2.25 – Flooding - Section 32 evaluation for the Proposed Auckland Unitary Plan

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1. Overview and Purpose

This evaluation provides a summary of analysis of the Proposed Auckland Unitary Plan's (the Unitary Plan) provisions relating to flood hazard management, in accordance with section 32 of the RMA.

1.1 Subject Matter of this Section

This section deals with subdivision, development, buildings and activities within and beside flood plains, in areas of overland flow and in areas where flood water may pond due to natural depressions and / or blockages to the stormwater network.

Four different flood hazards are managed by the Unitary Plan:

- River / stream flooding in a 1% AEP event
- Flood sensitive areas, being land beside 1% AEP flood plains that may be subject to some risks to buildings and structures
- Overland flow paths - areas where stormwater flows are concentrated during heavy rainfall
- Flood prone areas, being areas which may flood due to blockages of the stormwater system.

Each of these four areas is identified on Council's GIS viewer, with objectives, policies and rules triggered when development occurs in these areas.

1.2 Resource Management Issue to be Addressed

Flooding is a natural process, and flood plains are part of the natural water system.

Flooding becomes a hazard when people, property and development are located within flood plains; overland flow paths (areas along which flood waters flow); and areas that are susceptible to flooding when drainage networks are blocked (flood prone areas).

Historically, flood plains have been used for urban development as they were often the only flat land available in Auckland's otherwise hilly topography, and as a result, commonly accommodated industrial and commercial development. Residential development has steadily intruded into flood plains as the urban area intensified, and people sought to make use of what was perceived to be "spare land". Risks from flood events are usually underestimated by landowners, while over time, as urban areas develop and impermeable surfaces increase, flood events increase in severity.

Combined, these pressures have seen the number of properties at risk of flooding steadily increase. Currently, more than 7,000 houses are estimated to lie in 1% AEP flood plains with floor levels that are below the 1% AEP flood height. AEP stands for Annual Exceedance Probability. ARI stands for Average Recurrence Interval and is sometimes used instead of AEP. A 1% AEP event means that a flood of that magnitude has a 1% chance of occurring in any given year.

A similar number of houses are estimated to lie in significant overland flow paths, where the consequences of flood flows may be even more severe.

The area of land affected by 1% AEP flood plains is set out in Table 1, organised by August 2012 draft AUP zones, for the region as a total, and for the area within the current Metropolitan Urban Limit (MUL) as defined in the Auckland Regional Policy Statement.

As set out in Table 1, the 'other' land use category is the largest area affected (both inside the MUL and across the Region as a whole). This category comprises a range of different

zones which do not contain urban activities including roads, rural and countryside living areas.

Nevertheless, it is evident from Table 1 that the residential zones within the MUL are significantly affected by flooding, with almost 70,000 separate land parcels within 1% AEP flood plains. Many of these land parcels will only be partly affected by flood plains, with approximately 5,700 residential parcels 100% covered by flood plains and a further 18,500 parcels containing the mapping centroid for the 1% AEP flood plain (and are therefore are likely to be only partly affected in one form or another).

Table 1: Land Uses in 1% AEP Flood Plains, Auckland Region

Zone (August 2012 draft AUP)	Total Across Region			Within MUL		
	Parcels affected (No.)	Area affected (ha)	Proportion of flood plain (%)	Parcels affected (No.)	Area affected (ha)	Proportion of flood plain (%)
Open Space	8,602	5,742	7.6	5,592	1,327	19
Residential	76,117	2,414	3.3	68,471	1,990	28
Centres	3,221	203	0.3	2,470	119	2
Business	702	43	1.3	6,234	912	13
Other	30,577	65,368	87.5	3,814	2,502	38
Totals	128,285	75,911	100	87,531	7,027	100

1.3 Managing Flood Risks

People and property, where located in flood plains, cannot be protected from flood risk. It is simply not possible to capture the large volumes of water that run off from urban areas and to divert or channel these floodwaters away from housing and businesses. Capturing, concentrating and discharging large flows can also lead to significant environmental effects through the hard engineering solutions required. In addition, the costs of resolving flooding hazards are prohibitive.

Resolving existing flood-related problems has been estimated by the Council, in 2012, to cost between $2.9 and $5 billion, although in reality there are limitations to what can be achieved in practice. There are also substantial opportunity costs involved, in that often the only land available for flood detention works in existing urban areas is open space areas used for passive and active recreation.

Another issue is that in the long term these works may increase risks. Time and again, flood mitigation works have been shown to lead to a false sense of security as development levels intensify in areas that are perceived to be safer as a result of mitigation works. However, there always remains a residual risk through failure of structures or extreme, unanticipated weather events that see flood mitigation structures “overtopped”. Over time, changing rainfall patterns and greater run-off volumes from more intense development in contributing catchments can make the works obsolete.

Planning can reduce the rate at which more people and properties are placed in locations where they are exposed to flood hazards, thereby avoiding current problems growing in scope and severity. To be implementable, planning policy has to identify at what point flood hazards become significant and what issues need to be addressed when considering development that is affected by this level of hazard.

Current practice in Auckland is to express risk in terms of the potential exposure of people and property to flood events of a certain probability of occurrence. For example, most legacy district plans use the 1% AEP flood event as being the trigger point as to when the risks of adverse effects start to mount. However, this threshold may understate the risks of adverse effects where the consequences of being exposed to a flood event are particularly severe, such as for critical infrastructure that may be rendered inoperable for many months after an event, with no alternatives available (unlike a business that could shift premises after experiencing a flood event, for example). In some cases, the 2% AEP flood event has been used for particular activities. This reflects the 50 year timeframe for building longevity in the Building Act and/or consideration that some activities like business activities can tolerate a higher level of risk.

In terms of consequences, most district plans and associated design requirements have sought to protect the habitable floors of houses (not basements, garages or sheds) from the 1% AEP flood event, plus a freeboard safety margin. That is, building within the floodplain is possible, provided the living areas are above the flood level. Legacy district plans specify different levels of freeboard between flood heights and building floors. While the most common freeboard is 500mm between the flood height and the floor level, freeboard ranges between 300mm and 1,000mm for residential buildings. To an extent, this freeboard requirement reduces the risk to people's lives and livelihood. However, this does not recognise the difficulties of evacuation if that is required during a more extreme event. It is a common reaction of people who experience flood events to wish to get out of their house onto dry land or to retrieve cars from flood waters, but by so doing they often have to make their way through fast flowing water. Materials stored in and around the house are often entrained by the flood water, causing blockages at downstream pinch points like culverts and bridges that worsen localised flooding. Flood plain functioning is affected on a cumulative basis by people closing in basements, adding garages and the like. The ability of the household to recover from a flood event is also an issue if the event results in the need to replace building materials, household property or infrastructure connections, and therefore they have to find alternative accommodation while this occurs. Reinsurance may also become an issue.

To date, the primary focus of flood hazard management has been on residential property. In contrast, commercial and industrial buildings have been subject to less stringent flood hazard controls. Commercial and industrial development has often been allowed to locate within flood prone areas, utilising land that is otherwise subject to only infrequent inundation, on the basis that flood risk is better understood and can be managed and mitigated by businesses. However, it is not clear whether the consequences of locating in flood plains are fully understood and accepted by business operators, as the impacts of flood events can be significant, both in terms of the cost of damage to goods and plant, as well as the impacts on business continuity.

Houses and other buildings can also be at risk from overland flows that occur during extreme rain events, when the capacity of the primary piped system is exceeded. High flow rates can pose significant risk to both life and property. Overland flow has not been well managed in the past – partly as a consequence of poor information on the location of them and also due to difficulty in applying controls to protect flowpaths from blockage/impediments.

1.4 Summary: Current Implementation Issues

Discussions with council's stormwater engineers involved in resource consent applications for development in flood plains note a range of issues with current provisions:

- GIS coverage is incomplete across the region, with some flood plain mapping of a generalised nature. It is not possible yet to distinguish different levels of hazard within

- There is a tendency for council staff to rely on the Building Act to decline applications for housing in flood plains as district plan land-use provisions are perceived to be too weak. The Building Act provides a clearer statement that building in flood plains should be avoided. However the Building Act is limited to controlling development within the 2% AEP (50 year event).
- Plans allow for garages to be built with floor levels lower than residential floor levels, however these spaces are often used for habitable purposes, for example sleepouts, second lounges, bedrooms.
- There are significant issues around providing for parking on sites subject to flooding – people want to remove cars during a flood event, but this places them at risk, while cars can also be washed off sites, causing downstream blockages.
- Plans for intensification are seen to give rise to a significant conflict between urban growth planning and flooding.
- Residents / buyers of properties are often unaware of risks of flooding, or assume that the council can fix the problem. For residential development already in flood plains, there is an expectation that the district plan needs to provide for reasonable use of properties – people should be able to renovate and extend houses.

1.5 Strategic Planning Context

Flood hazards are the most common natural hazard facing Auckland, and with predicted changes to climate patterns, flood hazards are expected to increase due to larger and more frequent intense rainfall events.

Existing approaches to flood hazards have seen the number of people and properties at risk from flooding steadily increase, and it is not feasible to effectively prevent flooding through engineering solutions. A different approach needs to be taken to managing flood hazard risks which ensures that the situation does not continue to worsen and is improved where possible.

1.6 Auckland Plan

The Auckland Plan discusses the importance of building resilient and safe communities, protecting people and their homes from natural hazards. Importance is also placed on maintaining critical infrastructure (energy supply, sewerage systems, water reticulation, telecommunications systems) and protecting social infrastructure (community and health, civil defence, emergency services), in the event of natural hazards.

The Auckland Plan also talks about the impact of climate change on the nature and frequency of flood events:

- Directive 7.14 of the Auckland Plan is to take account of environmental constraints including flood plains, when planning for growth

- Directive 7.15 is to avoid placing communities and critical infrastructure and lifeline utilities in locations at risk from natural hazards, unless the risks are manageable and acceptable.

- Also relevant is Directive 8.5, to increase resilience and take a cautious, risk based approach where there is uncertainty on the effects of climate change.

The Auckland Plan envisages managing urban growth pressures through a mixture of urban expansion and urban infill and redevelopment. This overall direction is being advanced by the AUP. Significant areas for greenfields urban growth are to be identified and provisions

are put in place for structure planning to precede urbanisation of this land. In the next decade, up to 50% of Auckland's growth could occur through greenfields expansion. In terms of infill and redevelopment of existing urban areas, over time the percentage of growth expected to be accommodated in this way is anticipated to increase.

