Floodplain management planning

2/3/2015

Greater Wellington Regional Council

Quality Information

Document Floodplain management planning – principles

Ref **Doc No 1366413 v11**

Prepared by Tracy Berghan

Reviewed by Mark Hooker

Revision History

Revision	Revision Date	Details	Authorised	
			Name/Position	Signature
1	22/09/14		Tracy Berghan	
2	03/02/15		Tracy Berghan	
3	10/03/15		Tracy Berghan	

Table of Contents

1 Introduction

Floodplain management planning is an internationally recognised approach to managing flood risk, and one that generally comprises the following phases:

- Investigating and understanding the probability and consequences of flooding, and the economic, social, cultural and environmental values within a defined catchment;
- Identifying, evaluating and selecting a range of appropriate management options, with community input, to reduce flood risk; and
- Implementing a preferred option(s) for managing the flood risk in a way that ensures a co-ordinated response by relevant agencies and/or individuals.

The outcome of this process is a Floodplain Management Plan (FMP), a high-level strategic planning document prepared in collaboration with key local decision-makers and the relevant catchment community to identify agreed policies and options to manage flood risk.

The floodplain management approach described above was introduced in the mid 1990's and endorsed by Greater Wellington Regional Council (GWRC). Since that time five FMPs[1] have been finalised, two are nearing completion and work on a further two is currently underway.[2]

In light of the importance placed by GWRC on the effective management of flood risk in the region, the purpose of this report is to outline:

- Four core principles that underlie GWRCs approach to floodplain management in the region;
- The rationale behind the introduction and application of these principles; and
- Examples of relevant national and international research, guidance and policy directives that support their application.

2 Principles

The floodplain management planning approach adopted by GWRC represents an effective response to managing flood risk, and is premised on a set of core principles that reflect the following:

- The evolving nature of Council practice in preparing and implementing FMPs throughout the region and the corresponding lessons learnt; and

[1] These include the Hutt, Otaki and Waikanae River FMPs, the Porirua Stream Management Plan completed in the mid 1990's and the Waitohu Stream Study completed in 2006.

[2] In the Wairarapa, GWRC predominantly manages those rivers and streams which have River Schemes in place. In the balance of the region GWRC also manages in association with local Territorial Authorities the rivers and streams listed in the Watercourses Agreement [1991], with city and district councils assuming primary responsibility for smaller urban streams and stormwater channels located within their particular jurisdictions.

- The political and economic realities associated with any prospective change to GWRC's current approach to managing flood hazard risk (e.g. managed retreat vs building or upgrading flood protection structures).

The principles also reinforce and complement the objectives and policies in the Regional Policy Statement for the Wellington Region (RPS) and the Council's operational floodplain management guidelines.

The four core principles that underpin GWRC's approach to floodplain management planning are as follows:

- Avoid building in areas at high risk of flood hazard;
- Only consider new flood protection infrastructure where existing development is at risk;
- Establish standards of flood protection relative to the degree of risk; and
- Plan for climate change in assessing the degree of flood hazard risk and in determining an appropriate response.

The manner in which these principles are applied to specific catchments is largely determined in discussion with individual communities during the process of preparing a FMP. This process and discussion includes, for example, consideration of such matters as:

- What constitutes 'an unacceptable level of risk' to the local community and what are the structural and non-structural measures available to reduce exposure to these risks; and
- How estimates of potential flood damage are derived (e.g. current land use and potential future losses under existing development conditions vs increased development opportunities and economic growth resulting from the introduction of structural measures).[3]

2.1 Avoid building in areas at high risk of flood hazard

Avoiding the construction of residential and other buildings vulnerable to flooding in undeveloped urban and rural areas (i.e. a 'greenfields' situation) exposed to a high level of flood hazard is the most effective way of managing flood risk in these locations in the long-term. In areas subject to a lesser degree of flood hazard, activities and development should be appropriate to the circumstances and should not exacerbate flood risk.

2.2 Only consider new flood protection infrastructure where existing development is at risk

Where existing urban or rural land use and/or development (e.g. dwellings, irrigation infrastructure, dairy sheds) is subject to an unacceptable degree of flood risk the construction of new structural

[3] To date economic analysis undertaken for FMP purposes has not included an explicit objective of pursuing economic growth, as increased land-use intensity in areas subject to high flood hazard risk is not an outcome contemplated by GWRC due to the core principle that any building in these areas should be avoided

protection measures (e.g. stopbanks, elevating existing buildings) will be considered. This includes circumstances where, for instance, there is an elevated risk to human life or safety or where the impact on lifeline utilities or the local/regional economy is judged to be significant.

