

# Wharekawa Coast 2120

## Natural hazard risk threshold results

### Executive summary

This document provides the results and conclusions of an exercise undertaken by community members and asset and emergency managers to identify their natural hazard risk thresholds as part of the Wharekawa Coast 2120 project. Eighty-three community members and ten asset and emergency managers took part in this exercise. Detailed results and conclusions are provided for the project area, as a whole, and for six sub-compartments identified within the project area. All results presented are the median results. A brief background on the assessment of the community risk thresholds is also provided.

The community risk threshold results were presented to the community panel to seek feedback on whether they are an accurate representation of the communities' tolerance to natural hazard events and this feedback is provided.

### Key outcomes from exercise

- Generally, a sufficient level of responses was received for all sub-compartments to ensure good representation of the people who live within them.
- For coastal inundation, those living within the northern sub-compartments generally indicated a higher level of tolerance. This means thresholds are expected to be reached sooner in the southern sub-compartments, where some thresholds have already been reached (Pūkorokoro Miranda (1a) and Kaiaua township (2a)).
- In Kaiaua township (2a), the level of tolerance for impacts from coastal inundation and Huarahi Stream flooding is similar – the threshold for Huarahi Stream flooding has also been reached.
- All community risk thresholds (except in Pukekereru (4a) where there is no threshold for the moderate event) are reached significantly earlier for a moderate event than for a major event. This result has implications for the time available before adaptation actions need to be implemented.
- Nearly all community risk thresholds are reached earlier than those by the asset and emergency managers.
- The community panel felt that the community risk threshold results are generally a good representation of the communities' tolerance to natural hazard events. They were not surprised by the results.

### Glossary

**ARP (average return period)** – How often a given size event is estimated to happen on average, e.g., once every 100 years.

**Community risk threshold** – The point at which the community can no longer tolerate the impacts of a natural hazard event. Adaptation actions or pathways should be implemented prior to a community risk threshold being reached.

**Level of tolerance (tolerance)** – The level of tolerance the community has to the impacts from the major or moderate event scenarios, as defined by the community risk thresholds. A community risk threshold is influenced both by how tolerable (or severe) the impacts are and by how tolerant the community is to those impacts (vulnerability factors).

**NA (not assessed)** – Where the community was not asked to assess a threshold because, of the elements assessed as part of the exercise, there were either none present in the sub-compartment or none exposed to flooding.

**No threshold** – Where a threshold was assessed but the community considered the impacts to be so low that they would be tolerated at a frequency of every 2.4 months (a shorter timeframe was not assessed).

**Overall impacts** – All the impacts to the elements across all the categories (impacts to homes and buildings, and disruption to residents; rural land, roads and bridges; services; and recreation and tourism). When considered together, these impacts may interact in ways that are cumulative, increasing the overall risk. Because of this, there may be a lower tolerance to the overall impacts than to the impacts to any one category.

## Background

The Wharekawa Coast has already experienced significant coastal inundation and freshwater flooding events, particularly from Huarahi Stream. With the projected effects of climate change, these events will become more frequent and more severe. To help plan for the future, we asked the community to assess when they would no longer be able to tolerate the impacts from coastal inundation and Huarahi Stream flooding.

Information from the report *Wharekawa Coast 2120 – Natural Hazard Risk Assessment* was used to create a booklet for each sub-compartment in the project area (these can be found on the [project website](#)). Each booklet presented the impacts of two natural hazard event scenarios (the major and moderate event). Participants were given a booklet relating to their sub-compartment and asked to assess the information to determine their community risk thresholds for the applicable impact categories and for overall impacts. They recorded their community risk thresholds and any comments in their booklet.

The six sub-compartments assessed were:

- 5a – Waharau
- 4a – Pukekereru
- 3a – Whakatiwai
- 2a – Kaiaua township
- 2b – Kaiaua inland
- 1a – Pūkorokoro Miranda

The impact categories assessed were:

- Homes, properties and disruption to residents
- Rural land
- Road access
- Services
- Recreation and tourism

Eighty-three community members took part in this exercise, assisted by the community panel who delivered and collected the booklets and explained the exercise. The community risk threshold results have been collated and analysed and are presented in this report. The comments that accompanied the thresholds have also been recorded and are summarised in [Appendix A](#).

The community risk threshold results were presented to the community panel to seek feedback on whether they are an accurate representation of the communities' tolerance to natural hazard events. The feedback is provided in [Appendix B](#).

Risk thresholds assessed by asset and emergency managers during a workshop in September 2020 are also presented in this report. These thresholds relate to what these managers can tolerate in terms of resources required for them to respond to natural hazard events. Ten participants from Hauraki District Council,

Waikato Region Emergency Management Group and Waka Kotahi NZ Transport Agency took part in this workshop.

Combined, these thresholds will be used to figure out how much time is available to implement adaptation actions to reduce the natural hazard risk to the community. The thresholds can also be used to prioritise sub-compartments and impact categories where risk will need to be addressed sooner.

## Risk threshold results and conclusions

All community risk threshold results presented in this document are the median results, as the median provides the best representation of the average risk tolerance across the community. Where the median result fell between the ARP options provided, the result was rounded up to take a conservative approach.

The asset and emergency managers’ risk thresholds were determined by consensus at the workshop. This was possible due to the much smaller number of participants.

## Risk thresholds and tolerance

### Understanding the results

ARP	200yr	100yr	75yr	50yr	20yr	10yr	5yr	2yr	1yr	6m	2.4m	no threshold
Classification	v. low		low	medium	high					v. high	NA (not assessed)	

The risk threshold results for the major and moderate event scenarios are coloured coded according to the above table. If a community has a high tolerance for the impacts from an event scenario, then they can tolerate that event happening more often. If a community has a low tolerance for the impacts, then they can’t tolerate the event happening very often. Generally, a community has a higher tolerance for less severe impacts, and a lower tolerance for more severe impacts. But tolerance is also influenced by vulnerability factors such as demographics.