In terms of planning responses to flood hazards in these different development types (greenfields versus brownfields):

- In greenfields areas, it is standard practice for flood plains to be identified and set aside from urban development. The main issue is over the future use of the floodplain. While once seen as multi use corridors accommodating a range of sports and community facilities as well as stormwater retention and treatment facilities, the ever increasing cost of these facilities is seeing calls for them to be located away from flood hazards from an asset management point of view. Thus, flood plains fall back to being passive open space corridors, which while having significant amenity value and some recreational attributes, nevertheless can consume a considerable area of land. Thus there is pressure for flood plains to be modified through earthworks, reducing the storage capacity of the flood plain in some areas and making compensatory changes elsewhere. A further issue is the cost and responsibility for flood plain maintenance, and whether they should be vested in Council.

- In existing urban areas, where many existing properties are covered by flood plains, there is continual pressure for further development and infilling. There is a general expectation that landowners be able to make reasonable use of their property. Where there are no options but to build into the flood plain, and if the public (council) is not prepared to buy the property, then the issue becomes one of appropriate mitigation through limiting the amount of development in the flood plain and lifting floor levels above flood levels, while still allowing for reasonable use. There is also a wider issue of not wishing to see "blight" set in. That is, properties not being able to be maintained in areas affected by flood hazards, and as a result social and economic decline sets in, degrading the amenity of the wider area. In some cases councils have bought properties at severe risk of flooding (such as at Henderson in Waitakere) and either removed the affected houses or renovated them so floor levels are above flood levels. Generally such action is taken to resolve current problems, with the planning (RMA) process seen as the best means to avoid future problems growing in scope and size. However as identified above, the current framework is not achieving this.

2 Current Objectives, Policies, Rules and Methods

This section briefly reviews current RMA plan approaches to flood management. Appendix 3.25.1 contains a more detailed review**.**

2.1. Auckland Regional Policy Statement

The Auckland Regional Policy Statement (ARPS) reflects the most up to date region wide statutory approach to flood hazards. The objective is to avoid, remedy or mitigate the adverse effects of natural hazards on human life, property, infrastructure and the environment. The ARPS policies outline under what circumstances development shall be allowed in the 1% AEP floodplain but states that district plans may use alternative standards for development in the floodplain, no less stringent than the 2% AEP.

The ARPS provisions reflect the diverse approach of the former councils in the region and raise a number of issues that suggest that they do not provide an appropriate, consistent

statutory base for the management of development in flood plains, particularly as it relates to existing urban areas. Specific issues include:

- Avoidance versus mitigation. It is not clear as to when an avoidance approach should be taken; that is development is to be kept clear of flood plains. This is clearly an option for greenfields areas.
- Level of risk. The policies leave open the option of a 1% or 2% "standard". What level of risk is acceptable?
- The types of risk. The policies do not provide any guidance on the types of risks to be considered. For example one policy refers to adverse effects to habitable floors being avoided but without specifying what adverse effects are to be avoided – to occupiers and their safety or to the safety of the building?

2.2. Auckland Council Regional Plan: Air, Land and Water

The regional plan most relevant to flood management is the Auckland Council Regional Plan: Air, Land and Water (ALW Plan). The focus of this plan in relation to flooding relates to managing stormwater diversions and discharges so that flooding problems are not exacerbated.

In terms of standards applying to discharges, permitted discharges must not cause:

- flooding, in a 100 year ARI storm, of a habitable floor level in any existing authorised dwelling (applies to existing impervious areas).
- flood levels in a 100 year ARI storm to rise within 0.5 metres of a habitable floor level in any dwelling, unless the relevant District Plan or "Local Authority Infrastructure Design Standards" establishes an alternative freeboard which shall prevail (applies to new impervious areas).

2.3. Legacy District Plans

Legacy district plan provisions as they apply to flood plain management are varied and complex. The plans use different ways to identify flood hazard areas, with some using the 1% AEP floodplain as defined by detailed flood mapping that lies outside the district plan, with others using areas defined by them on planning maps, or as held in council "records or plans". A variety of terms are used to describe areas subject to flood hazards, few of which are defined within current district plans.

The legacy district plans vary in the extent to which they control different types of development within flood plains: between them all they have rules for activities, development, subdivision, buildings, structures, site works, earthworks, vegetation clearance, stormwater treatment devices, and storage of materials within the flood plain.

First generation district plans prepared between 1999 – 2003 generally classified development and activities in flood susceptible areas as a restricted discretionary activity.

Some district plans distinguish between activity types, having different standards for business activities than residential and community activities or habitable buildings and non-habitable buildings. Various definitions are given for habitable rooms / buildings.

More recent plan provisions relating to greenfields areas have significantly more emphasis on flood prevention and development fitting in around flooding constraints. Flood plains have been identified and zoning provisions generally support little development in these areas – with appropriate development being infrastructure and minor works associated with recreational activities.

North Shore City Council was the council who most recently replaced their entire flood-related district plan provisions (operative in 2012). The rules include:

- Network utilities in the flood sensitive area (within 0.5mm elevation of flood plain) or the 100 year ARI flood plain are a permitted activity subject to standards.
- Buildings within the flood sensitive areas and flood protection works within the 100 year ARI flood plain are a controlled activity subject to standards.
- Buildings, alterations to existing buildings increasing building coverage, and site works not associated with flood protection works within the 100 year ARI flood plain are a discretionary activity, along with permitted and controlled activities that do not comply with the standards.

2.4. International and Rest of NZ Approaches

As outlined in the above sections, current policies and provisions in Auckland district plans are seeing risks to people and property from flood hazards increase in the urban area, rather than being maintained or even reduced. This suggests that current provisions are inadequate in the way they identify risks and enable appropriate management responses.

This is not a problem unique to Auckland. Flood events in Australia, the UK and other parts of New Zealand are leading to a reassessment of flood management provisions. This section provides a review of recent initiatives.

Appendix 3.25.2 sets out a review of national and international approaches to flood hazard management. A common theme that emerges from this review is a more nuanced approach to considering risks, both in terms of the types of risk, as well as in terms of the consequences for different activities to being exposed to flood hazards.

3. Information and Analysis

Developing the draft AUP provisions for flood hazard management has involved:

1. Review of current district and regional plan provisions
2. Workshops and meetings with council stormwater and planning experts to determine how existing provisions are working
3. Review of national and international management approaches
4. Development of working papers and background material on issues and options
5. Presentations to councillor workshops
6. Preparation of draft material.
7. Revision of draft material after internal and external feedback received.

Further details are given in section 5.1.

3.1. Consultation Undertaken

Section 5.2 sets out the detail of the consultation undertaken during the development the flood hazard management provisions. This included:

- workshops with councillors
- discussions with stormwater industry representatives
- feedback on the March 2013 draft

3.2. Decision-Making

Stormwater outcomes were initially established in two council workshops in November 2011. Issues and options were explored and the preferred approach for flooding established by February 2012. The flooding objectives, policies and rules were researched, discussed at workshops and drafted in mid 2012. The flooding provisions were presented to the Unitary

Plan senior management group and the Political Working Party in the latter half of 2012. Further internal and external engagement was undertaken once the March draft of the Unitary Plan was published.

3.3. Reference to other Evaluations

Refer to the Section 32 Topic Matrix for reference to related section 32 evaluations. These include:

- 2.22 Future Urban zone
- 2.24 Urban stormwater
- 2.28 Natural hazards
- 2.31 Earthworks

4. Objectives, Policies and Rules

The significant flooding rules introduced into the Unitary Plan (compared to current rules) are:

- Distinguishing between more vulnerable and less vulnerable activities. New vulnerable activities and extensions to existing vulnerable activities in the 1% AEP flood plain are a non-complying activity, while less vulnerable activities are a discretionary activity. None of the legacy district plans take such a detailed approach to vulnerability.
- The factors taken into account in an assessment of the appropriateness of development in flood plains are wider ranging than they previously have been, including integrity of structures, access and egress during a storm event, storage of material and hazardous substances.
- Infrastructure vulnerable to flooding is required to be resilient in the 0.5% AEP flood event.
- Fences, walls, car parking and the storage of materials and hazardous substances in floodplains are subject to controls. This is not currently controlled by most of the legacy district plans.
- Building in, diverting and reducing the capacity of an overland flow path requires consent. Most of the legacy district plans have no specific rules associated with overland flow paths.

4.1. Objectives

The Regional Policy Statement chapter of the Unitary Plan (Chapter B 6.7 Natural hazards) sets the high level direction for natural hazard management. Two objectives are set out:

> *1. Reduce risks to people, property and infrastructure from natural hazards while minimising any adverse effects on the environment.*
>
> *2. Protect the natural functions of floodplains and overland flow paths from the adverse effects of development and infrastructure.*

The first objective describes a core direction of ***reducing*** risk, not just managing or minimising (mitigating) risk. Reducing risks involves actively avoiding creating new risks, not exacerbating existing risks and where ever possible reducing current risks. The focus on reducing risks recognises that as climate change accelerates, risks (and associated costs)

will increase in the future unless active and adaptive management is put in place now (a point most recently made by the Chief Science Advisor to the Prime Minister[1]).

The second objective recognises the importance floodplains play in flood hazard management and that when development is placed in flood plains, then there are always significant consequences for flood management and the activities themselves.

Other objectives and policies take forward the above objectives. For example Chapter B 2.1 - Providing for growth in a quality, compact urban form - identifies the need to consider constraints such as natural hazards. Chapter B 2.3 Development capacity and supply of land for urban development has a policy 3: *Avoid urban development within areas subject to natural hazards. Where avoidance cannot be achieved urban development must be done in such a way that protects against significant risks.*

The Regional Policy Statement objectives and policies are addressed in a separate Section 32 report.

Section 5.13 of Chapter C - Auckland Wide Objectives and Policies - sets out specific objectives and policies for management of areas identified as being subject to flood hazards. These objectives and policies are separate to those of other natural hazards. This is because of the significance of flooding as natural hazards, as well as the extent to which a wide range of activities are affected by flood risks.

The following two objectives for flood hazard management are proposed:

- New development vulnerable to the adverse effects of flooding does not occur in areas at risk of flooding.
- Development or redevelopment necessary in existing flood prone areas is designed and managed to prevent any increase in flood-related risks.

In developing these objectives, a number of alternatives were considered, including relying on existing plans, taking an avoidance-based approach across the region or taking a case-by-case risk management approach. These alternatives involved a range of advantages and disadvantages, as set out in the following table. These alternatives can be described as:

1. Status quo: The status quo for the management of the flooding hazard, including both flood plains and overland flow paths, is represented by the existing legacy district plan provisions. This is characterised as providing variable opportunities for mitigation, particularly for commercial and industrial properties that have historically accepted a higher level of residual risk.

2. Avoidance of flood hazards: This option relies on land use controls within the AUP directing that all development is avoided within identified flood plains and primary overland flow paths. The avoidance approach would be applied consistently over all zones/environments and to both greenfields and re-development.

