



Natural Hazard Risk Assessment User Guide

Regional Policy
Statement for the
Bay of Plenty

**Ngā Tikanga Whakahaere
I Ngā Rawa o Te Taiao**







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What is the Regional Policy Statement?

The Regional Policy Statement (RPS) is a document prepared by Bay of Plenty Regional Council under the Resource Management Act 1991 (“the Act”). It does not contain rules but it does contain policy that regional, city and district plans must ‘give effect to’. The natural hazards provisions have been designed to influence resource consents and the development of regional, city and district plans as they affect natural hazards.

The RPS was made operative with almost no natural hazards provisions in 2014. At the same time, Change 2 (Natural Hazards) was publicly notified. From 5 July 2016

the Change 2 provisions, amended through the submission and appeal process, are operative and merged into the RPS.

This User Guide should be read with the RPS natural hazards provisions, including, in particular, Appendix L (Methodology for Risk Assessment).

Where necessary, the Regional Council may amend or supplement this User Guide, in response to any unforeseen implementation issues that may arise.

An aerial photograph showing a massive debris flow of sand, rocks, and logs that has inundated a residential area. Several houses are partially submerged in the thick, brown slurry. A road is also visible, completely covered by the debris. The surrounding area is lush with green trees, contrasting sharply with the destruction in the foreground.

Part 1: Background

1.1 Introduction

The natural hazards provisions of the Bay of Plenty Regional Policy Statement are derived from Proposed Change 2 which was publicly notified on 1 October 2014. The Change required that a “risk-based approach” be taken to the management of natural hazards across the region.

The RPS is very specific about what it means by a “risk-based approach”. Risk means the likelihood and consequences of a hazard. The RPS natural hazards provisions include, in Appendix L, a default methodology for risk assessment.

The default methodology is to be used unless an alternative recognised risk assessment methodology is approved for use.

1.2 Purpose

Who should read this User Guide

This implementation guide is relevant to two groups of people:

- The Bay of Plenty community who participate in Resource Management Act (RMA) processes, or who may require resource consent from the Regional Council or any of the city or district councils in the region. This includes iwi and hapū, developers, landowners and special interest groups.
- The Regional Council, and city and district councils of the region, as they review their regional, city or district plans or prepare changes to existing plans in relation to natural hazards issues. It aims to assist the Regional Council and city and district councils and other stakeholders in the Bay of Plenty region to interpret and apply Appendix L and its requirement for natural hazard risk assessment.

Purpose of the user guide

- As a result of feedback received through submissions and hearings, the Regional Council decided that implementation guidance on Appendix L would be issued. Guidance on a range of detailed matters associated with how the default methodology in Appendix L should be applied is provided.
- City and district plans are to “give effect to” the regional policy statement (section 75(3) of the Act). Similarly, regional, city and district councils are required to “have regard to” the RPS when considering resource consent applications (section 104(1)(b)(v) of the Act).
- This full User Guide replaces interim guidance issued with the Regional Council’s decisions on submissions.
- This User Guide is not part of the RPS. It is provided to assist users of the RPS. Adherence to the User Guide is not mandatory but it does set out the Regional Council’s expectations about how Appendix L can be appropriately implemented and therefore provides clear direction on the position the Regional Council may take in statutory processes.

1.3 Risk assessment methodology

For the purpose of this User Guide, a risk assessment methodology is a systematic procedure for determining the level of risk from a natural hazard that an area or site and its associated development is exposed to. A risk assessment methodology must consider the combination of both the likelihood of an event occurring and the consequences on people and communities (including their property, the lifeline utilities they depend on and their health and safety) from the event occurring.

The natural hazards provisions make a clear and deliberate distinction between what is in policy and what is in guidance (including, in particular, the guidance provided by Appendix L). In simple terms, the requirements on local authorities

and applicants (i.e. what needs to be done) is located in the policy. How councils and applicants give effect to the policy requirements is contained in appendices K, L and M (being a form of implementation guidance) and in guidance published outside of the RPS, including this User Guide. Hence Appendix L sets out how risk analysis and evaluation is to be undertaken and Appendix M sets out how risk reduction can be achieved. The requirement to analyse, evaluate and reduce risk (the what) is the subject of the natural hazards policy within the RPS.

1.4 What this User Guide covers

This User Guide is produced in five parts. Part 1, Background, is this part.

Part 2: Context

Part 2 provides some context to understanding the way the natural hazards provisions are constructed and some of the key concepts it proposes for natural hazards management. It also contains flow diagrams that explain:

- a. The use of Appendix L and the process steps involved in determining how risk categories are assigned (Figure 1), and
- b. The overall process by which natural hazard risks are to be identified, assessed and managed (Figures 2, 3 and 4).

This is important context for understanding how Appendix L fits within, and is integral to, the broader natural hazards management framework.

Part 3: How to apply Appendix L with incomplete information

One of the most frequently expressed concerns of stakeholders is what to do if the information required to implement the Appendix L methodology is incomplete. Part 3 addresses:

- the relationship of planning timeframes, susceptibility and hazard event likelihoods,
- the use of information on the consequences of a hazard,
- the process of undertaking secondary analysis and the role of qualitative risk assessment and proportionality of effort,
- the inclusion of hazard mitigation in the risk assessment.

Part 4: Recognised risk assessment methodology

Another key concern of stakeholders is that some have used, or propose to use, a risk assessment methodology that differs from that promoted through the default methodology of Appendix L. Appendix L provides for the use of an alternative methodology, provided that it is a “recognised risk assessment methodology” (RRAM). Accordingly, this interim guidance provides greater clarity about what will be regarded as a RRAM.

Part 5: Examples

Two examples illustrate use of the policy.

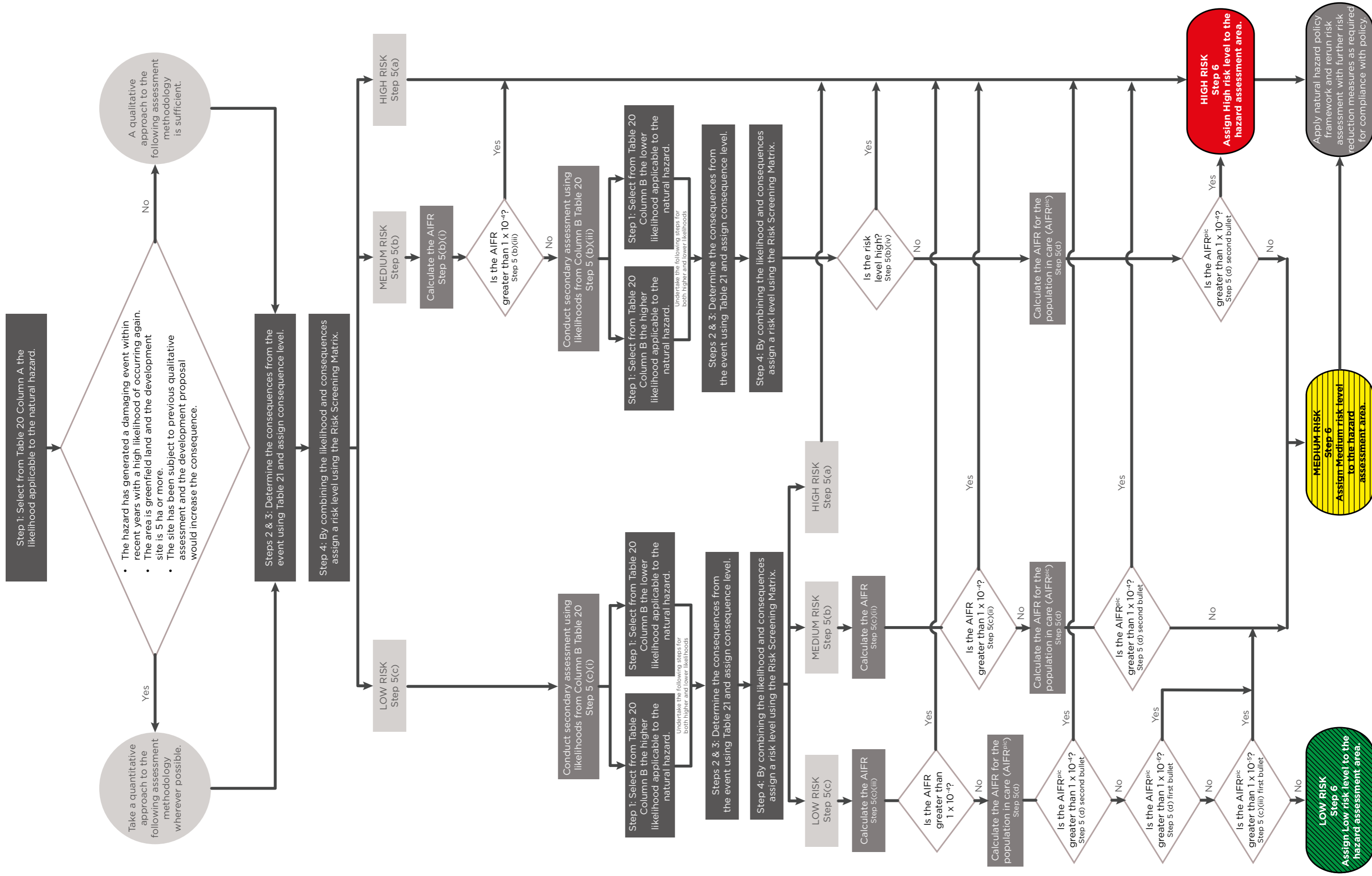


Figure 1 - Appendix L Methodology for Risk Assessment Expanded Flow Chart. Note: Table and step references are to Appendix L.





Part 2:
Context



2.1 The structure of the natural hazards provisions

The policies set out a framework that:

- a. Directs that a risk-based approach is to be used (Policy NH 1B).
- b. Establishes the risk categories to be used for the risk-based approach (Policy NH 2B).
- c. Specifies the management approach to be taken in respect of each risk category (Policy NH 3B).
- d. Provides direction on the management of natural hazard risk in particular contexts:
Policy NH 4B
Policy NH 5B
Policy NH 6B.
- e. Requires identification of areas susceptible to natural hazards in the context of regional, city and district plan development (Policy NH 7A).

