided by general rules and criteria rather than set target levels.	

Consultation with Mahaanui Kurataiao Limited will be required through-out the plan drafting process to further this discussion to interpret/apply these provisions. It is noted that the policies identified above support a risk-based approach to natural hazards and provide an important cultural perspective on natural hazard management.

SDC have already had indications that particular areas of interest are:

- Effects of natural hazard mitigation measures on the natural environment; and

- The role of natural hazard management alongside s6e and s8 of the RMA.

In addition, it is understood that initial discussions with Mahaanui Kurataiao Limited indicate that they may have a preference to review and possibly contribute to drafting some natural hazard areas of interest.

4. Gap Analysis by Natural Hazard Type

4.1 Overview – information and uncertainty

This section of the report analyses the gaps in the required information needed to develop plan provisions under a risk-based approach for each of the identified natural hazard types. It follows on from the summary and review of the reports identified above, noting that the appropriateness of this information for land use planning purposes within a district plan has already been commented on above as part of the review.

Table 4: Gap Analysis

NATURAL HAZARDS	Gaps identified (summary) and what is required (experts/report)	Critical gap(s) ✓ or ✗
Liquefaction	Review of Liquefaction Hazard in Eastern Canterbury, including Christchurch City and parts of Selwyn, Waimakariri and Hurunui Districts (ECan Report R12/83 – December 2012). • The project area covered by this report is only part of Selwyn District, but this is not a significant gap as the 2nd report below covers the whole district. • The parts of Selwyn in the "Liquefaction assessment needed" area and including some areas that have a MBIE TC rating have minimal information on the extent of the risk (moderate/high) and this could be investigated and refined further. Alternatively, reports can be requested through the resource consent process to provide site specific details on the extent of the liquefaction risk in these areas as per the current plan provisions. Overtime the site specific information could be collated to identify any high risk areas of the District. Geotechnical Reporting for Subdivision Applications (Geotech Consultancy Ltd, Letter:July 2013. • A higher resolution GIS map is required than that provided in the letter report for use as a planning map layer. • The area to the west involving a high terrace brings in a slope stability issue rather than a liquefaction issue, as does areas towards the Port Hills. Some of these areas will have a liquefaction issue, some a slope stability issue. It would be good to distinguish the two for mapping purposes (it is recognised they both represent a "geotechnical" risk). This may be able to be resolved relatively easily with discussions with the authors of the report. • The definition of small subdivisions, being up to 15 lots in this report, needs further consideration to determine whether that is appropriate.	✗

NATURAL HAZARDS	Gaps identified (summary) and what is required (experts/report)	Critical gap(s) ✓ or ✕
	Within and around settlements and growth areas more detailed research on liquefaction hazard is likely to be required over time (close to rivers for example, or areas where gravel tongues indicate variable ground). Given the extent of the settlements scattered across the District the risk-based approach would focus on areas of greatest risk (such as settlements within the UDS area). Methods such as use of assessments required under Section 106 of the RMA for subdivision and plan changes can contribute to the knowledge-base on liquefaction and be supported by policies in the District Plan. This approach may not require considerable change to the existing provisions in the operative District Plan, but possibly requires some resources to ensure that as more information becomes available through assessments for plan changes and subdivisions it is in a form that can be used to increase awareness and knowledge of this hazard in the District. This would also assist with the requirements of the NPS on Urban Development Capacity.	
Coastal hazard – inundation and erosion – high coastal hazard risk	No coastal hazard – erosion or inundation reports appear to exist for the coastal area other than the coastal hazard lines (erosion) in the CRPS. The maps in Appendix 5 of the CRPS are derived from Volume 3 of the Regional Coastal Environment Plan ("RCEP") which was made operative in 2005. The lines have been reviewed, updated and inserted into the RPS but may not meet the requirements of the NZCPS in respect to accounting for the cumulative effects of sea level rise, and may not account for storm surge or wave height under storm conditions. The coastal hazard lines may not be defendable from an evidential basis in terms of the requirements of Policy 24 of the NZCPS which requires hazard assessment over at least a 100 year time frame and to take into account: 1. sea level rise; 2. potential for inundation; 3. storm surge and wave height under storm conditions; 4. fluctuations in erosion and accretion; and 5. overall effects of climate change. Additional assessments will be required to take into account national guidance and the best information available. Comprehensive coastal hazard work needs to be completed at some time in the future and it may be appropriate to engage a costal expert to assess coastal erosion and inundation at the settlements of Taumutu Village and Rakaia Huts, to ascertain the level of risk (if any). It is noted that coastal erosion is recognised as a problem in this location in the policies of the Mahaanui Iwi Management Plan. Conclusion: The availability of coastal hazard information is a significant gap in the District Plan review process at the present time.	✓

NATURAL HAZARDS	Gaps identified (summary) and what is required (experts/report)	Critical gap(s) ✓ or ✕
	However, given the lack of national guidance on Policy 24, and limited time and resources, it may be appropriate to use the RPS hazard lines as a 'holding position' to update the lines already in the District Plan while acknowledging that additional work is required, once the DoC guidance on Policy 24 of the NZCPS is available. This may be preferable to leaving the coastal hazard lines out of the Plan altogether. The recent experience in Christchurch and Kapiti in respect to their respective district plan supports this view and highlights the lack of clear direction for Councils trying to implement the requirements of the NZCPS, Policy 24. There is also a risk for SDC that any methodology adopted now may not align well with the requirements of any future NPS on natural hazards or the DoC guidance on Policy 24 when each are finally published.	
Flooding – high flood hazard and 1% AEP flood plain and ponding areas	Project Scope of Works for NH001 2017 - Agreed Environment Canterbury Flood Investigations Works for Selwyn District (see Appendix 2 in Appendix A of this report). The operative District Plan provisions pre date the CRPS and only cover a small proportion of the district being: • Te Waihora (Lake Ellesmere) Flood Area • Lower Plains Flood Area • Waimakiriri A Flood Area This information relies on known historic flood levels for these specific areas and has not been updated for more than 20 years. It is noted that implementation of Policies 11.3.1 and 11.3.2 of the CRPS require the following: • Identification of areas subject to inundation in a 0.5% AEP flood event and areas subject to high flood hazard[5]. • When determining high hazard areas, and areas subject to inundation in a 0.5% AEP flood event, climate change projections including sea level rise are required to be taken into account (where relevant). • The regional council is to provide information it holds on historical and design flood events to assist territorial authorities in determining areas subject to 0.5% AEP flood events. • The regional council is to work with local councils to investigate and define potential high hazard areas where information is uncertain or insufficient. It is noted that generally reasonably detailed flooding information (or flood modelling), at sufficiently high resolution, is required to determine the depth and speed of flooding to identify high flood hazard areas. Best practice also requires the use of up to date LiDAR information in flood investigations and modelling, particularly given that the Canterbury Earthquake Sequence (CES) changed	✕

[5]High hazard areas include flood hazard areas subject to inundation events where the water depth (metres) x velocity (metres per second) is greater than or equal to 1, or where depths are greater than 1m, in a 0.2% AEP flood event. Page 11-8 CRPS 2013.

NATURAL HAZARDS	Gaps identified (summary) and what is required (experts/report)	Critical gap(s) ✓ or ✕
	land levels, while noting that for Selwyn District the change is relatively small. Consequently, the output of a single report is valuable as per the agreed scope as it will collate various investigations that have been completed by Environment Canterbury in respect to flood risk within Selwyn, with accompanying GIS maps determining the extent of the 0.5% AEP and 0.2% AEP flood events. The reports will also ulitise updated LiDAR (Lower Plains and Te Waihora Flood Area). However, the proposed scope of work is limited to summarising other investigations and findings for areas already contained in the operative Plan outlined above. It is understood from discussions with Environment Canterbury that no new modelling is proposed. The agreement also requests ECan *"to identify other areas at risk of flooding for which further information could be considered* by *Selwyn District Council".* These are not required to be investigated and included in the report. This will result in gaps in the information required for this district plan review in respect to flood risk and high flood hazard in some areas of the District, some of which are already known to be affected by flooding (e.g. Leeston). Some high flood hazard areas, including around Te Waihora, are unlikely to be able to accurately identified under the agreed scope. It is understood that further areas will be identified as and when more investigations are completed, and that the process will be to introduce plan changes as the work is completed in the future. It is further understood that SDC is comfortable with that approach as the work cannot practically be carried out in the time frame required for this District Plan Review. Reliance on site specific flood assessments under the current processes will therefore continue for many areas in the District. This includes use of Section 106 of the RMA in assessing subdivision proposals in areas recognised as being prone to flooding. It is noted that SDC and Environment Canterbury consider that the current process of requiring site specific assessments has worked well to date. Notwithstanding the above, concerns with the agreed scope of works per se include: – Uncertainty in respect to allowances to be made for climate change and sea level rise; – Uncertainty over whether the investigations will stand up to scrutiny at hearings (use of modelling versus use of historic flood extents) although it is noted that the agreed scope requires the methodology for mapping to be clearly stated[6];	

[6] Note that this uncertainty does not in any way relate to the expertise of the personnel carrying out the work, but whether the agreed scope of investigations is robust enough given likely challenges to the maps and provisions expected through the planning process.

NATURAL HAZARDS	Gaps identified (summary) and what is required (experts/report)	Critical gap(s) ✓ or ✕
	It is noted that in some areas of the Selwyn District the effect of including an allowance for sea level rise will be minimal. Overall, however, climate change allowances could potentially have an effect on the extent of mapped areas and flood levels in the Lower Plains, Te Waihora and coastal areas. As noted earlier the allowance for sea level rise for the Halswell study, was considerably lower than the MfE guidelines. In the agreed scope, mapping for the Waimakariri break out area is due by mid-2018, with the other reports due mid October 2017. These dates appear to be within the revised timeframe needed to enable consultation with key stakeholders prior to notification of the District Plan Review.	
Earthquake	No specific reports reviewed. Unlikely to feature in the District Plan Review in a specific sense – dealt with by the Building Code and MBIE Guidelines. It may be useful to search updated reports post CES 2010-2011 on the revised seismicity risk to Selwyn District from the perspective of policy development rather than rules in the DPR.	✕
Slope stability	The report Geotech Consultancy Ltd, Letter: July 2013 is a useful report in respect to subdivision applications and could be extended to other development types. The lines of the low and very low geotechnical hazard areas need to be defined well enough if they were to be included in the District Plan planning maps, but appear to be suitable guidance for use outside the District Plan for subdivision assessment under Section 106. It would be helpful if “moderate” or “higher” risk areas (currently lumped together and identified by virtue of not being in the low and very low areas) could be separated through more detailed investigations, as does the liquefaction from slope instability areas. However, large areas of SDC are sparsely populated. Use of Section 106 of the RMA to require subdivision assessments for site specific proposals triggered at the moderate level may be more cost effective than mapping it in more detail. <u>Arthurs Pass Village Slope Stability Assessment, Report no.1525119_7407-002-R-Rev0 Golder Associates (August 2016)</u> This report adequately summarises the findings of a slope stability assessment for Arthurs Pass village and surrounding road and rail network on a qualitative rather than quantitative basis. Despite the potential consequences, the likelihood of rock avalanche affecting Arthurs Pass Village is considered to be low (occurring once every several thousand years) as the village only ever has a small proportion of buildings permanently occupied . Future development outside the existing village footprint is unlikely, due to lack of relatively flat areas, but Maori Flat is a potential location (though likely it is in the National Park). This risk will increase if future infill within the existing village footprint (due to increased resident and visitor numbers) occurs. A small area is identified for potential village growth at Maori Flat, although ownership of that land was uncertain. The main concern is debris flow and rockfall hazard affecting rail and road links	✕

NATURAL HAZARDS	Gaps identified (summary) and what is required (experts/report)	Critical gap(s) ✓ or ✕
	which has the potential to isolate the Village. Overall, the report is considered to provide an adequate level of information for Arthurs Pass Village in respect to rockfall risk. If any expansion was considered, a thorough more quantitative analysis would be required and could be achieved through a plan change process in the future. The report identifies civil defence and evacuation planning as the main mitigation method alongside earthmoving equipment on standby and regular maintenance of drainage channels, with little required in the way of regulation in the District Plan. Slope instability generally in the district – high river terraces, hill country, Port Hills It is considered that more work is required generally to identify rockfall, cliff collapse and mass movement areas within the District, particularly if there are sloping areas where development pressure could occur (Port Hills, terraces, etc). However, it is understood, from discussions with SDC, that slope instability is unlikely to be a significant issue for this District Plan Review as no additional areas on sloping ground are likely to be considered for development and pressure in these areas is low. A plan change process could be initiated should such areas be proposed for development. Policy provisions in the District Plan Review could be drafted to ensure adequate assessment of hazards such as rockfall and mass movement in growth areas. Geotechnical Summary Report – Porters Expansion Project 12 July 2010 – URS plus review by Clive Anderson for SDC, dated 09 June 2010. These reports provide useful information on a range of natural hazards including slope instability in the Porters Ski area, and are reasonably comprehensive. Some uncertainty remains on issues such as avalanche risk and fault rupture, but the experts consider that adequate mitigation is available to manage these risks.	
Fault-lines	The Greendale Fault: Investigation of surface rupture characteristics fault avoidance zonation (ECan/GNS Science Report 2011/121, R11/25 – May 2011)) report and General Distribution and Characteristics of Active Faults and Folds in Selwyn District (ECan/GNS Report 2012/325, R13/27 – July 2013) are both useful reports. While the Greendale fault report is at sufficient detail to map a fault avoidance zone, the report indicates that the recurrence interval (RI) is only preliminary and that further work is being undertaken by PhD studies. The report identifying the general distribution of active faults contains mapping at a scale (1:250,000) which is not suitable to include as fault avoidance zones in the District Plan. More investigations are required where these faults occur in areas of potential future development (requires further discussions). Taking a risk based approach it would be appropriate to focus any further detailed investigations in locations where there is potential for significant damage or loss of life from fault rupture (e.g. villages, towns and ski field resorts). SDC require such investigations on a case by case basis by proponents of development usually through the Plan Change process, as this	✕

NATURAL HAZARDS	Gaps identified (summary) and what is required (experts/report)	Critical gap(s) ✓ or ✕
	method ensures adequate detail is provided and the cost of such studies are borne by the developer. On current information available only the Greendale Fault (and, potentially, the Torlesse fault in the Porter Ski area) can be developed into Fault Rupture Hazard Zones in the District Plan Review.	
Volcanic Hazard	No information has been sighted on volcanic hazard. It is likely to be a very low risk hazard in the Selwyn District. No further information is required for the District Plan Review. CDEM issue.	✕
Tsunami	Current information reviewed does not indicate a significant need to source further information in respect to tsunami risk for the district plan review purposes. It is noted, however, that there have been no studies sighted, or known of, for tsunami generated by earthquakes sourced off the Canterbury coastline. A tsunami from this source could arrive much quicker than the regional and distance tsunami identified earlier. However, they are also likely to have a shorter "fetch", and therefore lower wave heights. Civil defence and evacuation planning response appropriate rather than provisions in District Plan, although a policy provision would be appropriate.	✕
Residual risk	No reports have been sighted on residual risk, although some studies are being undertaken by Environment Canterbury in respect to breakouts of the Rakaia and Waimakariri Rivers. Further /investigation may be required (see CRPS Policy 11.3.5 method (5)). Note: Residual risk is the term used to define those risks that cannot be defined in more detail after elimination or inclusion of all conceivable quantified risks have been addressed. Residual risk can also be described in terms of "the bigger than event". For example, if planning and operational measures are implemented for 2% AEP event, then anything larger (e.g. 1% or 0.5% AEP events) would be considered as residual risks.	✓
Drought	No reports have been reviewed in respect to this gap analysis. Useful reports include - Climate Change Resources for Regions: http://www.mfe.govt.nz/climate-change/how-climate-change-affects-nz/how-might-climate-change-affect-my-region/canterbury While drought is a natural hazard in itself, this site discusses the likelihood of more frequent droughts in Canterbury Region as a result of climate change. The risk –based framework needs to include drought but is unlikely to feature in the District Plan Review in a specific sense. Development of policy on water efficiency and conservation including low impact design to reduce drought risk, is a potential area requiring further research.	✕
Wildfire	No reports have been reviewed in respect to wildfire and should be covered by natural hazard policies.	✕

NATURAL HAZARDS	Gaps identified (summary) and what is required (experts/report)	Critical gap(s) ✓ or ✕
	Information does exist including existing rural fire provisions and CDEM resources. Canterbury Civil Defence and Emergency Management Group Plan Some in-house research and discussions with New Zealand Fire Service and CDEM would assist. It is noted that work is currently underway in respect to wildfire risk in the Port Hills as part of the Recovery Plan.	
Economic	Economic assessment is required as part of a risk-based approach to determine both the costs of natural hazards to the community but also the costs of various options to reduce risk. It is accepted that few councils in New Zealand are undertaking this work comprehensively due to the complexity of the topic and the costs involved. In addition, it is accepted that Selwyn District is a very large district with a relatively small population base.	✓
General	In terms of the risk literature, a risk-based approach requires community engagement to determine matters such as • the Selwyn community's perceptions and appetite for risk; and • options and community preferences for dealing with natural hazards. Community engagement is likely to occur as part of the District Plan Review development process, and it is there that various community perceptions of "risk" and "significant risk" in respect to natural hazards can be explored.	✕

5. Recommendations for a Risk-Based Approach – DPR

5.1 Overview - the risk-based approach

A review of the risk literature suggests that, in terms of a district plan, a risk- based approach for natural hazards management means that the outcome of the approach will be 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 none 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, are 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 traditional approaches in 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.