2.3 Establish standards of flood protection relative to the degree of risk

In designing and implementing structural and/or non-structural measures within areas subject to flood risk, the following standards are to be applied by GWRC and city/district councils:[4]

- Protection of all habitable buildings and urban areas
    - A minimum 1 in 100 year flood standard to floor levels for habitable buildings and new development within existing urban areas, along with provision of safe access.
- Stopbank protection
    - Where required to protect existing urban areas and associated land use, stopbanks will be constructed to achieve a minimum 1 in 100 year flood standard;
    - Where required to protect rural areas and associated land use, stopbanks are generally constructed up to a 1 in 20 year flood standard to alleviate frequent or nuisance flood events.

2.4 Plan for climate change in assessing the degree of flood hazard risk and in determining an appropriate response

In assessing flood hazard risk and determining appropriate structural and/or non-structural responses in areas subject to flood risk, GWRC will apply the following allowances for climate change predicted to occur over the next 100 years in the design criteria for its flood hazard investigations:

- Current allowances[5]
    - Increases in rainfall intensity - 20%.
    - Sea Level Rise - 0.8m.

3 Reasons for principles

The introduction and application of the abovementioned principles are based on a number of reasons, some of the more fundamental of which are as follows:[6]

3.1 Avoidance

The RPS contains a clear policy directive that inappropriate subdivision and development in areas at high risk from natural hazards is to be avoided,[7] and is therefore a matter that needs to be given

[4] These standards complement and reinforce the considerations to which particular regard must be had that are outlined in Policies 51 and 52 of the Regional Policy Statement for the Wellington Region (refer Appendix 2), particularly Policy 51(i) which relates to the need to locate habitable floor areas and access routes above the 1:100 year flood level, in identified flood hazard areas

[5] Refer memo WGN# 1256418 – Climate Change Design Parameters attached as Appendix 3

[6] Also refer to the supporting information included in Appendix 1

effect to in relevant district plans.[8] It also includes an associated regulatory method that stipulates that the process to amend district plans to implement this policy is to commence on, or prior to, the date on which city and district councils in the region commence a review of their district plan or relevant plan provisions.[9]

Determining what is 'inappropriate' (and conversely appropriate) subdivision and development in identified flood hazard risk areas will depend on the local context (e.g. rural vs rural areas) .[10] However, inappropriate development in such areas would generally include, for example, activities that accommodate a high number of people, provide a critical service (e.g. medical, educational, emergency), or involve physical works (earthworks or vegetation clearance) that could obstruct natural overland flow paths (e.g. elevated roadways, embankments) or intensify the flow of water into natural or man-made drainage systems (e.g. vegetation removal, increase in hard surface area). Locating critical facilities and infrastructure in high hazard areas (e.g. hospitals, Civil Defence centres, substations, sensitive developments like housing for vulnerable people) would also be considered as inappropriate development.

By contrast appropriate development in flood risk areas would generally include, for example, activities and development which either involve no/limited human occupation of the area (e.g. farmland, passive open spaces, native habitats) or no significant physical works or structures being constructed. However, in some contexts it may also be appropriate to include activities and development that accommodate people where the level of identified flood hazard risk is satisfactorily recognised and responded to (e.g. minimum floor levels, setbacks/buffer areas).

The Supreme Court recently observed that the term 'avoid' was a strong word, meaning 'not allow' or 'prevent the occurrence of', and that the term 'inappropriate' needs to be considered and assessed against the characteristics of the environment that particular policies sought to preserve.[11]

It has also been noted that there appears to be an increased emphasis on engineered solutions in NZ which, while valid in many situations, may insufficiently manage the associated risks where design parameters are exceeded, thereby prompting consideration of avoidance of development in hazard prone areas.[12]

Consequently, a policy of avoidance clearly signals intent within areas of high hazard and averts the need for structural measures to be constructed to 'protect' subsequent development.

---

[7] RPS Policy 29; the associated explanation indicates that an area 'should be considered high risk if there is the potential for moderate to high levels of damage to the subdivision or development, including the buildings, infrastructure or land on which it is situated' (pg.109)

[8] Section 75(3)(c) RMA

[9] Section 4.5.1 Regulatory Methods – Method 1: District Plan Implementation

[10] This would include an evaluation of the costs and benefits to assess the levels of acceptable risk within an area along with the impact of different management options

[11] *EDS v NZ King Salmon & Ors*, SC 82/2013 [2014] NZSC 38

[12] B Glavovic, W Saunders, J Becker (2010), *Realising the Potential of Land-use Planning to Reduce Hazard Risks* in NZ in The Australasian Journal of Disaster and Trauma Studies, Vol. 2010-1