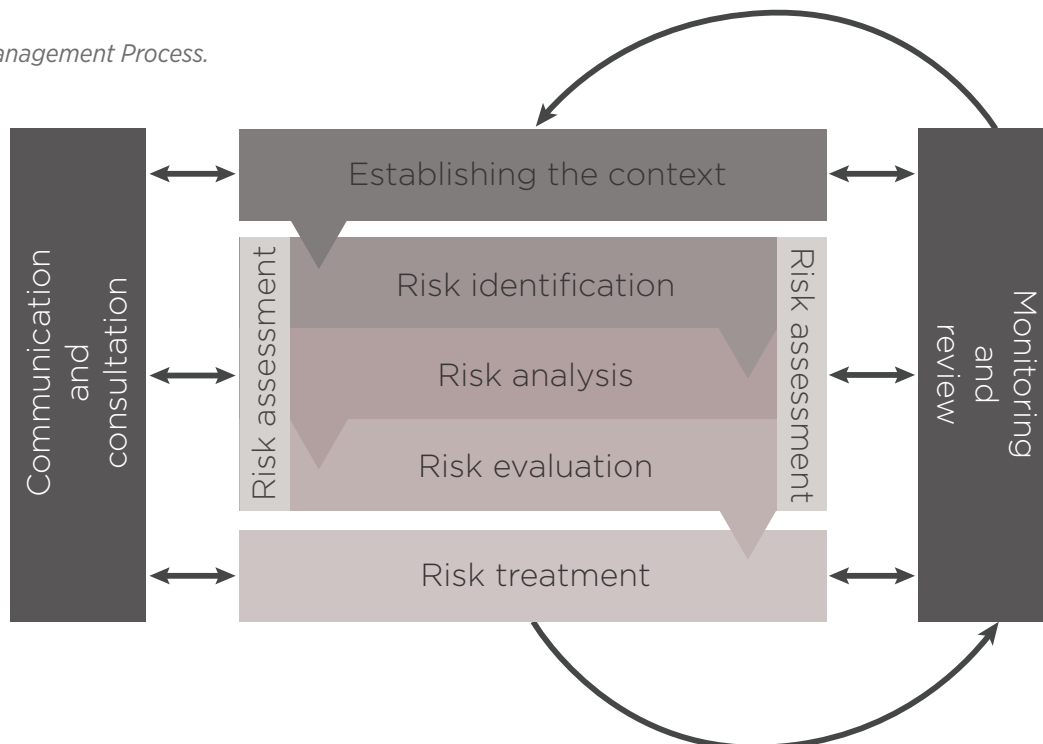
- f. Requires risk analysis and evaluation in the context of both plan development and consent applications (Policies NH 8A and NH 9B / NH 10B respectively).
- g. Requires regional, city and district plans to manage land use to reduce natural hazard risk (Policy NH 12A).

As shown in Figure 2, the RPS natural hazards provisions broadly reflect the risk management process from AS/NZS ISO 31000:2009, particularly (e) and (f) above which together represent the “risk assessment” stage of the process.

The process elements of the policy framework, as they apply in the context of regional, city and district plan preparation, are illustrated in Figure 3. The process elements of the policy framework as they apply in the context of resource consents are illustrated in Figure 4.

Both Figures 3 and 4 illustrate that analysis and evaluation (the subject of Appendix L) are at the heart of the natural hazards risk management process. This document accordingly sets out guidance on the methodology to be used when risk analysis and evaluation are required under Appendix L (i.e. when (f) applies).

Figure 2 - Risk Management Process.



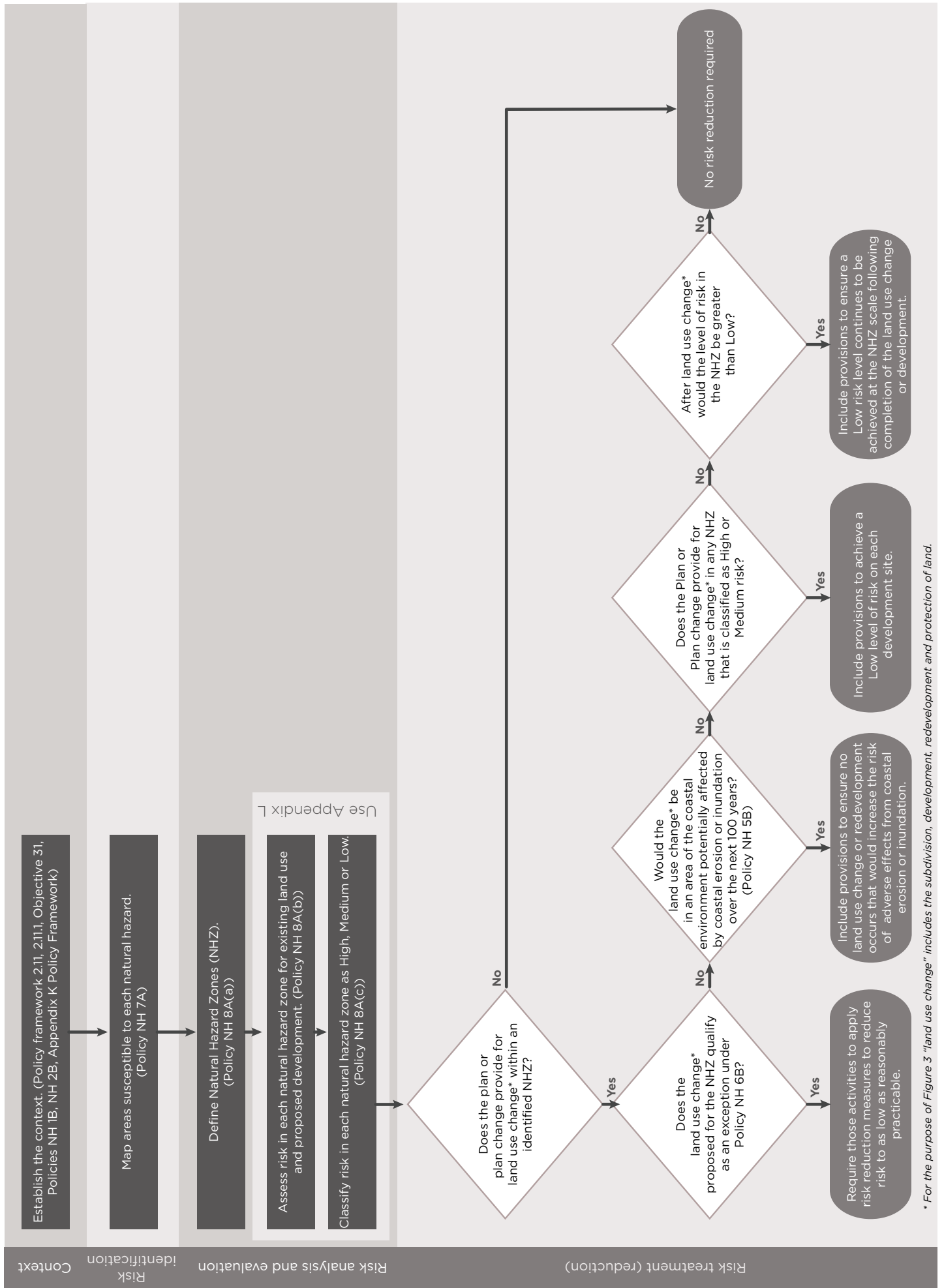


Figure 3 - Natural hazard risk management policy framework for regional, city and district plans.

