

WAIHI BEACH FLOOD 'NOT A STORM IN A TEA CUP'

C.K. Ertel., & K. P. Hill., Western Bay of Plenty District Council (WBOPDC).

ABSTRACT

Waihi Beach is a coastal town at the western end of the Bay of Plenty. The name Waihi, "Rising Water", is said to be named after a stream which flows onto the beach.

Over the course of the last 80 years the once rural community with coastal dunes and intermingled rural and coastal properties, has transformed into a popular holiday destination. The current population of around 2,500 people swells to 20,000 over the holiday periods.

Development has seen a was once flat swamp land, converted to urban environment with a significant shift to hard stand areas with minimal consideration given to stormwater conveyance. This has seen historical settlement patterns increase the consequence of flooding events.

Three significant flood events occurring in two years brought the flooding issues to a heed with the community demanding a solution.

Possible solutions being investigated by WBOPDC Council could see \$30M being spent with some dwellings still flooding in certain extreme events. Due to the large expenditure required for a small community careful planning and community engagement would be needed. Existing infrastructure has historically been fragmented and a long term roadmap with clear storm water conveyance pathway was required. Projects would need to be assessed to follow in a logical manner.

WBOPDC undertook an extensive community consultation process 'not just a storm in a tea cup', this took Council and the community on a three year journey to better understand flooding in Waihi Beach, solutions, and the level of risk acceptable to the community. Consultation included an Investment Logic Mapping (ILM) process undertaken by Council in partnership with the community, to prioritise expenditure, and inform Council's Long Term Plan and Levels of Service.

KEYWORDS

Flood risk assessment, Investment Logic Mapping, Coastal environment, Flooding.

PRESENTER PROFILE

Coral-Lee is a young engineer working at the WBOPDC. Since she graduated in 2010 from Auckland University with a Bachelor of Engineering, Coral-Lee has been working at WBOPDC as an Asset Engineer for Drainage. During her 6 year tenner at Western Bay Coral-Lee has had the opportunity to be involved in a number of projects involving both storm water design and flood mitigation.

1 INTRODUCTION

Flooding is part of life in New Zealand and is the country's most frequent natural hazard. Decisions made long ago have dictated our settlement and land development patterns, increasing the consequence of many flood events.

Waihi Beach, a small coastal community located in the western sector of the Western Bay District has, since it was first developed, experienced flooding. Three significant events within a 24 month period created an outcry in the community, demanding for a solution. Knowledge of flooding and vulnerability to events are increasing and it was opportune to assess if Council was managing the risks rationally and sustainably, both socially and financially.

Council's and all other stakeholders can take meaningful steps to improve practices, develop better tools, target investment, and increase understanding. Acceptance of public and private roles can lead to a less vulnerable, more risk aware, and more resilient community.

There was a need for acceptance from rate payers that;

- In some locations flooding is inevitable and;
- If overland flow is confined to property (as overland flow) as opposed to the dwelling (inundation) then this should be acceptable.

This paper outlines Council's journey taken with the Waihi Beach community to better understand the flooding experienced, the level of risk acceptable to the community, and funding required.

2 DISCUSSION

2.1 HISTORY OF WAIHI BEACH

Waihi Beach is a coastal town at the western end of the Bay of plenty.

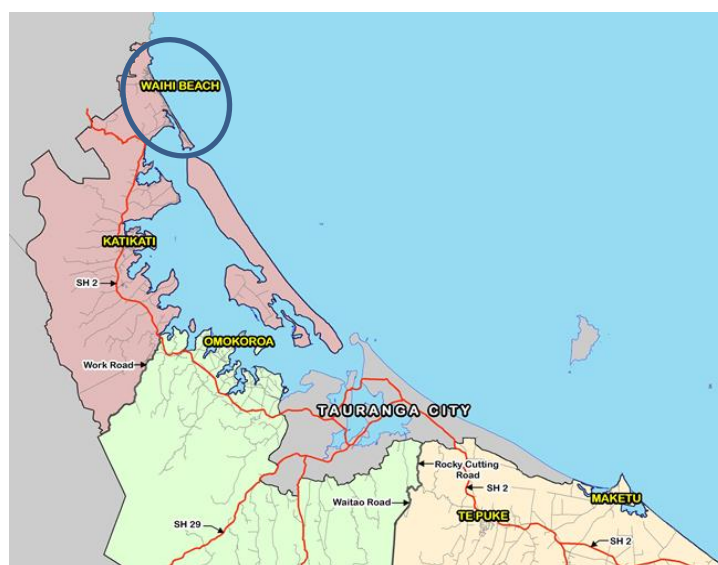


Figure 1: Location of Waihi Beach

Land in the area literally rose from the sea. Waihi Beach's topography originated through the build up and compaction of sand, which led to the area known as Bowentown connecting to the mainland. Eventually covered with forest, the area provided rich bounty to its first inhabitants, Kaimoana (seafood), estuary and harbor, and an array of flora and fauna from the forest.

