Infrastructure strategy: Flood protection and control Rautaki Hanganga

Overview

This strategy has been prepared for flood protection and control works infrastructure as required under the Local Government Act 2002, section 101B. The Local Government Act (LGA) 2002 Amendment Act 2014 included provisions that require councils to prepare an infrastructure strategy for at least a 30-year period, and to incorporate this into Long-Term Plans. The purpose of this strategy is to:

- Identify significant infrastructure issues over the period of this strategy
- Identify the principal options for managing those issues, and the implications of those options
- Outline how the regional council intends to manage its flood protection and control assets, and what the most likely scenario is for the management of these assets.

This strategy presents a 30-year plan for the regional council's flood protection and control assets. It will help us make informed decisions in the short term that will position us to deal with the major decisions and investments that will occur in the next 10 to 30 years.

The Northland flood scheme infrastructure currently comprises three main flood management schemes: The Awanui flood scheme, Kāeo-Whangaroa flood scheme, and in Whangārei, the Hopua te Nihotetea detention dam. These three schemes have a combined asset value of $22.7 million. Relative to other regions, flood infrastructure managed by the council is limited, but in response to demand, this infrastructure strategy provides for new flood schemes.

The Whangārei and Kāeo-Whangaroa flood schemes have been constructed in the last five years and the assets are relatively new. Recent maintenance has been done on the main Kāeo stopbank to top up the crest level following initial settlement, but we anticipate that maintenance on these new assets over the period of this infrastructure strategy will be limited. New capital expenditure is planned to extend both the Kāeo-Whangaroa and Whangārei flood schemes within the first ten years of this strategy.

The Awanui flood scheme is a much older scheme, and its assets are variable in age and condition. This scheme is also much more extensive than the other two schemes, in terms of length of stopbanks and spillway, and number of floodgates that the council has responsibility for. Maintenance and renewal costs are significantly higher for the Awanui flood scheme. A review of the Awanui flood scheme identified a number of major upgrades that are likely to be required, and which are included in this Infrastructure Strategy as well as other financial planning included in this Long Term Plan.

There are a number of new areas where flood scheme works are to be implemented, including the Kerikeri–Waipapa catchment, and other smaller settlements including Panguru and Matangirau. Historically, it has been a challenge to implement significant works in areas of low population due to the limited rating base for a targeted rate. The approach to the funding of flood scheme works in Northland is being reviewed, as in many cases, there are broader regional benefits from flood infrastructure, which extend beyond the local community.

Northland context

Northland is a long, narrow peninsula with a subtropical climate. It has a land area of 13,286 km^2, of which 526 km^2 is classified as alluvial and estuarine plains and low terraces, much of which is prone to flooding. Over 50% of the land is in pasture and 10% in forests. Northland's coastline is 3,127 kms (mainland), and a high proportion of the population live in coastal settlements, including the main urban centres of Whangārei and Dargaville. The region therefore has a relatively high exposure to potential sea level rise and future coastal inundation, and this is clearly shown in the council's coastal flood hazard maps.

River flooding provides the highest natural hazard risk to the Northland region because of the extensive development on floodplains and the region's exposure to high intensity rainfall events. River flooding affects many of Northland's main urban centres, including Whangārei, Dargaville, Kaitāia, and Kerikeri-Waipapa, and many of the smaller townships. It presents a risk to human life, disrupts communications and access, damages property and infrastructure, including the productivity of farmland. River flood hazard has been mapped for the major urban centres as well as a number of rural catchments.

Demand assumptions

Unlike a number of the other infrastructure types, the demand for flood protection and control works is not directly related to population growth. Instead, demand is driven by:

- The geographical extent of population centres and assets sited within floodplain areas
- Public perceptions of flood risk, and acceptable levels of flood risk
- Population density within at-risk areas, which has a bearing on level of service expectations.

Future demand for flood protection works can be reduced via alternative interventions such as land use planning, managed retreat from at risk areas, and investment in improving the resilience of assets located within at risk areas. Effective land use planning requires at risk areas to be mapped with some precision. The council has commissioned a land information LIDAR (Light Detection and Ranging) survey across the whole region, which will enable flood risk to be comprehensively mapped, across all catchments, and around the coast. Current flood mapping is based on LIDAR surveys done since 2003, which covers only 16% of the region. The coastal flood hazard mapping clearly shows the impact of projected sea level rise over 50 and 100 years.

We consider that population growth within floodplains is unlikely to make a significant difference to the funding basis of flood schemes, or on the demand for services over the time frame of this strategy, especially in rural areas. This is primarily due to improved land use planning, based on more accurate flood mapping. However, the identification of flood risk areas across the whole region, including areas which may be affected by future climate change, does have the potential to change public perception of flood risk. If sea level rise becomes evident to the public, public demand for flood protection works in coastal areas is likely to increase significantly over the time frame of this strategy.

In 2008 we identified 26 river catchments where we considered the risks from river flooding were highest to communities and essential infrastructure throughout Northland[1]. The rivers and streams in these priority catchments pose potential threats to life, buildings, road access, infrastructure and agriculture. River management plans were developed for these 26 catchments which documented the potential flood risks and identified mitigation options in order to reduce the impacts of flooding. Our focus has now moved towards implementation of river management plans with communities, and this is reflected in the capital works programme put forward in this strategy.

In many cases it is not physically possible, nor affordable, to provide communities with total protection from flooding in Northland. In this context, we work with communities to identify and map at risk areas, develop community response plans, issue flood warnings and carry out minor river works to reduce flood risks.

Vision for the community over the next 30 years

The overall vision for this strategy is to progressively reduce the flood risk to defined and achievable levels of service, in a cost-effective manner, and in consultation with the public. This includes effective prioritisation of flood protection and control interventions based on an updated region-wide overview of flood risk.

A starting point for this vision is the assumption that if no intervention was made, existing levels of service would gradually reduce due to asset deterioration, and projected climate change effects.

When looking ahead, we expect that flood protection will be a major activity for us. The vision includes pro-active consultation and planning to put in place strategies and structures which will endure well beyond the time frame of this strategy.

Overview of flood protection assets

Existing flood protection infrastructure

At the current time, we have flood control infrastructure in place to reduce flood risk in three scheme areas:

- Awanui flood scheme (asset value of $11,118,670)
- Kāeo-Whangaroa flood scheme (asset value of $882,778)
- Hopua te Nihotetea detention dam, part of the Whangārei urban rivers flood scheme (asset value of $10,735,055)

Details of each scheme are shown in the following table.