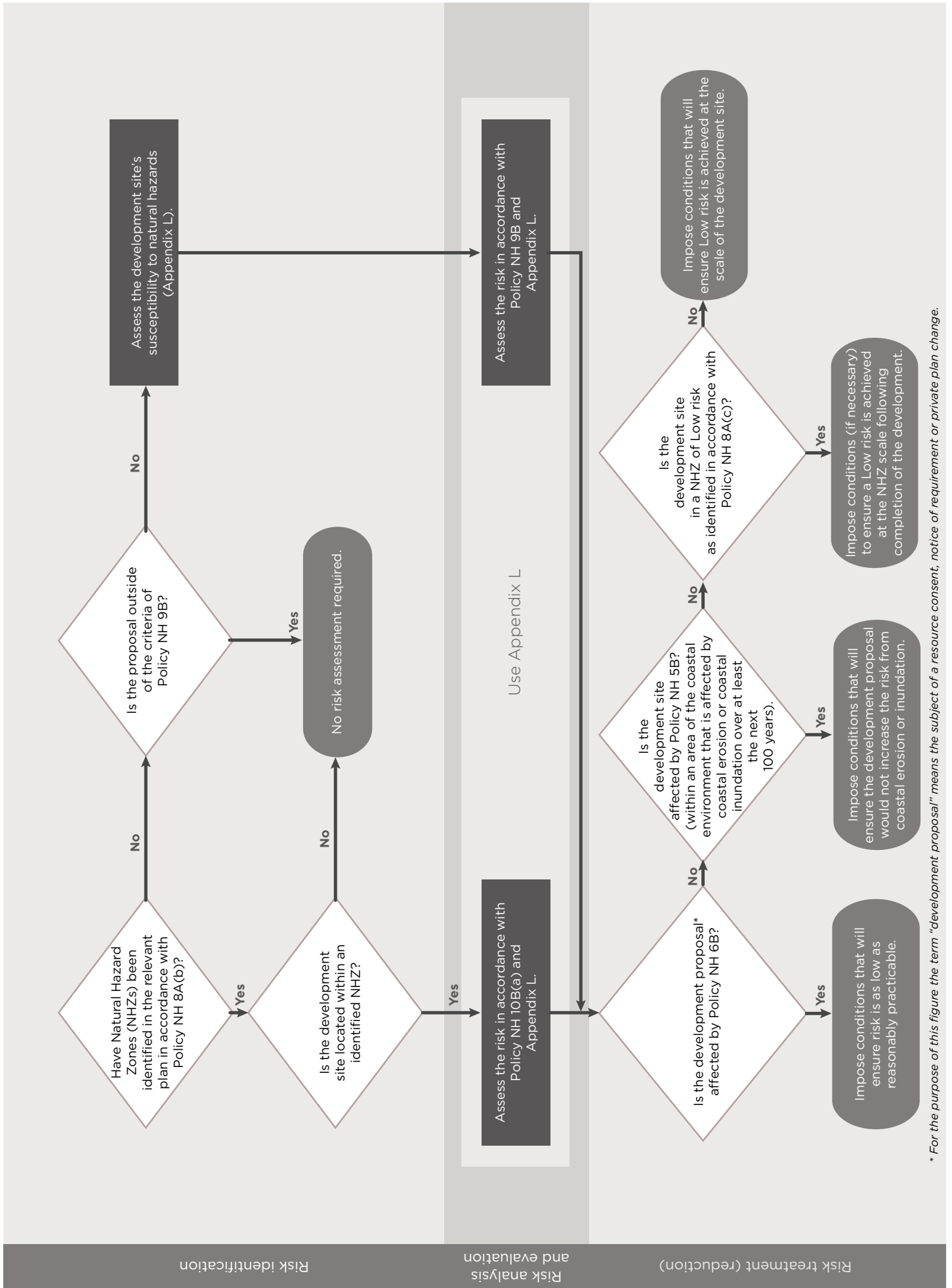


Figure 4 - Natural hazard risk management policy framework for development proposals.

2.2 Spatial scales

The Regional Policy Statement's natural hazards provisions use a number of terms to describe the various spatial scales and mapping that is envisaged. These include:

- Hazard Susceptibility Area (HSA)
- Natural Hazard Zone (NHZ)
- Development Site
- Hazard Assessment Area (HAA).

These are interrelated terms.

2.2.1 Susceptibility

The HSA is simply a mapped area representing the spatial extent of a particular hazard (see Policy NH 7A). See discussion in 2.6 of the link between susceptibility and planning timeframe.

2.2.2 Natural Hazard Zone

The NHZ is a zone defined by a regional, city or district plan as being the scale at which hazard risk assessment is to be undertaken for the purpose of developing appropriate risk management provisions in plans (see policy NH 8A). An NHZ can be an entire HSA or (more likely) part of such an area, but it cannot be bigger than a HSA.

2.2.3 Development Site

A development site is also defined and means that area of land on which development of land is to be undertaken. A development site can be land held in a single certificate of title (CT) or land held in multiple CTs that are contiguous. The development site is the scale at which risk assessment is to be undertaken when required by Policies NH 9B and NH 10B.

2.2.4 Hazard Assessment Area (HAA)

HAA is the collective term that can mean either the NHZ or Development Site. The term HAA is only used in Appendix L. It is included simply to avoid having to refer to “natural hazard zone or development site whichever is applicable”.

The HAA for the purpose of applying Appendix L will be:

- one of the NHZs (when applied in the context of plan development); or
- the development site (when applied in the context of a resource consent application, notice of requirement or plan change related to a specific development project).

A conceptual depiction of these terms is shown in Figure 5.

In this example, the HSA has been divided into three NHZs for the purpose of hazard risk assessment. These are based on actual or potential land use. It is anticipated that land use will be a common criterion used to define NHZs. Separating existing development from new development (future urban), for example, will ensure that the risk level applicable to the future urban area is not influenced by the level of hazard mitigation present in the existing urban area. That is, if the existing urban area is already subject to high risk, that need not influence the “developability” of the future urban area provided that it can meet the low risk criterion within its own zone. Conversely, if an existing urban area has invested heavily in hazard risk mitigation to achieve “low” risk, it may not be appropriate to allow new adjacent development to

rely on that low existing risk level, to “dilute” the risk of its own development, by effectively sharing the same zone for assessment purposes¹.

Establishing the boundaries of NHZs will require considerable thought and the appropriate boundaries will be very much place and context specific. For that reason the RPS requires (Policy NH 8A) that they be set through the Schedule 1 process, as part of regional and district plan development, and not be defined in an ad hoc manner.

Assessing risk by NHZ has the effect of averaging risk across the NHZ. After an initial assessment, it may be realised that dividing a NHZ into multiple zones could allow for more discrimination in establishing the level of risk and, consequently, the selection of mitigation options. This will call for informed judgement.

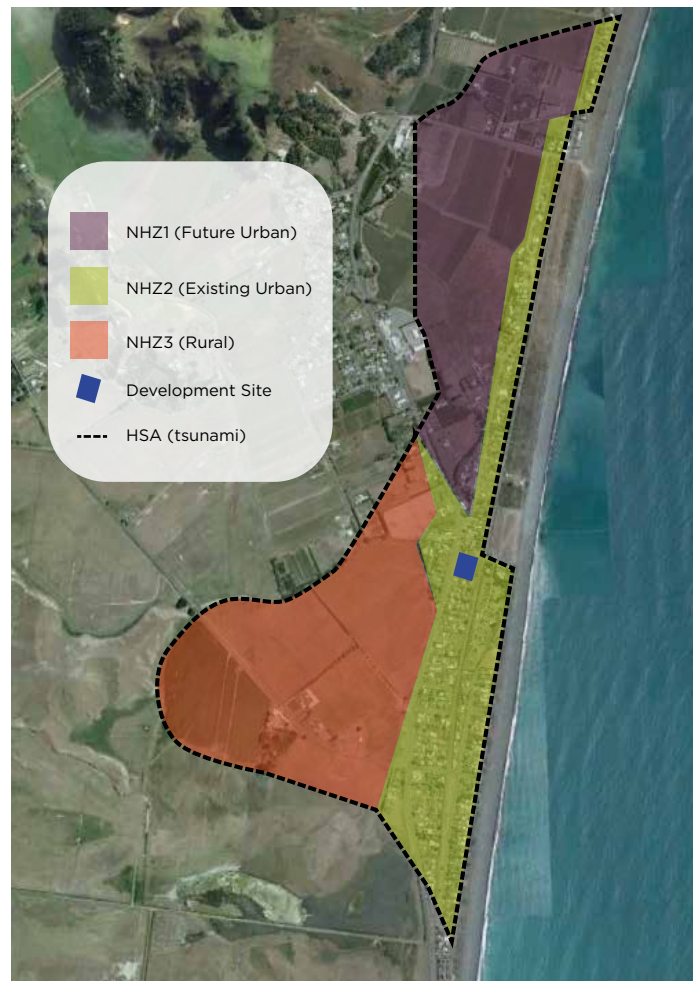


Figure 5 - Hypothetical example of hazard susceptibility area (HSA) and natural hazards zone (NHZ) based on a tsunami hazard.

¹ Whether this should be allowed or not ought to be a conscious decision of the regional, city or district council, made in the context of defining NHZs through the Schedule 1 process prescribed in the RMA. Some increase in risk to an existing developed area may be acceptable, for example, provided the overall level of risk remains in the low range.

2.3 Mapping risk

It is important to be clear about the purpose of risk assessment. It is not, as is sometimes described, the precursor to “mapping risk” in the traditional sense of hazard lines on planning maps.

That said, areas of like risk can be spatially defined (i.e. “mapped”). For example, following risk assessment an area might be identified, based on existing land use, as low risk. However, that does not mean that anything can occur within that area without hazard assessment, simply because the area is low risk. A change of use can, and to a greater or lesser degree will, change the risk.

This is the fundamental difference between a risk-based approach and the more traditional approaches that have informed land use planning in the past, where areas subject to a certain likelihood of hazard event (e.g. flooding or coastal erosion) have been mapped and only if an activity is proposed within such an area do hazards provisions apply.

Traditional hazard maps are more akin to what the RPS has termed “susceptibility mapping” (although hazard susceptibility maps will often define the maximum credible event, whereas traditional hazard maps are typically based on events of greater likelihood – i.e. more frequent – than the maximum credible event).

Risk classification by contrast is context (or “scenario”) dependent. That is, what the appropriate risk classification is on any site or area depends on what use that site or area is put to.

An area of greenfield land, therefore, cannot be described as low, medium or high risk, unless that classification is associated with a particular future land use of known design.

In short, while the extent of effect of a particular hazard (of a certain likelihood) can be mapped, risk cannot be “mapped” except in respect of a particular development scenario.

Risk can only be assessed, and hence mapped, in respect of land and its associated use.

2.4 Multiple hazards - cumulative and cascading

2.4.1 Cumulative hazards

Cumulative hazards involve multiple unrelated hazards affecting a property or area. For example, a property may be affected by both flooding and fault rupture. As the natural hazards are unrelated it is unlikely that any given area would be affected by all natural hazards at the same time. Areas subject to cumulative hazards have a higher likelihood of experiencing a natural hazard event, and therefore a higher risk, than an area that is exposed to one natural hazard.

The policy allows for the investigation and mapping of natural hazards to occur in a staged approach from each of the hazards individually. There is no requirement to consider the cumulative likelihood or consequences of hazards under this policy.

Consideration may be given to some mitigation measures to avoid doubling up on restrictions or setting inconsistent measures. For example a TA may wish to have one combined flooding layer in a plan which sets a building floor level in consideration of both flooding and coastal inundation (i.e. whichever is higher).

2.4.2 Cascading hazards

Cascading hazards are where two or more natural hazards, caused by the same ‘trigger’ event, affect human life and/or property. For example a storm may result in a specific area experiencing both a tornado and flooding. Both of these have been caused by the first event. This means that when the trigger event occurs, the people and property in the cascading hazard zone are likely to be affected by all, or a combination of, the resulting hazards.

Therefore, properties in cascading hazard zones are likely to experience greater damage when the ‘trigger event’ occurs than properties not located in areas susceptible to cascading hazards during that event. The likelihood of the trigger event is used when analysing cascading hazards.