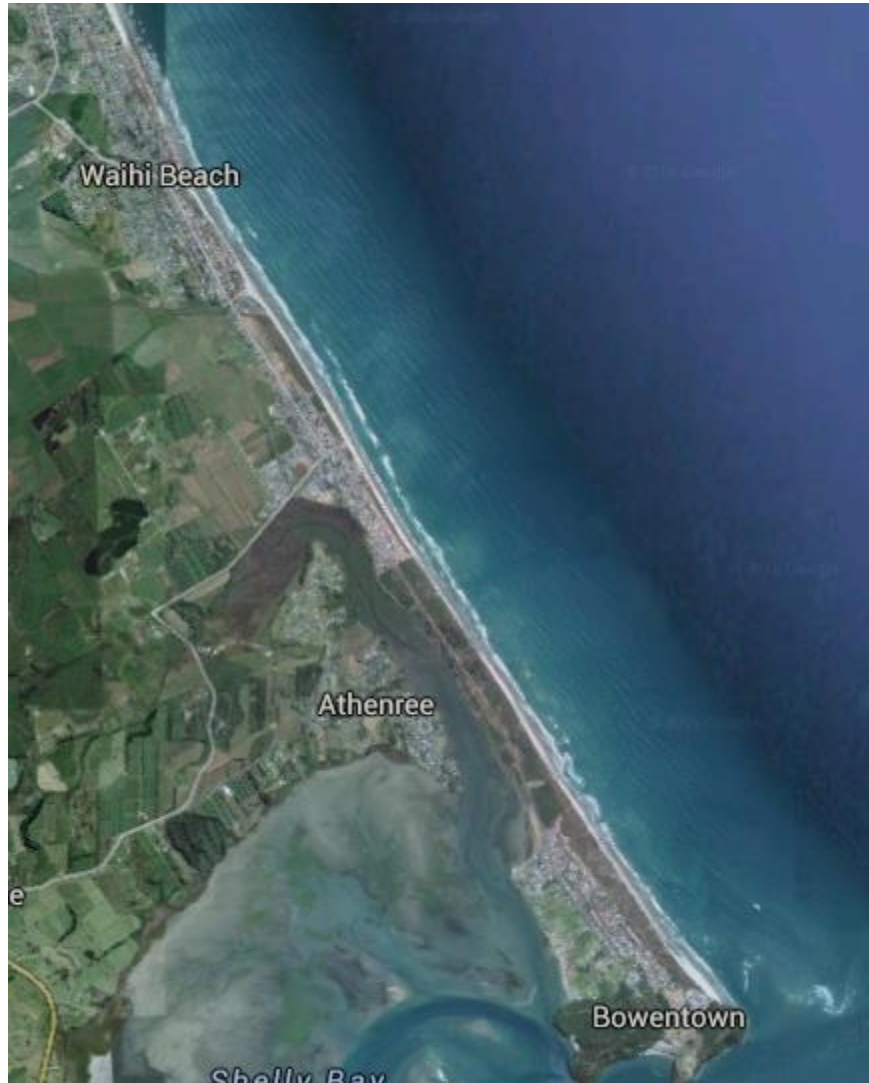


Figure 2: Aerial image of Waihi Beach

The Waihi Beach development dates back to the 1910's, when the population in the district started to migrate to the area bringing increased infrastructure and facilities. At this time the area was very much classed as swamp land, with minor water races darterd across the area. By the 1920's an increase in farming production brought about change with areas being drained for pastoral use. The construction of the man-made Two and Three Mile Creeks assisted in providing drainage channels for managing stormwater runoff.

As the Waihi Beach community grew, further land was subdivided with properties being built directly on top of old swamp and wetland areas. It has seen a flat swamp land, converted to an urban environment. A significant shift to hard stand area has occurred with minimal consideration given to storm water conveyance. This has seen historical settlement patterns lead to an increase in the consequence of flooding events.

Waihi Beach has a normal residential population of 2,500, however due to the beautiful coastal environment the population can swell to 20,000 over the holiday periods.

2.2 WAIHI BEACH STORMWATER NETWORK

The stormwater network at Waihi Beach can be split into three main drainage areas; Waihi Beach North, Waihi Beach Central, and Bowentown. A map of each area can be found in the appendices.

Stormwater in the northern part of Waihi Beach is drained through one of three main outlets, onto the beach; One Mile Creek, Two Mile Creek, or Darley Drain. Two Mile Creek and Darley Drain are man-made creeks, constructed to drain the area for development. This area receives significant stormwater from the upper catchment. The old township acts as a basin for direct rainfall and at times of high tide, stormwater cannot drain from the area causing localised flooding.