3. Mitigation of flood hazards: This option relies on land use controls within the Unitary Plan that allow development to occur within identified flood hazard area subject to requirements to mitigate the flood hazard effects. The provisions would:

[1] New Zealand's changing climate and oceans: The impact of human activity and implications for the future. An assessment of the current state of scientific knowledge by the Office of the Chief Science Advisor, July 2013.

- Be applied consistently over all zones/environments and to both greenfields and re-development.
- Rely on technical assessments through land use consent processes as to appropriate methods of mitigating flood hazards.

4. Risk-based assessment: This option relies on land use controls within the Unitary Plan that require developers to undertake an assessment of flood hazards and adopt appropriate measures to avoid or mitigate risk. The provisions would:

- Rely on technical assessment generated during a consent process to identify flood hazards.
- Rely on the land use consent process to identify when risks should be avoided and what is acceptable mitigation.

Table 2

	Status Quo	Alternative 1 Avoidance of flood hazards	Alternative 2 Mitigation of flood hazards	Alternative 3 Risk-based assessment
Costs	• Variable interpretation of standards has led to inconsistencies on whether risk has actually been 'avoided' • Variable interpretation of standards has led to uncertainties in the ongoing compliance of flood risk avoidance relating to additions and alterations, thus cumulatively affecting both flood storage capacity and flow obstruction • Variable standards within the new Council will be confusing to administer • No real attempt to integrate floodplain/overland flow path management with management of other values (e.g. recognise their value as private/public open space) • Requires ongoing monitoring of compliance of buildings and structures in flood plains and flow paths • Reliance on other Acts, like the Building Act, to avoid risks	• Puts onus on council to "get flood hazard zones right" • Achievable in greenfields areas, but will reduce development potential in existing zoned areas • Likely to cause planning blight in existing urban areas affected by flooding (i.e. no further investment in buildings / properties) and lead to calls for land / properties to be purchased by the council • Does not recognise the potential for some redevelopment to assist in reducing risks (i.e. raising floor levels above flood levels, building flood resilient structures).	• Requires mapping over entire area to a similar standard • Put onus on council to "get mitigation right" • Allows new development to be sited in flood hazard areas, increasing risk • Likely to increase calls for council to undertake remediation works • May require on-going monitoring of mitigation measures (e.g. evacuation plans).	• May result in different standards/levels of performance across the region which may be difficult for people to understand • Relies on a good understanding of consequences/costs of hazards • Who determines the acceptable level of residual risk? Developers may accept higher levels of risk to reduce costs than may be desired by community • High consent transaction costs and significant emphasis on consent process • Onus still on council to approve flood hazard identification and mitigation • On-going monitoring of mitigation required.
Benefits	• The existing legacy provisions have had some success at avoiding/minimising risk in some new residential areas • The existing legacy provisions have been formulated by sub-regional communities as a collective expression of risk acceptance and are understood by the development community • The variable flood standard (adoption of 2% standard) has recognised that the 1% standard is not achievable in some circumstances	• Regional consistency • A high level of protection is afforded to flood plains and critical overland flow paths • Significantly reduces existing flood risks and future liabilities • Avoids resource commitment to ongoing monitoring of compliance • Certainty and low transactional costs	• Regional consistency • Enables greater level of development within flood plains (subject to mitigation) • Enables redevelopment within existing flood risk areas • Moderate to high transactional costs	• Case by case assessment that enables more customised management of flood risk • More cost effective in some instances as it aligns mitigation to risk, rather than a blanket approach of avoidance/mitigation • Reduces requirements for Council to map flood hazard areas • Puts greater onus on developer to identify and manage flood risk

The recommended approach is a mixture of the above alternatives. The Status Quo is clearly not achieving acceptable outcomes. Risks from flood hazards are increasing, not decreasing. The main issue is in relation to the existing urban area. Within greenfields areas, steps are being taken to identify and set aside flood plains from development and this overall approach is to be maintained and strengthened. Within the existing urban area, the current framework is not managing risks – the consequences for activities and the community of additional development in flood plains is consistently being underestimated.

In looking at a more appropriate model for areas of re-development, a risk-based approach is an attractive prospect, providing flexibility for individual activities to be assessed in a case-by-case way, taking into account their characteristics and context (i.e. the type of flooding that they are subject to and the consequences for the activity of being subject to a flood event). However the weakness of the approach can be a lack of guidance within the Plan as to what level of risk is appropriate or reasonable in the variable circumstances across the Region, as well as the limited current state of knowledge about site-specific flooding hazards.

This is where a hybrid avoidance / mitigation option comes into play, based on the prior adjudged vulnerability of activities to flood hazards. By more clearly identifying those activities that are particularly vulnerable to flood hazards in existing urbanised areas, a stronger signal can be sent as to what type of development should be avoided, and in what circumstances a mitigation type approach may be appropriate.

This is compared to the current status quo, more generalised approach, which has a focus on keeping building floor levels above flood events, but limited focus on the consequences for the activities housed by these buildings. In all cases however, there needs to be discretion for the council to decline consent to develop in flood plains where risks and consequences for the specific situation are too high and cannot be adequately mitigated.

A mix of alternatives provides the most efficient approach to avoiding and minimising risk from flood hazards. The approach continues with the existing mechanisms, which are generally well accepted, but makes them consistent over the region with a greater emphasis on avoidance than mitigation in new development and a stronger policy framework to better ensure that more sustainable outcomes are achieved in existing urban areas. This is also consistent with the strategic direction provided by the Auckland Plan.

It is recognised that council, over time, is likely to move to a more risk-based approach to managing flood hazard than one with blanket controls based on the spatial location of flood hazards only and fairly generalised categorisation of land use vulnerability. A more targeted approach will result in more cost effective management of flood risk. However, at this stage, there is insufficient information available to enable a consistent risk-based approach to be developed. This is in terms of both greater detail on actual flood hazards, as well as the specific issues of the range of land uses involved.

4.1.1. Appropriateness of the Objective(s)

The appropriateness of the objectives under the requirements of the RMA can be summarised as follows:

Objective 1: New development vulnerable to the adverse effects of flooding does not occur in areas at risk of flooding
The RMA requires the council to avoid risks from flood hazards, where avoidance results in sustainable management of natural and physical resources (i.e. people and businesses can provide for their economic well being, while adverse effects on the environment are avoided or mitigated). Development in flood plains creates public costs which are not always accounted for / carried by individual developments. This includes impacts on properties upstream and downstream from modified flood flows, as well as pressure for public investment to "fix" flooding problems when they do occur. In flood hazard situations, other people's lives can be put at risk when residents and workers face a flood hazard (for example people trying to help evacuate a site that is flooded) In areas of new greenfields development there is the ability to design subdivision and development so that flood plains are avoided without imposing significant costs on landowners' economic and social well being. While specific areas of land need to be set aside as flood plains, reducing development options for particular parcels of land, there is the opportunity - through structure planning and zoning decisions - to "make up" for this lost land through development elsewhere outside the flood plain. This is for all types of urban uses – residential, community and business. A clearly articulated avoidance approach to flood hazards is therefore reasonable. Land values should adjust to reflect the lower development potential of flood prone land (effectively representing the negative externality placed on the community and other activities when development does occur in flood plains). In greenfields areas, flood plains can form green corridors that add amenity to residential and business areas, while assisting with recreational and open space outcomes.

Objective 2: Development or redevelopment necessary in existing flood prone areas is designed and managed to prevent any increase in flood-related risks.
In existing urban areas there is often significant development in flood plains, much of which is industrial or commercial in nature. As a result, sustainable management of natural and physical resources in existing urban areas requires more of a balancing of risks to individual activities and costs to the community of fewer housing and business activities that might arise from stopping all further development in flood plains. A key issue is whether development has to locate in flood plains. In the case of vulnerable activities – which are discussed more fully below and cover activities like residential and community uses - the costs of being subject to flood risks are considered to outweigh any benefits, particularly taking into account the opportunities for housing to be located elsewhere (i.e. not in flood plains). In comparison to residential uses, industrial activities have fewer location choices,

while the consequences of being subject to flood risks are different to those experienced by residential uses.. While limiting newfurther development within flood plains is possible so as to not place more people and activities at risk, there is still considerable scope for redevelopment of sites. Redevelopment does provide some opportunities to remediate existing risks.

It is acknowledged that experience demonstrates that a "mitigation" type approach (i.e. allowing some development in flood plains where the consequences of such development are considered to be reasonable) can fail to address cumulative issues to flood plain functioning. On a site-by-site basis it is very hard to determine what level of development is "safe" - risks can be both over and under-estimated. Improved assessment of risks and fuller consideration of the range of risks has the ability to better mitigate the costs to the community of activities in flood hazard areas (but cannot completely eliminate these costs).

The council, as the community's agent, does not have the resources to purchase all sites in flood plains, and so existing risks need to be managed. Business land is scarce in the urban area and stopping further industrial and commercial development in flood plains has considerable economic consequences.

In rural areas, lots are generally large enough to accommodate farm buildings outside of flood plains. Residential buildings should not be in flood plains. In some cases, non-residential buildings (such as barns and sheds) may need to be located in areas affected by flooding due to site features such as availability of flat land. The cumulative impact of such structure is not necessarily large due to the site sizes involved, provided structures are able to withstand flood flows and not block them.

4.1.2. Conclusion

A dual avoidance / mitigation approach is appropriate for the Auckland Region, given the mix of greenfields expansion and urban redevelopment envisaged by the Auckland Plan and being advanced by the draft AUP. In particular, it is important that the AUP is clear as to where an avoidance approach is to be taken in greenfields otherwise a degree of uncertainty is introduced into the consenting process that will add to transaction costs, as well as possibly see community-wide costs increase if inappropriate development occurs in floodplains.

In relation to existing urban areas, the objective implements the overriding goal of reducing risks overtime.

4.2. Policies

The relevant policies in the proposed Unitary Plan are 5.13 Flooding (1 to 22).

Important shifts in policy settings, compared to existing legacy plans, relate to:

- Residential intensification
- Vulnerability
- Infrastructure
- Overland flow paths
- Flood sensitive and flood prone areas.

These policy changes are discussed in turn.

4.2.1. Residential Intensification – Chapter B Policy 2.1.1 and Chapter C 5.13 Policy 3
There is a potential conflict between the Auckland Unitary Plan's promotion of residential intensification through urban redevelopment and the management of flood hazards that seek to avoid new residential development in flood plains.

Areas identified for residential intensification include areas in and around town centres including the proposed Terrace Housing and Apartment Buildings zone and town and local centres. Some of these areas lie within flood plains. The flood plain rules will apply to these areas, irrespective of the zoning. However the combined objectives for these areas (accommodate more development while reducing hazards) are incompatible and this and is likely to be used to play off one objective against the other. This conflict should be resolved by not up-zoning those residential areas subject to significant flooding hazards.

Initial analysis of the August 2012 draft Unitary Plan zones for terrace housing and town centres identified that around 260ha falls within a flood plain, or 8% of the total area in these zones (see Table 10 below).