To determine the risk from cascading hazards, they should be analysed in the order in which their consequences occur. For example, a fault rupture could then cause liquefaction and a tsunami. The consequences from each hazard need to be accounted for prior to, and then excluded from, consideration of the next hazard. The consequences are then added together to get the total consequence of the cascading natural hazards.

2.5 Planning timeframe

The concept of planning horizon, planning period or planning timeframe is only briefly referred to in the Regional Policy Statement’s natural hazards provisions.

Policy NH 11B gives effect to the New Zealand Coastal Policy Statement 2010 (NZCPS) by requiring a minimum 100-year timeframe when undertaking coastal hazard assessments. Also, Policy IR 2B requires that the predicted effects of climate change are recognised and provided for. Climate change factors such as increased rainfall intensity and sea-level rise affect hazards such as flooding, coastal erosion and inundation. The extent to which these gradually changing climate factors contribute to hazards and need to be taken into account in planning gives rise to the need to establish a planning timeframe. The chosen planning timeframe will influence the amount of the climate change factor that needs to be included in establishing the magnitude of the hazard being assessed.

In the coastal environment, the NZCPS directs that hazards are considered over at least 100 years. The NZCPS directs that assessing coastal hazard risks, preparing plans, and making consent decisions are all to be done using a planning timeframe of ‘at least 100 years’.

While the NZCPS timeframe is not particularly precise, it removes further debate over whether a 50-year planning timeframe is appropriate in potentially hazard-prone areas. A 50-year timeframe has been justified in the past because the Building Act 2004 specifies a 50-year timeframe. However, that Act is concerned with the fitness of a building during its finite lifetime (specified as being a minimum of 50 years). The RMA’s concern is with sustainable resource management, including meeting the foreseeable needs of future generations. Resource management expectations include expectations of ongoing development on land, particularly for new lots created by subdivision.²

Outside of the coastal environment no direction on planning timeframe is provided by national policy.

² [Department of Conservation - NZCPS 2010 draft guide to implementing Policies 24-27 coastal hazards Steering Group version 11 December 2012.](#)

In the absence of such direction, it falls to the regulatory authority — the regional, city or district council — to decide on an appropriate planning timeframe. The considerations behind the NZCPS’s adoption of a minimum of 100 years are equally applicable elsewhere.

2.5.1 Case law guidance

One case that addresses the issue of planning timeframe, albeit obliquely, is *J. Hemi (Hohua Warren Hemi) v Waikato District Council* [2010] NZEnvC 216 Decision (Environment Court, Judge Harland presiding). In this case, sea-level rise was an issue. The decision stated that, “Out to 2090–2100, sea-level rise of between 1.5 and 2 m cannot be ruled out but available evidence justifies an estimate of 0.5 and 1.5 m being adopted generally.” If the higher sea-level range is taken as corresponding with a longer planning timeframe, the Court’s comments about when to use a higher sea-level rise and when to use a lower sea-level rise can be inferred to inform the choice of planning timeframe:

“[T]he upper estimate [over a longer timeframe] should apply to particularly expensive investments with high public welfare and benefit and with no hazard adaptation options because hazard failure would have major catastrophic consequences[, e.g.] major infrastructure such as new highways or large subdivisions, ... where there is minimal opportunity for subsequent adaptation and policy emphasises hazard avoidance. For these types of uses ... consideration of potential [sea-level rise] over a longer time-span may ... be appropriate. The lower estimate should apply to investments of limited value where personal safety is not an issue and viable adaptation options are available; hazard failure would have minor to insignificant consequences. Deciding on an appropriate sea-level rise value [or planning timeframe] for a particular use needs to be based on a robust risk assessment that balances the likelihood and magnitude of the potential hazard impact against different sea-level rise scenarios. [judgment paragraph 57] ... [T]he value of the investment at issue coupled with an assessment of personal risk and an assessment of the options for dealing with the development if predictions prove to be worse than expected is a good basis for considering the value to be attached to sea-level rise [or planning timeframe] in any given case. [62]”

2.5.2 Sea-level rise relative to Moturiki Datum

Policy NH 11B provides minimum values to be used when taking sea-level rise into account:

“Use the following projections as minimum values when undertaking coastal hazard assessments:

- a. A 100-year time frame,
- b. A projection of a base sea-level rise of at least 0.6 m (above the 1980–1999 average) for activities/developments which are relocatable,
- c. A projection of a base sea-level rise of 0.9 m (above 1980–1999 average) for activities where future adaptation options are limited, such as regionally significant infrastructure and developments which cannot be relocated, and
- d. An additional sea-level rise of 10 mm/annum for activities with life spans beyond 2112.”

For the avoidance of doubt, the expression “(above the 1980–1999 average)” should be read as “(above the 1980–1999 average sea level)”.

The date range 1980–1999 aligns with that used in *Coastal Hazards and Climate Change: A Guidance Manual for Local Government in New Zealand*, Ministry for the Environment, May 2008.

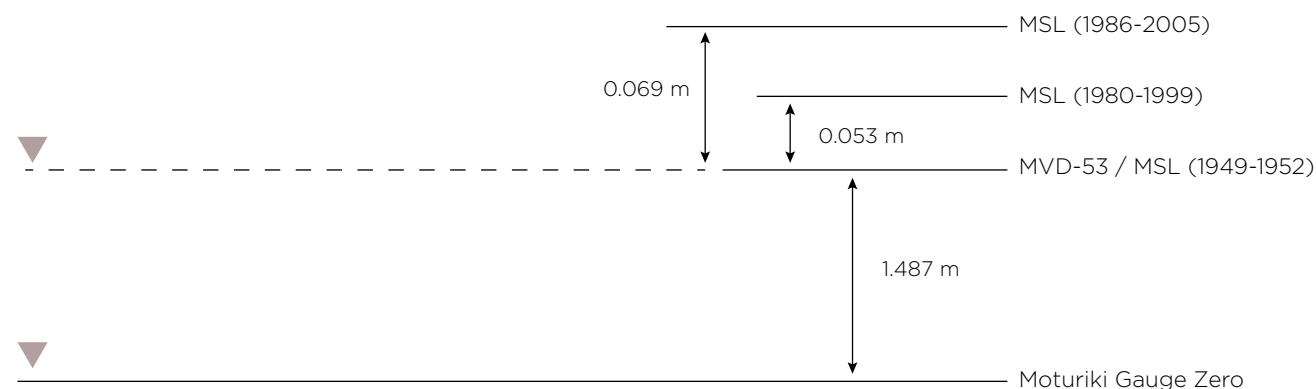
For the Bay of Plenty region, elevations are defined relative to the Moturiki Vertical Datum 1953 (MVD-53) which is a fixed vertical survey datum. MVD-53 was derived from sea-level measurements from February 1949 to December 1952 at Moturiki Island, Mount Maunganui.

The rise of the mean sea-level between the 1949–1952 average to the 1980–1999 average is 0.053 m. Hence, the 1980–1999 average sea-level is 0.053 m relative to MVD-53.

Note that not all sea-level rise information is presented as being above the 1980–1999 average. For example, the Fifth Assessment Report of the Intergovernmental Panel on Climate Change presents sea level rise “relative to 1986–2005”. Care must be taken when applying “up-to-date projections of changes in sea level” (as required by Policy NH 11B) to ensure that they are correctly reduced to MVD-53.

The long term permanent sea-level recorder at Moturiki is used to provide historic sea-level rise information. Any data retrieved from the instrument are to Gauge Zero, the zero datum of the sea-level recording instrument, unless otherwise documented. Gauge Zero on the long-term permanent sea-level recorder at Moturiki is 1.487 m below MVD-53.

The relationship of these various levels is illustrated in Figure 6 below:



▼ Denotes fixed survey datum
Not to scale

Figure 6 - Relationship between height datums in the Bay of Plenty.



2.6 Link between susceptibility and planning timeframe

Some hazards include a component that changes over time. For example, sea-level is expected to rise due to climate change. This will affect coastal erosion, coastal inundation and tsunami.

In these cases, the extent of the susceptibility area will be dependent in part on the amount of sea-level rise that is allowed for. The amount of sea-level rise is related to the planning timeframe. As noted above, the NZCPS requires a minimum of 100 years. For proposals such as new highways or large subdivisions a longer planning timeframe may be appropriate, recognising that the form that is put in place will last a long time. For hazard susceptibility mapping purposes — as part of describing the context of the risk management — the sea-level rise that would occur over that longer period could be included when determining the spatial extent of the particular coastal hazard.

Because of the uncertainty associated with estimates of sea-level rise, particularly beyond 100 years, the natural hazard zone need not extend to the limit of the hazard susceptibility area. Limiting the NHZ to the extent of the hazard associated with 100 years of sea-level rise is appropriate given that NHZs

are used for regulatory control of the use of land. A more extensive susceptibility area could inform decisions about the need for risk assessment of specified activities, e.g. large subdivisions, outside of NHZs.

Apart from repeating the NZCPS's requirement for the assessment of coastal hazard risks over “at least 100 years”, the RPS is silent on the timeframe to be used. The decision on what timeframe to use is for the planning or consenting authority, informed by guidance and case law.

The Ministry for the Environment's Coastal hazards and climate change: A guidance manual for local government in New Zealand, Ministry for the Environment, May 2008, includes a figure that shows the relationship between annual exceedance probability (AEP) and the likelihood that an event with a specified AEP will occur within a planning timeframe.

Policy 24 of the NZCPS requires identification of areas potentially affected by hazards over at least 100 years. Draft guidance on Policy 24 proposes that “potentially” is more or less equivalent to a 33% likelihood of occurring within the planning timeframe. From Figure 7, it can be seen that, in a 200 year (approximately) planning timeframe, an area is “potentially affected” by a 0.2% AEP event. When the planning timeframe has been decided on, Figure 7 will assist in selecting the AEP to be used for determining the hazard's susceptibility area.