3.2 Flood Protection Infrastructure

The intent underpinning this principle is that new or future development in areas subject to flood hazard needs to take account of the hazard by either avoiding it altogether or mitigating the hazard if avoidance is unachievable (e.g. by raising the land or other methods that don't rely on the construction of physical flood protection structures such as stopbanks).[13] This, in turn, avoids the emergence of a 'safe development' paradox.[14]

Although flood protection structures can be highly effective when appropriately used, a residual flood hazard still remains. In particular, structures can be overtopped by events outside their design capacity, and structural solutions can also impose a high upfront cost, ongoing maintenance costs, induce complacency by their presence, and result in increased impacts if they fail or are overtopped.

3.3 Standards

Although the Building Act and the Resource Management Act (RMA) both manage natural hazards, there are important distinctions between their respective statutory imperatives and the methods through which hazards are addressed. Under the RMA, local authorities are authorised to control the use of land or any actual or potential effects of the use, development or protection of land to avoid or mitigate natural hazards,[15] while the Building Act authorises territorial authorities to grant building consent on land subject to specific natural hazards with certain exceptions.[16]

It has been observed that there is a tendency for territorial authorities to rely on the assessment of proposed building construction under the Building Act to control development on land at risk from natural hazards instead of proactively managing the location of development through regional and district planning instruments.[17] Equally, it has been noted that caution should be exercised in relying on the Building Act as the primary method of regulating development in hazardous areas as only certain hazards may be taken into account when determining whether to grant a building consent (e.g. ground shaking from earthquakes).[18]

Although a minimum 1 in 100 year flood standard for buildings exceeds the 1 in 50 year standard referred to in the Building Code,[19] sections 68(2A) and 76(2A) of the RMA expressly empower local authorities to make rules for the protection of other property from surface water (e.g. flow

[13] Decisions by GWRC regarding the construction of structural measures are currently based on an evaluation of the impacts on present land/building/productive value; however, consideration of the future economic benefits/value of undertaking such measures may be applicable in future FMP processes
[14] This is a situation where provision of protection against a moderate flood hazard leads to development intensification and increased exposure to catastrophic hazard if an event exceeds the design standard or protective works are breached due to design and/or construction deficiencies (e.g.earthquake, flap gate malfunction)
[15] Sections 30(d)(v) & 31(b)(i) RMA respectively
[16] Section 71(1), Building Act 2004
[17] J Harker (2012), *Local Authority Liability for Developments in Areas Subject to Hazards* in NZ Journal of Environmental Law, pg.320
[18] J Harker, op cit, pg.321
[19] Clause E1.3.2, Building Regulations 1992

diversion, debris build up) by enabling the requirement for people undertaking building work to achieve a more stringent standard than that contained in the Building Code.

The High Court has held that the purpose of these sections is to enable local authorities to impose controls over buildings to protect property from the effects of surface water, notwithstanding that the Building Code contains performance criteria covering this exact issue and provided that the controls are created for a resource management purpose.[20] As natural hazard management is a specific functional responsibility of local authorities under sections 30(d)(v) and 31(b)(i) of the RMA the Court has noted that control of the use of land for the purpose of avoiding or mitigating natural hazards is within the powers of regional councils and territorial authorities, including the power to prohibit or restrict activities such as residential occupation and the erection of buildings.[21]

The High Court has also observed that where a territorial authority is facing a particular planning or resource management issue that necessitates the imposition of a requirement that goes beyond the Building Code, that the Building Act does not prevent this from occurring where such a departure is justified.[22]

Consequently, application of a 1 in 100 year design standard to urban areas and habitable buildings is not unreasonable, will increase the likelihood that such areas/development are resilient to inundation in the event that a stopbank is breached or overtopped and is consistent with NZ and international best practice.[23]

In addition to the reasons highlighted above the following factors are also important considerations in establishing appropriate standards of flood protection:

- There is no utility in constructing a stopbank that achieves less than a 1 in 100 year flood standard in an urban situation as structural measures designed and built in such circumstances need to be of a standard that affords effective flood protection given the level of public funding expended (i.e. a marginal increase in construction cost can result in an improved level of protection); and
- Access to insurance and mortgage finance is increasingly influenced by such factors as the level of exposure to flood risk, and financial and insurance institutions are requiring minimum standards of building performance to be satisfied (e.g. minimum protection or floor levels) to reduce potential exposure to flood damage.