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 district like Selwyn 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.

However, ideally it is a systematic district wide natural hazard risk scoping assessment that provides guidance on those priorities, determined by a group of relevant experts. For instance, discussions with Environment Canterbury indicated some concern for areas of the Upper Plains where there are no records of known major flooding, but if a major flood were to occur the consequences could be quite large. A lower population does not necessarily mean that the overall risk will be low, particularly if the hazard could result in loss of lives, or significant damage to key regional infrastructure.

To implement a risk-based approach an understanding of the concept of risk and risk assessment is required. This is discussed in the next section.

5.2 Managing risk based on the scale and likelihood of a natural hazard event occurring

5.2.1 The NZCPS and CRPS definitions of risk

The NZCPS defines risk as follows:

***Risk**:*

Risk is often expressed in terms of a combination of the consequences of an event (including changes in circumstances) and the associated likelihood of occurrence (AS/NZS ISO 31000:2009 Risk management – Principles and guidelines, November 2009).

The CRPS does not define risk but **Policy 11.3.5 – General risk management approach** requires the following (our emphasis):

For natural hazards and/or areas not addressed by policies 11.3.1, 11.3.2 and 11.3.3, subdivision, use or development of land shall be avoided if risk from natural hazards is unacceptable. When determining whether risk is unacceptable, the following matters will be considered:

1) *the likelihood of the natural hazard event; and*
2) *the potential consequences of the natural hazard event for: people and communities, property and infrastructure and the environment, and the emergency response organisations.*

Where there is uncertainty in the likelihood or consequences of a natural hazard event, the local authority shall adopt a precautionary approach.

Formal risk management techniques should be used, such as Risk Management Standard (AS/NZS ISO 31000:2009) or the Structural Design Action Standard (AS/NZS 1170.0:2002).

SA/SNZ HB 436:2013 Risk Management Guidelines – Companion to AS/NZS ISO 31000:2009 (the handbook) assists in implementing the Risk Management Standard identified above (see Appendix F for a general outline of the process).

The handbook identifies risk more generally as "the effect of uncertainty on objectives". It describes the level of risk as the likelihood that a particular consequence will be experienced. Further, it states, *"the likelihood being referred to is not just that of the event occurring, but also the overall likelihood of experiencing the consequences that flow from the event".*[7]

The handbook goes on to say that typically there can be a range of possible consequences that can flow from an event and each will have its own likelihood. These mechanisms will be complex rather than simple and will often involve interactions between multiple risk sources. In Selwyn District earthquake shaking can trigger movement on faultlines, liquefaction of soils, structural failure of flood defences leading to flooding, rockfall and potentially inundation from tsunami, each with different consequences (and likelihood of consequences) on people and property depending on a number of factors including location and societal influences.

Therefore, it is not enough to manage risk based on the scale and likelihood of a natural event occurring per se. The consequences (and the likelihood of those consequences) must be integral to a risk-based approach in a district planning context.

Inherent in the risk-based approach are assumptions about acceptable and unacceptable levels of risk. There is considerable literature on this topic. Many studies attempt to "measure" the level of risk by analysing the magnitude and frequency of events adding in various assumptions and scenarios in respect to consequences and build in thresholds of what is acceptable, often based on consultation with the communities affected. This is because different communities have differing appetites for risk.

Also relevant is s6 of the RMA, which requires the management of significant risks from natural hazards as a matter of national importance (s6h). There is minimal case law to guide the interpreatation of "significant" as this clause is a recent amendment. However, risks considered

[7] SA/SNZ HB 436:2013 Risk Management Guidelines – Companion to AS/NZS ISO 31000:2009, page 8.

significant are unlikely to be applied across the board. It is more likely that what is a "significant" risk from a natural hazard will depend on the particular circumstances and location. Community acceptance and appetite for risk (whether local or New Zealand wide) is likely to an important aspect of this determination.

5.2.2 Key aspects of the risk-based approach

The key aspects of a risk-based approach include (summary)[8]:

1. Know your hazard –assess the natural hazard information, including modelling, probability and extent, commission studies where required to identify the natural hazards affecting the district.
2. Determine the severity of consequences – build a picture of the possible consequences. Who and what is vulnerable (built environment, community facilities, productive land, people), cultural, social, environmental and economic values.
3. Evaluate the likelihood of an event resulting in the identified consequences.

> **"When using judgement to develop likelihood scales (and, subsequently, assigning likelihoods to such scales), care is needed to avoid a natural bias assuming that high consequences are more likely to occur than available evidence suggests, or to be unduly influenced by the recent occurrence of a high consequence low likelihood event (e.g. a major damaging earthquake, even though the recurrence interval might be several thousand years)."**
>
> [SA/SNZ HB 436:2013 page 118]

4. Determine (qualitative or quantitative) the level of risk (using 1 to 3 above), consider mitigation regime, including district plan response (draft provisions). This will require stakeholder input about acceptability of risk. Where the level of risk is found to be low or "as low as reasonably practicable" (ALARP), or acceptable, no intervention may be the appropriate district plan response (this could be reflected directly or indirectly as a permitted activity or supportive policy direction). Alternatively, it may be the district plan response that brings the risk down to "as low as reasonably practicable". Minimum floor levels are an example of this.

> **"level of risk**
>
> **magnitude of a risk or combination of risks, expressed in terms of the combination of consequences and their likelihood."**
>
> HB page 137

5. Monitoring and evaluation – assess further necessary actions, evaluate effectiveness and acceptance of provisions, residual risk evaluation. Adapt and/or amend provisions where new information changes the known understanding of the risk. Evaluate new or emerging natural hazard risks as they become known.

[8] Adapted from Risk-based landuse planning for natural hazard risk reduction, GNS Science Miscellaneous Series 67 and NZS 9401:2008 Managing Flood Risk – A Process Standard

In respect to point 4, a simple categorisation of low, medium or high risk might be sufficient[9] to make a decision on whether the Plan needs to contain any provisions and how restrictive they need to be. It will still need to be clear why the risk from a particular natural hazard has been given that specific category, linked to the consequences and likelihood (and there is general agreement about that at a stakeholder level). Further refinement can be introduced after the broad initial categorisation if required.

On the other hand, the higher order planning documents may prescribe the need for district planning provisions and the level of restriction required in its policies and methods. Given that the higher order policy statements must be given effect to in the preparation of a district plan, those decisions on the level of risk have already been made. This issue is discussed further below.

For natural hazards that are not already captured by the higher order documents the guides in Appendix G may be helpful to categorise the level of risk of a particular natural hazard or collection of natural hazards.

The table in Appendix G is taken from SA/SNZ HB 436:2013 Risk Management Guidelines – Companion to AS/NZS ISO 31000:2009. Below is a summary of what the table developed could look like. Examples from the handbook on how consequence and likelihood might be described are also provided in Appendix G.

Table 5: Risk assessment – level of risk based on consequences and likelihood

Likelihood	**Consequences**				
	Insignificant (1)	Minor (2)	Moderate (3)	Major (4)	Catastrophic (5)
Almost certain	low	medium	high	very high	very high
likely	low	medium	high	very high	very high
possible	low	low	medium	high	very high
unlikely	low	low	medium	high	very high
unlikely	low	low	medium	medium	high

The above summary and "heat map"[10] could be used in further developing (and testing) the risk-based approach for the natural hazards section of the district plan review and included as supporting information in the section 32 Assessment for the eventual provisions/methods adopted.

5.2.3 Policy on flooding, coastal and other hazards (including high hazard areas)

5.2.3.1 Flooding and high flood hazard

In respect to flooding, the CRPS already provides the essentials for the risk-based approach. The CRPS identifies the scale of hazard to be managed in terms of flooding being 0.5% AEP

[9] SA/SNZ HB 436:2013 Risk Management Guidelines – Companion to AS/NZS ISO 31000:2009, page 62.
[10] Risk Based Approach to Natural Hazards under the RMA Prepared for MfE by Tonkin and Taylor Ltd, June 2016 page 22.

flood plain and the 0.2% High Flood Hazard (depth greater than 1m or depth x velocity exceeding 1m/s. It also includes coastal hazards in its definition of high hazard. The definition of high hazard is outlined below:

> *"High hazard areas" are:*
>
> 1. *flood hazard areas subject to inundation events where the water depth (metres) x velocity (metres per second) is greater than or equal to 1, or where depths are greater than 1 metre, in a 0.2% AEP flood event;*
> 2. *land outside of greater Christchurch subject to coastal erosion over the next 100 years; and*
> 3. *land within greater Christchurch likely to be subject to coastal erosion including the cumulative effects of sea level rise over the next 100 years. This includes (but is not limited to) the land located within Hazard Zones 1 and 2 shown on Maps in Appendix 5 of this Regional Policy Statement that have been determined in accordance with Appendix 6; and*
> 4. *land subject to sea water inundation (excluding tsunami) over the next 100 years. This includes (but is not limited to) the land located within the sea water inundation zone boundary shown on Maps in Appendix 5 of this Regional Policy Statement.*
>
> *When determining high hazard areas, projections on the effects of climate change will be taken into account.*

[CRPS – page 11-8]

The CRPS also has policy provisions and methods that are to be applied given the identified scale of flood events to be managed. Policies 11.3.1 and 11.3.2 outline the relative vulnerability of certain types of development and, where relevant, the risk to people. The explanations and reasons to these policies indicate that assumptions have been made about the consequences taking into consideration the vulnerability of the community and its infrastructure, and the social and economic environment, including expectations of safety, and the need to provide certainty on how future development will be managed. It identifies that new land uses that are unlikely to suffer material damage to land or property (for example rural activities and recreational parks), and which do not result in increased risk to life, will be acceptable in areas subject to flooding in a 0.5% AEP flood event. Small buildings, including small additions are singled out as being acceptable in these areas (i.e. the risk of costly damage is lower).

The CRPS requires Selwyn District to identify high hazard areas over the entire district (whether intended or not)[11] by 2020[12]. The work currently commissioned and discussed in section 3.1.2 (Agreed Environment Canterbury Flood Investigations) includes the identification of high hazard areas, but not over the entire district. The SDC has prioritised and commissioned what can reasonably be achieved in the time-frame for inclusion in this District Plan Review. Given that this includes areas under the most pressure for urban growth where the consequences of allowing new development in areas prone to "high flood hazard" will be significant, prioritising this area is consistent with the risk-based approach.

However, there are locations through-out the district where investigations/modelling may indicate high flood hazard within and on the periphery of existing settlements. A thorough risk-based approach to natural hazards in the District would identify those areas as soon as time and resources allowed.

Given the extensive nature of the District, the alternative to thorough district-wide risk-based assessments for high hazards commissioned by the Council , as identified earlier, is to require comprehensive reports on natural hazards for new development as a requirement of resource

[11] It is noted that there has been discussion whether Policy 11.3.1, method 7 requiring high hazard areas to be identified was intended to apply to the entire Selwyn District or just that part of Selwyn District included in "Greater Christchurch". It is the authors view that application of the policy required by method 7 intentionally applies to the entire Selwyn District (but making no judgment on whether that should be the case).

[12] Method 7(c) provides 5 years from policy 11.3.1 becoming operative. The provision that requires specified councils within greater Christchurch to identify high hazard areas was inserted by way of a change to policy 11.3.1, which became operative in late 2015.

consents or plan change processes. This enables information on the natural hazards present, and the required risk-based assessments to be provided. Consequently, specific provisions, conditions or standards can be developed on a case by case basis. Collating this site by site information in a format that is easily accessed will progress a greater understanding and awareness of the risk posed by natural hazards in the district.

5.2.3.2 Coastal hazards

In respect to the coastal hazard lines 1 and 2, the CRPS identifies that these lines may not be adequate for long term planning. It suggests that authorities within greater Christchurch may wish to undertake more detailed assessments on the effect of sea level rise and include additional zones within their district plans[13]. In respect to Selwyn District this would likely involve a high level assessment to identify areas where coastal hazards will be a particular concern for more detailed investigations. This is likely to result in targeting Taumutu, the settlements at the Rakaia River mouth and settlements at Upper and Lower Selwyn Huts.

5.2.3.3 Other hazards

For hazards not covered by policies 11.3.1, 11.3.2 and 11.3.3, the CRPS requires a general risk management approach (Policy 11.3.5). Part of the policy states:

"Formal risk management techniques <u>should</u> be used, such as Risk Management Standard (AS/NZS ISO 31000:2009) or the Structural Design Action Standard (AS/NZS 1170.0:2002)." (Underlining added)

The key word for the Council in developing an approach to managing other natural hazards in the District that gives effect to the CRPS is the word "should". The word "should" identified above is not as directive as the other polices discussed previously. Formal risk management techniques are preferred but not required.

If the Council seeks to adopt a risk-based approach based on formal risk-based techniques then the approach outlined above (section 5.2.2) is relevant. If it does not chose to, or it is considered impractical in the time frame, or too costly given the geographical spread of the district and the likely low level of risk in these areas, then alternatives to formal risk management techniques are open to the Council (some of these have already been discussed but others will be discussed later).

However, the policy framework in the CRPS does anticipate that districts will apply controls on buildings and development (either avoidance or mitigation) in areas where natural hazards are identified as a means of reducing vulnerability to loss or damage to property.