The Waihi Beach Central area drains primarily through the man made drain, Three Mile Creek. A large back dune can trap stormwater causing water to pond on private property, however this catchment has not experienced flooding in dwellings in recent storm events.

The stormwater network at Bowentown was installed in 1970's and was based on Low Impact Design principals. At the time it was constructed there was very little or no understanding of maintenance required, which has lead to a poor performing system. Council has subsequently built 5 pump stations to drain the area to the dunes and alleviate flooding issues.

2.3 RECENT STORM EVENTS AT WAIHI BEACH

Waihi Beach has experienced a number of storm events since it was first established in the 1920's. Infrastructure has been constructed for localised areas in an effort to deal with conveyance of these stormwater problems. Three significant events occurring within a 24 month period brought the flooding to a head. During the 24 month period the following storm events impacted on the community with both property and dwellings suffering from severe flooding (Table 1);

<i>Event Date</i>	<i>Average Return Period (ARI)</i>
3 July 2012	1 in 3 Year event
8 August 2012	1 in 8 Year event
20 April 2013	1 in 8 Year event

Table 1: Storm events experienced at Waihi Beach in 2012 and 2013

The 3 July 2012 storm event was extraordinary in that a very heavy hail storm was experienced prior to the start of the stormwater deluge that occurred over a 12 hour period. The hail storm completely engulfed the stormwater inlets of the reticulation system causing the overland flow path to be prematurely activated.

The event in April 2013 prompted a demand from the community for action by the council. A community initiated group was set up, Stormwater Action Team (SWAT), and

hosted a session for people to share their flood experiences. Over 60 personal accounts of flooding were presented to Council asking for a resolution.

2.4 STORMWATER MODELLING

In 2012 WBOPDC commissioned Tonkin and Taylor (T&T) to carry out a flood hazard assessment of the northern Waihi Beach catchments. The assessment was required to define the flood hazards based on a hydrological and hydraulic model. Information relating to historic data for the area was sparse and hence the model input information was carried out in accordance with industries best practice. During the course of four months, historical information was collected from the consultation process, with property owners who provided photographic information on previous flood events. The hydrological model was calibrated utilising this information, rain gauges and flow gauges from nearby catchments. The model has been validated from the 3 July 2012, and 20 April 2013 storm events. The model was then used to provide a potential list of engineering flood mitigation and management options that could be assessed against a wide range of flood scenarios.

The extensive modelling undertaken to date only encompassed the north end of Waihi Beach up to Two Mile Creek. In order to ascertain the effects of the flood hazard on a dwelling, a floor level survey was undertaken of all dwellings within the identified area. The modelling to date, as well as a floor level survey, has enabled us to show the flood affected properties for a series of rain events, 1 in 2, 1 in 5, 1 in 20, and 1 in 50 year rain events.

FLOOD IMPACT	2 Year Event	5 Year Event	20 Year Event	50 Year Event
Flooding in house	51	58	84	136
Flooding on land	162	182	216	220
TOTAL AFFECTED	213	240	300	356

Table 1: Northern Waihi Beach Property Flood Impacts

The modelling indicates there is a high chance that a number of houses will have flood waters through the house on a regular basis. For example; 51 properties in the northern catchment will have a 50% chance flood waters will enter the house each year.

The low lying, coastal nature of this catchment means that it is very difficult to convey the stormwater through a piped network. If a rainfall event occurs during a high tide, the existing piped network will not work resulting in ponding and flooding of private property and houses. In order to defend against these rainfall events, extensive infrastructure such as upper catchment retention dams or stormwater pumping systems will be required to reduce the risk of flooding to these properties. This infrastructure could cost \$10's of millions and may not remove the flood risk for all properties affected.

With the community demanding a solution to the flooding and more than \$30million required, extensive community consultation was required.

2.5 INVESTMENT LOGIC MAPPING

Due to the complex nature of the stormwater issues at Waihi Beach along with the response from the community, a structured, whole catchment approach deciding on a route forward was required. A key aim of the consultation exercise was to communicate as effectively as possible with the various stakeholders and community groups, therefore an Investment Logic Mapping (ILM) approach was decided upon.

The Investment Logic Mapping approach creates a decision-making framework which brings key stakeholders to the decision-making table for a facilitated discussion. It aims to build a shared understanding of the need for investment, the benefits sought and the preferred options collated. The output is a one page Investment Logic Map that can be understood by a lay person without prior knowledge. The process is typically undertaken over a series of workshops.

The ILM process was first undertaken by in-house staff using an independent facilitator. The methodology proved sound and therefore it was decided to open the process up to the wider Waihi Beach community and stakeholders.