1 *The Priority Rivers Flood Risk Reduction Project*

Summary of existing flood protection infrastructure

	Awanui flood scheme	Kāeo-Whangaroa flood scheme	Hopua te Nihotetea (Whangārei urban rivers flood scheme)
Total value of assets	$11.1 million	$883,000	$10.7 million
Condition of assets	Good to average.	Excellent	Excellent
Types of assets	89km of stopbanks and 141 floodgates	900m of stopbanks, 160m of floodwall and 4 floodgates	18m high detention dam which can hold up to 1.27 million cubic metres of floodwater
Quality of asset information	Excellent to good, further work required on coastal stopbank condition assessment	Excellent	Excellent
Age of assets	Floodgates: average age 35 years Stopbanks: varies, majority constructed prior to 1970	All assets newly constructed in 2013/14	All assets newly constructed in 2014/15
Depreciation (2018/19)	Depreciated replacement cost (DRC). Depreciation calculated as $51,266 per annum	DRC. Depreciation calculated as $6,333 per annum.	DRC: Depreciation calculated as $34,639 per annum.
Level of service objective (flood protection)	Urban areas: 1:100yr Rural areas: 1:20yr	Township: 1:20 year.	Urban central business district (CBD): 1:50 year.
Current Level of Service	Urban Kaitāia: Awanui: 1:100 year Tarawhataroa: 1:30 year Rural areas: Variable, Low end < 10 year average recurrence interval (ARI)	Township: 1:10 year.	Urban CBD: 1:20 year.
Performance information	Scheme has performed well, and save for the July 2007 flood, has successfully prevented flooding of the Kaitāia town centre since scheme works were completed in the 1960's. In July 2007 the Tarawhataroa stopbank was over-topped by Awanui River overflow, which resulted in flooding of the southern part of the town centre.	Scheme has performed in accordance with design, as demonstrated during July 2014 flood. The July 2014 flood was less than a 1:10 year event at Kāeo.	Scheme has performed in accordance with design, during minor storm events in 2017. The extent of the design 50 year ARI has been significantly reduced in the CBD, due to the detention dam, and other works completed since 2012.

Awanui flood scheme

The key levels of service for the Awanui flood scheme are contained within the scheme Asset Management Plan, including specific details on how we renew or replace our existing assets. Recent upgrades to the flood scheme include the Whangatane Spillway Intake modification works completed in 2016, and the Awanui River channel re-profiling at the "choke", immediately downstream of the Whangatane spillway intake, which was completed in 2017.

Level of service

The level of service objective is for 1:100 year river flood protection in urban areas, and 1:20 year river flood protection in rural areas. This objective is not currently achieved. This Long Term Plan has adopted option 1 for urban Kaitāia, which is to meet the level of service objective, including 1:100 year flood protection for both the Awanui River and the Tarawhataroa Stream.

Managing assets

The Awanui flood Scheme Asset Management Plan contains the details on the life cycle maintenance of the scheme assets. Renewal of floodgates and maintenance of stopbank assets is scheduled to be undertaken prior to the end of expected life, which is assessed through the annual condition monitoring process. Renewal prior to failure (beyond anticipated design life) is considered to be the most cost effective and efficient approach for the floodgate assets when viewed in association with the asset management plan risk framework. Stopbanks are maintained in perpetuity.

Kāeo-Whangaroa flood scheme

The key levels of service for the Kāeo-Whangaroa river scheme are contained within the scheme asset management plan, including specific details on how we renew or replace our existing assets.

Level of service

The level of service objective is for 1:20 year river flood protection for the Kāeo Township. This objective is not currently achieved.

The completed Stage One of the Kāeo-Whangaroa flood scheme was designed to prevent high velocity floodwaters from the Kāeo River flowing through the township by the use of a series of deflection stopbanks that divert river floodwater to the south of the township. Whilst the Kāeo stopbanks are designed to be above the 1:100 year flood level, the township is still exposed to flooding from the Waikare Creek as well as from backwater from the Kāeo River. This Long Term Plan includes implementation of Stage Two of the Kāeo flood scheme, which seeks to mitigate flood risk from these two sources, and in so doing, achieve the level of service objective. Other Kāeo-Whangaroa river works to be implemented under this Long Term Plan include the construction of a new floodway at Matangirau.

Managing assets

The Kāeo Stage One works were constructed in 2013/14. In 2017 the western section of the main stopbank number two was topped up as settlement had been identified from a monitoring survey. It is assumed that no renewals expenditure will be required to the constructed assets over the 30-year timeframe, as these are newly constructed assets and their design life (before renewal is required) is expected to exceed the 30-year timeframe of this plan. The most likely period for settlement of the stopbanks is in the first three years following construction, and it is therefore considered that settlement issues have now been identified and addressed. As a consequence, we have made no provision during the 30 year time frame of this strategy for further topping up of the stopbanks.

Hopua Te Nihotetea detention dam (Whangārei urban rivers flood scheme)

The key levels of service for the Hopua te Nihotetea (Kotuku Street) detention dam is contained within the Kotuku Dam Asset Management Plan, including specific details on how we renew or replace our existing assets.