The Christchurch City Council for instance, following the CES in 2010 – 2011, and working with the Crown, identified Annual Individual Fatality Risk (AIFR's) for areas of the Port Hills deemed to be at high risk from rockfall. Using best practice advice from GNS, the Council and the Crown established a threshold of acceptability of $1x10^{-4}$. (assuming people are evacuated after the first shake). This equates to a 1 in 10,000 probability or likelihood of a person living in the Port Hills being killed at their place of residence by rockfall in an earthquake. As an upper limit of acceptability this information was used to delineate housing and other development located at or above this threshhold as a non-complying activity in the Replacement District Plan.

It is important to note that in a risk-based approach the focus has to be on the vulnerability to loss or damage to buildings or lives from the natural hazard, as the determining factor for the need for a district plan response. If there is no infrastructure, settlements, or people (or an important cultural /physical environment) likely to be affected, the risk overall is likely to be low and no specific regulatory intervention is required.

[13] CRPS 2013, page 11-9

The following are key documents for developing a risk-based approach based on risk literature documents available to the Council:

- NZS9401:2008 (Flood Risk Management – A Process Standard)
- ISO 31000: 2009 (Risk Management) (as per above)
- SA/SNZ HB 436:2013 Risk Management Guidelines – Companion to AS/NZS ISO 31000:2009.

However, there are other methods the Council can use which may be practical and legitimate given the time and resources available to the Council.

5.2.3.4 Other methods including Section 106 RMA

In respect to subdivision, the newly amended Section 106 of the RMA makes provision for the Council to manage the risk associated with subdivision of land subject to a range of natural hazards. Section 106 always enabled the Council to refuse subdivision consent or apply appropriate conditions to address the risks from some specified natural hazards. The amendments make it clear that all natural hazards come within the ambit of this section and the focus is risk-based. Section 106 (1A) in particular requires the applicant to provide an assessment of the risk from natural hazards. This is likely to be based on risk-based assessment techniques such as Risk Management Standard (AS/NZS ISO 31000:2009). Under the amended Section 106 the cost of the risk-based approach will be passed on to the developer for specific areas where subdivision is being proposed. Section 106 is outlined below:

106 Consent authority may refuse subdivision consent in certain circumstances

(1) A consent authority may refuse to grant a subdivision consent, or may grant a subdivision consent subject to conditions, if it considers that—

(a) there is a significant risk from natural hazards; or
(b) [Repealed]
(c) sufficient provision has not been made for legal and physical access to each allotment to be created by the subdivision.

(1A) For the purpose of subsection (1)(a), an assessment of the risk from natural hazards requires a combined assessment of—

(a) the likelihood of natural hazards occurring (whether individually or in combination); and
(b) the material damage to land in respect of which the consent is sought, other land, or structures that would result from natural hazards; and
(c) any likely subsequent use of the land in respect of which the consent is sought that would accelerate, worsen, or result in material damage of the kind referred to in paragraph (b).

[Section 106 – RMA)

In respect to development that does not involve a subdivision, the resource consent process or plan change process, as mentioned earlier in this report, can be used to obtain further information to target natural hazard issues. This assists where there is uncertainty or insufficient natural hazard information held by the Council at the time a new development is proposed. Overall, this approach can incrementally add to the body of knowledge of natural hazards in the District.

Other useful tools include:

- Information held on the Council's natural hazards register and on LIMs.
- Applying the provisions of Section 71 of the Building Act 2004 to buildings and structures in areas subject to, or likely to be subject to, natural hazards.

- Relying on rules in Regional Plans – e.g. earthworks and works near rivers, lakes and other waterbodies. Rules on stormwater management.
- Relying on the Building Code, for example, in respect to minimum floor levels (note that to do this only, would not give effect to the CRPS)
- Where appropriate, use Integrated Catchment Management Plans to provide information on land subject or likely to be subject to inundation from stormwater run-off, sea level rise or other natural processes (bank erosion).

Regardless of whether the Council opts to not do a full risk–based approach (as per the risk assessment literature) in its District Plan Review, or not, it is considered that it will still need to review the current objectives and policies and other wording in the Plan to ensure that the terminology used is consistent with a risk-based approach.

5.3 Managing risk when there is uncertain or insufficient natural hazard risk information

"Uncertainty is the state, even partial, of deficiency of information related to, understanding or knowledge of an event, its consequence, or likelihood."

Definition of risk – note 5
SA/SNZ HB 436:2013 page 137

Both the CRPS and the NZCPS require a precautionary approach to be adopted when there is uncertainty in natural hazard information. Policy 11.3.5 of the CRPS states:

"Where there is uncertainty in the likelihood or consequences of a natural hazard event, the local authority shall adopt a precautionary approach".

Policy 3 of the NZCPS requires the adoption of a precautionary approach towards activities whose effects on the coastal environment are uncertain, unknown or little understood and towards use and management of coastal resources potentially vulnerable to the effects of climate change.

The following document provides a useful guidance in terms of methods for dealing with uncertainty and the adoption of a precautionary approach:

Department of Conservation - NZCPS 2010 Guidance Note Policy 3: Precautionary Approach.

The guidance states that the precautionary approach is a risk management approach and is required when the risk of potential significant adverse effects or irreversible environmental effects cannot be adequately assessed because of uncertainty about the nature and consequences of activities or processes.[14] The guidance discusses prudent avoidance, adaptive management and issues relating to climate change to deal with the issue of uncertainty.

1. **Prudent avoidance** – effectively means not allowing an activity until there is sufficient scientific certainty that the activity will not create significant adverse effects.
2. **Adaptive management** – effectively means allowing an activity, subject to complex and detailed conditions and a programme of specified testing and monitoring on a case-by-case basis after weighing all relevant matters. It involves structured experimentation and responses in a situation where management can be adjusted to achieve performance objectives. Conditions or standards developed under this approach must clearly specify the level of effect that is anticipated, and if monitoring reveals the

[14] NZCPS 2010 Guidance Note Policy 3: Precautionary approach, page 6

threshold to have been reached, then the conditions or standards provides for the activity to be adjusted.

Situations where adaptive management is not appropriate include where no monitoring is proposed of the issues of concern (e.g. vulnerable species populations), or where the adaptive management cannot remedy the effects that might arise, before they become irreversible.

This process is more helpful in the resource consent situation, but work is being progressed on how adaptive management could work in a district plan process. The most likely scenario at this stage is that triggers could be identified for when a set of zone provisions would be overtaken by a new set, taking into consideration existing use rights. The standard method to achieve a change in zone provisions is the plan change process. Recent studies are investigating drafting "change over zonings" much like deferred zonings currently work. Such provisions could be used in tandem with procedures under the Building Code that can be used to render buildings unsafe for occupation.

3. **Climate change** - the guidance cautions that despite uncertainties, local authorities and applicants are required to implement risk-based precaution in responding to the effects of climate change on the coastal environment. The approach should maximise the potential for natural coastal systems to absorb much of the potential consequences of climate change including sea level rise.

   This might be able to be achieved using land use planning approaches such as avoiding intensification of land use in coastal risk areas; and investigating options to reduce existing land use intensity in coastal risk areas.

The nature of uncertainty and its effect on objectives can change over time with the result that risk will change. What is true at a point in time might not be true in the future. That is particularly so in very dynamic operating environments such as natural hazards. Ongoing 'monitoring and review' and therefore anticipation and detection of change are inseparable and important aspects in a risk management process.[15]

The precautionary approach indicated above includes exploring adaptive pathways. This is sometimes expressed as identifying multiple plausible future scenarios or "what ifs". There is no need to attempt to predict one "likely" future but consideration of multiple possible futures. This approach requires identification of a tipping or trigger point – this point identifies when a particular action will no longer be adequate for meeting the Plans objectives and a new action is necessary. The identified trigger point – specifies the conditions under which a specified action to change the plan is to be taken. This could include implementing, for example, a setback provision prohibiting new buildings being erected which increases landward as sea level reaches specified markers.

The main point is that regardless of what words are finally drafted into the Plan and agreed through the planning process, the Council needs to be well prepared for climate change. That may mean setting up a system through this review process to monitor the effects of climate change so that if various trigger points are reached, plan changes can be initiated.

5.4 Key Recommendations

1. The CRPS indicates that the coastal hazard lines 1 and 2 may not be adequate for long term planning. It is recommended that SDC commission, in the first instance, a high level coastal hazard assessment to identify areas where coastal hazards will be a

[15] SA/SNZ HB 436:2013 Risk Management Guidelines – Companion to AS/NZS ISO 31000:2009, page 9

particular concern, followed by more detailed assessments as recommended by the coastal expert. This is likely to result in targeting Taumutu, the settlements at the Rakaia River mouth and settlements at Upper and Lower Selwyn Huts.

2. Investigations on residual risk were not included in any of the reports reviewed in this report but is a requirement under Policy 11.3.5 (method 5) of the CRPS. A brief investigation into how this is addressed in other parts of New Zealand is recommended.
3. Research other district councils in respect to section 32 requirements to provide economic assessment/evaluation of natural hazard provisions. Seek guidance from other council's planners/economic analysts who have already been through a second generation hearing process in respect to natural hazards provisions.
4. If a risk-based approach, as per the risk-based literature outlined in this report, is preferred, the Council develop and adopt a simple categorisation of level of risk from natural hazards in the district of low, medium and high (and include subgroups later if greater detail required) using a group of technical experts to assist this process. The group could include technical experts from Environment Canterbury, iwi, MBIE and some of the Councils own natural hazard experts and consultants, to the extent possible, with the information available, in the timeframe. Where the risk is low consider responses outside the district plan. Where the risk is determined medium or higher consider a range of options including regulation in the district plan. Draft relevant provisions for each.
5. Where a full risk-based approach as per the risk-based literature outlined in this report is not practical in the circumstances, adopt a process where risk-assessments are required on a case-by-case basis before new development proceeds. Use Section 106 of the RMA, the resource consent process and plan changes as necessary (with rigorous information requirements and matters of discretion outlined in the reviewed District Plan). Any of the other methods outlined above, including, where relevant, methods outside the Plan (evacuation planning for example) should be considered.
6. Draft the required policies and provisions to give effect to the higher order documents for natural hazards that have already been carefully prescribed in policy under a risk-based approach (flooding, high flood hazard, coastal erosion and inundation, fault traces and liquefaction) to the extent possible in the time-frame available. Be prepared to initiate variations/plan changes for areas not able to be included at notification of the Proposed Plan.
7. Regardless of whether a full risk-based approach as per the literature is adopted, review the current objectives and policies, and other wording in the Plan, to ensure that the terminology (and hence the focus of provisions) adopted in the District Plan Review is consistent with the risk-based approach.
8. Deal with uncertainty based on the requirements of both the CRPS and NZCPS: that is: adopt a precautionary approach. That approach requires – prudent avoidance or adaptive management (adjust management through monitoring and review), or in the case of climate change maximise the potential for natural coastal systems to absorb much of the potential consequences of climate change including sea level rise, through a range of techniques such as avoiding intensification of land use in coastal risk areas. Exploring adaptive pathways is recommended. That may mean setting up a system through this district plan review process to monitor the effects of climate change so that if various trigger points are reached, plan changes can be initiated.
9. Do not await the National Policy Statement on Natural Hazards as it could be more than 12 months away but keep abreast of the conversations occurring for input into policy.

Be prepared to change/vary the Plan to give effect to any inconsistencies once a NPS is approved.

10. For further information on the risk-based approach the following documents are recommended:
    - NZS9401:2008 (Flood Risk Management – A Process Standard)
    - ISO 31000: 2009 (Risk Management)
    - SA/SNZ HB 436:2013 Risk Management Guidelines – Companion to AS/NZS ISO 31000:2009.

Appendices

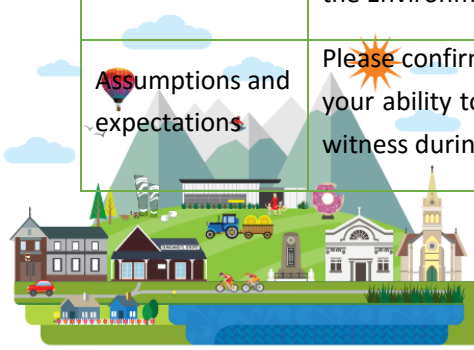
Appendices

Appendix A – Project Scope of Works

DISTRICT PLAN REVIEW SUPPLIER PANEL
PROJECT SCOPE OF WORK

RELEASE DATE:	Monday 8 May 2017
CLOSING DATE FOR PROPOSALS:	COB Wednesday 17 May 2017
TOPIC NAME:	Natural Hazards
SCOPE TITLE/DESCRIPTION:	Advice on Risk Based Planning for Natural Hazards
SERVICES REQUIRED:	Planning
INTERDEPENDENCIES/LINKS:	Outputs from this Scope of Work feed into the Scope for 'Development of District Plan provisions for the management of natural hazard risk to the development, use and subdivision of land'

Contact information	**Project Manager:** Emma Hodgkin Project Manager District Plan Review Phone: 021 2401 242 Email: emma.hodgkin@selwyn.govt.nz	**Technical Contact:** Michael Rachlin Strategy and Policy Planner Phone: 03 347 2936 Email: michael.rachlin@selwyn.govt.nz
Project Scope	The Canterbury Regional Policy Statement, New Zealand Coastal Policy Statement and best practice* promote a risk-based approach to managing natural hazard risk to people and property. The Council defines a risk-based approach as: - Managing risk when there is uncertain or insufficient natural hazard risk information - Managing risk based on the scale of a particular natural hazard event, together with the likelihood of that event occurring and the effects on people and property. The Operative District Plan does not incorporate a risk-based approach. The Council currently holds/is aware of a number of existing reports/information sources that identify natural hazard risks within the district. These reports/information sources are identified in Attachment 1. They post-date the Operative District Plan and do not inform the associated district plan provisions for natural hazard risk. **Risk-based land use planning for natural hazard risk reduction* – GNS, September 2013 (GNS Science Miscellaneous Series 67); *Risk-based approach to natural hazards under the RMA* – Tonkin & Taylor, June 2016 (publication ref: 31463.001, prepared for Ministry for the Environment).	
Assumptions and expectations	Please confirm that you have no actual or perceived conflicts of interest that may impede your ability to complete the Deliverables and Outputs set out below or to be an expert witness during the hearings and appeal stages of the Review.	



	The consultant will need to assign a project manager responsible for liaising with the SDC contact person and confirm with SDC the project cost break down prior to the work commencing. Weekly updating of progress and identification of any issues or risks to delivery will be required. The consultant will be expected to liaise and/or work directly with Mahaanui Kurataiao Ltd in delivery of this Scope of Works and to be familiar with the content of the Mahaanui Iwi Management Plan as relevant to this Scope of Works. It is assumed that the consultant will work closely with SDC, clarifying scope and confirming direction as the project progresses. The consultant should advise of any specific documents, data or planning assistance required from the Council in order to complete the project.

DELIVERABLES AND OUTPUTS

Stage 1: Review of Operative District Plan

Familiarisation with the operative Selwyn District Plan, including looking at the SWOT Analysis Framework and the DPR SDP Summary Provisions Table for the natural hazards topic area (provided with this Scope of Work).