Table 3: Area of terrace housing and centres within flood plains

	Area Affected by Flood Plains (ha)	Total Area (ha)	% in flood plains
Terraced housing, metro and town centres	259	3418	8%

These are coarse, high level figures:
- Many properties will only partly be in flood plain
- Some properties will only be minimally impacted (e.g. shallow depth/velocity)

Overall less than 10% of the land identified for substantial intensification is affected by flooding.

The Mixed Housing zone covers a much larger area (up to 50% of the urban area). This zone allows for unlimited density when sites are amalgamated.

The main risk is in the residential zones from infill and redevelopment. This increases people and property that will be subject to (possibly devastating) events and increases pressure on council to fix existing problems in these areas. In town centres, residential activity will generally be above street level, but nevertheless people will still wish to access properties or otherwise evacuate during a flood event. There is no real difference between an apartment building in a residential zone and an apartment building in a town centre in terms of vulnerability of the occupier.

On the other side of the coin, there is the potential for more intensive residential developments to be constructed so as to mitigate risks in ways unlikely to be achieved by a single dwelling style development, particularly where the intensive development occurs in a comprehensive way and flood risks are not significant, such as in areas of ponding and low velocities. In these areas flood risks could be mitigated in a number of ways:

- If sites are large enough, flood plains could be reconfigured to enable development to occur outside of it;
- Type of construction ensures the building will not be damaged (e.g. concrete rather than timber frame);
- Habitable floors are placed well above the flood plain, safe access for evacuation is provided, and the area within the flood plain remains unobstructed to facilitate flood flows;
- Additional height could be enabled where this results in smaller building footprints than at present.

In some areas it is possible that infrastructure solutions will help to mitigate risks to an acceptable level. In these areas development could be deferred until the flood hazard is remedied, through works identified in an approved Catchment Management Plan and implemented to council standards (either by council itself or approved by council).

As a result of initial analysis, the Stormwater Unit reviewed the areas that were to be zoned terrace housing and apartment zone and identified those areas where flood hazards were likely to be significant. As a result of this desktop, judgment-based review, a number of areas were re-identified as areas that should be maintained at their current, legacy plan zoning level of intensity. That is, zoned under the AUP for single houses or if already developed in multi unit form, mixed housing.

A similar exercise has been undertaken for the proposed mixed housing zone. While building coverage controls still apply where amalgamation occurs, inevitably redevelopment will see more houses built in areas subject to flood hazards. In most cases, where mixed housing lots are more than 30% covered by a flood plain, then the recommendation has been made for these sites to be re-identified as Single House Zone.

Summary

Policy: Intensification: Not up-zoning in floodplains and allowing for redevelopment only where it reduces risks	
Costs	• Fewer opportunities for residential intensification and hence less ability to achieve the overall aim of a compact urban area • People may not maintain their property, creating a form of planning blight, if they perceive the controls to be a “burden” • Some redevelopment options that could reduce flood hazards could be foregone.
Benefits	• Additional people and properties are not put at risk of flood hazards • The compact city policy is not undermined by a perception that people are being “forced” to live in areas subject to flood hazards • The need to buy out residents in flood plains, should flood hazards increase to the point where habitation is too risky, is avoided.
Risks	• Flood hazards are over-estimated, and as a result appropriate development opportunities are foregone. This risk is largely avoided through updating of flood modelling and adjustments to flood plains. Resource consent processes can address sites where risks are very small.
Appropriateness	• The policy of down-zoning flood plains ensures that the policy of a compact city does not clash with the policy of avoiding and mitigating risks from natural hazards.
Effectiveness	• The policy provides a clear direction as to how hazards are to be managed that minimises transaction costs.

Efficiency	• The benefits are considered to outweigh the costs. The sustainable management of the city's urban resources is achieved, as significant future costs from more housing developments in flood plains are avoided.

Conclusion
It is appropriate for the draft AUP to take more of an avoidance-based approach to residential intensification in areas subject to flood hazards. This is based on the cumulative effects experienced under current policy settings, as well as the experience of other cities and states which have seen significant flood hazards in recent years. In all cases these cities and states have moved to increase the level of control exercised and to strongly discourage more residential development in flood plains.

4.2.2. Vulnerable activities - Policies 5.13 Flooding1 to 6

At the regional policy statement level the proposed UP states that the consequences of development locating in areas subject to natural hazards are to be assessed based on the type and severity of the event, the effects of other activities from development and the vulnerability of the activity to adverse effects. The flood hazard specific policies in section 5.13 Flooding at the regional and district objectives level take this general direction further, and state that activities vulnerable to flooding are to be located out of the 1% AEP floodplains. Activities less vulnerable to the effects of flooding (such as commercial and industrial development) can locate in 1% AEP floodplains in urban areas if the activity does not increase risks to people or property from flooding, and must prepare a flood hazard mitigation plan.

An important starting point in developing this set of provisions is how the concept of risk is to be incorporated into the provisions that will apply.

As set out in the section on current plans and policies, there is a distinction in some plans between habitable and non-habitable floors of buildings, with habitable floors having to have higher freeboards than non-habitable floors. This is one form of a risk-based approach. However it deals with only one type of risk, and in a fairly coarse way.

Risk is a concept incorporated in the RMA. The meaning of adverse effect (section 3 (f) of the RMA) includes: any potential effect of low probability which has a high potential impact. This covers the flood hazard situation, and introduces the notion of risk. Schedule 4 of the RMA – Assessment of effects on the environment – further refers to "any risk to the neighbourhood, the wider community, or the environment through natural hazards". However the definition of sustainable management includes avoiding, remedying, or mitigating any adverse effects of activities on the environment, with no preference given for any option. That is, there is no guidance as to how the notion of risk is to be applied.

The above discussion of current approaches in the Auckland Region, recent experience and the review of national and international management regimes highlights the need to look at the two interrelated issues of risk, being the likelihood of experiencing a flood event and consequences of being subject to such an event. Generally, district plans currently identify one side of the risk-based equation, the likelihood of a flood event with significant consequences – being the 1% AEP event. However plans provide much less guidance as to what consequences are acceptable, and which should be avoided.

As noted by GNS Science (Saunders and Beban, 2012), in the RMA context, avoidance achieves risk reduction by not putting people and property in harm's way. In contrast, mitigation provides measures that reduce risk, but may still leave people and property at risk

of some harm (i.e. residual risks), and therefore may not achieve comprehensive risk reduction.

What is left unanswered by the RMA is what constitutes an acceptable consequence and who faces these consequences (a property developer is likely to accept a higher level of risk as they only own a property for a short period of time, whereas future residents would probably only accept a much lower level of risk).

Currently there is limited guidance available to councils in NZ on how to include natural hazard risk into land use plans, and how to determine an acceptable level of risk for risk reduction. A project funded by the Ministry of Science & Innovation and led by GNS Science (Saunders and Beban, 2012), aims to provide guidance on levels of acceptable risk for decision making, and provides a framework for risk reduction through land use planning. This research is to develop a tool to assist councils in assessing the level of risk and subsequent consequences of natural hazards (Envirolink Tools Project). Initial work on the tool kit refers to the concept of vulnerability as a way of helping to categorise combinations of consequences and risk, and what types of risk may be acceptable.

A three step risk-based approach to land use planning is to be proposed:

1. Categorise land use according to its importance to a community and economy (e.g. farm shed vs. hospital);
2. Assess the level of exposure of social or human elements in a given location and their differing levels of vulnerability, and thus risk. This can be achieved at either regional, district, or site-specific scale, and from acceptable through to intolerable levels of risk; and
3. Apply a quantitative and qualitative risk-based decision tool that incorporates health and safety, social, economic and environment consequences into planning policy and consent requirements. This approach allows for locational context to be included, rather than a ‘one fix for all’ approach. It also provides a new approach to managing risk – by assessing consequences first, then the likelihood of an event occurring with those consequences. Local decision makers can use the tool to estimate relevant levels of risk and consequences for their communities.

While traditionally hazard management has focused on the broad idea of risk, more recent international flooding provisions take an approach that looks at the different consequences of flooding depending on the type of activity, that is whether an activity may be ‘more vulnerable’ or ‘less vulnerable’ to the consequences of flooding.

For example, a freeboard may keep the habitable floor above the predicted flood level but it does not address all of the consequences of being exposed to a flooding event, such as the ability to evacuate, or the social effects of damage to personal property. People have a natural desire to evacuate a building that is subject to flooding, although this may not always be safe due to high velocity flood flows, while people seek to remove cars from flood waters, often placing themselves at severe risk of being harmed.

Vulnerability therefore reflects the human perspective of a natural flooding event. Flooding is a natural process that only becomes a hazard if there is risk to people or property. Vulnerability represents the interface between exposure to the physical threats to human well-being and the capacity of people and communities to cope with those threats (Kelman, 2011).

What makes particular activities ‘more’ vulnerable than other activities relates to a number of different factors – social, generational, geographic, economic and political, and tangible and

intangible effects on people. Those ‘more vulnerable’ are usually impacted in a wider range of ways than those less vulnerable.

In other words, by using the term ‘vulnerable’ instead of the traditional term ‘risk’ a wider gambit of considerations are captured. A risk-focused approach tends to be more focused on the human exposure to the hazard rather than on the ability of people to cope with hazards once they occur (Brooks, 2003).

How settlement or development occurs affects vulnerability, as exposure will depend on where people live in relation to the hazard while different activities have different type of consequences (or adverse effects) from floods. Different dimensions may include:

- People intensity – the number of people in harm’s way
- People’s response to a flood – residents (young, older adult, disabled) versus workers – and ability to evacuate during a flood event
- Property damage – home versus business premises, stock versus personal belongings
- Exposure to risk – permanent occupation versus daytime only
- Costs of locating out of flood plains versus flood-resilient design.

Table 4 sets out a basic categorisation of vulnerability.

Table 4: Categorisation of vulnerability

Type of risk / effect	Residential , retirement, child care, schools	Business – office, retail, service
People intensity	In a one hectare urban area there may be up to 40 or 45 people (i.e. 15 dwellings per ha, with 2.5 to 3 people per house).	Depending upon the type of business area, there may be only 20 or so workers for a warehouse type district of one hectare, but up to 200 or 300 people in a large centre.
People’s response (safety)	Cannot be controlled (panic). People enter flood waters to escape buildings, access relatives and friends and/or to retrieve belongings, like vehicles.	Can be managed to an extent by preparation of evacuation plan, similar to fire drills. People can be designated to ensure safe, orderly evacuation, provided a route is available.
Ability to evacuate	More likely to involve people who may have trouble evacuating, e.g. young, old, infirm, otherwise disabled.	While still involving a range of people, more concentrated on people of working age and more likely to involve buildings with multiple entrances and site exits.
Property / structures	Less resilient – often timber construction, with fittings not resistant to water	More resilient – structure often concrete, even if fittings not flood resistant
Stock / belongings	High cost – emotional, intangible attachment to possessions not covered by insurance	Business cost, often covered by insurance

Type of risk / effect	Residential , retirement, child care, schools	Business – office, retail, service
Exposure to risk	Higher (activity occupied day and night, weekdays and weekends)	Lower (daytime only)
Opportunity costs (alternative location)	Moderate – residential development can occur outside flood plains	Higher – there is a scarcity of business land and there are less opportunities for businesses and industrial activities to locate elsewhere, especially within the existing urban area
Overall risk assessment	More vulnerable	Less vulnerable

It is proposed that the revised flood hazard rules be built around those activities that are less or more vulnerable to the effects of flooding, using a similar approach to the UK guidelines. While people intensity of activities is important in determining risk, people's response to a flood event is equally important.