3.4 Climate change

Research on the impact of climate change and how it might affect New Zealand strongly supports the position that rainfall intensity and sea level will increase in future, with the outstanding issue

[20] *Building Industry Authority v Christchurch City Council* [1997] 1 NZLR 573
[21] *Canterbury Regional Council v Banks Peninsula District Council* [1995] 3 NZLR 189
[22] *Christchurch International Airport Limited v Christchurch City Council* [1997] NZRMA 145, 148 (HC)
[23] Refer section 4.3 of this report

being the extent of the increase.[24] Currently GWRC applies the mid-range values specified in relevant technical guidance and will continue to rely on these until the guidelines are more specifically refined for the Wellington region based on further empirical research.

GWRC will apply the design criteria set out in section 2.4 of this report to all future flood hazard assessment work, noting that a similar climate change allowance has already made for the review of the Waikanae FMP as well as the Waiohine and Pinehaven FMPs.[25]

[24] Refer, for example, PCE (2014), *Changing Climate and Rising Seas: Understanding the Science* and IPCC (2013), *Climate Change 2013: The Physical Science Basis*, Working Group I Contribution to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change

[25] Also of note is that a 2800 m3/s design standard was selected for the Hutt River to allow for some climate change although not specifically for the criteria outlined in section 2.4 of this report; equally, at this stage no account for climate change has been included in the earlier work undertaken on the Waiwhetu and LWVDS reviews - Refer to report WGN#741469 – Climate Change

Appendix 1 - Supporting Information

The principles identified in section 2 are supported by a wide range of relevant national and international research, guidance and policy directives, examples of which are as follows:

4.1 Avoidance

Avoidance in areas of high risk is advocated by the following guidelines/research:

- Ericksen (1986), *Creating Flood Disasters* – Water & Soil Miscellaneous Publication No.77
    - The research paper suggests that land uses should be compatible with the projected flood risk, including open space for recreation, reserves, rural and similar uses in areas of high risk and housing (and other building development) in areas of little or no risk.
- Commonwealth of Australia (2000), *Floodplain Management in Australia – Best Practice Principles & Guidelines* (SCRAM Report No.73)
    - The report outlines a series of best practice principles for floodplain management in Australia, one of which is that land use needs to be appropriate to the level of hazard and should be carefully matched to both maximise the benefits of using the floodplain while minimising the risks and consequences of flooding.
- MfE (2008), *Meeting the Challenges of future flooding in New Zealand*
    - The review notes past reliance on protection works and that the focus on response and recovery needs to change so that future decisions place greater emphasis on flood hazard avoidance. It also observes that in the absence of improvements to the way in which flood risk is managed, future generations would likely become more vulnerable to flooding, experience greater losses and require escalating expenditure on response and recovery efforts.
- MfE (2010), *Preparing for Future Flooding – A Guide for Local Government*
    - The guide outlines a series of principles to manage flood risk including adopting a precautionary approach to minimise exposure to harm as much as possible when a plausible risk has been identified, and use of progressive risk reduction to ensure that new developments are not exposed to, or increase, flood risk over their intended lifetime and that the level of risk to existing development is progressively reduced.
- UK Department of Communities and Local Government (2012), *Technical Guidance to the National Planning Policy Framework*
    - The document provides guidance to local planning authorities to ensure effective implementation of the planning policy on development in areas at risk of flooding set out in the UK National Planning Policy Framework. In particular it emphasises that inappropriate development in areas at risk of flooding should be avoided by directing development away from high risk areas.
- Jha, Bloch & Lamond (2012), *Cities and Flooding – A Guide to Integrated Urban Flood Risk Management in the 21st Century*
    - The guide suggests that ideally buildings should be located to avoid flood risk, but notes that if this is unattainable flood resilience measures such as elevating or raising buildings above the flood level, or allowing buildings to rise with the floodwater could be considered.

- Quality Planning (2013), *Natural Hazards*
    - The guidance note identifies 3 overarching principles that underpin a risk-based approach to planning for natural hazards, one of which is that natural hazards should be avoided by preventing building and development on known hazard areas.