Stage 2: Review Current Natural Hazard Information Base

Please provide a written report covering the following matters:

1 A summary and review of the natural hazard reports and information base, listed in Appendix 1 and the flood investigation scope of works agreed with Environment Canterbury in Appendix 2. This shall be done by natural hazard types; and

2 Review the Mahaanui Iwi Management Plan and identify relevant policy guidance or outcomes anticipated in respect of managing natural hazard risk including climate change. Any liaison or collaboration with Mahaanui Kurataiao Ltd required in order to interpret and/or apply the provisions of the Plan is to be facilitated through the Selwyn District Council technical contact. As the time required to liaise with Mahaanui Kurataiao Ltd is unknown you may wish to cap the hours specified with an hourly rate applying for additional time over and above the capped hours.

3 An evaluation of their appropriateness for land use planning purposes within a District Plan; and

4 Identify any gaps in the information base by natural hazard type

5 Based on 1 to 3, provide recommendations for a risk-based approach to managing natural hazard risk to people and property in the replacement district plan which includes:
- Managing risk when there is uncertain or insufficient natural hazard risk information.
- Managing risk based on the scale of a particular natural hazard event, together with the likelihood of that event occurring and the effects on people and property.

POTENTIAL SCOPES OF WORK

N/A

TIMEFRAMES

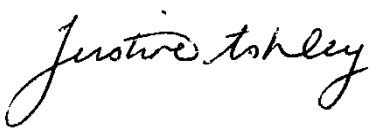
Please provide an estimate of time to complete Stages 1 and 2, and a first draft of the report. As a guide the Council had anticipated a timeframe of approximately 5 weeks for completion of the first draft. This will be followed by a 2 week review period by SDC.

BUDGETS AND PAYMENTS

Please provide a fee estimate to complete the above Deliverables and Outputs.

The fee estimate should identify the personnel undertaking the work, their hourly rate and number of hours to complete the tasks. Any assumptions or tags should also be clearly identified.

Please note that this estimate must be consistent with the pricing schedule outlined in your Supplier Panel Agreement.

Final Sign-off		
	Who	**Signature**
Project manager:	Emma Hodgkin	
Prepared by:	Michael Rachlin	
Reviewed by:	Justine Ashley	
Approved for issue by:	Emma Hodgkin	

APPENDIX 1

List of current natural hazard reports for Selwyn District:

- General distribution and characteristics of active faults and folds in the Selwyn District (ECan/GNS report 2012/325, R13/27 – July 2013).
- Greendale Fault: investigation of surface rupture characteristics for fault avoidance zonation (ECan/GNS report 2011/121, R11/25 – May 2011).
- Review of liquefaction hazard in eastern Canterbury, including Christchurch City and parts of Selwyn, Waimakariri and Hurunui Districts (ECan report R12/83 – December 2012).
- Halswell River/huritini floodplain investigation (ECan report R12/68 – June 2013).
- Hikurangi Subduction Zone and Wairarapa Fault tsunami modelling for the Canterbury coast (ECan report R15/130 – October 2015).
- Updated inundation modelling in Canterbury from a South American tsunami (ECan report R14/78 – November 2014).
- Appendix 5 of the Canterbury Regional Policy Statement showing revised coastal hazard lines.
- Geotechnical Summary Report – Porters Expansion Project 12 July 2010 – URS plus review by Clive Anderson for SDC, June 2011.
- Development of Design Rainfalls for Selwyn District (Opus 2009).
- Opus Memo to SDC, dated 9 June 2010.
- Geotechnical reporting for subdivision applications (Geotech Consultancy Ltd, July 2013).

APPENDIX 2

Agreed Environment Canterbury flood investigations works for Selwyn district:

Project Purpose

1 To review and update all flood risk areas identified on the planning maps to the Operative District Plan against the 200 year ARI flood event and 500 year ARI flood event flood event requirements of the Canterbury Regional Policy Statement, where this is known or modelled.

2 To identify other areas at risk of flooding for which further investigations could be considered by the Selwyn District Council.

Output

1 A single report addressing flood risk within the Selwyn district. This report will identify and refer to other already published (or soon to be published) ECan technical reports for the Selwyn/Waikirikiri, Halswell/Huritini and Waimakariri Rivers.

2 GIS maps identifying areas at risk of flooding in a 0.2% AEP flood and 0.5% AEP flood event.

Time

1 Draft report and mapping will be made available to Selwyn District Council within 10 months of SDC/ECan agreeing this scope of work.

2 Following SDC review and comments on draft report, final report, mapping and GIS shapefiles (excluding 3 below) will be published and made available to the Selwyn District Council as soon as reasonably practicable following the receipt of SDC comments.

3 Final flood area mapping and GIS shapefiles for the Waimakariri River breakout will be made available to the Selwyn District Council by the mid-2018.

4 The Selwyn District Council would wish to see, where this is possible, for work on the Te Waihora/Lake Ellesmere flood area and the Lower Plains flood area to be prioritised since this affects the Greater Christchurch part of the district where high growth is occurring.

The Work will include:

A brief history of the existing district plan flood mapping (including who undertook the mapping and the information it is based on).

Lower Plains and Te Waihora Flood Areas

- A review of the Lower Plains Flood Area and Te Waihora Flood Area utilising up to date LiDAR and other records, and present options for updating GIS maps to define areas at risk of local rainfall runoff flooding/ponding together with an assessment of the merits of the options.
- Identify the mapping methodology including whether it is based on historical photographs and records rather than modelling.

- Assess whether the Lower Plains and Te Waihora flood areas should be amalgamated for land use planning purposes and rationale for this.
- A discussion on the accuracy and limitations of the mapping.

Selwyn/Waikirikiri River

Provide a brief outline of the flood modelling investigations being undertaken by ECan and provide maps of areas likely to be affected by flooding from this source. Further detail regarding this modelling will be contained in a separate published ECan technical report to be referenced in the report to SDC.

Waimakariri River

- Provide a brief description of the Waimakariri River flood protection scheme (primary and proposed secondary stopbanks). Comment on the flood risk to areas of the Selwyn District based on ECan's current understanding of the hydrology, channel capacity, scheme standard and risk assessment of bank failure. Further detail will be available in a separate published ECan technical report.
- Provide mapping of areas that may be at risk of inundation from the Waimakariri in a 200 year ARI flood event (likely none) and map areas that could meet the RPS definition of 'High Hazard' areas (likely limited to areas between the primary and proposed secondary bank). It is likely that high hazard areas will be quantified with modelling at a later date, but this information is unlikely to be available prior to notification of the plan.

General

- Provide maps of high hazard areas where model results are available (i.e. Halswell catchment and Selwyn floodplain, and in time Waimakariri River floodplain). 'Smooth' the model results to identify the main high hazard areas and remove minor isolated areas. Describe the methodology for the mapping and any limitations or other issues regarding accuracy of the mapping.
- Provide some general comments around the approximate time it would take for water in the identified high hazard areas to pond to 1m in depth in the modelled scenarios. It should be noted that these times will be highly variable within a given ponding area for a given event, and would also vary depending on the type of rainfall event. These limitations on use and accuracy of the ponding times will be identified in the report to SDC.
- Identify and describe any climate change scenarios/assumptions used in any flood modelling or reference where this is available in other published reports for the Selwyn/Waikirikiri, Halswell/Huritini and Waimakariri Rivers.

Other

- Provide comment on information available for the remainder of the district, and potential gaps in the mapping. Identify future work that could be done to address the potential flood risk in these areas (predominantly upper Selwyn catchment), and to better quantify the flood risk in the 'Lower Plains' flood areas.
- The above will describe the potential flood risk from the Rakaia River based on the best information available at the time of writing.

- ECan technical staff will be made available to present findings of the reports to Selwyn District Council's District Plan Committee.
- ECan technical staff will be available to help inform and/or be involved in any community engagement project related to the technical findings and mapping.

Appendix B SWOT analysis provided by SDC

Relevant Legislation or Planning Document	Level of 'regard' required	Key Outcomes Sought	Key Approaches within District Plan for achieving these outcomes?	Comments arising from a review of resource consent data, complaints, monitoring etc	Feedback from other sources i.e. community, stakeholders, consultants etc	Overall assessment of whether the District Plan achieves the outcomes sought?
NATURAL HAZARDS						
RMA 1991 • s7 and s31	High	Particular regard to be had to climate change (s7). • Purpose of district plan includes control of the effects of development for purpose of avoiding or mitigating natural hazards (s31)	See analysis under RPS and NZCPS	See analysis under RPS and NZCPS		**Overall comment** The operative district plan achieves s31 insofar as it does manage development for purpose of avoiding or mitigating natural hazards but it does not have particular regard to climate change. In order to continue to implement requirement of s31 the following issues are identified for the DP review: • Understanding of natural hazard risk in the district including effects of climate change and how to manage risk. • Improving clarity regarding how and when natural hazard risk will be managed and to what level • Requirement to give effect to the changed planning framework for managing natural hazard risk contained in higher order documents (RPS and NZCPS). • Consideration of the role of the district plan in managing natural hazard risk alongside other methods and responsibilities under other statutes.
<u>Earthquake Recovery:</u> Recovery Strategy (RS) and LURP	High (s15 and 23 CER Act)	Draw on sound information regarding natural hazards including climate change. (RS) Where necessary avoid development in high hazard areas	As per RPS	N/a	N/a	• Requirements of RS and LURP distilled into RPS and NZCPS. See discussion under RPS & NZCPS.
Amending and Reform Legislation Resource Legislation Amendment Bill 2015: s.6(h) s.106 To be supported by NPS on Natural Hazards – anticipated to be operative in 2018 Stage: Select Committee report due early June 2016	Low	New matter of national importance: • "the management of significant risks from natural hazards" • S106 provisions to be amended to refer to "significant risk from natural hazards" and include direction that assessment of risk involves the likelihood of the hazard occurring, the damage it may cause and how proposed use of the land would accelerate or worsen damage. • Recovery Strategy and LURP likely to become Regeneration Plans.				**Comments:** • New s.6 matter reinforces role of management of natural hazard risk in promoting sustainable management. • "significant" will need to be addressed and perhaps defined in the district plan. • Again issue of meaning/understanding of "significant". • District Plan will need to give effect to the NPS so timing likely to be an issue, given plan notification date of September 2017. Any appeals following hearings decisions likely to involve issue of giving effect to the NPS if it released in 2018. • Unlikely to materally alter the legisalative and higher order context for managing natural hazard risk in the district plan review.

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Greater Christchurch Regeneration Bill Stage: Select Committee report received 25th February 2016.						
New Zealand Coastal Policy Statement (NZCPS) http://www.doc.govt.nz/Documents/conservation/marine-and-coastal/coastal-management/nz-coastal-policy-statement-2010.pdf	High	Manage coastal hazard risk, including effects of climate change, by (Obj 5): • Locating development away from risk prone ares • Other responses such as managed retreat • Protecting and restoring natural defences. Includes requirements (Policies 3, 24, 25 & 26) to • Identify areas in the coastal environment1 affected by hazard risks over next 100 years including cumulative effects of sea level rise ("SLR") and storm surges. • Avoid increasing risk from coastal hazards • Protection and restoration of natural defences • Adopting a precautionary approach [1]defined in Policy 1	Rural Objectives seek: • Activities do not cause or exacerbate hazards • Mitigation measures do not exacerbate effects on environment *Rural Policies and rules provide for:* • Erection of a dwelling or principal building and utility buildings are non-complying seaward of Coastal Hazard line • Residential subdivision and subdivision where a principle building could be erected seaward of Coastal Hazard line are non-complying. • Other subdivisions seaward of Coastal Hazard line are RDA with discretion over allotment shape, utilities and point strips. *Other:* • Manufacture and disposal of hazardous substances are discretionary and non-complying (district wide), but		<u>DoC:-</u> Comments contain a number of questions including: • Have all areas affected by natural hazards been identified? • What knowledge is there of faults in the district? • Will changing sea levels impact on the ability to open Te Waihora? • Is there a flooding issue at Rakaia Huts? • Are there areas where significant development is affected by coastal hazards? Other comments include: • It would be useful to identify areas subject to different flood risks. • Need to identify role of various organisations in management of natural hazards. • A new objective to take into account NZCPS Policy 25 is needed. For example the area of rapid erosion	**Strength:** • Dwellings and other buildings, and residential subdivision are avoided seaward of hazard line. • A coastal hazard line is shown in the Planning Maps. **Weaknesses:** • Objectives and policies would benefit from improved clarity and direction. In particular Obj 3.1.1 and Policy B3.1.2 in terms of more clearly identifying/articulating the outcomes sought, direction on what is "acceptable" and "unacceptable" risk, and on the methods to achieve outcomes. • Controls should be extended over inappropriate land uses as well as inappropriate buildings and subdivisions. Plan does not manage the land-uses that give rise to the need for buildings forward of the coastal hazard line for example storage of hazardous substances. • Coastal Hazard lines now out of date and need to include effects of SLR and storm surges as required by NZCPS • Need provisions that better enable the protection and restoration of natural features which mitigate the effects of coastal hazards. **Opportunities** • Can build on existing provisions which already avoid some inappropriate activities in mapped coastal hazard areas • Improved clarity to objectives and policies will provide better direction including what is "unacceptable" and "acceptable" risk, and what development is inappropriate • Coastal hazard lines already mapped in the district plan and so represent an established resource management tool **Threats** • Potential cost of remodelling hazard line and areas affected by seawater inundation. • Resistance from landowners to possible further restrictions on their activities • Disagreement over effects of climate change and how to incorporate into new model, for example SLR **Overall comment:** The operative plan has successfully managed development seaward of the coastal hazard line, but it is unclear whether the lack of development pressure may have contributed to this. Main driver in the DPR is the changed requirements of the NZCPS and need to give effect to this. This includes: • the need to update identification of coastal hazard in the district including seawater inundation • opportunity to improve clarity and direction provided by objectives and policies

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			storage is permitted • Other activities captured by general district wide rules such as prisons and industry in rural areas which are discretionary and non-complying respectively. • Anticipated environmental outcomes: • Houses not erected in areas prone to coastal hazards or Waimakariri floodplain		from Rakaia mouth to Taumutu, overtopping of Kaitorete Spit, effects of Te Wainhora opening on shoreline stability • Policy B3.1.2 is supported but the bed of Te Waihora should include the area covered by major floods (1% AEP). • Policy B3.1.3 is not supported • The Lower Selwyn Huts need further discussions between DoC and SDC; copy of special conditions for hut leaseholders provided.	• gaps in district plan coverage including role of climate change in hazard identification and enabling restoration of natural features which mitigate effects of coastal hazards
Regional Policy Statement Chapter 11 – Natural Hazards Chapter 10 – Beds of Rivers and Lakes and their Riparian Margins Chapter 6 - Greater Christchurch Chapter 5 – Land use and infrastructure Definitions: High Hazard areas and critical infrastructure http://ecan.govt.nz/our-responsibilities/re	High	Objective 11.2.1 – • New subdivision, use and development avoid risks associated with natural hazards • Where avoidance not possible, mitigation to minimise risk. Objective 11.2.2 – • Hazard mitigation does not create adverse effects, or effects are able to be mitigated • Objective 11.2.3 – • Effects of climate change recognised and provided for. Objective 11.2.4 – • Agencies and organistations cooperate in the management of risks of natural hazards. • RPS Policies • Define High Hazard Areas and avoidance policy (using 0.2% AEP event for flood hazards) • Manage risk of 0.5% AEP flood event • Manage earthquake risk • Manage risk to critical infrastructure • General risk management approach for other hazards • Recognise role of natural features • Manage physical works	**Township Volume** Objectives seek: • Minimise adverse effects from slope stability (Ob B1.1.1) • Activities do not intensify effects of natural hazards (Ob B3.1.1) • Mitigate loss of life or damage to property from natural hazards (Ob B3.1.2) • Manage adverse effects of natural hazard mitigation. (Ob B3.1.3) • Policies requiring consideration of natural hazards when rezoning land for residential or business use in Arthur's Pass,	<u>Port Hills</u> For new dwellings in the Port Hills resource consents required due to location within VAL (controlled) or within Lower Slopes (restricted discretionary) and Upper Slopes (non-complying). A geotechnical assessment is required to confirm the suitability of the site for the development proposed. Rule also refers to "Port Hill Areas" which lacks clarity <u>Lower Plains Flood Area and Lake</u>	<u>ECan: –</u> **Flood hazard:** • Current approach of mapped flood areas and a permitted activity rule based on use of minimum floor levels provided by ECan is working well. • Might be need to include areas affected by local rainfall events into the Lower Plains Flood Area (Doyleston, Leeston and Southbridge). • Currently finalising floodplain investigation for	**Strengths** • Approach to managing risk from flooding working well • Flood hazard areas are mapped • Recognition of natural hazard risk in township growth policies (for plan changes) • Liquefaction and lateral spread a matter for discretion in subdivisions but only in Living Zones **Weaknesses** • Management of geotechnical and earthquake hazards is inconsistent (for example a controlled activity in VAL and RDA on ONLs only if building height limits or floor areas breached – floor area controls and heights limits set for amenity purposes). In case of VAL only applies to dwellings and not to other buildings) • Lack of integration with "other methods", eg SDC's Engineering Code Of Practise • Objectives and policies would benefit from improved clarity and direction. In particular Obj 3.1.1 and Policies B3.1.2, B3.1.5, B3.1.6 & B3.1.7 in terms of the outcomes sought, guidance on what is "acceptable" and "unacceptable" risk, and how risk is to be managed. • Based on out of date information, e.g. mapped flood areas now need to be mapped to 0.2% and 0.5% AEP events to reflect RPS requirements. • Reliance on section 106 RMA rather than being more upfront and directive regarding natural hazards. • Although flood hazards are mapped in the district plan, no other hazard areas are similarly mapped at land-use planning scales (for example slope instability areas, liquefaction areas, fault avoidance areas).