The definition for 'activities that are more vulnerable to the effects of flooding' could be as follows:

Activities that are vulnerable to the adverse effects of flooding due to their permanent occupation, difficulty of evacuation and limited resilience to flood-related damage, including but not limited to:

- All types of residential development (permanent and temporary, including residential dwellings, visitor accommodation units, lodges and boarding houses, residential care and retirement units)
- Care centres
- Educational facilities
- Health and welfare services, involving overnight accommodation
- Community Centres.

This approach to vulnerability can then be applied in a context-specific way, i.e. in relation to the general location of the activity, as set out in Table 5.

Table 5: Approach to vulnerable activities by context

Flooding risk location	More Vulnerable activities	Less Vulnerable activities
Greenfields	Avoid all types of development	Avoid all types of development – opportunity costs less than in existing urban area, i.e. can design new greenfields areas to have enough business land outside flood plains

Flooding risk location	More Vulnerable activities	Less Vulnerable activities
Existing urban area (e.g. single house / mixed housing / large lot, general business areas, town centres)	Avoid new, more vulnerable activities. Allow for maintenance / upkeep of existing properties and option for redevelopment where this lessens risks	Mitigate effects based on specific risk assessment – take into account factors such as people intensity, site layout, resilience of structure, access/egress, site management – outdoor storage, hazardous substances, car parking

In other words the concept of vulnerability helps to distinguish between those activities where their location in flood plains raises risks that are likely to be significant and cannot be reasonably avoided, versus those activities where there are risks, but there is potential for these risks to be mitigated. In this way, the focus of RMA provisions is to shift away from habitable floor levels as being the main form of mitigation to a more wide ranging assessment of the risks and consequences of development. The range of activities being particularly susceptible to flood risks is widened from residential to include a range of community-related activities, while a wider range of consequences are considered (not just building safety).

Summary

Policy: Within the urban area, assess risks on the basis of the vulnerability of broad groupings of activities to flood hazard effects, rather than take a case-by-case approach to all activities	
Costs	• New residential and community-related development in flood plains is largely curtailed, possibly reducing some housing supply opportunities and possibly affecting property values • Business development is likely to face more costs in terms of preparing and complying with resource consents than at present, such as maintaining evacuation plans, reviewing how goods are stored on site, enhancing building design and placement so development is more flood resilient
Benefits	• Those activities more able to cope with the consequences of flood hazards, e.g. business uses, have more scope to redevelop where they are located in flood plains, provided flood risks to others are not increased. This also reflects regional pressures on business land supply and the need to promote employment opportunities • A wide range of adverse consequences are considered and mitigated (e.g. not just about raising floor levels above flood levels) through policies focused on overall vulnerability
Risks	• Assessments of flood hazards may be under or overstated, but can be refined over time based on better knowledge of what does and does not work • Council may still be seen to be liable to fix flood hazards experienced by less vulnerable activities.
Appropriateness	• The policy of basing risk assessment on vulnerability supports the mitigation approach proposed for existing urban areas
Effectiveness	• A policy of assessment based on vulnerability provides a better means of identifying and managing risks than the previous approaches to flood management and aligns with the general policy direction of the AUP
Efficiency	• The policy helps to better distinguish what the costs and benefits are and as a result, allows for more targeted mitigation measures.

4.2.2.1. Conclusion

It is concluded that the concept of vulnerability provides a more appropriate means by which to identify and manage the different types of risks associated with development in flood plains, compared to current provisions in operative district plans.

4.2.3. Infrastructure – Chapter B 6.7 Natural hazards Policy 9 and Chapter C 5.13 Flooding Policies 15 to 18

Much infrastructure is located in flood plains. The proposed UP regional policy statement in relation to infrastructure and natural hazards requires the design and location of new significant infrastructure that functions as a lifeline utility to undertake a risk assessment based on a 0.2 per cent Annual Exceedence Probability (AEP) natural hazard event, and to avoid significant adverse effects on the community from the failure of that piece of infrastructure. Two issues arise in relation to implementing this approach:

- Is some infrastructure more critical than others in terms of being resilient to flood hazards, compared to other types of hazards?

- How to accommodate normal maintenance and upgrade of infrastructure that is located within flood plains.

The proposed policies state that new infrastructure should only locate in the floodplain if it is functionally required there or cannot practically locate elsewhere. They require infrastructure that must function during a flood event (including major transport networks, emergency services and power supply systems) to be located, designed and managed to enable continued operation in up to the 0.5% AEP flood event.

For existing infrastructure in flood plains, maintenance, alterations and upgrades can occur if flood risk is not increased.

4.2.3.1. Vulnerability of infrastructure

In the event of significant floods occurring (such as 1% AEP or more extreme events), there is potential for these events to impact on infrastructure that is critical to the hazard response. This includes police and fire service facilities being put out of action and major roads for evacuation being blocked. There is also long term disruption of infrastructure services due to flood damage, such as power, telecommunication and wastewater services serving urban areas disabled for long periods of time due to flood damage.

To ensure that this infrastructure can still continue to operate in and after an emergency it is prudent to avoid locating them in areas affected by high risk hazard events, and where they do have to locate in flood plains, designing them so they are resilient to the effects of flood damage.

Recent events in Queensland have highlighted the costs to the community of replacing flood damaged infrastructure, often multiple times. It is reported that the Queensland government is reconsidering building public works in floodplains due to the frequency of flood events. Deputy Premier Jeff Seeney[2] has said it could be necessary to rebuild infrastructure in different locations (i.e. out of flood plains), given the cost of replacing the same infrastructure damaged in two recent flood events.

In the UK vulnerability of 'essential infrastructure' is specifically addressed in their relevant national planning policy (PPS 25). This policy refers to essential transport infrastructure (including mass evacuation routes) which has to cross areas at risk; and essential utility infrastructure which has to be located in a flood risk area for operational reasons (including electricity generating power stations and grid and primary substations; water treatment works), but which if knocked out by a flood could cause widespread, long term disruption to communities. Emergency services are also classified as being highly vulnerable to flood effects. Under the PPS, highly vulnerable infrastructure cannot locate in 1% AEP flood plains, while essential infrastructure needs to pass an exception test that considers alternative locations, as well as the specific effects of locating in flood plains. If located in flood plains, then essential infrastructure should be designed and constructed to remain operational and safe for users in times of flood.

4.2.3.2. Defining infrastructure that is vulnerable to flood events

One question is how such infrastructure is to be identified.

Critical infrastructure is defined in the Auckland Plan to mean:

[2] (http://nz.finance.yahoo.com/news/qld-flood-prompts-town-planning-025725757.html)

Infrastructure assets, services and systems which:

> *are an immediate societal requirement and fundamental to enabling development. In the event of being destroyed, degraded or rendered unavailable for periods of more than one day, their loss would have serious consequences for the health, safety, security and social and economic well-being of the Auckland Region.*
>
> *are fundamental to the long-term well-being of society and contribute to Auckland's liveability. The overall network is critical, such as matters relating to cultural and social infrastructure (e.g. open space and libraries.)*

The Auckland Plan highlights the importance of water, wastewater and electricity, as well as emergency services (policy, fire, ambulance and others) in the event of a disaster. It also states that infrastructure planning and provisions should improve the resilience of critical infrastructure.

Definitions of infrastructure currently within the proposed UP include Significant Infrastructure. Significant infrastructure is defined as:

> *Existing or proposed infrastructure, or a component of infrastructure, which:*
>
> *due to its location, function, development or operation, is of strategic (critical) importance to the form, function and/or growth of Auckland, or otherwise has national significance; or*
>
> *if unavailable, would have a serious adverse effect on the social or economic wellbeing of Auckland or a community within Auckland, or*
>
> *it is a lifeline utility as defined in section 4 of the Civil Defence Emergency Management Act 2002.*

Other definitions of critical or important infrastructure include lifelines under the Civil Defence Emergency Management Act 2002. Schedule 1 Part A and B of that Act list the following:

- Radio NZ and TVNZ
- Main airports
- Ports
- Gas production and distribution
- Electricity generation and distribution
- Water supply
- Waste water
- Telecommunications
- Road networks including State Highways
- Petrol stations and distribution
- Rail networks.

The above definitions need to be modified to focus in on that infrastructure which, if disabled by a flood event, is likely to cause widespread disruption during or after a flood event. This can be seen as a sub set of the 'lifelines' under the Civil Defence Act, but should also include emergency service facilities, but does not need to include Radio NZ and TVNZ, Ports, airports, gas production and distribution or petrol stations.

The definition of infrastructure that is likely to be vulnerable to flood hazards that is included within the proposed UP is as follows:

Flood Vulnerable Infrastructure
Means infrastructure assets, services and systems which, in the event of being destroyed, degraded or rendered unavailable for extended periods by a flood event, would have serious consequences for the health, safety, security and economic well-being.
Includes:

- *state highways and access points to and from state highways*
- *arterial roads*
- *rail lines*
- *metropolitan water supply and wastewater treatment plants*
- *telecommunications*
- *electricity generation plants, major transmission lines and sub stations*
- *emergency services*.

It is appropriate for this flood-vulnerable infrastructure to be subject to a higher level of risk assessment that other activities, i.e. a 0.5% rather than 1% event, as signalled by regional-level policy. This reflects the importance of such infrastructure to the community. However the nature of this assessment will vary as to whether the activity is within or outside the 1% AEP flood plain:

- *Where located outside the 1% AEP flood plain and within the 0.5% flood plain, the assessment would be focused on ensuring that the infrastructure is built to be able to withstand the adverse consequences of more extreme flood events.*

- *Where to be located within the 1% AEP flood plain, then as with other activities, then assessment is required that involves the identification of flood risks, alternative locations and the ability to mitigate the associated risks via a consent process*.

It is noted that the Council does not currently have the ability to map a 0.5%/ 200 year ARI flood plain. This means that flood-vulnerable infrastructure has to determine whether the 0.5% flood plain is relevant. This places some costs on them. However, the council should be able to map the 0.5% flood plain in the future. In the meantime, the benefits of requiring consideration of greater risks are considered to outweigh costs for the narrow range of infrastructure considered "flood vulnerable".