4.2 Flood Protection Infrastructure

This principle is supported by the following guidelines/research/policies:

- Ericksen (1986), *Creating Flood Disasters* – Water & Soil Miscellaneous Publication No.77
    - The research paper notes that while measures such as stopbanks and flood-proofing buildings effectively reduce losses from less than design floods, they enhance the prospects for future disasters because eventually the 'protection' will fail against larger than anticipated floods;
    - The paper also observes that although river control works may present the best option for 'protecting' existing property, in most cases the opportunity exists for communities to implement complementary methods to reduce flood loss (e.g. land use management, insurance, emergency preparedness) and that these not only help to reduce losses to existing development but also to avert future disasters that river control works potentially create.
- Burby (2006), *Hurricane Katrina and the Paradoxes of Government Disaster Policy: Bringing About Wise Governmental Decisions for Hazardous Areas*
    - The article argues that there are two paradoxes at play which help to explain the devastation caused by Hurricane Katrina in New Orleans and which can be anticipated to contribute to similar disasters in future:
        - The safe development paradox – occurs when efforts to make an inherently hazardous area safe instead makes them highly susceptible to disasters of catastrophic proportions;
        - The local government paradox - occurs when local governments, whose citizens bear the brunt of suffering and financial loss when disasters occur, pay insufficient attention to threats posed by hazards when they allow hazardous areas to be intensively developed.
    - The article notes that these paradoxes, in the US context, account for the upward spiral in the frequency and magnitude of natural disasters, and if this trend is to be reduced or reversed that it will be necessary for local governments to share more of the burden through careful planning and management of development in hazardous areas and by assuming more of the financial responsibility for development at risk.
- MfE (2010, pg.30), *Preparing for Future Flooding – A Guide for Local Government*
    - The guide suggests that hard engineering solutions or structural treatment options to reduce the frequency of occurrence should be considered after natural flood management solutions[26] have been explored.

[26] Such solutions aim to slow the flow of water and to store water along catchments by maintaining or restoring natural land and water processes.

- Glavovic, (2014, pg.255), *Chapter 10: The 2004 Manawatu Floods, New Zealand - Integrating Flood Risk Reduction and Climate Change Adaptation* in Adapting to Climate Change: Lessons from Natural Hazards Planning
    - This chapter notes that although the 2004 flood experience in the Manawatu underscores the importance of having structural flood protection in place for communities already situated in perilous locations, there is a need to move beyond reliance on structural measures as the consequences of any exceedance of the design standard is likely to be significant. It also suggests that this experience demonstrates that a flood risk avoidance strategy is imperative for 'greenfield' development, but that structural works are necessary for communities in low-lying areas and need to be complemented by non-structural measures.

4.3 Standards

This principle is supported by the following guidelines/research/policies:

- FEMA (1987), *Reducing Losses in High Risk Flood Hazard Areas – A Guidebook for Local Officials*
    - The guide suggests that, at a minimum, new construction or re-construction behind stopbanks unable to provide protection from a 1 in 100 year event should be elevated or flood-proofed.
- BC Ministry of Environment, Lands and Parks (1999), *Guidelines for Management of Flood Protection Works in British Columbia*
    - The guide notes that new flood protection works are to be designed and constructed to ensure efficient and effective operation to contain a 1 in 200 flood event and associated forces.
- NSW Department of Infrastructure, Planning & Natural Resources (2005) *Floodplain Development Manual – The Management of Flood Liable Land*
    - The manual suggests that flood planning levels are generally based on a 1 in 100 year flood. It also notes that while there is potential to vary this, any variation should only occur where it can be clearly demonstrated that the situation is exceptional.
- Queensland State Planning Policy 1/03 (2003), *Mitigating the Adverse Impacts of Flood, Bushfire and Landslide*
    - The policy requires planning schemes to nominate a flood event, referred to as a defined flood event, to determine land subject to flood related planning controls, with most councils nominating a 1 in 100 year flood event as a baseline to govern planning decisions.
- BC Ministry for the Environment (2004), *Flood Hazard Area Land Use Management Guidelines*
    - The guide suggests a range of construction requirements relating to residential land uses including a horizontal setback from a flood hazard to reduce the risk of erosion and allow access to equipment and a minimum vertical elevation above a flood hazard typically equivalent to a 1 in 200 year flood event.
- Waikato Regional Council (2013), *Proposed RPS – Control of Development within a Floodplain*
    - Policy 13.2.5 requires that subdivision, use and development only occurs in a floodplain with an annual exceedance level of 1% (and which is not defined as a High Risk Flood

Zone) where any adverse effects of such an event on habitable buildings are avoided or mitigated.