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gional-plans/rps/proposed-crps-2011/Pages/Default.aspx		• Have particular regard to effects of climate change • Integrated management • Coastal hazards lines identified in RPS for greater Christchurch until replaced by provisions in district plan Objective 6.2.1 – Recovery Framework (only applies to UDS part of district). • Recovery framework seeks to protect people from unacceptable risk from natural hazards and effects of sea level rise Objective 10.2.2 • Maintenance of flood carrying capacity of rivers • Policy 5.3.2 – Development conditions (Wider Region) • To enable development including regionally significant infrastructure which avoid or mitigate natural and other hazards, or land uses that would likely result in increases in the frequency and/or severity of hazards;	Coalgate, Doyleston, Hororata, Leeston, Lincoln, Sheffield/Waddington, Southbridge, Springston, Tai Tapu and Whitecliffs. • Policies avoid development between a waterbody and stopbank and within bed of rivers and lake (B3.1.3); ensure use of minimum floor levels in Tai Tapu to avoid a 2% AEP event (B3.1.4) and ensure earthworks in Tai Tapu do not divert floodwater (B3.1.5). • Policies manage effects from natural hazard mitigation (B3.1.6) • Controls on earthworks, buildings and subdivision within the Living 1A & 2A Zone, Tai Tapu (Rules 2.1.5 4.1.1) • General controls on volume and cut face height (Rule 2.1.1.6) • Dwellings, additions or principal buildings at Rakaia Huts non-complying activity (Rule 4.1.3) • Any dwelling between a river and stopbank – prohibited activity. (Rule 4.1.4) • Geotechnical assessment in	<u>Ellesmere Flood Area</u> For new dwellings in the Lower Plains Flood Area, in almost all cases the application includes a letter from ECAN that assesses the flood risk and recommends a minimum floor level, which the applicant proposes to comply with to meet district plan requirement (Rule 3.1.1.1d & e). <u>Waimakiriri A Flood Area</u> • Non-complying consents processed indicate some sites are outside a high hazard (new RPS definition) area and outside 0.5 AEP event area, which indicates mapped area may need reassessment. <u>Earthquake Hazard</u> • A small number of subdivisions have been considered that involve faultlines. The risks were assessed through a geotechnical report under	Selwyn River and could do some mapping for the Upper Selwyn River. • Waimakariri A flood area needs to be reassessed due to secondary stopbank – likely to involve a reduction in area subject to land use controls. **Geological and Seismic:** SDC has all the relevant information on this held by ECan. Tsunami modelling is only suited for Civil Defence work Regional active fault report published for district. Mapped at 1:250,000. Gvien scale, best used as an "alert layer". Greendale fault has been mapped at a more detailed level, suitable for land use controls in accordance with MfE guidance http://www.mfe.govt.nz/node/20772/ Given sparsity of population in High Country and associated areas, SDC's current pragramtic approach in relation to geotechnical investigation might be appropriate. Land instability in Arthurs Pass currently being investigated.	• No policy direction on how climate change effects are to be managed. • District Plan does not incorporate a risk based approach to natural hazard management. For example all buildings in ONL where they breach height rule require consideration of geotechnical conditions regardless of whether risk is to life or property. **Opportunities** • Update and extend mapping • Consider ways to better integrate with other methods and reduce overlap/'double dipping' with controls under other legislation and processes. • Improve level of direction for the management of natural hazards • Consider use of "certification" and other methods to reduce consenting burden • Implement a risk based approach to natural hazard management **Threats** • Determining the extent to which the District Plan needs to identify hazards versus putting cost onto applicants • Cost of remodelling flood plains and other natural hazard risks • Community concern • Scale of tasks and ability to deliver within timeframes • Effects of climate change and assumptions used in remodelling work need to be agreed • Consistency of approach with adjacent TAs **Overall comment:** • The operative DP has had a degree of success and has achieved the anticipated environmental results for flooding. In terms of not siting buildings on land prone to slips this is harder to guauge due to lack of monitoring. • Notwithstanding this, the following issues have been identified: **Flooding:** • Known high hazard areas (as now defined in the RPS) have not been identified. For example parts of the Halswell River floodplain currently subject to the minimum floor level management approach may contain high hazard areas (see ECan Technical Report R12/68) • (http://ecan.govt.nz/publications/Reports/halswell-river-floodplain-investigation-r12-68.pdf) where inappropriate development is now to be avoided. • The district plan mitigates to a lower level than now required (ie floor levels currently only protect from a 2% AEP event rather than 0.2% AEP) • Inappropriate land uses need to be avoided in high hazard areas and not just inappropriate buildings and subdivisions. • Need to reassess the three mapped flood areas to take into account effects of climate change and the requirements of RPS (0.2 % AEP and 0.5% AEP flood events) • There is a need to update coastal hazard lines and to incorporate sea water inundation into consideration of coastal hazards **Fault lines, rockfall, landslips:** • Lack of risk based approach to managing seismic and geotechnical risk • Need for a more consistent approach to managing seismic risk including in areas where mapping of faults not to a scale suitable for land use planning purposes and also in relation to Greendale fault which has been mapped

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			respect to liquefaction and lateral spread, matter for discretion for subdivision in Living Zones (Rules 12.1.4.12 and 12.1.4.13) **Rural Volume** People and their property are not affected by unstable land (Obj B1.1.2) Activities do not cause or exacerbate natural hazards (Obj 3.1.1) Manage adverse effects of natural hazard mitigation . (Obj B3.1.2) • Policy to avoid multi storey buildings in Malvern Hills or High Country (Pol B3.1.6), but no specific rules to implement. Managed by building height limits; over 4m is a restricted discretionary activity with discretion retained over site stability. (Rule 3.2.4) • Slope stability policies seek to manage earthworks and to ensure low risk of damage from earthquakes and slips, and to avoid adverse effects on people and property (B1.1.4, B1.1.5 & B1.1.7) • Policies avoid development between a waterbody and stopbank; within bed of rivers and lake; seaward of coastal hazard line	s106 RMA. Otherwise not a matter for control listed for rural subdivisions.	The 'ECan liquefaction line' can continue to be used for managing liquefaction in the district. This identifies areas in Greater Christchurch more susceptible to liquefaction: http://files.ecan.govt.nz/public/r12-83-liquefaction-hazard-canterbury-report.pdf <u>River Engineers:</u> • Halswell Drainage Rating District is now at capacity. This is likely to have implication for subdivisions in Lincoln and Prebbleton including new rules from the Selwyn-Waihora sub-regional plan. • Reference should be made in the District Plan to the regional counci's Flood Protection and Drainage Bylaw • River engineering works and tree planting within 20m of water bodies for flood defence purposes should be a permitted activity. • ECan operate a number of drainage rating schemes in the district primarily to manage erosion and flood mitigation. Works required	• Inconsistent rule triggers for geotechnical assessments and consideration for new dwellings and buildings in Port Hills, Malvern Hills and High Country ; triggers generally based on building height, which is not a risk based approach. • Acceptable risk level for activities not identified in district plan. • Limited policy direction on how and when geotechnical hazards will be managed by the district plan and to what level. **Liquefaction** • Area susceptible to liquefaction not identified in district plan. Relies on information that sits outside of the district plan. • No policy direction on how and when liquefaction will be managed by the district plan and to what level. Instead assessment matter 12.1.4.12 drafted as a policy. **Other natural hazards such as snow, wind and fire** • District Plan does not articulate why these natural hazards are generally managed by other methods rather than district plan rules unlike flooding and geotechnical hazards. **Enabling hazard mitigation works** • Agencies such as ECan and SDC control important hazard mitigation assets such as stopbanks, and stormwater management systems. These assets need active management. At this stage no issues identified in the ability to manage these assets under the district plan except with Te Waihora openings. **Climate change** • Lack of policy direction on how and when effects of climate change will be managed and its role in land use planning . This includes the modelling of risk. **Definitions** • Need to consider inclusion of definition of "high hazard" to support policy framework and approach to managing risk from natural hazard as per RPS definition • Need to consider inclusion of definition of "critical infrastructure" to support policy framework and approach to managing risk from natural hazard as per RPS definition • District Plan includes natual hazard mitigation works within definition of "utilities" and these benefit from few controls. Given broadness of definition, the wide range of works it provides for and their potential environmental effects, definition needs to be reconsidered since it does not implement the objectives of the plan (B3.1.2) and could create tension with RPS policies. • Need to consider extending the application of the definition of "Building Importance Category" provided for Porters Ski Area to othe parts of the district.

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			and Waimakariri flood area (B3.1.2); ensure use of minimum floor levels in identified flood areas to avoid a 2% AEP event (B3.1.3) and ensure earthworks in identified flood areas do not divert floodwater (B3.1.4). • Policy to manage adverse effects of natural hazard mitigation methods (B3.1.8) implemented by Rules 3.1.3 & 1.4.2 which retain discretion over effects of floor levels and earthworks on displacing floodwater. • Controls on earthworks in flood areas (Rule 1.4.1.2) • General controls on volume and cut face height of earthworks (e.g. Rule 1.5.2) • Discretion to consider a fire management plan for plantations, shelterbelts and amenity plantings that require resource consent • Controls on new dwellings or principal buildings, roads, utility structures and buildings in flood hazard areas and coastal hazard		under this should be permitted. • Enable opening of Te Waihora as a permitted activity to assist hazard management for Selwyn district. • Effects on land drainage should be included in matters of discretion as well as flooding e.g. Rule 4.1 • Include requirement for utility buildings not to impede or divert flood waters. **SDC (Internal Feedback):-** Andrew Mazey (Asset Manager - Transportation) • No real issues in relation to district plan and natural hazards in terms of road network. Generally managed under their own powers and asset management plans. • Engineering Code of Practise is being updated to one that will be used throughout Greater Christchurch – reference in DP will need to be amended accordingly • One issue is works in riverbeds to	

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			areas (e.g. Rules 3.1.4 and 3.1.1.1d) • Controls on new dwellings and/or buildings in Port Hills Visual Amenity Lanscape Area and Outstanding Natural Landscape in relation to slope stability and geotechnical condition of site. (Eg Rules 3.2.2, 3.2.1, 3.2.4, 5.6.2) • Controls on subdivision within flood hazard and coastal hazard areas (Rules 10.2.1 & 10.2.4) • Lower plains flood area mapped (2% AEP event) • Waimakiriri flood plain area mapped (based on ECAN modelling of likely outbreak point) • Lake Ellesmere flood area (stormwater ponding due to high groundwater table) Maintenance, upgrade, operation and replacement of existing natural hazard mitigation works are generally permitted (Definition of utility, Rules 5.1.1, 18.1.1 and 6.1.1.9) Earthworks for maintaining and repair of flood protection works exempt from earthwork controls in townships. No similar exemption in Rural zones.		maintain assets such as bridges. Needs to be more enabling (likely to be a regional plan matter) Murray England (Asset Manager – water) • Floodwater diversion scheme being constructed for Leeston. Others to be considered for Doyleston and Southbridge but need ratepayer approval. • Stormwater Management Plans to be prepared for each township. ECan consented SMPs exist for Lincoln, Rolleston and Castle Hill. • SMPs will only cover existing zoned areas. New areas will be responsibility of developers. • 2010 Opus climatic cycle report due to be updated. • In addition new Lidar information and rapid assessments being carried out. • There is a need to retrofit pipes and culverts to reduce flooding as part of stormwater management. • DP consenting requirements	

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			Porters Ski & Recreation Area is subject to its own package of rules controlling activities, earthworks, subdivision and buildings to reflect the natural hazard risk and intensity/nature of development within the management area.		generally not a problem. Vanessa Beavan (Business & Training Development Leader – Building Control) • General difficulty in use and understanding of the DP • Public confusion and lack of understanding of differences between RC and BC systems • Risk of 'double dipping' ie mitigating natural hazards required by DP and Building Act. • Need to educate public about level of investigations (e.g. liquefaction) at subdivision stage versus that required at BC stage. • Use of Building Act for managing natural hazard risk is not strongly embedded in terms of actually declining consents under s71. More focus on "adequate provision" approach to risk management. • If more use made of the Building Act rather than DP to manage natural hazard risk then stafft raining/ development required.	