### Tolerance to the major event

		Sub-compartments (community risk thresholds)							Project area (risk thresholds assessed by asset & emergency managers)			
		Homes, properties & disruption to residents	Rural land	Road access	Services	Recreation & tourism	Overall impacts	Roads & bridges	Stormwater & stopbanks	Recreation & community facilities	Civil defence/HDC emergency response	
Coastal Inundation	5a	medium	high	high	high	high	medium	medium	v. high	high	medium	
	4a	high	high	high	NA	no threshold	high					
	3a	medium	medium	medium	medium	medium	medium					
	2a	low	medium	low	low	medium	low					
	1a	low	low	medium	NA	medium	low					
Hauarahi Stream	2a	low	medium	medium	low	medium	low	? (not assessed)	v. high	high	high	
	2b	NA	no threshold	NA	NA	NA	no threshold					

### Tolerance to the moderate event

		Sub-compartments (community risk thresholds)							Project area (risk thresholds assessed by asset & emergency managers)			
		Homes, properties & disruption to residents	Rural land	Road access	Services	Recreation & tourism	Overall impacts	Roads & bridges	Stormwater & stopbanks	Recreation & community facilities	Civil defence/HDC emergency response	
Coastal Inundation	5a	NA	high	high	NA	v. high	high	medium	v. high	high	high	
	4a	NA	no threshold	no threshold	NA	no threshold	no threshold					
	3a	NA	high	high	NA	high	high					
	2a	medium	medium	medium	medium	high	medium					
	1a	medium	medium	high	NA	high	medium					
Hauarahi Stream	2a	medium	high	medium	medium	medium	medium	? (not assessed)	v. high	high	v. high	
	2b	NA	no threshold	NA	NA	NA	no threshold					

Equivalent tables with quantitative (numerical) results for risk thresholds (ARPs) are in [Appendix D](#).

## Estimated time until risk thresholds reached

### Understanding the results

Coastal inundation:
reached
v. short (0-10 years)
short (10-30 years)
medium (30-50 years)
long (50-70 years)
v. long (no threshold)
NA - where no threshold has been assessed

Haurahi Stream flooding:
reached/exceeded
not reached
NA - where no threshold has been assessed

The risk threshold results have been used to calculate the estimated time that is available before the risk thresholds are reached. This provides an indication of how much time is available before adaptation actions need to be implemented. In some cases, the results indicate that community risk thresholds have already been reached or exceeded.

The RCP 8.5 climate change scenario has been used for the results presented in the following tables. See [Appendix C](#) for information on RCP scenarios and an explanation of how the results were calculated.

### Estimated time until risk thresholds reached for the major event

		Sub-compartments (community risk thresholds)							Project area (risk thresholds assessed by asset & emergency managers)			
		Homes, properties & disruption to residents	Rural land	Road access	Services	Recreation & tourism	Overall impacts	Roads & bridges	Stormwater & stopbanks	Recreation & community facilities	Civil defence/HDC emergency response	
Coastal Inundation	5a	long	long	long	long	long	long	long	long	long	long	
	4a	long	long	long	NA	v. long	long					
	3a	long	long	long	long	long	long					
	2a	medium	long	medium	medium	long	medium					
	1a	medium	medium	long	NA	long	medium					
Haurahi Stream	2a	not reached	not reached	not reached	not reached	not reached	not reached	? (not assessed)	not reached	not reached	not reached	
	2b	not reached	not reached	not reached	not reached	not reached	not reached					

### Estimated time until risk thresholds reached for the moderate event

		Sub-compartments (community risk thresholds)							Project area (risk thresholds assessed by asset & emergency managers)			
		Homes, properties & disruption to residents	Rural land	Road access	Services	Recreation & tourism	Overall impacts	Roads & bridges	Stormwater & stopbanks	Recreation & community facilities	Civil defence/HDC emergency response	
Coastal Inundation	5a	NA	short	short	NA	short	short	v. short	short	short	v. short	
	4a	NA	v. long	v. long	NA	v. long	v. long					
	3a	NA	v. short	short	NA	v. short	v. short					
	2a	v. short	v. short	v. short	v. short	v. short	reached					
	1a	v. short	reached	v. short	NA	v. short	reached					
Haurahi Stream	2a	exceeded	reached	exceeded	exceeded	exceeded	exceeded	? (not assessed)	not reached	not reached	not reached	
	2b	NA	not reached	NA	NA	NA	not reached					

Equivalent tables with quantitative (numerical) results for estimated times till thresholds reached (years from 2021) are in [Appendix D](#).

## Conclusions

- Enough responses were received from participants to ensure good representation for all sub-compartments but two – (Pukekereru and Kaiaua inland).
  - For Pukekereru (4a), only two respondents filled out the rural land section for the major event and no-one filled out the rural land section for the moderate event (may be because no threshold reached).
  - Only one participant completed the Kaiaua inland (2b) booklet.
  - In both cases, feedback from the community panel has been used to fill the gap in results. For Pukekereru (4a), the wider community will also be provided with the opportunity to comment.
- There was a relatively large spread in the results from all the sub-compartments. The median results have been used in this document; however, some participants have a higher or lower level of tolerance than the median and assessed their thresholds accordingly.
- For coastal inundation, the level of tolerance is generally higher in the northern sub-compartments for impacts from both major and moderate events. This means thresholds are expected to be reached sooner in the southern-sub compartments.
  - The community risk threshold for coastal inundation has already been reached for the moderate event in Pūkorokoro Miranda (1a) and Kaiaua township (2a).
  - No threshold has yet been reached for the major event.
- For Haurahi Stream flooding, the community risk threshold has been reached or exceeded for the moderate event in Kaiaua township (2a). No threshold has been reached for the major event.
- All community risk thresholds (except in Pukekereru (4a) where there is no threshold for the moderate event) are reached significantly earlier for impacts from the moderate event than from the major event.
  - This means there is significantly less time to implement adaptation actions than if only the major event had been considered.
  - This key outcome has been tested with the community panel and they agree with this outcome.
- The communities' median risk thresholds are mostly reached earlier than the asset and emergency managers' median risk thresholds.
  - The only exception is for the coastal inundation moderate event, where the asset managers' median threshold for 'roads and bridges' (for the whole project area) is reached earlier than the communities' median risk thresholds for Whakatiwai (3a), Pukekereru (4a) (pending 'rural' results) and Waharau (5a).
  - Of the thresholds assessed by asset and emergency managers (for resources required for repair, maintenance and emergency response responsibilities), there is generally a much lower level of tolerance for impacts to roads and bridges and civil defence/Hauraki District Council emergency response than there is for impacts to stormwater and stopbanks and recreation and community facilities.