2.5.1 PROBLEM DEFINITION

Whatever the solution ends up being, it will come from the community and it will affect them. The very first step, but perhaps the most important one, is to agree what the problem is we're trying to solve. As this process moves forward, community driven solutions will emerge and these will need to be prioritised with preferred options selected. These preferred options will then be considered as part of the '2015-25 Long Term Plan' in June 2015.

The problem definition stage of the ILM process is typically done during the workshop where the problem is defined, the strategic interventions that will best respond to the problem are identified, and the benefits that any investment will be required to deliver will be articulated.

In order to better understand the root problem twelve workshops were held with an average of 10 people attending each workshop. It was important a variety of community members attend the workshops and that they encompassed permanent residents, holiday makers, flood affected property owners, and property owners that were not affected by flooding. The workshops provided community members and stakeholders the opportunity to share their story over a cuppa. Output from the open day could then be used to develop the problem definition.

The following summaries the main points made by the stakeholders from the first series of workshops held in February and March 2014.

How flooding has affected me	What I think causes flooding
<ul style="list-style-type: none">▪ Trauma, stress, anxiety, despair – I don't want to live here anymore▪ I can't sleep or relax when it rains I don't feel listened to or supported by the Council▪ We can't enjoy our beach the way we used to▪ I have moved away from the area▪ My family and children have been	<ul style="list-style-type: none">▪ Development on the hills/water from the hills▪ Subdivisions▪ Increased land coverage by new housing▪ Increase in sealed/impervious surfaces▪ Speed of runoff (particularly from driveways)▪ Land being filled/raised

<p>affected to</p> <ul style="list-style-type: none"> ▪ My home is uninhabitable ▪ Impacts on my work and private life ▪ We don't get early enough notification of forecast events by authorities ▪ I've suffered damage to my property ▪ I feel trapped in a house no one wants to purchase ▪ My property has been devalued ▪ I can no longer get insurance ▪ Unexpected costs of lifting my house ▪ Financial hardship ▪ Having to clean-up each time my place floods ▪ Surface flooding on my property ▪ Flooding affects the ability to build on my site ▪ Land lost through erosion ▪ My property is a 'catchment' for everyone else's stormwater ▪ My house is at risk – my foundations have been undermined ▪ There's a possibility my rates will go up and I'm on a fixed income ▪ The flooding is localised and doesn't affect me – I don't want to pay ▪ I'm concerned the council will ask 80% of people unaffected to pay for fixing the problems of 20% of people who are. ▪ Rates are unaffordable now, if rates rise any further it will cause depopulation ▪ I shouldn't have to pay for someone who has knowingly bought in a flood zone or who didn't do proper due diligence before purchasing. ▪ If you've built in a low lying area, you take the risk ▪ Flooding is a nuisance ▪ The storm water erodes the beach and dunes 	<ul style="list-style-type: none"> ▪ Natural overland flow paths now built on ▪ Artificial diversion of Two and Three Mile Creeks ▪ "Clashing" of creeks with the tide ▪ Otawhiwhi drain being blocked ▪ Lack of maintenance of stormwater system ▪ No local maintenance crew ▪ No transfer of knowledge between council and contractors. They don't understand the 'intimacy' of the Waihi Beach stormwater system ▪ Local knowledge dismissed ▪ Stormwater infrastructure is not adequate enough to cope with population growth. ▪ Poor planning in the past ▪ Piecemeal fixes aren't effective. Keep doing patch jobs ▪ Stormwater upgrading not keeping pace with development ▪ Climate change ▪ Heavier, more intense and more frequent rainfall ▪ Waihi Beach is a floodplain and we've built on it ▪ Higher ground neighbours need to take more responsibility for what comes off their properties onto mine ▪ People don't want to help themselves and put their hands in their pockets ▪ Lack of prioritisation in council spending ▪ Costs too much to fix
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Table 2: Summary of responses received from community consultation

2.5.2 BENEFIT DEFINITION

Once the problem is defined, a workshop is required to consolidate the benefits that are expected to be delivered and to identify the key performance indicators (KPIs) that will provide the best evidence that the benefits sought have been delivered.

Community members from the workshop were invited to be part of a reference group. The reference group was made up of seven community members, community board reps

and councilors. Again it was important a range of affected land owners were included in the reference group.

The nature of the reference group was to sit along side council and work in collaboration to discuss strategic responses, options and solutions (including consideration of cost implications) to the stormwater issues at Waihi Beach. Ultimately Council was required to make the decision to pursue a course of action, including the costs (and consequently rate payer impact) that will flow from this decision. The aim of Council’s commitment to this collaboration process was to ensure that when the ‘crunch’ time comes and as decisions need to be made, it has been discussed openly with the wider community and the reference group has partnered with the council to get to this point.