Relevant Legislation or Planning Document	Level of 'regard' required	Key Outcomes Sought	Key Approaches within District Plan for achieving these outcomes?	Comments arising from a review of resource consent data, complaints, monitoring etc	Feedback from other sources i.e. community, stakeholders, consultants etc	Overall assessment of whether the District Plan achieves the outcomes sought?
					• Good to keep BC team involved in DPR • No systematic mapping of hazards such as rockfall following the earthquakes. • Aerial photographs of 2013 floods taken and provide a record. • BC make use of fault mapping in the Map Viewer GIS system.	
Proposed Canterbury Land and Water Regional Plan http://ecan.govt.nz/our-responsibilities/regional-plans/lwrp/Pages/plan-decisions-version.aspx	Medium (relevant parts now operative)	Objective and Policy framework seeks (for natural hazards) to: Manage stormwater run-off volumes and peak flows so that they do not cause or exacerbate inundation, erosion or damage downstream (Pol 4.17). Manage earthworks, vegetation removal and other land uses within river beds so that they do not restrict flood flows in rivers or adversely affect established flood protection works (Pol.4.89 and Pol. 4.9.1). Manage earthworks on erosion-prone land (Pol 4.20) and control sedimentation of water bodies including by maintaining vegetation cover adj to water bodies to protect their water carrying capacity (Pol 4.22) Protect communities from flood hazards through gravel extraction and maintenance of flood protection assets; including enabling gravel extraction for flood management purposes and, linking duration and volume of extraction to the Regional Gravel Management Strategy (Pols 4.92 to 4.95) (proposed Pol4.95A). Provide for remediation works to enable people and communities to recover from natural hazards and in urban areas allow site-specific remediation to occur where groundwater hydrology has changed due to seismic activity (Pols 4.96-4.98). Prevent increase in inundation of land in Halswell River catchment by requiring stormwater/drainage water not covered by management plan to require evaluation through resource consent process (Pol 11.4.34) Implemented by:	Land and Water Objectives: • Objectives B1.1.1& B1.1.2seeks to minimise adverse effects from unstable land. • Objectives B1.2.1 and B1.2.2 seek to protect water quality, ecology and provide for public access to waterway margins.Similar provisions in Rural Volume. Managed by: • Requiring earthworks to be set back from waterways (Rules 2.1.1.8 and 3.13.1.4) otherwise discretionary activity. • Managing scale of earthworks (Rules 2.1.1.6 and 1.7.1.1)		ECan agree with SWOT commentary	**Strength:** • Earthwork rules help to protect water carrying capacity of waterways **Weakness:** • Potential conflict between requirement for buildings to be setback from waterways and controls on hazardous substances, and LWRP's enabling of gravel extraction from rivers for flood management purposes. • Earthwork rules do not target erosion prone areas and are not intended to protect waterway capacity. **Opportunities:** • Streamline to avoid duplication of controls with regional plan • Improve targeting of rules and integration with regional plan. • Better enable flood protection activities **Threats**: • Inertia in relation to determining role of regional rules versus district plan rules • Reliance on regional rules may not adequately manage adverse effects of earthworks on other values such as visual amenity, biodiversity etc. **Overall comment:** • The operative plan does have regard to the LWRP but could be improved to ensure better alignment and avoid duplication of controls.

Relevant Legislation or Planning Document	Level of 'regard' required	Key Outcomes Sought	Key Approaches within District Plan for achieving these outcomes?	Comments arising from a review of resource consent data, complaints, monitoring etc	Feedback from other sources i.e. community, stakeholders, consultants etc	Overall assessment of whether the District Plan achieves the outcomes sought?
		• Rules managing stormwater discharges including floodwater/riverflow controls (5.93-5.95) • Rules which enable and manage gravel extraction (5.147-5.153) • Rules enable installation, alterations etc of bridges, culverts and flood defence works as permitted activity with controls over effect on flood carrying capacity (5.137-5.138) • Planting and removal of vegetation in beds of rivers permitted only with approval of flood control rating district agency (5.163) • Controls on earthworks and vegetation clearance in erosion-prone ares (5.170-5.174) • Controls on earthworks and vegetation clearance adjacent to waterways (Rules5.167-5.169) • Stormwater/drainage water discharge not to a consented network is a discretionary activity (Rules 11.5.23, 11.5.24 & 11.5.31)				
Canterbury Regional River Gravel Management Strategy	low	Seeks to manage extraction of river gravel for flood management purposes. Stated Actions include streamlining consent requirements for these activities between ECan and TAs.				See above and in particular need to streamline consent requirements
Mahaanui Iwi Management Plan http://mkt.co.nz/mahaanui-iwi-management-plan/Mahaanui-IMP-web.pdf	medium	Issue: Climate change could have significant impacts on the relationship of Ngāi Tahu and their culture and traditions with their ancestral land, water, sites, wāhi tapu and other taonga. Policies R3.1-R3.6 concerned with the effects of climate change and seek: • Work with TRoNT regarding climate change policies • Recognise and provide for the effects of climate change on resouces important to Ngai Tahu. • Restoration planning for wetlands and lagoons should take into account sea level rise Issue: Lake level management must be consistent with the protection and restoration of Ngāi Tahu customary values and interests associated with Te Waihora. • TW5.1-5.2 concerned with lake opening of Te Waihora • Policy TW10.1 seeks to encourage research, extent and effects of coastal erosion on Te Waihora and Taumutu coastline. Issue: Activities occurring within the beds of rivers and lakes and their riparian zones can adversely affect Ngāi Tahu values associated with these areas. • Policy WM12.18 supports gravel extraction as part of flood management regime subject to	Key approaches to acheiveing these outcomes are as per RPS at top of table.	N/a	None undertaken for purposes of SWOT	**Strengths** • Coastal erosion on Taumutu coastline recognised and mapped on Planning Maps **Weaknesses** • Unclear how climate change has been recognised in mapping of hazards • No specific policy or implementation method recognise the effects of climate change **Opportunities** • Update modelling (flooding, coastal erosion etc) to incorporate effects of climate change. • Involvement of iwi/runanga in developing policy/rules response to effects of climate change • Utilise runanga experience of natural hazards to gain better understanding of effects on their resources **Threats** • Iwi/runanga capacity • Potential complexity of hazard management framework - role of district plan versus regional plans and asset management plans e.g. effect of climate change on water quality • Any study of Te Waihora will require multi-agency approach risking ability to complete such a study (if desired) within DPR timelines. • Potential conflict between hazard mitigation such as land drainage and exotic tree planting along rivers by regional council and runanga values **Overall comments:** The operative district plan does not adequately take into account the IMP and there is a wider issue of ensuring partnership working between iwi/runanga and SDC in developing the replacement DP.

Relevant Legislation or Planning Document	Level of 'regard' required	Key Outcomes Sought	Key Approaches within District Plan for achieving these outcomes?	Comments arising from a review of resource consent data, complaints, monitoring etc	Feedback from other sources i.e. community, stakeholders, consultants etc	Overall assessment of whether the District Plan achieves the outcomes sought?
		various proviso eg avoid sedimentation, protect wahi tapu etc. <u>Issue: Loss of wetlands, waipuna and riparian margins, and the cultural and environmental values associated with them.</u> • WM13.1 –protect wetlands and riparian areas as wahi toanga including role in natural flood protection				
Selwyn 2031 http://www.selwyn.govt.nz/__data/assets/pdf_file/0008/147977/Selwyn-2031-Finalr.pdf	Medium	Ensure District Plan gives effect to chapter 11 fo the RPS as part of the review of the District Plan.	See analysis under RPS and NZCPS	N/a	None	See analysis under RPS and NZCPS
Lincoln Structure Plan, Prebbleton and Rolleston Structure Plan **<u>Rural-residential Strategy 2014</u>** http://www.selwyn.govt.nz/services/planning/policy-strategy/rolleston-structure-plan http://www.selwyn.govt.nz/services/planning/policy-strategy/lincoln-structure-plan http://www.selwyn.govt.nz/services/planning/policy-strategy/prebbleton-structure-plan http://www.selwyn.govt.nz/services/planning/policy-strategy/rural-residential	Medium	**Prebbleton**: • Identifies risk from stormwater inundation due to springs and high water table associated with Halswell River floodplain **Lincoln:** • Lower Plains Flood Area identified as a constraint to growth **Rolleston:** • Identified development principles include being "drought ready" through measures such as managing stormwater in landscape, developing a Water Demand Management Strategy, plant types in landscaping and re-use of water in urban green spaces **Rural-residential Strategy 2014** • Flood risk and stormwater management identified as a potential constraint, but matter left to be decided at time of re-zoning under RMA process.	• Rezoning of residential and business land through PC7 and LURP have avoided the flood plain and high water table. • ODPs identify stormwater management areas where appropriate.	N/a	None	**Strengths** • Has guided rezoning proposals for these towns and avoided identified flood areas • Use of ODPs to manage stormwater risk by providing for stormwater management areas **Weakness** • Focuses on flooding and not other risks • Reliance on earthquake recovery processes to implement **Opportunity** • Review township growth policies to provide greater clarity on how, when and to what level natural hazards will guide growth. • Option to consider carrying out township assessment as part of DPR and providing specific direction in district plan. **Threats** • Ability to resource township studies in relation to natural hazard risk • Community/landowner resistance to possible limits on growth **Overall assessment** • The operative district plan achieves the outcomes sought in these structure plans, save for being "drought ready" in Rolleston. • These structure plans, however, pre-date the Canterbury earthquake sequence and do not address geotechnical hazards in the same way as flooding. They have also been implemented, in part, by earthquake recovery processes and these are winding down. DPR likely to need to review natural hazard risk and township growth.
Draft Malvern and Ellesmere Area Plans:	Medium	• Natural hazard risks identified for each township particularly in relation to greenfield growth pathways. • Implementation action includes reviewing flooding risk consistent with RPS requirement (0.2% AEP flood event and 0.5% flood event)	Township growth objectives do not address natural hazard risk. Township policies including B4.3.54,			**Strengths** • Policy framework provides some direction for township growth and natural hazard risk for rezoning proposals **Weakness** • Outcome and planning direction unclear as to when development is to be avoided and when mitigated. • Planning direction unclear as to acceptable level of mitigation

Relevant Legislation or Planning Document	Level of 'regard' required	Key Outcomes Sought	Key Approaches within District Plan for achieving these outcomes?	Comments arising from a review of resource consent data, complaints, monitoring etc	Feedback from other sources i.e. community, stakeholders, consultants etc	Overall assessment of whether the District Plan achieves the outcomes sought?
		together with localised floods from stormwater/land drainage. • For Malvern townships implementation action includes a general review of district plan township growth policies.	B4.3.21, B4.3.45, B4.3.69 & B4.3.84 seek to ensure that rezoned land does not exacerbate or create natural hazard risk. These implement Objective B3.1.1			• Planning framework does not provide specificity required by Area Plan **Opportunity** • Review township growth policies to provide greater clarity on how, when and to what level natural hazards will guide growth • Option to consider carrying out township assessment as part of DPR and providing specific direction in district plan. Threats • Ability to resource township studies in relation to natural hazard risk • Community/landowner resistance to possible limits on growth **Overall assessment** • Area Plans will be an important driver of the DPR and provides the opportunity for clearly linking natural hazard risk directly to greenfield urban growth.
Canterbury Civil Defence Emergency Management Act 2002 Canterbury Civil Defence Emergency Management Plan http://cdemcanterbury.govt.nz/media/34987/canterbury-cdem-group-plan-2014.pdf	Medium	Purpose of Act is to improve and promote management of hazards[1] and encourage co-ordination of activities related to civil defence emergencies under range of legislation including RMA. Duty for lifeline utilities to function during and after an emergency. [1]Hazards definition is broader than just natural hazards. <u>Canterbury CDEM Plan:</u> **Goals include**: • Increasing community awareness and understanding of risks from hazards • Reducing risks from hazards **Specifics include**: • Risk profile for Selwyn including ranking of risks (highest are earthquakes and fire) • Importance of role of risk assessment • Working with the Natural Hazards Research Platform to identify hazard investigation projects • Identification of Lifeline utilities in the region	See analysis under RPS/NZCPS	See analysis under RPS/NZCPS	Ryan O'Rourke – SDC Emergency Management Officer: • Rural Fires represent a key hazard risk for the district with particular problems regarding rural-residential developments such as at West Melton. Education is important to reducing this risk. • Main focus of activity is response and recovery e.g. tsunami response plan	• The Operative District Plan has regard to the Canterbury Civil Defence Emergency Management Plan: • It increases awareness by mapping flood areas and fault lines • Rules reduce risk by, inter alia, use of minimum floor levels in flood areas, requirement for geotechnical assessments for new dwellings in the Port Hills, and geotechnical assessments for urban subdivisions in areas at risk of liquefaction • Fire risk is managed through non-district plan processes such as Rural Fire Bylaw 2009 and associated activities. • Other risks are managed by non-DP processes such as the Tsunami Response Plan and Lifeline Utilities Response Plan **Overall comment:** • Given high level contents of Canterbury CDEM Plan and lack of specificity this plan will not be a major driver of DP review. • Main use is to recognise that some natural hazards, such as tsunami and fire, are currently managed outside of the DP and there maybe no need to change this.