- Horizon's Regional Council (2013), *Proposed One Plan – Development in Areas Prone to Flooding*
    - Policy 10-2(a) requires the Regional Council and Territorial Authorities to ensure, amongst other matters, that any structure or activity within a scheduled floodway is designed so that the effects on it of a 1 in 200 year event are avoided or mitigated.
    - Policy 10-2(d)(ia) further requires that in exercising decision making responsibilities under the policy that the Regional Council and Territorial Authorities ensure that occupied structures have a finished floor or ground level (including freeboard) above the 1 in 200 year flood level.
- Canterbury Regional Council (2013), *RPS – Development in Areas Subject to Inundation*
    - Policy 11.3.2 requires any new subdivision or development (excluding critical infrastructure) to be avoided in areas subject to inundation by a 1 in 200 year flood event unless there is no increased risk to life and, amongst other matters, new buildings have an appropriate floor level above the 1 in 200 design flood level.
    - The principal reasons and explanation for this policy and other policies in the Natural Hazards chapter of the RPS notes that most territorial authorities in Canterbury have adopted higher than Building Act minimum floor level controls in their district plans, based on 1 in 200 year or 1 in 500 year flood events.
- UK Department of Communities and Local Government (2014), *Planning Practice Guidance – Flood Risk and Coastal Change*
    - The practice guide notes that where a flood risk cannot be avoided, consideration should be given to constructing a building and its surrounds (at site level) above the level of a 1 in 100 year event.

4.4 Climate change

Adopted GWRC Climate Change Policy (refer to report WGN# 741469 – Climate Change and subsequent memo WGN# 1256418 – Climate Change Design Parameters attached as Appendix 3).

Appendix 2 – Relevant RPS Objectives and Policies

Table 8(a): Natural hazards objectives and titles of policies and methods to achieve the objectives

Objectives	Policy titles	Page	Method titles	Implementation (* lead authority)	Page
Objective 19 The risks and consequences to people, communities, their businesses, property and infrastructure from natural hazards and climate change effects are reduced.	Policy 29: Avoiding inappropriate subdivision and development in areas at high risk from natural hazards – district and regional plans	109	Method 1: District plan implementation	City and district councils	153
			Method 2: Regional plan implementation	Wellington Regional Council	153
			Method 14: Information about natural hazard and climate change effects	Wellington Regional Council*, city and district councils and Civil Defence Emergency Management Group	155
			Method 22: Information about areas at high risk from natural hazards	Wellington Regional Council* and city and district councils	157
			Also see – Coastal environment (Table 2) policy 3; Energy, infrastructure and waste (Table 3) policies 7 & 8; Fresh water (Table 4) policies 14 & 17; Natural hazards (Table 8b) policy 62; Regional form, design and function (Table 9) policies 30, 31 & 32 **and consider** – Coastal environment (Table 2) policies 35, 36 & 37; Energy, infrastructure and waste (Table 3) policy 39; Fresh water (Table 4) policy 43; Natural hazards (Table 8a) policies 51 & 52; Regional form, design and function (Table 9) policies 54, 55 & 56; Resource management with tangata whenua (Table 10) policies 48 & 49		
	Policy 51: Minimising the risks and consequences of natural hazards – consideration	130	Method 4: Resource consents, notices of requirement and when changing, varying or reviewing plans	Wellington Regional Council and city and district councils	153
			Method 14: Information about natural hazard and climate change effects	Wellington Regional Council*, city and district councils and Civil Defence Emergency Management Group	155
			Method 22: Information about areas at high risk from natural hazards	Wellington Regional Council* and city and district councils	157
			Also consider – Coastal environment (Table 2) policies 35, 36 & 37; Energy, infrastructure and waste (Table 3) policy 39; Fresh water (Table 4) policy 43; Natural hazards (Table 8a) policy 52; Regional form, design and function (Table 9) policies 54, 55 & 56; Resource management with tangata whenua (Table 10) policies 48 & 49		
Objective 20 Hazard mitigation measures, structural works and other activities do not increase the risk and consequences of natural hazard events.	Policy 52: Minimising adverse effects of hazard mitigation measures – consideration	131	Method 4: Resource consents, notices of requirement and when changing, varying or reviewing plans	Wellington Regional Council and city and district councils	153
			Method 14: Information about natural hazard and climate change effects	Wellington Regional Council*, city and district councils and Civil Defence Emergency Management Group	155
			Method 23: Information about natural features to protect property from natural hazards	Wellington Regional Council* and city and district councils	157
			Also consider – Coastal environment (Table 2) policies 35, 36 & 37; Energy, infrastructure and waste (Table 3) policy 39; Fresh water (Table 4) policy 43; Natural hazards (Table 8a) policy 51; Regional form, design and function (Table 9) policies 54, 55 & 56; Resource management with tangata whenua (Table 10) policies 48 & 49		