2.5.3 STRATEGIC RESPONSE

Typically the strategic response workshop aims to define and scope the most likely best solution to the identified problem. The output from the investment logic mapping process undertaken with the community can be found below;

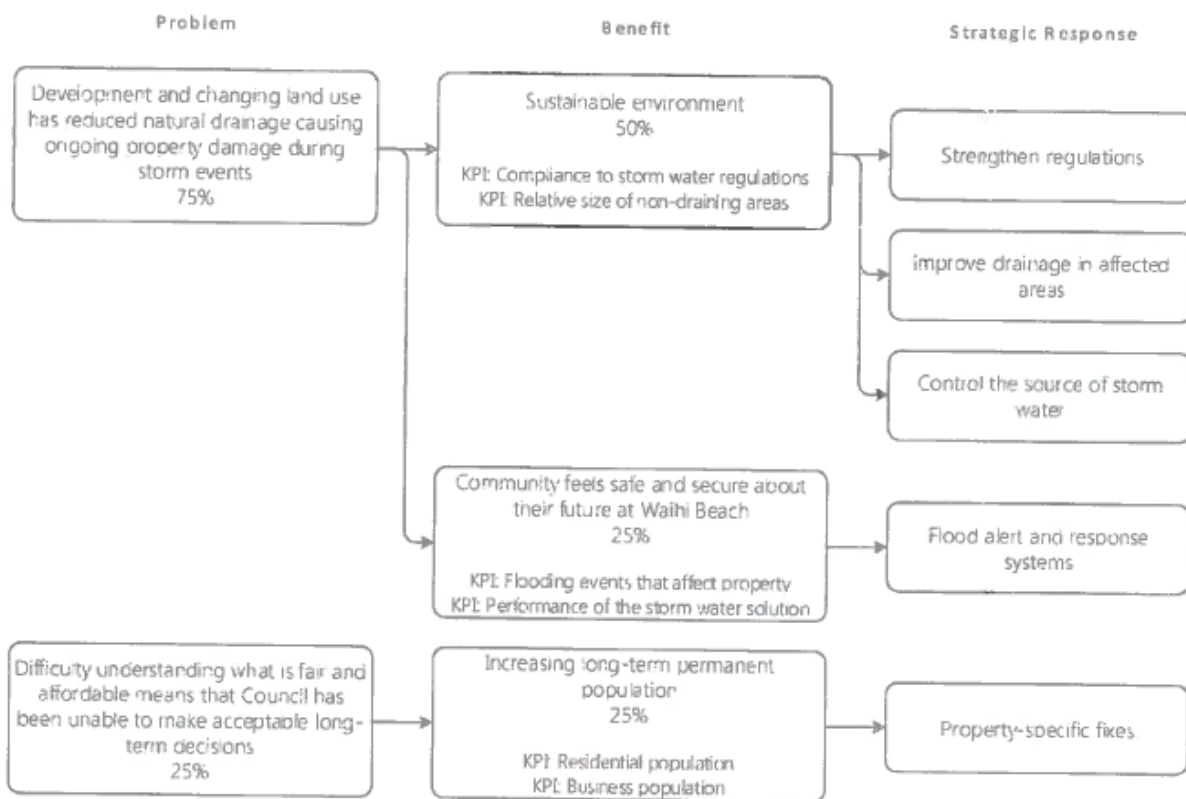


Figure 3: Waihi Beach Stormwater Investment Logic Map

2.6 SOLUTIONS

The problem was conclusive defined to be that;

'Development and changing land use has reduced natural drainage causing ongoing property damage during storm events' and

'Difficulty understanding what is far and affordable means that council has been unable to make acceptable long-term decisions'

We were then required to determine the preferred solution.

Council commissioned Tonkin & Taylor to undertake an options assessment for flood mitigation. Waihi Beach was broken into 14 sub-catchments. For each sub-catchment all possible flood risk mitigation options were defined. For each option T&T assessed the number of dwellings that would be removed from the flood hazard in a 10 year and 50 year event. Flood mitigation options included;

- Raising dwellings above the flood level
- New stormwater pipes or increased pipe sizes
- Bunding or flood protection walls
- Stormwater pump stations

Council decided upfront they would not purchase property to remove houses from within the flood hazard. While the purchase of land was considered as an option, it was however quickly disregarded as it would likely prove unpalatable to landowners without financial compensation.

Each option was assessed based on the following criteria;

- Number of properties removed from the flood hazard in a 1 in 10 year and 1 in 50 year event.
- Engineering prefeasibility, assessed by T&T and based on the practicality of implementation, consent ability, maintenance requirements, legality or easements and future proofing of the option.
- Cost per property.
- Likely time frame to implement.