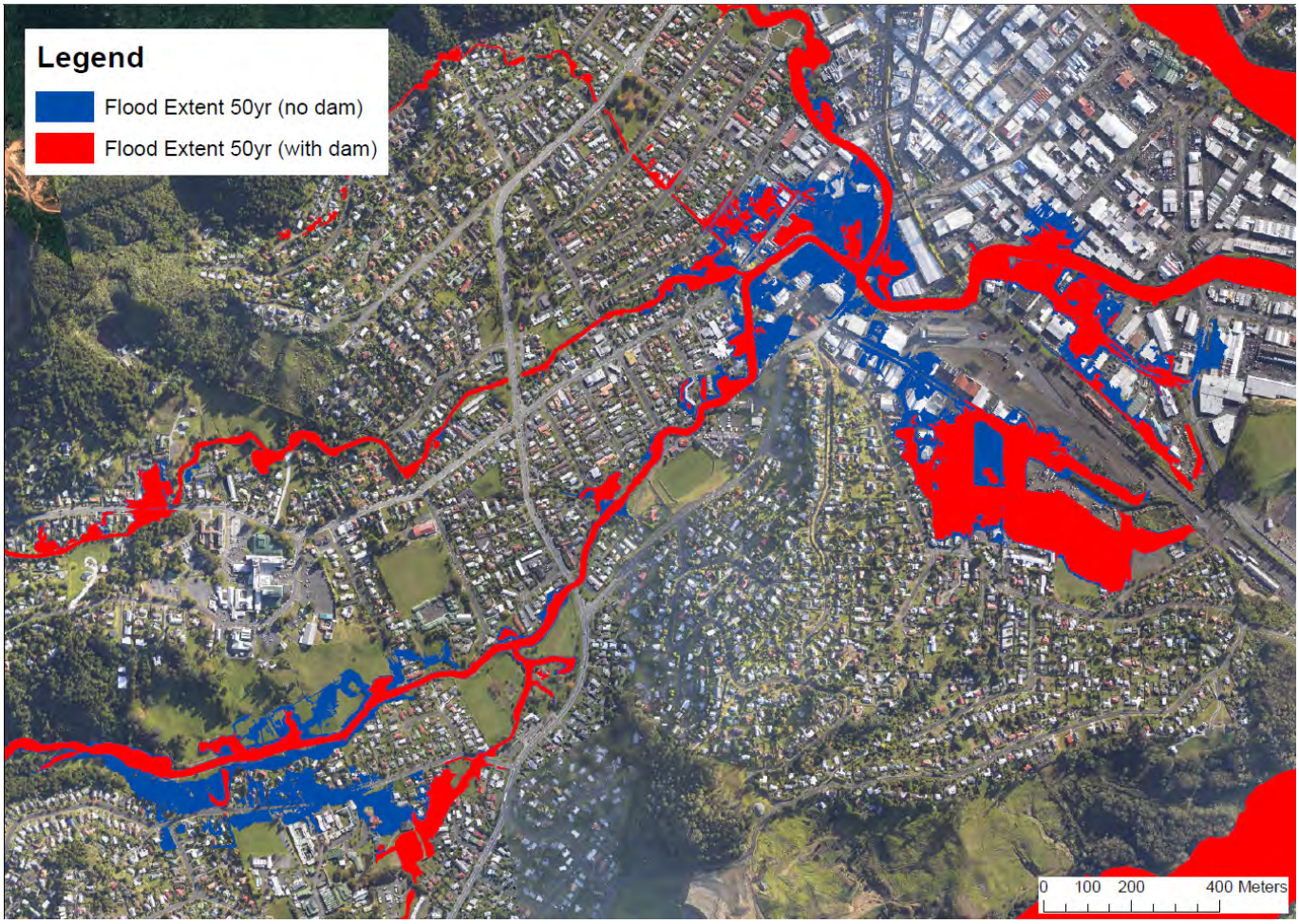
Level of service

The level of service objective is for 1:50 year river flood protection for the Whangārei CBD.

The Hopua te Nihotetea dam is designed to detain water for up to the 1:100 year flood with an allowance for climate change and freeboard. The dam slowly releases detained flood waters over several days and reduces the peak flood levels in the Whangārei CBD. The detention dam has brought closer achievement of the level of service objective for the CBD, and has largely achieved the level of service objective for the Raumanga Valley Road area. Works options outlined in 'Significant decisions about capital expenditure' for Whangārei CBD are anticipated to enable achievement of the level of service objective for the main stream channels.

Note that the figure below does not show the impact of the new Limeburners Stormwater overflow channel draining Morningside, nor the Rust Avenue Bridge upgrade.

Impact of the 'Hopua te Nihotetea' detention dam of the 1:50yr flood extent in the CBD



Managing assets

We do not anticipate that the Hopua te Nihotetea dam assets will require significant renewal or replacement expenditure in the first 30 years of operation (having been constructed in 2014/15). When we obtain further information through annual condition monitoring of the dam assets, we will make adjustments to forecast renewal expenditure.

Significant issues, options and implications

The most significant high level strategic issues facing our flood protection and control infrastructure are outlined in 'Strategic overview of issues and options for flood protection assets' below, with options to address them. These issues also apply more broadly around Northland, and not just to existing flood scheme areas. Decisions over specific works options for existing and proposed flood schemes are outlined in 'Significant decisions about capital expenditure'.

Strategic overview of issues and options for flood protection assets

Issue	Issue summary	Principal options	Implication of options	Preferred option
Climate change	If climate change projections are realised, protecting flood plains and low lying coastal areas will become less sustainable and more expensive over time. Levels of service associated with flood protection assets will gradually reduce and public demand for protection will be likely to increase	Protect	Depending on the context, may be a preferable short to medium term approach but costs will gradually increase over time, especially for coastal areas vulnerable to sea level rise. Drainage of storm water will eventually require pumped systems. There are also risks associated with intensification of development in protected areas.	The preferred option is likely to be location and context specific. The various options may each be suitable for different areas. Consultation and planning is required to develop adaptation strategies with various stake holders.
		Retreat	There is potential for managed or unmanaged retreat from at risk areas. The main implications are loss of land or development potential, and likely expectation for compensation. Land use planning to regulate new development is a first step in a retreat strategy.	
		Accommodate	Lower intervention strategy means lower initial cost. Gradual adaptation over time through more resilient buildings and infrastructure. Requires acceptance of reducing levels of service over time.	
Renewal / replacement of assets	Aging assets will require renewal or replacement at end of design life. This is primarily an issue for the Awanui flood scheme, as Kāeo and Whangārei assets are relatively new.	Renewal at end of design life to design standard/level	Depends on design standard but likely to result in reduction of level of service over time. Short term saving relative to other options.	The Kaeo and Whangārei flood schemes require no renewal or replacement over next 30 years. Awanui flood scheme assets are being renewed at or near end of design life. Stopbank re-alignment is preferred to
		Renewal at end of design life with upgrade to maintain or increase level of service.	Maintains level of service for a finite period of time but without flexibility to re-configure areas to be protected to achieve efficiencies.	
		Replace with alternative structure, including potential relocation of asset.	Consistent with a managed retreat option from areas that have highest residual risk, and are more expensive to defend. High initial cost due to asset relocation and lost land. Opportunity to set back stopbanks and create wider flow paths to raise level of service.	

Issue	Issue summary	Principal options	Implication of options	Preferred option
				provide for wider floodways.
Demand for services	Demand for services likely to increase due to region wide mapping of flood risk. Increased demand is anticipated if/when climate change effects become readily apparent.	Limit increase in demand by identifying at risk areas, and promote regulatory approach to risk avoidance (over at least 100 years) for new development.	Not directly related to management of flood protection assets, but critical to limiting increase in future demand.	Limit increase in demand through land use planning and respond to existing demand and anticipated future demand by expanding number of flood protection schemes, and extent of existing schemes.
		Limit number of schemes, and extent of existing schemes.	Fails to meet current demand, or anticipated increase in demand. Lower flood scheme cost but higher flood damage cost.	
		Increase number of schemes, and extent of existing schemes.	Responds to current demand, and anticipated increase in demand. Higher flood scheme cost is likely to require adjustment to rating policy to make works more affordable. Flood damage cost minimized.	
Levels of service (existing schemes)	Levels of service are not always well defined or met. Actual level of service from existing assets is likely to reduce over time due to climate change impacts and geomorphological changes such as channel migration and flood plain accretion.	Upgrade existing assets in the Awanui flood scheme to meet current levels of service. No change for Kāeo or Whangārei.	Limited initial cost, primarily for Awanui flood scheme, to meet current intended levels of service. Note that considerable cost will still be required to ensure resilience of Awanui assets (see below).	Upgrade and expand assets for existing flood schemes to meet target levels of service.
		Upgrade and expand assets. Raise levels of service to: Rural: 1:20 year Urban: 1:50 year – 1:100 year	Awanui: Requires considerable investment to reduce flood risk to urban Kaitāia down to 1% probability in any year. Achieving this Level of Service requires re-routing flood flow through Kaitāia, including upgrade of Whangatane spillway. Whangārei and Kāeo require additional works downstream of existing assets to raise level of service to protected urban areas.	
Public health and environmental outcomes	Flood schemes are required to prevent or reduce public health and environmental impacts associated with flood events.	Implications and principal options not clear until the regulation or information is made available. Presumption is that flood protection	Complying with new requirements is likely to incur a cost. Non- compliance is likely to incur a liability risk, however there should be a grace period over which compliance with new requirements can be achieved.	Comply with new requirements in a cost-effective manner