## Results and conclusions by sub-compartment

For each sub-compartment, the key outcomes are presented first, with more detail provided below.

### Waharau (5a) – coastal inundation

**Key outcomes:** The community risk threshold occurs at a 10-year ARP for the major event and a 2-year ARP for the moderate event due to impacts to homes, properties and disruption to residents and, to a lesser degree, impacts to road access. Neither of these thresholds have yet been reached.

- 17 participants; 14 gave usable threshold results and all comments were considered.
- For the major event, the overall community risk threshold occurs at a 10-year ARP (medium tolerance).
  - This is due to impacts to homes, properties and disruption to residents.
  - There is a high tolerance for impacts to road access (5-year rural land, services and recreation and tourism (all 1 to 2-year ARP)).
- For the moderate event, the overall community risk threshold occurs at a 2-year ARP (high tolerance).
  - The high tolerance for impacts to rural land and road access (1-year ARP) is slightly less than the very high tolerance (or NA) for impacts to the other impact categories.
  - When the impacts were considered together, this reduced the overall level of tolerance.
- **The community risk threshold is estimated to be reached between 11 and 14 years from 2021** (RCP8.5H+ and RCP2.6/2032-35), and in 13 years using the RCP8.5 scenario (2034), because of increasing frequency of the moderate event impacts.
- The community risk threshold for a major event is estimated to be reached between 46 and 73 years from 2021 (RCP8.5H+ and RCP2.6/2067-94), and in 55 years using the RCP8.5 scenario (2076).

### Pukekereru (4a) – coastal inundation

**Key outcomes:** The community risk threshold occurs at a 5-year ARP for the major event due to impacts to homes, properties and disruption to residents, impacts to road access and potentially impacts to rural land. This threshold has not yet been reached. No community risk threshold has been identified for the moderate event, likely because the impacts are relatively low. There were limited responses for the rural land impact category so feedback from the community panel has been used to fill the gap in results.

- 15 participants; all gave usable threshold results (despite low response to rural land) and all comments were considered.
- For the major event, the overall community risk threshold occurs at a 5-year ARP (high tolerance).
  - This is due to impacts to homes, properties and disruption to residents and impacts to road access.
  - It may also be due to impacts to rural land. Only two responses were received for rural land (who marked a 10-year and 50-year ARP). Feedback from the community panel suggests impacts could likely be tolerated more often (at least a 5-year ARP) because most of the rural land is above the inundated area, productive farmland is not heavily stocked (dry stock rather than dairy) and stock can be moved to higher ground.
  - Feedback from the community panel suggests the overall impacts threshold should greatly reflect the thresholds for homes, properties and disruption to residents and road access (5-year ARP).
- No community risk threshold has been identified for the moderate event, likely because the impacts are relatively low, therefore people are prepared to tolerate them.

- No assessments were received for rural land. Feedback from the community panel suggests this may be because the impacts are low so there is no threshold.
- The remaining categories results were either NA or no threshold.
- **The community risk threshold is estimated to be reached between 48 and 79 years from 2021** (RCP8.5H+ and RCP2.6/2069-2100), and in 59 years using the RCP8.5 scenario (2080), because of increasing frequency of the major event impacts.

### **Whakatiwai (3a) – coastal inundation**

**Key outcomes:** For the major event, the community risk threshold occurs at a 10-year ARP and the level of tolerance is uniform across all impact categories (10-year ARP). For the moderate event, the community risk threshold occurs at a 5-year ARP due to impacts to rural land and recreation and tourism. Neither of these thresholds have yet been reached.

- 15 participants; 13 gave usable threshold results and all comments were considered).
- For the major event, the overall community risk threshold occurs at a 10-year ARP (medium tolerance).
  - There is a medium tolerance (10-year ARP) for each of the individual impact categories.
  - The raw median result was that when all the impacts were considered together, this reduced the overall level of tolerance to a 20-year ARP. However, feedback from the community panel suggested that a more appropriate threshold for the major event would be a 10-year ARP as most places bounce back quickly. This is not considered inconsistent with the raw results as the reduced tolerance to overall impacts was because of just one respondent. The overall risk threshold has therefore been changed to a 10-year ARP.
- For the moderate event, the overall community risk threshold occurs at a 5-year ARP (high tolerance).
  - This is due to impacts to rural land and recreation and tourism.
  - There is a high tolerance for impacts to road access (2-year ARP) and the remaining categories were NA.
- **The community risk threshold is estimated to be reached between 6 and 7 years from 2021** (RCP8.5H+ and RCP2.6/2027-28), and 7 years for the RCP8.5 scenario (2028), because of increasing frequency of the moderate event impacts.
- The community risk threshold for the major event is estimated to be reached between 42 and 66 years from 2021 (RCP8.5H+ and RCP2.6/2063-87), and in 51 years using the RCP8.5 scenario (2072).

### **Kaiaua township (2a) – coastal inundation and Huarahi Stream flooding**

**Key outcomes:** For both coastal inundation and Huarahi Stream flooding, the community risk threshold occurs at a 50-year ARP for the major event and a 20-year ARP for the moderate event. For both, the moderate event threshold has already been reached or exceeded. For both hazards the level of tolerance to impacts across the different categories is relatively similar. For the moderate event (for both hazards), considering all impacts together reduced the level of tolerance from any individual category.