The adoption of the 0.5% standard for triggering the assessment of resilience to flood hazards, rather than the 0.2% 500 year policy in the RPS reflects the councils knowledge of flood hazard profiles.

4.2.3.3. Maintenance of Infrastructure

Given the widespread location of infrastructure in flood plains, a further question is how to allow for regular maintenance and upgrade of this infrastructure in a way that does not trigger significant resource consent processes for infrastructure providers. The draft AUP provisions for infrastructure in flood plains were not explicit as to whether minor upgrades and repairs of infrastructure trigger resource consent requirements. Feedback sought allowance for small scale infrastructure, such as telecommunication masts.

The proposed network utility rules of the draft Unitary Plan provide for a range of permitted activities for infrastructure, as follows:

- The operation, repair and maintenance of network utilities and electricity generation facilities in existence [as at the date of public notification of the Unitary Plan]

- Minor infrastructure upgrading of existing network utilities and electricity generation facilities
- Minor utility structures
- Removal of network utilities and electricity generation facilities
- Emergency works, including the repair of networks, in accordance with s. 330A(2) of the Resource Management Act.

In response to issues relating to infrastructure maintenance, explicit provision has now been made for this in the policies and methods.

Summary of costs and benefits

Policy: Identify flood vulnerable infrastructure as requiring specific attention, require consideration of alternative locations while allowing for upgrade and maintenance of infrastructure.	
Costs	• Consenting costs (preparing applications etc) for infrastructure that has to locate in flood plains for operational reasons is likely to increase due to wider range of issues considered • Some infrastructure may be more costly to build if it has to cope with a 0.5% ARI flood event. There is no definition of what is meant by being "resilient". • Regular maintenance and small scale upgrades may be subject to consent processes creating costs and uncertainty to utility operators • Locating flood-vulnerable infrastructure out of 100 year ARI flood plains may involve buying more expensive land/sites.
Benefits	• Community are less exposed to long term disablement of important infrastructure • Council is less exposed to calls from infrastructure providers to undertake works to try to control flood hazards in areas where essential infrastructure is located • Infrastructure providers do not face replacement costs if infrastructure is located outside flood plains, or is otherwise designed to be flood resistant.
Risks	• Risks from flood hazards may be overstated for some types of infrastructure or some locations - a risk that can be minimised through the flexibility of the consent process.
Appropriateness	• A requirement for assessment of risks on a case-by-case basis for flood vulnerable infrastructure accords with expectations under the Civil Defence Act that infrastructure providers will plan for the adverse effects of natural hazards.
Effectiveness	• Network utility provides have powers to issue notices of requirements which can override land use controls. However policies of the plan relating to important infrastructure in flood plains can still influence what conditions should be attached to such notices of requirements.
Efficiency	• Overall, the policy approach should help to ensure that, over the longer term, the community does not face large scale costs associated with repairing and protecting essential infrastructure affected by flood hazards.

4.2.3.4. Conclusion

The policy approach of identifying infrastructure that is particularly vulnerable to the effects of flooding is appropriate and reasonable, given the cost to the community of such infrastructure being rendered inoperable. A specific policy for such infrastructure signals that the council cannot mitigate flood hazard effects and that infrastructure needs to be located and designed to be resilient to flood hazards.

4.2.4. Overland Flow Paths – Chapter C 5.13 Flooding Policies 19 to 22

Overland flow paths are an important part of the stormwater management system, but have not been consistently managed across the region. When on private property they can be modified by structures (for example new houses, industrial buildings or extensions to them built over them, as well as fences and earthworks). They may be piped or diverted as a result. Both can result in overland flows being directed onto other properties.

The relevant UP policies are 5.13 (19 to 22). These are to require the flow paths to remain unobstructed, and any changes to overland flow paths should retain their capacity to pass stormwater flows safely.

Table 6: Summary of costs and benefits

Policy: Management of overland flow paths	
Costs	• Some redevelopment opportunities will be reduced and others will be subject to resource consent processes to determine appropriate mitigation actions • Piping of overland flow paths may be appropriate in some circumstances because of health and safety issues. However alternative (secondary) routes are still needed in the event of blockage.
Benefits	• Less potential for overland flow paths to be diverted onto other properties without mitigation. Un-managed, risks to properties near overland flow paths are high due to potential for uncontrolled piping and diversions. • Overland flow path issues can be identified and managed at the planning stage, rather than reactively at the building stage.
Risks	• Council's information about overland flow paths is increasing as modelling becomes more sophisticated.
Appropriateness	• Overland flow paths can result in significant risks to individual properties and therefore need to be managed.
Effectiveness	• The proposed provisions represent an improvement on the status quo.
Efficiency	• The risks to people and property from poorly managed overland flow paths are substantial and improved management of adverse effects from their modification will improve sustainable management outcomes

4.2.4.1. Conclusion

It is appropriate for the AUP to manage overland flow paths, and the proposed provisions represent an effective improvement on the status quo. The risks to people and property from poorly managed overland flow paths are substantial, and improved management of adverse effects from their modification will improve sustainable management outcomes.

4.2.5. Flood sensitive and flood prone areas - Policies 5.13 (8 and 9)

Flood sensitive areas cover land beside flood plains. The definition of flood sensitive area is the land within 0.5m vertical height of the 1% AEP flood event. Within this area, floor levels of buildings are controlled to provide freeboard.

Flood prone areas are natural depressions and man-made ponding areas (such as the upstream side of culverts) where flood waters can concentrate, if parts of the stormwater system become blocked. Flood prone areas have recently been mapped by the council's stormwater unit (Brown and Irvine, 2013). The height of flood waters in flood prone areas varies, and can be above the 1% AEP flood level for adjacent flood plains.

Flood prone areas have been mapped based on the following:

- involves the area that would be inundated if infrastructure (e.g., pipe or culvert) failed
- only included depressions greater than 300mm deep at some point, more than 500m^2 area and greater than 50m^2 volume
- these depressions filled to a level expected in a 1% AEP rainfall event.

For both flood sensitive and flood prone areas, the policies generally seek that floor levels be above flood levels. However in the case of flood prone areas the height which buildings will need to be built to will vary from one flood prone area to another. In some cases it could be over a metre above ground level. This may not always be practical. For example in town centres and commercial areas, buildings need to have entrances at street level. In residential areas, if buildings are significantly above ground levels (e.g. more than a metre), then there is likely to be a temptation for property owners to store goods and items below their house and potentially to block in part of it to create secondary rooms. These actions increase flood risks.

Raising floor levels above flood levels therefore has particular implications for the cost and design of business and commercial buildings, for example large floorplate warehouses and shops and businesses aimed at walk in business. Raising floor levels of residential buildings has fewer design implications (except perhaps for buildings specifically design for the elderly / disabled).

Requiring a free board about 1% AEP flood levels is common practise when development is within floodplains (for example when buildings are sited in the shallow edges of a flood plain). The extension of the freeboard requirement to adjoining land outside of the flood plain and in identified flood prone areas is a new requirement, but one that is justified on the basis of providing some buffer space that can accommodate uncertainty over future flood levels.

In relation to flood sensitive areas, the requirement ensures consistency of approach between development in and out of floodplains. Without control on development beside flood plains, then it would be possible for two houses to be nearly side by side, and for one to be 0.5m above ground level, but the other not. That is, the house in a flood plain, on its extreme edge, would need to be 0.5m above ground level. Another house close by that is just outside the flood plain could have a floor level at ground level, below that of the house in the flood plain.

Flood prone areas are a new category of flood hazard, and as a result the following table concentrates on the costs and benefits of the flood prone area policy. Activities in flood prone areas face different risks to activities in flood plains. In flood prone areas, waters may rise more rapidly, but may not have the same velocity and force of flood waters flowing down a flood plain. The policies recognise that building above flood prone levels may not be

desirable in all cases, and that particularly for commercial buildings, a management response may be more appropriate.

Table 6: Summary of costs and benefits

Policy: Management of flood prone areas	
Costs	• Houses and commercial buildings may need to be more than 0.5m above ground level. This will increase building costs. • Fewer storeys may be able to be built, as height limits do not change, depending upon how high the floor level needs to be • Access to buildings may be more difficult, particularly buildings that attract pedestrians
Benefits	• Reduced risks to people and property •
Risks	• Flood prone areas have been known about for a long time, but have only recently been mapped. Failure to manage known risks may mean that the council is liable to remediate flood risks when development occurs in flood prone areas
Appropriateness	• Small, localised flood events due to blockage of stormwater systems are common across the region
Effectiveness	• Policies and rules are an effective means of managing risks as most developers will downplay/ignore risks when building, while future occupiers may not appreciate the extent of risks when buying/renting property that looks like it is outside/above a floodplain
Efficiency	• The policies recognise that it may not be appropriate to raise floor levels above flood prone areas in all cases. This provides a degree of flexibility as to how to manage risks

4.2.5.1. Conclusion

It is appropriate for the AUP to manage flood sensitive and flood prone areas.

4.2.6. Rules

This section provides an assessment of rules that are significantly different to those set out in legacy plans. Specific rules addressed are:

4.2.6.1. Activities

The UP introduces the terms 'vulnerable and less vulnerable activities'.

- Vulnerable activities are a non-complying activity, while less vulnerable activities are provided for as a discretionary activity.

- Redevelopment of existing buildings containing vulnerable activities that does not increase building footprints is a discretionary activity. Otherwise development is non-complying.

The following rules are proposed:

Maintenance, repair and alterations to buildings which do not result in any increase of site coverage or floor area and/or lower finished floor levels	P
Public amenities, informal recreation and leisure and organised sport and recreation, including associated parks field structures but not club rooms	P
Farming and associated non-residential buildings situated outside the urban area with a GFA equal to or less than 100m²	P
Less vulnerable activities including all associated buildings,	D
Non-residential farm buildings with a GFA greater than 100m² situated outside the urban area	D

Redevelopment of existing buildings accommodating vulnerable activities that increase building coverage and/or habitable floor area above flood levels	D
New vulnerable activities and all associated buildings, including conversion and/or change of use of an existing building to accommodate a vulnerable activity	NC

The main alternative considered was the activity status for these different activities:

All development could have been:

- restricted activity, with discretion limited to buildings not blocking flood waters and habitable floors being above flood levels
- discretionary, with a wide ranging assessment of flood related hazards
- vulnerable activities identified as being particularly inappropriate in flood plains due to the specific risks involved.