Issue	Issue summary	Principal options	Implication of options	Preferred option
	Levels of service and resilience for scheme assets is likely to be affected by new regulation such as a National Policy Statement for Natural Hazards, and the outcomes from Public Enquiries (such as into Edgecumbe flooding of April 2017).	assets will need to comply with any new requirements.		
Resilience of infrastructure	Resilience of flood protection infrastructure may be compromised due to structural failure, or higher flow and flood level resulting from climate change.	Maintain assets to design standard.	New scheme works at Whangārei and Kāeo are designed to be resilient over the next 100 years.	Implement measures to safe guard resilience of flood channels that protect urban areas.
		River channel banks through urban Kaitāia require targeted toe protection to ensure bank stability.	Estimated cost of approximately $7.9 million to complete Kaitāia river bank stabilisation works, and Bells Hill slip remediation works. Potential liability risk if these works are not completed.	

Recurrent themes in the preceding table are the affordability and resilience of assets, and uncertainty associated with current and future flood risk.

Affordability relates to the ability to be able to continue to invest in the maintenance, renewal and upgrade of infrastructure, and depends on the condition of the assets, what increases in service level are required, and the ability of ratepayers to fund the works. We will continue to strive to ensure that the flood protection and control works are affordable by providing options that can be sustained on both a financial and an operational basis. This may mean that the levels of service may be maintained at the current level and it may not generally be possible to provide complete protection from flooding given funding constraints. Funding policies have been reviewed for flood scheme works, and under this Long Term Plan a newly adopted Flood Infrastructure Rate will fund 70% of qualifying capital works on flood schemes to reduce the burden on the local targeted rate.

Ensuring our infrastructure assets are resilient in the face of future natural hazards is important in continuing to protect our communities in flood prone areas. Flood scheme works implemented since 2010 have been designed to be resilient in a 1:100 year event, and allowing for climate change effects in line with Ministry for the Environment guidance to Local Government (2008). This measure of resilience for flood protection assets should not be confused with the level of protection afforded by the assets, as the latter is often lower, as shown in the preceding table "Summary of Flood Protection Assets".

While we have modelled flood risk and gained an understanding of the risk profile, a degree of uncertainty remains. Flood plains and river channels are dynamic and it is not possible for us to model all potential storm profiles and flood scenarios, including the potential for structural failure of flood protection assets, and long term accretion of floodplains. We will need to continue to monitor storm events and their effect on scheme assets and settlements located in the flood plain to update our understanding of levels of service and asset resilience. Climate change effects are currently predicted to fall within a wide range, and it is likely that over the course of the next 30 years, climate change projections will be refined, resulting in greater certainty. This will facilitate the design process, especially in relation to the timing of replacement or upgrading of affected scheme assets.

Management of future flood protection works

Significant decisions have been made on management of flood protection works in Northland, including over which new flood schemes to construct, and which existing schemes should be expanded or upgraded to increase level of service.

Significant decisions about capital expenditure

A timeline of new flood infrastructure projects, including upgrades to existing schemes, is shown in the following image. Decisions made for this Long Term Plan on upgrades to the three existing flood schemes and two new flood schemes are laid out in the table below. The timing of future decisions required for these flood schemes is also identified.

As can be seen from the time line below, work on all five of the flood schemes is planned to be undertaken within the period of the Long Term Plan 2018-2028, and therefore a number of major decisions in relation to this Infrastructure Strategy have been taken by council following consultation on the proposed Long Term Plan.

This Infrastructure strategy includes a capital works programme of up to $24.43 million. A substantial part of this budget is for planned upgrades to the Awanui flood scheme, which accounts for up to $19.2 million (79%) of the total capital works in this strategy.

Proposed funding methods

New capital expenditure includes investment in new infrastructure for the existing Kāeo-Whangaroa, Whangārei and Awanui flood schemes. Additionally, two new flood schemes are proposed over the planning time frame for this Infrastructure Strategy. The new infrastructure for the Kāeo-Whangaroa flood scheme is to be located at both Kāeo at Matangirau.

Flood control schemes have historically been funded from targeted rates collected over the properties that are within the defined catchment area of each scheme. Funding for large capital works projects has been borrowed from the council and repaid over a set period from the revenue received from targeted rates. Occasionally these works also receive grant subsidies from central government.

Under this Long Term Plan a Flood Infrastructure Rate has been adopted so that new qualifying capital works for flood protection will receive at least a 70% subsidy.

The remaining 30% will be collected from the local targeted rate, which will also be used to cover all on-going operational and maintenance costs of each scheme. For Panguru, the planned capital works are to be 100% funded from the Flood Infrastructure Rate, as the affected community has an insufficient rating base to justify collection of a local rate.

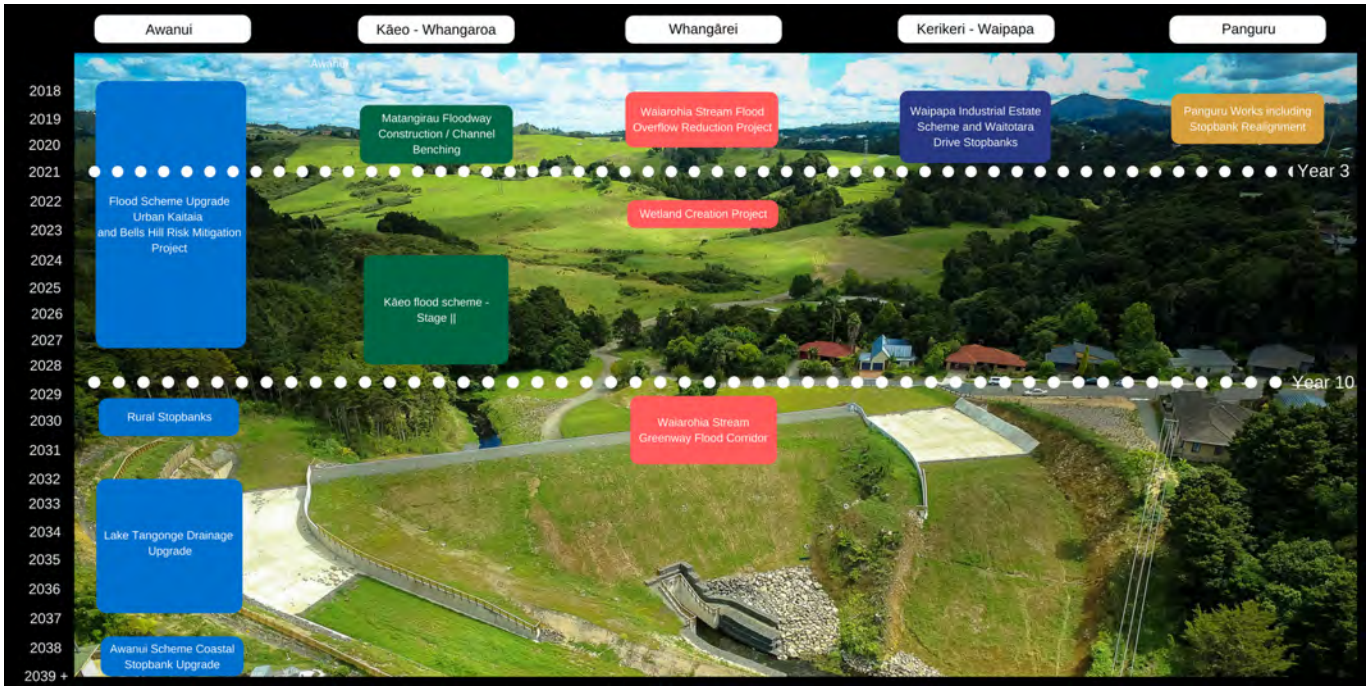
The new Flood Infrastructure Rate is levied at a region-wide level to address priority areas such as the Kaitāia urban area, and for smaller settlements with a significant flood risk but low rating base. The region-wide flood infrastructure rate funds all of council's wider flood management activities. The component of the rate that funds new capital works is $6.94 inclusive per SUIP per year, and was adopted by the council following consultation as part of the Long Term Plan 2018-2028 process.