Working with the reference group, each sub-catchment was presented. For each area the catchment characteristics, problems and potential solutions were identified. Each option had an associated cost and number of dwellings that would be removed from the flood hazard for a 10 and 50 year event. The reference group was then required to give each option a priority ranking; High, Medium or Low. The group also assessed, if the option was implemented who gains the benefit and therefore should pay; District rate, Waihi Beach ward or targeted land owners. An example sub-catchment plan out-lining the options is presented below;

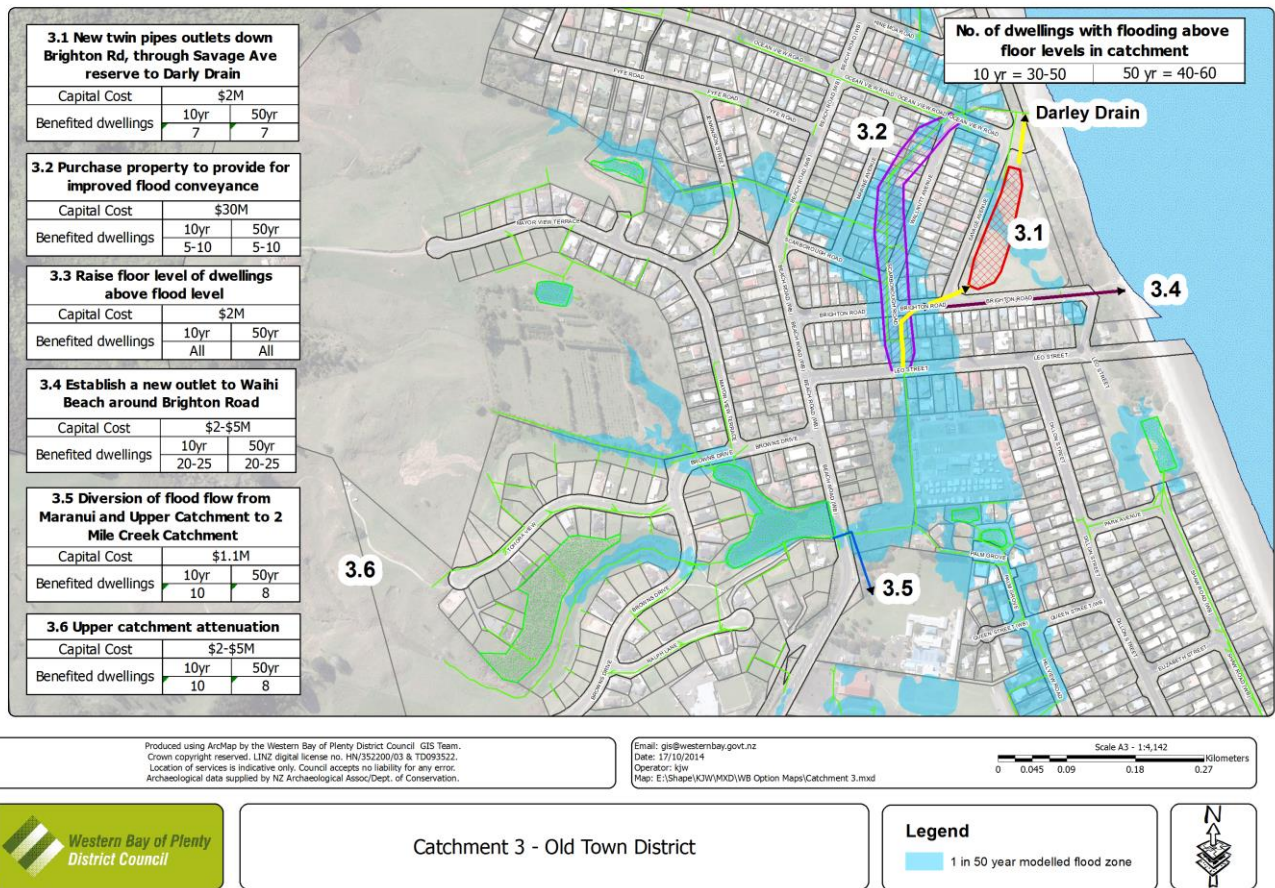


Figure 4: Example catchment map detailing flood mitigation options

Catchment	Item	Location	Issue	Potentially affected dwellings		Wider Catchment Contributes ?	Mitigation Description	Potential benefited dwellings		Estimated cost	Cost per property (Approx.)	Engineering feasibility	Effectiveness of Option			Likely timeframe to consent and implement
				10yr Storm Event	50yr Storm Event			10yr	50yr				A	B	C	
3	4	Old Town District (lower catchment)	Insufficient conveyance capacity to deliver flow to Darley Drain, resulting in residential flooding.	30-50	40-60	No	3.1 New twin pipe outlets down Brighton Rd, through Savage Ave reserve to Darley Drain.	5-10	5-10	\$2M	\$250k	C	X			6 months
							3.2 Purchase property to provide for improved flood conveyance	5-10	5-10	\$30M	\$4.3M	C		N/A		20 years
							3.3 Raise floor level of dwellings above flood level	All	All	\$2M	\$35K	C	X			5 years
							3.4 Establish a new outlet to Waihi Beach around Brighton Road	20-25	15-20	\$2 - \$5	\$100K - \$200K	C			X	5 years
5	Old Town District (up gradient of Beach Road)	Outflow contributes to flood depth on downstream system, resulting in flood water entering residential dwellings	30-50	40-60	Yes (Upper Catchment)	3.5 Diversion of flood flow from Maranui and upper catchment to Two Mile Creek catchment	10	8	\$1.1M	\$110K	C				Unknown	
						3.6 Upper catchment attenuation	10	8	\$2 - \$5M	\$200k - \$500k	C	X			5 years	

Figure 5: Example working spreadsheet with flood mitigation options for Waihi Beach (supplied by T&T)

Funding was then allocated in the Long Term Plan (LTP) based on feedback received by the reference group.

2.7 IMPLEMENTED SOLUTIONS

Based on the feedback received from the community, the following solutions have been implemented;

2.7.1 RAISE DWELLING ABOVE THE FLOOD LEVEL

For the majority of the catchments the most feasible solution was to raise the dwelling above the flood level. To enable this Council agreed to subsidise the costs to landowners by 'waving' the building consent and resource consent fees to undertake the building work. Since this initiative was approved in 2015, 8 land owners have opted for this solution.

2.7.2 HEAVY RAIN WARNING RESPONSE

Working with the community and SWAT, Council was able to develop an extensive heavy rain warning response program. When a heavy rain warning is initiated, high risk outlets are inspected and cleared, inlets are inspected and ponding areas increased by lowering the water level (Waihi Beach Earth Dam).

2.7.3 FUNDING ALLOCATED IN LONG TERM PLAN FOR FLOOD MITIGATION

Council has allowed a total of \$14million for storm water mitigation in the LTP. The ILM process helped the council and community to focus investment on high priority projects. The \$14million of allocated stormwater expenditure includes both the reprioritisation of existing storm water projects and additional funding.