#### **Coastal inundation**

- 36 participants; 29 gave usable threshold results and all comments were considered.
- For the major event, the overall community risk threshold occurs at a 50-year ARP (low tolerance).
  - This is due to impacts to homes, properties and disruption to residents, road access and services.
  - There is a medium tolerance (20-year ARP) for impacts to rural land and recreation and tourism.

- For the moderate event, the overall community risk threshold occurs at a 20-year ARP (medium tolerance).
  - There is a medium tolerance (10-year ARP) for impacts to all but one of the categories – there is a high tolerance to impacts to recreation and tourism (5-year ARP).
  - When the impacts were considered together, this reduced the overall level of tolerance (to a 20-year ARP).
- **The community risk threshold has already been reached due to the frequency of moderate event impacts.**
- The community risk threshold for the major event is estimated to be reached between 37 and 56 years from 2021 (RCP8.5H+ and RCP2.6/2058-77), and in 44 years using the RCP 8.5 scenario (2065).

### Hauarahi Stream flooding

- 35 participants, 26 gave usable threshold results and all comments were considered.
- For the major event, the overall community risk threshold occurs at a 50-year ARP (low tolerance).
  - This is due to impacts to homes, properties and disruption to residents and impacts to services.
  - There is a medium tolerance (20-year ARP) for impacts to the remaining categories.
- For the moderate event, the overall community risk threshold occurs at a 20-year ARP (medium tolerance).
  - There is a medium tolerance (10-year ARP) for impacts to all but one of the categories – there is a high tolerance to impacts to rural land (5-year ARP).
  - When the impacts were considered together, this reduced the overall level of tolerance (to a 20-year ARP).
- **The community risk threshold has already been exceeded because of the frequency of moderate event impacts.**
- The major event threshold has not been reached.

### Kaiaua inland (2b) – Hauarahi Stream flooding

**Key outcomes:** No community risk thresholds are expected to be reached for the major or moderate event due to very low exposure to and impacts from Hauarahi Stream flooding in this sub-compartment. Only one participant completed this booklet, so feedback from the community panel has been used to fill the gap in results.

- 1 participant with usable threshold results but no comments.
- There was only one impact category for this sub-compartment – rural land (the rest were NA due to the very low exposure to and impacts from Hauarahi Stream flooding in this sub-compartment).
- There is no community risk threshold for the major or moderate events for impacts to rural land. As a result, **no community risk threshold is expected to be reached.**
- Feedback from the community panel confirmed this result.

### Pūkorokoro Miranda (1a) – coastal inundation

**Key outcomes:** The community risk threshold occurs at a 75-year ARP for the major event and a 20-year ARP for the moderate event due to impacts to rural land and, to a lesser degree, impacts to homes, properties and disruption to residents. The moderate event threshold has already been reached.

- 10 participants; 7 gave usable threshold results and all comments were considered.
- For the major event, the overall community risk threshold occurs at a 75-year ARP (low tolerance).
  - This is due to impacts to rural land.

- There is also a low tolerance for impacts to homes, properties and disruption to residents (50-year ARP), with a medium tolerance for impacts to road access (20-year ARP) and recreation and tourism (10-year ARP). Impacts to service were NA.
- For the moderate event, the overall community risk threshold occurs at a 20-year ARP (medium tolerance).
  - This is due to impacts to rural land.
  - There is also a medium tolerance for impacts to homes, properties and disruption to residents (10-year ARP), with a high tolerance (5-year ARP) for impacts to road access and recreation and tourism. Impacts to services were NA.
- **The community risk threshold has already been reached due to the frequency of moderate event impacts.**
- The community risk threshold for the major event is estimated to be reached between 34 and 51 years from 2021 (RCP8.5H+ and RCP2.6/55-72), and in 41 years using the RCP 8.5 scenario (2062).

## **Appendix A – Summary of comments from community risk threshold booklets**

The following is a summary of all of the comments that were provided in the community risk threshold booklets. It accompanies the 'Risk threshold results and conclusions' document.

The comments have been summarised in two ways:

1. Key themes from each sub-compartment
2. A summary of comments by topic for the Wharekawa Coast project area (all sub-compartments):
  - a) Impacts from coastal inundation and river flooding
  - b) Suggestions for mitigation of/adaptation to impacts
  - c) Concerns/complaints/development ideas
  - d) Selection of quotes

Each of the comments has also been recorded in full and is available on request.

### **1. Key themes from each sub-compartment**

The following key themes are those that received the most comments relating to that topic in each sub-compartment.

#### **Waharau (5a)**

Losing road access has been a major issue with slips to the north and bridge/road closure to the south, particularly for access to emergency and other services and for the elderly. This will happen again. Improve the bridge before the next event happens.

Rain from the hills is a big concern (more than coastal inundation), causing water runoff, falling trees, slips and soil erosion. This needs to be mitigated and the trees cut back. Drain clearance and maintenance needs to be improved.

The community is used to dealing with flood events, is self-reliant and helps each other. Insurance has been/will be a problem.

There was not enough assistance after the 2018 coastal inundation event. The Waharau bridge damage in 2017 was handled very well.

The mussel farms will increase fishing, traffic and rubbish and may affect coastal processes.

#### **Pukekereru (4a)**

Coastal erosion is an issue/is becoming an issue.

It is up to individual owners if they want to stay in the area, as long as they understand the risks. Some properties are at greater risk than others.

Improve the resilience of the road by raising it or creating an alternative route. Access is important for emergency services, and travel from/to Auckland.

Clear and maintain the streams as stream erosion and blockages are causing issues. Planting and retiring marginal farmland will help with stability.

### **Whakatiwai (3a)**

The foreshore has already changed and beach been damaged/destroyed from rising sea levels and storm events. Coastal inundation events have significant impacts, both financially and emotionally.

Concerns relating to Whakatiwai Stream including its capacity and the potential for a damaging flood.