A number of criteria apply to new work to be part-funded by the flood infrastructure rate. These criteria were adopted in this Flood Infrastructure Strategy and apply to the 2018/19 year and every year following unless otherwise resolved by decision of council.

- The work must take place in an area that has been identified as a priority rivers area. This currently includes 26 rivers and catchments where priority has been allocated on the basis of flood risk to lives, buildings, road access, infrastructure and agriculture.
- The new rate would fund work for high risk urban or residential areas only, with protection schemes for farmland alone excluded.
- There must be demonstrable community support for the works.
- Funding would only apply to new capital work, with any operational work required funded by targeted rates.
- The new rate would fund 70% of the cost of work where the total cost is $500,000 or more, with the balance of the work funded from targeted rates on the area.

In areas where proposed capital works will cost less than $500,000, and it is not practicable to establish a targeted rate, the new flood infrastructure rate will fund 100% of the cost of the flood works. It may not be practicable to establish a targeted rate where there are less than 1,000 rating units, where the benefits of the flood works are limited to a very small area, or where the rate to be collected would amount to less than $100,000 a year.

Time line of projected flood infrastructure projects (Background photo of Hopua te Nihotetea Detention dam, Whangarei)



Significant decisions about capital expenditure

Flood scheme	Major works options	Estimated capital expenditure	Year/s for works	Decision required by
Awanui flood scheme Urban Kaitāia	Option 1: Urban Kaitāia (Council has adopted Option 1) Urban Kaitāia resilience upgrade with level of service upgrade for urban areas to 100 year average recurrence interval (ARI) event: River bank protection works for high and medium risk channel sections, Bells Hill slip remediation works, and re-routing of flood flow through Kaitāia to Whangatane Spillway.	Upgrades to Whangatane Spillway and urban Kaitāia river channels, including rock protection. New flow diversion spillways upstream of Kaitāia. Total resources: $15.0 million	2018 - 2027 (LTP years 1-9)	LTP 2018 (Decision made)
	Option 2: Urban Kaitāia River bank protection works for high and medium risk channel sections through Urban Kaitāia, with Bells Hill slip remediation works.	Total resources: $7.9 million	2018 – 2026 (LTP Years 1-9)	LTP 2018 (Decision made)

Flood scheme	Major works options	Estimated capital expenditure	Year/s for works	Decision required by
Awanui flood Scheme Rural and coastal	**Rural scheme upgrade** to achieve 20 year ARI flood protection (level of service objective).	Rural stopbanks: $622,000 **Total resources: $622,000**	2028 – 2030 (LTP years 11–13)	LTP 2027
	Rural scheme upgrade Lake Tangonge drainage upgrade to reduce risk of contamination events associated with drainage of de-oxygenated flood water to the Awanui River, which causes fish die off.	New 2nd flood gate and channel: $500,000 New lake outlet to Waipapakauri drain, and drain upgrade 5kms: $640,000 **Total resources: $1.14 million**	2032 – 2037 (LTP years 15–20)	LTP 2030
	Rural scheme renewal Renewal of existing major flood gates (Waihoe and Oinu gates)	**Total resources: $300,000**	2038 – 2040 (LTP years 21–22)	LTP 2036
	Option 1: Coastal stopbanks Increase coastal stopbank crest levels to defend against potential 0.4m of sea level rise over 50 years.	Coastal stopbanks (2.4 metres Reduced Level): **$1.87 million** Note: will require re-assessment once all coastal stopbanks have been surveyed.	2041 – 2047 (LTP Year 23–29)	LTP 2039
	Option 2: Coastal stopbanks Increase coastal stopbank crest levels to 20 year ARI storm surge and defend against potential 1.0m of sea level rise over 100 years.	Coastal stopbanks (3.0 metres Reduced Level): **$2.15 million** Note: will require re-assessment once all coastal stopbanks have been surveyed.	2041 – 2047 (LTP Year 23–29)	LTP 2039
Kāeo – Whangaroa flood scheme	**Kāeo-Whangaroa flood scheme** Adjusted Stage Two works: • Waikare Creek widening (350m) • Kāeo River re-alignment (600m) • Deflection bank number four extension (500m). The works are to further reduce flood risk and flood level in the Kāeo township.	Waikare Creek widening: $150,000 Kāeo River re-alignment: $450,000 Deflection bank number four extension: $150,000 **Total resources: $750,000**	2024 – 2028 (LTP Year 8–10)	LTP 2024 (Decision made LTP 2018)
	Matangirau flood scheme Floodway (1.5 km), including 1km upstream of Wainui Road and 500m downstream.	Flood way construction / channel benching: **Total resources: $400,000**	2019 – 2021 (LTP years 2–3)	LTP 2018 (Decision made)