The advantages and disadvantages of these options are as follows:

	Status Quo Restricted Discretionary	**Alternative 1 Discretionary**	**Alternative 2 Mixed Non Complying / discretionary**
Appropriateness *Does it address the issue; is it consistent with RMA Part 2*	Does not provide a strong signal as the appropriateness of development in flood plains	Allows for case-by-case assessment, but discretionary activity status usually taken to mean that development may be appropriate in certain circumstances	Yes - addresses need to avoid development that has significant risks arising from exposure to flood hazards
Effectiveness *Does it achieve the objective, taking into account risks and uncertainties?*	Unlikely to be effective in avoiding and mitigating risks, based on current experience	Likely to see risks from hazards mitigated, but not avoided	More effective than option 1, provided that there is clear policy guidance that non-complying activities should generally be avoided
Efficiency *Do the benefits outweigh costs?*	Not an efficient use of resources - costs will outweigh benefits	Over time is unlikely to be efficient as most people underestimate costs of hazards that are not immediate	Yes will lead to more efficient use of resources as long term liability /costs from having vulnerable activities in flood plains will be reduced
Costs	Likely to see significant development occur in floodplains and at some point experiencing a major hazard	Some costs will be avoided through mitigation, but not all	Some development opportunities are foreclosed and vulnerable activities have to locate elsewhere possibly raising some costs that they face (e.g. land costs)
Benefits	None from a community perspective as benefit of	Sees floodplains are possible development	Significant social and economic costs from

	additional development in flood plains will be off-set by costs on the community to manage flood risks	areas, subject to assessment	having activities particularly vulnerable to flood effects are avoided
Risks of acting or not acting	Hard to judge risks on a case-by-case basis without good information and strong guidance	Allows for consideration of a wide range of risk factors, but limited ability to address cumulative effects	Risks of not acting are substantial, given frequency and likelihood of major flood events

4.2.5.2 Infrastructure

As discussed in the section on policies, the UP provisions introduce the term flood vulnerable infrastructure, while provision is made for the maintenance of existing infrastructure. New infrastructure requires consent.

The following activities are listed:

Below ground infrastructure, except septic tanks and other forms of wastewater treatment and disposal systems	P
Maintenance and repair of infrastructure, including flood mitigation and land drainage works	P
Construction of stormwater management devices or flood mitigation works that are to be vested in the council, or otherwise approved by way of a structure plan incorporated into the Unitary Plan or network discharge consent	P
Stormwater management devices and flood mitigation works that are not to be vested in council, or which have not been approved in a structure plan or network discharge consent	RD
Placement of any septic tank, wastewater treatment and disposal system and effluent disposal field	RD
Above ground infrastructure involving structures that occupy less than or equal to $25m^2$ of ground surface area	RD
Other above ground infrastructure involving structures that occupy more than $25m^2$ in ground surface area	D
Any flood vulnerable infrastructure involving structures placed within the 0.5 per cent AEP flood plain	P

The main alternative advanced in feedback on the draft plan was whether there should be a more liberal approach to small scale infrastructure, such as telecommunication masts, and how the provisions relating to flood vulnerable infrastructure were to be interpreted.

In relation to small scale infrastructure, consideration was given to whether this could be made a permitted or controlled activity. The advantages and disadvantages of this are as follows:

	Alternative 1 Small scale is permitted/ controlled	**Alternative 2 Small scale is restricted discretionary**
Appropriateness *does it address the issue; is it consistent with RMA Part 2*	No - not consistent with objective to better manage risks to the community from natural hazards	Yes - consistent with part 2 and gives effect to the need to consider risks for all types of infrastructure
Effectiveness *does it achieve*	No -not effective, in that individual and cumulative risks of infrastructure failure are not explicitly addressed.	Yes, it is effective, in that the objective is achieved, even taking into account transaction costs involved

	Alternative 1 Small scale is permitted/ controlled	Alternative 2 Small scale is restricted discretionary
the objective, taking into account risks and uncertainties?		
Efficiency *do the benefits outweigh costs?*	Not an efficient use of resources	While there are transaction costs for infrastructure providers
Costs	Risks to infrastructure of being disabled from flood event are assessed by the operator. They may expect the council to manage flood risks	Risks to operation can be assessed in the consent process
Benefits	Small scale infrastructure can be provided without invoking a consent	Small scale infrastructure requires consent
Risks of acting or not acting	Presumes that risks on an individual and cumulative basis are no more than minor	Some small scale infrastructure may not locate in floodplains, and as a result have to be sited in residential areas or in road reserves

4.2.5.3 Management of floodplains

This set of rules covers activities like fencing, car parking and storage of materials. Relevant rules include:

Fences that do not obstruct flood flows and walls less than or equal to 0.5m in height	P
Fences that do obstruct flood flows and walls over 0.5m in height	D
Surface parking or parking areas	P
Below ground car parking or parking areas	P
Maintenance, repair and alterations to buildings which do not result in any increase of site coverage or floor area and/or lower finished floor levels	P
Storage of material in any zone, including the storage of hazardous substances where the amount of hazardous substances would be permitted by the hazardous substances rules apply to the residential zones	P
Storage of hazardous substances in any zone where the amount would not be permitted by the hazardous substances rules applying to the residential zones	D

These rules did not attract substantial comment in the feedback received, and as a result no specific analysis of their appropriateness has been undertaken. Generally they are seen to be necessary to give effect to the objectives and policies. As has been mentioned in several places, flood hazards are often made worse by obstructions to flood plains from non-building structures, as well as goods and materials being washed off sites.

It is acknowledged that monitoring and enforcement of the provisions is not easy, while many activities may be able to claim existing use rights. However the rules provide the basis of controlling and conditioning new development, and will work alongside other methods such as Bylaws.

4.2.5.4 Overland flow paths

Explicit control of development within overland flows paths was not universal across the legacy plans. Associated rules cover:

Fences located within or over an overland flow path that do not obstruct the overland flow path	P
Flood protection works within an overland flow path required to reduce the risk to existing buildings from flooding hazards	P
Infrastructure, including maintenance and minor upgrading, road construction, maintenance and resurfacing	P
Modifying the alignment of an overland flow path within a site, but not diverting the entry or exit point or reducing its capacity	P
Diverting the entry or exit point or reducing the capacity of any part of an overland flow path	D
Any buildings or structures, including retaining walls (but excluding permitted fences) located within or over an overland flow path	D

Permitted activity standards cover:

> *1. Fences:*
> *a. Fences must:*
> *i. provide an opening equivalent to twice the area required to convey the 1 per cent AEP flow of the overland flow path*
> *ii. the opening must be constructed to minimise the chances of blockage of the overland flow path.*
>
> *2. Flood protection works:*
> *a. Works must maintain the same entry and exit point of the overland flow path at the site boundary, and must not alter the volume and velocity of water flow, and must not cause additional adverse flooding effects on neighbouring sites.*
>
> *3. Infrastructure, including road construction, maintenance and resurfacing:*
>
> *a. The path and capacity of the overland flow path where it enters or exits the site or crosses the road must not be altered by the works, and*
>
> *b. where any structure is placed across the overland flow path or piping of it occurs, provision must be made for a secondary flow path that can accommodate the overland flow in a way that will not cause or increase flooding of neighbouring properties, in the event of blockage of the main flow path or when the capacity of the obstructed path is exceeded, during a 1% AEP storm event.*

The main alternatives advanced in informal feedback related to piping of overland flow paths. The March 2013 draft identified the piping of overland flow paths as a non-complying activity. This drew criticism, as in many situations overland flow paths needed to be piped for reasons of safety, such as where they crossed main roads or harmed existing houses. In response to these comments, the overland flow paths were amended to acknowledge the overland flow paths may be piped to allow for the provision of infrastructure, but there would still have to be an alternative flow path available, should the main path become blocked or the capacity of the pipe was exceeded during a major storm event.

	Alternative 1 piping of overland flow paths so long as an alternative route is provided	**Alternative 2 No piping**
Appropriateness *does it address the issue; is it consistent with RMA Part 2?*	Yes it ensures that an overland flow path is always available while allowing for alternative routes / arrangements	No, not appropriate as it overstates the need to protect overland flow paths in their current alignments

	Alternative 1 piping of overland flow paths so long as an alternative route is provided	**Alternative 2 No piping**
Effectiveness *does it achieve the objective, taking into account risks and uncertainties?*	Yes, is an effective response to ensuring capacity of overland flow paths are retained, while allowing for development	No, is not effective in that piping may be appropriate in some cases / situations
Efficiency *do the benefits outweigh costs?*	Costs of the alternative can be weighed by each development	Costs for some sites could be high, particularly where an alternative, safe route of appropriate capacity is available
Costs	Secondary / alternative flow paths need to be provided	Pipe capacity would have to be large, and the pipe may get blocked during a storm
Benefits	Allows for specific site circumstances to be taken into account	Allows development to proceed
Risks of acting or not acting	Should not result in any significant risks	May see desirable and acceptable development not occur

4.2.5.5 Flood Prone areas

Explicit control of development within flood prone areas was not universal across the legacy plans. The Auckland Isthmus District Plan did refer to flood prone areas in its rules on natural hazards, but did not define what it meant by the term.

Associated rules in the Unitary Plan cover:

Buildings containing vulnerable activities	P
Buildings containing less vulnerable activities	P
Buildings with finished floor levels that do not meet the permitted activity standards	RD

Permitted activity standards cover:

Vulnerable activities in flood prone areas

a. Finished floor levels of buildings are at least 500 mm above the 1 per cent AEP flood prone level
b. Finished floor levels of buildings are no more than 1500mm above ground level

Less vulnerable activities in flood prone areas

a. Finished floor levels of buildings are at least 300mm above the 1 per cent AEP flood prone level

Flood prone areas were not included in the March 2013 draft of the Unitary Plan (due to mapping not being finalised). As a result no specific consultation or feedback has been received on the proposal.

The main alternative to identifying separate rules for flood prone areas would be to manage risks using the “standard” flood plain rules. In this case, most development would be subject to a resource consent. This alternative would need to involve a change to the definition of flood plains to include localised flooding effects (i.e. flood prone areas).

	Alternative 1 : Specific rules relating to floor levels	**Alternative 2 Rely on flood plain rules**
Appropriateness *does it address the issue; is it consistent with RMA Part 2?*	Would be consistent with Part 2	Would be consistent with Part 2, although the cost of compliance would be higher than alternative 1.
Effectiveness *does it achieve the objective, taking into account risks and uncertainties?*	Focus of assessment on floor levels and the use of area below finished floor levels means that the rules are more effective than generalised flooding rules in managing risks	Focus of assessment on risks and vulnerabilities is wide ranging and may see excessive analysis of risks in flood prone areas that lie outside flood plains.
Efficiency *do the benefits outweigh costs?*	Rules and assessment focus on avoiding effects through raising floor levels	Not as efficient as the assessment of risks is not specific to the different types of flooding, that is risks in flood prone areas are different to those in flood plains
Costs	May make some development difficult to achieve, i.e. where floor levels have to be substantially above ground levels	Most development will be subject to a resource consent and this will create a degree of uncertainty for properties that are outside flood plains, but inside flood prone areas
Benefits	Long term costs to the community of more development being subject to flood risks are reduced / do not increase	Easier to administer as only one set of rules apply
Risks of acting or not acting	Flood prone areas extend outside flood plains and so more people and property are affected	Some flood prone areas fall outside flood plains and so not all risks will be appropriately managed

4.3 Adequacy of Information and Risk of Not Acting

The main area where there is some uncertainty over the adequacy of information relates to flood mapping and the quantification of different flood hazards.