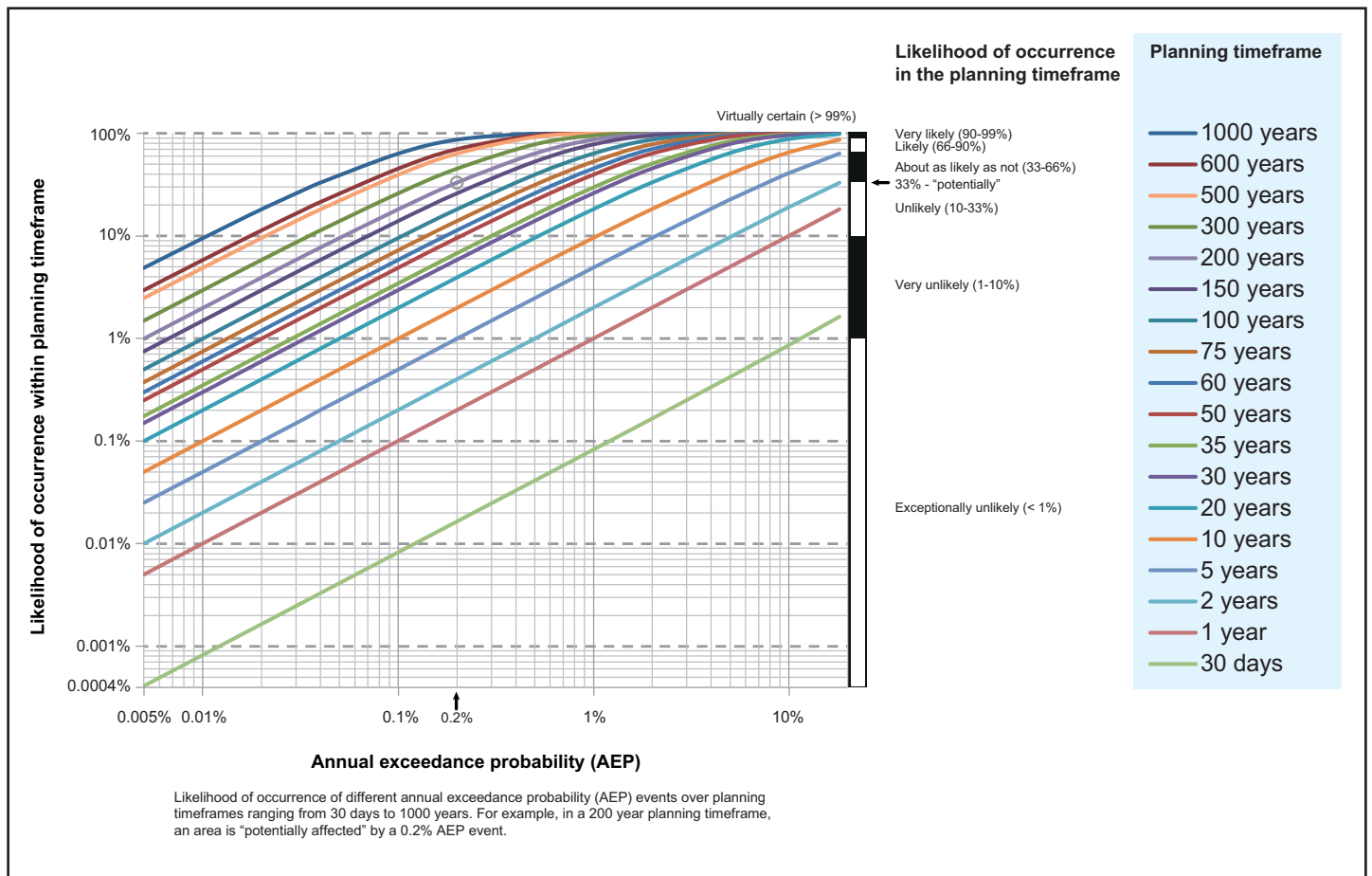


Figure 7 - Annual exceedance probability and likelihood of occurrence within a range of planning timeframes.



The background of the slide is a photograph of a beach. In the foreground, there are white, foamy waves washing onto a sandy shore. Behind the sand, there is a dense thicket of tall, dry, golden-brown grasses. In the upper right portion of the image, there are some bare, thin tree branches. The overall scene is a natural coastal landscape.

Part 3:

How to apply
Appendix L with
incomplete
information



To apply the default risk assessment methodology of Appendix L the user needs:

- Information about the scale of event that would occur from events of the likelihoods specified in Column A and (potentially) Column B of Table 20 of Appendix L.
- Information to assess the potential consequences (in terms of loss of life/injury, building loss, damage to lifeline infrastructure) from the scale of event described above.

Considerable information exists on the natural hazards of the Bay of Plenty region. This is held mostly by the Regional Council and city and district councils. However, information is currently not comprehensive across the region. There will be gaps in terms of particular hazards and particular localities.

For that reason, this part provides guidance on how to apply Appendix L in the absence of complete information.

3.1 Likelihood

The likelihood of the event is required to assess the level of risk for that particular event. Appendix L, Table 20, requires a range of likelihood events to be analysed. For each hazard type, the range of likelihoods is selected to include the likelihood that corresponds with the maximum risk of the hazard.

A concept underpinning the RPS natural hazards provisions is that the maximum risk of a hazard is to be managed and there is some likelihood that corresponds with the maximum

risk. Rather than require multiple risk assessments over a large range of likelihoods, the default methodology has three nominated likelihoods to be assessed for each hazard type. The nominated likelihoods were selected after specialists in each hazard type indicated the range of likelihoods over which their discipline usually operates.

For many risk assessments it will be sufficient to assess the risk associated with the three given likelihoods. However, there may be situations where risk management failure would have catastrophic consequences and more detailed assessment is warranted. This may involve assessing risk over more likelihoods to establish the maximum risk.

likelihood: chance of something happening

Note 1: In risk management terminology, the word “likelihood” is used to refer to the chance of something happening, whether defined, measured or determined objectively or subjectively, qualitatively or quantitatively, and described using general terms or mathematically (such as a probability or a frequency over a given time period).

Note 2: The English term “likelihood” does not have a direct equivalent in some languages; instead, the equivalent of

the term “probability” is often used. However, in English, “probability” is often narrowly interpreted as a mathematical term. Therefore, in risk management terminology, “likelihood” is used with the intent that it should have the same broad interpretation as the term “probability” has in many languages other than English.³

³ ISO Guide 73:2009(E/F), 3.6.1.1

3.1.1 Likelihood information: Primary and secondary analysis

Table 20 of Appendix L sets out the likelihoods of hazard events for which risk assessment is required.

Hazard	Column A: Likelihood for initial analysis AEP (%)	Column B: Likelihood for secondary analysis	
		AEP (%) - More likely	AEP (%) - Less likely
Volcanic hazards (including geothermal)	0.1	0.2	0.005
Earthquake (liquefaction)	0.1	0.2	0.033
Earthquakes (fault rupture)	0.017	0.2	0.005
Tsunami	0.1	0.2	0.04
Coastal erosion	1	2	0.2
Landslip (rainfall related)	1	2	0.2
Landslip (seismic related)	0.1	0.2	0.033
Flooding (including coastal inundation)	1	2	0.2

Likelihoods for risk assessment - expanded Table 20.

The likelihoods listed in Column A of Table 20 are the starting point for the analysis (called the “initial analysis”). These likelihoods were selected as they broadly represent commonly researched likelihoods for the respective hazards. When an initial analysis results in a risk assessment of Medium or Low, secondary analyses over two other likelihoods are to be undertaken. The ranges differ by hazard. They were set after input from specialists in the different hazard types, members of the Technical Working Group⁴ who assisted with development of Variation 2, the forerunner of Change 2.

Column B includes upper (more likely) and lower (less likely) likelihoods whose consequences may also need analysing through what Appendix L refers to as “secondary analysis”. The lower likelihood generally aligns with the worst case scenario or maximum credible event. Therefore, the lower likelihood events may also be used for hazard susceptibility mapping.

As explained in Appendix L, the purpose of primary and then secondary analysis is to try to identify the hazard event (shown as “likelihood of maximum risk (LMR)” in Figure 8 below) that represents the greatest risk – being the point of maximum risk on the conceptual risk curve shown in Figure 8.

The likelihood in Column A of Table 20 might represent the event of maximum risk or it might not. That cannot be determined until events of other likelihoods are also analysed (through what is, in effect, a form of sensitivity analysis).

In that regard it does not much matter (within reason) what event likelihood is selected for the initial analysis, as long as that analysis and secondary analyses ultimately identify the event that represents maximum risk.

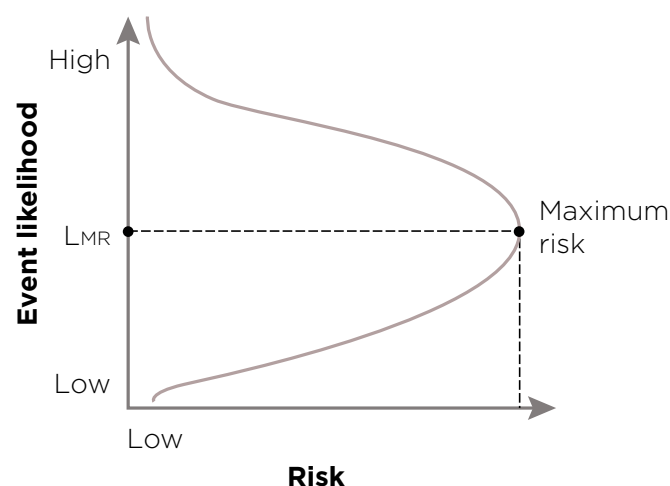


Figure 8 - Conceptual Curve of Maximum Risk.

For that reason, the approach adopted by AECOM in report “Proposed Change 2 Natural Hazards Scenario Testing, May 2015” is considered appropriate. In that report, information was not available on events of the likelihoods set out in Table 20 (then Table 6 of Change 2). The authors accordingly analysed events for which information was available. For example, a flood event with a 2% AEP (50 year ARI) was analysed, rather than the 1% AEP (100 year ARI) as specified for initial analysis in Table 20.