Appendix C Liquefaction Hazard Information - Maps – Eastern Canterbury

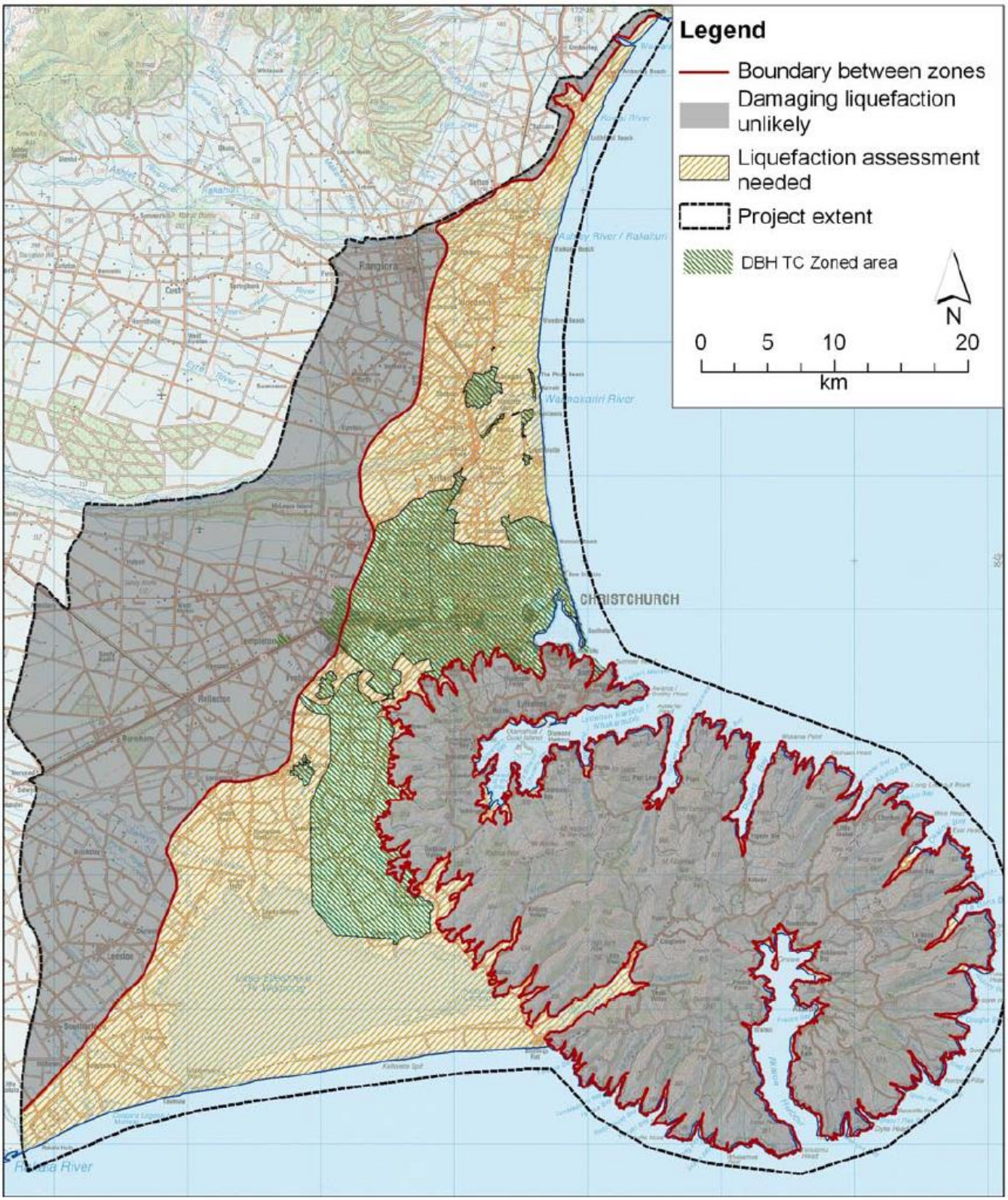
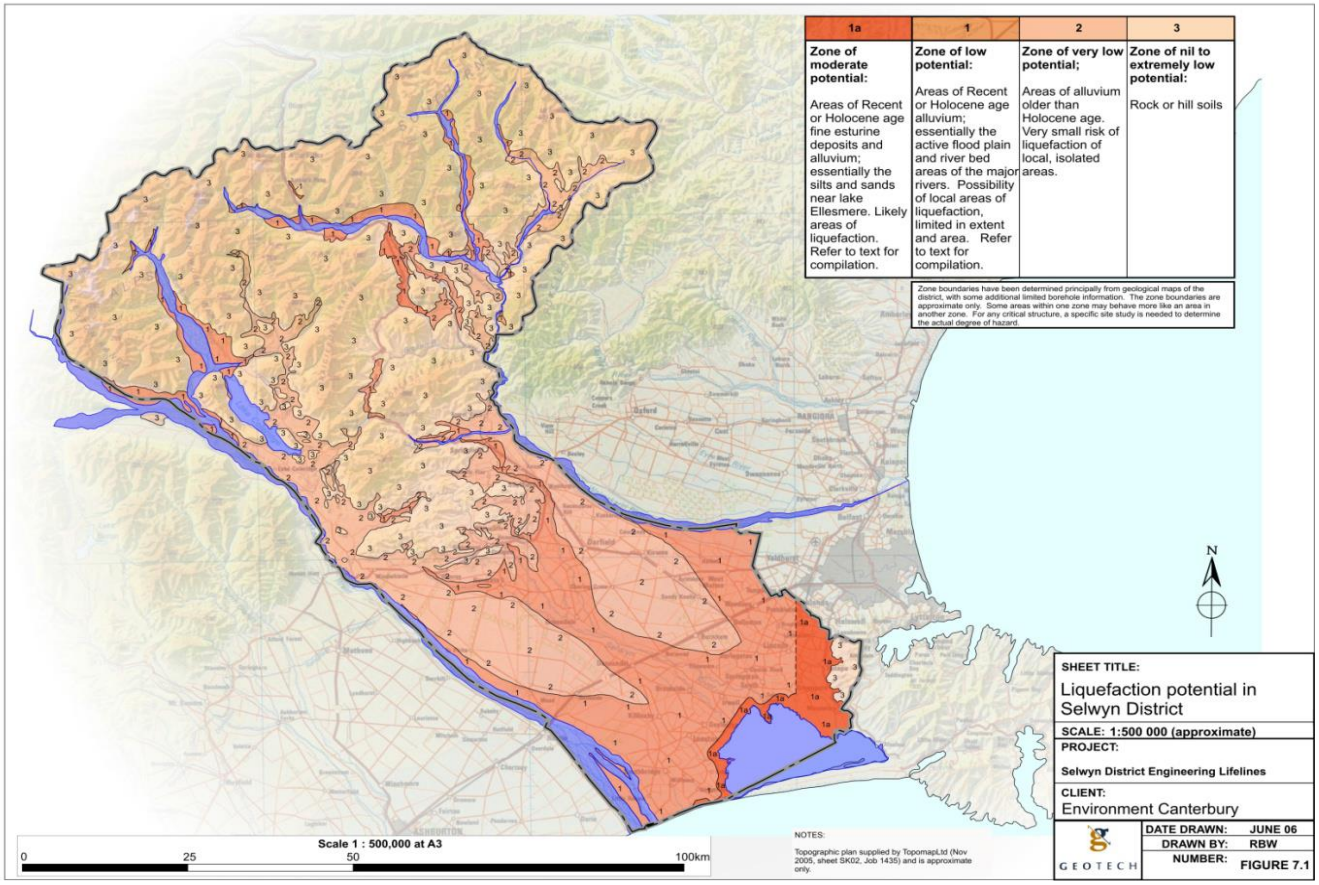


Figure 2.1 Liquefaction assessment area map for the eastern Canterbury project area. Liquefaction susceptibility is categorised in two areas, "damaging liquefaction unlikely" and "liquefaction assessment needed". The area covered by DBH Technical Categories at the time of this report is excluded.



Liquefaction Susceptibility Map for Selwyn District from Yetton and McCahon (2006)

Appendix D Tsunami Maps for South Canterbury

South American Tsunami [Environment Canterbury Report number R14/78]

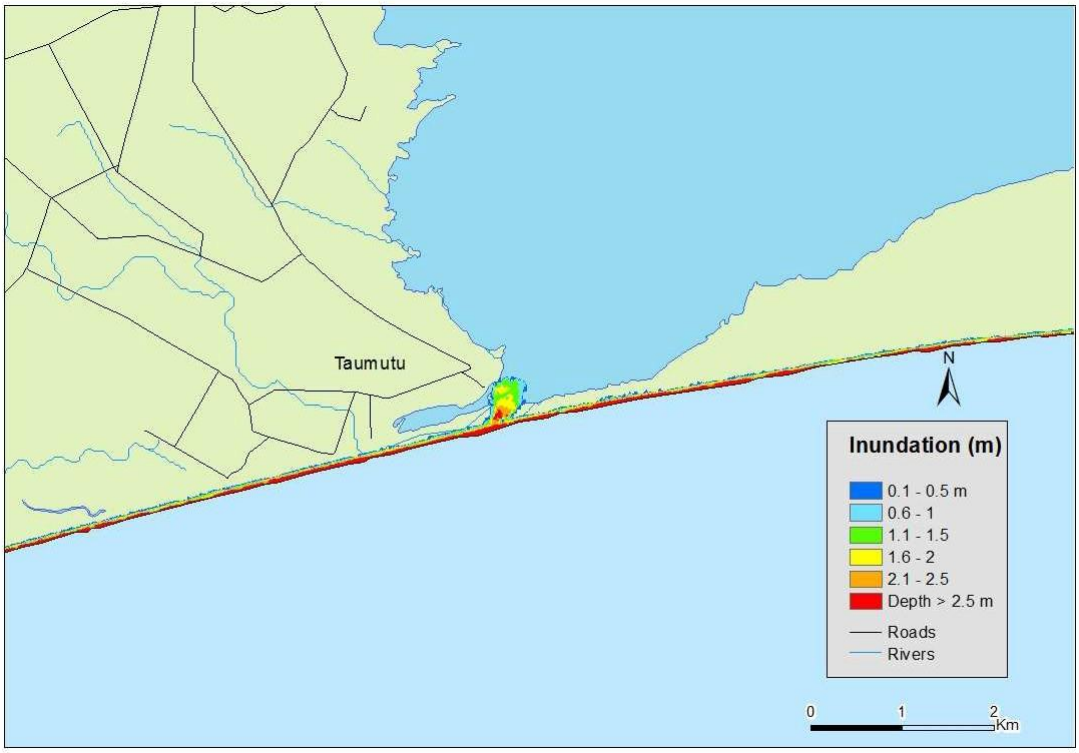


Figure 4-23: Maximum inundation depth for Taumutu village and the margins of Lake Ellesmere assuming the largest wave arrived at MHWS. Inundation depths are only shown for inundated land.

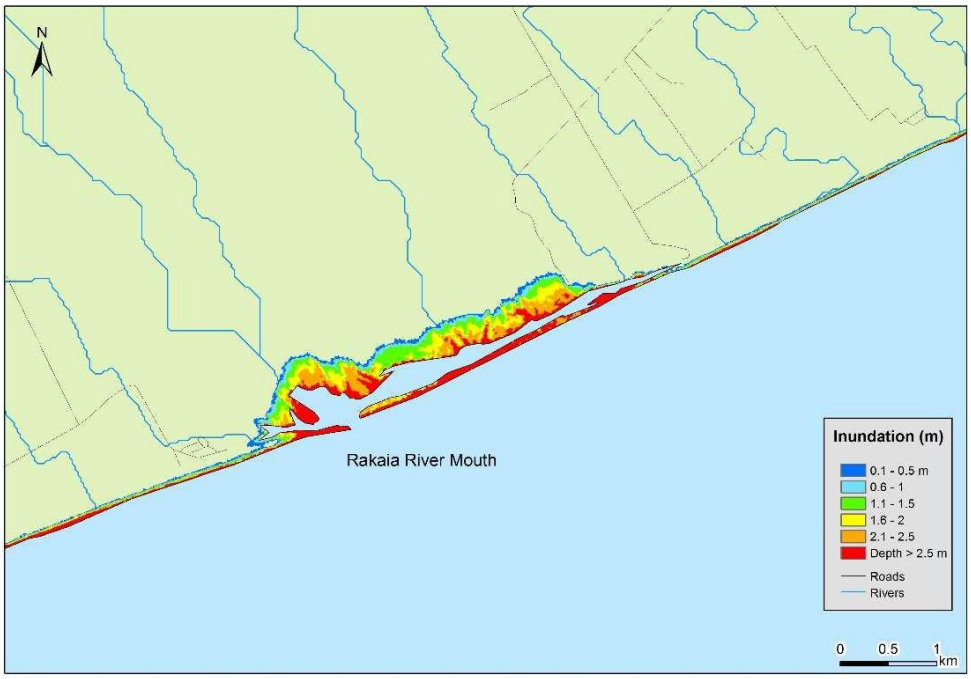


Figure 4-25: Maximum inundation depth for the Rakaia River Mouth assuming the largest wave arrived at MHWS. Inundation depths are only shown for inundated land.

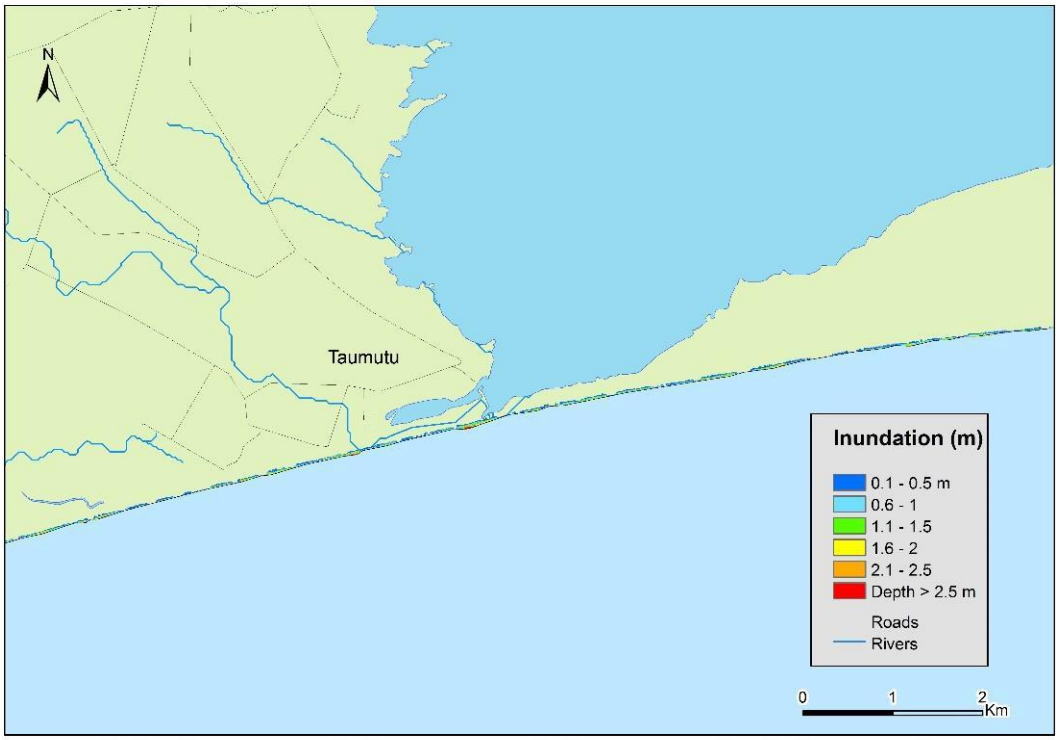


Figure 5-23: Maximum inundation depth for Taumutu village and the margins of Lake Ellesmere for the combined scenario assuming the largest wave arrived at MHWS. Inundation depths are only shown for inundated land.

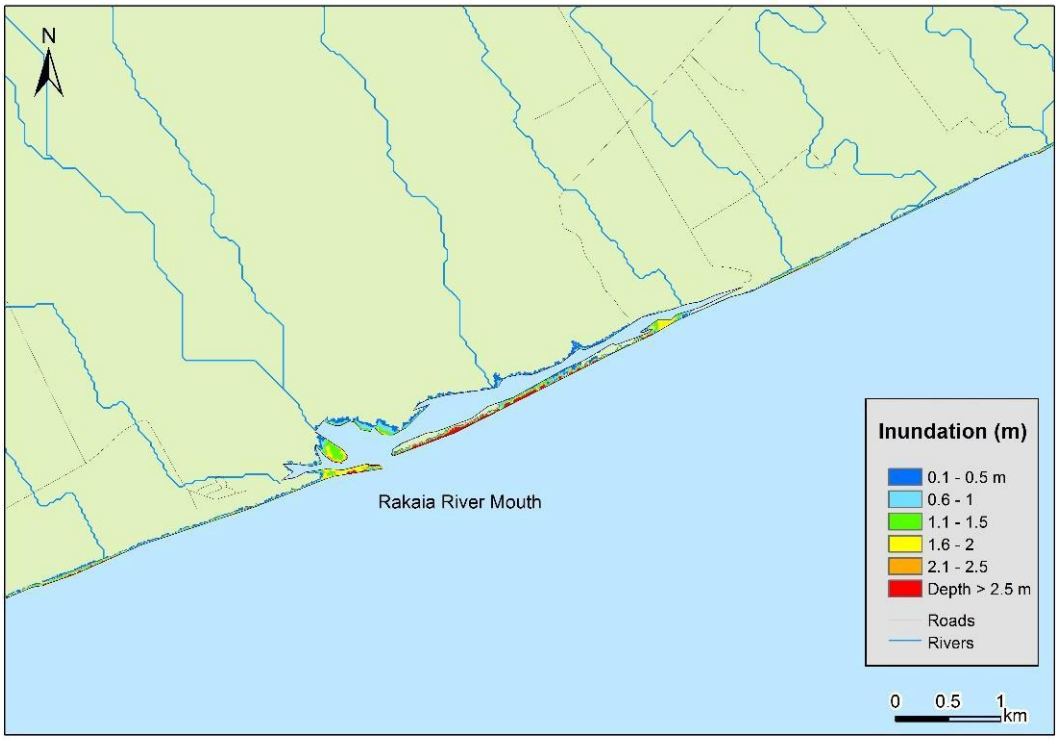


Figure 5-25: Maximum inundation depth for the Rakaia River Mouth for the combined scenario assuming the largest wave arrived at MHWS. Inundation depths are only shown for inundated land.