The community are likely to be quite resilient and able to cope.

Te Kohanga Reo, the marae and EcoQuest are valuable resources to the community. EcoQuest is supportive to the community and provides employment on the coast.

Relocate the caravans to higher ground to prevent them being swept into the water. Raise the floor levels of vulnerable buildings.

### **Kaiaua township (2a)**

The stress of the 2018 coastal inundation event impacted on our whole family and caused significant damage to personal property and extensive mental distress and risk to safety of residents. Its stressful watching weather warnings and worrying about evacuating. Early warnings will help.

Kaiaua has always been a sustainable community. Our services and assistance from external agencies are minimal. The community will work together to help those who need it.

Increasing insurance premiums and excesses is a problem.

Regular clearing/maintenance of streams, culverts, drains and floodgates will alleviate much of the damage to rural land, roads and properties. Reinstate natural floodplains and wetlands. Improve the stormwater system.

Improve the maintenance of roads and bridges, as road access is essential, especially for emergency services. The Fire Station also needs protection. Could create a seawall/raise the road to act as a seawall.

The Hauraki Rail Trail is not fit for purpose.

### **Kaiaua inland (2b)**

No comments received

### **Pūkoro Miranda (1a)**

The impacts of the 2018 coastal inundation event on farming were severe and ongoing and the stress was huge.

Property damage and mental distress is a significant issue, and it's especially a concern for me/my family as I live alone.

Upgrade/maintain existing drainage and streams. Consider some form of coastal barrier, such as by raising the road or using naturally deposited shell material (and don't level it out after events).

The Hauraki Rail Trail is not high enough.

## 2. Summary of comments by topic for Wharekawa Coast project area

### Impacts from coastal inundation and river flooding

Emotional toll	<ul style="list-style-type: none"> <li>• mental distress</li> <li>• social impact (loss of social interaction/facilities)</li> <li>• unpredictability</li> <li>• stress of always watching the weather forecasts</li> <li>• scary living across from Tikapa watching beachfront disappearing</li> <li>• displacement from home</li> </ul>
Financial health	<ul style="list-style-type: none"> <li>• loss and damage to personal property, e.g. houses, lawns, vehicles, garage contents, freezer full of kai</li> <li>• any event impacts businesses</li> <li>• still have to go to work and earn a living if a disaster happens</li> <li>• increasing insurance premiums and excesses will become/has always been an issue</li> <li>• farming – no milk - no money coming in, find and pay for grazing elsewhere, replace vehicles, longer term impacts of saltwater inundation - reduce stock numbers and buy feed in</li> <li>• loss of fishing and tourism visitors</li> </ul>
Resilience/ vulnerability	<ul style="list-style-type: none"> <li>• reliance on family</li> <li>• clean up done by local residents</li> <li>• community works together to help each other</li> <li>• people choose to live here, want to stay, can leave</li> <li>• used to dealing with flood events</li> <li>• can cope</li> <li>• know when to leave</li> <li>• local school closed</li> <li>• road access (also see below)</li> </ul>
Road access	<ul style="list-style-type: none"> <li>• access via roads is a big problem,</li> <li>• Waharau can be cut off completely both north and south</li> <li>• southern route via Kaiaua is preferred – northern route back-up</li> <li>• slips to the north will come down again with next heavy rain</li> <li>• if road closed same impact for moderate and major event</li> <li>• FENZ and St Johns can't get through when roads are closed</li> <li>• no road access to Ngatea High School</li> </ul>
Other services	<ul style="list-style-type: none"> <li>• Te Kohanga reo, Marae, EcoQuest vital to our community</li> <li>• Hauraki Rail Trail has small area damaged by tidal events, will happen again unless track built higher</li> <li>• loss/damage of boat ramp affects users</li> <li>• sewage and electrical are essential</li> <li>• water pump damage – houses become uninhabitable</li> <li>• sewage leaks from septic tanks</li> </ul>

## Suggestions for mitigation of/adaptation to impacts

Planting	<ul style="list-style-type: none"> <li>• trees for shelter</li> <li>• native planting to stabilise coast and reduce erosion</li> <li>• planting along waterways to mitigate heavy rainfall and stabilise banks</li> </ul>
Drainage, stormwater, floodgates, waterways/stream, culverts	<ul style="list-style-type: none"> <li>• regular cleaning and maintenance of culverts, waterways/streams, drains and floodgates to increase speed and drainage of water</li> <li>• improve SW system to reduce likelihood of events e.g. Puriri Ave lacks any major stormwater system</li> <li>• maintain/clear the Haurahi Stream mouth regularly, and consider removing mangroves</li> <li>• combine coastal inundation and stormwater in a community wide scheme</li> <li>• a breakwater at each stream outlet to help keep streams, tidal inlets and outlets open and allow sea water to come in and out again</li> </ul>
Road	<ul style="list-style-type: none"> <li>• raising road (e.g. at Miranda one-lane bridge) - higher level of road with protection walls and culverts large enough for the sea to flow in and out when the tide pressure is high</li> <li>• provide alternative access road/s to get out</li> <li>• look at getting road through Higgens farm to get away from slips (Waharau)</li> <li>• fix the bridge before the next event happens (Waharau)</li> <li>• improve maintenance of roading and bridges</li> </ul>
Sea walls	<ul style="list-style-type: none"> <li>• make sea walls from recycled plastic</li> <li>• sea wall down far end of beach (Waharau)</li> <li>• dredge the Firth and use material removed to build sea walls</li> <li>• stopbanks no lower than 3m</li> <li>• use shell material pushed up by inundation as a barrier for next event - pushed up and planted</li> </ul>
Resilience	<ul style="list-style-type: none"> <li>• raise the floor levels of houses</li> <li>• improve resilience of houses/buildings to flooding e.g. strengthened fences, shutters to protect joinery and prevent ocean waves entering home</li> <li>• encourage insurance companies to allow people to raise their houses when re-building following an event - replacing like with like is not sensible</li> <li>• subsidised inflatable flood barriers for all business owners and school</li> <li>• building consents for new structures should include measures to reduce the impacts of flooding, older structures should be modified or demolished</li> <li>• don't want all properties lumped together, assess properties on own merits if people want to build/rebuild (e.g. on higher land)</li> <li>• relocate caravans to higher ground (Whakatiwai)</li> <li>• limit growth/development of area to enable adaptation to climate change</li> <li>• up to owners/occupiers of property - as long as they know the risk of living here</li> <li>• devise a septic tank seal/lock in the event of floods to prevent/reduce waste leakage</li> </ul>