This accords with the principle of using best available information. Should there be information on multiple event likelihoods but none corresponding to the initial assessment likelihood of Table 20, then the event closest to the likelihood listed in Table 20 should be used.

⁴ Bay of Plenty Regional Council Regional Policy Statement – Variation 2
Natural Hazards Technical Working Group Report



3.2 Consequence

For a number of hazards and hazard prone areas, detailed studies have been undertaken of the consequences of particular hazard events. However, in many cases, applying Appendix L will mean making an assessment of the likely consequences of a hazard event for the first time.

Just because no previous detailed, highly quantified study can be drawn on, that does not mean that no assessment can or should be made.

The expectation is that, in the absence of existing information, a systematic approach to working through each of the potential consequences (from Table 21) will be undertaken, with documented reasoned judgements about the extent to which damage and loss could be expected.

3.2.1 Built assets

Where a hazard assessment area has been defined, the number of dwellings and other buildings (including “social and cultural” and “critical” buildings) within the HAA will be readily determined, through manual survey or analysis of aerial photographs and cadastral databases. Judgement is then required to be exercised about the extent to which these buildings will be functionally compromised.

When there are few buildings within a category

Low numbers of buildings in the “social and cultural” and “critical” categories can give rise to concern about whether the consequence metrics relating to them are valid. Just one building in the category being functionally compromised could equate to a “catastrophic” consequence level. Such a result should not be dismissed; mitigation can be targeted and may be straightforward. However, if such a result is an outlier relative to other consequence categories, judgement supported by a reasoned explanation may lead to a lower consequence level being attributed.

Functionally compromised

For the built environment consequence categories, the severity of impact is based on whether the building is functionally compromised. “Functionally compromised” means the building cannot continue to be used for its intended use immediately after the event. For example, if an apartment building does not have a water supply, it is unable to be used for residential accommodation due to firefighting requirements. As such, the functionality of this building has been compromised by the natural hazard event.

Based on the above definition and empirical observations from New Zealand, compromised building functionality for flood hazards occurs as soon as flood water depth exceeds building ground floor level if not before. Recognising the limits to the precision of the base LiDAR information and the flood modelling, when floor levels are unknown building functionality is assumed to be compromised when the modelled flood level is 500 mm above the LiDAR ground level.

The expected impacts of most other hazards are believed to be relatively straightforward to assess “functionally

comprised”. Suitably qualified experts (as set out in the Policy) will be relied on to make this assessment based on best practice and national guidance.

Similarly, the presence and nature of lifeline utilities within the HAA should be relatively easily identified. Again, informed judgement is required about how long such lifelines might be out of service.

When conclusions are made about particular consequences based on judgement (rather than mathematical calculation or modelling) the assessment will be qualitative (at least in part).

3.2.2 Lifeline utilities

Assessment of the level of consequence of disruption of lifeline utilities will generally require input from relevant representatives of each lifeline utility operator. Representatives will be asked to consider each hazard’s effects on their networks and nodes. There is a requirement to identify what effect the hazard event, modelled for each likelihood under consideration, has on their ability to deliver the lifeline’s service. If the service is found to be interrupted, assessments of the duration of the outage and the population affected are required to assess the consequence level. If a particular network or node is able to be bypassed and service restored or maintained, that is to be taken into account in the assessment.

Some lifeline utilities are dependent on other lifelines. For example, if a liquid fuel retailer was reliant on electricity to function, an interruption of the electricity supply would lead to an interruption of the fuel supply service. Thus, utility operators need to be aware of their own dependency on other lifeline utilities.

It has been queried whether particular lifeline utilities should be weighted as more critical than others. The Appendix L methodology does not address this directly. However, when the duration of the outage and the population affected takes into account dependencies, this should have the effect of prioritising the effect on some lifelines in advance of others and influencing the choice and sequencing of mitigation options accordingly.

3.2.3 People: Health & Safety

Human loss vulnerability functions are derived empirically from injury and death rates recorded in comparable events elsewhere. For example, RiskScape⁵ estimates human losses from tsunami for people located in buildings based on the report by Reese et al. (2007⁶) following the 2006 Java tsunami, and similar work after the 2009 Samoan tsunami.

Those undertaking risk assessments can either refer to previous risk assessments for examples of the determination of health and safety effects or engage specialist risk assessors to apply their human loss vulnerability functions to the particular hazard parameters in question.

Human loss vulnerability functions and methods for estimating human losses are reviewed and updated as information becomes available.

3.2.4 Assessing the maximum development scenario

Policy NH 8A requires risk assessment to be undertaken in the context of district or regional plan development. It should consider consequences in terms of potential adverse effects on existing development and on any proposed development (or development provided for in the plan).

The first step in addressing proposed development is when defining natural hazard zones within a hazard susceptibility area. Care should be taken to distinguish between areas that have already been developed and those where prospective development is to be provided for in a city or district plan. Different risk thresholds apply to existing and new development. An area identified for proposed development should have its own natural hazard zone.

Prospective development must be modelled before a risk assessment can be undertaken. For example, for a future urban zone, this may involve overlaying an existing digital terrain model with the maximum development density allowed by the city or district plan and a mix of house and other building types corresponding to similar existing situations. This will require a degree of judgement. All assumptions should be recorded to allow them to be tested later, if challenged.

⁵ RiskScape is a multiple hazard impact and loss modelling software application jointly developed by NIWA and GNS Science.

⁶ Reese, S., Cousins, W. J., Power, W. L., Palmer, N. G., Tejakusuma, I. G., Nugrahadi, S. (2007). Tsunami vulnerability of buildings and people in South Java. Field observations after the July 2006 Java Tsunami. *Natural Hazards and Earth System Science* 7: 573-589.





3.3 Explanation of Secondary Analysis

Step 5 of the default methodology of Appendix L sets out in narrative form the process to be followed where secondary analysis is required.

The purpose of secondary analysis is to ensure that the primary analysis has not provided a “false” assessment of risk as being less than High (i.e. because it has not identified the maximum risk). In other words, it seeks to test whether a less or more likely event represents a greater risk.

Secondary analysis is not required where the primary analysis already shows risk to be High.

Figure 9 below sets out the steps to be followed for the secondary assessment. Note, this is also depicted on Figure 4 of Appendix L but is presented here in a different format to assist understanding of what is a complex process.

Figure 9 is to be read from left to right. While it may appear complex, the underlying theory is straightforward. The risk must be assigned as High if either:

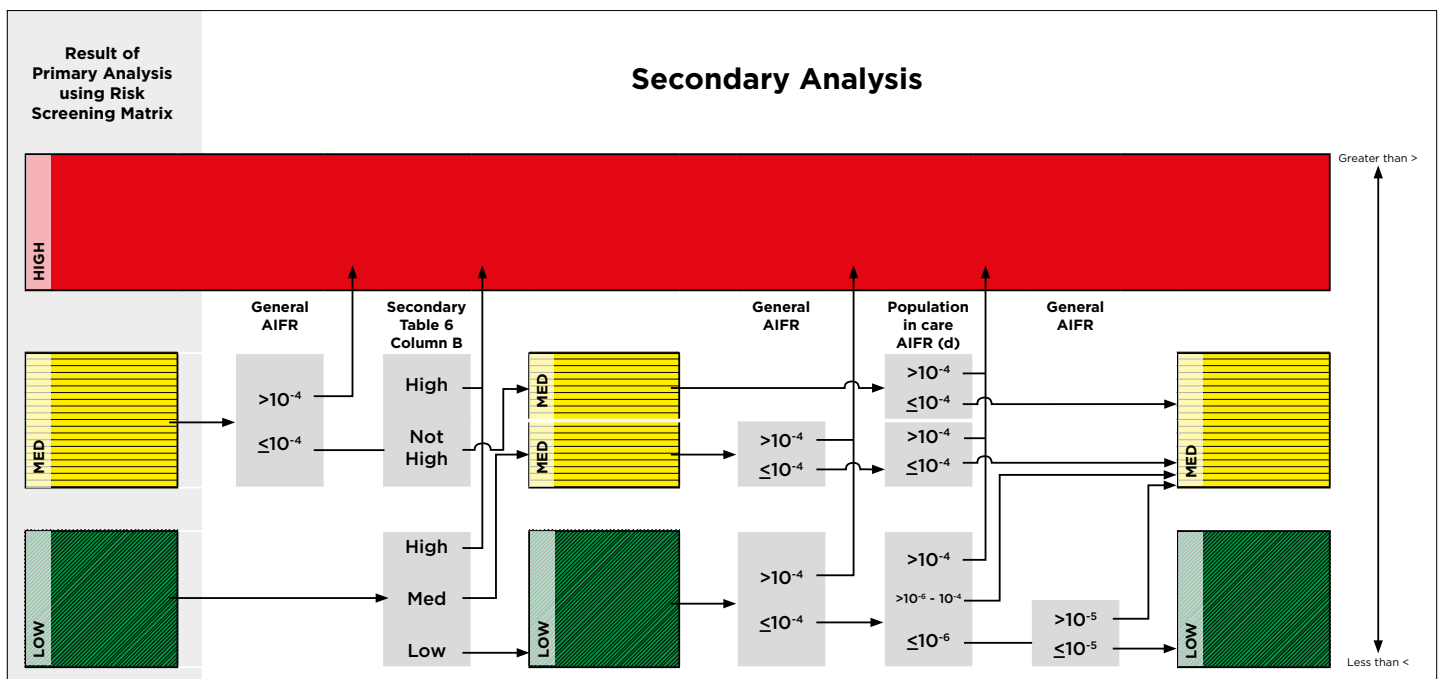
- the risk assessed using the risk assessment matrix (RAM) is in the red part of that RAM; or
- the risk of an annual individual fatality (death) (AIFR) is greater than 1 in 10,000 (i.e. 10^{-4})

That basic test must be applied to the assessment of events of the likelihood set out in Column A of Table 20 (primary assessment) and to the assessment of events of higher and lower likelihood as set out in Column B of Table 20 (secondary assessment).