Projects have been prioritised to flow in a logical manner with a clear pathway forward for stormwater management at Waihi Beach.

For example the significance of Two Mile Creek as an important drain has been highlighted to the Council and community, hence significant funding has been allocated in the LTP to allow flood conveyance and to protect private property for erosion. For further information on the Two Mile Creek project, consult 'Two Mile Creek – Implications Today of a 1930's Decision, K.P. Hill, 2016'.

2.7.4 REVIEW OF COUNCILS LEVEL OF SERVICE

The ILM process and community consultation triggered a review of the Council's stormwater strategy and has seen a shift in Council's Level Of Service (LOS). Council's new direction for the LOS for stormwater states no more than 3% of dwelling will be affected in a 10 year event.

2.7.5 TIGHTER DEVELOPMENT CONTROLS

Historical development occurring in what was once swamp land has resulted in the Waihi Beach community at high risk of flooding. In response to the problem statement;

'Development and changing land use has reduced natural drainage causing ongoing property damage during storm events.'

Council has strengthened regulations and controls for developments. These strengthened controls are placed on properties to ensure any development will not increase the flood risk for any downstream properties. In addition Council will not allow

sub-divisions inside identified flood hazard areas without clear evidence from developers that their will be no increase in flood risk.

3 CONCLUSIONS

Maintaining and upgrading the stormwater network and building new flood prevention works is expensive and must be balanced against the severity, risk and physical and social impacts of potential flooding. Our decisions enable Council to meet the proposed level of service which sets a target of no more than three percent of habitable properties District-wide experiencing flooding in a 10 year rain event. We can also keep working with communities to address significant flooding issues at Waihi Beach and other low-lying coastal areas. Funding stormwater from both targeted and District-wide rates recognises there are both private and public benefits gained from stormwater networks, and better management of stormwater debt. We think this is fairer because stormwater networks benefit us all by keeping communities functioning in times of heavy rainfall, reducing stress in communities at risk of flooding, preventing the erosion of waterways and reducing the amount of sediment in stormwater entering the Tauranga Harbour and coastal estuaries.

More than 70 percent of submitters supported additional works at Waihi Beach through the Long Term Plan process, with the vast majority of these in favor of Council's preferred option. This included maintaining our current network, offering a house-raising consent fee waiver for at-risk properties and the reprioritisation of existing projects in the LTP with the allocation of additional funding. The work taking place over the next 10 years is a continuation of a collaborative process between Council and the Waihi Beach community - and in particular members of the Stormwater Action Team – SWAT. We know we can't entirely remove the flood risk at Waihi Beach. However, we are confident this plan is the most sustainable and cost effective way to reduce the flood risk for as many properties as possible.