	<ul style="list-style-type: none"> <li>• services need protection in order to support community</li> </ul>
Erosion	<ul style="list-style-type: none"> <li>• Erosion protection/reinforcing/gabion baskets</li> <li>• Boardwalk for rail trail where old dump was</li> </ul>
Emergency response	<ul style="list-style-type: none"> <li>• HDC to have a plan for the next event</li> <li>• evacuation routes should be planned</li> <li>• early warning alert system helps people to prepare better and reduces stress e.g. new alert system available through power companies using power meters</li> <li>• council to give local fire service authority to use bulldozers directly after floods to reduce lost time</li> <li>• nominate person to oversee clean up using locals</li> <li>• funding package to be maintained by councils to respond to events</li> </ul>
Rural land (also see Drainage, stormwater, floodgates, waterways/stream, culverts category above)	<ul style="list-style-type: none"> <li>• reinstate natural floodplains and wetlands - low lying farms would become reserve land with floodgates able to be opened to large tidal events and take pressure off other areas</li> <li>• retire marginal farmland</li> <li>• diversify rural land to become more resilient</li> <li>• use local resources and strategies to manage risks of drought</li> </ul>
Other	<ul style="list-style-type: none"> <li>• keep and look after our birds and ecology - not for tourists but for the birds</li> </ul>

### Concerns/complaints/development ideas

Hauraki Rail Trail (HRT)	<ul style="list-style-type: none"> <li>• HRT susceptible to coastal inundation, already compromised and collapsing</li> <li>• make HRT safer for kids</li> <li>• rail trail stopbank not high enough</li> <li>• did local ratepayers pay for HRT?</li> <li>• HRT seats, tables BBQs, shade, dog management</li> </ul>
Drainage	<ul style="list-style-type: none"> <li>• culverts haven't been checked in 70 years</li> <li>• large culvert under the roadway between no's 1195 and 1194 delivers water to my property 1200 East Cast Rd</li> <li>• people have been allowed to fill in drains outside their houses that take surface water off the roads - increase risk</li> <li>• open/clear the stream by one way bridge at Miranda - urgent job</li> </ul>
Erosion	<ul style="list-style-type: none"> <li>• concerned that the no. of campervans at Rays Rest are compressing the shell banks, have watched this erosion from vehicles over many years</li> <li>• disappointed that shell material was levelled out/removed after 2018 event - to benefit campervans</li> </ul>
Roads	<ul style="list-style-type: none"> <li>• roads signs from Mangatangi turn off</li> <li>• add a footpath when new roadworks are done e.g. Kaihua School and Whakatiwai Point</li> <li>• reduce speeds of roads to 30km/hr - East Coast Road, road to Marae</li> <li>• Waharau bridge damage was handled very well</li> </ul>

	<ul style="list-style-type: none"> <li>• if rates are increased because of high repair costs for roads and bridges, they may become unaffordable for some</li> <li>• since the road was raised water flows off the road down our drive and under our house (15 Kaiaua Rd). Council staff were to address this - still no action</li> </ul>
Services/development	<ul style="list-style-type: none"> <li>• toilets at Domain not beachfront</li> <li>• Kowhai Ave - kerb and channel, street lights, footpaths</li> <li>• concrete bank at boat ramp</li> <li>• Doctor and Pharmacy for Kaiaua</li> <li>• provide suitable land for a decent café</li> <li>• Blue carbon farming</li> <li>• being able to trust regional council to follow up on actions regarding pollution</li> <li>• allow farmers to help themselves (digging out and clearing drainage) without objecting and fining them</li> <li>• mussel farms/increasing mussel farms will be a problem</li> </ul>
Other	<ul style="list-style-type: none"> <li>• major event estimate too low</li> <li>• council have decided what will happen and no amount of consultation will change their mind</li> <li>• council will do what iwi want so why bother to ask us</li> <li>• council will say they will do something and then nothing happens</li> <li>• much time and money is wasted on consultations</li> <li>• info in questionnaire is long, small print hard to read, language insufficiently concrete, glossary does little to help/very hard to understand and confusing</li> <li>• sooner things are started the better</li> </ul>

### Section of quotes

- *Rural-Coastal communities like this are part of the cultural landscape of New Zealand. Especially magic on this coast is the forest to the west and the sea to the east.*
- *Waharau is a small treasure of a place, sheltered by the hills from the Auckland light pollution, the night skies are spectacular. Tikapa is the soul.  
We live here to be by the sea and the forest, the awa, moana, ngahere.  
We are here to live WITH the forces these elements bring. Including floods, it is a part of the connection to the place.*
- *Our coast is very dynamic, our gravels move around - sometimes exposes us and sometimes protects us.*
- *It is not as if no one will live here if/when conditions get such that flooding become more frequent. It may just not be the same people.  
The world over people have moved with the tides - stability is not something to expect - especially not from nature.*
- *This is the first survey for our area. We have no Civil Defence plan; we have tired infrastructure; we have non maintained drainage; we have a river that we have had to pay for to get modified to ease flooding/not fix. We know we will have another event. We will stay here as long as we can because we choose to be here. Would be good if the rates we pay were spent in our area.*

## **Appendix B - Feedback on community risk threshold results**

The community risk threshold results were presented to the community panel at an online workshop on 28<sup>th</sup> September 2021 to seek feedback on whether they are an accurate representation of the communities' tolerance to natural hazard events. The purpose of this was to carry out a sense-check of the results, rather than a detailed review.