Flood scheme	Major works options	Estimated capital expenditure	Year/s for works	Decision required by
Whangārei flood scheme	**Hopua te Nihotetea detention dam basin wetland project** Fencing and planting, earthworks to reduce land levels to create wetland and improve the amenity of the reserve upstream of the dam.	**Total resources: $50,000**	2022/23 (LTP year 5)	LTP 2021 (Decision made LTP 2018)
	Whangārei CBD level of service upgrade to 50 year ARI flood protection. **Total resources: $3.3 million**	Lower Waiarohia Stream flood overflow reduction to protect Commerce Street. **Total resources: $950,000**	2018 – 2020 (LTP years 1–2)	LTP 2018 (Decision made)
		Waiarohia Stream greenway flood corridor (Rust Avenue to Lower Tarewa Road). **Total resources: $2.15 million**	2028 – 2032 (LTP years 11–14)	LTP 2027
		Wharowharo Stream re-alignment at Carruth Park including drop structure. **Total resources: $150,000**	2032 – 2033 (LTP years 14–15	LTP 2030
Kerikeri / Waipapa flood scheme	Waipapa Industrial Estate Flood Protection including rerouting and containing of Kerikeri River Overflow *and* Waitōtara Drive stopbanks (part of original Kerikeri River flood scheme)	Waipapa Industrial Estate scheme works: $200,000 Waitotara Drive stopbanks: $140,000 **Total resources: $340,000 (within existing reserve)**	2018 – 2021 (LTP years 1–3)	LTP 2018 (Decision made)
Panguru flood scheme	**Panguru floodway** Whakarapa Stream works (widening) downstream of West Coast Road (200m). Te Rapa Stream benching left bank upstream of Tautoro Road (200m). Stopbank re-alignment downstream of Tautoro Road right bank (1km). Stream bank re-profiling (lowering to 2.3m OTP) downstream of Otengi Road - left bank (300m).	Stopbank re-alignment: $280,000 Stream channel benching: $120,000 Stream bank re-profiling $40,000 **Total resources: $440,000**	2018 – 2020 (LTP years 1– 2)	LTP 2018 (Decision made)

Proposed levels of service following future works

Awanui flood scheme:

A decision has been made to adopt Option 1 for flood protection of Kaitāia urban area. This includes the asset resilience upgrades for Urban Kaitaia included under option 2 ($7.9 million), as well as increasing the level of service for flood protection of the CBD ($7.1 million). The most significant flood risk to the CBD is from over-topping of the Tarawhataroa Stream stopbanks. This results not solely from Tarawhataroa catchment runoff, but from Awanui River flood overflow across State Highway 1 (SH1) upstream of Kaitāia. A combination of high flow from both sources caused by two flood peaks approximately 12 hours apart presents the highest risk. Due to construction constraints along the Tarawhataroa, including the existing height and steep slopes of stopbanks, and built development in close vicinity to stopbanks, the preferred option to achieve the level of service objective is to reduce Awanui River overflow. This involves increasing the flow capacity of the Awanui River through Kaitāia so the current 100-year level of protection is maintained, and accommodating the majority of the additional flow within the Whangatane spillway (option 1). Planned works under this Long Term Plan will raise the level of service provided by the Tarawhataroa flood protection assets from 30-year to approximately 100-year flood protection. The estimated cost of achieving this level of service upgrade is $7.1 million (the difference between the two options for Kaitāia in the table above).

The CBD is also at risk of flooding due to failure of flood protection assets during a flood event. This may arise due to river bank slumping which could undermine a stopbank and lead to a breach situation. The cost of $7.9 million is required to stabilise river banks through rock armouring of the river bed and lower bank slopes along assessed medium and high risk sections of the Awanui, Tarawhataroa and Whangatane channels as they pass through urban areas (option two). It is considered that completion of this work is a necessity to safe guard resilience of Kaitāia flood defences, and both options one and two included it.

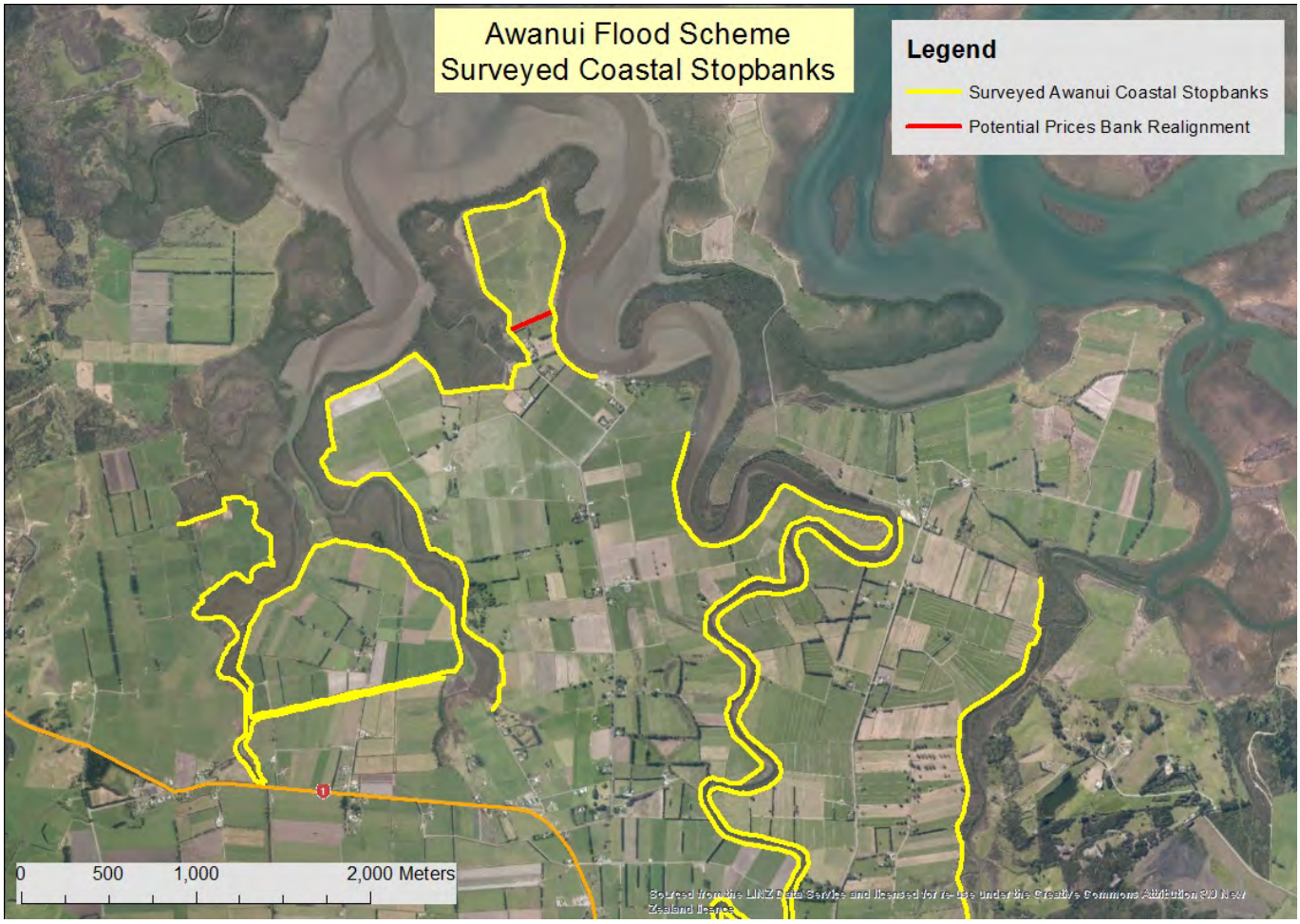
The implications of not progressing option one would be likely to increase over time if climate change were to result in higher flood flows than currently occur. This is because a high percentage of the additional Awanui River flow caused by warmer temperatures would overflow to the Tarawhataroa Stream across the SH1 on the upstream side of Kaitāia.