A third test applies to those hazard events that, after primary and secondary risk analysis, are found to have a risk less than High. In those cases, the AIFR test is applied again but it is limited to considering only the population in care (shown as PIC). The population in care is a defined term and includes those in hospitals, aged care facilities, schools and early education and child care facilities.

After all stages of analysis are completed the appropriate risk classification is the highest recorded at any stage in the process. That is why a High risk outcome at any stage means that no further assessment is necessary. It is also why a scenario assigned as Medium risk by the primary assessment can never be assessed as Low risk at any subsequent stage (unless risk mitigation options are added to the evaluation). Conversely the process can result in a scenario assessed as Low risk by the primary assessment being assigned Medium or High risk by a subsequent assessment stage. In short secondary assessment and the application of the AIFR test can result in an increase in the assigned risk level but not a reduction in the assigned risk level.

Figure 9 - Secondary analysis process.



3.4 Qualitative vs quantitative

Appendix L allows for assessments of consequences to be quantitative or qualitative (or a combination). It sets out clear criteria for identifying when assessment must be quantitative. For completeness these are repeated here.

A quantitative approach must be used where:

- *The hazard has generated a damaging event in the recent past and there is a high likelihood that events of a similar scale will continue, or occur again.*

This recognises that communities who have experienced hazard events, or at least have first-hand knowledge of events in their community, will have a heightened sensitivity to hazard risk and will expect careful and considered assessment of risk should, for example, further land be proposed for urban development.

- *The hazard susceptibility area is greenfield land and is proposed to be developed with an ultimate urbanised footprint of five hectares or more.*

This recognises that larger developments mean greater potential consequences should a hazard event occur.

- *The hazard susceptibility area has been subject to previous quantitative risk assessment and the development proposal that gives rise to the need for risk assessment would materially increase the potential consequences of an event.*

This recognises that the conclusions of previous quantitative assessments can be invalidated by new development occurring within the hazard assessment area. Because a previous quantitative assessment exists, a new quantitative assessment (based on updating the original assessment) ought not to be onerous.

3.4.1 The qualitative method of determining likelihood and consequences

As noted earlier, outside of the situations outlined above, Appendix L allows for the assessment of consequences to be qualitative. This just means that likelihood and consequences need not be identified and described in highly quantitative terms.

Qualitative analysis has been defined in the guidance on taking a “risk-based approach to planning for natural hazards” contained on the Quality Planning website. That definition is as follows:

Qualitative analysis: Qualitative analysis uses words to describe the magnitude of potential consequences and the likelihood that those consequences will occur. These descriptions can be adapted or adjusted to suit the circumstances, and different descriptions may be used for different risks. Qualitative analysis may be used:

- As an initial screening activity to identify risks which require more detailed analysis.
- Where this kind of analysis is appropriate for decisions.
- Where the numerical data or resources are inadequate for a quantitative analysis.

Qualitative analysis should be informed by factual information and data where available.

Appendix L provides that where a qualitative approach is used, the assessment should be undertaken by a “suitably qualified person”. It is expected that such a person would estimate the level of each potential consequence and assign an overall consequence level (using the five-tier scale of Table 21).

Guidance on who a suitably qualified person might be is provided in Box 1 below.

Box 1 - Guidance on suitably qualified and experienced practitioners

As a general guide, a suitably qualified and experienced practitioner is a person who is independent, applies good professional practice, and assesses consequences with reference to accepted benchmarks and industry guidelines. Environmental practitioners are not expected to act alone across the large number of disciplines required to deal with natural hazard risk issues. For example, someone may be suitably qualified in understanding the consequences associated with flooding but have no experience

in assessing earthquake related consequences. The practitioner is essentially an expert in some specific and relevant fields and experienced in drawing together multi-disciplinary inputs and drawing conclusions about likely consequences.

A suitably qualified and experienced practitioner would need to be willing to certify (by signature) that the content of the hazard consequence assessment complies with good practice and professional standards, and to stand by the conclusions of the report. For example, a person certifying a report should be someone who could ultimately stand in the Environment Court and provide expert testimony, and whose experience and qualifications stand up to Court scrutiny.

3.7 Proportionality of effort

The Regional Council is also mindful of other national level guidance on risk assessment associated with natural hazards. In the publication *Coastal Hazards and Climate Change: A Guidance Manual for Local Government in New Zealand*⁷, the following advice is provided:

Any risk assessment needs to be:

- conducted at a level of detail appropriate to the scale of the risk and nature of the decision.
- consistent with the level of data or information available.

This User Guide endorses both the definition of qualitative assessment and the “proportional principle” included in the Ministry for the Environment’s coastal hazards guidance.

3.8 Accounting for mitigation in the risk assessment

Where a risk assessment finds that a High or Medium risk exists, risk reduction may be required and hazard mitigation proposed.

Mitigation structures are usually engineered solutions aimed at reducing the consequence of likely hazard events or avoiding a certain hazard event (such as flooding) occurring up to a specified design limit. Typically they include structures such as:

- stop banks and river/stormwater management works (designed to protect against flooding),
- sea walls and/or groynes or similar coastal structures (designed to protect against coastal erosion and/or inundation),
- debris nets (design to protect against rock and other debris falling from cliffs or other debris flow pathways).

Although not common, mitigation structures would also potentially include structures used (as a secondary purpose) for vertical evacuation in the event of a tsunami.

The existence of such structures will generally reduce the potential consequence of hazard events up to a prescribed design limit. Where such structures exist, or are proposed as part of a development, the assessment of consequences will need to give full regard to the likely effect and effectiveness of such structures. The relevant engineering detail and design parameters of any mitigation structure will be critical to understanding the degree of mitigation that will be achieved. From that, reasonable assumptions can be made about the level of reduction likely to be achieved of each of the consequences in Table 21 of Appendix L. For existing structures the performance in the face of previous hazard events may be important context. [The regional council will hold information that can assist in that regard.]

It is also important to understand that some structures can lead to increased consequences. That can result when hazard events occur that are beyond the design limit of the mitigation structure leading to a consequence greater than might have occurred without that structure. Stop banks are a good

example of this. A stop bank may be designed to protect against a 2% AEP (one in fifty year) flooding event. If a stop bank fails or is overtopped due to an event beyond its design limit, water impounded behind that bank can be released creating a greater volume and rate of discharge than would otherwise have occurred.

Furthermore, the existence of a river management scheme has at times allowed for development to occur in natural flood plains in the belief that flood risk has been adequately addressed (and it will have been so but only for events within the design limit). For events that are less likely than the design event, consequences may actually increase if more development is located in the area “protected” by the flood protection scheme than might have been the case without that scheme.

Hence, in considering development in areas “protected” by a flood control scheme it is important to understand the design limits of that scheme. This will apply even where the development is proposed in an already highly developed area. In practice this will mean disregarding any benefits of the flood protection scheme for events beyond the scheme’s design limit.

In summary, provided a flood protection scheme does not fail there will be a reduced consequence from events at the highly likely end of the likelihood spectrum. However, if there is a failure or over-design event, there may be increased consequences. Both potential effects (positive and negative) would need to be evaluated using expert judgment to assess whether, overall, the risk target is achieved.

Physical mitigation structures can confidently be included in the risk assessment if they are community assets, funded and maintained by a local authority and subject to asset management plans. Privately owned structures may be taken into account in an assessment but their inclusion will require judgement as to whether they can be relied on over the planning timeframe.

Non-structural risk reduction may be achieved by, for example, building public awareness and understanding of natural hazards and promoting evacuation education. The potential consequences of injury and death from natural hazards are a component assessed under the natural hazards provisions of the RPS. Therefore, community evacuation measures should be taken into account when assessing natural hazard risk in collaboration with the region’s Civil Defence Emergency Management Group. Where emergency management responses such as evacuation are proposed, their modelled effectiveness would be included in the risk assessment.

When mitigation is relied on to achieve the intended level of risk, plan provisions or resource consent conditions must ensure that the mitigation is required as part of any authorisation of a development or activity.

⁷ Ministry for the Environment 2008, (Publication Reference ME892).



3.9 Overview

In summary, the following general principles are adopted here:

1. An absence of pre-existing quantified information on potential likelihood or consequences of a natural hazard event does not mean that no risk assessment is required or possible.
2. Quantified information should be gathered where it is reasonably practical to do so. This will ordinarily require at least the number and type of buildings and lifeline utilities within the HAA to be calculated or estimated where calculation is not reasonably practical.
3. Where it is impractical or unreasonable to gather quantitative information (through, for example, modelling), qualitative assessment of effects and consequences using the five-tier scale of Table 21 is appropriate, provided it is undertaken by a suitably qualified person.
4. The approach taken in the absence of full information should be systematic and transparent.
5. Where estimates and judgements about the scale and degree of consequences are used, the assumptions and uncertainties should be described.
6. The degree of effort and depth of analysis should reflect the scale, intensity and severity of the potential consequence.





Part 4:

Recognised
risk assessment
methodology

The preceding part explains how to apply the default risk assessment methodology of Appendix L when there is an absence of information.

Another option available to councils and resource consent applicants is to use an alternative recognised risk assessment methodology (RRAM).

Appendix L states that a RRAM must be either:

included in a regional, city or district plan, or

recognised in the consideration of a resource consent application (note that this reference should be read to include a private plan change process or notice of requirement).

In determining whether a risk assessment methodology can qualify as an RRAM for the purpose of the RPS, regard should be had to the criteria set out below.

4.1 Criteria for determining a qualifying RRAM

1. The risk assessment method is generally used or is generally accepted for use in New Zealand as good practice to meet professional standards.