There were community panel member representatives for all sub-compartments but one – Kaiaua inland (2b). Following the presentation, the community panel broke into groups for each sub-compartment (Kaiaua inland (2b) was grouped with Kaiaua township (2a)), each with a technical advisory group (TAG) member to facilitate the discussion. The key points to seek feedback on were:

- Do the community risk threshold results make sense for the major and moderate event and the different impact categories?
- Do you agree with whether the community risk threshold has already been reached or not (for overall impacts)?
- Could the community possibly tolerate the moderate event impacts more often than the results indicate?
- For Pukekereru (4a) and Kaiaua inland (2b), can you fill the potential gap in/confirm the results?

The feedback has been summarised for each sub-compartment.

### **Waharau (5a)**

The panel member and joint working party (JWP) iwi representative from 5a agreed that for the major event, the 10-year ARP community risk threshold feels right. They also agreed that it's correct that the key driver of this is impacts to homes, properties and disruption to residents. They noted that the area has a large proportion of residents aged 70+ which informed this. They also noted that there are three subsets of the community who are all affected differently by different hazard events depending on the wind direction at the time; however, they felt the 10-year ARP threshold represented a good spread for all parts of the community.

For the moderate event, the panel member and JWP iwi representative felt that the threshold results were about right, but with some short-term action to achieve regular drain clearance, this would likely enable the community to tolerate the moderate event more frequently. They noted that the drains haven't been cleared since the community cleared them following the recent flood events,

They agreed that the community risk thresholds have not yet been reached for the major or moderate event.

They felt that the key influence for the major event is the sea, but that the main cause of the moderate event is land/river influenced.

### **Pukekereru (4a)**

The panel member from 4a felt that for the major event, the 50-year ARP community risk threshold for overall impacts (as a result of impacts to rural land) is incorrect, and it should more reflect the thresholds for homes, properties and disruption to residents and road access (5-year ARP). He felt that the impacts to rural land could be tolerated more often because most of the rural land is above the flooded area, the productive farmland is not heavily stocked (dry stock rather than dairy) and the stock can be moved to other parts of the far on higher ground.

The panel member agreed that there is no community risk threshold for the moderate event (including for rural land) because the impacts are relatively low, and people are prepared to tolerate these impacts. He

also agreed that the community risk thresholds have not yet been reached for the major or moderate event.

However, the community panel member noted that he mainly talked to coastal landowners who don't own rural farmland and that is why there weren't many threshold results for rural land.

The panel member noted that coastal erosion is the main issue for this area, which needs to be mitigated, including protecting the council reserve. He also commented that stream mouths need clearing before events and that Waihopuhopu Stream is eroding to the south. He said that the residents are resilient.

### **Whakatiwai (3a)**

The panel members from 3a were comfortable with all of the risk threshold results but one – the 20-year ARP for overall impacts from the major event. The panel members felt that a more appropriate community risk threshold for the major event would be a 10-year ARP as most places bounce back quickly. They suggested testing this with the wider community and stressed the need to understand the reasons behind this result – for example, rural land is a possible exception as it is a livelihood issue. They also suggested that the 20-year ARP result may reflect concerns relating to home insurance, rather than physical impacts (excesses in particular have massively increased in recent years, and insurance issues have been in the media a lot which is worrying people). *As a result of this feedback, and from reviewing the results, the overall impacts threshold for the major event has been changed from a 20-year ARP to a 10-year ARP.*

The panel members also agreed that the community risk thresholds have not yet been reached for the major or moderate event.

The panel members commented that people in Whakatiwai are generally much more concerned about river flooding which is regularly a problem, than about coastal inundation which they see as a low frequency/unlikely event. They also noted that new residents to the area (post-January 2018 event) were less likely to engage in this process.

### **Kaiaua township (2a)**

The panel members from 2a agreed that all of the community risk threshold results sounded about right. They also agreed that it is correct that the community risk threshold has already been reached for both coastal inundation and Huarahi Stream flooding, particularly because of the recent flood events. They don't think that the community could tolerate the moderate event impacts any more than the results indicate.

The panel members noted that new residents to the area often had a higher tolerance than long-time residents as they have not yet experienced a major flood event. They feel that residents who have experienced the past flooding events have had enough.

The panel members also think that the works on Huarahi Stream (carried out since the Huarahi Stream rapid flood hazard assessment that informed this exercise) may generally improve people's tolerance as they will reduce the severity and frequency of freshwater flood events. Panel members from other sub-compartments also agreed with this.

### **Kaiaua inland (2b)**

The panel members from 2a agreed that there was no community risk threshold for Huarahi Stream flooding in 2b because the impacts of both the major and moderate events are very low.

### **Pūkorokoro Miranda (1a)**

The panel member from 1a and HDC councillors agreed that the community risk threshold results are an accurate representation. They also agreed that the community risk threshold has already been reached for coastal inundation.

They noted that it is accurate that there is a lower tolerance for impacts to rural land, because:

- The land (in 1a) is largely rural and used for farming, it's important to their income and livelihood.
- Many farmers are intergenerational.
- People were very badly affected in the 2018 storm tide event, and some are still dealing with ongoing impacts, such as requiring lower stock numbers. There have been significant mental health impacts to mental health, as well as financial impacts.
- Despite this, the land has always been cheaper in this area and the owners always knew there were risks.

They also noted that people have a higher tolerance if an event doesn't affect their livelihood.

## **Appendix C - Calculating estimated time until risk thresholds reached**

### **Coastal inundation**

With projected sea level rise, the frequency of the major and moderate events will increase. NIWA has conducted analysis of the records from the tide gauge at Tararu which tells us how often the major and moderate events are currently estimated to occur (on average). Using this information, and sea level rise projections for New Zealand, NIWA has been able to estimate how long it will take to reach the risk thresholds set by the communities for the major and moderate event scenarios, i.e. when the major and moderate events are estimated to occur at the frequencies which are no longer tolerable to the community.