Objective	Policy titles	Page	Method titles	Implementation (* lead authority)	Page
Objective 21 Communities are more resilient to natural hazards, including the impacts of climate change, and people are better prepared for the consequences of natural hazard events.	Policy 29: Avoiding inappropriate subdivision and development in areas at high risk from natural hazards – district and regional plans	109	Method 1: District plan implementation	City and district councils	153
			Method 2: Regional plan implementation	Wellington Regional Council	153
			Method 14: Information about natural hazard and climate change effects	Wellington Regional Council*, city and district councils and Civil Defence Emergency Management Group	155
			Method 22: Information about areas at high risk from natural hazards	Wellington Regional Council* and city and district councils	157
			Also see – Coastal environment (Table 2) policy 3; Energy, infrastructure and waste (Table 3) policies 7 & 8; Fresh water (Table 4) policies 15 & 17; Natural hazards (Table 8b) policy 62; Regional form, design and function (Table 9) policies 30, 31 & 32 **and consider** – Coastal environment (Table 2) policies 35, 36 & 37; Energy, infrastructure and waste (Table 3) policy 39; Fresh water (Table 4) policy 43; Natural hazards (Table 8a) policies 51 & 52; Regional form, design and function (Table 9) policies 54, 55 & 56; Resource management with tangata whenua (Table 10) policies 48 & 49		
	Policy 51: Minimising the risks and consequences of natural hazards – consideration	130	Method 4: Resource consents, notices of requirement and when changing, varying or reviewing plans	Wellington Regional Council and city and district councils	153
			Method 14: Information about natural hazard and climate change effects	Wellington Regional Council*, city and district councils and Civil Defence Emergency Management Group	155
			Method 22: Information about areas at high risk from natural hazards	Wellington Regional Council* and city and district councils	157
			Also consider – Coastal environment (Table 2) policies 35, 36 & 37; Energy, infrastructure and waste (Table 3) policy 39; Fresh water (Table 4) policy 43; Natural hazards (Table 8a) policy 52; Regional form, design and function (Table 9) policies 54, 55 & 56; Resource management with tangata whenua (Table 10) policies 48 & 49		
	Policy 52: Minimising adverse effects of hazard mitigation measures – consideration	131	Method 4: Resource consents, notices of requirement and when changing, varying or reviewing plans	Wellington Regional Council and city and district councils	153
			Method 14: Information about natural hazard and climate change effects	Wellington Regional Council*, city and district councils and Civil Defence Emergency Management Group	155
			Method 23: Information about natural features to protect property from natural hazards	Wellington Regional Council* and city and district councils	157
			Also consider – Coastal environment (Table 2) policies 35, 36 & 37; Energy, infrastructure and waste (Table 3) policy 39; Fresh water (Table 4) policy 43; Natural hazards (Table 8a) policy 51; Regional form, design and function (Table 9) policies 54, 55 & 56; Resource management with tangata whenua (Table 10) policies 48 & 49		

Table 8(b): Allocation of functions for natural hazards in accordance with the Resource Management Act

Objective	Policy titles	Page	Method titles	Implementation (* lead authority)	Page
Section 62(1)(i)(i) "Content of regional policy statements".	Policy 62: Allocation of responsibilities for land use controls for natural hazards	140	Method 5: Allocation of responsibilities	Wellington Regional Council and city and district councils	154
			Also see – Natural hazards (Table 8a) policies 29, 51 & 52		

Appendix 3 – GWRC Climate Change Policy

greater WELLINGTON
REGIONAL COUNCIL

Report	10.82
Date	22 February 2010
File	N/50/02/05
Committee	Catchment Management Committee
Author	James Flanagan, Senior Engineer

Climate Change

1 Purpose

- To inform the council of the impacts of climate change on Flood Protections' Design Criteria and how we incorporate this into our ongoing investigation and flood risk management work.

- To recommend to council specific climate change design criteria for investigations and design work.

2 Significance of the decision

The matters for decision in this report do not trigger the significance policy of the Council or otherwise trigger section 76(3)(b) of the Local Government Act 2002.

3 Background

Scientific evidence and thinking points to an increase in global temperatures due to climate change. This increase in temperature has many implications for New Zealand. Implications of climate change have been evaluated by the Ministry for the Environment (MfE). The National Institute of Water and Atmospheric Research (NIWA) was the agency commissioned by MfE to evaluate the magnitude of these changes and their implications for New Zealand. Council does not have any specific policy with regards to flood protection design criteria taking into account climate change.

The increase in temperatures predicted by MfE for the end of this century will have a direct effect on two elements crucial to flood risk management and design of flood protection for the community.

- **Increased rainfall intensity**; As the air temperature increases the atmosphere is able to hold more moisture, leading to an increase in rainfall intensity. This has a direct effect on the amount of water flowing in our rivers and streams and hence the level of protection required and the depth and extent of the resulting flood hazard. An assumption is made (based on NIWA guidance) of an 8% increase in rainfall intensity per degree Celsius increase in temperature.