Beyond the time frame of this Long Term Plan, works proposed on Awanui flood scheme rural flood defences include: Stopbank topping up to 20-year flood design levels, Lake Tangonge drainage upgrade and replacement of the two major flood gates on the Waihoe Channel and Oinu Stream. The combined cost of these works is $2.06 million.

Awanui coastal stop bank works aim to raise the level of service to the 20-year coastal storm surge level taking into account potential sea level rise over the next 50 or 100 years. A future decision will be required on whether to accommodate sea level rise over 50 years ($1.87 million) or 100 years ($2.15 million). As this work is scheduled to be undertaken in the 2040's, it is likely that there will be greater certainty over the rate of sea level rise to be expected, which will assist in making design decisions.

Coastal stopbank upgrade costs given above have been estimated for surveyed sections of stopbank shown in the following map.

Extent of coastal stopbank survey for the Awanui Flood Scheme



The Awanui flood scheme has been expanded in recent years to include new coastal areas, and coastal stopbank survey has not yet been undertaken for those areas. This additional survey will be required prior to the final design of the coastal stopbanks.

Re-alignment of coastal stopbanks can be undertaken to reduce long term renewal cost. An example of this is the Prices Bank shown in the map above (Extent of coastal stopbank survey for the Awanui Flood Scheme), where a considerable length of stop bank is required to protect a modest area of coastal farmland. An option would be to exclude this area from the flood scheme, and instead install a short length of stopbank (shown in red on the map) just North of the small settlement near the base of the peninsula.

Kāeo–Whangaroa flood scheme:

A decision has been made to progress Stage Two works at Kāeo which will increase the level of service to the Kāeo township to 20-year flood protection. Stage Two works are estimated to cost $750,000. Stage One works done previously are estimated to have achieved a 10-year level of service for the township.

A decision has been made to progress the Matangirau flood scheme, consisting of a 1.5 km floodway. The benefit of these works will be increased by an upgrade of the Wainui Road bridge, to provide addition flood flow capacity under the road. The cost of these works is estimated at $440,000 (excluding bridge upgrade).

Whangārei urban rivers scheme:

A decision has been made to undertake Stage 1 of works within the CBD to increase the level of service to a 50-year level of flood protection. These Stage 1 works have been estimated to cost $950,000. Under this Infrastructure strategy, Stage 2 will be implemented in years 11 to 15. A decision has also been

made to develop a wetland site within the detention basin of the Hopua te Nihotetea detention dam in year 5 of this LTP.

Kerikeri-Waipapa flood scheme:

A decision has been made to implement stream channel widening works for the Waipapa industrial estate and stopbanks along Waitōtara Drive, which are intended to increase the level of service at these locations to almost 50yr level of flood protection. The estimated cost of these works is $340,000 which is to be funded from the existing reserve.

Panguru flood scheme:

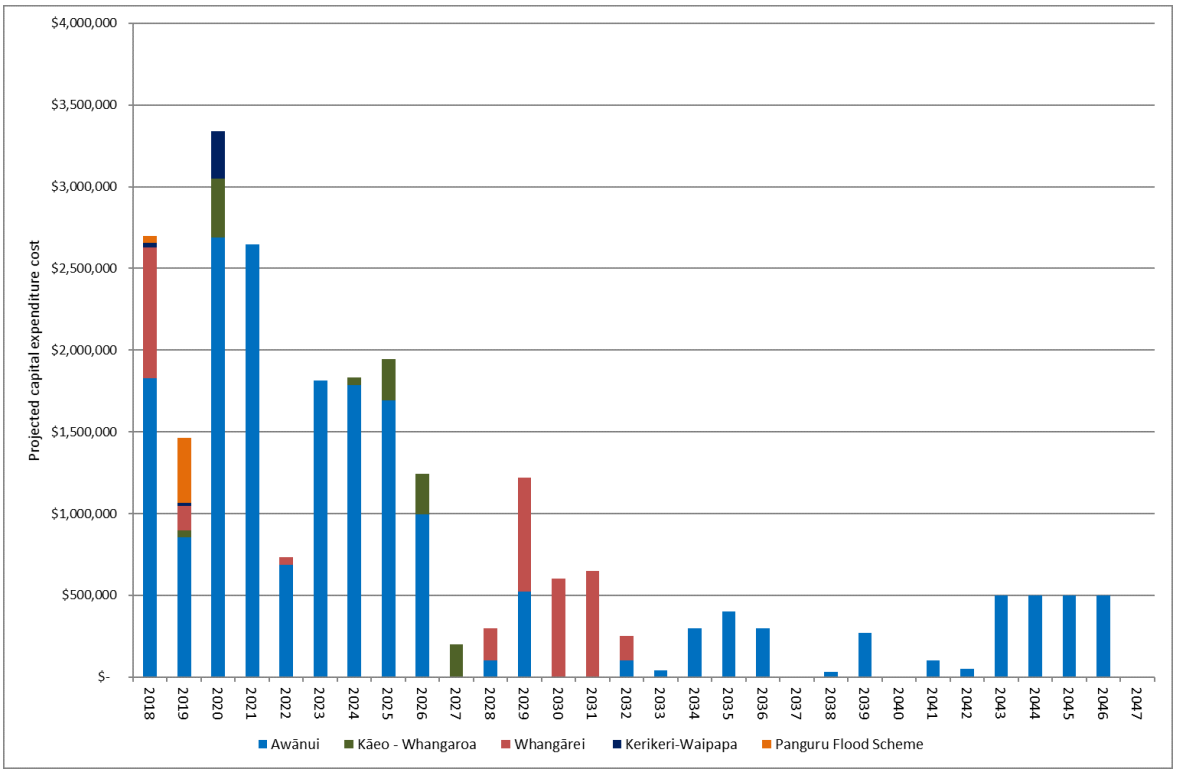
A decision has been made to implement Panguru flood scheme works, and to bring forward these works to years 1 and 2 of this LTP. The proposed works include re-aligning 1.0 km length of stopbank and additional channel benching works with total estimated cost of $440,000. The works are to be implemented in conjunction with Far North District Council with the objectives of reducing flood risk to Panguru settlement, and improving access along the West Coast Road during flood events. Improving access along that road, is a specific project within the Far North District Council Long Term Plan.