Because of uncertainties, there is a range of [climate change projections](#) (RCP scenarios). This means there is also a range in when the thresholds are estimated to be reached. The results presented in the tables use the RCP 8.5 scenario (continuing high carbon emissions) so are relatively conservative.

### **Hauarahi Stream flooding**

For Hauarahi Stream flooding, the major event scenario is currently a 100-year ARP and the moderate event scenario is a 5-year ARP. Therefore, if the community can only tolerate impacts from the major event every 100 years or less often, or from the moderate event every 5 years or less often, then the community risk threshold for each event has already been reached or exceeded. If they can tolerate the impacts more often then the thresholds have not yet been reached.

It's more difficult to estimate into the future when thresholds for stream flooding will be reached factoring climate change. However, the impacts of coastal inundation are expected to far eclipse those from Hauarahi Stream flooding.

## Appendix D – Quantitative results tables

### Risk thresholds and tolerance

ARP	200yr	100yr	75yr	50yr	20yr	10yr	5yr	2yr	1yr	6m	2.4m	no threshold
Classification	v. low	low	low	medium	medium	high	high	high	high	high	v. high	NA (not assessed)

### Risk thresholds for the major event:

		Sub-compartments (community risk thresholds)							Project area (risk thresholds assessed by asset & emergency managers)			
	Sub-compartment	Homes, properties & disruption to residents	Rural land	Road access	Services	Recreation & tourism	Overall impacts	Roads & bridges	Stormwater & stopbanks	Recreation & community facilities	Civil defence/HDC emergency response	
Coastal Inundation	5a	10	2	5	5	1	2	10	20	0.5	5	20
	4a	5	5	5	NA	no threshold	5					
	3a	10	10	10	10	10	10					
	2a	50	20	50	50	20	50					
	1a	50	75	20	NA	10	75					
Hauarahi Stream	2a	50	20	20	50	20	50	? (unable to assess)	0.25	5	5	
	2b	NA	no threshold	NA	NA	NA	no threshold					

### Risk thresholds for the moderate event:

		Sub-compartments (community risk thresholds)							Project area (risk thresholds assessed by asset & emergency managers)			
	Sub-compartment	Homes, properties & disruption to residents	Rural land	Road access	Services	Recreation & tourism	Overall impacts	Roads & bridges	Stormwater & stopbanks	Recreation & community facilities	Civil defence/HDC emergency response	
Coastal Inundation	5a	NA	1	1	NA	0.5	2	10	0.5	2	5	
	4a	NA	no threshold	no threshold	NA	no threshold	no threshold					
	3a	NA	5	2	NA	5	5					
	2a	10	10	10	10	5	20					
	1a	10	20	5	NA	5	20					
Hauarahi Stream	2a	10	5	10	10	10	20	? (unable to assess)	0.25	1	0.5	
	2b	NA	no threshold	NA	NA	NA	no threshold					

## Estimated time until risk thresholds reached

Coastal inundation:	Hauarahi Stream flooding:
reached	reached/exceeded
v. short (0-10 years)	not reached
short (10-30 years)	NA - where no threshold has been assessed
medium (30-50 years)	
long (50-70 years)	
v. long (no threshold)	
NA - where no threshold has been assessed	

The RCP 8.5 climate change scenario has been used for the results presented in the following tables.

### Estimated time until risk thresholds reached for the major event:

Sub-compartments (community risk thresholds)								Project area (risk thresholds assessed by asset & emergency managers)			
	Sub-compartment	Homes, properties & disruption to residents	Rural land	Road access	Services	Recreation & tourism	Overall impacts	Roads & bridges	Stormwater & stopbanks	Recreation & community facilities	Civil defence/HDC emergency response
Coastal Inundation	5a	55	62	59		65	62				
	4a	59	59	59	NA	no threshold	59				
	3a	55	55	55		55	55				
	2a	44	51	44		44	51				
	1a	44	41	51	NA		55	41	51	68	59
Hauarahi Stream	2a	not reached	not reached	not reached	not reached	not reached	not reached	? (not assessed)	not reached	not reached	not reached
	2b	NA	no threshold	NA	NA	NA	no threshold				

When threshold is expected to be reached classification (coastal inundation only) (using RCP 8.5):

RL 3.0 m (MVD-53) (major)												
ARP	200yr	100yr	75yr	50yr	20yr	10yr	5yr	2yr	1yr	6m	2.4m	
Year	2053	2060	2062	2065	2072	2076	2080	2083	2086	2089	2093	
Years from 2021	32	39	41	44	51	55	59	62	65	68	72	

### Estimated time until risk thresholds reached for the moderate event:

Sub-compartments (community risk thresholds)								Project area (risk thresholds assessed by asset & emergency managers)			
	Sub-compartment	Homes, properties & disruption to residents	Rural land	Road access	Services	Recreation & tourism	Overall impacts	Roads & bridges	Stormwater & stopbanks	Recreation & community facilities	Civil defence/HDC emergency response
Coastal Inundation	5a	NA	17	17	NA	22	13				
	4a	NA	no threshold	no threshold	NA	no threshold	no threshold				
	3a	NA	7	13	NA	7	7				
	2a	2	2	2	2	7	reached				
	1a	2	reached	7	NA	7	reached	2	22	13	7
Hauarahi Stream	2a	exceeded	reached	exceeded	exceeded	exceeded	exceeded	? (not assessed)	not reached	not reached	not reached
	2b	NA	no threshold	NA	NA	NA	no threshold				

When threshold is expected to be reached classification (coastal inundation only) (using RCP 8.5):

RL 2.4 m (MVD-53) (moderate)												
ARP	200yr	100yr	75yr	50yr	20yr	10yr	5yr	2yr	1yr	6m	2.4m	
Year	now	now	now	now	now	2023	2028	2034	2038	2043	2049	
Years from 2021	0	0	0	0	0	2	7	13	17	22	28	