Appendix E – Halswell Catchment 0.5 and 0.2% Flood Maps

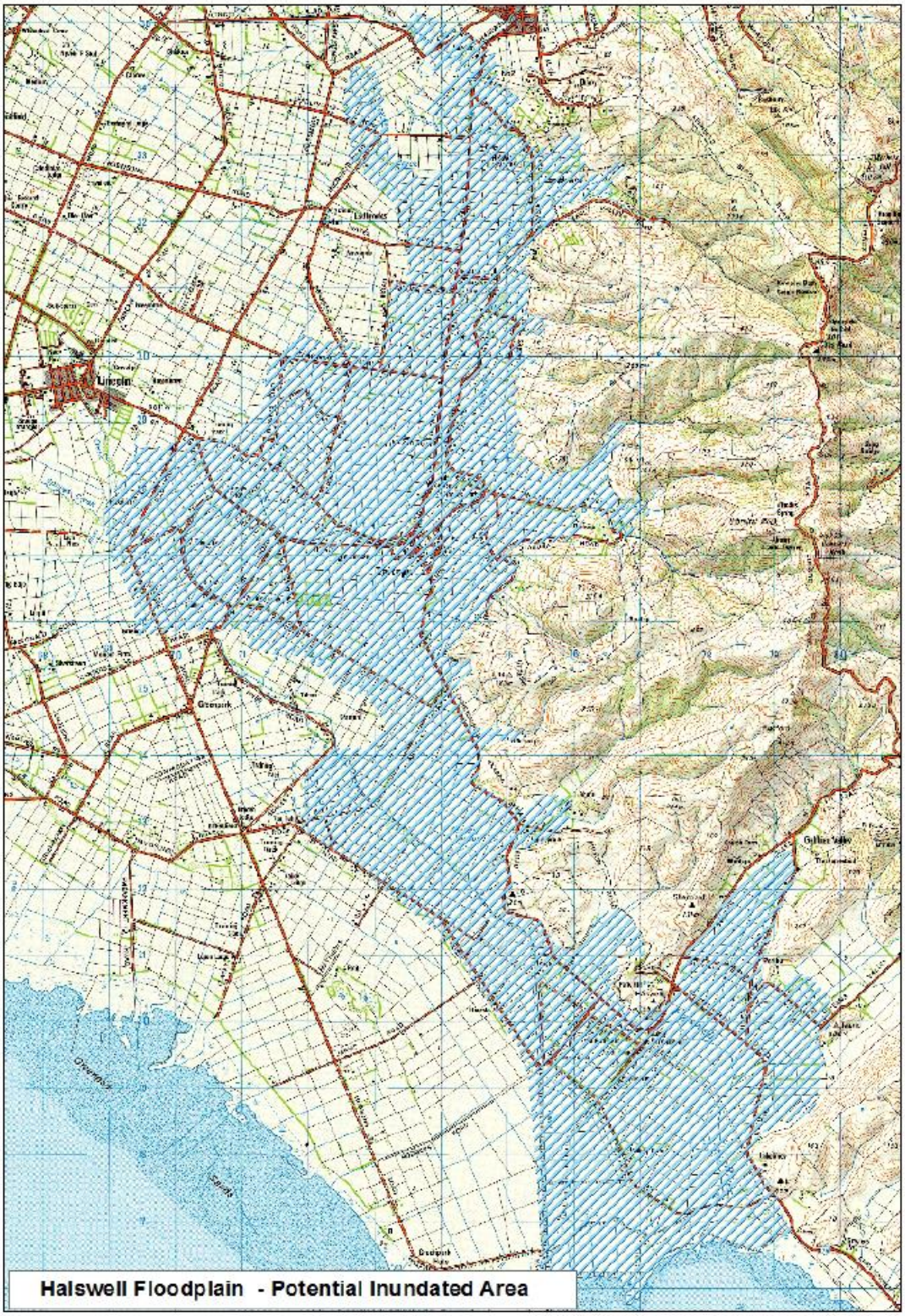


Figure 4-2: Halswell floodplain – potential inundated area

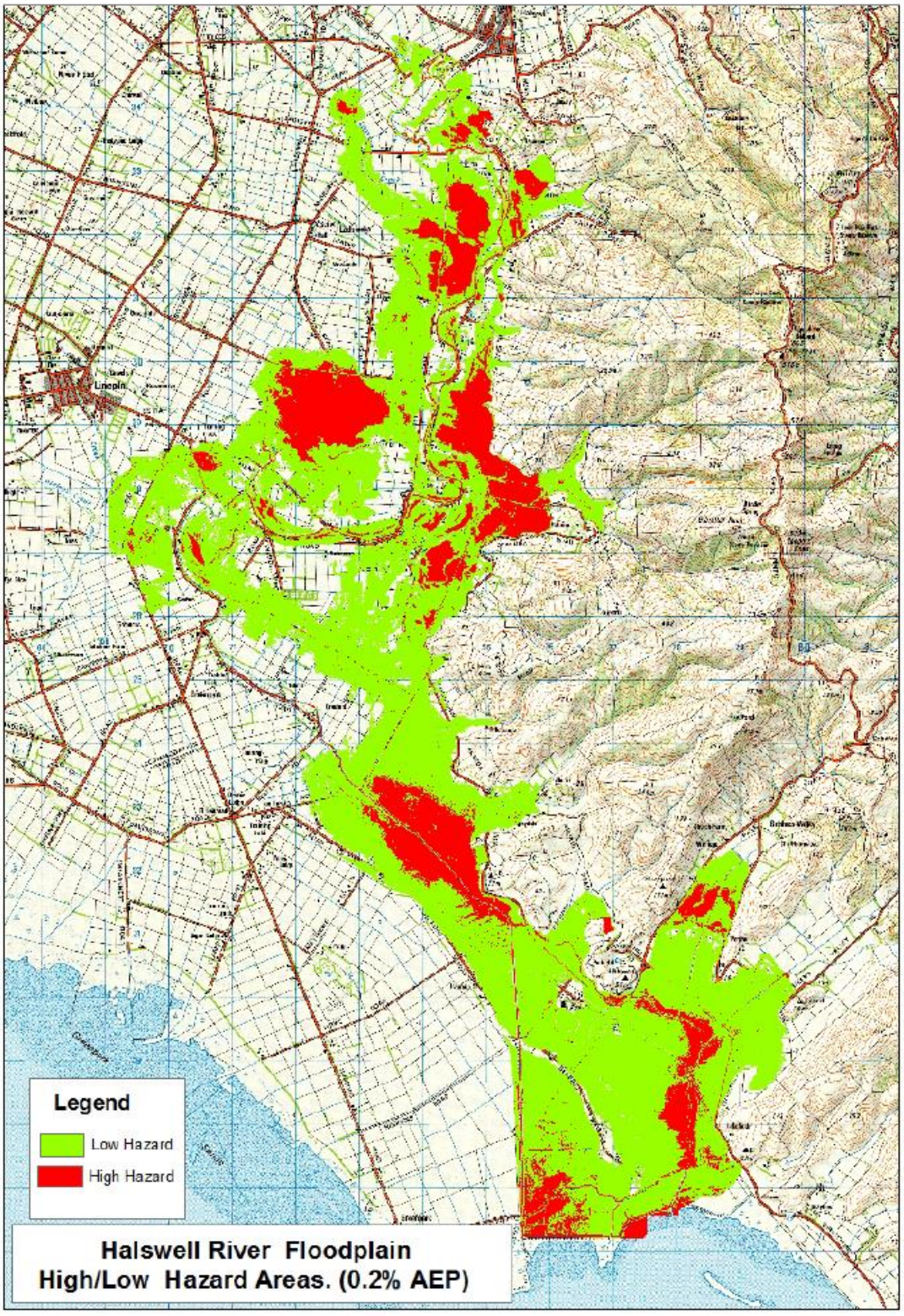


Figure 4-1: Halswell River/Huritini floodplain high/low hazard areas (0.2% AEP)

Appendix F– Risk Treatment Process

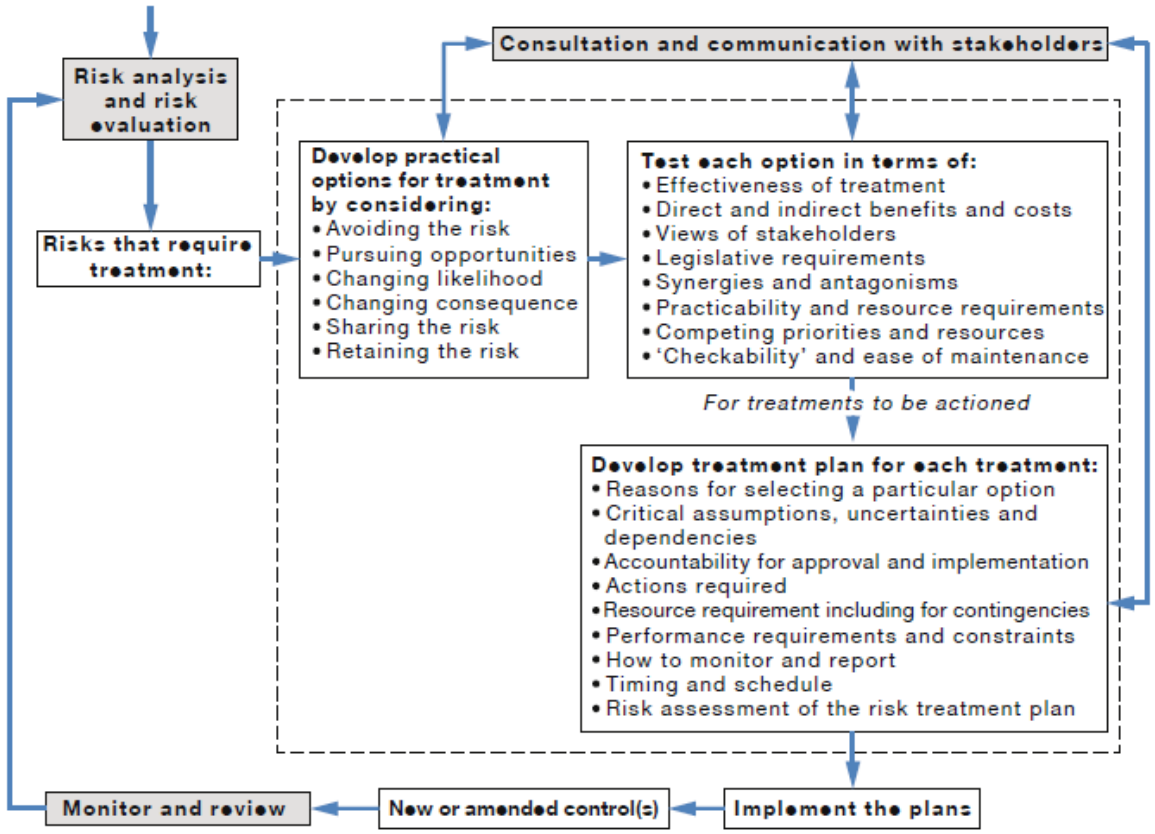


FIGURE 5 THE RISK TREATMENT PROCESS

Appendix G– Template examples for assessing consequences and likelihood

Likelihood	**V**	Medium	High	High	Very high	Very high
	IV	Low	High	High	Very high	Very high
	III	Low	Medium	Medium	High	Very high
	II	Low	Low	Medium	High	Very high
	I	Low	Low	Medium	Medium	High
		1	**2**	**3**	**4**	**5**
		Consequences				

EXAMPLE OF A LIKELIHOOD SCALE RELATING DESCRIPTORS, FREQUENCY AND PROBABILITY
(Illustrative example only: Derive actual scales and metrics from Paragraph C2.4)

Descriptor	Description	Indicative return period*	Indicative probability (over the time frame or activity of interest)
Almost certain	The consequence expected to occur on an annual basis	Every year or more frequently	>0.9
Likely	The event has occurred several times or more in your career	Every three years	>0.3, <0.9
Possible	The event might occur once in your career	Every ten years	>0.1, <0.3
Unlikely	The event does occur somewhere from time to time	Every thirty years	>0.03, <0.1
Very unlikely	Heard of something like that occurring elsewhere	Every 100 years	>0.01, <0.03
Extremely unlikely	Have never heard of this happening	Every 1000 years	>0.001, <0.01
Incredibly rare	Theoretically possible but not expected to occur	Every 10 000 years	<0.001

* Return period is an estimate of the likelihood of an outcome occurring. It is also known as recurrence interval.

TABLE C3

EXAMPLE CONSEQUENCE SCALES FOR HYPOTHETICAL ORGANIZATION (MINERIGHT LIMITED)
(Illustrative example only: Derive actual scales and metrics from Paragraphs C2.2 and C2.3)

Consequence level	Financial (EBITDA)	Growth (NPV)	People	Environment and community	Reputation	Legal
6	>$100m	>$500m	More than one fatality from one event or significant irreversible effects on 10s of people	Regional and long term impact on an area of significant environmental value Destruction of an important population of plants and animals with recognized conservation value Complete remediation impossible Complete loss of trust by affected community threatening the continued viability of the business	Prominent International media coverage Long term impact on share price Leads to changes at Executive or Board level	Public inquiry taking up considerable resources and Executive management time Major litigation or prosecution with damages/fines of >$50m plus significant costs Custodial sentence for a manager Suspension of shares by the ASX
5	>$10m, <$100m	>$50m – <$500m	Single fatality or severe irreversible disability to one or more persons	Destruction of an important population of plants or animals or of an area of significant environmental value Complete remediation not practical or possible Long-term community unrest and outrage significantly impacting business performance	National media coverage over several days Shareholders and Board exercise control Potential for class action Major customers cancel key contracts	Major litigation or prosecution with damages or fines of <$50m plus significant costs Imposition of a fine by ASIC Major breach of regulation leading to cancellation of operating license

(*continued*)

TABLE C3 (*continued*)

Consequence level	Financial (EBITDA)	Growth (NPV)	People	Environment and community	Reputation	Legal
4	>$1m, <$10m	>$5m, <$50m	Extensive injuries/illnesses or irreversible disability or impairment to one or more persons	Extensive and medium-term impact to an area, plants or animals of recognized environmental value Remediation possible but might be difficult or expensive Community protest requiring intervention and substantial management attention	State media coverage over several days Publicly disclosed involvement by regulator(s)	Litigation or prosecution costing <$5m or involving substantial management time (manager level and above) Publishing of a warning by the FSMA Breach of regulation leading to suspension of operating license
3	>$100k, <$1m	>$500k, <$5m	Medium-term reversible disability to one or more persons, such as significant medical treatment, disabling or lost time injury	Localized and medium term impact to areas, plants or animals of significant environmental value Remediation may be difficult or expensive Persistent community complaints	State media coverage. Interest by regulator(s) and NGOs.	Major breach of regulation with punitive fine Involvement of senior management
2	>$10k, <$100k	>$50k, <$500k	Recordable injuries or illnesses with up to one week of job restrictions or lost time	Localized and short term impact to an area, plants or animals of environmental value Minor remediation is required Complaints from interested parties	Local media coverage interest by local NGOs One or two community complaints	Breach of regulation with investigation or report to authority with possible prosecution and fine
1	<$10k	<$50k	Minor injury or illness, first aid or medical treatment without job restrictions	Localized and short term environmental or community impact requiring no or very minor remediation	Kept on site—no media or community interest	Minor legal issues, non-compliances and breaches of regulation

[from: SA/SNZ HB 436:2013 Risk Management Guidelines – Companion to AS/NZS ISO 31000:2009, Appendix C].

GHD

Level 3
138 Victoria Street
Christchurch 8013

T: 64 3 378 0900 E: chcmail@ghd.com

\\ghdnet\ghd\NZ\Christchurch\Projects\51\37285\Planning\Reports\post draft\Risk and Natural Hazards Report (CW)docx.docx

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Revision	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
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