In responding to flood hazards, the former councils in the region have steadily built up their information bases as to the extent of these hazards. Modelling of flood hazards typically occurs on a catchment by catchment basis as part of Catchment Management Plans. As GIS-based data has become more accurate (such as improved contour information), the accuracy of flood hazard mapping has improved. Inputs relating to assumed rainfall intensities and sea level rises are also constantly updated. Generally, the modelling is based on a maximum probable development scenario for the catchment, i.e. it is assumed that the catchment is fully developed, allowing for considerable infill and redevelopment of existing sites. However it is not possible to be precise as to how every site in the catchment is to be developed and there are always localised variations.

The standard of flood mapping is not uniform across the region and the new Auckland Council is attempting to get all flood hazard information as up to date as possible, prior to the

AUP being notified. This flood hazard information is still at a fairly coarse level, identifying the extent of the 1% AEP flood plains.

More detailed information about flood velocities and depths is not available across the Region. This has an impact upon how flood plain management controls are to be structured.

The flood plain rules are part of the Unitary Plan. However, the spatial extent of flood plains, flood prone areas and flood sensitive areas will be shown as a non-statutory layer on the Council's Unitary Plan website. This is because of the need to constantly update the GIS layer as new information comes to hand from modelling exercises. If the flood plains were part of the Unitary Plan, then each change to the flood plain maps would require a plan change – a lengthy and costly exercise which means that they would only be updated in batches. This would create problems for the council and landowners, as the council has a duty to disclose hazard information it has available to it. Should there be a lag between the council preparing new information, and changing the AUP maps to reflect this information, then there could be confusion and uncertainty when development proposals are advanced in areas that may be affected by updated flood hazard information as to whether the area is "in or out".

Having the flood plains depicted on maps that are not formally part of the proposed Auckland Unitary Plan follows the practice of a number of the former Councils that now make up the Auckland Council and allows people to access the most up to date information when considering property purchases and developments.

In the future, the Council will develop the ability to define areas within flood plains that are at particular risk due to the depth and velocity of water flows. However this information will not be available by time of notification. In the future, the Council will also be able to delineate a 10% AEP and 0.5% flood plain (or at least specify how these are to be calculated).

5 Conclusions

Based on the above consideration of the RMA, existing legacy plan approaches to flood hazards, the issues associated with current approaches, overseas examples of flood management and the consideration of the costs and benefits of proposed approaches, the following overall approach is recommended:

- Provide a greater level of protection to flood plains and overland flow paths during the preparation of structure plans and comprehensive development plans, including vesting of flood plains, and through use of covenants and restrictive zonings;
- Avoid the placement of all buildings and other structures in identified flood hazard areas and overland flow paths in greenfields development and where large scale urban redevelopment occurs;
- Do not up-zone for intensive housing, areas within flood plains with significant hazards that cannot be remedied through building design or infrastructure upgrades;
- Avoid additional residential redevelopment in all flood hazard areas in existing urban areas, and allow for redevelopment of existing residential development only where current flood hazards can be reduced through building redesign and placement;
- Allow for commercial/industrial redevelopment in flood hazard areas in existing urban areas provided risks are not increased and subject to measures to communicate, manage and mitigate flood risks, based on a flood hazard assessment and mitigation plan;
- Manage a wider range of risks from development in floodplains in existing urban areas including egress during a flood event, hazardous substances, storage of goods, car parking areas and ancillary structures;

- Avoid placing critical infrastructure within flood hazard areas, and ensure that they are resilient to extreme flooding events where they must locate in those areas
- Manage modifications of overland flow paths to limit adverse impacts on adjoining and downstream properties;
- Control the floor height of buildings in flood sensitive and flood prone levels to limit dangers to occupiers.

This approach should lead to more appropriate sustainable management of natural and physical resources than current district plan frameworks.

6 Record of Development of Provisions

6.1 Information and Analysis

Developing the draft AUP provisions for flood hazard management has involved:

1. Review of current district and regional plan provisions
2. Workshops and meetings with council stormwater and planning experts to determine how existing provisions are working
3. Review of national and international management approaches
4. Development of working papers and background material on issues and options
5. Presentations to councillor workshops
6. Preparation of draft material
7. Amendments following feedback to draft.

A list of reports and research referred to during the consideration of the policies and rules is set out below under the heading Bibliography.

Further data and analysis is contained in the following Appendices
Appendix 3.26.1: Proposed Policies
Appendix 3.26.2: Statutory Base
Appendix 3.26.3: International and national examples

6.2 Consultation Undertaken

Table 7: Key decisions and milestones for stormwater provisions

Date	Event	Key milestone or decision
Dec 2010	Summary of key stormwater management messages for Auckland Plan approved by Stormwater Unit Management and delivered to Auckland Plan workstream leads	Identified key flooding, environmental and infrastructure matters and directions for inclusion in the Auckland Plan, many of which are also implemented through the Auckland Unitary Plan
21 Jun 2011	Presentation of draft Stormwater Unit Implementation Plan to Environment and Sustainability Forum	Establishes Stormwater Unit (SWU) vision and key principles which direct input to Auckland Plan and Unitary Plan, particularly: • Integrated Land Use and Stormwater Planning; • Commitment to Water Sensitive Design; • Prevention of new adverse effects and prioritised resolution of existing; • Management of source/at source with prioritised communal/public solutions.
7 Nov	SWU workshops	Established outcomes sought by the Stormwater Unit in the Unitary Plan through two SWU workshops with

Date	Event	Key milestone or decision
2011 11 Nov 2011		Environmental Strategy and Policy representation.
30 Nov 2011	Unitary Plan outcome matrix	Stormwater Input to Unitary Plan Outcomes Matrix. Approved by R Bannister and J Heijs 29 Nov 2011
Feb 2012	Stocktakes of water and flooding provisions in legacy plans	Summary of existing provisions
Feb 2012	Flooding and Stormwater Management Issues and Options Paper delivered to Unitary Plan workstream lead	Establishes preferred approach for Flooding and Stormwater Management Policy development, in response to statutory requirements, National Policy Statements and Auckland Plan
28 Feb 20121	Meeting with Stormwater Hydraulic Modelling team	Agreed ability to deliver 100 year ARI flood plain maps and flooding maps should not be included in the Unitary Plan
1 Mar 2012	Stormwater management input to engagement workshops with Iwi on freshwater	Engagement
28 Mar 2012	First draft Flooding and Stormwater Management Tier 1 and 2 objectives and policies delivered to Unitary Plan workstream lead	Outline of main approaches to flood plain management
17 May 2012	Meeting with Stormwater Technical Services regarding Technical Publication 10 (GD01) alignment with Unitary Plan	
8 Jun – 9 Jul 2012	Series of workshops with SWU, RIMU and CLAW technical specialists on aspects of stormwater management and flooding rules	Topics include flooding, land use rules for quality and quantity, stormwater discharge rules, network discharges and BPO, growth, structure planning, infrastructure
25 Jul 2012 16 Aug 2012	Presentation of Flooding and Stormwater Management provisions to Unitary Plan Senior Management Group	Strong focus on flooding constraints associated with intensification areas. SWU agree to assess constraints in TH&AB Zone
3 – 15 Aug 2012	Stormwater Management Area – Flow mapping and moderation by Catchment Management Planning and Hydraulic Modelling	
Aug 2012	Delivery of amended integrated Freshwater Tier 1 and 2	
31 Aug 2012	Stormwater management and flooding objectives, policies and rules delivered	
7 Sep	Presentation to annual	Engagement – no feedback sought

Date	Event	Key milestone or decision
2012	Stormwater Seminar	
19 Sep 2012	Response to legal opinion on excluding natural hazard maps from the Unitary Plan	SWU provide written justification for exclusion of flood plain maps from the Unitary Plan while making them publicly available
1 Oct 2012	Presentation of assessment of flooding constraints in Apartment and Terraced Housing Zone to Penny Pirrit and John Duguid	Decisions re: zoning of areas subject to flooding
31 Oct 2012	Delivery of SWU feedback on 31 August draft Unitary Plan	
8 Nov 2012	Meeting with John Duguid re delivery of flooding provisions	Agreement to remove impervious area thresholds from Stormwater Management provisions and include in zones. Agreement for GIS to amend zone maps as advised by SWU Apartment and Terraced Housing flooding constraints assessment and recommendation
7 Dec 2012	ICONs formatted stormwater management and Flooding provisions delivered	Amendments to stormwater management provisions:
14 Dec 2012	Delivery of Tier 1 and 2 stream and riparian management policy	SWU feedback on the 31 August working draft Unitary Plan noted shortcomings in policy relating to stream loss and riparian areas. Amendments to stream and riparian management policy were offered to Unitary Plan workstream leads.
15 Jan 2013	Delivery of unitary plan provisions for stormwater management including updated road network provisions	
18 Jan 2013	Unitary Plan Oversight Group feedback on stormwater management and flooding provisions	Removal of impervious area thresholds from commercial and some industrial zones (retained in business centres)
1 Mar 2013	Flood Prone Area meeting with SW Hydraulic modelling	Agreement to prepare policy proposal for Flood Prone Areas to present to UP oversight group and PWP for inclusion in notified Proposed Plan
25, 27, 28 Mar 2012 3 Apr 2013	Stormwater Unit workshops on stormwater management and flooding provisions in the UP	Internal engagement
8 Apr 2013	Stormwater Industry engagement workshop of stormwater management and flooding provisions in the draft UP	Engagement
22 Apr 2013	Workshop with Water NZ Stormwater SIG to clarify questions for their feedback on the UP	Engagement
10 May	Presentation to Water NZ Conference break out group	Engagement

Date	Event	Key milestone or decision
2013	focusing on UP feedback	
10 May 2013	SWU feedback across UP presentations with IF providers and with ESU	

6.3 Decision-Making

The key decisions and milestones for the wider Unitary Plan process undertaken by the Council's Stormwater Unit (SWU) were:

Table 8: Key Decisions and Milestones for Unitary Plan

6 Sep 2012	Presentation to Political Working Party	Information only – no direction from PWP
31 Oct 2012	Presentation of Stormwater Management and Flooding provisions to Political Working Party	Supported directions of proposed stormwater approach but seeking further information on implications for development in floodplains, and extent of application of stormwater provisions at mapping workshops

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