- **Sea level rise**; There has been a recorded increase in sea level for the last 100 years of approximately 200mm and this rate of rise is predicted to increase dramatically by the end of this century. This has a direct effect on flood hazard schemes close to the coastline and in particular for the larger schemes such as the Lower Valley Scheme in the Wairarapa, the Waiwhetu Stream, the Hutt, Waikanae and Otaki Rivers.

Direction from NIWA for predicted temperature increases are based on the Intergovernmental Panel on Climate Change (IPCC) 4th Assessment. The current modelling estimates that New Zealand is likely to experience an increase in temperature of 2°c by 2090. Eastern portions of the country which currently have a dry weather pattern are likely to experience drier conditions and the western parts of the country which generally experience wetter conditions on average. The predictions for sea level rise from the IPCC 4th assessment are between 0.18 and 0.59m. Recent recommendations from agencies suggest that 1m is more likely to be the sea level rise by 2100.

4 Discussion

Much has been written on the impact of climate change and how it might affect New Zealand. From all of this debate there is sufficient certainty that rainfall intensity and sea level will increase. The uncertainty is by how much. With much of the flood protection work influencing decisions about long term development it is recommended that an allowance for climate change is made for GW design work. The estimates made by all of the agencies give quite broad ranges for climate change whereas for GW design work we must use a specific number. For this reason we are recommending using the mid range of the current assessments. GW should continue to use these numbers until National and International research refines the guidelines more specifically for the Wellington region.

The design criteria will be used in all future flood hazard assessment work. An allowance has already made for climate change, similar to those recommended in this report, for the WFMP review and for the Waiohine and Pinehaven flood hazard assessments. The Hutt River design standard was also chosen at the 2800 m^3/s level to allow for some climate change although not specifically for the criteria recommended in this report. The work undertaken earlier for the Waiwhetu and the LWVDS review does not take any account of climate change at this stage.

5 Criteria Selected

The two design criteria selected are as follows:

Increased Rainfall Intensity: for all floods of or greater than a 1 in 50 year return period, the increase in rainfall intensity to be used will be 16% based on a 2°c increase in temperature. The reason why this is applied to 50 year and greater return period floods is that the changes will take place over 80 to 90 years and hence the return period events need to be within a similar timeframe context.

Sea Level Rise: based on the top of the mid level range indentified by IPCC 4th assessment, the design sea level to be used is current sea level plus 0.5m.

6 Consultation

The design criteria for climate change will be clearly conveyed to the community as we proceed with flood hazard assessment work. No general press release is proposed at this stage.

7 Recommendations

That the Committee:

1. ***Receives** the report.*

2. ***Notes** the content of the report.*

3. ***Notes** that any selected climate change design criteria will likely change over time.*

3. ***Endorses** the currently selected Design Criteria Selected being:*

   - *The increase in rainfall intensity to be used for calculation will be 16%*

   - *The Sea Level Rise to be used for calculation is 0.5m by 2100.*

Report prepared by:	Report approved by:	
James Flanagan	Graeme Campbell	Wayne O'Donnell
Senior Engineer	Manager Flood Protection	General Manager, Catchment Management

greater WELLINGTON
REGIONAL COUNCIL
Te Pane Matua Taiao

MEMO

TO	Graeme Campbell, Manager Flood Protection
COPIED TO	Alistair Allan, Senior Project Engineer Iain Dawe, Senior Policy Analyst (Hazards)
FROM	James Flanagan
DATE	19 September 2013
FILE NUMBER	N/50/02/05-v1

Climate Change Design Parameters

After review of the regions flood vulnerability and climate change (as approved in Environmental Wellbeing Committee Report 13.720), a revised set of design criteria have been selected for use by Flood Protection. These revised criteria are to allow for increases in the effects of climate change.

Increased Rainfall Intensity

The temperature increase currently used by Flood Protection is 2 degrees Celsius by 2090, which is a 16% increase in rainfall intensity for design storms of greater than a 50 year return period. This rainfall intensity is now to be increased to 20%.

Increased Sea Level

The current allowance was for an increase of 0.5m in mean sea level by 2100. This increase in level is now to be 0.8m by 2100.

I recommend that these changes to the departments design parameters be approved and they be implemented as soon as possible (to be consistent with Report 13.720). It should be noted that increases that take into account the effects of climate change are likely to change again as the science and policies are still being refined,

Date: 19/09/13	Status: For approval
Requestor: James Flanagan	Approver: Graeme Campbell
Senior Engineer	Manager, Flood Protection