A qualifying methodology will be:

- a. Endorsed or promoted by a national policy statement or national environmental standard or regulation under section 360 of the Resource Management Act (or any associated official guidance), or
- b. Endorsed or promoted by regulations (or any associated official guidance) under any other New Zealand statute, or
- c. Accepted by a New Zealand Court as being appropriate for risk assessment by a decision or declaration pursuant to the Resource Management Act, or
- d. Contained within an Industry Code of Practice issued by an organised industry collective or industry-good organisation,

OR

2. The method is well-founded and based on accepted scientific principles.

A qualifying methodology will be:

- a. Based on deliberative consideration of both the likelihood and consequence of a natural hazard event, and
- b. Peer reviewed and published in a reputable science or industry publication, and
- c. Promoted by a public agency or independent professional organisation (e.g. institute or society) with a statutory or professional development role in risk assessment and/or natural hazards research or policy development.

AND

3. The outputs from applying the method are generally comparable with those from other accepted risk methodologies and relate to the RPS policy framework.

A qualifying methodology will produce outputs that assign a risk level that can be applied, or be reasonably adapted to apply, within the High, Medium and Low risk framework. That is, the output must enable a determination of whether the risk is acceptable, tolerable or intolerable by reference to other risks faced by the community. Similarly, the risk assessment must enable councils to apply the RPS's natural hazards policies with confidence that the management approach will be the same, or similar, to what would apply if other recognised risk assessment methodologies were used.

4.2 Application of criteria

For the avoidance of doubt, to qualify as a RRAM for the purpose of Appendix L, a methodology must meet primary criteria 1 or 2 and, in either case, primary criterion 3 as set out above.

In asserting through a resource consent application, or through a regional or district plan preparation process, that a methodology other than the default methodology may be used to assess natural hazard risk, justification should be provided referencing the above criteria.



4.3 Risk methodologies deemed to comply

For the avoidance of doubt and to provide certainty for potentially affected stakeholders, the Regional Council invites stakeholders to identify risk methodologies that they believe comply with the criteria set out above.

The Regional Council will consider any methodology submitted to it and maintain a list of methodologies on its website that it considers comply with the criteria set out above.

At this point, the Regional Council can confirm that it regards the following guideline as a RRAM. As noted above, further methodologies may be added to this list from time to time.

Name	Date	Author	Hazard type
Landslide Risk Management	2007	Australian Geomechanics Society	Landslide

In addition, the Regional Council notes the general approach to hazard risk assessment promoted in the following publications and considers that the concepts and approaches

proposed in those guidelines provide useful context for applying the RPS's natural hazards policies.

Name	Date	Author	Hazard type
Risk management - Principles and guidelines AS/NZS ISO 31000:2009, and SA/SNZ HB 436:2013 Risk management guidelines – Companion to AS/NZS 31000:2009	2009	Standards Australia Standards New Zealand	All
Risk-based land use planning for natural hazard risk reduction	2013	Standards Australia Limited/ Standards New Zealand	
Preparing for future flooding: A guide for local government in New Zealand	2010	GNS Science	All
Coastal Hazards and Climate Change: A Guidance Manual for Local Government in New Zealand	2008	Ministry for the Environment	Flooding
Climate change effects and impact assessment: A Guidance Manual for Local Government in New Zealand - 2nd Edition	2008	Ministry for the Environment	Coastal
Managing Flood Risk - A Process Standard. Standards New Zealand NZS 9401:2008	2008	Ministry for the Environment	Coastal/ Flooding
Managing Flood Risk - A Process Standard. Standards New Zealand NZS 9401:2008	2008	Standards New Zealand	Flooding







Part 5:
Examples

The following two examples illustrate how the RPS natural hazards policies are to apply in practice. Both are completely hypothetical in nature and of necessity involve reference to fictitious territorial council planning provisions. Reference to such provisions should not be read as endorsement of any particular approach and are included here purely to illustrate the possible application of RPS policies.

5.1 Example 1: Simple suburban subdivision

Example 1 involves a small-scale urban development. The following scenario applies. Mr Smith wants to subdivide the existing family home from his 780 m² residential section in a coastal settlement creating an additional allotment that he intends to sell enabling an additional dwelling to be constructed to the rear of the existing dwelling. The relevant City Plan provides for the subdivision as a controlled activity.

The site is generally free of natural hazards except that both the City Council and the Regional Council hold information indicating that the site is within the inundation zone of a tsunami with an estimated AEP of 0.05%. It is outside the inundation zone of a tsunami with an estimated AEP of 0.1%.

The application is lodged in the period before the City Plan is amended to give effect to Bay of Plenty RPS's natural hazards provisions.

Application of RPS policy

Policy NH 9B applies because the application is made in the "interim period" (i.e. before the City Council has given effect to policies NH 7A and NH 8A).

Hence the planning consultant engaged by Mr Smith submits the subdivision application to the City Council with a statement that no assessment of natural hazard risk using Appendix L ought to be required and sets out the justification for that position against the criteria listed in policy NH 9B of the RPS.

The City Council assesses the reasoning provided by Mr Smith's consultant and decides whether or not to accept the application without an Appendix L assessment. In this case the City Council is satisfied that it has an understanding of the tsunami risk and that, given the small increase in potential consequence represented by the one additional dwelling enabled, it will accept and process the application without an Appendix L risk assessment.

5.2 Example 2: Simple suburban subdivision five years later

Five years after Mr Smith subdivided a rear section from his site, his neighbour, Ms Jones, decides she wants to do the same.

Ms Jones' property is very similar to Mr Smith's and the same tsunami susceptibility is present.

The City Council has by this time amended its City Plan to give effect to Policies NH 7A and NH 8A. Accordingly it has:

- Defined a tsunami susceptibility area over parts of the coastal suburbs (as required by Policy NH 7A), and
- Divided that susceptibility area into three natural hazard zones on the basis of its assessment under Appendix L (as required by Policy NH 8A (a)-(b)).
- Applied a Low hazard risk zone over Ms Jones property (consistent with Policy NH 8A (c)).

In preparing its plan the City Council has been conscious of the possible cumulative effects of infill housing within the new tsunami hazard Low risk zone. For that reason, it has limited the number of additional dwellings that may be allowed to be built within the zone that would be below a certain elevation/floor level. That number has been calculated on the basis of the number of dwellings that would be functionally compromised in the event of a tsunami. The City Council has determined that in the Low risk zone where Ms Jones' property is, the total number of "at natural grade" dwellings that could be permitted before triggering reassignment of the area as Medium risk is 1,250. There are currently 1,080 dwellings in the zone.

Accordingly the subdivision rules of the new City Plan have been redesigned to allow an additional 170 new dwellings only. That has meant that in the area where Ms Jones lives the minimum lot size for a controlled activity subdivision consent has been increased from 325 m² to 425 m². The City Council has developed those provisions to give effect to its obligation under Policy NH 12A (b).

Policy NH 10B applies because the application is lodged by Ms Jones after the City Council has given effect to Policy NH 7A and NH 8A. This means that Ms Jones' application must be accompanied by an Appendix L risk assessment if the City Plan requires it.

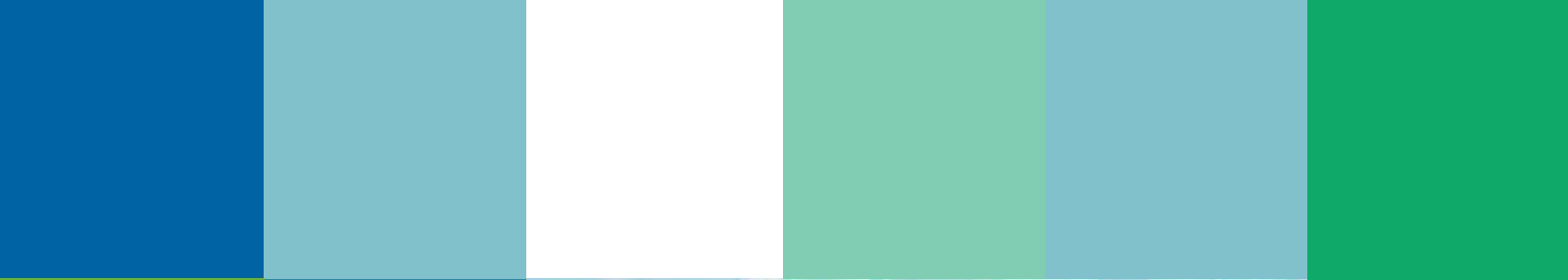
In this instance because Ms Jones' application requires a discretionary activity consent (because it does not comply with the minimum lot size) the plan does require that the subdivision application be accompanied by an Appendix L assessment.

Because the application is for a single residential lot no exemption will apply under Policy NH 6B. Hence, to give effect to Policy NH 3B the City Council will need to be satisfied that the risk assessment demonstrates that the development would not raise the risk within the hazard risk zone from Low to Medium.

To demonstrate that, Ms Jones may need to propose some risk mitigation measure or point out risk mitigation measures that have been instituted by others since the initial Appendix L assessment on which the plan provisions were based and show that including those new measures allows for additional dwellings without an increase in risk.

Credits

Inside cover	<i>Shane Iremonger</i> - Whakatāne to Ohope aerial view, 2015
Page 4-5	Matata debris flow/flood, 2005
Page 8-9	Matata debris flow/flood, 2005
Page 10	<i>Lloyd Homer, GNS Science</i> - Fault rupture, Edgecumbe earthquake, 1987
Page 16	<i>Jo Heath, BOPRC</i> - Kuirau Park, Rotorua, 2016
Page 18-19	<i>Lisa Tauroa</i> - Whakatāne flood, 2010
Page 20	Bay Park Stadium, Tauranga, flood, 2005
Page 22	<i>GNS Science</i> - White Island eruption, 2013
Page 23	<i>Lisa Tauroa</i> - Valley Road, Whakatāne, scrub fire, 2002
Page 24	<i>Geospatial Group, BOPRC</i> - Landslides on Hinewa Road, Otumoetai, Tauranga, 2005
Page 27	<i>Lisa Tauroa</i> - Hail storm, Ohope hill, 2009
Page 28-29	<i>Health Emergency Management New Zealand (HEMNZ)</i> - Edgecumbe earthquake, 1987
Page 30-31	<i>Shane Iremonger</i> - Cyclone Pam, Torere, 2015
Page 32-33	<i>Shane Iremonger</i> - Cyclone Pam, Hawaii, 2015



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