In summary, we think these decisions will enable Council to continue improving stormwater protection throughout the District in collaboration with the community and funding partners.

4 APPENDICES



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Date: 13/03/2016
Operator:
A4 Scale 1: 10,000
0 500 Meters



North Waihi Beach Catchment





1 50 year flood hazard

Three Mile Creek Outlet

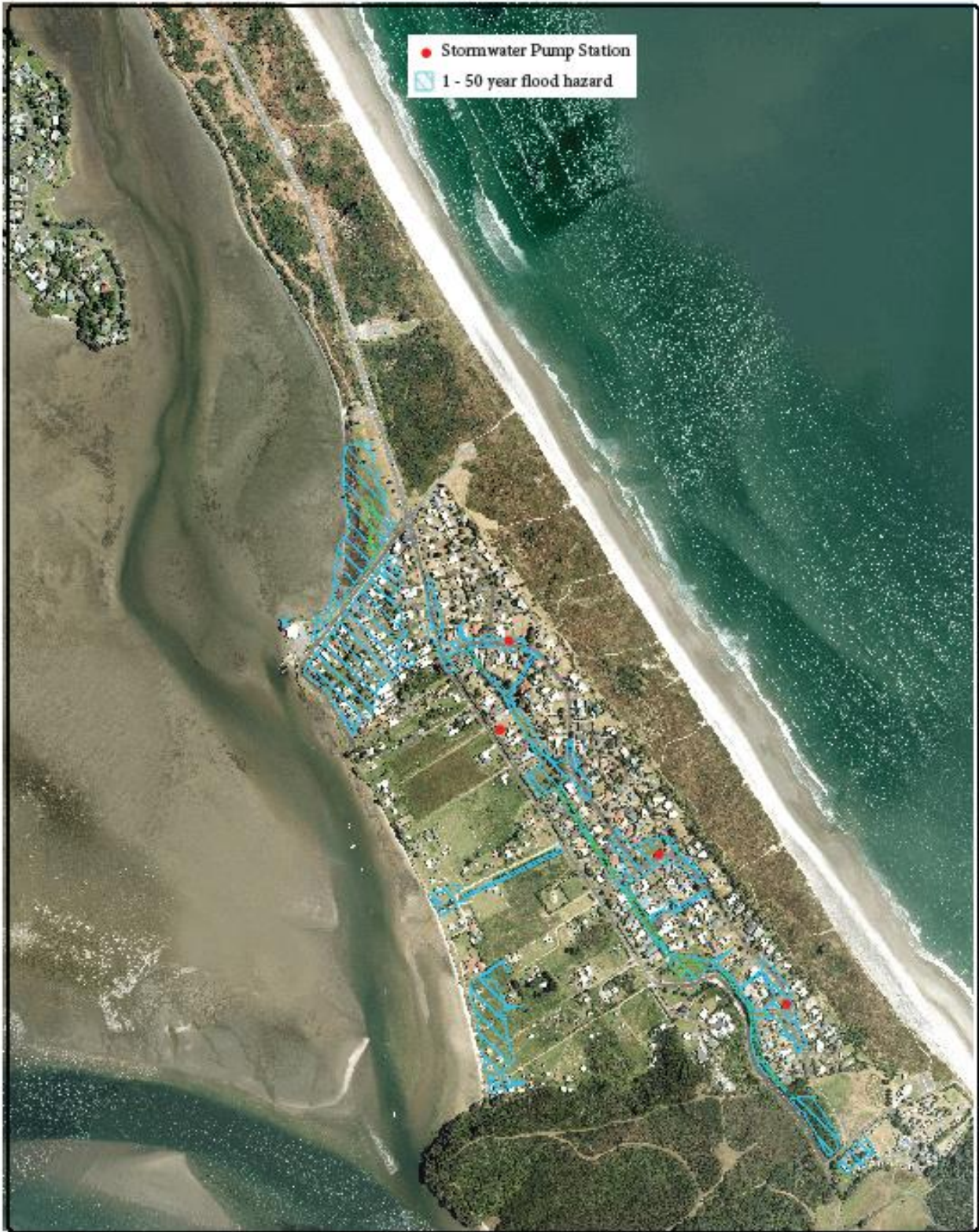
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Date: 13/03/2016
 Operator:
 All Scale 1: 13,000
 0 650 Meters



Central Waihi Beach





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Date: 13/03/2016
 Operator:
 All Scale 1: 10,000
 0 500 Meters



Bowentown



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