Indicative estimates of projected and operating expenditure

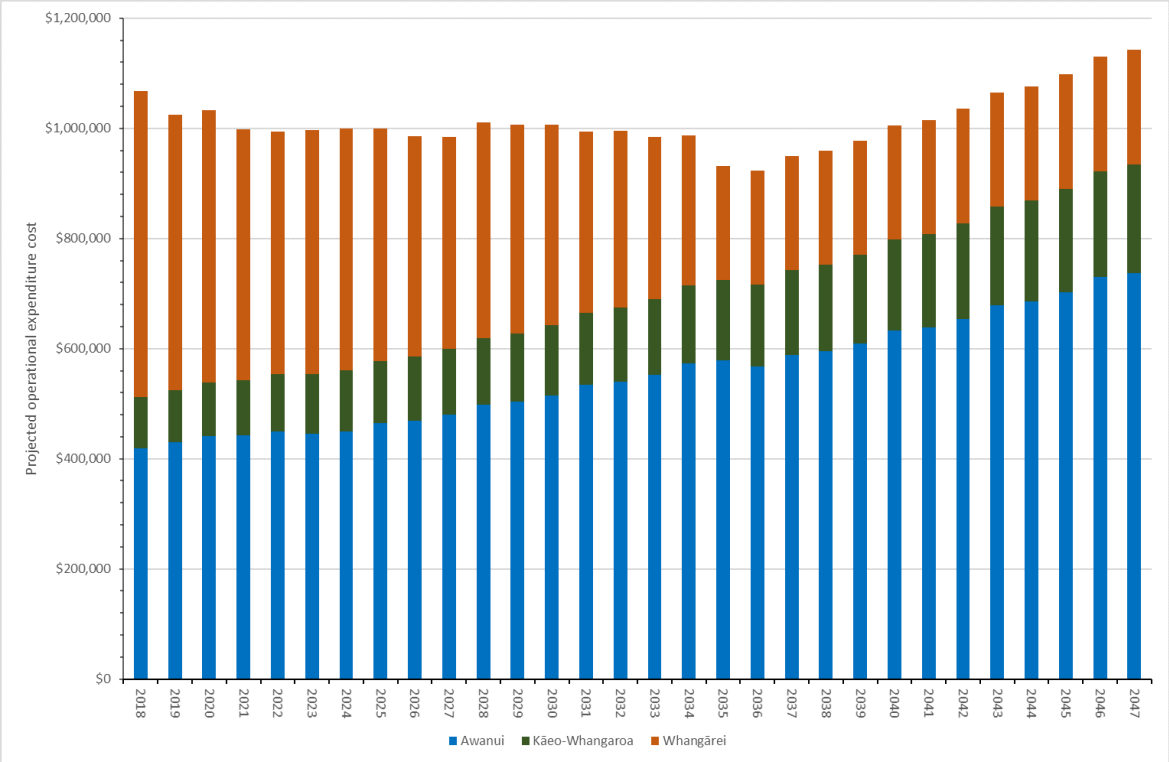
Our indicative estimates of the projected capital and operational expenditure for flood scheme assets are provided below. They show:

- Projected capital expenditure in each of the 30 years covered by the strategy (see 'Projected capital expenditure for river scheme assets by river scheme ').
- Projected operational expenditure in each of the 30 years covered by the strategy (see 'Projected operational expenditure for river schemes').

Projected capital expenditure for river scheme assets by river scheme



Projected operational expenditure for river schemes



A summary of total and annualised expenditure is provided in 'Estimated projected capital and operating expenditure summary' . Asset maintenance and renewal expenditure is a relatively small cost that is used to ensure that existing flood control assets are replaced as they reach the end of their design life. Operational expenditure is the costs associated with the running of the three existing river management schemes, including items such as insurance, interest repayment and general maintenance.

All of our scheme assets carry full insurance replacement cover, including cover for the risk of natural hazards. We also ensure that operational expenditure is budgeted at a level sufficient to undertake maintenance to scheme assets from minor storm damage (i.e. damage that is not sufficient to lodge an insurance claim for). The maintenance programme includes repair and long term renewal of stopbank assets, and therefore no depreciation is applied to stopbank assets within the operational spend budget.

The three existing flood schemes have significantly different opex expenditure forecasts over the 30 year time frame of this strategy. Awanui and Kāeo-Whangaroa operational spend Is projected to increase, mirroring increased capital expenditure, while the Whangārei Operational spend progressively reduces over time due to repayment of scheme debt.

Estimated projected capital and operating expenditure summary

Expenditure category, all schemes	Total over 30 years	Annualised
Operational	$30,379,491	$1,012,650
New capital	$24,430,000	$814,333
Totals	**$54,809,491**	**$1,826,983**

Key assumptions

In developing this Infrastructure Strategy, we have identified a number of key assumptions that we have made in determining our future planning and expenditure estimates. These are summarised in the following table.

Key assumptions

Area	Assumption	Level of uncertainty (low to high)	Nature of that uncertainty	Potential effects of that uncertainty
Life cycle of significant infrastructure assets	Significant renewal expenditure for newly constructed assets will not be required over the first 30 years of asset life (i.e. Kāeo and Whangārei assets).	Medium	Stopbank settlement rates and failure of ancillary components.	Increased expenditure.
	Accuracy of asset data and flood modelling underlying the financial projections is sufficiently robust	Medium to low	Stopbank settlement rates; Flood plain accretion rates; Flood modelling assumptions. Large, low probability events have the potential to shift probability estimates.	Increased expenditure, or requirement for upgrade to address increases in assessed risk.
	Potential structural failures are able to be detected and remedied before they occur	Medium	River bank and stop bank conditional surveys are successful in identifying risk. This risk is currently being assessed for Kaitāia	Flooding of protected areas if structural failure occurs during a flood event. Capital expenditure to stabilize river banks at Kaitāia is provided for in this strategy.
	Future sea level rise associated with climate change does not exceed Representative Concentration Pathways (RCP) 8.5 mid-range trajectory.	Low	More rapid sea level rise would lead to more frequent over-topping of coastal stop banks, and reduced efficiency of natural drainage.	Higher cost of protecting and draining low-lying coastal areas. May trigger managed retreat strategy earlier than anticipated.
Growth or decline in the demand for relevant services	Population growth/decline and land-use development in flood plains is not expected to be a significant driver based on population growth projections and land use planning to reduce risky development.	Low	Accuracy of growth projections and effectiveness of land use planning. Planning processes are successful in limiting exposure to residual risk in protected areas, particularly in areas protected by stopbanks.	Significant additional growth and development in flood prone areas will lead to additional flood risk and drive additional demand for protection.

Area	Assumption	Level of uncertainty (low to high)	Nature of that uncertainty	Potential effects of that uncertainty
	Public perception of flood risk may change due to region wide flood mapping, and demand may increase if climate change effects become apparent.	Medium	Public perception about climate change and personal risk.	Changes in public perception of risk is hard to anticipate and may lead to sudden increase in demand.
Increases or decreases in relevant levels of service	Adequate provision has been made for the projected impacts of climate change in scheme designs based on MfE climate change projections.	Low	Climate change tracks along high end projections resulting in lower levels of service.	Effect is low, as scheme adaptation can take place over decadal timescales, but ultimately there will be increased costs to maintain levels of service or implement a retreat strategy.
	Adequate operational expenditure is provided to maintain scheme service levels.	Medium	Estimation of extent of maintenance works required	Reduce level of service or increase expenditure to maintain level of service
	Level of service standards for urban areas may eventually be adopted at a national level following public enquiries into flood events.	Medium	May require urban flood schemes to meet a higher level of service, which may not be considered affordable by the community.	Review and change potential funding mechanisms to enable national standards to be met, or maintain existing level of service and accept that national standards will not be met.